PD-AAS-023
ISN 41819

ST. KITTS/NEVIS

RESOURCE MANAGEMENT PROJECT

GRICULTURAL SECTOR ASSESSMENT AMENDMENT NO. 2

Vincent F. Bralts

and

Douglas D. Southgate

16

August 31, 1985

Midwest Universities Consortium
For International Activities
101 Agriculture Hall
Michigan State University
East Lansing, MI 48824

000838

001757
S

ST. KITTS / NEVIS

RESOURCE MANAGEMENT PROJECT

AGRICULTURAL SECTOR ASSESSMENT AMENDMENT NO. 2

By

Vincent F. Bralts

and

Douglas D. Southgate

August 15, 1985

This analysis was supported by Contract No. LAC -0000-1-00-2030-00 between the Midwest Universities Consortium for International Activities, Inc. and USAID, entitled "Technical Support to Mission / Caribbean", Project No. 538-000, Under Work Order No. 6. The views expressed herein are the views of the Contractor and do not necessarily reflect the views of USAID.

53S0108

EXECUTIVE SUMMARY

Soon after St. Kitts/Nevis achieved independence in 1983, the Rural Development Office of AID's Eastern Caribbean mission (RDO/C) commissioned a team of specialists to conduct an agricultural sector assessment of the country. A number of constraints to agricultural diversification and development were noted in the Assessment. The fact that virtually all of SKN's best farmland is owned or controlled by the public sector was identified as by far the most important constraint. In Nevis the government is selling some of the more than 5,000 acres presently held. In St. Kitts, however, the government must raise some US $7.5 million to compensate the previous owners before it will be in a position to sell a portion of the more than 23,000 acres it presently controls. Another serious obstacle to agricultural development is the small size of the existing market for agricultural commodities. Therefore, marketing and production capabilities on SKN must be developed together.

When the government of SKN and the RDO/C were called upon to prepare a project in August and September of 1984, limited time prevented the development of a large, integrated marketing and production project. Instead, a soil and water management project was agreed upon and discussion of broader issues was postponed.

The project basically focuses on the renovation of certain ghauts, the development of a soil conservation program and the potential development of surface water sources for irrigation on the two islands.

Because the project was designed in just one month, parts of the design were more indicative than definitive. In the case of all civil works to be undertaken during the project, a detailed design and economic analysis were required before the work could begin. During the USAID Mission review of the project, serious concern was expressed regarding the imbalance between the costs and benefits associated with the Hope Ghaut component. The economic analyses of all the components which were originally presented were based on very rough estimates of the associated costs and benefits. The purpose of this Amendment to the Resource Management Project Paper and Agricultural Assessment was to refine the original project design in terms of both the engineering and economic feasibility. The result of this effort has been the development of alternative designs with lower associated costs.

Recommendations for St. Kitts include the possible selection of lower cost alternatives for ghaut treatment with surplus funds used for the development of a more complete soil and water resource information base, improvement of soil conservation extension activities, and the development of irrigated agriculture.

The more complete analysis of the Nevis project subcomponents clearly showed that the marginal cost for developing surface water for irrigation is as much as 20 times the cost of developing groundwater sources for the same irrigation system. Thus, efforts to develop water resources on Nevis should principally be directed towards location and exploitation of groundwater sources.

ACKNOWLEDGEMENTS

The authors would like to express their appreciation to David Jesse of the Agriculture and Rural Development Office, USAID/Barbados, for his assistance and to other members of the Mission who supplied additional support. We would also like to acknowledge the assistance of Valdemar Warner, the Project Manager, Vincent Joseph, Head Agricultural Engineer NACO, and the numerous members of the St. Kitts/ Nevis Agriculture Ministries for their input related to project component alternatives and costs. Finally the authors would like to give special recognition to Charles Mills, Jim Newman, Claude Nesbitt and Eric Evelyn, the host country project participants for their assistance in information gathering and preliminary report writing.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

I. INTRODUCTION 1

II. BACKGROUND. 8

A. Lavington Lynches Treatment and Settlement 8
B. Sir Gillies ghaut Treatment 13
C. Hope Ghaut Treatment 15
D. Soil Conservation Plan 18
E. Surface Water Development Work Plan 19
F. Watershed Protection Work Plan 20

III. ST. KITTS REPORT 21

A. Engineering Alternatives 21
B. Economic Evaluations 42
C. Summary Discussion 52

IV. NEVIS REPORT 56

A. Engineering Alternative Components 57
B. Economic Evaluation 67
C. Summary Discussion 71

V. PROJECT MANAGEMENT 74

A. Local Advisory Committees 74
B. Refined Implementation Plan 76
C. Training Component Recommendations 77

VI. CONCLUSIONS AND RECOMMENDATIONS 78

VII. REFERENCES

VIII. APPENDIX

LIST OF TABLES

Table		Page
1	Results of Lavington Lynches Project Site Soil Analysis	25
2	Summary of St. Kitts Alternative Designs, Costs and Benefits	53
3	Summary of Nevis Subproject Components	72

LIST OF FIGURES

Figure		Page
1	St.Kitts/Nevis Project Site Locations	9
2	Lavington Lynches Project Site Diagram	11
3	Sir Gillies Project Site Layout	14
4	Hope Project Site Diagram	17
5	Topographic Map and Land Profile of Lavington Lynches	23
6	Topographic Map and Land Profile of Sir Gillies Ghaut	27
7	Stream Channelization using Gabions	29
8	Stream Side Slope Stabilization	30
9	Topographic Map and Land Profile of Hope Ghaut	32
10	Example of a Chute Spillway	34
11	Example of a Drop Inlet Spillway	35
12	Barbados-St. Andrews Stabilization using Wall Drop Structures	36

Chapter I. INTRODUCTION

Like most Caribbean countries, St. Kitts and Nevis (SKN) has traditionally been a plantation economy, primarily dependent on the production of sugar for export. With the exception of a brief boom period ten years ago, sugar prices have been falling in real terms for two decades. As a result of this market condition, SKN's sugar industry has declined dramatically.

Sugarcane cultivation on Nevis has been completely abandoned and the SKN government took charge of St. Kitts' decapitalized sugar industry in the early 1970's. However, the latter action has not reversed the long term trend toward less land being devoted to sugar production. Thus, the challenge facing the agricultural sector over the next twenty years is to build a profitable and diversified non-sugar agriculture industry.

The transition from sugarcane production to a more diversified agricultural base could potentially benefit SKN's economy through the export of more profitable agricultural commodities and, import substitution of crops in which SKN has a comparative advantage in production. Crops which could be cultivated in lieu of sugar include citrus, coffee, cocoa, oil seeds, legumes and vegetables among others. In addition to the

above mentioned advantages, a more diversified agriculture could facilitate the stabilization of export revenue. Beyond any potential revenue increase, revenue stabilization allows for the long term planning and investment vital for any development effort.

Although sugarcane is no longer a highly profitable crop, it does have some distinct ecological advantages in a tropical agricultural environment. The soils of SKN are quite fertile but composed of highly erodable sand and volcanic ash. Because sugarcane is a grass planted in dense stands, it is highly effective in the prevention of both wind and water erosion. Historically, as estate land in the Caribbean region has been taken out of sugarcane production and put to use in small farm cultivation of row crops, serious erosion problems have been created. Haiti, Jamaica, Trinidad and Nevis have all experienced severe soil erosion due to the transition from sugarcane. To avoid these potential difficulties in St. Kitts, the diversification process must be carefully managed.

Small farms must be commercially viable in order to attract young farmers. Irrigation offers one means of increasing small farm profitability by reducing the risks of farming and by extending the growing season. The institution of irrigation is another potentially erosive action which also must be thoughtfully

planned to avoid serious environmental damage.

After St. Kitts /Nevis achieved independence in 1983, the Rural Development Office of AID's Eastern Caribbean mission (RDO/C) commissioned a team of specialists to conduct an agricultural sector assessment of the country. In addition to describing the current state of agriculture in SKN and evaluating trends in the production of agricultural commodities, the team was expected to identify goals for the agricultural sector that were in keeping with national government and AID policies. Projects consistent with those objectives were also to be identified. The team spent approximately two weeks in SKN during the last half of October, 1983. Its members interviewed government officials, civil servants, entrepreneurs, representatives of private firms, and professionals employed by regional research organizations and donor agencies. Following this, they travelled to Barbados, where they worked for several days in the AID mission. A report (Adams, et al.) was submitted to the AID mission in late November of 1983. Shortly thereafter, copies were forwarded to the government of SKN for comment. The government's response was offered to representatives of AID in separate meetings held on each island on February 14-15, 1984. Specific comments on the Assessment are contained in memoranda attached to minutes of the meetings.

The Assessment team agreed with all parties concerned that agricultural diversification is a high priority for SKN. The islands have an ample endowment of land and water resources. It would not be necessary to impinge greatly on the sugar industry in order to produce more fruit, vegetables, meat and other commodities. However, efforts made during the past two decades to diversify the country's sugar-based agricultural economy have met with little success. If anything, SKN is becoming more dependent on imported food, a situation which exacerbates the country's chronic balance of payments deficit. Also, benefits that could be obtained from development of non-agricultural sectors of the economy are often lost. Perhaps the most glaring example of this is the opportunities foregone in the growing tourism industry which must import most of the food purchased by visitors.

A number of obstacles to agricultural diversification and development were noted in the Assessment. The fact that virtually all of SKN's best farmland is owned or controlled by the public sector was identified as by far the most important constraint. In Nevis the government is selling some of the more than 5,000 acres presently held. In St. Kitts, however, the government must raise some US $7.5 million to compensate the previous owners before it will be in a position to sell a portion

of the more than 23,000 acres it presently controls. Another serious constraint to agricultural development is the small size of the existing market for agricultural commodities. Therefore, marketing and production capabilities on SKN must be developed together.

When the government of SKN and the RDO/C were called upon to prepare a project in August and September of 1984, time limitations prevented the development of a large, integrated marketing and production project. Instead, a soil and water management project was agreed upon, and discussion of broader issues was postponed. In St. Kitts, at the initiative of the Government, the team focused on the treatment of certain ghauts. Because the government had recently endorsed an agricultural development program authored by the British Development Division (BDD) for Nevis, discussions centered on aspects of that program which fell within the soil and water management jurisdiction. Because a Canadian International Development Agency (CIDA) project was to begin exploratory drilling for groundwater, the RDO/C preferred to concentrate on surface water.

The Resource Management Project which emerged from the discussions contains minor elements which aim at relieving the constraints to agricultural diversification and development.

Some modification of the project is possible over the course of its implementation, provided it is achieved with Government and RDO/C agreement. In fact, the purpose of the project reinforces the transition to a diversified agriculture and will be critical to the successful transformation from a sugar to a non-sugar agricultural industry. The challenge facing persons implementing this project is to support diversification and development while achieving the stated purpose of this project: "To establish appropriate soil and water management practices in demonstration areas on agricultural land and to strengthen the institutional capacity to maintain and extend these management practices."

Because the project was designed in just one month, parts of the design were more indicative than definitive. In the case of all civil works to be undertaken during the project, a detailed design and economic analysis will be required before the work can begin. During the USAID Mission review of the project, serious concern was expressed regarding the imbalance between the costs and benefits associated with the Hope Ghaut component. The economic analyses of all the components which were originally presented were based on very rough estimates of the associated costs and benefits. This report seeks to refine the original project design in terms of both the engineering and economic feasibility. For the convenience of the reader, the original

designs are presented in Chapter II. The description is taken verbatim from the Project Paper and the Project Request for Technical Proposals. Chapters III and IV consist of Engineering Alternatives and Economic Evaluations of the proposed project components on St. Kitts and Nevis. Further refinement of the design alternatives will be required before any project component is initiated. The designs contained herein are still preliminary in nature.

Chapter II. BACKGROUND

Six distinct project components are present in the Project Paper; a) establishment of small farms in, and treatment of, the Lavington Lynches area (St. Kitts); b) treatment of Sir Gillies Ghaut (St. Kitts); c) treatment of Hope Ghaut (St. Kitts); d) preparation of a Soil Conservation Plan (St. Kitts and Nevis); e) preparation of Surface Water Development Work Plan and execution of certain small projects from the Work Plan (Nevis) and f) preparation of a Watershed Protection Work Plan and execution of certain small projects from the Work Plan (Nevis). The Project Paper additionally proposed the strengthening of the NACO Soil Conservation Unit (St. Kitts) and the establishment of a Land Use Unit (Nevis).

The following background information has been excerpted from the original USAID St. Kitts/Nevis Resource Management Project Paper Request for Proposals and Scope of Work. See Figure 1 for the location of project components on St. Kitts and Nevis.

A. Lavington Lynches Treatment and Settlement (St. Kitts)

Lavington Lynches, an early stage erosion problem, was identified as an area for terracing to minimize the loss of topsoil, and for limited civil works to stabilize the gully.

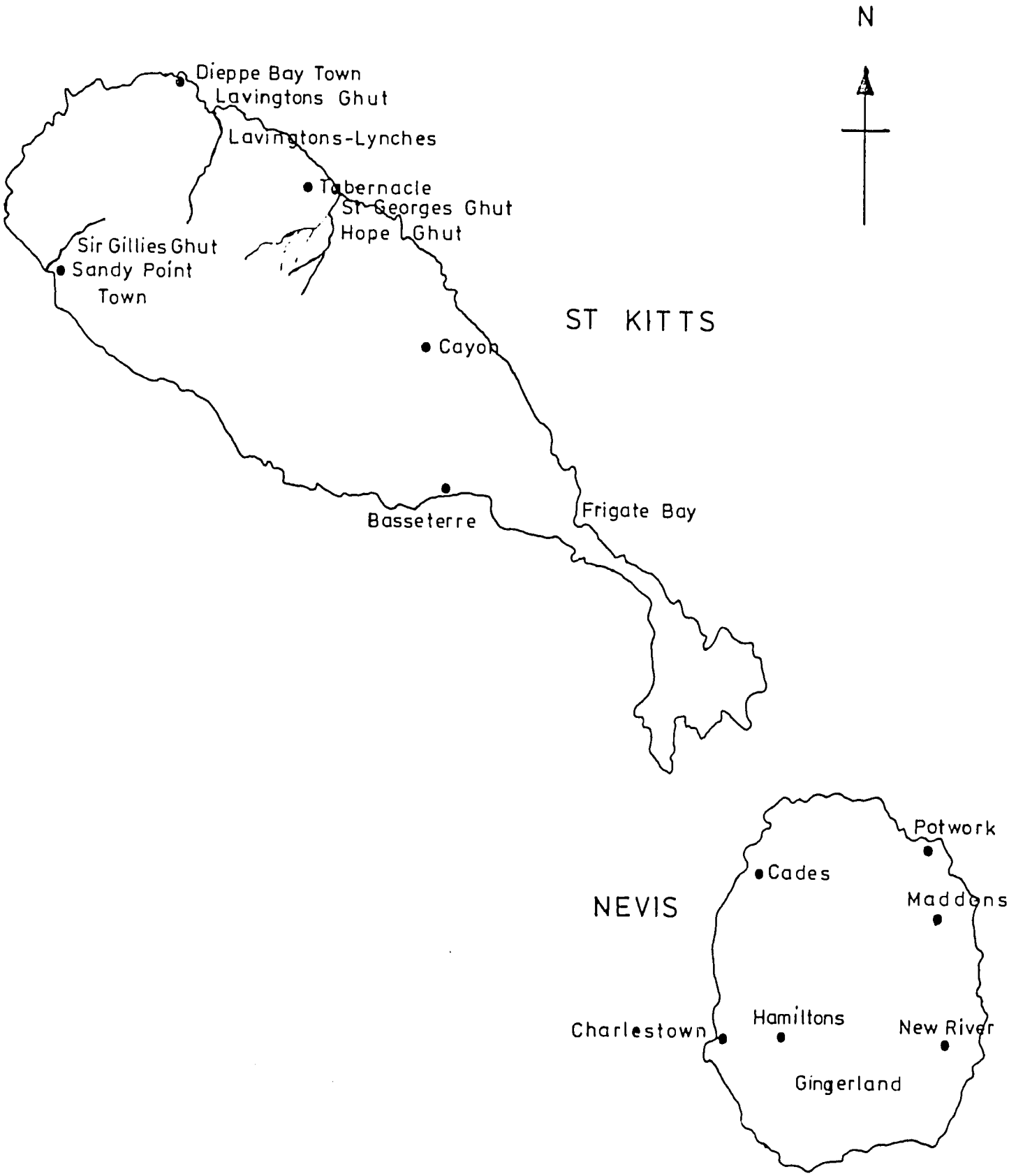


Figure 1. St. Kitts / Nevis Project Site Locations.

See Figure 2 for a sketch of the work to be done at the Lavington Gully. Terracing will be done on a rectangular block of land totaling 135 acres, bordered by gullies on both sides. Graded terraces will be constructed by NACO. The standard Soil Conservation Service (SCS) method of determining vertical and horizontal spacing of graded terraces is to be used. Based on the SCS method, a rough estimate for the total length of terraces required is approximately 40,000 linear feet. It will also be necessary to protect and stabilize the banks and sidewalls of the gully. In some reaches, the sidewalls are vertical and in agroforestry will be planted under the supervision of the Agriculture Department along the edge of the gully. The strip should consist of 4 or 5 rows of trees and should be located adjacent to the grassed waterways. Seven areas in the gully have been identified as being unstable and thus require treatment. Gabion structures will be placed at these locations by NACO.

The Project will establish procedures whereby local farmers wishing to occupy this area under long-term leases will be permitted to do so. Small farmers cultivating the gullies and the upper watershed will be offered long-term leases to cultivate approximately 40 acres in the higher elevations of the field which have been marginal for sugarcane production but might be

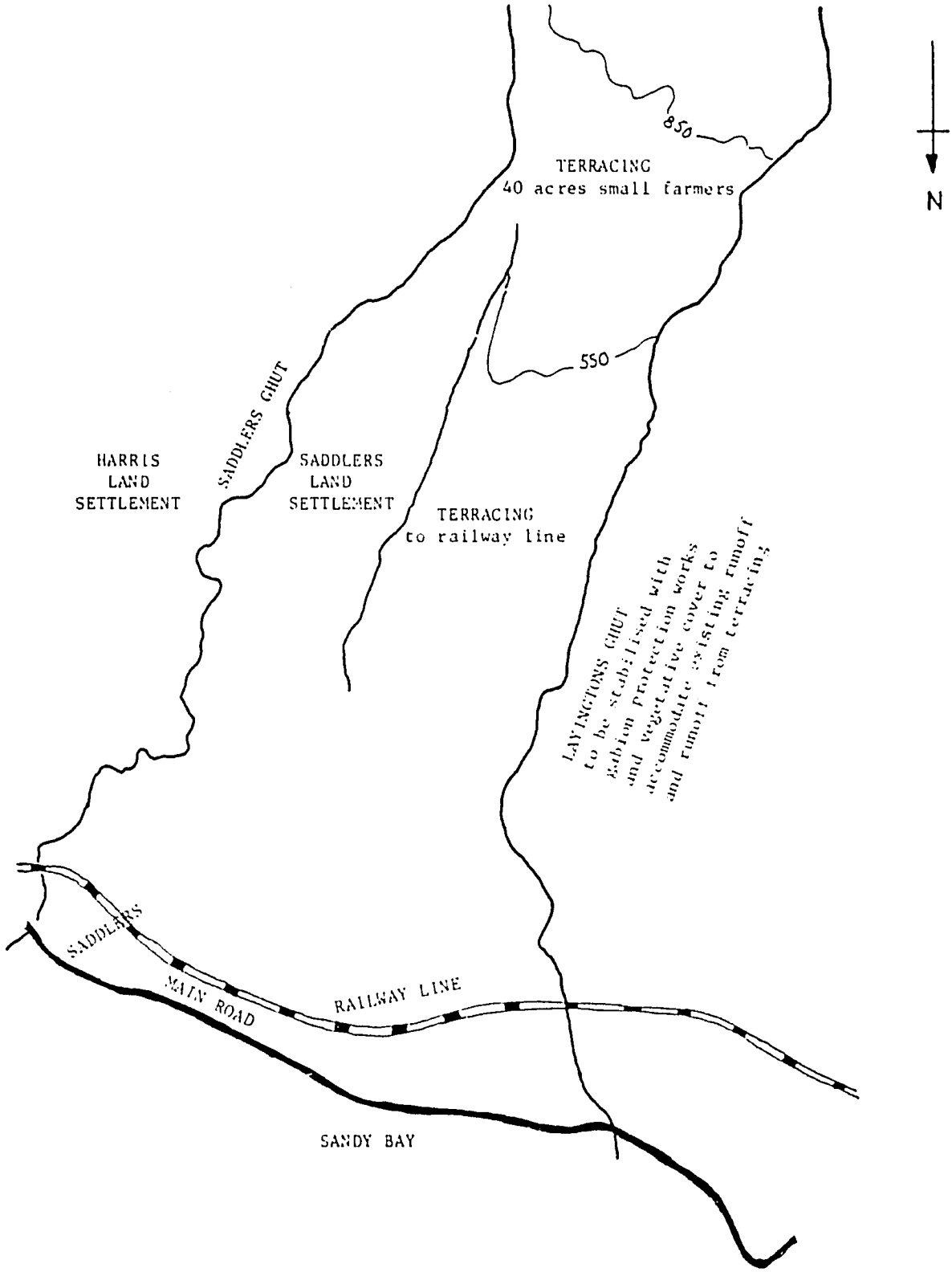


Figure 2. Lavington Lynches Project Site Diagram.

more productive in food crops. The Agriculture Department and CARDI will work with these farmers and supervise the use of the land. This work will address two important aspects of the soil erosion problem, loss of topsoil from the field and degradation of adjacent gullies and upper watershed areas as a result of inappropriate farming practices. It will demonstrate how these erosion problems might be effectively addressed through new farming practices. Secondary, but important aspects of this work will be the new knowledge gained with regard to cultivation of more diversified crops, improvement of soil and water conservation, and agroforestry practices.

