BENCH TERRACING
A COST EFFECTIVE ALTERNATIVE TO TRADITIONAL IRRIGATION IN THE PHILIPPINES

John E. Priest[1]

ABSTRACT

The case study presented in this paper, a pilot program for the construction of permanent bench terraces throughout the Philippine islands, was designed to increase grains production at costs that would be competitive internationally. Additionally, the terraces would alleviate the severe problem of hillside erosion that currently is silting rivers, reservoirs and canals. Compacted dikes would form terraces for capturing all depths of rainfall, in-place, for crop production. With the generally predictable rainfall regimes particular to each island of the Republic, one to three high yielding crops could be produced annually without the construction of flood-vulnerable diversion works, reservoirs, and long canals.

A Pilot Project was designed to achieve construction of some 1400 separate terraces averaging 50 hectares each, in several areas of the three regions of the country -- Luzon, Visayas, and Mindanao. For execution of the project, the central government could decide to purchase equipment and employ personnel to complete construction. Alternatively, the central government could elect to contract construction and engage local government to provide legal, social, and administrative support. The landowners, in this case, likely would enter into a tripartite contract with a bank and a developer, not with the government.

For either scenario, the objective of the pilot program would be to demonstrate to landowners, nationwide, that they could come together and transform now largely unproductive hillsides into land that could produce high yielding crops of maize, sorghum, millet and grain amaranth. Besides encouraging private investment on a broad scale, it was anticipated that through the pilot program, local government would gain expertise and resources. Local government and landowner cooperation would be of critical importance because then on-going reforms had subdivided land to an extent that would require a range of legal and social actions to re-aggregate small holdings into viable project blocks.

Development costs would approximate US $800 per acre ($2000 per hectare), 1997/98 prices, whether carried out totally as a private development or as a government program.

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[1] Consultant and Executive Vice President, RDT International, 2442 West Dry Creek Court, Littleton CO 80120

OBJECTIVE

The objective of the combined policy proposals of this author was to realize the mobilization of private resources for expansion of corn producing lands and the focus of available public resources for the expansion of rice producing areas of the Republic of the Philippines.

INTRODUCTION

During the decade of the 1990s agricultural trade worldwide was liberalized. Rules changes for agriculture within the framework of the World Trade Organization (WTO) and the then evolving preferential trade rules among the ASEAN countries required that fundamental modifications be made to the policy foundation and the structure and operations of the grains sector in the Philippines. Consideration of policy options required that a thorough review be made of the conditions that prevailed with the infrastructure of the Nation and how the key organizations were constituted, operated and financed.

The Grains Project

To address the considerable anti-competitive, inefficient distortions that had arisen in the agricultural sector, the Department of Agriculture (DA) of the Philippines secured funding from the Asian Development Bank. The financing was used to develop a set of policy initiatives. The policy initiatives addressed institutional capacities, issues and constraints that restrict efficient production of grains, and modifications to infrastructure required to release constraints and to increase cost-competitive agriculture.

Development Alternatives Inc. (DAI) of Bethesda, Maryland was awarded a contract to assist the DA with the development of a set of policies and companion programs that crosscut all sectors and institutions that affected grain production. The policies and programs analyzed and proposed varied from those for research and marketing to the construction of works. It was as a member of the DAI team that this author carried out a broad study of how to rehabilitate and expand deteriorated irrigation systems largely dedicated to rice production.

As well, water law and legislation was studied and policies were drawn to guide reorganization of the administration and use of water. Formulated was an organizational framework of governments and water user organizations to undertake sustainable operation, maintenance, and rehabilitation of existing irrigation systems with minimal input of financial resources by the Federal government.

The bench-terrace case study was formulated in recognition of the impossibly large financial commitments required to rehabilitate and to expand the irrigation systems of the country. Of equal importance was the need to introduce a program that would facilitate and hasten the on-going devolvement of many technical, administrative, and coordination functions away from the central government to provincial and local units of government (LGUs).

It was assumed that following implementation of the proposed Pilot Project, and if there would be continuing allocation of adequate financial resources, LGUs would have considerably enhanced capacities to directly support cultivators. Such support would be expected to emerge as traditional extension services to irrigation farmers and as the support necessary for the conduct of a program of bench terracing which would be financed and carried out by private interests, ie entrepreneurs.

