ENVIRONMENTAL IMPACT ASSESSMENT

UPPER DIDESA REPORT

United States Agency for International Development

Ministry of Agriculture
Ethiopian Provisional Military Government

May, 1976

TIPPETTS-ABBETT-McCARTHY-STRATTON

ETHIOPIA

TABLE OF CONTENTS

Table of Contents (Cont'd)

Table of Contents (Cont'd)

FIGURES

I. Description of the Project: Background Information

A. Reasons for the Project

1. Background

In response to accelerating population pressure in the highlands, the Planning and Programming Department of the Ministry of Agriculture (PPD/MOA) in 1972 directed an interministerial effort in carrying out a reconnaissance survey of the Southwest Region of Ethiopia to identify potential project developments. The purpose of this survey was to locate underdeveloped and largly unsettled areas whose apparent technical and economic potential deserved more attention in the Government's resettlement and agricultural development programs. Criteria for selection were areas that would offer attractive agricultural and livestock benefits and, at the same time, provide large tracts of Government-owned lands for settlement of indigenous groups and resettlement of peasant farmers from the overcrowded highlands. As a result of the 1972 reconnaissance survey, several areas in the Southwest Region were identified for more detailed study.

In 1973, the Government of Ethiopia requested USAID participation in a two-phase study of five areas selected from those identified. USAID, in 1974, contracted with Tippetts-Abbett-McCarthy-Stratton (TAMS) to carry out the study. The Phase I pre-feasibility survey of four areas (the fifth area deleted by the Interministerial Committee with USAID concurrence during the first week of Phase I activities) was completed in August, 1974, upon submission of "Prefeasibility Report, Phase I Southwest Development, USAID and GOE," August, 1974.

The Interministerial Committee accepted the Prefeasibility Report in September, 1974, and the GOE requested USAID to provide continuing support for Phase II activities which comprised in-depth studies of the two recommended project sites, the Upper Didesa and Gambela. Mobilization for Phase II work was initiated in December, 1974.

As a result of the TAMS Phase II report, as amended, the GOE requested that a project be initiated in the Upper Didesa Valley that would establish a comprehensive model from which tested hypotheses about settl-

ment could be replicated in other areas of Ethiopia.

2. Project Goal

The primary project goal is two-fold:

1) to settle up to 6,800 landless farmers, and farmers from overcrowded highlands into seventeen peasant associations within a selected net area of 17,000 hectares in the Upper Didesa River Valley, thereby enabling them to:

a. enjoy a higher quality of life;

b. make the transition from a subsistence level to the cash economy with incomes well above the national average for small farmers in Ethiopia;

c. participate in social and political decision-making at the basic, or "grass roots" level of Ethiopian Government, and

2) to increase agricultural production from its present level of less than 250 tons per year (less than two percent of the Project Area is now under cultivation) to over 39,000 tons of grains and pulses annually.

A sub-goal is to find the best means of opening up new lands for settlement of large numbers of rural poor.

Among the potential opportunities for advancing agricultural development and promoting the goals cited above; is the opening of unpopulated or under-populated, but fertile, lowland areas for settlement and crop and livestock development. Utilization of new settler areas with development potential will serve as a means to increase domestic food production and distribute land and farm income more equitably. Settlement in new areas will also help alleviate population pressure to some extent in a few of the overcrowded highland regions of Ethiopia and provide new employment opportunities. The purpose of the Project supports the goals cited above through the initiation of planned settlement and congruent agricultural development in a potentially productive, lightly populated lowland area.

The Project is viewed by GOE and USAID as a "test case" for settlement projects in low lying rainfed areas. If the project proves the possibility of low-cost operations, vast areas of land will be made available. Successful implementation of the Didesa Project would have a decisive effect on GOE's rural development strategy in the coming decades.