The site allocation to small farmers will include demonstration work on a small portion of the field (less than 1 acre) in effective cultivation techniques and evaluation of different methods of crop diversification and agroforestry practices. The Project will provide agricultural production inputs and equipment for field trials and improved varieties of crop and tree seed. Climate monitoring equipment will be installed and maintained at this site. Information will also be gathered concerning surface runoff and soil loss.

The Agriculture Department and CARDI will provide technical assistance and supervision of Project activities to assist the farmers with crop diversification, agroforestry and soil

conservation practices and will evaluate the effectiveness of these practices in preventing top-soil loss and increasing agricultural production. The water resources of the upper watershed will be assessed by short-term technical assistance. It is possible that small springs and strata with perched groundwater exist on the steeper slopes of Mount Misery. These waters, if available, might provide a source for irrigation in the future. Also, the potential for water harvest using treated catchment areas and lined storage reservoirs will be investigated.

B. Sir Gillies Ghaut Treatment (St. Kitts)

Sir Gillies was selected to demonstrate control measures for a flat bottomed, meandering gully. The work needed is not complex (e.g. construction of gabions and channelization) and should provide a model for civil works control of this type of gully. See Figure 3 for a sketch of works to be done in Sir Gillies Ghaut. NACO will be responsible for civil works to straighten the meandering path of the gully. The work will consist of constructing a shallow earthen channel to discharge the runoff through a controlled area. Some of the bends will be protected by gabion works. Care will be taken to protect the

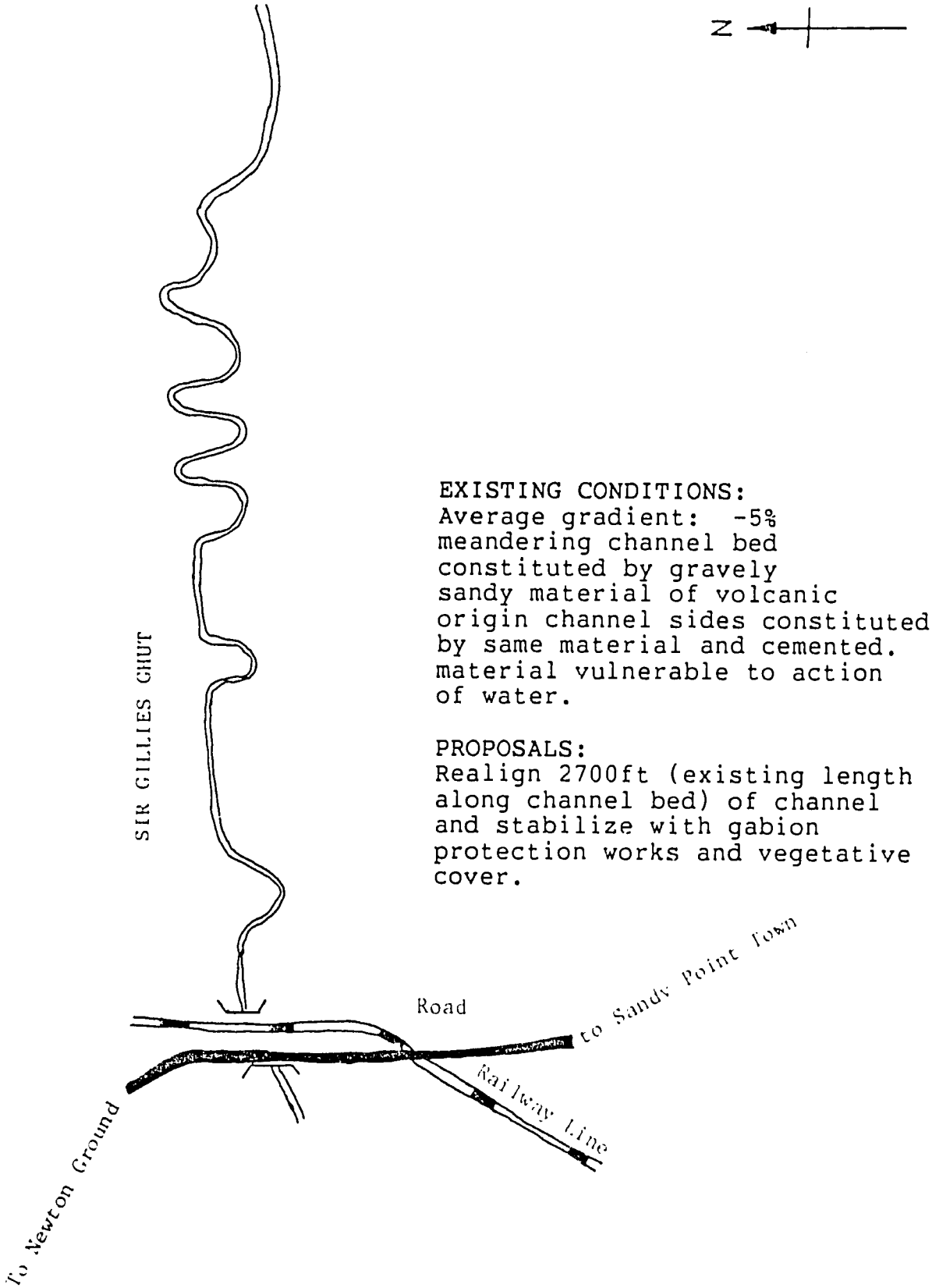


Figure 3. Sir Gillies Project Site Layout.

channel bottom and sides against scouring from the increased velocity of the runoff resulting from channeling. Bulldozer work will be required to build and maintain the channel. On site supervision and training will be provided during the earthmoving operation to insure the bulldozer work is done in an appropriate manner.

A shelter belt area will be established along the sides of the gully as required. This 30 to 40 ft. wide area will be set aside for permanent tree cover. The upper watershed area will be assessed to determine what action is necessary to protect it from further land clearing, encroachment, and tree cutting for charcoal production. This could also involve reforestation of some of the higher elevations above the gully. This work will be conducted by Project funded labor and supervised by the Agriculture Department.

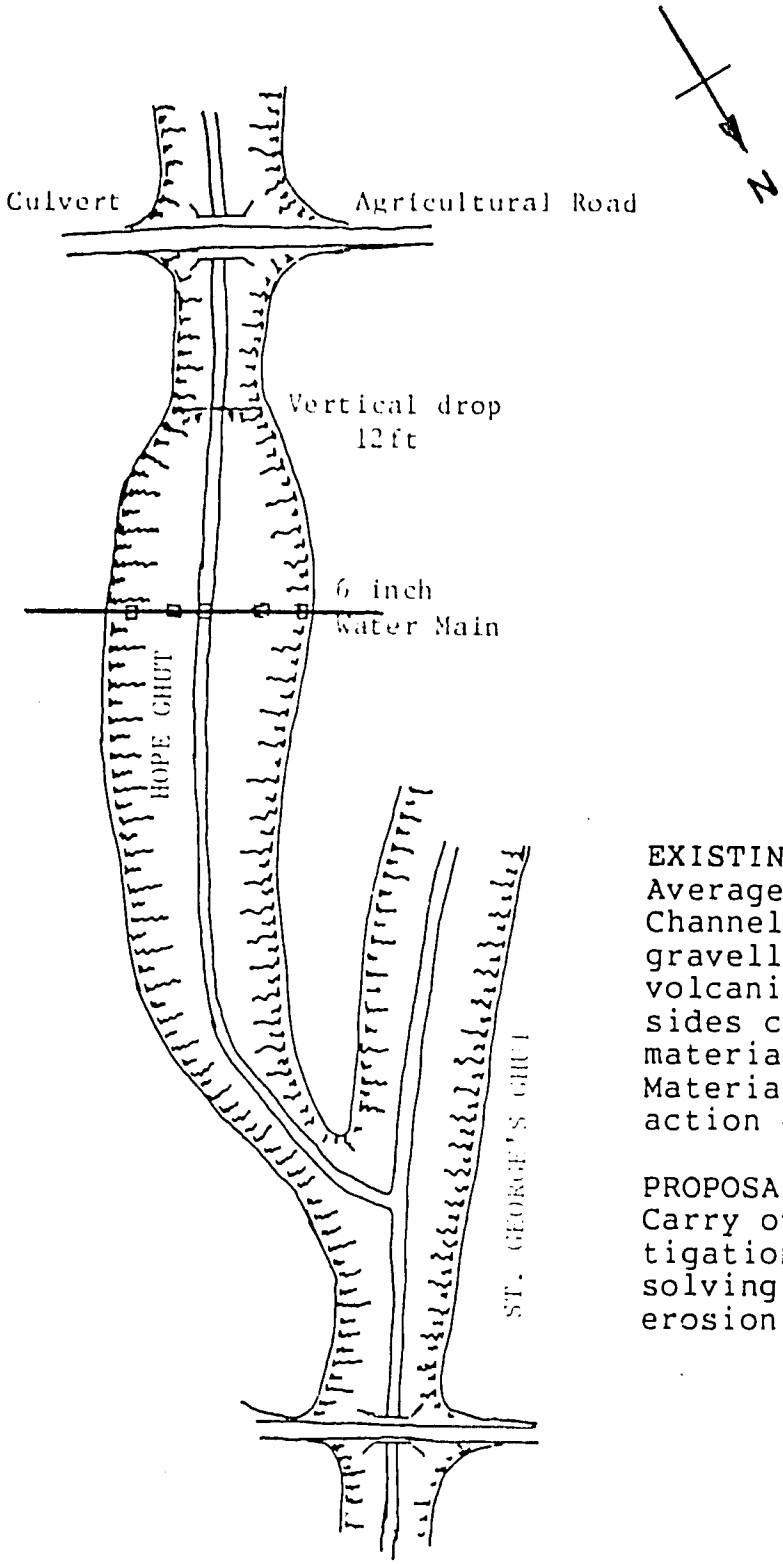
C. Hope Ghaut Treatment (St. Kitts)

Hope Ghaut, a highly developed, headcut type gully was identified for treatment to provide control of a severe erosion problem which threatens the water pipeline to four towns and the only access point to 60 acres of agricultural land. Amendment of Hope Ghaut will also serve to demonstrate procedures for

prevention of further degradation in this type of gully. The sandy loam soil of the gully has allowed serious downcutting when trees in the area were removed for charcoal production.

The downcutting of the bed of the gully has reached severe proportions. The old agricultural road crossings have steadily caved in and the road has progressively been located further upstream. Recently, in an attempt to stabilize the situation, NACO has constructed a twin pipe culvert. Though some stability has resulted in the immediate vicinity of the culvert the downcutting process has continued to the extent that an 11 ft drop now exists about 120 ft. from the culvert. If nothing is done, the culvert will be destroyed in a few years time and an entire agricultural area will be cut off. In addition, erosion threatens the sides of the gully near the location of a water main which currently supplies four villages. Further degradation in this area will result in the collapse of the water main.

Subject to further analysis and design by project funded technical assistance, the most cost solution was initially considered for this design. See Figure 4 for a sketch of the work to potentially be done at the Hope Gully. This would involve the construction of a concrete drop structure and an 1,800 ft. concrete channel (less expensive options than this are possible, depending on the assessment by short-term technical



EXISTING CONDITIONS:
Average gradient = 17%
Channel bed constituted of gravelly, sandy material of volcanic origin. Channel sides constituted of same material and cemented. Material vulnerable to action of water.

PROPOSAL:
Carry out detailed investigation with a view to solving problem of ghut erosion.

Figure 4. Hope Project Site Diagram.

assistance). The Department of Public Works would be responsible for concrete work and NACO would be responsible for the construction of gabions in the upper portion of the gully. The gully banks will be planted with trees in a 40 ft. belt on either side of the gully where required. This work will be conducted by the Agriculture Department.

D. Soil Conservation Plan (St. Kitts and Nevis)

A Soil Conservation Plan will be drafted by the project manager in coordination with the Department of Agriculture, NACO and the planning Unit. The objective of the Plan will be to establish a soil conservation strategy and a work program which will institutionalize an ongoing program to succeed this Project.

The Plan will locate, characterize, and quantify the soil erosion problems in St. Kitts. It will establish criteria for making choices among alternative preventive and remedial activities. It will include a manual with references, describing technical and cost aspects of these activities including terracing techniques, cultivation and planting techniques, agroforestry techniques, treatment of incipient gullies, control of land use, and other relevant activities. The plan will also establish a work plan and schedule which includes definitions of responsibilities and resources. One

important result of the plan will be the institutionalization of a soil conservation program and the replication of the more successful treatment activities of this Project

E. Surface Water Development Work Plan and Works (Nevis)

Water for household use, livestock, agriculture, and light industry is scarce on Nevis, despite an average annual rainfall of about 40 inches. There is keen interest in developing the groundwater resources of the island. At present, only three wells are supplying the urban centers. However, a serious constraint to this development is the lack of available information regarding the extent, quality and the safe yield of the groundwater resources on Nevis. Furthermore, knowledge of the underlying geology is insufficient at this time to allow reliable estimates of the impact that pumping may have on the groundwater/sea water balance.

The information needed can only be determined by drilling, coring, pump tests and water quality analysis. The government has assigned a high priority to these proposed activities and has mounted an exploratory drilling program with the Canadian International Development Agency (CIDA).

An equally high priority is the conservation and development of surface water resources. There are a number of natural

springs on the island, some of which are admittedly underdeveloped, but the potential for the full development of all existing springs will be investigated by this project. The presence of springs and seeps indicate that there may be other unknown sources of near-surface water that could be developed.

F. Watershed Protection Work Plan and Works (Nevis)

The longterm water resources specialist will also develop a Watershed protection plan and Work Program for Nevis. The Watershed Protection Work Program shall incorporate existing knowledge, capability and hydrologic studies. It will establish general criteria for determining the nature and level of restrictions and incentives to be placed on land and water use. It will help establish the responsibilities of the owner of the land for proper management of the land. Watershed areas shall be prioritized in terms of need for immediate attention. For purposes of demonstration, the work program should initially focus on the following watersheds: New River, Maddens, Fothergill's and Springhills, all areas in poor condition. Three to six activities will be identified and designed. The social, financial and economic feasibility of the projects will also be determined. The specialist will supervise the implementation of the feasible activities.

Chapter III. ST. KITTS REPORT

Four of the project components discussed in the previous chapter relate specifically to the island of St. Kitts. The components were a) Lavington Lynches treatment and settlement; b) Sir Gillies Ghaut treatment; c) Hope Ghaut treatment; and d) Development of a soil conservation plan and handbook. In this chapter, each of the above components will be presented from both an engineering and economic perspective. The proposed alternatives were presented and discussed with the St.Kitts Project Advisory Committee before being included in this report.

A. Engineering Alternatives

The following design alternatives and cost estimates are based upon a preliminary review of design constraints and local construction costs. The cost for formed concrete work and gabion basket type structures (estimated on the basis of recent NACO and Public Works Department experience) is EC $500 or US $200 per cubic yard installed.

For each of the proposed alternatives, probable life of the structure has been estimated. In general, all hydraulic control structures can be considered temporary in nature. This is because the capacity of the structures must be based upon the

probability of a specific rainfall event. For a simple diversion structure a return period of 10 years is common. For larger more expensive structures a 50 year return period may be adequate. When life and property are at stake a 2,000 year return period is not inappropriate. For this study a 25 year return period was used because the proposed hydraulic structures are for erosion control and do not fall in the category of life threatening.

1. Lavington Lynches Treatment and Settlement

In the original project paper the primary engineering works described for Lavington Lynches consisted of terracing to minimize soil erosion and minor civil works to stabilize the gullies. The total direct costs of the project include $108,700 for management, $125,000 for terracing, $67,600 for gully improvement, $33,600 vehicle and tractor costs, $21,100 for short term technical assistance and $30,000 for tree planting. The cost for additional gully stabilization required because of increased channel flow due to terracing in the upper reaches was $67,600. A preliminary analysis of the Lavington Lynches watershed was conducted and is included in Appendix B. Figure 5 illustrates the topography and layout of the watershed at Lavington Lynches. Using the rational method, an estimated peak runoff of 555 cfs was determined for the project area. Using the Universal Soil Loss

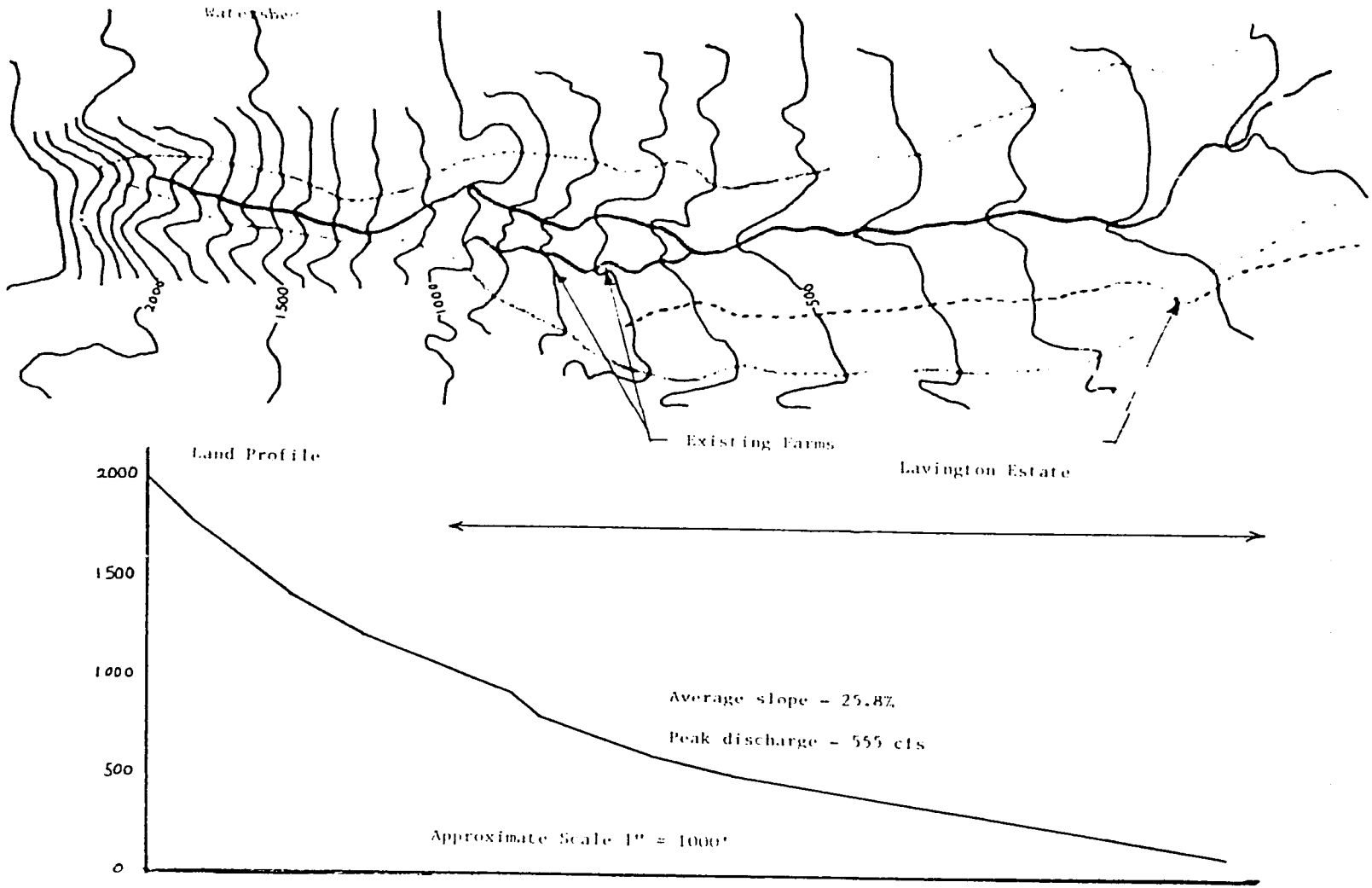


Figure 5. Topographic Map and Land Profile of Lavington Lynches.

Equation, the average soil loss without terraces could be as high as 77 tons per acre per year. With terraces, the soil loss would be reduced to approximately 3.5 tons per acre per year.

Based on the above analysis and the existing stabilization efforts, there is no reason to change the original plan or cost estimate at this time.

In addition to terracing and gully stabilization, the project was to establish procedures whereby local farmers could occupy the newly terraced land under a long term leasing arrangement.

After inspecting the Lavington Lynches site, it was decided that a soil analysis should precede the establishment of farms on the newly terraced lands. The consulting team also expressed some concern as to the marginal value of the upper slopes of the Lavington Lynches site.

