

A SOIL AND WATER CONSERVATION PROJECT IN TWO SITES  
IN SOMALIA: SEVENTEEN YEARS LATER

A.I.D. PROJECT IMPACT EVALUATION REPORT NO. 62

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### FOREWORD

In October 1979 the Administrator of the Agency for International Development (AID) initiated an Agency-wide ex post evaluation system focusing on the impact of AID-funded projects. These impact evaluations are concentrated in particular substantive areas as determined by AID's most senior executives. The evaluations are to be performed largely by Agency personnel and result in a series of studies which, by virtue of their comparability in scope, will ensure cumulative findings of use to the Agency and the larger development community. This study of the impact of the Somalia Soil and Water Conservation: Ceel Bardaale and Arabsiyo project was conducted in February 1983 as part of this effort. A final evaluation report summarizes and analyzes the results of all the studies in this sector and relates them to program, policy, and design requirements.

### SUMMARY

Semiarid Somalia has a protein and fat surplus but a grain deficit. The country as a whole not only consumes per capita quantities of milk and meat that are large by international standards, but it also supplies the Arabian Peninsula with more than one-third of its live-slaughtered meat. Grain -- sorghum in most areas, maize in the south -- forms an important secondary staple for most families, including practitioners of nomadic pastoralism; also, because it can be stored, it is the primary food source during dry seasons and drought. What could be called semisubsistence cultivation of sorghum and a little maize has long been practiced in the better watered pastoral areas of the

country, such as the northwestern area bounded by Ethiopia, Djibouti, and the Gulf of Aden. However, limited and unpredictable rainfall severely limits farm productivity.

In the early 1960s, the Agency for International Development (AID) and the Somali Ministry of Agriculture and Animal Husbandry carried out a soil and water conservation project, the bunding {1} of a cultivated watershed in the northwest. The project was intended to deliver at one stroke environmental benefits -- conservation of the eroding topsoil -- and farm irrigation by arresting and concentrating the rainwater that runs off the hills during spring storms. The project aimed to demonstrate an easily replicable technology, water gathering, which could substantially increase grain production in other similar areas during years of subnormal to good rainfall, although not during drought.

Approximately half the watershed was bunded. Late in the project period a second project was added: a brief intervention at another site to demonstrate flood-irrigation techniques by building three dams in the dry riverbeds that flow only after upland rainstorms, and canals and watergates to channel the diverted floodwater to fields.

This impact evaluation was done in March 1983, 17 years after AID's participation ended. The team found that grain production on the cultivated portion of the bunded watershed effectively doubled in the early years, with no other development inputs beyond the construction of bunds. However, subsequent maintenance by individual farmers was generally spotty; 16 years later the bunds had broken down in places and had not been built up to compensate for silting behind them, which led to a decline over time in the efficacy with which they trapped runoff and prevented erosion. Even so, at the time of our assessment, bunded farms were still yielding, on average, 50 percent more grain than similar but unbunded holdings.

The demonstration impact of this project turned out to be modest. Some private farmers subsequently hired tractors to bund their own lands. The Ministry of Agriculture followed up only years later when other international donors became interested in pursuing bunding in the northwest. The project's implementation style -- use of heavy equipment instead of the earlier practice, which employed oxen teams or small-wheeled tractors for bund construction -- clearly encouraged a trend that was only embryonic at the time: substitution of mechanical for animal traction by those farmers who could afford to own or rent tractors. Further unintended impacts, these relating to the nature of the technology itself and its fit into the local context, included an increase in the proportion of maize cultivated relative to sorghum, and the abandonment of crop rotation (grain with pasture) on bunded farms.

The team concluded that ignoring the agropastoral nature of food production in this semiarid area led to several sorts of slippage from the original plan. First, the environmental focus

was ironically undercut by planners' ignoring the second farm crop -- small numbers of home-kept livestock. Planners did not consider the potential impact of permanently cultivating the best watered part of the farm and its reverse implication, perennial grazing on the rest. Second, they assumed or hoped that crop production increases would provide sufficient incentive so that farmers would maintain the bunds. However, it appears to us that even bunded small-scale farming remains an unpredictable enterprise, useful as a supplement to extended family subsistence but not worthy of serious private "investment," and that maintaining the bunds properly seemed, to these professional agropastoralists, simply too labor-expensive to be worthwhile within their overall economic context.

The flood-irrigation subproject demonstrated a viable water-conservation technology to a religious community that was developing communal farming. Here the demonstration impact was significant; without any systematic training inputs from the project, the community observed the construction and the product, and subsequently replicated the technology at four new sites. The result was cultivation of enough grain to feed themselves and, of economically greater significance to them, the ability to produce for sale an important cash crop, qaad -- a mildly stimulant drug that is widely used in East Africa and much of the Arabian Peninsula. This strategy allowed the community to create dependable cash reserves and obtain farm machinery and chemical inputs in an environment in which the individual farmer finds these latter all too often unavailable through either Government or market channels. However, the cultivation and use of qaad were outlawed by Government decree during our evaluation visit; whether this community can make an adequate living cultivating only food crops with flood irrigation remains to be seen.

Like a stereoscopic photograph, these two very different approaches to the water-gathering problem illustrate a complex of issues that come to a focus in the nature of the development relationship between the less powerful but more knowledgeable rural "beneficiaries" who wish to get along and, if possible, get ahead, and the more powerful outsiders -- government and international "development agents" who come with greater technical and financial resources and, all too often, predetermined policies and plans. We found that national and international goals were well served by the bunding project, which did and does contribute to reducing the national grain deficit. But at the local level, most of the resulting quality-of-life gains were captured by others rather than by the "beneficiaries." Conversely, national and international goals were poorly served by the flood-irrigation work, which has not contributed significantly to reducing Somalia's need to import grain, but has ensured its recipients of a degree of material security and well-being not found in the average Somalia community, as well as resources with which to continue their own development.

These results correlated, in the bunding case, with outside planning which then sought community acquiescence. By contrast,

the flood-irrigation case evinced active community intervention in seeking out assistance with planning and implementation. These behavior-result clusters also correlated with the question of whether the activity aided was of paramount or merely secondary importance in the recipients' subsistence profile.

In other words, there was a conflict between local and outsiders' priorities. Where this was resolved in favor of the recipients, with the outsiders taking a responsive, technical-assistance role, self-reliant behavior and local economic empowerment resulted, although the national and international economies were not necessarily helped. Where the conflict was resolved in favor of the outsiders, local people resisted until they had rendered the intervention safe; they subsequently remained uninvolved, although they extracted what benefits they could. "Community participation" may be a less manipulable commodity than is often supposed. In this particular case, the degree of participation (including subsequent maintenance) seems to link most directly to how important the aided activity was in the local, as opposed to the international, economic context.

It seemed to us that the local attitude, as expressed through reactions at the time of the project and subsequently, made sense. To aid small rain-fed farming in such an area, without considering possible long-term impacts on herding, is to ignore the economic, productive, and nutritional strengths of the area in favor of a weaker, secondary activity. Although pastoral production probably cannot be further intensified and farming can, we feel some doubt as to the marginal impact on the local economy, on rural food security, and on the national economic position of encouraging any large-scale conversion of pasture land to cultivation, or of further promoting unrotated grazing on already existing farms.

The scale of the AID bunding project was not so great as to create major adverse impacts on local herding. Thus, in general, it enhanced the dry-farming activity without seriously supplanting the area's economic mainstay. However, on a regionwide scale, the sort of policy most likely to lead to long-term food security is probably not a global drive to intensify and extend crop agriculture, but an eclectic one that exploits each area's profile of productive strengths and weaknesses to meet its profile of nutritional needs. Such an approach should be based on dispassionate and open-ended research, which gives rural producers voice-and-vote participation from beginning to end. It looks as though they know what they are doing.

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{1} Construction of earthen dikes used to impound surface water runoff.

## GLOSSARY

ADC	- Agricultural Development Corporation
AID	- Agency for International Development
bund	- earthen dike used to impound surface water runoff
FAO	- Food and Agriculture Organization (United Nations)
groyne	- irrigation diversion structure extending only partially across a toq
GSDR	- Government of the Somali Democratic Republic (used since 1969)
hectare (ha)	- 2.47 acres
horticulture	- cultivation of fruits, vegetables, or flowers
kilogram (kg)	- 2.204 pounds
kilometer (km)	- 0.62 miles
MOA	- Ministry of Agriculture
northwest, the	- The history of administrative division in this area is complex. When the Soil and Water Conservation Project was implemented, the relevant administrative unit was the Northern Region, comprising the entire former British Protectorate (as of this writing divided into the Awdal, North West, Togdheer, Sanaag, and Sool regions). At the time of the evaluation visit in 1983, the North West Region extended from the Ethiopian and Djibouti borders to well east of Hargeysa and included both project sites. Subsequently, however, North West was further subdivided into two administrative regions, Awdal and North West. The team has been unable to ascertain into which of the two regions the new boundary places Ceel Bardaale. Both for clarity and for accuracy, therefore, we have opted to employ the geographical term "the northwest" in all references to the area.
ONAT	- Farm Machinery and Agricultural Services Organization (acronym from the Italian)
pastoralist	- one engaged in transhumant livestock production

- qaad - Catha edulis, a woody shrub valued for the mildly stimulant properties of its leaves
- quintal (qu) - 100 kilograms
- quintal/hectare - 89.23 lbs/acre (qu/ha)
- religious community - In this report, the term refers to a group of members of one of the Muslim religious orders, living together in a settlement headed by a shiikh. Many such communities farm; indeed, the first farms in northern Somalia were established by religious communities around the beginning of this century.
- shiikh - a Muslim religious leader (often rendered in English as "sheik" or "sheikh")
- So. Sh. - Somali shilling; exchange rate at the time of the evaluation US\$1.00 = So. Sh. 15.1
- Somali Democratic - official country name since 1969 Republic
- Somali Republic - official country name, 1960-1969
- tog - intermittently flowing streambed, known in some other countries as a wadi
- transhumance - seasonal rotation of livestock between pastures
- weir - a dam across a stream to back up or divert water

#### PROJECT DATA SHEET

1. Country: Somali Democratic Republic
2. Project Title:  
Soil and Water Conservation  
Northwest Subproject
3. Project Number: 649-11-120-019
4. Project Implementation Dates: 1963-1966
5. Project Completion-Final Disbursement: June 1967
6. Project Funding:
  - a. AID \$506,000
  - b. Government of Somalia 66,000

Total                      \$572,000

7. Mode of Implementation:

Joint project between AID, as represented by technical adviser, and the Ministry of Agriculture, Division of Natural Resources

8. Project Officer: Calvin Wixom, Soils Adviser, USAID

MAP

"Agriculture continues to be a gamble in the hands of Nature."