Threat of Erosion

The Congress of the Republic and the World Bank both had identified erosion of the volcanic hillsides as the defining threat to the environment. Hillside erosion had filled river channels such that even small frequent floods overtopped levees and damaged hydraulic structures. Topsoil on hillsides is naturally shallow. Thus any erosion results in diminished capacity for supporting desirable vegetation, cultivated or natural.

Simplicity and Economy of Bench Terraces

Bench terraces effectively are lineal reservoirs with the entire terrace constituting the catchment area and the soil profile affording storage. Effectively the water supply is derived through subirrigation. The dike heights were designed to retain the precipitation of a typhoon.

Designs and costs were developed at the reconnaissance level for the formulation of policies to be adopted by the government of the Philippines and for use in securing international financing for the bench terracing and companion programs. It was estimated that bench terraces could be constructed for approximately US $800 per acre ($2000 per hectare). By contrast, construction of irrigation works, with storage and hydraulic capacity adequate to assure a low risk of crop failure would require an initial investment in excess of US $4000 per acre ($10,000 per hectare). In fact, costs for large-scale reservoir storage, major conveyance, diversion works, and the on-farm development of the land, a drainage system, and minor canals could cost as much as US $7500 per acre ($30,000 per hectare).

Farmers would be capable of maintaining and repairing dikes and drainage works of a terraced area under most circumstances. It was anticipated that the farmers

would be part of a cooperative through which they would be able to pool resources and secure the support of provincial and local governments.

Grain Production

Rice is irrigated whereas corn largely is produced from rainfall. Rice and corn are the two basic grains for human consumption and for animal feed. When corn is in short supply, rice is used as animal feed. Changes to the trade agreements occurred even as the demand for grain was increasing some three-percent per year and supply was declining. It was during the first half of the decade of the 1990s that the area of corn harvested decreased 4.9 percent while the availability of rice decreased precipitously during 1995 due to a combination of circumstances.

Condition of Infrastructure

Major irrigation projects, with a few exceptions, are serviced by low gated structures that lie across river channels. Often the channel has filled with sediment upstream from the structures, and levees have been built to prevent water from flowing overbank. These structures and levees sustain severe damage or destruction when a typhoon centers or passes over their drainage basin. It was due to the occurrence of several severe typhoons, earthquakes, and the volcanic eruption of Mt. Pinatubo that several sizeable blocks of agricultural lands were lost to production during the 1990s.

In-place programs for operation and maintenance (O&M) and for rehabilitation of typhoon damage were reviewed by the author and were identified as totally inadequate. Their shortfalls occurred due to under-funding of the responsible agencies and the inability of farmers to retain their water taxes and dues for direct use for O&M. The resulting severe lack of O&M and rehabilitation money was a major determinant of the level of grain production realized during the 1990s.

On-going Legislative and Administrative Programs

In the context of legislative and planning programs, far-reaching efforts were in progress to catalyze grains production to higher, more economic levels. These programs dealt with project planning and legislation regarding decentralization/devolution of federal functions to the provinces and LGUs and with the strengthening of cooperatives in conjunction with the program of land distribution. The demand for a limited supply of land had resulted in the breakup of large holdings into non-economic units with many small holders of limited financial capacity. To counter the economic effects the government was promoting the reorganization of cooperatives to bring together the many new small-landowners.

The second program related to the devolution of governmental functions from the Federal level to the local level. The program of devolution had yet to be funded and supported for startup. It was the anticipated increase of local capacity, however, that was the basis for the training component of the proposed Pilot Project and the incorporation of the principle of extension support by LGUs of future landowners and entrepreneurial activities.

Agrarian Reform: The Department of Agrarian Reform and the Department of Environment and Natural Resources had distributed 9.25 million acres (3.7 million hectares) of land to small farmers and workers, including 0.5 million share tenants, through the Comprehensive Agrarian Reform Program, implemented in 1987. During the period from 1987 to 1996, three associated activities with importance for the future potential increases of grain production were undertaken and required funding. The activities were: 1) agrarian reform communities which would serve as the focal point of reform activities and interaction between government and beneficiaries, 2) the expediting of land titling through a memorandum of agreement between the Department of Agricultural Reform and the Land Registration Authority, and 3) coordination with the Land Bank of the Philippines to simplify the process of land valuation.

Effects of Devolution: Devolution had the potential to place decision making closer to recipients and, thus, to be more responsive and efficient than programs operated from a central bureaucracy. Devolved agricultural extension staff were experiencing considerable difficulties, however, in securing administrative and financial support. Even though agriculture provides some 43 percent of employment, the need for training, budget and infrastructure were not commonly recognized.