A soil sample taken in early March 1985 (Table 1.) and NACO yield records for the site confirmed that the ghaut soils had considerably higher PH levels and more available nutrients then the soils in the area to be terraced. The sugarcane yields in the project area were also 20-40 percent less than those of surrounding areas. If NACO had not released the site for use as part of the resource management project, it is unlikely that the area would have been replanted at all.

Based on the above analysis, a request was made to the NACO

Table 1. Results of Lavington Lynches Project Site Soil Analysis

Location/Depth in.				Pounds per Acre			
		PH	BPH	P	K	CA	MG
Ghaut Soil	0-12"	6.5	6.9	11	152	2667	432
	13-24"	6.8		6	109	3360	623
Ghaut Soil	0-12"	6.2	6.6	5	176	2514	384
	13-24"	6.8		2	93	3200	480
Lavington Lynches Upper Slopes	0-12"	5.2	5.7	21	184	505	34
	13-24"	5.9	6.0	7	118	589	42
Lavington Lynches Lower Slopes	0-12"	5.6	6.0	33	348	842	118
	13-24"	5.7	6.1	21	264	1600	160

Chief Executive Officer to move the project to the lower reaches of the Estate. Aside from increased yields due to more fertile soils, several additional benefits would result from such a move, i.e. irrigation water from groundwater sources would be more readily available and farm to market roads would be more accessible. In March 1985, movement to the lower reaches of Lavington Lynches was verbally approved by the NACO Chief Executive Officer for follow through during the project implementation.

2. Sir Gillies Ghaut Treatment

In the original Project Paper, the primary engineering works to be considered for Sir Gillies Ghaut were channelization and stabilization of the waterway for an estimated cost of US $200,000. The following is a description of the preliminary analysis and alternative solutions proposed for Sir Gillies Ghaut.

A preliminary analysis of the Sir Gillies watershed was conducted and is included in Appendix B. Figure 6 illustrates the topography and watershed layout at Sir Gillies. Again, using the rational method, a peak runoff rate of 280 cfs was estimated for the project area.

Based on the above analysis, it is evident that the soil erosion and side slope cutting action of the Sir Gillies Ghaut

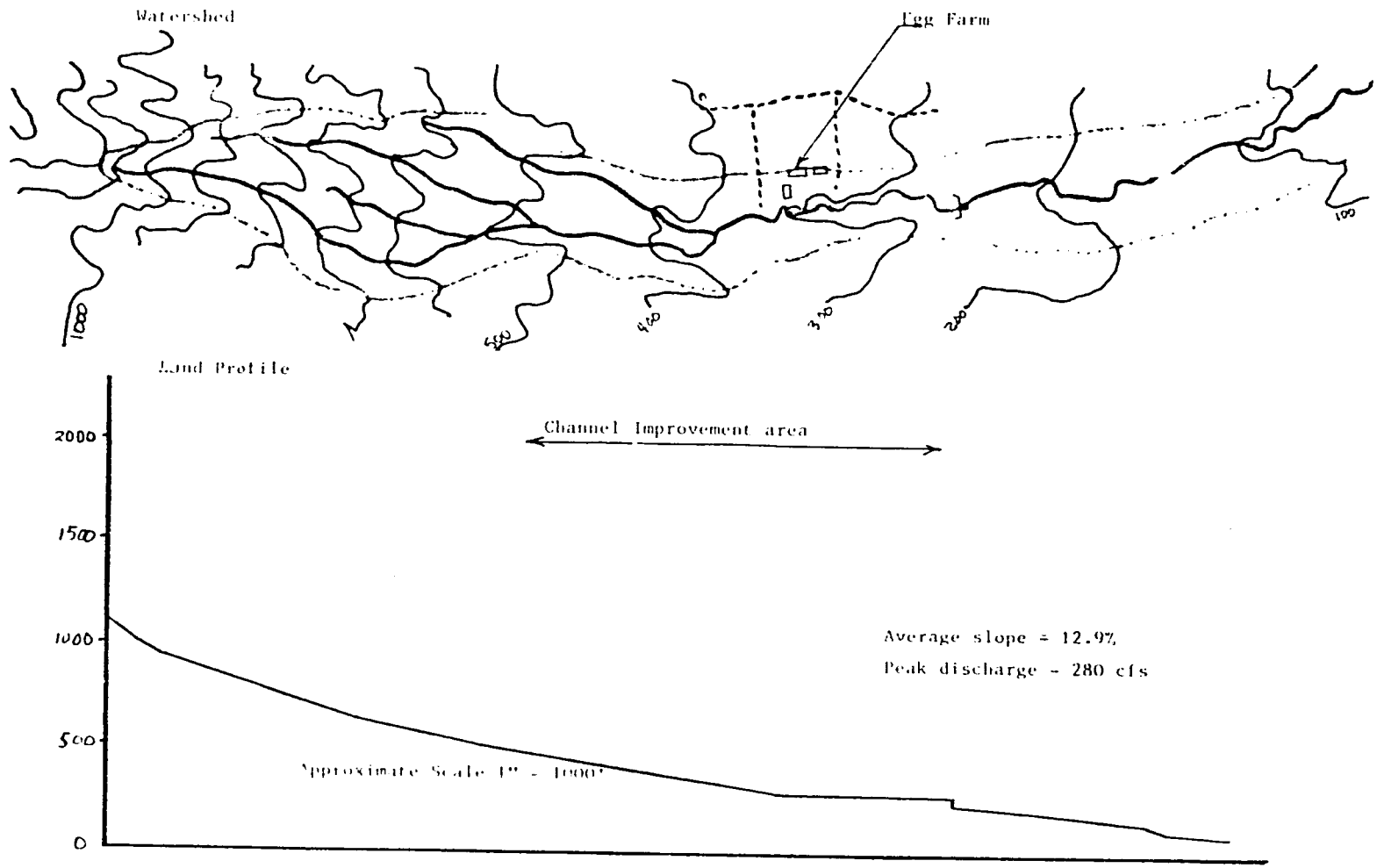


Figure 6. Topographic Map and Land Profile of Sir Gillies Ghaut.

waterway is a classic example of a stream attempting to find equilibrium. The side to side slope cutting action of the stream adds aggregate to the stream flow. The additional sediment load reduces the velocity and the stream continues this process until equilibrium is achieved. In the case of Sir Gillies Ghaut this could mean decades before sides-slopes and sediment load reach equilibrium or acceptable erosion levels.

Man's activities in the watershed area significantly affects the dynamics of stream and watershed development. For example, if trees are excessively harvested or if roads are improperly routed, the result may be higher peak runoff and higher stream bank erosion. In the case of Sir Gillies Ghaut, the stream is simply taking its course.

To resolve the imminent loss of additional farmland, the following alternative solutions were proposed to the Project Advisory Committee. The first alternative follows that proposed in the original project paper and the second alternative consists of a minimal action partial solution.

Alternative i - Sir Gillies

In the original project proposal channelization and gabion control structures were recommended at an estimated total cost of US $200,000. If channelization is to be successful a combination of side wall and bottom protection must be used (see Figure 7). The estimated cost of such a gabion structure would be approximately US $500 per ft. In this case a maximum of 400 ft. of channel could be installed for US $200,000. This cost includes the stabilization of surrounding areas with vegetation.

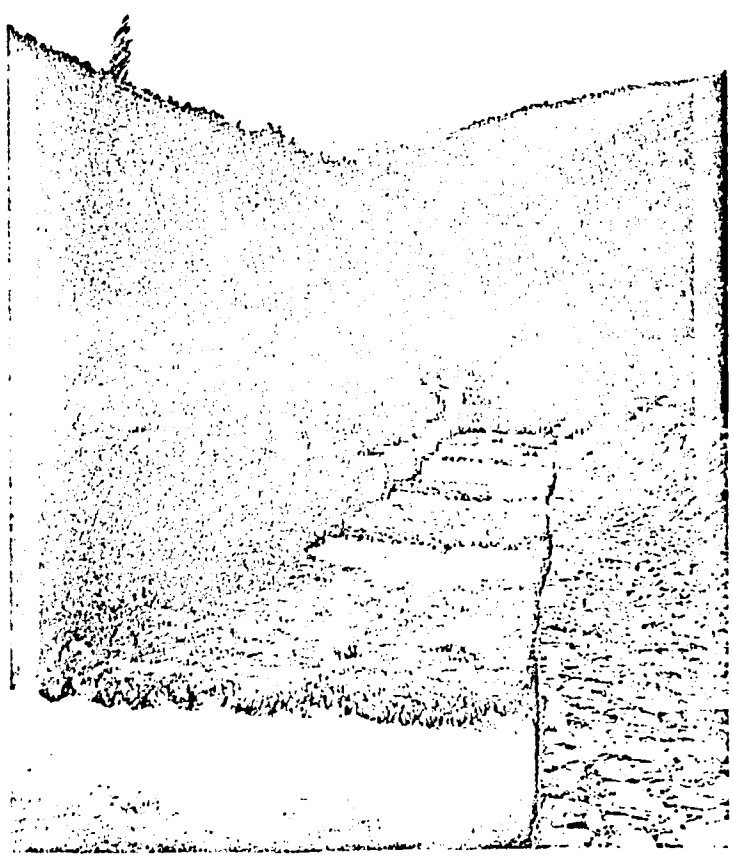


Figure 7. Stream Channelization using Gabions.

Alternative ii - Sir Gillies

A minimal cost partial solution to the Sir Gillies Ghaut problem would consist of side slope stabilization and energy dissipation measures in the area near the egg farm. This solution would consist of approximately 75 ft. of gabion side walls and bed stabilization efforts (see Figure 8.). In addition, two simple low drop energy dissipation spillways will be constructed on either side of the side slope stabilization works. The cost of this structure could be approximately $40,000 and includes revegetation and landscaping in the area of the works.

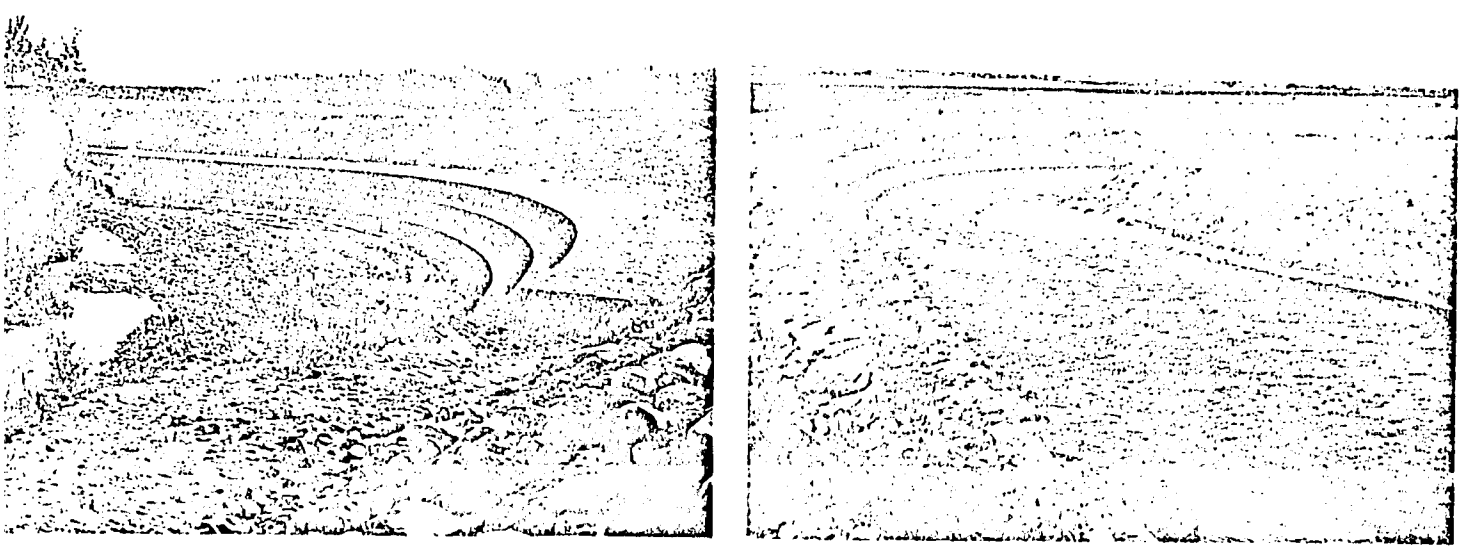


Figure 8. Stream side slope stabilization.

3. Hope Ghaut

In the original Project Paper, the principal engineering works to be considered for Hope Ghaut were channalization and stabilization of the waterway at an estimated cost of US $700,000. The following is a discussion of the preliminary analysis and alternative solutions proposed for Hope Ghaut.

A preliminary analysis of the Hope Ghaut watershed was conducted and is included in Appendix B. Figure 9. illustrates the topography and layout of Hope Ghaut. Because of its smaller area, the peak runoff estimate for the ghaut is only 157 cfs.

Based on the above analysis and several on-site visits, it is evident that the soil erosion and head cuts along Hope Ghaut have been caused primarily by man's activities in the upper reaches of the ghaut. The two major culprits are cultivation of Class D land (10-20° slopes) and concentration of runoff in the access roads. By far, the best method of dealing with gully formation is prevention. Prevention involves maintenance of proper vegetative cover rerouting of access road runoff, buffer strips and vegetative waterways.

Once headcuts have begun the preventative measures mentioned above will not stop the cutting action, they will only slow it down. For this reason corrective measures proposed for Hope

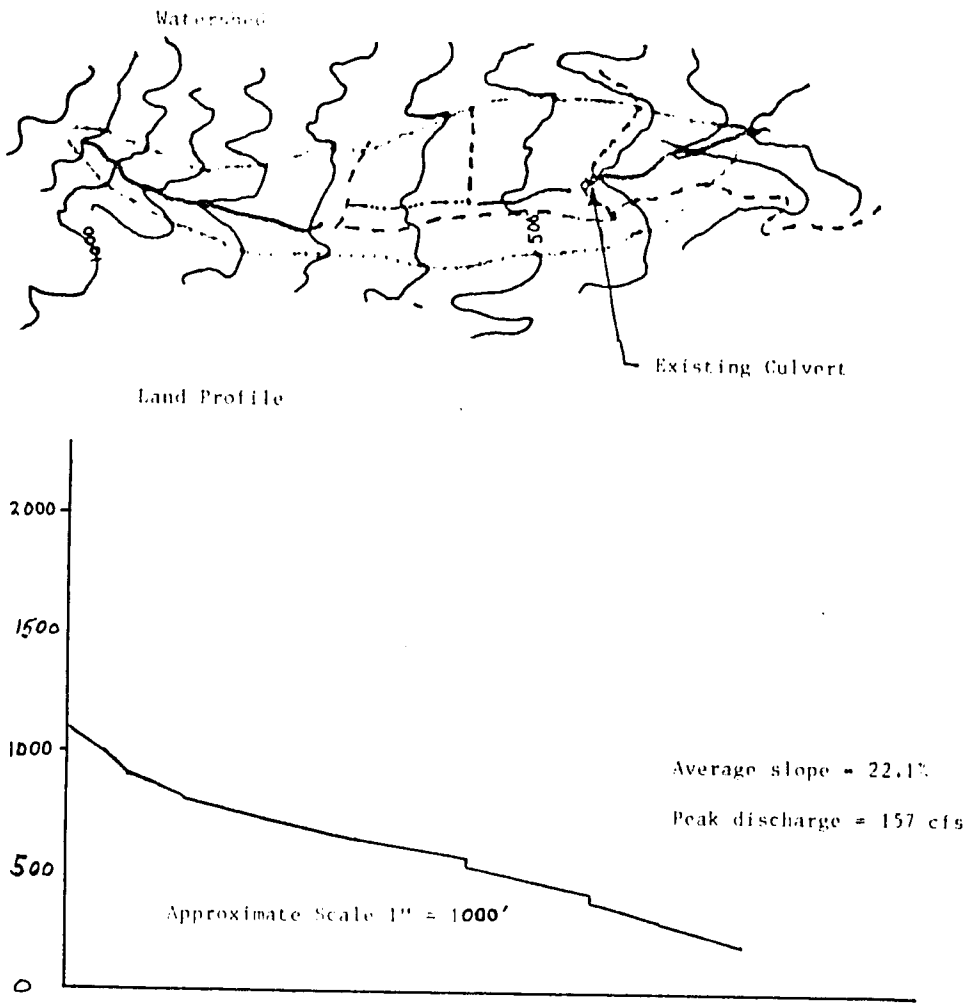


Figure 9. Topographic Map and Land Profile of Hope Ghaut.

Ghaut should include both structural and land rehabilitation measures.

The following alternative solutions were presented to the Project Advisory Committee. The first alternative follows that proposed in the original project paper. The second and third alternatives represent lower cost and minimal action partial solutions.

Alternative i - Hope Ghaut

The original solution proposed for Hope Ghaut was the construction of a concrete chute spillway and channel for the full length of the Ghaut (see Figure 10). A cost estimate of this alternative was made by a USAID civil engineering and was found to be approximately US $700,000. The concrete chute spillway option included energy dissipation devices along the channel as well as a bell shaped outlet into Sir Georges Ghaut.

The advantages of this alternative include Ghaut stabilization, reduced erosion and improved energy dissipation. The disadvantages of this alternative are that it does not remediate upper reach head cuts and/or prevent additional head cuts from forming in surrounding areas.

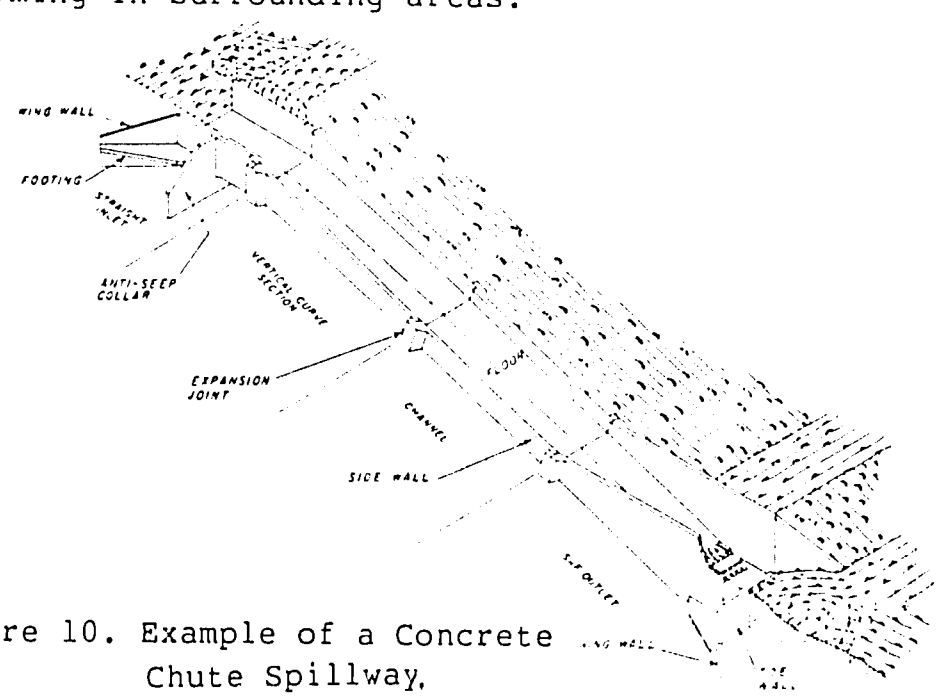


Figure 10. Example of a Concrete Chute Spillway.

Alternative ii - Hope Ghaut

The following alternative attempts to address several specific head cut problems as well as the rehabilitation of the upper reach areas. This alternative has been divided so that individual gully control measures can be carefully considered.

a) Drop Inlet spillway - see Figure 11 for an example of a drop inlet spillway. The cost of this structure is estimated to be US $100,000. The advantages of this component are head cut stabilization and access road protection.

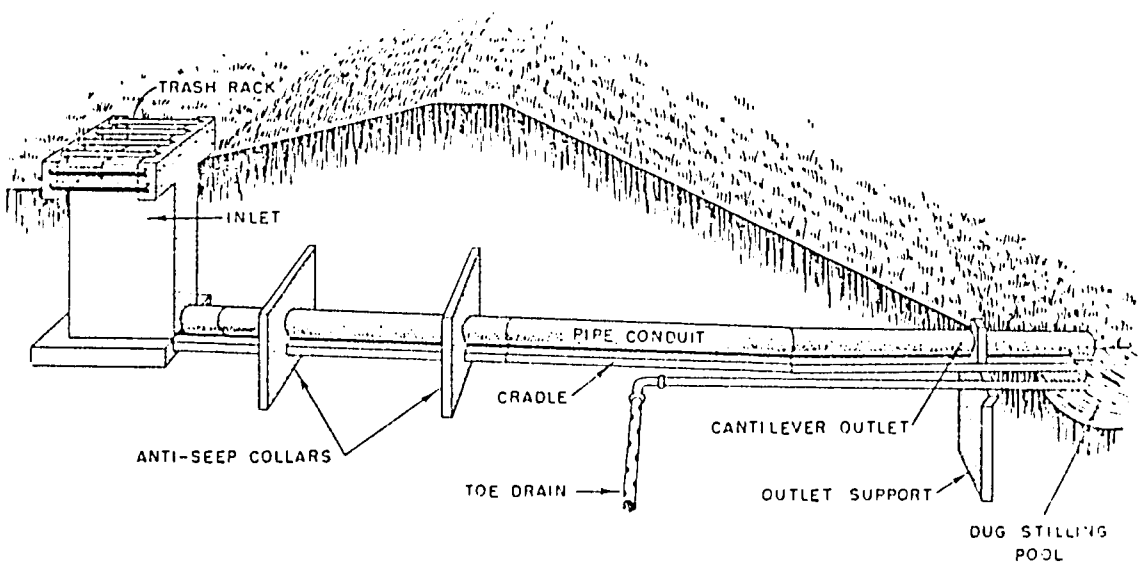


Figure 11. Example of a Drop Inlet Spillway

b) Gabion Drop Structures - Over the past few years three additional head cuts have formed along Hope Ghaut, one in the upper reaches and two others on newly formed tributaries. These new head cuts will continue to erode unless appropriate measures are taken. The options include a concerted landscaping and revegetation effort combined with upper watershed rehabilitation and gabion drop structures at the head cut areas. See Figure 12 for an example of a gabion drop structure.