Agriculture Extension and Farm Management Training Project, 1982

1. INTRODUCTION

Like most of the countries in the eastern Horn of Africa, Somalia depends heavily on nomadic pastoralism. Nonetheless, urbanized Somalis have often dreamed of sowing their deserts with farms and with settled people. The sentiment articulated by one policymaker in the 1980s is not a new one: "You don't THINK when you're a nomad!" he said. "You're like a warrior. If you settle down, you learn patience -- you are forced to live peacefully with others."

Somalia as a whole has been said to have the largest camel herd of any country in the world. Camels, cattle, sheep, and goats constitute a mobile food-production system well suited for exploiting a semiarid to arid environment which receives rain unpredictable in its exact timing, its quantity, and its distribution over the land. True drought, when the livestock wilt and die, is simply an extreme; vegetation, which suffers in place, suffers more frequently. However, rain-fed farming has been practiced for generations in parts of the country. Growing steadily, it has become a significant, if still fairly modest, part of total food production in the northwest. Practiced by individual families, rain-fed agriculture constitutes part of an integrated agropastoral enterprise wherein extended families combine stationary cultivation of maize and sorghum with nomadic stockraising; rain-fed agriculture could not -- here or in most of the country -- provide an adequate sole source of family subsistence.

Anxiously awaited downpours may be brief, but they are fierce. Tons of water fall on the arid hills and rush away over hard land into gullies which rage for a few hours and dry away

into a network of desiccated cracks. Farmers in the northwest have naturally dreamed of "stopping the water"; various forms of water harvesting have been practiced at least since the 1940s. Somali agriculture students overseas still light up with the notion of grasping and exploiting all that lost water. "We are always fighting with the speed," said one Somali farmer.

The first attempt to apply knowledge gleaned from small projects to stopping the water on a large scale was the Agency for International Development's (AID) Soil and Water Conservation Project, carried out in the northwest from 1963 to 1966. As the name implies, this project aimed at arresting the loss not only of runoff water but also of the topsoil it carried along, and, as a result of impounding the swift waters and letting them sink in, increasing agricultural productivity. The original design of the project was technologically so simple that the structures could have been built, maintained, and replicated with existing local technology: animal traction.

In 1983 an impact evaluation team returned to the two sites in the northwest where, 17 years earlier, the project was undertaken. During the intervening years and vagaries of national policy, the two subprojects had endured, although their present functioning and product are not entirely what was originally envisioned. Records and knowledgeable personnel, on the AID and Government sides, have largely vanished. We walked about, we observed, we inquired, we did calculations, we listened. We took oral histories from some interviewees who were clearly anxious to attract new aid to their locale, and from others who recalled the 1960s with a nostalgia that obviously colors their memories now. Everyone obligingly presented herself or himself as a "farmer," or a "nomad," or a "villager" depending on the stated interest of the intruders. Courtship and containment of strangers is often the safest policy; no one ever prodded us to think about possibly related information that fell outside our obvious purview.

The history of this project thus raises at least as many questions as it answers. It slowly became clear to us that, in an area like the northwest, farming issues are never clean of pastoral issues. In one instance we were reminded of the cattlemen and the encroaching farmers of the old American West. However, we returned to the United States convinced that few could disagree with Calvin Wixom, USAID's adviser to the Northwest Soil and Water Conservation Project, when he wrote: "Water is life. It is a great pity that most of the water which falls in this region escapes to the sea."

## 2. PROJECT SETTING AND DESCRIPTION

The first agreement for the Soil and Water Conservation Project was signed in May 1961. Somalia had been independent for less than a year. Development policy was still being articulated; the country's first Five-Year Economic Development

Plan was not published until 1963. But there already existed a very lively interest in the potential of agriculture, and the consequent settlement of nomadic people, as a means to national progress. Efforts to develop agricultural research and the germ of an extension service were concentrated in the more fertile and better watered interriverine areas of the south. However, the Ministry of Agriculture and Animal Husbandry maintained an Agricultural Department at Hargeysa, capital of the Northern Region -- a sprawling area which by 1983 had been considerably subdivided. Government wielded a lighter hand in those days. The Somali Republic, born a parliamentary democracy, did not intervene in the pricing or marketing of agricultural products or livestock, nor yet in the land tenure issues which were beginning to develop as cultivation expanded in the rangeland.

The AID project consisted of five subprojects, each addressing soil and water problems in a distinct area of Somalia. One of the designated areas lay in the northwest, where rain-fed cultivation of sorghum and maize was expanding slowly but steadily in parts of the interior plateau. Here, as in most of Somalia, the primary limiting factor in agricultural production was water. A few settled religious communities and some business-oriented individuals were irrigating using small diesel pumps, spurred by the growing urban markets for horticultural produce in Hargeysa and Djibouti. But rain-fed cultivation was highly drought sensitive, and even in good years the sporadic but intense rainstorms fell on slopes of low absorptive capacity, escaping to the sea and, in the process, causing severe (if gradual) sheet-wash erosion of the topsoil and an inexorable growth of gullies on prime agricultural land.

The northwest project proposed to build bunds, or contoured earthen dikes, to impound the runoff over one entire catchment area. Its objectives were to increase the water available to crops and thus, it was projected, double grain production on bunded land, and to arrest the erosion of topsoil and the growth of gullies. Planners chose the cultivated watershed near the town of Arabsiyo, 52 kilometers west of Hargeysa. This small catchment (about 10,000 hectares -- ha -- total) was less eroded than others in the area and had the additional advantage of proximity to an all-weather road. AID provided bulldozers, project vehicles, fuel, and maintenance; participant training in soil conservation for some Ministry personnel, as well as local training for technicians and tractor operators; and a project adviser as counterpart to the Ministry project director. The Government provided all personnel for the work, two-wheel tractors with plows, and office and storage space, and undertook to finish bunding the watershed after AID's intervention was over. The agreement also stipulated that local beneficiaries provide men, oxen, and equipment for land smoothing between the bunds, and for constructing some of the bunds themselves in the ratio of one to every three built with project machinery. This procedure had worked well in prior, smaller ventures. Also, it was agreed that local farmers would subsequently repair and maintain the bunds.

The project was explicitly intended to "demonstrate to the people within the region how good agricultural production can be achieved permanently on their farm lands of low rainfalls." Participation of local farmers in actual construction, using animal traction, was intended to encourage this demonstration effect. The overall project design also proposed to foster the creation of a national-level Soil and Water Conservation Department within the Ministry of Agriculture, to continue on a wider scale the work demonstrated in the pilot projects.

Work at the Arabsiyo Valley began in January 1963. However, many farmers resisted, some violently, the bunding of their farms; considerable renegotiation with local leaders and a change in project design, so that bunds would not cross the boundaries of individual holdings, were required before work could proceed. Due to farmers' complaints that bulldozers ran rings around their oxen teams, the requirement that they participate in construction was dropped.

Fortunately, the bunds' impact on production was immediately visible in the next growing season. In 1964 AID's project adviser reported: "The success of this project will bring other problems. Already the demand for similar bunding is growing in other parts of the Northern Region." One source of demand was Ceel Bardaale, a religious farming cooperative with a vigorous and well-connected leadership, located some 70 kilometers northwest of Arabsiyo. This unusual community had been established at its present site in 1961 on the basis of a negotiated agreement with the pastoral groups of the area. Its leader, Shiikh Maxamad Raage, and many of his original band of followers constituted one of the early, modest waves of Somali migration from the relatively hostile sociopolitical climate of Ethiopia to greater opportunity within Somalia. Influential community members, including a high official of the Ministry of Agriculture, succeeded in interesting AID in their site; a June 30, 1966 amendment to the Project Agreement added Ceel Bardaale to the project scope and work plan.

This was the other side of the coin with regard to water conservation. While the Arabsiyo subproject exploited runoff at its upland source, Ceel Bardaale lay lower on the banks of several togs, the intermittently flowing streambeds which hurry the escaping waters toward the sea. Here a flood-diversion irrigation system was installed to irrigate approximately 15 ha. Three masonry structures were constructed to divert flood waters from one major tog and two of its tributaries; some 2,600 meters of canal were built to convey the diverted water to the fields via a simple system of masonry and wood gates, drops, and turnouts. The fields were divided into roughly leveled, bunded basins with adjustable overflow gates.

This work was done at Boodhka, settlement number two of the community. A third settlement, Kawneen, was then being developed; the Shiikh and other leaders pushed hard to get project work extended to these new lands which, lying as they do on the gentler slopes near the valley floor, augured better for

future cultivation. However, even at that time the community was beginning to experience difficulty with local pastoralists who apparently found this ambitious expansion to be more than they had bargained for when they initially ceded settlement rights. Ceel Bardaale's claim to the new lands being still in some doubt, work was confined to Boodhka.

Despite this disappointment, but in line with their active approach to AID, the Ceel Bardaale group facilitated project implementation in a number of ways. A resource commitment, chiefly manual labor and storage facilities, was met to the best of the community's ability, despite the fact that in 1966 "the unusually dry season caused many people to go to the interior with their animals, who would have normally stayed and been available for intermittent labor." However, the Shiikh did "his best to maintain a labor force of 25-30 men," reported the project adviser; the work was completed in January 1967.