It was observed that devolution temporarily had slowed or stopped programs that formerly were run by a centralized bureaucracy. It was for this reason that both the proposed hillside agriculture program and the in-place irrigation systems were viewed as important to the securing of resources for equipping and training local administrative and technical staff.

Conditions for Re-aggregation of Small Holdings

The program for the breakup of large land holdings and the distribution of these lands in small parcels to the landless has created technical, legal, and social challenges for the implementation of a successful national program of terracing,

Only if the new small holders would join a viable, active cooperative that could secure the advantages of strength in numbers, would there exist the conditions required for government or an entrepreneur to negotiate agreements for the financing and physical development of large tracts of land.

Problems could occur, for example, because dikes and drainage ways would occupy some 20 to 25 percent of terraced areas. Consequently the cultivable terraced land would have to be proportionally distributed or the produce would have to be marketed proportionally.

Similarly the soundest opportunity for recovery of investment costs would occur with the execution of firm agreements drawn before the start of construction. If legal, technical and financial staff of LGUs would be properly funded and trained during the execution of the Pilot Project, they should be able to support and even spearhead the drawing of pre-construction agreements subsequent to the execution of the Pilot Program. Thus, it was assumed that staff of local governments would facilitate the preparation of triangular agreement among landowners, banks, and entrepreneurs.

Widespread bench terracing could be an important catalyst for the successful devolution of responsibilities from the central government to LGUs.

Environment

Climate and weather were recognized as both an asset and an impediment to the production of grains. Intense rainfall was eroding the topsoil from hillsides and was clogging the rivers and canals. Yet rainfall originates from four great global systems to the benefit of rainfed agriculture either year round, as in northern Mindanao, or seasonally as on the northern end of Luzon. Understanding of the climate of the archipelago is essential to a full understanding of the potential for hillside agriculture.

Conclusion Regarding the Future of the Irrigation Program

The author realized early that no matter how artfully revenues would be collected and disbursed by the government, they would be inadequate. Revenues were required to support a sizeable national bureaucracy for operation, maintenance, and rehabilitation of typhoon-ravaged existing irrigation systems, even as efforts were underway to free up monies for construction of new or expanded areas for irrigation. Construction of large new irrigation systems would require substantial inputs of front-end capital, perhaps US $2500 to $7500 per acre ($10,000 to $30,000 per hectare). Also lands still to be developed would be those that would be technically difficult to service and would require high unit cost investments to develop low risk agriculture.

As shown below, extensive land areas could be developed on hillsides to produce one to three high yielding crops of corn per year based on a system of terraces to retain all rainfall, even that of typhoons. Costs would average some US $800 per

acre ($2,000/ ha.) depending on the cost of diesel fuel and the necessary profit to motivate the mobilization of substantial private resources.

It was this recognition, coupled with a study of legislation before the National Congress, which led the author to focus on the potential for rapid, extensive expansion of the area dedicated to the cultivation of corn.

THE HILLSIDE PROGRAM

A hillside agriculture program would represent the best means to set the farmer of the Philippines on the road to prosperity and international competitiveness. The objective was to greatly expand acreage dedicated to grains and to reduce hillside erosion and consequent sedimentation. This would be accomplished with a program of bench terracing modified to create permanent dikes.

A bench terrace, as designed for the Pilot Project, would be effectively a total self-contained water supply system within the confines of an agricultural field. Similar to an irrigation system, the dike impounds rainfall on-site, the water is throughput to storage in the soil profile through infiltration, and it is returned to the crop through a form of sub-irrigation.

It would be important that the government would implement a Pilot Project to demonstrate to farmers, entrepreneurs, and local governments that much would be gained by a nationwide program of bench terracing. A program for the development of, say, 140 125-acre (50-hectare) parcels would provide for the training of equipment operators across all three island-groups, Mindanao, Visayas and Luzon. Farmers would immediately realize the great benefits, local governments could learn their roles, and entrepreneurs could be introduced to a potentially profitable undertaking that would continue for 20 years or more. The stock of land with slopes between 5 percent and 20 percent is extensive across all the islands.