The estimated costs for the gabion drop structures is approximately US $50,000. The average drop for each spillway system is about 12 ft. The total cost for stabilizing all three additional head cuts would be approximately US $150,000.

The advantages of the gabion structures are that they would be easy to install and effective in reducing the head cutting erosion.

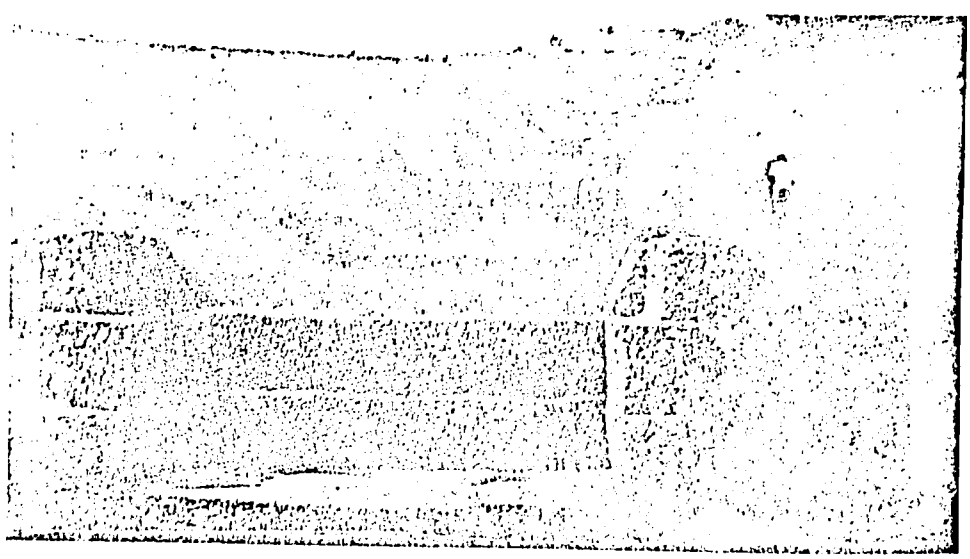


Figure 12. Barbados-St. Andrews-stabilization using a series of gabion drop structures.

c) Rerouting Access Roads - Probably the single most destabilizing factor in Hope Ghaut is the current farm access road system. The upper reach roads for the most part, do not have sluice diversion embankments to redirect water into the sugar cane fields. For this reason water has concentrated and cut heavily into the roadway. In addition concentration of water flow has caused a new upper reach head cut to form.

In general rehabilitation and rerouting of the access road, including landscaping and sluice embankments should cost about US $10,000 per mile of road. Given the current road system, it is estimated that at most 3 miles of roads would require rerouting. The total cost would then be US $30,000 for this component.

d) Reforestation and Landscaping: A very effective method of reducing erosive runoff is through reforestation and installation of vegetative buffer strips along the ghaut. The estimated cost of these efforts would be approximately US $20,000 for 40 acres of agroforestry in and around the ghaut.

Alternative iii - Hope Ghaut

In most conservation planning situations cost benefit analyses dictate the ultimate selection of alternatives. For this reason a third minimal action option has been developed with a total associated cost of less than US $100,000. In this option a gabion drop structure similar to that proposed in Alternative ii component (b) would be installed at the culvert crossing location. With the selection of this option the access road would be preserved, some rerouting of secondary access roads would be undertaken and rehabilitation of the upper reaches would be proposed.

The rest of the ghaut would be left to follow its own course. However, the effect of the road rerouting and upper reaches rehabilitation would be to slow down the head cutting action of the ghauts.

4. Alternative Project Components

The following is a preliminary discussion of several alternative project components which were suggested by the Project Advisory Committee.

Alternative i. Irrigation at Lavington Lynches

The potential for irrigation of the proposed terraced area at Lavington Lynches would depend upon the availability and development costs of various surface and groundwater sources. A surface water source which flows at about 30 gpm was identified approximately 2,000 ft. from the proposed terraced area. The 30 gpm water source would adequately irrigate 5 to 8 acres of vegetable production land or approximately 25% of the proposed area. Additional possibilities for surface water and ground water extraction should be more fully considered. A CIDA project paper evaluating groundwater resources should be available in early 1986.

The estimated cost of ground development is US $500 per acre and the estimated cost of sprinkler irrigation would be approximately US $2,000 per acre for a total development cost of approximately US $2,500 per acre. The total development cost for irrigation at Lavington Lynches would be approximately US $100,000 for the 40 acres of terraced land.

The reason for the extremely high cost of irrigation in the Lavington Lynches area is the fact that on forty acres there will be as many as twenty farmers each wanting to irrigate on demand. Thus, the design situation resembles a municiple water system rather than a conventional irrigation system where one farmer would irrigate 40 or more acres at less than half the cost. One method of reducing the cost of this alternative would be to provide farmers with water and low interest loans so that they may invest in their own irrigation equipment.

Alternative ii. Terraces at Wingfield Feeder Road

The Wingfield Feeder Road area was considered for terracing and general agricultural development opportunities. The area is rain feed for most of the year because of its high elevation. The current farming enterprises consisted primarily of pasture with some vegetable production. The soil conservation opportunities on this parcel consist of ditch terracing on the major slopes (20-40%) and conservation bench terracing on the minor slopes (10-20%).

The total cost of the above conservation activities would depend on the total area involved. Estimates of the total area vary from 60-100 acres. If costs can be justified additional consideration of this component should be made.

Alternative iii. Background Data and Irrigation Development

The following alternatives for background data collection nd irrigation development were discussed by the Project Advisory ommittee and are presented here as possible future project omponents.

- Soil Survey - A comprehensive Soil Survey including assessments of Engineering as well as agricultural characteristics of various soil groups be developed.
- Extension Soil Conservation -The employment of an extension specialist with a soil conservation background should be encouraged.
- Convipps - The potential irrigation and cultivation of this area would further agriculture independence and diversification aims.
- Sir Gillies - The potential irrigation in this area should also be considered more fully.

B. Economic Evaluation

From an economic perspective, a variety of benefits would be created if the soil conservation and ghaut treatment measures described in the engineering alternatives section were implemented. Estimates of the benefits associated with each project component, which were obtained using the approach to economic analysis described in Appendix B, follow. Those benefits are compared to the estimated costs of alternative designs for each component (see preceding subsection) using the NPV criterion for economic efficiency. NPV contains the same information as the benefit/cost (B/C) ratio. The latter criterion equals the present value of the benefit stream generated by a project (B) divided by the present value of the project's cost stream (C). NPV equals B - C. If, at some given r (discount rate), NPV is positive (negative), then the B/C ratio evaluated at the same r, will be greater (less) than unit and the project satisfies (fails to satisfy) the efficiency criterion, again assuming a given r. In this study, a real discount rate of 8 percent is used.

1. Lavington-Lynches Treatment and Settlement

On-site benefits of three activities to be undertaken on the Lavington-Lynches Estate were estimated. The activities

include (a) planting fruit trees on 6 acres in Lavington Ghaut in order to arrest its development; (b) initiating irrigated vegetable production on 40 of the 135 acres to be terraced at Lavington-Lynches Estate; and (c) establishing 20 acres of forest uphill from terraced farmland. The off-site benefits of these three activities were not estimated. Neither were the on-site benefits of terracing the other 95 acres of land, which will continue to be planted to sugarcane. The three on-site benefits were compared both to the costs of improvements (primarily, terracing and installing an irrigation system) as well as to the income lost because annual cropping in the ghaut, where soils are of high quality, is abandoned.

In the project working paper annual income from an acre of fruit trees, which would begin producing during the eighth year of the project, would be US $1600. This figure, obtained from studies on Nevis financed by the British Development Division (Davis, Errinigton and Gordon), assumes that the farmers provide half of the labor inputs at an opportunity cost of zero. Using a real discount rate of 8 percent to evaluate future revenues on those 6 acres, one obtains a present value of US $66,000 for the on-site benefits of the first activity at Lavington-Lynches.

The BDD study also identified annual net revenues on an acre of irrigated land used to grow three types of vegetables

(tomatoes, cabbages, and cucumbers) and various field crops (including peanuts, blackeye peas, pigeon peas, dry corn, and sweet potatoes). The model farming system on which the BDD budgets are based is designed to yield 100 pounds of vegetables per acre during 35 weeks of the years when the two islands' vegetable farms, which by and large receive no irrigation water, are unable to supply more than a small fraction of local demand for produce. The model system was based on irrigation trials performed by CARDI in 1979. As is the case with fruit tree production, it is assumed that farmers supply half the required labor at zero opportunity cost. Prices for various outputs are those observed in the Charlestown public market in 1984.

Although the model farming system is designed to reduce SKN's dependence on imported vegetables, it should be remembered that development of irrigated vegetable production could have substantial impacts on commodity prices. If farmers can obtain the same yields that CARDI achieved in its trials, total annual domestic demand for tomatoes, cabbages, and cucumbers could be satisfied from production on 40 to 50 acres of irrigated land. To avoid price impacts that reduce the net revenue projections reported below, development of export markets would be necessary if implementation of the project analyzed in this report results in more than 50 acres of irrigated land coming into

production.

Understanding the potential impacts on commodity prices of work at Lavington Lynches (and understanding that farmers might not actually achieve the same yields that CARDI did), we turn to an evaluation of the on-site benefits of irrigating 40 acres of terraced cropland at the Estate.

Allowing for lower yields during a two-year "run-in" period, BDD projected the following annual net revenues/acre when irrigation is made available: EC $485 in year 1, EC $920 in year 2, EC $1623/year thereafter. Translating this net revenue stream into a present value using an 8 percent real discount rate, and the prevailing exchange rate yields benefits of irrigation of US $7225/acre. Subtracted from this benefit are the annual costs/acre of running and maintaining the system. Operating costs were assumed to be US $20/crop. If three crops are grown in a year, annual operating costs equal US $60/acre. Translating this cost stream into a present value using the 8 percent discount rate, one obtains US $750/acre. Annual maintenance costs were assumed to equal US $125/acre (5 percent of capital costs). the present value of this cost stream is US $1,550.

The net benefits/irrigated acre then approach US $5,000. Multiplying this net benefit/acre by 40 acres, we obtain US $200,000 for the second on-site benefit of work at Lavington-Lynches.

The third category of income is derived from managing the 20 acres of forest uphill from the irrigation acreage. The working paper's assumptions regarding production and labor inputs were used. They are: 6 tons of charcoal and 30 fenceposts are taken from each acre annually, beginning in the eighth year of the project and net revenues are US $82/ton of charcoal and US $15/fencepost. Thus, annual income, starting in year 8, is US $942/acre and the present value of future returns from managing the forest acreage is US $136,400/acre (again, assuming an 8 percent real discount rate).

Without varying any of the assumptions made in the BDD report and the working paper, the on-site benefits of work at Lavington-Lynches approach US $400,000 [$66,000 + $200,000 + $136,000]. If anything, those assumptions are optimistic, for reasons described above. One should keep this in mind when reviewing the comparison of benefits and costs that follows.

To repeat what was said in the preceeding subsection, project costs comprise US $125,000 for terracing, US $68,000 for gully treatment, US $100,000 for irrigation development, and US $30,000 for trees. Project costs also include income lost because small farmers are moved out of the ghaut. In the working paper, annual income was stated as equal to US $625/farm (average farm size is approxiamtely 1/2 acre). If annual cropping, the

principal activity on the 17 farms, could only be continued for 5 years before yield declines caused by soil erosion forced abandonment of the ghaut, the present value of foregone income would equal US $46,000.

The three on-site benefits [US $400,000] less the costs described above [US $370,000] yields a NPV of work done at Lavington-Lynches of US $30,000. One could infer from this figure that if CARDI yields were not achieved on the 40 irrigated acres or if farmers received lower prices than expected, this project component might not satisfy the efficiency criterion. However, neither the on-site benefits of terracing 95 acres of cane land nor the component's off-site benefits are reflected in the US $30,000 NPV estimates. Also, positive NPV should be achieved because small farmers resettled on irrigated acreage should not have an incentive to return to the ghaut; their net returns/acre should be substantially higher on the irrigated land.

2. Sir Gillies Ghaut

Treatment of Sir Gillies Ghaut yields smaller benefits than does any of the other project components. Perhaps 6 acres of farmland are threatened at Sir Gillies Ghaut. In order to stabilize the ghaut, however, about half of that area would have to be placed in vegetative buffer. Accordingly, farmland

preservation benefits of treating Sir Gillies Ghaut are no more than US $15,000 [3 acres x $5,000/acre].

Another primary benefit of this component is that a farm building that is in imminent danger of falling into Sir Gillies Ghaut would not have to be rebuilt in another location. The farmer states that the expense of rebuilding woud be approxiately US $20,000.

The benefits of treating Sir Gillies Ghaut, then are somewhere between US $35,000 and US $40,000. This range of estimates does not include the relatively small annual revenues that could be earned from the sale of fuelwood and forest products (e.g., fenceposts) that could be produced on buffer land.

Clearly the maximum possible benefits of treating Sir Gillies Ghaut do not begin to approach the costs of channelization. If the farm building and 6 acres of farmland would be lost soon in the absence of any corrective action, then the benefits of minimal (but effective) stabilization, US $35,000 - US $40,000, would exceed the cost of minimal stabilization, US $30,000.

3. Hope Ghaut Components

Two types of primary benefits would be created if Hope Ghaut were rehabilitated. First, access to more than 60 acres of land now planted to sugarcane would be maintained. (Part of that parcel is being threatened by incipient development of a small gully). Second, the frequency with which a water line stretching across the ghaut has to be repaired would be reduced.

Ignoring the few acres of cropland along the side of the ghaut that would become part of a vegetative buffer and assuming that no additional gullying of productive land occurs, we estimate that the benefits of preserving access to sugarcane land would be US $300,000 [60 acres x $5,000/acre].

The estimate of the second class of benefit to be generated by treatment of Hope Ghaut is based on data supplied by the St. Kitts Water Department. Four times during the last ten years, storm water racing down Hope Ghaut has severely damaged a waterline. After each event, approximately EC $15,000 has been spent on repairs [30 lengths of pipe costing EC $220/length, EC $5000 to install gabions, and slightly more than EC $3,000 in other expenses]. If the head cut lying between the road and the water line (the road is upstream from the water line) were stabilized, storm runoff would travel less rapidly down Hope Ghaut. Thus, damage to the water line would occur less

frequently.

This analysis assumes that if after treatment of Hope Ghaut, storm runoff ceases to damage the water line, then the expected value of annual benefits associated with this change would be the frequency of storms that, in the absence of the project, would cause damage multiplied by the repair cost. Observed frequency during the last ten years is 0.4 (4/10). Using that figure, we estimate the second category of primary benefits to be US $2,260 [0.4 repairs/year x EC $15,000/repair x US $1,000/EC $2.65].

To summarize, the benefits of treating Hope Ghaut include US $300,000 (the value of land that is not "lost" because the project is implemented) along with US $2,260 that is saved each year because water line repairs are no longer needed. Using a real discount rate of 8 percent, one can translate the latter annual benefits into a present value of US $28,250 [$2,260/.08].

As is the case with Sir Gillies Ghaut, the most expensive treatment measure originally identified for Hope Ghaut (constructing a concrete channel) cannot be justified on economic grounds. The present value of two primary benefits generated by treatment (maintaining access to cropland and reducing water line maintenance) approximately equals the total cost of establishing three gabion structures, a drop inlet, rerouting the road, and reforesting the sides of the ghaut. Both benefits and costs

approach US $300,000. Inclusion of the secondary benefits associated with maintaining employment on the 60 acres of NACO land that would otherwise become inaccessible helps to give the second treatment option a positive NPV.

Some of the benefits accrued because of implementation of the second treatment option would also be collected if the third option identified above were adopted. Because the third option (constructing a gabion spillway and vegetating the side of the ghaut) would cost only US $100,000, it probably features a greater NPV. This would be true even though implementation of the third option would not prevent the loss, through gullying, of some cropland. Also, the option is not as durable a solution to erosion problems at Hope Ghaut. Therefore, it might be necessary in the future to incur costs to treat problems that would not have arisen had the second treatment option been exercised.

C. Summary Discussion

A preliminary review of St. Kitts Alternative Solutions and Project Components resulted in a wide range of potential solutions. Table 4 consists of a summary of the Alternative Solutions and Project components proposed in this report. The ultimate selection of project alternatives will be highly dependent on their individual economic cost benefit ratios at the time of project implementation.

In general, the St. Kitts Project Advisory Committee reacted favorably to the alternatives presented. There was much discussion of the project priorities and selection of alternative components. Some concern was voiced with regards to the minimal solution (Alternative ii) for Sir Gillies Ghaut. The benefits of demonstrating channelization for future ghaut improvement projects was also mentioned.

It is important to note that selection of Alternative ii for both Sir Gillies and Hope Ghauts would result in a reduced capital cost estimate. In this case, the cost would be reduced from US $1,025,000 to US $465,000, a net reduction of US $560,000. If this figure holds true for the entire project, then the Alternative components become much more significant.

It is the opinion of the authors of this report that surplus project development funds be focused on three areas, a) development of

Table 2. Summary of St. Kitts Alternative Designs, Costs and Benefits

Project Components	Alternatives	Estimated Cost US$	Potential Benefit US$
1.Lavington Lynches Treatment and Settlement			400,000*
	i. a. Terracing	125,000	
	b. Ghaut Control	67,600	
	c. Tree Planting	30,000	
	d. Foregone Income	46,000	
	Total	268,600	
2.Sir Gillies Ghaut Treatment			40,000
	i. Channelization	200,000	
	ii. Minimal stabilization	40,000	
3.Hope Ghaut Treatment			300,000
	i. Concrete Channel	700,000	
	ii. a. Drop Inlet	100,000	
	b. Gabion Structures(3)	150,000	
	c. Road Rerouting	30,000	
	d. Reforestation	20,000	
	Subtotal	300,000	
	iii. Minimal Treatment	100,000	
4. Alternative Project Components			
	i. Lavington Lynches Irrigation	100,000	
	ii. Wingfield Feeder Road Terracing		
	iii. Others		
	a. Soil Survey		
	b. Extension Training		
	c Convipps Irrigation		
	d. Sir Gillies Irrigation		

*The potential benefit for Lavington Lynches assumes the selection of Alternative Project Component i, Lavington Lynches Irrigation.

a more complete soil and water resource information base; b) improvement of extension activity and training in soil conservation; and c) development of irrigated agriculture.

A soil conservation handbook without a survey indicating classification and properties of different area soils is of little use. The cost of such a survey and requisit laboratory analyses could use most of the surplus funds.

Improved extension in the form of an extension crew dedicated solely to assisting farmers in implementing low cost conservation measures such as ditch terracing would be invaluable in the prevention of severe soil erosion. The cost of such a venture could be as little as US $150,000 per year.

The groundwater resources in St. Kitts have hardly begun to be tapped. Based on the 1983 Holcrow report and discussions with a CIDA hydrologist, indications are that 1/10-1/20 of the safe freshwater yield is currently being extracted on St. Kitts. With this in mind, irrigation of over 1000 acres on the island would be possible. Of course, the exact location and safe yield of the water sources would have to be determined. However, it is important to note that 50 acres of irrigated vegetables would produc sufficient quantities to saturate the local market. Thus any developments in irrigated agriculture must be accompanied by the development of a stronger export market.

Chapter IV. NEVIS REPORT

On Nevis, the focus of the Project Paper was on surface water development and watershed protection. After carefully reviewing the existing surface water development and soil conservation works on the various estates it was decided by the Nevis Advisory Committee that the following subprojects warranted further consideration:

1. New River Estate

   a) Additional Diversion Structure
   b) Additional Water Storage Capacity
   c) Sprinkler Irrigation

2. Cades Bay and Spring Hill Estate

   a) Additional Surface Water Storage Dam
   b) Improved Catchment Area
   c) Sprinkler Irrigation

3. Hickmans and Fothergill's Estates

   a) Cattle Watering Ponds
   b) Windmill Pumps for Small Ponds
   c) Rehabilitation of Existing Water Tanks

4. Potwork Estate

   a) Fountain Ghaut Dam
   b) Groundwater for Irrigation
   c) Sprinkler Irrigation

5. Maddens Estate

   a) Improve Storage Pond
   b) Cattle Watering Ponds
   c) Increase Tank Storage
   d) Irrigation of Small Farms

The above potential works are listed in priority order based upon the recommendations of the Nevis Agriculture Department officials. In the next few sections the viability of the above mentioned works will be considered from an engineering and economic perspective.