### 3. PROJECT IMPACTS

#### 3.1 General Considerations

The long-term impact of these projects was substantially affected by subsequent developments in the country. In 1969 a socialist government replaced the earlier parliamentary democracy, and the new Somali Democratic Republic moved toward centralized economic planning. Self-sufficiency in basic foods, particularly sorghum, sugar, and maize, became an important national goal, leading the Government to favor large- over small-scale agriculture in hope of achieving rapid production increases. Between 1975 and 1981, over 45 percent of investment in agriculture went to irrigated State farms, and agricultural research was concentrated there. Despite the recent return to emphasis on the small farmer, this policy still endures in some ways; State farms and development projects appear to continue to receive first priority in the allocation of the limited imports of chemical inputs for agriculture.

During the 1970s, the Government also increased its control over surplus production. All surplus had to be sold at Government-fixed prices to the Agricultural Development Corporation (ADC), the Government marketing monopoly. A consumer-oriented pricing policy kept producer prices unchanged throughout the 1970s, irrespective of quality and despite significant inflation. A considerable difference developed between the official price and the parallel free market price; by 1980 farmers were selling to ADC only as a last resort. Recently the role of parastatal organizations like ADC has begun declining, and for the past year free market prices for grain have prevailed.

The freeing of market prices proved too late, however, and still too little, to prevent a parallel development -- the discovery and exploitation by northwest farmers of a new cash

crop, qaad, previously supplied by import from Kenya and Ethiopia. Chewing the leaves of qaad, a mild stimulant, has represented -- for a significant and growing proportion of Somali men, and small numbers of intrepid urban women -- a ritual comparable to social drinking in some other cultures. One invites, one prepares the house as for a party, and one sits down to it for several hours. In addition to serving as the truest indigenous form of the "party," qaad sessions have in recent decades constituted the classrooms and debating forums for much of Somalia's indigenous intellectual life. The price of qaad was always high and the demand highly inelastic. Its consumption severely reduces appetite, an ironic parallel with its substitution for the cultivation of food grain by income-oriented farmers.

Five days after the team's arrival in-country, the Government outlawed the importation, production, and consumption of qaad, with the proviso that farmers would have a 2-year grace period to phase out production. One of several reasons cited was that its production had come to occupy arable lands that would be better used in food production. It seemed clear to the team that qaad cultivation had been on the rise in the northwest; fields of young qaad trees alternated with sorghum farms along the road to Arabsiyo.

The town of Arabsiyo, administrative center of the project area, now adjoins a new paved highway which, according to plan, will eventually constitute a fast link between Hargeysa, Boorame, and Djibouti. It has grown considerably since one team member visited it in the late 1960s. Affluence, northern Somali style, shows in the great variety of goods available in the many shops; the large number of comfortable, gaily-painted stone houses; and the large, lush horticulture farms, irrigated by pumping, in whose cool greenery the team met with local elders and officials. Teysa and Xidhinta, where the AID project work was done at the upper end of the Arabsiyo watershed, show no such signs of prosperity: they are small, sunbaked mud villages partly surrounded by rain-fed farms. We saw no qaad growing there.

Talks with the farmer-herders of Teysa and Xidhinta indicated that the lack of coordination and outreach of agriculture and livestock services (now under separate ministries) makes it hard for them to utilize these services. They clarified that subsistence producers would find agricultural services in particular unaffordable unless they were highly subsidized. The undependability of rain makes periodic crop failures inevitable but not predictable, even on banded lands, thus raising the effective or perceived "cost" of such inputs relative to the gain from the dryland farm. The one subsidized input available, which many farmers reported they did use, was rental tractors provided by the Farm Machinery and Agricultural Services Organization (ONAT), at a rate two-thirds of the Agency's operating cost.

According to the producers whose lands were banded by the project, impact on soil and water conservation in the early years fully lived up to project expectations. "The bunds stopped the

water!" All affirmed that grain production has substantially doubled and the gullies had "stopped." But 17 years later the results were less visible. The farmers had failed to keep their end of the bargain and, except for repairing some of the more serious breaches, had not regularly repaired nor maintained the bunds, which appeared considerably worn down and breached in many places. Nonetheless, farmers said that in most instances productivity of bunded lands was still significantly higher than that of unbunded land nearby.

Ceel Bardaale presents a sharp contrast. The two pioneering settlements of the mid-1960s have grown into a flourishing agribusiness supporting some 1,500 residents in 11 settlements at the original valley site, plus 3 more at the newer Qabri Baxar location to the north. Horticultural crops, qaad, and offtake from the community's herds constitute its cash production, while milk, ghee, sorghum, maize, and a little wheat are produced for internal consumption. Each settlement has a farm manager and assistant; together the managers constitute a production management committee for the entire community. There is also a central policy and strategy committee which functions under the vigorous leadership of the Shiikh, who remains the spiritual and temporal head of Ceel Bardaale.

Horticultural production here may be characterized as "progressive." Active efforts are made to secure inputs such as pesticides for citrus production, and they are skillfully exploited. Knowledge of proper handling, storage, and application techniques of agricultural chemicals seems widespread. Organic materials are pit-composted with manure to use as fertilizer on qaad. When it was found that manure applied directly to citrus plantings released a larval pest that destroyed the roots, a system was devised whereby the manure was added to the irrigation water, effectively distributing the nutrients while controlling the pest. Weeding and cultivation activities appear to be executed in a timely and efficient fashion. The team saw bunding being done by a community bulldozer on a member's private farm nearby. Farm managers and workers credit the Shiikh himself with being highly knowledgeable about agriculture and with introducing many of their progressive practices.

One woman, a founding member of the community, recalled the project period eloquently: "Wixom barwaaqu ahaa" (approximately, "Wixom brought abundance"). She added that the security created by the AID scheme stimulated many marriages and the beginning of truly settled community life.

Now, only one of the three major structures built at Boodhka remains intact -- a masonry diversion weir in one of the main tog's tributaries which is now totally filled with alluvial deposits, as is much of its main canal. The weir in the other tributary was breached within the past 6 years. The partial weir diversion in the large tog was damaged in the heavy rains of 1970 along with its hand-powered, mechanically controlled headgate. However, all the lesser structures that the team saw seemed

serviceable, and the scheme does continue to function, conveying flood waters to 12 of the original 15 hectares.

Community leaders indicated that their failure to maintain the project structures more completely constituted a conscious postproject decision. The Boodhka site, which was the best available to the community in 1966, lies on the steeper slopes at the edge of the valley where both togs and direct runoff from the adjacent hills flow more swiftly and carry more silt than at the newer settlements on the valley floor. Therefore, it was decided to invest capital and labor inputs horizontally in the development of new schemes, using the knowledge and techniques learned from AID's assistance.

### 3.2 Agricultural Productivity

The Arabsiyo Valley subproject was viewed locally, and indeed was originally conceptualized, as primarily a crop production scheme. The spacing of bunds and their placement on the hillsides was explicitly calculated not merely to arrest but to concentrate the runoff in order to maximize crop production on approximately one-third of the total bunded area. It is a primitive type of irrigation, water gathering, which has seen widespread application in a variety of forms for thousands of years. Thus, although approximately 5,600 ha (58 percent of the total catchment) were bunded during the project period, only some 1,270 to 1,870 ha actually realized improved yields.

Research findings and farmers' reports indicate that the projected 100 percent average increase in cereal production on that portion of the land was, in fact, achieved. Sorghum production increased, on average, from a base of 7 quintals per hectare (qu/ha) to 14 qu/ha, an enormous achievement.<sup>{1}</sup> No other developmental inputs (fertilizer, training, and so forth) accompanied the project, and it can be said with certainty that this dramatic and immediate increase was wholly due to the bunding itself.

Within the project area the typical farm was about 10 ha, of which 3 were cultivated. The annual production of such a holding would thus have increased from 21 to 42 qu, representing an increase in value at the time from \$58.80 to \$117.60. Approximately 15 qu was necessary to cover annual domestic consumption; thus, marketable surplus would have increased from 6 to 27 qu, a net gain of 21 qu. If the entire surplus were actually marketed, the average farm's cash income would increase from \$16.80 before bunding to \$75.60 after. In those days, the shilling equivalent of the increase was more than a month's salary for many schoolteachers -- a significant if not astounding addition to rural income.

Bunding also dramatically increased, originally by perhaps 50 percent, the production of stover -- the stalk and leaves remaining after the panicle, or grain head, is removed from the sorghum

plant. It would be difficult to impute a cash value to this production since it appears to have been seldom traded. Its worth lies in its nutritive value to a farmer's livestock, particularly to draft animals; the farmer's need for draft power comes at the very end of the dry season when natural pasture is scarce and of poor quality, and the nutritive requirements of a working animal are high.

However, early increases in productivity have not lasted. Over time the project-wide averages have decreased gradually, yet particular areas, farms, or even portions of farms have experienced more precipitous drops in productivity due to variations in slope, soils, the specific siting and construction of bunds, and farmers' maintenance inputs. We estimate that average grain production on bunded farms was 170 to 200 percent of preproject levels throughout the first 10 years and 140 to 170 percent during the next 10, average current yields being 140 to 160 percent. Taking overall current production as 150 percent of preproject levels and using the current price of sorghum (500 Sh. So/qu), the current value of added annual production attributable to the project falls between US\$147,000 and US\$217,000. The project clearly continues to generate significant benefits to the national economy, given the country's grain deficit.

At Ceel Bardaale, crop production targets were never specified. Planned outputs were simply an unspecified number of structures constituting a flood-irrigation system for the targeted 15 ha, and bunding in the fields as appropriate. Some pump-irrigated citrus production was already occurring at the site. However, citrus needs water on a fairly regular basis year-round; given the long dry season when togs lie empty, it could not have been intended that the AID project would simply increase or extend citrus cultivation here. Current production on this land includes one "section" of orange groves, pump-irrigated from shallow hand-dug wells in the tog's sandy floor, and three "sections" -- several hectares -- of qaad.