B. Project Activities and Features

1. Recommended Land Use

The Project Area comprises virtually unsettled and uncultivated land which offers opportunities to devise optimum farm models based on more advanced practices than presently used. The proposed land use for the Project is as follows:

	Agricultural Land (Ha.)	Project Farm and Non-Agricultural Land (Ha.)
Farming - red-brown soils	17,000	-----
Black Soils [1/]	8,000	-----
Grazing and Forest	------	7,300
Major Settlements, Project Farm and Infrastructure	------	2,000
TOTALS	25,000	9,300

2. Proposed Settlement Program

Settlement plans were designed within the context of Government objectives and were based on, and related to, ecological conditions, in particular the soil characteristics, in the Project Area. The following schedules of settlement and land development are proposed for the 17,000 hectares of red/brown soils:

1/ Deferred for future utilization based on experimentation and experience gained during the initial years of project implementation.

Project Year	Red/Brown Soils	
	Settlers	Hectares
1	2,000	5,000
2	2,400	6,000
3	2,400	6,000
TOTAL	6,800	17,000

The first 2,000 settlers would actually start arriving on site during the last quarter of Year Zero, the Year Two settlers during the last quarter of Year One, etc.

No serious problems are anticipated in finding sufficient settlers for the Project. In general, present residents of the valley and those with valid traditional claims would be given priorities relocating to the newly formed peasant associations. New settlers would be recruited from among the large pool of landless farmers and laborers in the Jima area, and from among families in overcrowded highland areas in the Southwest region. Project development activities, including road construction, tsetse fly control, and clearance and operation of the Project testing, demonstration and seed multiplication farm, would all be labor-intensive and, thereby, afford sufficient opportunities to meet a large part of family requirements until first harvest.

If the Project purpose is to be accomplished, it is necessary that the following conditions should exist by the end of Year Four. By this time, 6,800 peasants would have been settled on 17,000 hectares of land and would be involved in viable, self-sustaining agricultural production increasing their net per capita income to about E$400. Settlement would have been possible due to control of human and animal diseases which now tend to make much of the area uninhabitable. Surplus production would be able to reach the markets via the upgraded and newly constructed road system which connects the Project Area to all weather roads. For the agricultural production

to have reached its expected level, it is also necessary that peasant associations would have been established and be functioning as organizations through which public services can be supplied.

It is reasonable to assume that the following conditions, outside of the influence of the Project, would prevail:

1) The indigenous groups and highland farmers will have responded favorably to inducements to settle in the new area;

2) Those who have settled will have been able to resolve the sociological differences resulting from the mixing of various tribal groups; and

3) Much of the burden for continuing the project will have been taken from the Land Settlement Authority (LSA) due to the effectiveness of this organization in coordinating with outside agencies to work in the Upper Didesa Region.

3. Agricultural Development Plan

As was discussed in A2, above, the Project is to settle 6,800 peasant farmers in peasant association units of 400 households each (1,000 hectares per association) over a three-year period. Two hundred hectares would be for villages, rural center, home gardens, community grazing and rural center. The remaining 800 hectares would comprise the production farming area.

The simplified cropping pattern selected for farming in each peasant association area is:

Maize - 400 hectares;

Sorghum - 400 hectares;

Chickpeas - 400 hectares interplanted with maturing maize.

Yields are assumed to build up to full production over a period of three years in each peasant association.

Direct production costs include seedbed preparation (by Project custom machine services on 400 hectares in peasant association model

Year One); seed; fertilizer, spray chemicals; bags; and input and output hauling. Indirect costs include animal health service provided by the Project and repair and maintenance of farm equipment.

The principal investment expenditures to be made by the farmers would be for housing and storage; oxen and cattle; oxen implements; sprayers; and hand tools.

Land would be allocated on the basis of peasant associations. As noted earlier, each peasant association would have within its boundaries a total of 1,000 net hectares of arable red/brown soils, on the average. The total geographic area assigned to each peasant association would vary depending on non-arable lands and black soils unavoidably included to obtain the above net hectarage of red/brown soils.