Bench Terraces

Bench terracing, as defined for purposes of this analysis, would be a series of land terraces each of which would lie along a topographic contour on a hillside. Such terraces could readily be formed on hillsides with slopes of 5 to 20 percent and where the total soils mantle would be adequately deep. The steepness of the land slope and the depth of soil would determine the width of terraces. It was noted that, for legal reasons, terracing likely would be limited to lands with slopes not in excess of 18 degrees (20 percent). It would be lands with slopes below 18 degrees

that could be "alienated" and "disposed" to private ownership for agricultural uses.

For example, as is shown on Fig. 1, lands with 10 percent of natural slope and topsoil with a depth of approximately one-half meter could be benched with terraces 10 meters wide without exposing the subsoil on the uphill side of the bench. Should the depth of the topsoil be less than 0.5 meters, the bench would best be formed with a lesser width. Or, topsoil could be stockpiled or moved into areas of shallow soil depth.

Water Balance on the Terrace

As may be seen on Fig. 1, dikes would be constructed about one meter high on their uphill side. When the leveling would be completed, there would be about 40 to 60 centimeters of dike freeboard. This freeboard, along with infiltration during a storm, should be sufficient to contain all but the most extreme rainfalls. Pipes would be installed near the tops of dikes to permit controlled downhill flow of any rainwater that otherwise could overtop the dikes.

There are four climatic patterns that influence rainfall across the Philippines, Fig. 2. Air streams that enter the Philippines from differing directions determine these four zones. The air streams are the Northeast Monsoon, the North Pacific Trades, the Southwest Monsoon, and the South Pacific Trades. Generally it is only the Northeast Monsoon that brings rains during the November to March period. Thus, with the exception of Mindanao, it is not coincidental that the western sides of mountains receive little or no rainfall from November to April. It may be that rainfall occurs throughout the year in Mindanao because the island is affected by the instability of the Intertropical Convergence Zone most of the year as it is near the equator.

Fig. 3 presents a prefeasibility level risk analysis that would need to be made in more detail for each area prior to development.

Cropping

The level shelf would retain a water supply adequate for dry-season cultivation of high yielding grains such as, maize, amaranth, sorghum or millet as well as providing the opportunity for cultivating high value vegetable and tree crops. The terraces would be designed to widths that would permit mechanized cultivation.

Crop selection and planting dates should be made on the basis of average and/or some dry year rainfall basis. If it is common, as in western Luzon, that an area would experience an abrupt secession of rainfall during the month of November, and knowing the probability that there would be little or no rainfall for five months, then farmers should be advised to plant drought tolerant crops. In other