Thus, the Ceel Bardaale project brought new crops to the land it affected and cannot be said, in the same absolute way as at Arabsiyo, to have produced by itself a calculable production increase. But the scheme itself and the community's subsequent pattern of development both urge the conclusion that introduction of diversion irrigation did play a major enabling role in the development and exploitation of these fields. The value of AID assistance there fell in the range of US\$200,000 to US\$250,000 (1966 dollars). Seventeen years later and with minimal maintenance, the average current fiscal value of 1 year's production on the original site approximated the fixed dollar amount of the original investment. And, given the rather dramatic demonstration impact on the community's farming in general (discussed below), the above considerably understates the project's full enabling impact.

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{1} The team disputes the base production figure of 10 qu/ha given in project documents.

### 3.3 Environment

The system of bunding introduced in the Arabsiyo Valley totally arrested the loss of soil to sheet-wash erosion by capturing runoff, the water's load of topsoil being deposited behind the bunds. The impounded water eventually percolated into the soil behind the bunds, replenishing groundwater supplies and increasing soil water available to crops. Gully formation in the area virtually ceased for some years, and the intensity of flooding in the valley declined. However, with the breakdown of the bunds, gully formation is now picking up again; without reliable maintenance, a fairly demanding task, the erosion control impact is disappearing.

Of longer term significance is that bunding seems to have led farmers to abandon traditional crop-rotation systems. Grain farmers without banded land would normally cultivate about one-third of their total arable holding while the remaining area would lie fallow, available to livestock for grazing. After several years of cropping, the cultivated third would be returned to pasture, while another section would be cultivated. Such a system has a long-term positive effect on soil tilth and fertility, contributes to soil conservation, and helps control crop pest populations. Crop rotation is frequently the very basis of a sustainable agriculture, especially given limited modern inputs.

Arabsiyo farmers whose lands were banded no longer rotate crops with pasture, preferring to cultivate continuously on that third of the farm where the water is held by the bunds and the higher yields obtain. The generally deleterious effects of continuous cereal cropping have, for the most part, been counteracted or masked by the positive effects of increased water availability and the added fertility of the silt deposited by the impounded water. However, with the gradual deterioration of the bunds, these positive effects wane. The remaining two-thirds of the farmers' lands that are now continuously pastured are subject to environmental degradation, including the destruction of the most economically useful native vegetation and the increase of undesirable and unpalatable plant species. There is no indication in project documents that traditional farming practices themselves, let alone their integration with herding, were considered during planning for their possible relationship to the outcome of bunding.

However, other factors can contribute to the breakdown of traditional practices. Environmental stress is not limited to banded lands. Like many salutary traditional practices, crop rotation is effort-intensive. Plowing previously uncultivated land requires higher power and total work inputs. For example, one of the poorest farmers at Xidhinta owned only 2 unbanded hectares, regularly planting sorghum on only 0.8 ha. Although he understood the theory and practice of rotational planting, he was

unable to implement it on his own holding because of his increasing age and infirmity and the poor quality of his oxen. He could not afford to rent a tractor.

There is an overall pattern of environmental degradation in the area, which is exacerbated by the ongoing expansion of the cultivated area into lands of decreasing crop production potential which previously had been open for herding. Viewed in terms of both its intended and unintended impacts, bunding seems overall to have added to this process, increasing rather than diminishing human-induced stress on the local environment.

### 3.4 Institutional and Demonstration Impacts

The project seems to have failed, on all intended fronts but one, to achieve lasting institutional impact in support of soil and water conservation goals. The team found no evidence that establishment of a Soil and Water Conservation Department had been pursued with any central ministry during the project period.

A report by the project adviser indicates that he hoped that the project's physical accomplishments would so clearly demonstrate the potential benefits that they "might very well lead to the establishment of a Conservation Department within the local Ministry of Agriculture." They did not, and had not -- in Agriculture nor any other relevant ministry -- by the time the impact evaluation was conducted 17 years later.

The Ministry had explicitly undertaken to finish bunding the entire Arabsiyo watershed after the AID-supported portion, which covered about half the area, was completed. The equipment and locally trained project staff remained. But of four Ministry staff who received U.S.-based training in soil conservation and who were destined for assignment to the Northern Region, only one was, in fact, assigned there at all; he served as project manager and counterpart technician for the later years of the project, but was assigned elsewhere at the end of the project period. The Ministry did not continue the bunding work on its own.

The public appreciated the benefits. There is evidence that some farmers who could afford it subsequently hired tractors and had bunding done on their own. Eventually, mechanized bunding was continued in the valley with the participation first of the Food and Agriculture Organization (FAO), and currently under the auspices of the World Bank Northwest Region Agriculture Project. However, project documents make it all too clear that a grand right-and-left from one donor to another was not the sort of institutional impact the AID planners, at least, had in mind; and it seems clear that no indigenous growing point endured within the Government after the project period.

Although the Government was not greatly stimulated by the institution-building and demonstration intents of the project, portions of the northwestern public were far more so -- sometimes in unforeseen ways. At the time, animal traction was commonly

used for cultivation, and most earlier bunding projects had been done with oxen teams and with the sort of community participation in construction that was envisioned for the AID project. However, this far more ambitious undertaking with large bulldozers seems to have unintentionally but conclusively demonstrated to farmers that a far less laborious method existed. Ironically, the very attempt to match farmers with oxen against bulldozers, constructing in the ratio of 1:3, served only to stress the far greater efficiency of mechanical traction. When project planners yielded to local complaints and dropped the participation requirement, they tacitly, but at the same time loudly and clearly, confirmed the essential rationality of the farmers' views.

The farmers pressed the logic further, petitioning that project tractors be used to plow the dense subsoil left behind the bunds. Their oxen, they argued, were too weak at the end of the dry season to break it up. Project management demonstrated flexibility with tractor time in other ways, occasionally detailing bulldozers to improve stock-watering ponds in response to local requests; however, the team found no indication that the plowing request was fulfilled.

If this was a belated attempt to keep mechanization from "seeping out" beyond certain bounds and supplanting local means of traction, it failed. A German project in the late 1960s and early 1970s provided tractor time at no cost to farmers, and ONAT provided the service at a subsidized rental fee in the 1970s and 1980s. Neither has been able to approach meeting the demand. Recent studies on agricultural mechanization in the northwest have estimated that as much as 85 percent of the annually cropped area is cultivated by tractor, although our own study, limited to the Arabsiyo Valley, suggested a figure closer to 40 percent. We cannot explain the discrepancy. It is clear, however, that even more farmers would like to hire tractors, but the cost represents a constraint. Further, wealthier individuals who own their own tractors complained of the difficulty in keeping them operable, because of the lack of spare parts.

To say simply that supply creates or fuels demand, without equally recognizing the active effort on the demand side to create, interpret, and exploit supply, would be to distort the interactional or systemic nature of the relationship between local beneficiaries and outside development agents. However, it can be said that it happened to be the Northwest Soil and Water Conservation Project that, by demonstrating so clearly the labor-saving technology which tractors and bulldozers represent, facilitated the beginning of a shift from animal power to tractors for cultivation in the northwest.

Although Ceel Bardaale was almost a project afterthought, it was there that the most successful intentional transfer of technology occurred. Despite the lack of formal training inputs in this rapid intervention, the community learned flood diversion techniques from the AID-advised work at Boodhka and later deployed them successfully in the construction of new schemes,

with their own resources, at four other sites which they felt were more adaptable to diversion irrigation. "Laga bari, laga badi" ("the student outdoes the teacher"), remarked one man smugly, claiming that the community's works were better done than AID's. The extent to which this intervention took hold perhaps is suggested best by the flowering of creative experimentation that it provoked, including a complex, largely useless frosting of zigzag masonry canal at the mouth of a large reservoir, which was described by the team's awed agricultural economist as "baroque!" Despite these enthusiastic excesses, large additional areas for grain and horticultural production were successfully opened up by the more sober application of the diversion technology at the four additional sites. Here canals are regularly cleaned of silt and diversion structures are well maintained.

Although it is tempting to conclude that this intervention created its own success, a number of factors seem to have combined at Ceel Bardaale. Its progressive technical leadership predated AID and remains today. The Shiikh and several other leaders had extensive agricultural knowledge and were already attempting to apply it. One was a high Ministry of Agriculture official for a time; another, an engineer, had had bunding experience under the British in the 1950s. Descriptions of those early "pioneering" days suggest that the community was in the grip of a strong dynamic to expand to a stabler size, to solidify its claim to the land, and to utilize the agricultural experience brought from Ethiopia. One could even speculate that the vacuum left by AID's refusal to work at Kawneen was a crucial energizing factor. Finally, remarks in project documents suggest that, as is generally characteristic of religious communities in this area, Ceel Bardaale even then was somewhat more hierarchically structured than the average small community. It thus had a prior base for the somewhat complex organization which is necessary, particularly at peak periods, to maintain and operate flood-irrigation structures.

From documents and oral histories, it seems clear that the idea of flood irrigation per se was contributed not by the Ceel Bardaale group, but by the AID project adviser after he visited the site. And, although examples of diversion irrigation -- some quite sophisticated -- are known from antiquity, the team found no indication that modern efforts using adjustable control structures were known in northern Somalia prior to AID's assistance. It seems probable, therefore, that the introduction of this highly appropriate technology can be attributed to the project intervention itself, but that its success and propagation were due as much to the nature of the human system into which it was introduced as they were to the "fit" of the technology to the agricultural problem. Perhaps the most telling symptom of the achievement of an overall, resonant fit is that not only did the technology initially find a sufficiently supportive organizational nest, but it subsequently fed back into the same organization and, by its very nature and growth, encouraged in turn the further growth and diversification of an effective management hierarchy in production.