A. Engineering Alternative Components

The following discussion of alternative subprojects components is preliminary in nature since most of the needs and cost estimates have been gleaned from existing BBD, CARDI and CARDATS reports. A more detailed investigation of the technical and economic feasibility of the proposed subprojects will need to be undertaken by the long term water resource specialist. The purpose of this analysis was to advance the process of identifying technically feasible subproject components and estimating the cost and potential benefits associated with their implementation.

1. New River Estate

The New River Estate consists of approximately 790 acres, 350 acres of which are usable for farming. In 1983 the British Development division (BDD) initiated an irrigation project on 10

acres of terraced land in the mid reaches of the New River Estate. The water for the irrigation scheme is supplied by a spring diversion structure in the upper reaches of the New River Valley. The estimated yield from the current spring diversion is 25,000 gpd. In addition to the irrigation demand the water supply is used for stock watering in the lower reaches of the New River Estate. The current demand for cattle watering is less than 1,000 gpd. To assist in irrigation a 25,000 gallon storage tank was installed so that water could be stored when irrigation was not taking place.

A preliminary estimate of the current irrigation and cattle watering demand indicates that during the dry seasons only 3-4 acres of the pilot project can be adequately irrigated. The reasons for this are the lack of an adequate supply and the inefficiency of furrow irrigation. With the above considerations in mind the following preliminary analysis and suggestions have been made:

a) Additional Diversion Structure - Just down stream from the current spring diversion a new spring has emerged. It has been estimated to be of similar volume as the current spring although this must be proven. Assuming a yield of 25,000 gpd an additional 3-4 acres could be irrigated. The estimated cost for the additional diversion structure would be approximately

US $20,000. This would include the installation of a diversion structure and the piping required to link the newly diverted water to the existing piping system.

b) Additional Storage Capacity - If the current spring volume is doubled and the irrigated acreage is also doubled it would be worthwhile to double the overnight storage capacity. An additional storage tank of 25,000 gallons would cost approximately US $25,000.

c) Sprinkler Irrigation - One method of increasing irrigated acreage with a limited water supply is to increase the water application efficiency. Furrow irrigation in general has an irrigation application efficiency of around 40% while sprinkler irrigation has an application efficiency of 75% or greater. With this in mind the current water supply plus the new diversion would be adequate for all 10 acres if sprinkler or drip irrigation were used. Considering the existing water delivery infra-structure for an investment of US $1,500 per acre or US $15,000 the total area could be fitted with sprinkler irrigation.

2. Cades Bay and Spring Hill

The Cades Bay project area consists of 112 acres, 26 acres

of which are currently cultivated. Since 1978 the Caribbean Agricultural and Rural Development Advisory and Training Service (CARDATS) has targeted this area to assist a small farmer cooperative to increase production. The key to increased production in this area is the development of an irrigation system which would allow cropping during the dry season.

A well which produces approximately 11,000 gpd of 45°C water is available at the farmstead. To augment the well water a small dam was rehabilitated by the BDD. It has been estimated that as much as 5,000 gpd would be available from the existing dam bringing the total irrigation supply to 15,000 gpd. A preliminary estimate of irrigation demand during the dry season indicates that the total water supply would adequately irrigate only 3 acres of vegetables. With the above considerations in mind the following preliminary analysis has been made:

a) Additional Storage Dam - Just down stream from the current small dam which contributes approximately 5,000 gpd to the Cades Bay irrigation area another small dam site has been identified. Assuming a similar capacity as the existing small dam an additional 5,000 gpd could be expected from the new dam site. The cost of the new dam structure would be in the neighborhood of US $50,000 based upon the rehabilitation costs of the existing small dam. This estimate would include the installation of a diversion

structure and the piping required to link the newly stored water to the existing piping system.

b) Improved Catchment - The catchment area above the two small dams in the above discussion is in need of some improvement. For example channelization of water in the upper reaches, if approached with conservation in mind, could improve the safe water harvest of the existing and proposed small dam. A rough estimate of the catchment improvement costs is US $10,000.

c) Sprinkler Irrigation - As in the New River area, one method of increasing irrigated acreage with a limited water supply is to increase the water application efficiency. Sprinkler irrigation has a potential application efficiency of 75% and drip irrigation has a potential application efficiency of 90% or greater. Thus, the current water supply plus the new diversion would be adequate to irrigate 4-5 acres if sprinkler or drip irrigation were used. Considering the existing water delivery infrastructure, for an investment of US $1,500 per acre or US $7,500 total, sprinkler or drip irrigation could be developed on 5 acres of the Cades Bay project area.

3. Hickmans and Fothergill's Estates

The Fothergill's Estate consists of 228 acres of which 34 acres are usable. The soils are a mixture of Charlestown and Madden series clay. The land is very rocky and cultivation would be nearly impossible. The current and best use of the area is for pasture. The Hickmans Estate is in the lower reaches of the Fothergill's Estate with similar soils and land utilization potential. The following is a preliminary analysis of potential projects in the above areas.

a) Cattle Watering Ponds - Because the best use of the estates is in pasture for cattle production, the development of several small rainfed cattle watering ponds has been proposed. The clay soils of the area make this a viable recommendation. The estimated cost of the cattle watering ponds, considering that the required bulldozer would be part of the land conservation unit, would be about US $3,000 each for several 1/10 acre ponds. In this project it is recommended that at least 3 such pond sites be identified for a total estimated cost of US $9,000.

b) Windmill Pumps - In the areas where successful boreholes have been developed and capped, consideration should be given to the development of windpump driven cattle watering stations. The

wind in the area of Hickmans and Fothergill's Estates is consistent throughout the year and thus this would be a reasonable alternative for this area.

c) Rehabilitation of Existing Water Tanks - There are several existing cattle watering stations which have fallen into disuse in the past several years. Some funds should be earmarked for rehabilitation of these existing tanks as part of the overall conservation and water development work program.

4. Potwork Estate

The Potwork Estate consists of approximately 90 acres of usable farm land. According to numerous reports the soils on this Estate are among the best on Nevis. The full potential however can only be realized if irrigation is made available. In the area of the Potwork Estate a potential dam site was identified and discussed related to Fountain Ghaut. The following discussion consists of a preliminary analysis of the potential for irrigation development in the Potwork area:

a) Fountain Ghaut Dam - The 1983 Halcrow Water Resources Report estimated that the total cost of an appropriate dam in the Fountain Ghaut area to be approximately US $2,000,000. The storage capacity of such a dam would be sufficient to

irrigate the full 90 acres of tillable land at Potwork. The total investment cost however does not include the installation of an irrigation system.

b) Groundwater Development - The development of groundwater for irrigation on the Potwork Estate was also considered. Based upon interviews with the CIDA project Hydrogeologist the potential for groundwater development near the Potwork Estate should be very high. The irrigation requirements for 90 acres under sprinkler irrigation is approximately 400 gpm. The development costs of groundwater wells is approximately US $10,000 per exploratory well. Assuming that some of the exploratory wells will be dry, the devel -opment costs of two 200 gpm wells should not be more than $70,000.

c) Sprinkler Irrigation - The development of sprinkler irrigation on the Potwork Estate would ultimately depend on the proposed farming system. If field crops for cattle feed are grown then a rolling type system such as a big gun or center pivot irrigation system might be considered. If the area is used for small farms such as those at Cades Bay and New River a more intensive irrigation system will be required. In the case of food crops such as those suggested in the BDD report, an irrigation system costing US $2,000 per acre should be adequate. Thus the total estimated costs for the irrigation system would amount to

approximately US $200,000.

5. Maddens Estate

The Maddens Estate consists of about 390 acres of usable land. The soils are primarily of the Maddens Clay and Charlestown Clay series. A project to improve the spring catchment area has beer undertaken by CDB and for this reason no further improvements are recommended to be funded by USAID. The improvement of the existing and the development of new rainfeed cattle watering ponds would however fill an important need. The following is a preliminary analysis and discussion of potential project components.

a) Improvement Pond Spillway - An existing pond on the Maddens Estate which is filled by tank spillover and surface water runoff have been severely eroded over the past couple of years. To repair the current spillway and revegetate the embankment areas would cost approximately US $1,000.

b) Cattle Watering Ponds - Because the best use of the estate is as pastureland for cattle production the development of several small rainfeed cattle watering ponds has been proposed. The clay soils of the area make this a viable recommendation. The estimated cost of the cattle watering ponds considering that the bulldozer would be part of the land conservation unit would be

about US $3,000 each for several 1/10 acre ponds. In this project it is recommended that at least 3 such pond sites be identified for a total estimated cost of US $9,000.

c) Increased Tank Storage - It has been suggested that increased storage capacity will be needed along with the current improvements on the spring diversion structure. An additional tank storing 25,000 gallons would cost approximately US $25,000.

c) Irrigation - Assuming a suitable groundwater source could be developed, irrigation of the 10 acres in small farms at the lower end of Maddens Estate would be feasible. However, the cost to develop this alternative would be high unless development near successful CIDA boreholes is possible. For these reasons the cost to develop irrigation in this area was estimated to be at least US $5,000 per acre or approximately US $50,000.

B. Economic Evaluation

In this subsection, the benefits of project components for the island of Nevis are outlined and compared to component costs. In addition, the cost effectiveness of surface water development is evaluated in light of available information concerning the expense of utilizing Nevis' groundwater resources.

1. New River Estate

At present, there are 10 acres of terraced farmland at New River. Using catchment, furrow irrigation (the present approach) and the existing system of a catchment, storage tank, pipes, and other physical capital, approximately 3 to 4 acres are being irrigated. The remaining 6 acres are limited to rainfed cultivation and remain idle for much of the year. Additional diversion structures costing US $20,000 would allow for 4 of those 6 acres to be irrigated. Substituting sprinklers for the present system of furrows, which would cost US $15,000, would reduce waste of water, thereby allowing an additional two acres to be brought into production. Adding another storage tank, to facilitate irrigation scheduling, would cost US $25,000. Because watering fields during the evening is an alternative to building the additional tank, the tank and its cost has been dropped from the analysis.

Before turning to analysis of the benefits of the New River improvements, it is essential to point out one factor which is critical to the resource management project. The marginal cost of increasing irrigation water from surface sources rises markedly as acreage receiving water expands. Increasing productive area at New River from 4 to 8 acres, which would require construction of the new diversion structure, would cost US $5,000/acre. Bringing the additional 2 acres that are presently idle into production (by installing sprinklers) would cost US $7,500 acre.

The benefits of raising vegetables on irrigated acreage were found to approach US $7,000/acre (see economic evaluation of Lavington Lynches component, section III-B-1). Using this figure, the NPV generated by irrigating 6 additional acres at New River would be US $7,000 [6 acres x $7,000/acre - $20,000 for the diversion - $15,000 for sprinklers]. However, because the marginal cost of supplying water from surface sources increases as more land is irrigated, a slightly higher NPV is attained by bringing only 4 of the idle acres into production [4 acres x $7,000/acre - $20,000 for the diversion = US $8,000]. Planners might also opt for the more limited design so that potential problems with oversupplying local produce markets, which could drive down prices, could be avoided (see evaluation of Lavington Lynches).

2. Cades Bay and Spring Hill Estate

From an economic perspective, this component is even less feasible than the New River component. The storage dam's cost, US $50,000, far exceeds the benefits of using the dam's water for irrigation. At most, constructing the dam would allow for 2 more acres to be irrigated. The economic value of that effect would be no more than US $14,000. If an additional US $7,500 were invested in a sprinkler system, increased efficiency of water use would allow irrigated acreage to increase by 1 acre. However, this small expansion increased benefits by only US $7,000. Thus, the NPV of the Cades Bay and Spring Hill component remains negative, probably with a high absolute value.

3. Hickmans and Fothergill's Estate

No estimates of the benefits of this component, which would cost a little more than US $10,000 were made.

4. Potwork Estate

One cannot begin to justify, on economic grounds, current proposals to develop surface water for irrigation at Potwork. Constructing Fountain Dam would cost US $2,000,000 and would supply enough water to irrigate 100 acres. It would be

impossible to cover the costs of such an irrigation scheme (US $20,000/acre) with revenues earned from increased crop sales.

By contrast, groundwater development at Potwork merits serious consideration. Drilling wells would cost US $100,000 and installing sprinklers on 100 acres would cost US $200,000. Thus, the capital costs of the groundwater-based irrigation system would average US $3,000/acre which is far below the per-acre capital cost of current proposals to irrigate with surface water in SKN. Irrigating 100 acres on Nevis would require careful examination of marketing opportunities. Clearly, alternatives to vegetable production (e.g., production of livestock feeds) would have to be investigated before a decision on irrigation is made.

5. Maddens Estate

No analysis of the benefits of improving existing cattle ponds and installing new ponds was undertaken. Neither were the benefits of increasing the capacity of the tank that feeds into Nevis' human water supply estiamted. The costs of irrigating with groundwater (US $5,000/acre) would seem to be covered by the returns of doing so (see discussion of the New River Component above) if vegetables can be raised and marketed.

C. Summary Discussion

In this report, 5 alternative subprojects have been proposed each consisting of 3 or more components (see Table 2). Each of the subprojects are technically feasible but several will not pass the scrutiny of a cost/benefit analysis. The purpose of this report was not to weigh the precise cost/benefits of each component but rather to establish an initial list of proposed subprojects which could be followed in the early stages of the project implementation.

Consistent with the project working paper, major focus has beer placed in this section and throughout this report on analyzing the economics of surface water development. Study of project components on the island of Nevis leads to the conclusion, however, that utilizing groundwater is much more cost-effective than is utilizing surface water. Furthermore, as demand for irrigation water increases, the difference between the marginal cost of delivering groundwater to cropland will also increase (see discussions of New River, Cades Bay, and Potwork Estate components). These and the other economic issues surrounding water resource development that have been raised in this section should be considered when planning Nevis' and SKN's agricultural development, especially after the CIDA study of groundwater has been completed.

Table Summary of Nevis Subproject Components

Alternative	Description	Estimated Cost US$	Potential Benefits US$
1. New River Estate			42,000
	a. Diversion Structure	20,000	
	b. Storage Tank	25,000	
	c. Sprinkler Irrigation	15,000	
2. Cades Bay and Spring Hill Estate			19,000
	a. Storage Dam	50,000	
	b. Improved Catchment	10,000	
	c. Sprinkler Irrigation	7,500	
3. Hickmans and Fothergill's Estate			------
	a. Cattle Ponds	9,000	
	b. Windmill Pumps	-----	
	c. Rehabilitation of Tanks	-----	
4. Potwork Estate			------
	a. Fountain Dam	2,000,000	
	b. Groundwater	100,000	
	c. Sprinkler Irrigatio	200,000	
5. Maddens Estate			------
	a. Improved Pond	1,000	
	b. Cattle Ponds	9,000	
	c. Increased Tank Storage	25,000	
	d. Irrigation	50,000	

After a cursory review of costs and benefits associated with surface water development, it becomes obvious that the marginal cost of developing surface water for irrigation is as much as 20 times the cost of developing groundwater sources for the same irrigation system. With this in mind, the only surface water source worthy of development in the early stages of the project is the New River diversion. In addition, work could be done on the small cattle watering ponds at Hickmans and Fothergill's.

As for the subsequent project components we recommend the development of groundwater for irrigation at the Potwork Estate or at Maddens. The cost of exploratory wells would be less than US $10,000 each. Once a well has been drilled, the subsequent cost of well development would be about US $20,000. A groundwater well to replace the proposed small dam at Cades Bay would cost less than US $30,000 and yield 2-5 times as much water.

Chapter V. PROJECT MANAGEMENT

The following section consists of a general presentation and partial catalog of efforts related to the SKN Resource Management Project. The specific areas to be discussed are a) SKN project management; b) refinement of the project implementation plan; and c) recommendations for training. A complete list of contacts made by the authors is contained in Appendix A.

A. St. Kitts / Nevis Project Management

Upon arrival in St. KItts, USAID gave high priority to the review and refinement of the USAID Request for Technical Proposal (RFTP) document. The reason for this early emphasis on the RFTP was the time frame being considered for a pre-bidders conference, March 25, 1982, and the RFTP approval process. The RFTP was received by the Project Manager Mr. Valdemar Warner and the NACO Head Engineer Mr. Vincent Joseph. After a brief orientation to the project, the authors of this report also reviewed the document. A final draft of the RFTP was prepared at the USAID office in Barbados on February 22 and 23, 1985.

Also, very early in the TSM, a St. Kitts ad hoc Project Advisory Committee was convened. The purpose of the committee was to

oversee the refinement of the original Project Paper. The Project Advisory Commitee consisted of Mr. E. Petty, Permanent Secretary of Agriculture; Mr. V. Warner, Project Manager; Mr. V. Joseph, NACO; Mr. G. Thomas, Department of Agriculture; and Dr. O. Libard, CARDI. The committee met several times during the months of February and March of 1985 and contributed substantially to the priority definition andd evolution of the St. Kitts project alternatives contained in this report.

Before leaving St. Kitts in April,1985, the authors of this report recommended that the Project Adivsory Committee remain intact for the purpose of aiding in the process of long-term contractor selection and in project implementation.

On Nevis, a similar advisory committee, consisting of Mr. A. Evelyn, Minister of Agriculture; Mr. E. Nesbit, Superintendent of Agriculture; and Mr. I. Gordon of BDD, was convened. In the case of Nevis, the priorities of the proposed project components were discussed and refined. The Nevis advisory committee contributed substantially to the formulation of this report.

Future project management recommendations include advocating that the above mentioned committees be held intact as the Resource Management Project will benefit greatly. A point of concern however, is that in order to keep the interest of the various organizations (i.e. CARDI, AD, NACO) some tangible

benefits must be evident for each. For example, if the expertise of specialists in the Agriculture Department is required for the Lavington Lynches development, some remuneration or transfer of funds must be possible. Otherwise, the wholehearted support of those organizations may be difficult to muster.

B. Refined Implementation Plan

A copy of the refined implementation plan can be found in Appendix C. Generally, the original implementation plan presented in the project paper was considered satisfactory.

Further refinement of the implementation plan without knowing the exact arrival dates of the long-term specialists was not possible. Assuming the arrival of a long-term specialist in September or October, 1985, the original implementation plan can be adjusted by about 4 months.

After the long-term contractor has arrived and is oriented to the project, it is recommended that the final planning and cost benefit analysis of the various project components be undertaken. Fall is a wet season in the Eastern Caribbean area and should allow the specialist to observe erosion problems in tthe ghauts first hand. In addition, the project implementation plan can be further refined during this period with initial implementation of works to begin during the dryer winter months.

C. Training Components and Recommendations

Before leaving SKN in April, 1985, the authors made several recommendations regarding the training of host country participants. The letters containing these training recommendations can be found in appendix D.

It was our recommendation that Charles Mills (St. Kitts) attend the USDA course titled "Water Management and Runoff Farming Methods for Small Scale Agriculture" in July, 1985. In addition, we recommended that Mr. Claude Nisbett (Nevis) attend the USDA course titled "Resource Development of Watershed Lands" in June, 1985. The content of these courses best fits the project objectives for each of the islands and would be of general benefit to the final project implementation.

As for Mr. Eric Evelyn (Nevis) our recommendation is not to send him to and USDA short courses until he has received a minimum of 2 years of university training. Mr. Evelyn is a very capable young man who deserves proper training if he is to assist in the technical aspects of the land use office.

The only additional training requirement for the project would be the possible education of an extension soil conservationist. The training of this individual could include a short visit to Puerto Rico for training in ditch terracing and other simple soil conservation techniques.

Chapter VI. CONCLUSIONS AND RECOMMENDATIONS

After reviewing the original project paper and working with the host country advisory committees to further refine the project, the following general conclusions and recommendations were developed. Additional project conclusions can be found in Chapters III and IV as part of the St. Kitts and Nevis reports.

CONCLUSIONS:

1. The original purpose of the TSM, which was to assist the Project Manager and RDO/C Project Officer in the refinement and early implementation of the original project proposal was achieved.

2. The refinement of the engineering and economic analyses from the original project was accomplished and resulted in numerous alternative, less costly, design options.

3. New project compor nts were identified and considered by the SKN Advisory Committee and the TSM.

4. A working Project Advisory Committee was established on both St. Kitts and Nevis and resulted in improved project implementation.

RECOMMENDATIONS:

1. The Project Advisory Committees established on both St. Kitts and Nevis should remain intact for the project duration.

2. Irrigation should be added to the Lavington Lynches project component in order to make it an economically viable component.

3. The lower cost minimal stabilization (Alternative ii) should be selected for Sir Gillies Ghaut treatment.

4. The lower cost intermediate treatment (Alternative ii) should be selected for Hope Ghaut.

5. Additional projects, such as soil survey development and extension soil conservation, should be considered as subprojects.

6. Irrigation development should be considered a high priority as a means to increase agricultural productivity. However, a marketing analysis to determine potential local demand and export feasibility must precede this development.

7. Additional diversionary structures and sprinkler irrigation technology for the New River Estate should be a high priority.

8. The cost of surface water development for irrigation is almost 20 times than that for groundwater. For this reason, ground water rather than surface water should be developed for irrigation.

Chapter VII. REFERENCES

McSween, G.J. and B. Goel. "Proposed Cades Bay Small Farmers, Trickle/Low Head/Low Volume Sprinkler Irrigation Projects", Project # CAR/81/002. CARDATS - Grenada, November 1984.