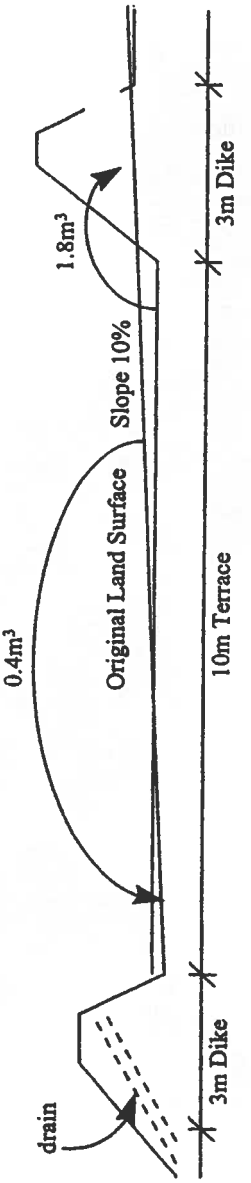

Fig. 1. Bench Terrace, 10 Percent Land Slope

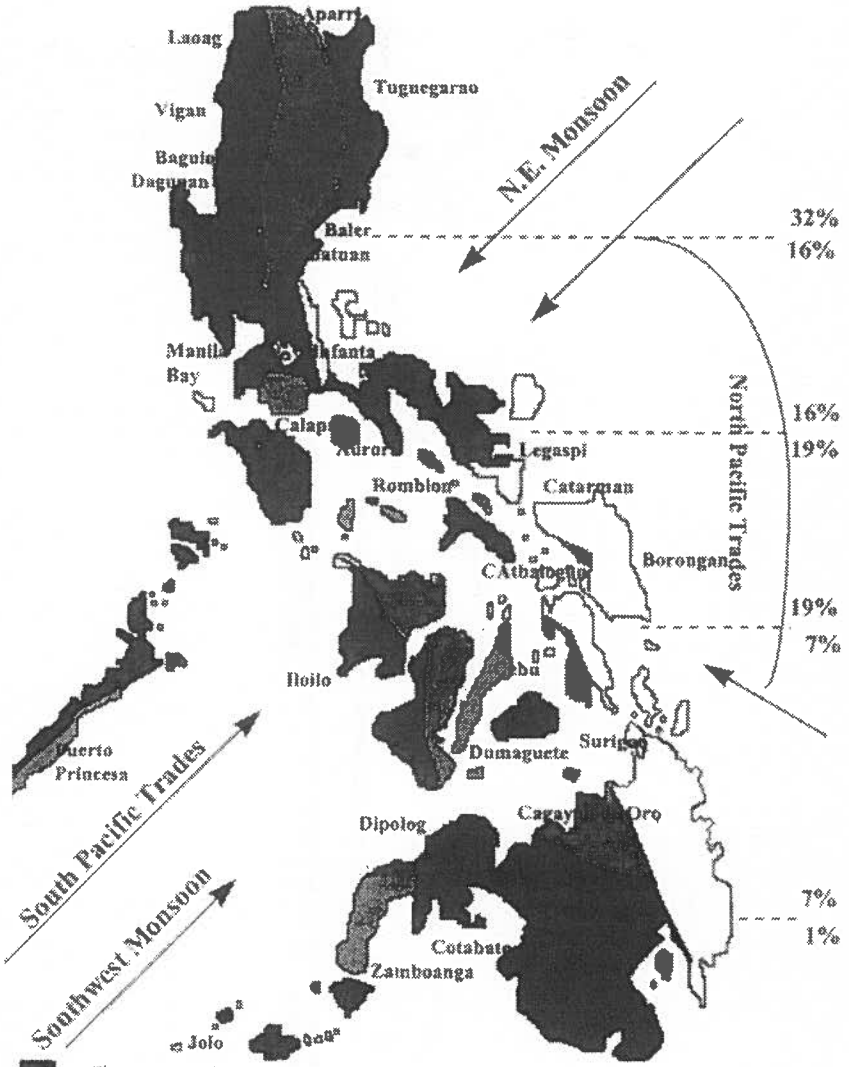

Fig. 2. Seasons of Rainfall

Data Used Rainfall record for Camp Phillips, Bukidnon, 1962 to 1989

Assumption

+Gram crops are to be planted in September or October and May or June.
+Consumptive use for corn is 400 mm over a period of 3.5 months, is 300 mm for grain sorghum or grain amaranth, and 200 mm for millet.
+If October is the month for planting and the soil moisture reservoir is nearly fall at the end of the rainy season, then rainfall of 300mm during the November, December, January period will be sufficient to water a corn crop, with only 200mm being required for grain amaranth or sorghum, and 100 mm to mature a millet crop.

Risk Test

+Inspection of the rainfall record shows that total rainfall during the May to August period is more than adequate for maturing a crop of corn during every year of the 28-year record.
+ Aggregate rainfall is shown for the October through January period, in the table below to test the viability of cropping corn into the early calendar year dry season.

ANALYSIS OF RAINFALL ADEQUACY
FOR OCTOBER THROUGH JANUARY GROWING SEASON
CampPhillips, Bukidnon

Year	October	Nov/Dec/Jan	Year	October	Nov/Dec/Jan
1962/1963		400+	1976/1977		400+
64	208	230	78		339
1964/1965		400+	79		380
66	201	224	1979/1980		400+
67		400+	81		400+
68		328	82		400+
69	166	267	83	162,	195
1969/1970		321	84		335
71		400+	1984/1985		400+
72		381	86		400+
73		400+	87		332
74		400+	88		400+
1974/1975		400+	1988/1989		400+
76		400+			

It is noted that during only one season in 28 years (1962to 1989) was rainfall marginal for a corn Crop planted in October and matured during the November through January period.
Inspection of the full monthly record also indicated that water supply would be more than adequate every year for a crop planted in May or June and matured by August or September.
Further, should farmers of Bukidnon wish to plant a grain crop during the January through April Period rainfall would be marginal I in 4 years except for millet crops.

Fig. 3. Critical Rainfall Period for Hillside Grain Production, Northern Mindanao

areas of the country, such as in Mindanao, pests permitting, two high yielding crops could be planted and there could even be scope for cultivating a third short season vegetable or fodder crop.