### 3.5 Income and Wealth

The farmers of Teysa and Xidhinta do not live by grain alone. Most farm families keep some milking stock at home year-round. Furthermore, our interviews confirmed earlier findings that rain-fed agriculture here is always combined with pastoral herding. Farmers, if asked, always acknowledged part ownership in livestock herds which were absent under the care of another family member. One herder who was watering camels at the Arabsiyo wells said his family also owns a farm in the area; his brother works it. He pointed out, "When one thing does badly the other may do well."

Not only does agropastoral production involve considerable integration of functions between the parts of an extended family; this man's statement also suggests the fluency with which goods, cash, and services circulate within the extended family. All these families have access to rural incomes (excluding the urban and overseas sources that many enjoy in addition) that comprise crop sales, livestock offtake for domestic and international markets, milk sales to urban populations, and occasional sales of hides. The team was unable in its brief visit to investigate the pastoral component of rural incomes, but national production statistics combined with quotations of prices for livestock on the hoof and milk drunk near its rural source suggest that sale of surplus grain probably constitutes only a modest portion of the cash income generated by family agropastoral enterprise.

In all likelihood, therefore, the actual perceived impact of the additional income created by the bunds has been relatively modest, though welcome, in the context of the larger family enterprise. According to families' reports of their deployment of cash income, part was absorbed by the developing demand for tractor rental. Certainly in the long run it is Arabsiyo town -- where no bunding was done until recently -- that visibly demonstrates affluence, and not Teysa and Xidhinta, which appear no more affluent than nearby farm communities without bundled farms. Relative location with respect to the major highway, with all the business opportunities (including grain dealership) that this represents for the Arabsiyo population, apparently has had a greater long-term impact on relative income and wealth in the area.

Within the bundled communities, project benefits have become less evenly distributed over time. This is due to physical variations between farms and to variations in farmers' maintenance inputs; there is no evidence that the project's continuing benefits have tended to be captured differentially by any one group. Indirectly, the very few individuals who own tractors have made significant gains by renting their equipment to others as the demand for mechanical traction has risen. Also, interviews suggested that those who copied the technique themselves were the wealthier farmers who were able to hire

tractors, thus reinforcing the ever-present notion that the "rich" can help themselves, but everyone else must wait for outside largesse.

The lands farmed by the Ceel Bardaale community are effectively held by the community, a quasi-legal entity, and the produce is similarly owned and sold. Those settled there are either members, or applicants for membership, or families of members who may or may not hold membership in their own right. The permanent labor force is male, although women are said to help occasionally at peak labor periods. Laborers and skilled workers receive identical benefits, as do other community members and apprentices engaged in other work activities. Cash income is not shared out to workers, nor does membership imply shareholder status. Benefits, which come in lieu of salary, include all the necessities of life: food, distributed from community stores; doles of cash for clothing, children's school supplies, and other personal purchases; living quarters; modest health services or financial support to seek medical services outside; and others.

Direct income benefits to the workers of Ceel Bardaale have thus been modest. Apparently the major material benefit gained from living and working here is adequacy and a level of year-round security in meeting material needs that is far greater than most community members would be able to achieve on their own. This security of the settlers can be attributed fairly directly to the availability of the flood-diversion technology -- in the policy context which, until recently, obtained.

Recent income figures were not made available to us, and so certain interesting questions could not even be addressed -- for instance, whether the leadership benefits disproportionately from the community's clearly substantial cash income. However, estimates for 1974, which were provided, offer certain instructive indications. In that year the community estimated annual cash income as follows: 100,000 Sh. So. offtake from communal herds; 85,750 Sh. So. from grain, fruit, vegetables, and animal fodder; and 840,000 Sh. So. from qaad. Put another way, 10 ha of qaad (all watered by flood irrigation) brought in 91 percent of the entire crop income, while 35 ha of fruit, sugarcane, vegetables, grain, and fodder together yielded only 9 percent. Including the community's livestock in the profile, herd offtake yielded 9.7 percent of the total, food crops and fodder 8.4 percent, and qaad 81.9 percent. The income proportions (and absolute values) may have adjusted themselves differently in intervening years. However, the team saw large areas planted to qaad, and it seems clear that, up to the time of our visit, a very large proportion of the community's total income was generated by qaad -- outstripping both livestock and food crops by a factor of 10 or more.

Among the visionary goals held by Ceel Bardaale's leadership since the community's inception are the following: (1) settling nomadic pastoralists, and (2) demonstrating the feasibility of the farming alternative in the semiarid Somali north. To date it seems that they have realized their goal of creating peaceful and

prosperous arid-land farmers -- who could, if necessary, even get along without the 9.7 percent of livestock income -- by "stopping the water" (in a more reliable way than does bunding), growing grain only in subsistence amounts for the membership, and depending almost entirely on qaad to provide the wherewithal both to support progressive farming operations and to provide the other necessities of life.

In the immediate future, farmers who have turned to qaad will find this major prop for their enterprise removed; the new policy calls for phasing out production over a short period. Ceel Bardaale's leadership seem committed to full observance of the new law. However, it is not now clear what alternative cash crops are technically feasible without supplemental watering. The results of community experiments with coffee production, using only rainfall and diversion irrigation, have not been promising. Groundnuts or cowpeas have not been shown to be reasonable alternatives. One can only speculate as to the ultimate outcome of the Government's efforts to eliminate qaad production, given the lack of a suitable alternative cash crop for local producers. Ten years from now, a follow-on impact assessment might find far different results at Ceel Bardaale; the farmer-herders of Tevsa and Xidhinta, who continue to depend more profoundly on livestock than on rain-fed agriculture (and, it seems, to modulate their labor and financial investments accordingly), may have the last word.

### 3.6 Impacts on Women

Women's roles here differ little from those described by rain-fed farming communities in other areas of the country. Both at Ceel Bardaale and the communities near Arabsiyo, women's role in agriculture seems, in the majority of instances, to be that of occasional laborer at peak periods in the fields, and responsibility for the home flocks of sheep, goats, and, occasionally, cattle. Given the modest overall impact of bunding on farm labor patterns at Tevsa and Xidhinta, it seems likely that only subtle changes, at most, were felt by women workers.

At Ceel Bardaale, despite a few ringing declarations of women's full participation in community labors on the farms and on the central committee, when we got down to specifics it just was not so. If anything, the team observed a more complete differentiation of work roles into traditional patterns than around Arabsiyo. This probably results from the religious thrust of community life and from the community's deliberately created pattern of "hide-and-seek settlement," the isolating impact of which is felt more by homebound women and small children than by the more mobile men and older boys.

### 3.7 Access to Health, Nutrition, and Education

The team surveyed health services, nutrition, and education in the Arabsiyo and Ceel Bardaale areas and concluded that the AID projects had had no observable direct impact on local access to these resources. The level and kind of Government health and education inputs here seemed wholly consistent with patterns in other parts of the northwest -- more correlated with a community's size and its proximity to good roads and a major urban center than with any other factor.

Nonetheless, the people of Ceel Bardaale seemed more confident of their right and access to health care for major emergencies than did others. Several stated that in case of a serious health problem their executive committee member would see that they got the necessary cash and transport. Some members are paramedics; the team had the experience -- unusual in Somalia -- of seeing settlement people consulting our local guide, a known paramedic, about illness, rather than approaching the visiting Americans to request medicine.

With regard to nutrition, despite the expansion of fruit and vegetable production in both areas (not, however, directly attributable to the AID project) there has been no significant change in farm families' tastes in food or in the composition of their diets. On occasion a farmer or laborer will eat something "off the tree" in the fields, and citrus and tomatoes are offered as snacks to urban visitors. However, despite their easy direct access to their own horticultural produce, these families and the Ceel Bardaale membership view fruits and vegetables almost exclusively as a cash crop.

Sheer quantity of basic foodstuffs is a seasonal problem in Somalia. One might have hoped that the increased grain production brought about by bunding might have helped to smooth out peaks and valleys in supply. However, families in the Arabsiyo area indicated that seasonal scarcity continues to occur; very possibly the increasing demographic pressure on this area -- not merely natural population increase, but continued in-migration from Ethiopia above and beyond that of known "refugees" -- has outpaced local productive resources and absorbed much of the grain.

At Ceel Bardaale supply seems constant and secure. The differences noted between Ceel Bardaale and other northwest communities seem to be directly due to the unusual degree of coordination and planning among the 14 distinct settlements that constitute this unique community, and to the enabling function of the community's cash flow. The latter has facilitated the partial mechanization of some agricultural work, the obtaining of agricultural inputs privately, longer term storage, and the avoidance of shortfalls. Both these factors in their turn were facilitated by the introduction of flood diversion within a receptive social and policy context.

#### 4. CONCLUSIONS

Stopping the water can work. Were it possible to compile accurate data, those two subprojects would probably evince outrageously favorable benefit/cost ratios and economic rates of return. Crop yields at Teysa and Xidhinta achieved the targeted 100 percent increase initially, and banded farms continue today to yield on average 50 percent above unbanded holdings. The average current value of 1 year's production on the Ceel Bardaale scheme approximates AID's entire investment in the site. And the continued retardation of topsoil loss over half the Arabsiyo watershed represents a significant, if unquantifiable value. On its own stated terms the project was highly successful at its sites, and it did serve as a model, in unforeseen as well as desired ways, for a few well-off individual farmers, the Ceel Bardaale community as a whole, and subsequent donor-supported projects.

By today's development standards, these projects appear quaintly skeletal. Neither depended for its functioning or continuance on the creation of any new human infrastructure for its support, and this appears to have been one of their principal strengths. The technologies put in place each fit appropriately into the social organization that already existed in each area. On the Arabsiyo watershed, the locus of responsibility was, and was allowed to remain, the individual farm family. It was, indeed, hoped that at that level new behaviors (regular maintenance of the bunds) would develop; but the technology was fundamentally self-operating, simple enough so that even if maintenance were not done the project could still succeed for a considerable period. Early project documents indicate that this possibility was foreseen and the choice was intentional. At Ceel Bardaale, AID had the somewhat unusual experience of achieving not just a mere fit, but a resonant fit: a complex technology fit into an existing community management structure sufficiently developed to operate it, which extended it to satisfy its own dynamic, and which was then stimulated by it to grow further and diversify -- a classic positive feedback loop.