Contains a description and economic analysis of a small-scale irrigation system proposed for Cades Bay, Nevis.

Wilson, L.A. "Some General Problems of Soil Erosion on disturbed Lands in the Caribbean", in J. Luchok, J.D. Cawthon, and M.J. Breslin (eds.) Hill Lands: Proceedings of an International Symposium held October 3-9, 1976. Morgantown, West Virginia University Press, 1977.

Contains an explanation of how shifts in cropping patterns (e.g., away from sugar) exacerbate erosion problems.

Adams, D.W., E.T. Bullard, R.L. Meyer, and D.D. Southgate. "Agricultural commodities and rural development in SKN. Privatization of country's land resources is recommended.

Hoekstra, D.A. and H. Solomon, CARDATS Evaluation Report: Small Farmers Project - Nevis, Project CAR/77/007. CARDATS - Greneda, August 1981.

Contains description and economic analysis of small farmers project. Rain-fed agriculture crop budgets are reported.

Davis, K., M. Errington, and I.R. Gordon. "Agricultural Development in Nevis (3 volumes)", Project Report 141. Surbiton, Surrey, U.K.: ODA Land Resources Development Center, 1984.

In addition to containing description of alternative projects, the report also contains an analysis of the state of agricultural and rural development in Nevis and SKN.

Gittianger, J.P. Economic Analysis of Agricultural Projects. Baltimore: Johns Hopkins University Press, 1982.

The World Bank bible for project evaluation.

Schwab et al. 1981. Soil and Water Conservation Engineering. Wiley, New York.

United States Soil Conservation Service. 1978. Engineers Field Manual. Washington, D.C.

United States Soil Conservation Service. 1980. Universal Soil Loss Equation, Caribbean Area Technical Notes. Puerto Rico.

United States Soil Conservation Service. 1980. Soil Erosion and Sedimentation Technical Bulletin. Hawaii.

Gordon, I.R. 1984. Agricultural Development in Nevis. British Overseas Development Administration, Tolworth Tower, Surbiton Surrey, England KTG 7DY.

Halcrow, Sir Williams and Partners. 1983. Report on Water Resources. Overseas Development Administration, Tolworth Tower, Surbiton Surrey England.

APPENDICES

A. SKN Contacts

B. Engineering and Economic Analyses

C. Implementation Plan Refinement

D. Project Management Memoranda

E. Alternative Projects

APPENDIX A: SKN and USAID Contacts

1. Project Management (Bralts and Southgate)

Bill Baucom	USAID	RDO	Chief of Agriculture Division
Kimberly Finan	USAID	RDO	Capital Projects
Stanley Heishman	USAID	RDO	Contract Officer
Hugh Heyleger	SKN		Minister of Agriculture
James Holtaway	USAID	RDO	Director
David Jesse	USAID	RDO	Agricultural Economist
Eugene Petty	PS		Agriculture
Kennedy Simmonds	SKN		Prime Minister
Valdemar Warner	PS		Trade (Project Manager)

2. Engineering Analysis (Bralts)

James Bailey	SKN	Supervisor of Public Works
Arthur Evelyn	Nevis	Ministry of Agriculture
Leonard James	NACO	Chief Executive Officer
Vincent Joseph	NACO	Head Agricultural Engineer
Elmo Liburd	Nevis	Agriculture Minister
Ozzie Liburd	CARDI	Assistant Head
Ken Martin	SKN	Chief Agriculture Department
Charles Mills	NACO	Agricultural Engineer
Evan Nesbit	Nevis	Superintendent of Agriculture
James Newman	Peace Corps	Agricultural Engineer

Hans Olf	FAO/UNDP	Advisor
Gerard Thomas	SKN	Agricultural Resources Officer
Victor Williams	SKN	Physical Planning

3. Economic Analysis (Southgate)

Ozzie Liburd	CARDI
Jenny Lowery	CARDI
David Reed	FAO short-term consultant
Brij Goel	CARDATS volunteer
Mr. Nisbett	supt., Nevis Min. of Ag.
Elvin Bailey	Dir. of Extension, Nevis Min. of Ag.
Vincent Joseph	NACO
Jerome Thomas	St. Kitts, Min. of Ag.
Atnil Rawlins	Water Dept.
Mr. Brown	CEMACO
Mr. Rogers	NACO

APPENDIX B: Engineering and Economic Analyses

A. Engineering Evaluation Methodology

The engineering approach for this evaluation consisted of obtaining topographic maps, soil surveys, hydrologic reports, and peak runoff and soil erosion equation publications specific to the Caribbean. After discussions with local resource planning officials, a trip to Puerto Rico to visit the USDA-Soil Conservation Service (SCS) Office was planned. In addition contracts were made with Hawaiian SCS counterparts to draw on the full range of existing knowledge.

The specific analysis for this report included watershed delineation peak runoff estimations using the rational method and soil erosion potential using the Universal Soil Loss Equation.

The following analysis are preliminary in nature primarily because of the lack of a detailed land survey and appropriate rainfall records. To overcome these hurdles a number of assumptions were required. For example, the rainfall intensity and duration for a 25 year return period was estimated using information from the Virgin Islands for similar topography. In general, however, the estimates should be within acceptable limits for this preliminary design analysis and feasibility study.

1. Lavington Lynches Treatment and Settlement

Figure 6 consists of a topographic map and land profile of the Lavington Lynches area. The estimated peak runoff for a 25 year storm has been estimated using the rational method at 555 cfs. The potential soil erosion without terracing has been estimated using the Universal Soil loss equation to be in excess of 76.7 t/a. See Table A-1 for analysis assumptions related to peak runoff and Table A-2 for the analysis of soil loss.

Table A-1 Lavington Lynches Peak Discharge Estimation

Peak Discharge using the Rational Method

Peak discharge, Q = CiA/360

C = 0.31
i = 192 mm/hr - 25 yr return period
A = 95 ha - entire watershed

Q = 0.31 x 192 x 95/360
= 15.71 cms
= 555 cfs

Peak discharge into ocean Q = 555 cfs

Table A-2. Lavington Lynches Soil Loss Estimate

Soil Loss Estimate using the Universal Soil Loss Equation

Average annual soil loss per acre A = RKLSCP

Where R is rainfall erosivity index
K is soil erodibility factor
LS is the topographic factor
C is crop management factor
P is conservation practice factor

i. Without Terraces

R	= 400	
K	= 0.27 tons/acre	- sandy loam, organic matter - 0%
LS	= 7.09	- slope length, L=1500 ft, avg slope = 12%
C	= 0.167	- sugar cane, 5 yr. rotation
P	= 0.60	- contouring

Thus, A = 400 x 027 x 709 x 0.167 x 0.60

= 76.7 tons/acres

ii. With Terraces

R	= 400	
K	= 0.27 tons/acre	
LS	= 1.83	- slope length, L = 100 ft.; avg. slope = 12%
C	= 0.147	- tomatoes, beans, peppers, etc. 1 year rotation
P	= 0.12	- soil loss from outlet of terrace

Thus, A = 400 x 0.27 x 1.83 x 0.147 x 0.12

= 3.5 tons/acre

Average annual soil loss per acre (small farmers, with terracing)

= 3.5 tons/acre

---

2. Sir Gillies Ghaut

Figure 5 consists of a topographic map and land profile of ir Gillies Ghaut. The estimated peak runoff for a 25 year storm as been estimated by the rational method to be 280 CFS. See able A-3 for analysis assumption.

Table A-3 Preliminary Analysis of Sir Gillies Ghaut

Peak discharge, Q = CiA/360

where,

C is runoff coefficient
i is rainfall intensity (mm/hr)
A is area at watershed (ha)

Now, C = 0.31 - Primarily cane lands
i = 188 mm/hr [7.4 in/hr] - 25 yr return period
A = 49.1 ha [121 acres] - entire watershed

Thus,

Peak discharge, Q (at outlet to ocean)

= (0.31 x 188 x 491)/360
= 7.91 ms
= 280 cfs

Peak discharge Q = 280 cfs

---

3. Hope Ghaut

Figure 6 consists of a topographic map land profile of Hope Ghaut. The estimated peak runoff for a 25 year storm has been estimated using the rational method to be 157 cfs. See Table A-4 for analysis assumption.

Table A- 4. Preliminary Analysis of Hope Ghaut

(i) Peak discharge, Q = CiA/360

C = 0.31	- primarily cane lands
i = 188 mm/hr - 7.4 in/hr	- 25 yr return period
A_C = 13.9 ha - 34 acres	- section at watershed contributing to flow into culvert

Qc = (0.31 x 188 x 13.9)/360
= 2.25 m^3/s
= 79 cfs

Peak discharge into culvert Q_C = 79 cfs

(ii) Area at entire watershed, A - 27.5 ha

Q = (0.31 x 188 x 27.5)/360
= 4.45 m^3/s
= 157 cfs

Peak discharge into St. Georges Ghaut Q = 157 cfs

B. Economic Evaluation Methodology

As is the case with soil and water conservation projects in other parts of the world, implementation of the St. Kitts-Nevis Resource Management Project would generate a number of different benefits. Primary benefits would include maintaining road access to agricultural land, avoiding damage to farm buildings and water lines, and preventing soil erosion. The project would also create inportant secondary benefits . If executing the project results in the employment of people who would otherwise have no job, then their earnings as well as the increase in economic activity throughout the nation as a result of those earnings being spent, should be treated as project benefits. Another positive outcome of the project would be that the government and people of SKN would gain experience both in the identification and treatment of environmental problems and in the planning of an effective resource management strategy.

Placing an economic value on any of these benefits is difficult. In order to furnish an idea of the reliability of the estimates of benefits found in this report, the analytical approach used to evaluate this project is explained in this section. In addition to justifying the results of analysis presented below, this section's discussion should help guide evaluation of other conservation projects that might be implemented in SKN in the future. Addressed in turn in this section are primary and secondary benefits. Also discussed are private and social-level analyses of resource conservation projects.

1. Primary Benefits

Adopting a soil conservation measure (arresting incipient development of a ghaut, terracing a field, etc.) yields both on-site and off-site benefits. On-site, yield decreases that would otherwise occur as a result of topsoil loss are not observed. Off-site, sedimentation problems are also eased. For SKN, a more important off-site benefit is that soil conservation would reduce the severity of periodic flooding. At present, extensive repair of roads and other public works as well as farm structures and other buildings is required after storms because eroded hill lands do not hold water well. A major thrust of the project is to treat the effects of advanced environmental degradation at ghauts that have been scoured by flooding.

Discussions of techniques used to estimate each type of primary benefit of soil conservation follow.

a)On-site Benefits- The benefits that a farmer accrues by managing soil resources better include improved yields and extending the useful lifetime of field. If conserving soil on a particular parcel requires a change in crops, then on-site benefits (or costs) are a function of the difference between net revenues earned on the parcel before the change and net revenues after the change.

There is a limited opportunity to estimate the yield enhancement benefits of soil conservation in SKN. In 1981-82, terraces were established on steeply sloped land at Green Hill

now planted to sugarcane. When data become available, it will be possible to compare pre-terracing trends in yields, which were negative, with post-terracing trends. Given projections of sugar prices, the value of altering those trends will be possible. In addition, it would be interesting to determine how indicative a decline in sugarcane yields is of the potential capacity of that land to produce other crops.

The impacts of soil erosion on the productive lifetime of agricultural land could also be estimated in SKN. NACO can identify fields that have passed out of production in recent years, how long those fields were used, what yields were, etc. However, the decision to take land out of production in SKN is influenced by other factors (e.g., scarcity of peak-season labor) besides erosion. Hence, this approach was not adopted in this study.

Given the design of the project, which calls for the establishment of soil conserving farming and agroforestry systems in threatened watersheds and other environmentally sensitive areas, the approach used in this study to calculate on-site benefits was to compare net revenues under alternative land uses. The present value of this type of benefit against which the costs of soil conservation work are compared, can be defined as follows:

$$NC_{ct}/(1 + r)^t - NR_{nt}/(1 + r)^t$$

where, NR_{ct} = net revenues for soil conserving land use in year t,

NR_{nt} = net revenues for the erosive (status quo) land use in year t, and

r = discount rate

Net revenue streams for soil conserving and status quo land uses (in some cases, there is no status quo land use; thus the second summation above equals zero) were obtained from secondary sources noted below.

b)Off-Site Benefits- To estimate the benefits of reducing the severity of periodic flooding, information on incidents where storm runoff from eroded land has damaged roads and water lines has been collected. With that data the expected annual benefits of improved erosion control and dissipation of runoff energy have been calculated. Expected annual benefits equal observed frequency of incidents multiplied by costs of repairs after each incident. For any given discount rate, those expected annual benefits can be translated into a present value equivalent, which can be compared to the costs of improved resources management, using standard techniques for project analysis.

c) Treatment Benefits Closely related to off-site benefits in this project are treatment benefits. The most important problems that would be remedied or avoided by treating Sir Gillies and Hope Ghauts are that some agricultural land would be saved from being washed into the sea while access to still more acreage would be preserved. Estimating the benefits of preserving land or maintaining its accessibility is complicated by limited information about the value of agricultural and in SKN.

In a competitive real estate market, the price of a parcel of land should approach the present value of future rents that

can be collected by the parcel's owner. If its highest and best use is for farming or if zoning laws prevent nonagricultural use of the parcel, then the competitive market price is a reliable indicator of the parcel's agricultural value.

Using market information to derive agricultural land value is not a viable analytical approach in SKN, however. Farmers have year-to-year tennancies on NACO and other government owned farm land. However, they are only charged a nominal ("peppercorn") rent of EC $30/acre/year, which greatly underestimates land values. At the same time, prices charged for agricultural land probably overstate how much that land would be worth for farming alone. Since land on the two small islands is scarce and since there are no effective legal restrictions on the use of rural land, one can never rule out the possibility that any given parcel of rural and is being acquired for a non-farming use.

Noting the complex set of forces operating in or constraining the performance of SKN's land markets, we offer the following information regarding land prices. From that information, one can infer a range within which the "true" value of rural land probably falls.

The upper end of that range is about EC $40,000/acre. this is the price at which one of the resort companies on Nevis with considerable real estate holdings is offering rural land to the general public. Farm land close to concentrations of population is being sold for that price because it is well suited for housing development. Of course, land in and around

Basseterre, Charlestown, and Frigate Bay changes hands at relatively high prices. At the other end of the price range, the Nevitian government has offered land to long-term tenants at EC $6,000/acre. There have been some takers (e.g., in the Cades Bay area). Here again, one cannot rule out the possibility that land purchased under those terms is actually being held for future residential development (e.g., by Nevitians overseas who would like to build a house on their home island).

Because the farmland threatened by Sir Gillies and Hope Ghauts cannot be classified among the highest-valued residential sites on the island, the price of land used to quantify the benefits of ghaut treatment is toward the lower end of the range identified above: US $5,000/acre (slightly more than EC $12,000/acre. This seems to be a very fair price for agricultural land located far from cities or towns in any part of the world.

2. Secondary Benefits.

In general, secondary benefits are created when a project implementation results in the employment of labor on capital that would otherwise lie idle. For this project, the specific secondary benefits to be gained relate to employment of individuals who would otherwise be unemployed or underemployed. Another, more important category of secondary benefits created by the project is the income earned by people on land that would pass out of production if the project were not implemented.

The size of the first category of secondary benefits is expected to be small . Terraces, ghaut treatments, and construc-

tion must be completed before the rainy season (the last four months of the calendar year). Thus, most work done by islanders must be started well before the end of the sugarcane harvest, which runs from January through June. Because the SKN economy operates at close to full employment during that time, one cannot claim that secondary benefits are gained from employing people on the project during the first half of the year. On the other hand, secondary benefits are created by employing people on the project between the end of the harvest season and the beginning of the rainy season. Those secondary benefits are incorporated into economic analysis of the project by using a shadow price to evaluate labor time rather than the much higher wage rate, which overstates the opportunity cost of labor time during the slack season.

Secondary benefits of keeping land now planted to sugar cane in production were evaluated using NACO data on both employment of agricultural labor and cultivated and harvested acreage.

Table A-5 reports the average numbers of agricultural workers employed by NACO in each month during 1984. It should be emphasized that NACO employment of farm labor has declined for two reasons during recent years. First, early retirements have been encouraged and retired workers have not been replaced. In 1980, average monthly "attendance" was 3241 agricultural laborers. by 1984, the average had declined to 2949. Second, work per week has declined.

Table A-5. Number of Farm Laborers Hired by NACO 1984.

Month	Monthly Attendance
Jan	1803*
Feb	2645*
Mar	2745*
Apr	2706*
May	2625*
Jun	2447*
Jul	2130
Aug	1816
Sep	1924
Oct	949
Nov	1850
Dec	1826
---	---
Ave	2949

*includes 1350 cane cutters

Source: NACO

During the slack season (July through December), when workers are involved in cultivation, laborers work fifteen days per month. During the harvest season (January through June), 1350 cane cutters work 22 days per month. Combining this employment data with data on cane land cultivated (11,718 acres) and

harvested (10,359) in 1984, it was found that it is normal for cultivated acreage to exceed harvested acreage by 10 to 20 percent. Labor inputs averaged 17 person-days of harvest labor and 35 person-days of cultivation labor. Harvest laborers, who are paid a piece rate, earn EC $22/day, on average cultivation laborers receive the minimum wage. thus, in 1984 average labor earnings/acre were EC $900, or US $340. Secondary benefit estimates found in this report are based on this estimate.

3. Comparing Benefits and Costs

Private and Social Analysis: A variety of criteria can be used to evaluate the efficiency of a project. In the working paper for the project, internal rate of return (IRR) was used. IRR indicates the return on capital invested in a project. In general, a project can be said to be feasible if its IRR is higher than some given target level. The target level depends on the opportunity costs of capital, the decision marker's aversion to risk, and other factors.

Net present value (NPV) and benefit/cost ratio (B/C) are two other efficiency indicators. NPV and B/C furnish equivalent information. The former equals the present value of project benefits less the present value of cost. Obviously, if at some given discount rate NPV is positive (negative), than B/C is greater (less) than unity and the project meets (fails to meet) the efficiency test.

In the economic analysis of individual project components reported below, the NPV criterion is used. The real (or post-

inflation) discount rate used in the analysis is 8 percent.

Finally, in the analyses contained in this report, a social-level accounting stance is adopted. In practical terms, this means that secondary benefits of project work and the off-site costs of soil conservation and ghaut treatment are taken into account as well as out-of-pocket costs and direct, on-site project benefits. For any project, it is also necessary to undertake private-level analysis, primarily in order to determine whether private individuals will find it in their interest to cooperate in the project.

No separate private-level analysis, as such, was done. However, likelihood of compliance (e.g., with resettlement of small farmers in the Lavington-Lynches area) was judged on the basis of comparison of per acre net revenues earned by farmers with and without the project. If with project net revenues/acre were higher, then the judgement was made that compliance ought not to be a problem.

For a more comprehensive treatment of these and other issues related to economic evaluation of agricultural projects, see Gittinger (1982).