Implementation

Proposed was a Pilot Project with the objective of promoting a nation-wide program of treating hillside tracts ranging in area from only a few hectares to those that cover entire slopes comprised of hundreds of hectares. The four-year pilot program would realize the construction of bench terraces in some 140 areas. Areas would average 125 acres (50 hectares) each. Approximately 17,500 acres (7000 hectares) of land would be treated. The primary objective of the program would be the establishment of trained cadres of technicians at the provincial and local levels along with the mobilization of private resources. Private resources for the Pilot Project largely would be in the form of labor, whereas if entrepreneurs would be attracted to extend the program to other areas the financing should be essentially all private.

It was expected that landowners, farmers, and their cooperatives would recognize the major levels of crop output that could be obtained with modest investment required per hectare and with very modest requirements for maintenance by each cultivator. It, also, was expected that entrepreneurs would recognize the possibilities for organizing their own machinery pools and providing the mechanized service for bench terracing to farmers for a fee. Thus, a second component of private funding would be mobilized and would contribute to acceleration of bench terracing at a rate greatly in excess of that achieved by the pilot program, some 17,500 acres (7,000 hectares) over a four-year period.

It would be essential that entrepreneurs and bankers be included at one or more stages of the training and implementation cycles of the Pilot Project. It then should be relatively simple to foster triangular organizations of farmer, banker, and entrepreneur. Contracts would be drawn and would specify that the bank would reimburse the entrepreneur directly for his terracing operations upon receiving a signed certificate from the landowner. The landowner would then pay the bank at the end of each cropping season until the debt would be retired. It should be possible for the farmer to retire the full debt and interest in just a few seasons where two high-yielding crops could be cultivated.

Particularly essential to sustainability of the program at a technical assistance level and at the extension level for high crop productivity would be continuing funding and administrative support to local governments. Local government would in turn provide technical and equipment support to farmers both during construction and following, during cultivation.

Contractual Considerations

Contracts would be drawn between landowners/cooperatives and government for the Pilot Project. Thereafter contracts would be drawn among landowners/cooperatives, entrepreneurs and banks. Of prime importance to the launching of the Pilot Project would be how to create a sustainable program that eventually would realize the recovery of tens of thousands of hectares nationwide. Among considerations could be the establishment of a short grace period before farmers and cooperatives undertake amortization of the physical works. This would permit DA or LGU extension staff and the farmer to assess the productive capacity of the soils of the terraces, adjust crops and inputs, and give farmers a chance to progress from subsistence level operations to a production level that would sustain the farm family even as it would undertake repayment.

TERRACE CONSTRUCTION, PILOT PROGRAM

Approach

It was proposed that six teams with tracked vehicles would be formed to accomplish construction of terraces on about 150 hectares of hillside lands per month. Each team would be equipped with the equivalent of a Caterpillar Challenger for rapid clearance of land. Tracked D-4 and D-6 bulldozers would be used to strip and stockpile or reposition topsoil. The dozers then would work with tracked frontend loaders to cut terraces and push the soil into dikes.

Laborers equipped with portable power equipment would shape and compact the dikes to their final grade level and shape. Laborers would position drainpipes to the specified locations and elevations.

Following dike construction small tractors and the Challengers, if still at the site, would assist farmers with preparation of the benched lands for the planting of a first crop. Initially the benches may not be perfectly level, but early cultivation could be oriented to promote final leveling through erosion of unexcavated soils from the high side of a terrace

The equipment teams would be supported and supplied by a fleet of 4-wheel drive pickup trucks, passenger vans, lowboy tractor-trailers, fuel tankers, and maintenance vehicles.

Professionals and technicians would lay out the plans, prepare area maps, survey soils, and stake the sites. The plans would detail each operation in terms of the sequential use of the different machines and specify for each operator the intended paths of earth movement whether it would be uphill, downhill, or along the

contour. The objective would be to minimize the reworking of the same material several times. Stockpiling of topsoil also could be minimized, for example, by directly depositing soil stripped from a new part of a bench onto a part of the bench that already would have been diked.

Areas would be selected and dikes would be designed and sited to minimize the need to rework and improve existing drainage ways.

Implementation

At least six months would be required for training and mobilization prior to the start of programmed construction. Required would be the indoctrination of federal, provincial, and local government decision makers and the assembly of equipment for the start of training of a cadre of operators. Program planning and indoctrination and training functions likely would be carried out by a consultant organization. Staff of the consultant would include experts in bench terracing and personnel experienced with the conduct of training and coordinating with staff of local government.