The Ceel Bardaale add-on could be criticized as having been hastily, and therefore poorly, planned -- in response to persuasion or perhaps even pressure from interested, influential people. It had no training component; it did not even have an objective worthy of the name. By all standards, it was an impulse, not a plan. However, if we reverse this coin, it can equally be called an example of unusually responsive, or flexible, planning which placed a set of locally defined needs and goals above the policy agendas of outsiders, and because of that enabled not merely a public works project, as at Arabsiyo, but a genuine technology transfer, which in turn enabled local, independent development. Whatever we may think about the community's choice of cash crop (a wholly legal, if nontraditional form of import substitution during the intervening years), real development occurred here as a result of AID's intervention. In contrast, the Arabsiyo project -- essentially imposed from outside -- seems to have yielded more mixed local results and had a relatively negligible long-term impact on the lives or empowerment of its

beneficiaries. Viewed together, these two projects certainly suggest the conclusion that impact is not a one-way street, but a circular process that may be stifled by a too rigorous application of outsider-formulated policy objectives.

Training, education, or extension are often employed to bring beneficiaries to act in support of outsiders' development goals. The very notion of fixed training "packages" suggests a unidirectional interaction. Thinking along these lines, our team wondered if a training component on how to maintain bunds would have increased the likelihood that farmers would subsequently do so. However, the presence or absence of training in desired behaviors seems to evince no correlation with actual behavioral outputs in this project. Extensive training of Ministry staff -- from tractor operators to project manager -- did not lead them to finish the project. And Ceel Bardaale mastered and applied complex techniques without any real training. One leader said, "They [project staff] never intended to teach the people; they were just doing the job . . . . But they never refused to teach them either, if they were asked." The maintenance activities required on the Arabsiyo bunds were not conceptually too difficult for the farmers to figure out -- if they had wanted to.

The question arises as to why they did not "want to." We cannot answer it. However, two aspects of our findings are suggestive. First, we found labor, or effort, to be a constantly recurring theme in people's explanations of their choices in agricultural action. Farmers would agree, or even suggest, that a certain activity was perfectly logical, it would have increased production or maintained an increase, but it represented "too much work." Small farmers who can afford it, hire tractors to plow their fields more in an effort to save labor than to extend cultivation. In general it appeared to us that, at some level above subsistence, the trade-off between investing additional labor in agriculture and achieving increased crop production becomes very "expensive" in the perception of farmers who use traditional technologies.

Second, it appears to us that the agropastoral families on the Teysa and Xidhinta hills are cropping in order to diversify and supplement the family living, but not as a substitute for pastoralism. If this is so, it is not surprising that they were less energized to maintain and propagate an agricultural innovation than were those at Ceel Bardaale, which has staked its future almost completely on cultivation. The investment choices that farmers said they make with spare cash -- livestock enterprise rather than the farm except for tractor rental -- certainly suggest that the marginal rate of return from nonessential hard work may be similarly perceived: not worth it on the farm. The case of Ceel Bardaale, which has on occasion been taken as demonstrating that crop agriculture can be substituted for herding in this area, actually confirms the above point: up to now, major substitution of food crops for herding has not been shown to be a viable economic alternative.

An issue that seems never to have been fully resolved at the national policy level in Somalia is the proper relationship between crops and livestock in the national, as well as local, food-production and income profiles. The present division of government responsibility into two separate bureaucracies, with all the effects on policy and planning that it entails, constitutes a symptom rather than the cause of the problem. After all, the Northwest Soil and Water Conservation Project was negotiated, planned, and implemented under a single Ministry of Agriculture and Animal Husbandry. Nonetheless, the project failed to consider the agropastoral frame, and the result is being felt now -- particularly on the two-thirds of the banded Arabsiyo watershed that has become permanent, overgrazed pasture.

Current concern over the country's grain deficit can become dangerous if it leads planners to ignore the country's excellent position in livestock foods. Somalia is not only self-sufficient in these, but qualifies as a major exporter. Neither a national dream nor international policy pressures should induce planners to take, without careful assessment and using a long-term (20 to 50 years) perspective, any steps that could cause rain-fed agriculture to become a substitute, rather than a supplementary, economic activity in an area like the northwest. In addition to the likelihood that the marginal impact of substitution may be negative, particularly on any but prime agricultural lands, the long-term impact on an already shaky environment augurs poorly, given the present ecological trends in the farming areas.

Unfortunately, pressures in this direction already seem to exist. The loss of full access to the Ethiopian summer pastures, and the extension of cultivation within the northwest, may well be chipping away at the agropastoral alternative. Ceel Bardaale continues to experience conflict with its pastoral neighbors. If the farmer-herders of the area are, over two or three generations, forced by regionwide and international pressures to give up their hyphenated status and become only farmers, true poverty, not now a widespread phenomenon in the northwest, may become one. The value of short- and middle-term crop increases in agropastoral areas needs to be assessed, not only in terms of their immediate contribution to Somalia's grain import status, but in light of longer term considerations as well. Current plans to concentrate heavy agricultural development in the more favorably endowed south have at least the one positive implication that, if equitable countrywide grain marketing is an assured outcome, the pressure to overstress agriculture in environments like the north may be mitigated.

## 5. LESSONS LEARNED

1. Agropastoral subsistence depends more on the pastoral than on the agricultural base. Our observations and earlier findings in the northwest show that farmers cannot exist without herds, although herders can exist without farms. The interest in experimentation evidenced by exceptional communities like Ceel Bardaale and the willingness of individual farmers to seek out

labor-saving developments or high-yield cash crops certainly suggest that the subsector may be less stable and more amenable to change than is the pastoral subsector. By comparison, the latter seems more stable, mature, and resistant to experimentation. However, in the absence of a major qualitative leap in the water-gathering potential of family farming, the secondary nature of this subsector will probably continue to dominate and limit the impact of agricultural interventions in agropastoral areas.

2. Projects that aim to enhance a productive subsector with a low relative priority for producers themselves (e.g., the agro in agropastoralism) should be designed so that basic success is not dependent on substantial community inputs before, during, or after project implementation. The bunding of the Arabsiyo Valley delivered local and national economic benefits for a considerable period, even though most farmers did not consider it worthwhile to invest substantial work in maintenance. (This behavior is in sharp contrast to that of families and communities with respect to their wells and water holes.)

3. Projects that aim to enhance a weaker productive subsector should be preceded by sufficient research to ensure that the enhancement of the one will not occur at the expense of another, more valuable subsector. In the case of agricultural interventions in an agropastoral system, research questions should include (but not be limited to) such items as the potential impact on the farm family's entire nutritional profile; potential impact on the movement, browsing/grazing, and watering of pastoral herds that use the area; potential of the proposed intervention to encourage extension of the aided activity into other economic niches, and the likely impact such an effect would have on the area's overall economic wellbeing; and the like.

4. Projects that seek to enhance areal or national food security should be based on comprehensive, open-ended and dispassionate study of the entire set of nutritional resources and problems of each area, the overall productive resources and problems of each, and how these two may best be brought into congruence. This report has suggested some of the strengths and weaknesses of arid-land farming and its nutritional product. But the stronger subsector, nomadic pastoralism, also evinces weaknesses in meeting a spectrum of nutritional needs. The main ones are two: recurring seasonal scarcity, which affects nearly everyone; and, beyond that, a profile of access to livestock products that discriminates against women and young children, the most vulnerable rural groups.

The complementary strengths and weaknesses of different parts of the resource base can best be combined and enhanced by an eclectic approach to the broad issue of food security, which seeks to build on local and national strengths. Once the basic research is done, such an approach can utilize a small number of basic strategies, tailoring them in their relative emphasis according to the problems and resources of each area and allowing heaviest dependence to be placed on the strongest capacities of

each.

5. An "appropriate" rural technology fits into existing social organization rather than depending for its success on social tinkering by outsiders. The principal strengths that AID and urban professionals from the host country bring to the development relationship are specific technical capabilities and great material resources. Creating, transforming, or simply building up rural organizations to meet new needs is, in most cases, probably best left to the discretion and greater social skills of the beneficiaries themselves.

6. Local communities invest themselves according to their own, not donors', priorities. Where local priorities do not coincide reasonably closely with those of the national government and the international development movement, some trade-off will have to be made between a public-works approach, wherein "community participation" will be more or less limited to being persuaded to accept implementation of the project, and an empowering approach, which responds to urgent local expression of priorities, even if current national or international goals will not be served by the resulting project.

Arabsiyo and Ceel Bardaale contrast so sharply that they almost define this spectrum, and from them a sharply separated group of correlations can be drawn. We found that the degree of learning (not training) that occurred -- of active community participation before and during implementation, subsequent maintenance and replication of the technology provided, and resulting quality-of-life gains by beneficiaries -- was high in the case of Ceel Bardaale, which pestered AID until it got the necessary technical help, and then used the result to serve its own interests far more than those of outsiders. The converse occurred at Arabsiyo, where the initial plan was formulated by AID and the Ministry, and (undoubtedly) rubber-stamped by local leaders when they were consulted; early implementation met not even with complete acquiescence but with scattered violence, although recipients of bunding ultimately accepted and were pleased by the results. Bunding supported the nationally and internationally important goal of increased grain production, but by all indications did not greatly help its primary beneficiaries to get ahead.

The findings of our study strongly suggest that, by their long-term patterns of choice if not in explicit conversation with outsiders, rural people in northwest Somalia and perhaps in many other places are more in tune with the long-term productive and nutritive realities of their area than are the development outsiders. If this is the case, local communities should be better heeded during project planning.

7. As a step toward this goal, the current trend to cross-disciplinary baseline studies, in AID as elsewhere, should be encouraged and refined. Rural people must be brought into the research, planning, and resource-allocation processes not as subjects of inquiry, but as participants with voice and vote.