Inputs to be supplied to peasant associations by the Project organization, in order to meet the production levels anticipated, would include direct production items (seed, fertilizer, insecticides); feed allowance to carry to first harvest; hand tools; oxen implements; bags; and back pack sprayer. Livestock inputs are discussed in 4), below. For the entire life of each peasant association, direct production items would be supplied on short-term credit (in-kind production loans). Food allowances would be supplied on credit and repaid after first harvest. The first contingent of hand tools would be supplied on credit and repaid within fourteen months. All other items would be supplied and paid for from harvest proceeds. Production inputs would be hauled to each peasant association by the Project organization for distribution within the cooperative farming areas.

Peasant association production farming areas would be surveyed and boundaries staked out by the Project organization. Clearing of these farming areas would be by hand on a cooperative basis by each peasant association. With technical assistance from the Project and through utilization of the extension services provided to the peasant associations, soil conservation measures, such as contour plowing and terracing where required, would

be observed. In the first year, seedbed preparation of one half (400 hectares) of each association's production farming area would be prepared by Project machinery pool mechanized equipment as discussed later. Thereafter, all seedbeds would be prepared utilizing oxen power. All other operations, including fertilizing, planting, weeding, harvesting, threshing, and bagging would be done by hand.

4. Livestock and Animal Health Services

Early in the second year of its participation in the project, each peasant association would acquire 270 oxen (135 teams) for which it would receive two-year term credit, and during its third year of participation it is anticipated that each association would acquire an average of roughly 200 head of cattle (192 cows and 8 bulls) with its own resources. Livestock are readily available for acquisition in the proximity of the Project Area.

It is anticipated that each peasant association would build up its cattle herd to an average size of about 1,500 by Year Six of its participation in the Project. The composition of the average herd, which would be maintained through sales commencing in Year Seven, would be roughly as follows: 270 oxen; 400 cows; 200 three-year olds; 400 two-year olds, and 230 one-year olds.

During the first year of settlement by each peasant association one half of their land will be plowed by tractors from the machinery pool (discussed later); thereafter, all 800 hectares of each peasant association's production cropping land will be worked by oxen.

The infrastructure proposed to be provided for livestock would comprise three livestock health facilities (two provided in the four-year project implementation period) strategically located through the Project Area.

The first livestock health unit would be completed and staffed by the beginning of Year Two. The second livestock health unit would be in place by May of Year Four, with the third unit available in Year Eight.

It is not practical, at this time, to quantify with any degree of accuracy the number of inoculations, dips and treatments required each year. Facilities provided are based on expected animal population and would be modified as required during Project implementation.

5. Project Farm

Key elements of support to the settlers would come from the proposed Project testing, demonstration and seed multiplication farm. Expert technical direction and advice would emanate therefrom in such areas as management, engineering, agronomy, and entomology. Results of Institute of Agricultural Research experimentation elsewhere would be tested under local ecological and climatological conditions. Improved oxen-powered farming methods would be demonstrated; seed varieties found to be adapted would be multiplied and distributed; and area would be provided for training extension agents so that all settlers could benefit from the farm's activities.

The Project Farm, covering an area of about 800 hectares, would be established in Year One. During Project Year Two, farm development would still be going on with the initiation of crop trials. Year Three should see the farm well developed and conducting a wide range of adaptive trials along with the first seed multiplication efforts.

The Project Farm would be managed and operated by personnel provided by the Ministry of Agriculture and Forestry under agreement with the Land Settlement Authority. All operations would be under the direction of the Project Director. The primary roles of the Project Farm would be:

1) seed trials;
2) demonstrations;
3) seed multiplication;
4) development of improved cultural methods, including the deferred black soils;
5) grazing trials;
6) nursery trials; and
7) extension agent initial and follow-up training.

Clearing of the farm area would be carried out by hand on a labor-intensive basis in conjunction with the tsetse fly control program described later.