APPENDIC C: Refined Implementation Plan

ACTIVITY DESCRIPTION	84 1985 1986 1987 D JFMAMJJASOND JFMAMJJASOND JFMAMJJAS	RESPONSIBLE
I. EARLY CONDITIONS PRECEDENT		
A. Conditions Precedent to First Disbursement		
a. Delegation of authority from Prime Minister to Project Manager and Project Coordinators.	0	Prime Minister
b. Attorney Generals opinion as to the legality of Project Agreement.	0	Attorney General
c. Project accounting procedures	0	AID
B. Conditions Precedent to Disbursement for other than Technical Assistance		
a. Project Implementation Plan developed.	0	Project Manager
b. Project Implementation Plan submitted to AID for concurrence.	0	Project Manager
c. Project Coordinators responsible for day to day project management identified on St. Kitts Nevis.	0	Project Manager
d. AID informed of the names of the project coordinators for St. Kitts and Nevis	0	Project Manager
II. REPORTS AND POLICY DISCUSSIONS		
A. Reports		
a. Monthly reports.	. 000000000000 000000000000 0000000..	Project Manager/
b. Monthly accounting reports and requests for reimbursement.	. ...	Contractor
c. Quarterly reports to AID, including implementation plan updates	. 000000000000 000000000000 000000000	Project Coordinators
d. Mid project evaluation.	. ..0..0..0..0 ..0..0..0..0 ..0..0..0	Project Manager
e. Final report to project manager.	. ...0.....	Project Manager/
f. Final report to AID.	. ...	Committee
g. Identification of external evaluators.	0	Contractor
h. Final Project evaluation.	0	Project Manager
i. Final accounts for project.	. ...0.....	AID
	. ...	External
	. ...0..0-0.	Evaluators
B. Policy Discussions (quarterly) CF Covenants	0	Project Manager
	. 0..0..0..0..	Prime Minister/AID
	. ...	Deputy Director

ACTIVITY DESCRIPTION	84 1985 1986 1987 D JFMAMJJASOND JFMAMJJASOND JFMAMJJAS	RESPONSIBLE
III. ST. KITTS ACTIVITIES		
A. Lavington - Lynches Estate and Lavington Gully		
a. Design work.	. .....00.....	Contractor/NACO/AID
b. CP 4.3 (a) met for terracing 135 acres at Lavington Estate.	. .....0.....	Contractor
c. Letter sent to AID indicating that CP 4.3 (a) for terracing has been met.	. .....0.....	Project Manager
d. Civil works CP 4.3 (a) for repair work on Lavington Gully.	. .....0.....	Contractor
e. Letter informing AID that CP 4.3 (a) for Civil work at Lavington Gully has been met.	. .....0.....	Project Manager
f. Policy on shelterbelts along gullies established	. ...	Project Manager/
g. Letter sent to AID that CP 4.3 (b) met.	. .....00..	Gov't of St. Kitts
h. Committee consisting of Project Manager, Project Coordinator, Agriculture Extension Officer for Lavington district, field supervisor of NACO for Lavington-Lynches and CARDI. Country team leader meet to develop process for terraced land. (Process must give priority to farmers farming in gully, and on upper watershed and those interested from local area.)	. .....0.	Project Manager
i. CP 4.5 met on Land distribution on Government agreement to process developed by committee.	. ..0--------- 0.....	Project Manager/ Committee
j. Letter sent to AID that CP 4.5 on land distribution met.	. .....0.....	Gov't of St. Kitts
k. Terracing work.	. .....0.....	Project Manager
l. Agriculture extension work for terraced land planned and appropriate inputs identified.	. .....0--- ----------0.	Contractor
m. Trees for shelterbelts and terraced land identified and procured.	. ...	Contractor/
n. Gully stabilization inputs identified and procured.	. .....0--- 0.....	Dept of Agr.
o. Farms distributed on terraced land.	. ...	Contractor/
p. Agriculture Extension plan for terraced area implemented.	. .....0--- -0.....	Dept of Agr.
q. Agricultural inputs arrive and are distributed.	. .....0--- 0.....	Contractor
r. Lavington gully repair and stabilization.	. .....0--- 0.....	Gov't of St. Kitts
s. Nursery set up for trees which are to be planted along gully and on terraced land.	. ...	Dept. of Agr/
t. Trees arrive and are sent to nursery.	0------0	Contractor
u. Trees planted.	. ...	Contractor/Dept.
B. Hope Ghaut (Subject to positive benefit-cost analysis and funds available in budget)	0-----0	of Agr.
a. Design work	. ...0-----0...	Contractor/NACO
b. CP Section 4.3 (a) for civil works on Hope Ghaut	. ...	Dept. of Agr./
c. Letter sent to AID informing them CP section 4.3 (a) for civil works on Hope Hope Ghaut has been met	. ...	Contractor
	. ...	Project Manager/
	. ...0.....	Dept. of Agr.
	. ...	Contractor/NACO/
	. ...0---- --0.....	Dept. of Agr.
	. .....0-0.....	Contractor/NACO
	. .....0.....	Contractor
	. .....0.....	Project Manager

ACTIVITY DESCRIPTION	84 D	1985 JFMAMJJASOND	1986 JFMAMJJASOND	1987 JFMAMJJAS	RESPONSIBLE
ST.KITTS ACTIVITIES (con't)					
d. Inputs required for civil works identified and procured.		0-----	0.....	.....	Contractor
e. Civil works on Hope Ghaut undertaken.		.....	.0----------	--0.....	Contractor/NACO
* f. Shelterbelt of trees planted.		.....	.....	.0----0..	Contractor/NACO Dept. of Agr.
C. Sir Gillies Ghaut					
a. Design work.		.....00.....	.....	.....	Contractor/NACO
b. CP section 4.3 (a) met for civil works on Sir Gilles Ghaut.		.....0.....	.....	.....	Contractor
c. Letter sent to AID informing them CP section 4.3 (a) for civil works on Sir Gilles Ghaut has been met.		.....0.....	.....	.....	Project Manager
d. Inputs required for civil works identified and procured.		0------	0.....	.....	Contractor
e. Civil works on Sir Gillies Ghaut undertaken.		.....	.0----------	--0.....	Contractor/NACO
f. Shelterbelt of trees planted.		.....	.....	.0---0...	Contractor/NACO Dept. of Agr.
D. Soil Conservation Plan for St. Kitts					
a. Development of outline of soil conservation plan.		.....0.....	.....	.....	Contractor
b. Development of outline of soil conservation handbook.		.....	....0.....	.....	Contractor
c. Approval of outlines of soil conservation plan and handbook.		.....	.....	.....	Project Manager/ AID
d. Development of soil conservation plan.		.....	....0.....	.....	Contractor
e. Development of soil conservation handbook.		.....	0----	--0.....	Contractor
f. Approval of completed soil conservation plan.		.....	0----	-----0...	Project Manager/ Ministry of Agr.
g. Approval and distribution of soil conservation handbook.		.....	.....	..0.....	Project Manager
IV. NEVIS ACTIVITIES					
a. Land Use Unit established.	0	.....	.....	.....	Minister of Agr.
b. Land Use Unit Personnel appointed.		0.....	.....	.....	Minister of Agr.
c. Letter sent to AID that CP 4.4 (b) has been met with establishment of unit.		.....	.....	.....	Project Coordin- ator Nevis
d. Long-term Technical assistance.		.0.....	.....	.....	Contractor
e. Potential surface water projects identified.		0-------	----0.....	.....	Contractor/Land Use Unit
f. Surface Water Development Plan developed.		....0----0..	.....	.....	Contractor Land Use Unit
g. CP 4.4 (a) on detailed plan development met.		....0----0..	.....	.....	Contractor Land Use Unit
h. Letter sent to AID informing them that CP has been met.		.....	.....	.....	Project Coordin- ator - Nevis
i. Inputs for water projects identified and procured.		.....0..	.....	.....	Contractor/Land Use Unit
j. Watershed Management Plan developed.		.....	.....	.....	Contractor/Land Use Unit
k. Training for Land Use Unit.		0---	-0.....	.....	Project Coordin- ator-Nevis/AID
l. Letter sent to AID requesting assistance in identifying training for land use personnel.		.....0-0.	.....	.....	Project Coordin- ator - Nevis
		....0-0.....	.....	.....	
		.....	.....	.....	
		.....	.....	.....	

ACTIVITY DESCRIPTION	84 D	1985 JFMAMJJASOND	1986 JFMAMJJASOND	1987 JFMAMJJAS	RESPONSIBLE
V. PROCUREMENT					
A. Bulldozers					
a. Prepare Invitations for Bids (IFB) for bulldozers.	0	.....	.....	.....	Project Manager
b. Submit the IFB to AID for their approval and indicate that with the approval of the IFB the CP 4.6 (a) for specifications for the bulldozer has been met.	.	.....	.....	.....	
	.	.....	.....	.....	
c. Prepare Advertisement for the Commerce Business Daily.	0	.....	.....	.....	Project Manager
	.	.....	.....	.....	Project Manager/
d. Submit the Advertisement to AID for approval and onward transmission.	.	0.....	.....	.....	AID
e. Identify those responsible for the operation and maintenance of the bulldozer for Nevis.	.	.....	.....	.....	Project Manager
	.	.....	.....	.....	
	.	.....	.....	.....	Project Coordin-
f. Identify those responsible for the operation and maintenance of the bulldozer in St. Kitts.	0	.....	.....	.....	ator/Nevis
	0	.....	.....	.....	Project Manager
g. Send letter to AID informing them that the CP 4.6(b) has been met for bulldozer by identification of the operations and those responsible for maintainance.	.	.....	.....	.....	
	.	.....	.....	.....	
h. Bids held, unopened, for public opening on date and time specified in IFB.	0	.....	.....	.....	Project Manager
i. Evaluation form prepared for evaluating bids.	.	00.....	.....	.....	Project Manager
j. Committee identified to evaluate bids.	.	.0.....	.....	.....	Project Manager
k. Committee meets (with AID representative present) to evaluate bids.	.	.....	.....	.....	Project Manager
	.	.....	.....	.....	Committee/Project
l. Upon successful bidder being identified, the IFB contract is signed and sent to AID for concurrence. Also a letter is sent to AID to the effect that with the the identificaion of a successful bidder the CP 4.6 (a) regarding bulldozer cost cost has been met.	.	..0.....	.....	.....	Manager/AID
	.	.....	.....	.....	
	.	.....	.....	.....	
	.	.....	.....	.....	
m. Unsuccessful bidders notified and successful bidder sent approved contract copy.	.	..0.....	.....	.....	Project Manager
n. Supplier receives direct letter of commitment from AID.					
o. Duty clearances prepared for St. Kitts.	.	...0.....	.....	.....	AID
p. Bulldozers arrive in St. Kitts and Nevis.	.	....0.....	.....	.....	Project Manager
	.	.....	.....	.....	Project Coordin-
q. Bulldozers arrive in St. Kitts and Nevis	.	.....0.....	.....	.....	ator-Nevis
r. Bulldozer moved from port to (NACO's main workshop) in St. Kitts.	.	.....0.....	.....	.....	Supplier
	.	.....	.....	.....	Project Manager/
s. Bulldozer moved from port to (main workshop at Prospect) in Nevis.	.	.....0.....	.....	.....	NACO
	.	.....	.....	.....	Project Corrdin-
t. Bulldozer training team arrives and is met by Project Manager.	.	.....0.....	.....	.....	ator-Nevis
	.	.....	.....	.....	Project Manager/
	.	.....	.....	.....	Project Coordina-
u. Operator and maintenance training.	.	.....0.....	.....	.....	tor-Nevis
	.	.....0.....	.....	.....	Supplier
* The direct letter of commitment cannot be sent until CPs 4.6 (a) (for bulldozers only) and 4.6 (b) (in its entirety have been met).	.	.....	.....	.....	
	.	.....	.....	.....	
B. Technical Assistance and Equiptment Procurement Services					
a. Prepare draft statement of work for Request for Proposal (RFP).	0	.....	.....	.....	Project Manager
b. Submit draft statement of work to AID for approval.	0	.....	.....	.....	Project Manager
c. Prepare RFP and submit to AID approval.	0	.....	.....	.....	Project Manager
	.	.....	.....	.....	/AID

ACTIVITY DESCRIPTION	84 D	1985 JFMAMJJASOND	1986 JFMAMJJASOND	1987 JFMAMJJAS	RESPONSIBLE
d. Prepare advertisement for Commerce Business Dail.	.	0.....	.....	.....	Project Manager/AID
e. Submit advertisement to AID for approval and onward transmission.	.	0.....	.....	.....	Project Manager
f. Hold proposals, unopened for public opening date time and place specified in the RFP. AID representative should be present at opening.	.	.....	.....	.....	
g. Cost of RFP contract estimates prepared to be used with evaluation criteria of RFP to determine the most responsive proposal.	.	.00.....	.....	.....	Project Manager
h. Committee identified to evaluate proposals.	.	.....	.....	.....	Project Manager/ Committee
i. Committee evaluates proposals with criteria specified in (F) above. An AID official must be presented when evaluation is carried out.	.	..0.....	.....	.....	
j. AID informed of successful proposer.	.	.0.....	.....	.....	Project Manager
k. Final draft contract prepared and agreed to by all parties. The draft contract contract to be approved by AID before signed.	.	.....	.....	.....	
l. Signed contract sent to AID for concurrence.	.	..0.....	.....	.....	Committee/AID
m. Unsuccessful proposers notified.	.	...0.....	.....	.....	Project Manager
n. Office space prepared for technical personnel in St. Kitts and Nevis.	.	.....	.....	.....	
o. Duty free privileges for technical personnel.	.	....0.....	.....	.....	Project Manager/AID
p. Long-term technical assistance arrives for St. Kitts and Nevis begin work.	.	....0.....	.....	.....	Project Manager
q. Design team arrives.	.	....0.....	.....	.....	Project Manager
	.	.....	.....	.....	Project Manager
	.	....0.....	.....	.....	Project Manager
	.	.....	.....	.....	Project Manager
	.	.....0.....	.....	.....	Project Manager
	.	.....0.....	.....	.....	Contractor
	.	.....0....	.....	.....	Contractor
B. Vehicles					
a. Prepare required specifications for vehicles and prepare cost estimates and maintenance plan(s)	.	.....	.....	.....	
b. Notify AID of information required in ProAg Section 4.6	.	.....	.....	.....	Contractor
c. Using good business proceedures, purchase the vehicle	.	.....	.....	.....	Project Manager
d. Duty clearance prepared for St. Kitts.	.	.....	.....	.....	Contractorr
e. Duty clearance prepared for Nevis.	.	....0.....	.....	.....	Project Manager
	.	.....	.....	.....	Project Coordina-
f. Accept delivery and make payment	.	.....0.....	.....	.....	tor/Nevis
g. Request AID reimbursement	.	.....	.....	.....	Contractor
h. Vehicles assigned to appropriate project technical assistance personnel.	.	.....	.....	.....	Contractor
	.	.....	.....	.....	Project Manager/
	.	.....	.....	.....	Nevis Coordin-
	.	.....	.....	.....	ator

Best Available Document

ACTIVITY DESCRIPTION	84 1985 1986 1987 D JFMAMJJASOND JFMAMJJASOND JFMAMJJAS	RESPONSIBLE
PROCUREMENT (cont'd)		
D. Training		
a. Identification of type of training program required for Land Use Unit personnel.	. ...	Nevis Coor-
b. Description of qualifications of Land Use Unit personnel in Nevis sent to AID with request to find appropriate training for them.	0 0.....	dinator
c. Land Use Unit personnel sent on training course.	. ...	
d. Identification of those requiring training and a listing of their qualifications for the St. Kitts part of the project.	. ...	Nevis Coord.
e. Identification of the appropriate training based on project needs and the qualification of those identified for training	. ...	Nevis Coord.
f. In country training course conducted.	. ...	Project Manager/
	. ...	Contractor
	. ..... .00.....	Contractor
E. Surveying/Monitoring Equipment		
a. Identify equipment required.	0 0.....	Project Manager
b. Write to at least 3 firms for catalogues with price listings.	. ...	/AID
c. Compare total price for items required to amount available in budget for each St. Kitts and Nevis.	. .0.....	Project Manager
d. Prepare request for Quotations (RFQ) based on requirements and available funds.	. ..0.....	Project Manager
e. Submit RFQ to AID for approval.	. ...0.....	Project Manager
f. Send RFQ directly to suppliers (3 to 5 or more if possible).	. ...0.....	Project Manager
g. Develop evaluation criteria based on those specified in RFQ.	. ....0.....	Project Manager
h. Identify committee to evaluate the RFQs.	. ....0.....	Project Manager
i. Open the RFQs at the date and time specified in the RFQ. (An AID representative should be present).	. ...	Project Manager
j. Committee evaluates the RFQs with an AID representative as an observer.	. .....0.....	Project Manager
k. Signed RFQ contract sent to AID for concurrence prior to onward transmission to successful offeror.	. .....0....	Committee/AID
l. Letter sent to AID requesting the direct letter of commitment be sent to successful offeror.	. .....0....	Project Manager
m. Duty clearances are prepared in both St. Kitts and Nevis.	. .....0...	Project Manager
	. ...	Project Manager/
	. ...	Project Coordin-
n. Goods arrive in both St. Kitts and Nevis and are cleared and sent to project office.	. .....0	ator/Nevis
	. .....0	Supplier
F. Agricultural Inputs		
a. Identify the inputs that will be required to support the extension activities of the project at Lavington-Lynches.	. ...	Contractor/
	. .....0...	Dept. of Agr.
b. Prepare Request for Quotations RFQ.	. .....0..	Contractor
c. Consider the possibility that the supply of inputs be done on a periodic basis.	. ...	Project Manager/
d. Submit the RFQ to AID for approval.	. .....0..	Dept. of Agr.
e. Prepare advertisement for submission to AID bulletin.	. ...	Project Manager
f. Submit advertisment to AID for approval and onward transmission.	. .....0..	Project Manager
	. .....0.	Project Manager

ACTIVITY DESCRIPTION	84 D	1985 JFMAMJJASOND	1986 JFMAMJJASOND	1987 JFMAMJJAS	RESPONSIBLE
PROCUREMENT (cont'd)					
g. Hold RFQs, unopened, for opening at time and date specified in RFQ.	.	.....00.	.....	.....	Project Manager
h. Develop evaluation criteria based on that specified in RFQ.	.	0	.....	.....	Project Manager/ Contractor
i. Select committee to evaluate RFQs.	.	0	.....	.....	Project Manager
j. Open RF at time and date specified, with aid representative present at observer.	.	0	.....	.....	Project Manager/ AID
k. Committee evaluates RFQs with AID representaive as observer.	.	0	.....	.....	Project Manager/ AID
l. Signed RFQ contract sent to AID for concurrence prior to onward transmission to successful offeror.	.	0	.....	.....	Project Manager
m. Unsuccessful offerors notified.	.	0	.....	.....	Project Manager
n. Letter sent to AID requesting direct letter be sent to successful offeror.	.	0	.....	.....	Project Manager
o. Duty clearances prepared.	.	.....	.0.....	.....	Project Manager
p. Location to store inputs identified.	.	.....	0.....	.....	Project Manager/ Dept. of Agr.
q. Inputs cleared from port and sent to storage location.	.	.....	..0.....	.....	Project Manager
G. Trees for Shelterbelts and Terraced Land					
a. Identified varieties of trees appropriate for project.	.	.....0.....	.....	.....	Contractor/Dept. of Agr.
b. Prepare Request for Quotations (RFQ).	.	.....0...	.....	.....	Contractor
c. Consider whether or not the tree (seedlings) should be supplied on a periodic basis.	.	.....0...	.....	.....	Project Manager/ Dept. of Agr.
d. Identify a location where the seedlings can be stored and determine how they will be cared for prior to planting.	.	.....0...	.....	.....	Project Manager/ Dept. of Agr.
e. Submit RFQ to AID for approval.	.	.....0..	.....	.....	Project manager
f. Prepare advertisement for submission to AID bulletin.	.	.....0..	.....	.....	Project Manager/AID
g. Submit advertisement to AID for approval and onward transmission.	.	.....0..	.....	.....	Project Manager
h. Develop evaluation criteria for RFQ based on the criteria specified in the RFQ.	.	.....0...	.....	.....	Project Manager/ Contractor
i. Select committee evaluates RFQs.	.	.....0..	.....	.....	Project Manager
j. Hold RFQs, unopened, for opening at time and date specified in RFQ.	.	00	.....	.....	Project Manager
k. Open RFQs at time and date specified with AID representative present as observer.	.	0	.....	.....	Project Manager/AID
l. Committee evaluates RFQs with AID representative as observer.	.	0	.....	.....	Project Manager/AID
m. Signed RFQ contract sent to AID for their concurrence prior to onward transmission to successful offeror.	.	0	.....	.....	Project Manager
n. Letter sent to AID requesting that a direct letter of commitment be sent to the successful offeror.	.	0	.....	.....	Project Manager
o. Unsuccessful offerors notified.	.	0	.....	.....	Project Manager
p. Duty clearances prepared.	.	.....	0.....	.....	Project Manager
q. Trees arrive and are cleared and sent to storage location.	.	.....	..0.....	.....	Project Manager
H. Construction Materials for St. Kitts					
a. Identify those materials required for civil works which cannot be supplied locally.	.	.....0..	.....	.....	Contractor
b. Prepare Request for Quotation (RFQ) or Invitation for Bid (dependent on the amount the amount and cost of materials required).	.	.....0.	.....	.....	Contractor

ACTIVITY DESCRIPTION	84 1985 1986 1987 D JFMAMJJASOND JFMAMJJASOND JFMAMJJAS	RESPONSIBLE
PROCUREMENT (cont'd)		
c. Prepare implementation plan for which ever type of procurement method is required (IFB ro RFQ).	. .....0.	Contractor
I. Construction Materials for Nevis		
Request waiver so that local cost financing procedures can be used.	. ... .0.....	Project Manager/ Project Coordinator/Nevis
b. All local purchases require proof that competitive procedures were used in procurement.	. ... 0---------- --------0	Project Coord - Nevis/Project Manager

APPENDIX D: Training Memoranda

ST. KITTS/NEVIS

RESOURCE MANAGEMENT PROJECT

MEMORANDUM

To: Mr. V. Warner, Project Manager

From: Dr. V. Bralts, USAID Consultant Date: April, 1985

Subject: Training Recommendations

Because there is a time lag between my consultantship and the arrival of long term project personel, I was asked by USAID to identify possible short term training opportunities for the host country professionals who will be participants in the Resource Management Project.

Attached please find a zerox copy of the USDA Course Catalogue and the relevant course options. It is my recommendation that Charles Mills (St. Kitts) attend the course titled "Water Management and Runoff Farming Methods for Small Scale Agriculture" in July 1985. The content and objectives of this course best meet the St. Kitts project objectives. In addition I would like to recommend that Mr. Claude Nisbett (Nevis) attend the course titled "Resource Development of Watershed Lands" in June 1985. The objectives and content of this course best meet the Nevis project objectives.

As for Mr. Eric Evylen (Nevis) I would personally not recommend sending him to any short courses until he has received at least 2 years of University Training. Mr. Evylen is a very capable young man who deserves proper training if he is to assist in the technical aspects of land use and water resources development. For this reason I would recommend that Mr. Evylen pursue a 2 year Associates Degree at any one of hundreds of 2 year Agricultural and Technical Colleges across the United States or in the Caribbean. This training could begin as early as the fall of 1985 or wait until the fall of 1986 after spending one year with the long term water resource specialist.