Otherwise, they have no reason to trust us with their knowledge. Such studies and planning should guide the formulation of policy rather than be directed by it.

## APPENDIX A

### EVALUATION METHODOLOGY

The evaluation team consisted of four members: the team leader and an institutional analyst, both AID/Washington staff; an agricultural economist; and an anthropologist-social analyst -- the latter two independent contractors. While in Somalia, this team availed itself of the services of local drivers and typists. Translation services were always informally available within the communities we visited. English is fairly widely spoken in northern Somalia, although not by rural people, and local English-speakers were always willing to accompany us. (The social analyst was pressed into service for translation during a few interviews.) We were well and enthusiastically assisted and supported by regional and district officials of the Ministry of Agriculture, who oriented us, saw us safely to the rural sites, and smoothed our way with local leadership. We also received all possible support from AID Mission offices in Mogadishu and Hargeysa; we are particularly grateful to the Hargeysa office for the crucial logistical support that got us out of town, and for aid and comfort on our return.

The evaluation visit was made during March and April 1983. All findings and analyses are as of that date. Actual subsequent developments that may have occurred -- for example, in the cultivation and use of qaad, which were made illegal precisely at the time of our visit -- have not been included. Therefore, all material in this report should be understood to represent the situation that obtained at the time of the evaluation visit.

The questions that the team attempted to answer can be summarized as follows:

- Did the projects' intended impacts -- increase in food production, arresting of erosion, establishment of a conservation agency -- occur? Why or why not?
- Did these benefits last? Why or why not?
- Were the results primarily attributable to AID and Somali Ministry of Agriculture intervention, or to other factors?
- What side effects or unintended impacts -- good or bad -- were created either by the doing of the projects or by their subsequent results?

Even though a 17-years-after evaluation offered the clear advantage of a longer term perspective, it also limited the availability of certain kinds of sources. Direct documentation

of the planning and implementation of the projects was mostly unavailable, as were AID or Ministry of Agriculture staff who had participated in their implementation. Before and during the field visit, the team studied available project documents as well as more general works relevant to the region, to Somali agriculture, to agropastoral production systems, and so on. Our principal sources, however, were people: donor and Government officials in Mogadishu and Hargeysa; district agriculture staff in Gebiley; the township leaders of Arabsiyo; and of course, the leaders and the led, the women, men, and children, the elderly and the young, of Teysa, Xidhinta, and Ceel Bardaale.

The team spent 4 days in the Arabsiyo Valley and 4 days at Ceel Bardaale. In each area, team members functioned in an interdisciplinary mode during first-stage group interviews with local government people, community leaders, and farmers. Such open-ended group interviews served to direct and refine subsequent research and to identify particular individuals as potentially valuable sources of additional information for each team member according to his or her specialization. Second-stage individual interviews also reached respondent categories such as women, teachers, and health workers, who were seldom encountered in the group meetings. The team normally met at the end of each day of interviews, to exchange information gleaned separately and to work on developing a consensus on the significance and utility of the information obtained.

The team attempted to work from interview protocols, but this proved both impractical and unnecessary: impractical, because team members were too exhausted after strenuous days of fieldwork -- which involved many hours of walking and intense talking under a very hot sun -- to compose questions which, all too often, proved not to take advantage of the emergent information in each encounter; and unnecessary, because after the initial contacts had been made and the research directions defined, the team members supported each other in filling gaps during group interviews. In the case of individual interviews, the evening feedback sessions filled in many vacancies. Finally, informality and spontaneity on our part generated the richest fund of "incidental information," that is, spontaneously provided information, as opposed to responses to direct questions. For elucidating patterns of cultural practice, evaluative generalizations, and the like, "incidental" data usually proved more trustworthy -- more internally consistent and more consistent with other observations -- than "direct" data.

Our stress on open-ended interviewing and observation of patterns led us at Ceel Bardaale to take several oral histories from the elderly founding members which complemented discussions of current goals and practices and the "official" history of the project. The histories were particularly useful in providing essential understanding of the nature of the community at the time of the AID intervention. Casual indirect surveys, visual observation, and lending an attentive ear to spontaneous comment provided the most accurate data in both areas on women's roles, nutritional practices, and the like. In the Arabsiyo Valley, the

team surveyed, informally but fairly widely, such matters as average farm size, crops grown, cultivation methods, and the existence or not of other, complementary income sources (the latter usually elicited by indirect means). A control group of nonmembers was used for the Ceel Bardaale fieldwork, but time did not permit establishing a nonproject control for Arabsiyo.

Before, between, and after the field visits the team continued discussion in Hargeysa with Ministry of Agriculture staff, other regional officials, and staff of the World Bank's Northwest Regional Agriculture Development Project. A temporary lack of air transport kept us longer in Hargeysa than originally planned, providing an unintended group retreat in which we worked out a consensus on findings and lessons learned, and began writing a draft.

The draft generated in Hargeysa and Mogadishu was written in sections by the individual team members, and later revised by one team member, Abby Thomas. The agricultural economist, Stephen Londner, currently overseas on assignment, was unavailable for consultation during this process; he in particular should not be held ultimately responsible for errors or distortions that may have been introduced into his work without his knowledge.

In the spring of 1983 the rains were late. (Astrologers in the Ceel Bardaale area remarked that this was especially worrisome because 1984 was almost certain to be a drought year -- a prediction since confirmed.) Our visit thus did not allow us the opportunity to see the bunds and floodwater irrigation structures at work. However, the day before we left, heavy rains fell around Hargeysa; the team was at least able to marvel at the thousands of tons of roaring, foaming water in the Hargeysa tog, rich with lost topsoil, on its way to the coast. Some small fraction of it, we knew, was being tapped at the project sites.

## APPENDIX B

### GENERAL AGRICULTURAL BACKGROUND

by Steven Londner

The Somali Democratic Republic, or Somalia, is located at the tip of the horn of northeastern Africa, between latitudes 11o 30' N and 1o 30' S. Its more than 3,300 kilometers of coastline and its borders with Djibouti, Ethiopia, and Kenya enclose a surface area of some 63.0 million hectares shaped rather like a number "7." It is predominantly a land of plateaus, broken by mountain ranges in the north and a broad coastal plain in the south, populated by an estimated 5 million people<sup>1</sup> and some 30 million domestic animals.

The climate varies somewhat throughout the country but may be simply characterized as semiarid. The major rains begin in March or April and continue through early June; the more variable lesser rains can fall in different areas anywhere between July

and December. Rainfall is erratic, undependable, and characterized by highly localized, intense storms. Therefore, despite average rainfall statistics that appear relatively favorable, the annual variation tends to make rain-fed agriculture a high-risk undertaking (see Tables B-1 and B-2).

Somalia is among the least developed and poorest countries in Africa. Since gaining independence in 1960, its general lack of infrastructure has hampered development efforts. The former British and Italian colonials focused their interests selectively; in the north, the British largely ignored the interior of the country, their principal aims being geopolitical control and the supply of livestock products to their garrison in Aden.

Current development efforts continue to be hampered by this colonial legacy. In addition, the country has difficulty in maintaining its scarce supply of technical and managerial expertise, finding it hard to compete effectively for these crucial resources in a local market that includes the wealthy Gulf states and Saudi Arabia.

The agricultural sector dominates the Somali economy, accounting for more than 60 percent of the gross domestic product (GDP) and virtually all exports. Live animals and animal products constitute more than 85 percent of the value of these exports (other exported commodities include bananas and incense), almost all of which are purchased by Saudi Arabia. The agricultural sector provides employment for about 80 percent of the nation's labor force; livestock husbandry is the primary occupation.

Table B-1. Somalia Northwest Region Rainfall Data  
(in millimeters)

(To see this table, please order the paper copy of  
Document Number PN-AAL-064)

Table B-2. Hargeysa, Somalia Temperature Data  
(in centigrade)

(To see this table, please order the paper copy of  
Document Number PN-AAL-064)

It has been estimated that as many as 60 percent of Somalia's people practice some form of nomadic pastoralism adapted to this rather harsh and unpredictable environment. The major determinants of their seasonal movements include the availability of water for both herders and livestock, pasture, disease and insect pests, and salt. With the onset of the gu or major rains, pastoralists disperse widely, not infrequently across international boundaries, to take advantage of pastures that at other times of the year are unusable because of a lack of water. The Somali are primarily viewed as, and consider themselves to be, camel herders, but in fact the number of camels in Somalia is

almost equaled by the number of cattle and far surpassed by the numbers of both sheep and goats. Yet the camel's value both to the herder and to the national economy argues its preeminence. Relatively few Somali farmers are actively engaged in the monetized economy; agricultural production, particularly crop production, is primarily subsistence oriented.

The northwest, in spite of its containing some of northern Somalia's finest agricultural land, is unable to provide for even its own grain needs. Of an estimated annual consumption of 70,000 metric tons, only some 30,000 are produced locally.

Many farmers, however, do produce in excess of their immediate needs, selling their surplus grain to middlemen or -women who then store and/or wholesale the grain to local merchants in towns and villages. Local market prices are said to fluctuate dramatically on an almost daily basis, with no clear seasonal trends. Farm gate prices are not particularly volatile; apparently the middlemen control the prices to an extent and realize most of the benefits of the price differentials.

The Agricultural Development Corporation (ADC) was established as a parastatal organization attached to the Ministry of Agriculture in 1971 to assume responsibility for standardizing and stabilizing grain marketing channels and prices and to build reserve stocks. For perhaps the first 5 years of its operation it achieved some success, although it never totally superseded private marketing channels. Over time, however, its consumer-oriented price policy resulted in the failure of its procurement price to keep pace with the rising parallel private market price -- in recent times at variance by several hundred percent -- which led to increased slippage. Nowadays, the ADC is not a significant factor in the local grain market.

The ADC has shared with the Ministry of Agriculture and later with the Farm Machinery and Agricultural Services Organization, which grew out of the ADC, responsibility for technical and informational (extension) inputs to agriculture. Loci of specific responsibilities for specific services have shifted over time both formally and informally. These movements, combined with foreign exchange and workforce deficiencies, have resulted in the erratic and undependable supply of type, quality, and quantity of agricultural inputs, particularly to the private farming sector.