Seed multiplication would be effected by fully-mechanized means. Demonstrations of improved cultural methods would require oxen and oxen implements improved and developed through experimentation. Special attention would be paid to developing methods whereby the deferred black soils could be made productive through oxen-power seed-bed preparation.

Housing and other buildings would be constructed under Project supervision utilizing locally-hired skilled and unskilled labor. Local materials (stone) would be utilized and construction would be of mortared masonry with corrugated metal roofing and glazed windows. Construction of fences and roads would be carried out by the Project on a labor-intensive basis, as would weeding and harvesting operations.

6. Extension Services

To facilitate settlement and enable realization of land development plans and surplus agricultural production, a supporting program in agricultural extension is required.

The agricultural extension program would be carried out by Extension V and Project Implementation Division of the Ministry of Agriculture under agreement with the Land Settlement Authority and would be a variation of the successful results obtained at Wolamo Agricultural Development Unit settlements. Senior agents would be assigned directly from EPID and would assist in training the junior agents who would be recruited locally within the Project region. The initial contingent of senior agents (two) should be on board not later than October of Year Zero.

Farm families would enter the scheme and be settled in village units of 100 families (four village units forming one peasant association). Each village unit would be assigned a junior agent who would reside in the village, provide year-round advice on cultural methods, assist in organiza-

tion of cooperative farming methods, and provide liaison with Project and settlement staff. One senior agent would be assigned to supervise approximately ten junior agents. After two years, the ratio would be reduced to 200 settlers to one junior agent for an additional two years. The Project extension program would then be phased out, after which the EPID Minimum Package Program would provide normal services.

The technical package to be passed on to the peasant association farmers would be adequate to ensure planned production levels and, at the same time, sufficiently simple to be accepted and implemented. Generally, the package would comprise improved seed varieties, fertilizer, insecticides, proper planting depth and seed spacing, proper and timely weeding, harvest timing, hand threshing techniques, and (gradually, over a period of time) introduction of improved oxen implements as they are developed through Project Farm experimentation.

7. Machinery Pool

It is proposed that Project machinery would prepare the first year's seedbed for each peasant association by plowing and discing one half of its production cropping land.

It should be noted that the machinery pool would cease functioning by the end of Project Year Three. Subsequently, the machinery would be utilized elsewhere by the GOE; consequently, the depreciated value of all equipment would be credited to the Project in Year Four.

Farm machinery would be procured, operated, and maintained by the Project. The central pool would be located at the Project Farm; however, during seed-bed preparation, the machinery would remain on site in the field.

Custom services would be provided to the peasant associations at hourly costs which were computed to include capital recovery, operation and maintenance, spare parts, insurance and downtime.

Machinery use would be scheduled by the settlement officer working through the senior extension agents.

8. Credit, Storage, and Marketing

On the assumption that settlers would arrive at the Project without cash, credit would have to be available when required. The types of credit envisaged are:

1) food allowances until first harvest;
2) production loans; and
3) investment loans for tools and oxen.

The extent to which credit is required would be alleviated somewhat due to paid labor opportunities in which the farm families can engage as they have have time available.

Farm credit would be administered by the Project staff working directly through the peasant associations and the assigned extension agents, not with individual farmers. Food allowances would be provided at the time settlers arrive on site and be recovered from the peasant associations after first harvest. Crop production loans (assumed to extend throughout the life of the Project) would be made yearly prior to the first and second season crop operations as needed to each association and recovered upon each season's harvest sales. Loans for hand tools (hoes, shovels, sickles, etc.) would be made in kind as the associations are formed and recovered after first harvest sales.. Livestock loans would be made to associations for purchase of oxen early in the second year of operation and recovered over a two-year period.

The storage structures would be rodent-proof, with a dry storage capacity equal to 25 percent of surplus grain and pulse production constructed in units of 1,000-ton capacity under Project supervision by locally-hired skilled and unskilled labor. Each unit would be a one-story structure with a floor area of 600 square meters. Construction would be of native stone-mortared masonry with corrugated metal roofing and glazed windows.