If you as the Project Manager agree with the above recommendations the next step in securing funds from the Resource Management Project would consist of a letter to Dr. David Jesse the USAID Project Development Officer requesting the early training.

cc D. Jesse

United States
Department of
Agriculture

Office of
International
Cooperation and
Development

Washington,
D.C.
20250

Catalog of Courses in Agriculture and Rural Development, 1985

Programs in the United States for Foreign Agriculturalists

Offered by the U.S. Department of Agriculture
in cooperation with the U.S. Agency for
International Development and U.S. Universities

CONTENTS

INTRODUCTION i

LIST OF TECHNICAL SHORT COURSES 1

CAPABILITIES OF THE INTERNATIONAL TRAINING DIVISION 4

GENERAL COURSE INFORMATION 6

COURSE DESCRIPTIONS 10

CRITICAL DATES LISTED BY COURSE NUMBER 56

CHRONOLOGICAL SCHEDULE OF COURSES 58

September 1984

LIST OF TECHNICAL SHORT COURSES

Animal Science and Natural Resources

TC 120-8 Resource Development of Watershed Lands 21

TC 120-10 Land Use Planning in Natural Resource Management 22

TC 130-4 Range Management and Forage Production 26

TC 130-9 Intensive Poultry Production Systems 29

TC 130-10 Small Ruminant Production Techniques 30

TC 170-7 Ecological Analysis for Management of Natural Resource Areas 55

Economics and Policy

TC 140-1 Agricultural Policy Seminar (for senior-level officials) . . 32

TC 140-2 Project Analysis for Agriculture and Rural Development . . . 33

TC 140-3 Strategies for Developing the Agricultural Sector 34

TC 140-8 Small Farmer Credit Policy and Administration 35

TC 140-11 Establishment and Management of Agricultural Cooperative Organizations 36

TC 140-12 Organization and Operation of Rural Electric Distribution Systems 37

TC 140-15 Project Planning for Agriculture and Rural Development . . . 39

TC 140-16 Project Implementation for Agriculture and Rural Development 40

TC 140-19 Policy Formulation and Analysis for Agriculture and Rural Development 42

TC 140-22 Economic Forecasting for Agricultural Policy and Decision-making 43

TC 140-26 Establishing Data Bases and Analytical Systems for Economic Decisionmaking in Agriculture 47

TC 140-28 Effective Livestock and Crop Management for Small Farms . . 48

TC 140-33 Basic Agricultural Survey Statistics and Methods 50

TC 140-34 Management of an Agricultural Statistics System 51

TC 150-5 Developing Markets for Agricultural Products 53

Management, Education, and Human Resource Development

TC 110-3 Agricultural Communications and Media Strategies (for communications specialists) 10

TC 110-5 Development and Operation of Agricultural Extension Programs (two sections) 11

TC 110-14 Application and Diffusion of Agricultural Research Results to the Community Level 12

TC 110-15 Training of Trainers for Agriculture and Rural Development 13

TC 110-18 Communications Planning and Strategy (for program managers of any technical specialty) 15

TC 110-19 Communication and Management Skills for Reentry and Introducing Change 16

TC 140-14 Organizational and Management Development. 38

TC 140-17 Management and the Role of Women in Development (for senior women officials) 41

TC 140-23 Management of Agricultural Organizations in Developing Countries (for entry- to mid-level managers) 44

TC 140-24 Management of Agricultural Research. 45

TC 140-25 Initiating and Managing Integrated Rural Development Programs 46

TC 140-32 Keys to Agricultural Development at the Local Level (five sections) 49

Production and Technology

TC 110-17 Agricultural Research Methodology 14

TC 120-1 Irrigation Problems and Practices 17

TC 120-5 Soil Testing and Fertilizer Management 18

TC 120-6 Technical and Economic Aspects of Soybean Production 19

TC 120-7 Soybean Processing for Food Uses 20

TC 120-14 Assessment and Improvement of Onfarm Irrigation Systems . . 23

TC 120-25 Water Management and Runoff Farming Methods for Small-Scale Agriculture 24

TC 130-3 Seed Improvement. 25

TC 130-5 Plant Quarantine. 27

TC 130-8 Integrated Pest Management. 28

TC 130-11 Vegetable Crop Production and Marketing 31

TC 150-2 Grain Storage and Marketing 52

TC 150-7 Postharvest Loss Reduction of Perishable Crops. 54

GENERAL COURSE INFORMATION

PARTICIPANTS

Courses are open to the staffs of agricultural and rural development institutions and organizations in developing countries. In their own countries, participants may fill such diverse roles as technicians, scientists, trainers, administrators, and policymakers. They may have varied subject matter backgrounds and wide ranges of experience in development positions.

PHILOSOPHY AND DESIGN

The design of each course represents a belief that training situations should provide participants with sound technical knowledge and the opportunity to test and practice new skills and knowledge in practical situations. Thus, all courses offer a mixture of technical instruction, exercises, practice, and field observations.

Experienced professional staff will find the courses stimulating and challenging because they focus on issues affecting developing countries. Participants are encouraged to identify specific personal objectives within the course objectives, share their home country situations, and apply course resources to the realities they face at home. The courses will help them do so through small group work, relevant case studies and examples, illustrative field trips, and ongoing evaluations of the training offered. All course instructors have international experience and are selected for their knowledge of specific subject areas and their skill in facilitating adult learning.

Each course is designed for a specific level of academic knowledge and professional experience. Target audiences are indicated in the individual course descriptions. Participants should have the ability to participate fully in classes, exercises, and projects conducted in English. Where simultaneous translation is available, it is indicated in the course description. Costs for translators will be furnished upon request.

LOCATION

Courses conducted by USDA staff are held in a training center in the Washington, D.C., metropolitan area. Courses coordinated by USDA but conducted by a U.S. university are typically presented at that university.

COURSE SEQUENCE

The schedule has been designed so that many of the courses can be taken in sequence. (See the chart on page 59-60.) In addition, special sections of TC 110-19, "Communication Skills for Development Professionals," can often be scheduled to follow enrollment in other short courses. Future schedules will approximate the 1985 calendar to help with long-term planning.

FUNDING AND FINANCIAL ARRANGEMENTS

Funding is arranged according to the sponsoring organization as follows:

AID participants	-	Project Implementation Order for Participants (PIO/P) documentation is required.
FAO fellowships	-	FAO Fellowship documentation is required.
Other sponsors	-	The World Bank, country governments, and other sponsors should make checks payable to USDA/ITD for the training fees and pay maintenance allowance directly to participants. See individual course descriptions for complete information.

Training Fee. Cost totals for each course vary according to the items included as training expenses by each sponsoring organization. All training fees include course costs (such as staff, materials, and field trips) and administrative support (such as course enrollment procedures, health insurance, logistical arrangements, and assistance with relevant appointments and personal needs). In addition, orientation to the United States and to the Department of Agriculture is provided for all participants by the Washington International Center and USDA.

Specifically, training fees by sponsor are as follows:

AID-sponsored participants:	Course costs, Resources Support Services Agreement (RSSA) fee, course coordination fee, insurance, orientation at Washington International Center and professional society membership. Books and book shipment allowance will be issued with maintenance checks.
FAO-sponsored participants:	Course costs, administrative fee, course coordination fee and orientation at Washington International Center.
Other participants:	Administrative fee, course coordination fee, insurance, orientation at Washington International Center, and a professional society membership. An allowance for books and book shipment amounting to $110 is included in the maintenance allowance paid directly to participants by the sponsor.

Maintenance Allowance. The maintenance allowance for food, housing, and incidentals is calculated at $60 per day for the first month and for field trips away from the training site. Washington-based courses continue for the duration of the course at $60 a day due to the high costs of living in the area. The allowance at other sites is reduced to $28.33/day after the first month. Governments and organizations that have their own policies with regard to maintenance allowances are encouraged to follow those policies.

Participants in senior-level courses 140-1, "Agricultural Policy;" 140-14, "Organization Development;" and 140-17, "Management and the Role of Women in Development" should be informed that the AID maintenance allowance has been established at $60 a day, with no increase anticipated. While this amount is adequate to cover basic expenses, it may necessitate sharing a hotel room to stay within the $60. Sponsors who wish to provide for single rooms for participants should provide additional maintenance allowance. AID missions that wish to request exceptional per diem for a participant should cable the person's name and rank at least 1 month in advance for forwarding to AID/Washington for approval.

ARRIVAL DATE AND ORIENTATION

Arrival date (call forward date) is scheduled 5 to 8 days prior to the actual course date to allow time for orientation and administrative processing. Both participants and instructors strongly agree that this lead time plays a critical role in the participants' readiness to begin an intensive course. During orientation, participants examine U.S. culture and customs, familiarize themselves with transportation, arrange permanent housing, and generally "settle in." Financial arrangements, visa problems, and other administrative matters are handled at this time. In addition, instructors often conduct individual interviews with participants to ensure that courses meet their needs.

When USDA is notified of scheduled arrival time, participants will be met at the airport by volunteers from the Washington International Center (WIC). WIC staff will assist with transportation and hotel arrangements at that time.

TRAVEL AND AIRLINE TICKETS

The airline tickets should be issued per instructions listed for each course. Space will be blocked in Washington for the flight from Washington to the course location so that participants can arrive as a group for more convenient transportation to lodging. Several States have cities with the same or similar names; for example, Columbus and Columbia, and these are often confused in international travel. Please check destinations carefully before requesting tickets.

ENROLLMENT

Telex or write to reserve space for course candidates. For most courses, enrollment is on a "space available" basis. Send funding documents or payment, English language proficiency scores, and biographical information at least 2 months before the course starting date so that administrative processing can be completed prior to participants' arrival. Refer to course descriptions for information on any home-country data or materials that participants should bring for use during the course. In all cases, we suggest that participants bring information to help explain their organization and job responsibilities.

Telex or write to:

David P. Winkelmann
Acting Director, International Training
Room 4118 - Auditors' Building
Office of International Cooperation and Development (OICD)
United States Department of Agriculture
Washington, D.C. 20250
USA

Telex address: AGRI/WASH 64334, Winkelmann, OICD

IRRIGATION PROBLEMS AND PRACTICES
(USDA) TC 120-1

DATES AND DURATION

8 weeks: June 17 - August 9, 1985. Participants should arrive in Washington, D.C., on June 10 for course orientation and administrative procedures.

TARGET AUDIENCE

Irrigation practitioners with an educational background at the bachelor's or master's level in agronomy or agricultural engineering.

OBJECTIVES

Participants will: (1) gain knowledge and practical experience in onfarm water management and crop production, (2) develop skills to plan, design, establish, and maintain new irrigation systems in their home countries.

CONTENT

For the first 5 weeks, the course is conducted primarily on the Colorado State University campus and includes lectures, field and laboratory practice, field training at the agronomy experiment station farm, and seminars centered on participant presentations of irrigation problems in their home countries. Topics covered include basic soils, soil-water-plant relationships, land leveling, irrigation methods and practices, administration and distribution of water, water law, water quality, salinity, drainage problems and remedies, economics and sociology of irrigation, and extension methods. The last 3 weeks of the course consist of field visits to irrigation programs and projects in New Mexico, Arizona, and southern California, including the rice production area around Sacramento.

OTHER INFORMATION

Conducted in English by Colorado State University. Simultaneous interpretation is not available. Six hours academic credit is available for qualified participants.

COST

AID participants: Total of $8,212 includes $4,445 for training fee and associated costs and $3,767 for maintenance allowance, books, and book shipment.
UN/FAO participants: Total of $7,902 includes $4,245 for training fee and associated costs and $3,657 for maintenance allowance.
All other participants: Total of $8,212 includes $4,445 for training fee and associated costs payable to USDA, and $3,767 for maintenance allowance, books, and book shipment payable directly to the participant.

TRAVEL

Participants should be provided air tickets from their home countries to Washington, D.C. on June 10; Washington, D.C. to Denver, Colorado, (open booking); and return from Fresno, California, to home countries on August 10. Surface transportation is provided by USDA from Denver to the course site at Ft. Collins, and also for the field trip from Ft. Collins to Fresno.

OVERSEAS AVAILABILITY

TC 120-14 "Assessment and Improvement of Onfarm Irrigation Systems" is a similar course specifically designed for overseas presentation.

RESOURCE DEVELOPMENT OF WATERSHED LANDS
(USDA) TC 120-8

DATES AND DURATION

6 weeks: June 10 - July 19, 1985. Participants should arrive in Washington, D.C., on June 3 for course orientation and administrative procedures.

TARGET AUDIENCE

For mid-level technicians and professionals engaged in the management and development of watershed lands in developing nations. For individuals with a bachelor of science or master of science in forestry or agriculture, or who work with water resources.

OBJECTIVES

Participants will acquire the knowledge and skills necessary for the effective development, use, and management of water resources to increase food and fiber production.

CONTENT

Watershed lands are habitable areas which do not include agricultural, urban, or reserve areas. Because production from these lands is linked with water, the course deals with the fundamentals of hydrology, including hydrologic measurement and predictive methods. The course presentation is supplemented by practical problems and demonstrations. Since most of the difficulties in developing the multiple products of watershed lands are social and economic, the course emphasizes those aspects of development. Other major areas include range assessment and management, soil and water conservation techniques, and natural resource economics and management.

OTHER INFORMATION

Conducted in English by the University of Arizona. Simultaneous interpretation is not available.

COST

AID participants: Total of $6,102 includes $3,429 for training fee and associated costs and $2,673 for maintenance allowance, books, and book shipment.
UN/FAO participants: Total of $5,792 includes $3,229 for training fee and associated costs and $2,563 for maintenance allowance.
All other participants: Total of $6,102 includes $3,429 for training fee and associated costs payable to USDA, and $2,673 for maintenance allowance, books, and book shipment payable directly to the participant.

TRAVEL

Participants should be provided air tickets from their home countries to Washington, D.C. on June 3; Washington, D.C. to Tucson, Arizona (open booking); and Tucson to home countries on July 20.

OVERSEAS AVAILABILITY

Available for overseas presentation upon request by AID, the World Bank, FAO, developing country governments, foundations, and private organizations. Can be conducted in English, Arabic, French, and Spanish.

WATER MANAGEMENT AND RUNOFF FARMING METHODS FOR SMALL SCALE AGRICULTURE
(USDA) TC 120-25

DATES AND DURATION

4 weeks: July 15 - August 9, 1985. Participants should arrive in Washington, D.C., on July 8 for course orientation and administrative procedures.

TARGET AUDIENCE

Agricultural personnel with a bachelor of science, master of science, or doctorate in plant sciences, soils, agricultural engineering, or range management; and other personnel interested in small scale water management and runoff farming.

OBJECTIVES

To provide participants with the knowledge and skills necessary for the effective design, development, operation, and maintenance of small scale water management and runoff farming facilities that can increase agricultural production in arid and semiarid areas.

CONTENT

Major topics to be included are the hydrology of runoff farming/water harvesting, small-scale water management technology, soil and topographic considerations, crop selection, design criteria, and the operation and maintenance of small-scale facilities.

The course will include lectures, laboratory exercises, group discussions, practical field experience, problem solving, and observation field trips.

OTHER INFORMATION

Conducted in English by the University of Arizona in Tucson and at nearby facilities. May be taken for university credit with permission of instructor.

COST

AID participants: Total of $4,756 includes $2,546 for training fee and associated costs and $2,210 for maintenance allowance, books, and book shipment.
UN/FAO participants: Total of $4,471 includes $2,371 for training fee and associated costs and $2,100 for maintenance allowance.
All other participants: Total of $4,756 includes $2,546 for training fee and associated costs payable to USDA, and $2,210 for maintenance allowance, books, and book shipment payable directly to the participant.

TRAVEL

Participants should be provided air tickets from their home countries to Washington, D.C. on July 8; Washington, D.C. to Tucson, Arizona (open booking); and Tucson to home countries on August 10.

OVERSEAS AVAILABILITY

Available for overseas presentation upon request by AID, the World Bank, FAO, developing country governments, foundations, and private organizations. Can be conducted in English and Spanish.

ST. KITTS/NEVIS

RESOURCE MANAGEMENT PROJECT

MEMORANDUM

To: Mr. V. Warner, Project Manager

From: Dr. V. Bralts, USAID Consultant Date: April 2, 1985

Subject: Engineering and Technical Manuals

Attached please find a partial copy of the Index of USDA-SCS National Technical Materials. Because of the normally long lead time and absolute necessity of some basic soil conservation materials I would like to recommend that a complete set of the National Engineering Handbook be ordered for the St. Kitts Soil Conservation Unit. In addition I would like to recommend that an Engineers Field Manual for Conservation Practices be purchased for Nevis.

If you as the Project Manager agree with the above recommendations the next step would be to request the materials through Dr. David Jesse the USAID Project Development Officer. Dr. Jesse can then follow up on your request through an interagency request for assistance since both organizations are part of the U.S government.

cc D. Jesse

United States
Department of
Agriculture

Soil
Conservation
Service

Honolulu,
Hawaii

Erosion and Sediment Control

Guide for Hawaii

in Cooperation with the Hawaii Association of Soil and Water Conservation Districts and the Soil Conservation Society of America, Hawaii Chapter

March 1981

CONTENTS

Foreword v

Introduction vii

Principles of conservation 1

Planning for erosion and sediment control 3

Erosion and sediment control measures 11

Access Road 11
Contour Farming 12
Cover and Green Manure Crop 12
Crop Residue Management 14
Crop Rotation 15
Dikes 15
Diversions 16
Environmental Planting 19
Filter Strip 20
Grade Stabilization Structure 21
Grassed Waterway 22
Ground Cover 25
Hillside Ditch 27
Land Grading 28
Mulching 28
Pasture Planting 29
Rock Filter Structure 32
Sediment Basin (Temporary) 33
Slope Protection Structures
Chute, Flume, Flexible Downdrain 36
Streambank Protection 36
Stripcropping, Contour 38
Surface Drainage Ditch 38
Terrace 39
Tree Planting (Woodland) 43
Use of Fibrous Netting Material 45
Vertical Drain 46
Windbreak 46

Maintaining erosion and sediment control measures 51

Appendix A Estimating soil loss 53

Appendix B Estimating run-off 79
Section 1. Estimating Run-off 79
Section 2. Hydrologic Soil Groups 82
Section 3. Rainfall Maps of Hawaii, 24-hour Amounts 82
Section 4. Peak Rates of Discharge for Small Watersheds 89
Section 5. Adjustment Factors for Peak Rates 92

Appendix C Characteristics of plants suitable for beautification and conservation 95

Glossary 169

APPENDIX E:
ALTERNATIVE PROJECTS CONTRIBUTING TO A SOLUTION OF ENVIRONMENTAL PROBLEMS OF ST. KITTS

Throughout the developing world, degradation of the natural environment goes hand in hand with skewed distribution of land. Where ownership of the best agricultural land is concentrated, individuals find that they can produce crops and livestock only on marginal land, which tends to be more easily eroded than the better farmland. As farmers clear trees and other vegetation in marginal areas, soil erosion increases, which in turn exacerbates sedimentation problems at lower elevations. In addition, the loss of vegetative cover associated with an expansion of cropland and pasture in marginal hill lands increased the frequency and severity of flooding problems.

In St. Kitts, where a very high percentage of the best farmland is owned or controlled by the government and NACO, the parastatal sugar corporation, the adverse environmental consequences of concentrated land ownership are evident. Lacking access to the island's best agricultural land, which is devoted almost entirely to sugar production, individuals raise vegetables in the ghauts (or gullies) and roads that border cane fields. They also clear trees from the hillside above sugar estates to establish pasture and cropland. Deforestation also results from fuelwood gathering.

That agricultural pressure on forested hill lands would

decrease in St. Kitts is indicated by changes in land use observed in Nevis since the demise of sugar production. Small farmers have established themselves on much of the latter island's better farmland, which was formerly planted to sugarcane. Very little of that land is irrigated. One can only infer from this behavior that, given the opportunity, at last some of St. Kitt's small farmers would move from steeply floped, marginal land to better farmland closer to the coast.

To recognize this preference does not imply that all renewable resource management problems facing St. Kitts can be solved by distributing better farmland to the island's small farmers. Agricultural pressure on hill lands would continue even if land redistribution were to occur. Rainfall is heavier at higher elevations. In addition, a small farmer pays only a fraction of the costs associated with deforestation and sol erosion. Since no major legal restrictions are placed on private access to hill land (i.e., because small farmers are allowed to squat on that land), the private costs of soil erosion are low; they consist of the relatively low expense of clearing a new parcel of land once soil fertility on an old parcel has declined too far. Hillside farmers typically do not absorb any of the off-site costs associated with erosion.

Recognizing that redistribution of prime farmland would partially ameliorate being observed in St. Kitts, we suggest that the island's government begin taking measures to facilitate that redistribution. Specifically, we recommend development of the following elements of an institutional infrastructure needed to

insure successful transfer of prime farmland to small farmers:

- complete a soil survey of the island,
- conduct a cadastral survey,
- train extension agents who would specialize in communicating information on agricultural activities to small farmers resettled on prime farmland, and
- obtain the technical assistance needed to help design the extension effort and identify needs for research.

We also recognize that for reasons identified above, resettlement of small farmers will not totally eliminate agricultural pressure on the island's hill lands. In order to accommodate that pressure without exacerbating existing soil loss problems, we recommend that a program for extending available information on soil conserving tillage practices and pasture management techniques be pursued. To establish such a program would require both technical assistance and training of extension agents.

Details on training, technical assistance, and other elements of both the land redistribution program and the program of extending soil conservation information to hillside farmers follows.