Specifically, the design and execution of the four-year Pilot Project should:

1. Detail the program.
2. Mobilize the necessary equipment, training resources, and personnel.
3. Conduct a training program at the national level for professional and technical staff of the extension arm of the DA, the Bureau of Soil and Water Management (BSWM) of the DA, and the National Irrigation administration (NIA). Training of extension workers and engineers at provincial and local government levels would follow the national program. Possibly bankers and entrepreneurs would be invited as observers at this stage of preparations.
4. Select pilot areas in the several provinces, sign contracts with beneficiaries, farmers and/or cooperatives, then carry out the detailed topographic and soil surveys for specific areas. It was suggested that it would be most efficient to collect data in a form that would permit preparation of a grid layout of topographic and soils information.
5. Assist owners of land tracts, large and small, to form cooperatives for each target area. The cooperative would be dedicated to the purchase of necessary inputs and marketing. Again it could be timely to involve bankers and entrepreneurs.
6. Design the earthmoving operations to the detail of: a) the precise equipment passes that would be made, and b) the sequence of hand operations to compact and dress dikes and possibly to re-distribute topsoil that may have been stockpiled. Consider whether the area has trees (coconut or other) to be preserved. In this case there would be an

opportunity for intercropping. Entrepreneurs should be invited to the site for observing operations that they may be able to provide in the future for areas outside those of the pilot program.

7. Provide on-site extension services to farmers, guiding them through the cultivation practices that should be followed while the terraces would be brought under cultivation. Extension workers would help farmers select which of the grains would be best for growing on their soils, assess what dependable soil moisture conditions would be with a particular rainfall conservation regime, and identify marketing prospects for the produce.

Costs

Purchase of equipment, costs for four years of operations and the funding of project design and a training program would total nearly $15 million for a pilot program to develop 17,500 acres (7000 hectares). Some 20 percent of the total would be for diesel fuel and lubricants at a cost of US $0.65/liter. Also, from the perspective of economics, after four years the machines would have a salvage value of $3.5 million. Gross costs of purchases and operations would be approximately as follows in 1997/98 US dollars:

Consulting Contract and Training Components	$2,000,000
Equipment Procurement - Challenger Tractors, Bulldozers	$2,060,000
Vehicles, Tractors, Trailers, Pickups, Vans and Tools	$1,720,000
Operation Costs *	$7,660,000
Site and Office Support Personnel	$ 1,210,000
Sum	$14,650,000

* Computed in the format of the Caterpillar Performance Handbook

CONCLUSION

The draft of House Bill No. 9820 of 1997 recognized that there were vast areas of sloping land being used by hillside farmers who were existing at or below subsistence level. The bill proposed Sloping Agricultural Land Technology (SALT) be implemented nationwide over a period of three years to promote comprehensive rural development. The bench terrace program proposed herein would provide a highly specific technological component to address the concerns that motivated the original legislative proposal. The bench terrace program likely

would continue for 20 to 30 years and result in the terracing of perhaps 1,250,000 acres (500,000 hectares) before it would begin to decrease in intensity.

The following is largely a qualitative evaluation of the bench terrace technology and the proposed modality for accomplishing a pilot program. The technology should spread throughout the provinces if there were to be a vigorous extension campaign. The campaign could be conducted by the DA through the BSWM at the national level and at the farm level through the staffs of local governments.

Cost Evaluation -- The cost of a full-scale program should approximate US $800 per acre ($2,000/ha). This general level of cost should hold true for the Pilot Project of the government as well as with private entrepreneurs running the entire operation with some level of support from the Local Units of Government.

Financial Evaluation -- The most important financial effect would be the potential for involvement of landowners and entrepreneurs and the consequent mobilization of private resources.

Environmental Evaluation -- The primary environmental benefits of bench terraces would be two-fold: reduction of hillside erosion and the reduction of flooding through water conservation. As well there would be a major increase in the stock of productive lands of the Nation.

Social Evaluation -- The building of close working relationships between extension staffs of the provinces and "dry land farmers", coupled with the assumption of the need for conservation by landowners, should be the most enduring aspect of the program. Further the restoration of hillside lands to high productivity should partially arrest the migration of farm workers to urban areas.

Local Government-Landowner Partnership – Participation of administrative, legal and agricultural extension staff of the LGUs in the pilot program would do much to facilitate devolution. And, should the MDF program for funding of provincial and local governments be successfully implemented, the LGUs should have the capacity and vitality to support and sustain an aggressive program of hillside agricultural development.