The Project would act as agent and sell to the Agricultural Marketing Corporation and/or other buyers. It is anticipated that all surplus maize, sorghum and chickpea production would be sold within the Project region (average 190 kilometers haul, which would include Addis Ababa).

Other input items would be a truck scale and three housing units for staff constructed of the same materials as grain storage units (all in Project Year One).

9. Surveying and Mapping

It is essential that either photogrammetric mapping or topographical ground survey be carried out and contour maps prepared of the entire area by early in Project Year One. These maps are required to enable layouts of village sites, cooperative farms, roads, Project Center water supply, the Project Farm, and other items of infrastructure. Three ground survey parties would be required so that field work could be completed in six months.

On the basis of peasant association layouts made on the contour maps, boundaries would be staked out during Project Years One through Three in accordance with the rate of settlement during these years.

The surveying work required includes cross-sections and subsequent contour mapping of the entire Project Area at one-meter intervals, except on the steeper lands; boundary-marking of the peasant association villages and rural centers; and farm boundary-marking in peasant association.

10. Roads

Both external access and an internal Project road network would be required to enable a smooth flow of farm inputs to the peasant associations and a means of transporting surplus production to outside regional mar[illegible]. External access (through up-grading the existing track) would be provided from the national primary road system at Bedele. The internal Project road network is kept to a minimum and is so located as to provide road access to within five kilometers of each peasant association. Peasant associations

would be encouraged, through cooperative effort, to tie their respective villages and service centers into the Project roads. With the exception of one bridge crossing the Ambelta River (the major tributary to the Didesa), all stream crossings would be by paved ford.

Labor-intensive methods (except for the bridge) under Project supervision would be used in up-grading and constructing the above roads with a minimum of equipment (one dozer, one grader, one dump truck, and one pick-up) leased from the Ethiopian Roads Authority (ERA).

For the Ambelta River bridge, Ethiopian Roads Authority standard concrete bridge drawings are proposed to be used as the basis for design and construction. ERA standards are based on AASHO and IBRD standard specifications.

As stated earlier, other tributary crossings would be by paved ford (culverts were ruled out due to high, short-duration flows which render culverts uneconomical) constructed of grouted masonry; ample native rock is readily available for this purpose.

11. Water Supply

A potable water supply system is proposed to be designed and constructed for the Project Center, the Project Farm, and the expected town at Kolosuri. Provision of village water supplies would be the cooperative responsibility of the peasant associations with technical advice provided by the Project organization. These village water supplies might be dug wells, if groundwater is present in sufficient quantity near the surface, or small earthen dams across minor waterways to carry through the dry season when many tributary streams dry up.

The Project water supply facility would be designed the first half of Project Year One; construction would start in October of Year One (by direct labor or local contract); and the facility would become operational by July of Year Two. The source of supply would be the Didesa River from which water would be pumped via a five-kilometer pipeline to a filtering plant and

reservoir on the slopes of Kolosuri Mountain. The filtered water would be chlorinated and flow by gravity through a pipeline to the Project Center and town, thence into a distribution system to public fountains and the Project Farm.

The facility would be operated by the Project at least during the four-year implementation period; however, continued operation and maintenance should eventually be taken over by the future municipality at Kolosuri.

To meet the demand tabulated above, the required pumping capacity would be about 45 horsepower. Power would be supplied to the pump by electricity which would require some 35 kilowatts; however, a 50-kilowatt diesel generator is proposed to be purchased and installed which would leave 15 kilowatts of surplus power to supply the needs of Project headquarters and the Project Farm. Pro-rated cost of the additional 15 kilowatts would be charged to Project headquarters.

Water would be charged for by having attendants at the public fountains; the rate should be such as to permit the facility to approximately break even over the 20-year period of analysis.