This situation has had a far more deleterious impact on the irrigated than the rain-fed agricultural subsector. The higher value of irrigated horticultural crops; the fact that the production is more market oriented; and the unpredictable, and therefore high-risk, nature of rain-fed farming all argue for greater investment, in chemical as well as labor inputs, in irrigated production.

However, private farmers without irrigation contacted at both Arabsiyo and Ceel Bardaale indicated that they believed that they could benefit by hiring additional labor inputs, particularly for

weeding. They are constrained from doing so, they said, by a lack of cash. Both traditional and "modern" credit sources continue to be unavailable to them for this purpose. In our discussions we learned that the only agricultural credit program even potentially available to the vast majority had been a short-lived agricultural input credit scheme by the ADC in the 1970s, which reportedly failed quickly because of a very high default rate.

It would not be overly dramatic to say that agriculture in Somalia is at a critical juncture. In addition to an absence of agricultural extension or credit, agricultural research -- particularly appropriate applied research designed with regard to local social, economic, and agronomic conditions -- is lacking in Somalia, as it is in so many countries. That this sad state of affairs is so common should in no way be allowed to vitiate arguments and specific programs advanced to rectify the situation. There is a dire need for this research. Although current efforts being made in Somalia to revitalize agricultural extension services are laudable, more attention should be focused on programs that will generate appropriate content for the messages to be extended.

This effort can only be based on a firmer understanding of the current agricultural system and its dynamics. For example, one of the major long-term impacts of bunding -- its effects on crop rotation -- has been discussed in the body of this report. It also appears that bunding as an agricultural technique has led to a relative increase in maize production both as a portion of total cereal production and in total area planted. Maize, not an important staple food in the north, has traditionally accounted for a small portion of total cereal production in the northwest -- on the order of 5 to 15 percent. It has normally been cultivated as a catch crop, that is, an insurance crop seeded after the usual sowing time for the principal crop (in this case, sorghum). Its shorter maturation time, 110-140 days versus 140-170 days for sorghum, permits it to be sown late and yet make good use of the limited rains at crucial times in its growth cycle. Maize is less drought resistant than sorghum and responds well to the improved moisture conditions created by bunds. Many factors might account for a farmer needing to sow a catch crop: illness, lack of timely draft power for cultivation, late onset of rains, early torrential rains washing out the initial seeding, and so forth. Certainly there are other agricultural situations and trends as yet unknown to Somali agricultural researchers that may be of much greater significance and should form the basis for further study.

However, for this research to be both appropriate and effective, it must be guided by, and at the same time contribute to, the intelligent formation of agricultural policies. Simple demographic projections of anticipated population growth in Somalia over the next 20 years indicate that the sector likely to experience the greatest absolute growth in this period is rain-fed agriculture. This anticipated expansion will come at a very high cost to the livestock sector unless major initiatives

to mitigate the potential conflict are taken by the Government.

Although there is no general quick fix waiting to be discovered or implemented, there are certain actions that might now be reasonably considered to assist northern Somalia in reducing its grain deficit in the short run. Many factors contribute to the current low cereal yields; among the more prominent and easily addressed are the following:

1. Broadcast sowing, which leads to highly variable plant populations and densities. Drilling seeds in holes in rows could stabilize densities, facilitate weed control, and increase the efficiency of water use for crops.
2. Covered smut disease (*Sphacilotheca sorghi*), which causes an average 15- to 20-percent preharvest sorghum grain loss (and occasionally serious postharvest maize grain losses). A simple on-farm treatment of sorghum seed before sowing could almost eliminate the problem.
3. Losses of standing sorghum grain to birds, known to be high, although no reliable estimates exist. Dwarf varieties, adapted to local agronomic conditions and palates, would be much more resistant to predation and would prove more resistant to lodging, a locally serious problem due to high winds.
4. Improper tillage practices, due particularly to the lack of appropriate tractor-drawn implements for cultivation and seed-bed preparation. Plowing with mouldboard plows and the use of harrows would produce better results and retard plow-pan formation. Improved implements for animal traction should also be considered.

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{1} 1980 GSDR estimate, excluding refugees.

## APPENDIX C

### TECHNICAL PROJECT HISTORY

by Steven Londner

The AID-assisted Soil and Water Conservation Project in northwestern Somalia was based on related, although limited, earlier efforts by the British in the area. The following passage describes these efforts:

During the years after the second world war up to 1953, many techniques developed in other countries were tried [in northern Somalia]. These included grass steps, broad-based terraces, lines of stones or contour stone walls and a simple basin lister drawn by a pair of

oxen. These systems, in the main, held the soil, but they did not hold enough water to make any appreciable difference to the yield. They were not popular, and there were technical weaknesses in each. Even in the lightest rain some run-off took place, and much water was lost. In this country it is necessary to hold as much as possible of available water.

In the late 1940s a number of so-called Yemeni farms were built for the Department of Yemeni Arabs. Such a farm collected water from a small wadi or gully into a fairly level field completely boxed in with strong earth banks. In later versions, overflows were made to work without attention. The system could not be adopted generally for many reasons; water from even the smallest wadi is difficult to control without masonry; flood risks are considerable; and the water carries much suspended matter resulting in high maintenance costs.

A system had to be devised which was not dependent upon wadis and gullies, but which was calculated to prevent their growth and to make maximum use of available water. The good results obtained with Yemeni farms indicated that some form of earth bank would be required. . . .

. . . The practice which has been developed and which is rapidly coming into general use consists essentially of a series of low earth banks, designed to collect and hold as much water as possible, while allowing large storms to pass by with least possible damage. Banks may be up to 120 yards long, and there are usually 3-4 banks to a 5-acre farm.

. . . The essential part of the system is an earth bank built on the contour to a height of 3 feet before settling. So that as much water as possible is held, each bank is turned uphill at its end for a vertical distance of 0.75 feet above the basal contour; this means that the arms are carried to within about 10 yards of the contour of the next higher bank, and there is no complete boxing-up effect.<sup>1</sup>

By 1954 a bunding hire service with 20 oxen teams and scraper boards had been established; each team was capable of producing 20 meters of completed bund daily. It met with limited interest, however, and the Government altered its program to provide one team free of charge to work alongside a farmer's own team for the purpose of bunding. The Government also produced the scraper boards and sold them at cost to participating farmers. This program commanded greater farmer interest and participation but faced certain inherent problems; a concentration of draft oxen in any one area overtaxed the region's generally poor grazing and water resources.

In response, a new approach was developed wherein the Government, using wheeled tractors, built two bunds on a farmer's land for each one the farmer built alone using oxen. This program was well accepted and generated high demand. The turmoil of independence probably interrupted its operation; the USAID project, as first designed in 1961, was a reasonable extension of it.

USAID proposed to carry on the "self-help" bunding approach using small (75 horsepower) crawler-type tractors, or bulldozers, in place of wheeled tractors, to construct three bunds for each one the farmer built. However, the bulldozers, able to build 300 meters of bund per day, proved so superior to the wheeled tractors that the farmers were unwilling to expend their energies as they had before. As a result, their anticipated work contribution to the bunding operation was dropped. Instead, they were expected to assume responsibility for ongoing maintenance -- a task that by default had always been theirs alone.

A further innovation introduced by the AID project was that, at least originally, its planning and implementation were undertaken on a catchment, or watershed, basis, striving for technical precision:

Bunding under this project was started at the upper end of the watershed at the beginning of the uppermost gully, between the villages of Hidinta and Taisa. The

1R.N. Green, "A Technique of Using Earth Banks for Soil and Water Conservation in the Northern Region of the Somali Republic," quoted in C. Wixom, Arabsiyo Soil and Water Conservation Project First Annual Report, Calendar Year 1963 (Hargeysa: USAID/ Somalia, 1964).

plan of progression calls for coverage of the upper reaches of the catchment area first, each small drainage in its turn, then construction proceeding north towards Arabsiyo, taking in side branches enroute.

. . . [A] complete plan of coverage of the catchment area is planned which disregards property lines and present land use.{2}

The plan called for a series of bunds down both sides of every existing gully to serve as protection to the gullies' steep sides. On the gentle, gradual slopes leading to the valley bottom, bunds were to be installed in groups of three. Within each of these groups the lowest bund was to be 180 meters long, the next 150 meters, and the uppermost 110 meters. This arrangement was intended to ensure that any surplus water escaping from one bund would be captured by the next. As construction would have progressed, the lower groups of three bunds would have been situated in such a way as to capture any

water escaping from bunds above them as well as to cover the gaps between the upper groups (see Map No. 3, Appendix D). The team was unable to determine how much these plans were in fact compromised to contend with the necessary modification of heeding existing farm boundaries in bund layout and construction.

The bunds themselves were built by straight bulldozer action. Soil was obtained from the back (downhill) side of the bund, for three reasons. First, it was hoped to leave the productive topsoil above the bund undisturbed; second, removing topsoil from above would have created an unnatural depression which would have perhaps stored too much water and led to crop death; and finally, earth removed from below the bund would tend to level the area rather than add to the existing slope of the land.

The horizontal spacing of the bunds was determined by vertical intervals rather than by horizontal measurement. The desired vertical interval was 0.6 meters; thus, on slopes of 1 percent the bunds averaged 60 meters apart, on 2-percent slopes 30 meters apart, and so forth. In the course of the project some 2,800 bunds totaling 380 km in length were constructed.

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{2} C. Wixom, First Annual Report.

## APPENDIX D

### MAPS

Map 1. Northwest Region  
(drafted by Steven Londner)

Map 2. Ceel Bardaale Diversion Scheme  
(drafted by Steven Londner)

Map 3. Arabsiyo Soil and Water Conservation Project  
(taken from Wixom's annual reports)

## APPENDIX E

### PHOTOGRAPHS

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