12. Tsetse Fly Control

Tsetse fly control is prerequisite to successful Project implementation to prevent the incidence of human and animal trypanosomiasis. In general, the proposed control measures include:

1) cleared buffer zones at the upstream and downstream project boundaries to an elevation of 1,500 meters;

2) cleared tributaries within the Project boundary;

3) cleared strips through the riverine forest to the Didesa River;

4) cleared Project Farm area;

5) cleared Project Center area; and

6) annual spraying of buffer-zone fringes, tributaries, fringes of riverine forest along the Didesa River and fringes of cleared strips.

The conventional technology of clearing and spraying was proposed since other measures, e.g., introduction of sterile male flies, are not yet perfected for practical application. Both the initial work and annual maintenance would be carried out by the Project on a labor-intensive basis through hired day labor.

Tributary, buffer zone and strip clearing would be carried out during Project Year One. The downstream Project boundary buffer zone would be about 15 kilometers long by 5 kilometers wide (7,500 hectares), and the upstream buffer zone would be approximately eight kilometers long by five kilometers wide (4,000 hectares). Tributary clearance would total some 200 hectares and Didesa River access strips about 100 hectares. Other cleared areas would total approximately 1,000 hectares.

13. Public Services

There are presently no public services in the Project Area. In addition to the Project-implemented infrastructure already described, there are certain other services which would be provided by other GOE agencies, requisite to successful project implementation, including malaria control and health; education; and police. Detrimental effects which would occur should these services not be provided would include:

1) endemic malaria, animal trypanosomiasis, the probability of human trypanosomiasis and other debilitating diseases which would lower productivity and cause a high rate of mortality and out-migration;

2) Illiteracy, resulting in lack of incentive for high production and improved quality of life and inability to carry out peasant association functions; and

3) Insecurity through lack of police to ensure law and order.

Required inputs to provide these non-Project services are included here in view of their essentialness to successful Project implementation. Costs of these inputs were not included as Project costs since the services would be provided by other GOE agencies from their budgeted funds

as arranged by the "Board" of the Land Settlement Authority. They will be planned to reflect the prediction that over the first ten years of Project implementation, the total population in the Project Area is expected to increase to a total of some 60,000 of which 30,000 would be farm families.

Malaria Control - is proposed to be advanced both by spraying and by widespread dissemination of drugs. The progress would be initiated in Project Year One, and continue through the 20-year period of analysis.

Clinical Medicine - would be provided by three health stations. It is noted, however, that the projected population of 60,000 would justify establishment of a health center. The first health station is scheduled to be established in Year One, the second in Year Two, and the third in Year Three .

The educational facilities planned include 17 minimum formal education (MFE) schools (grades 1 through 4) with a capacity of 200 students each, with five proposed to be established in Year Two and six each in Years Four and Six.

One Police sub-station is proposed to be established in Year Two which should be adequate to maintain law and order.

II. Description of the Project Area Environment (prior to implementation)

A. Natural Environment

1. Air

a. Climate

The precipitation of the Project Area must be deduced from records obtained from stations outside but near the site. Of these, the Dabana German Mission Station has the longest constant precipitation record. Data from this station obtained from 1967 through early 1975 (for precipitation in mm.) and supplied by the Ethiopian Meteorological Service of Civil Aeronautics are as follows:

J	F	M	A	M	J	J	A	S	O	N	D
31	40	59	77	251	278	327	328	349	160	64	15

The mean annual precipitation is about 2000 mm. ranging from about 1800 in 1972 and 1973 to 2100 or more in 1970, 1971, and 1974. November through February are always dry and June through September always wet, with rain occurring almost every day. Rainfall usually arrives not in severe storms, but in steady accumulations (highest per day was 70 mm for 15 August, 1973).

Temperature records from a former weather station in the Didessa Valley maintained from 1971 to 1973 by the United States Peace Corps at an elevation similar to that of the project area show monthly temperatures (^{o}C) as follows:

Month	Maximum	Minimum
J	32.9	6.3
F	33.4	7.6
M	34.5	11.9
A	34.1	12.1
M	31.2	10.8
J	28.7	11.5
J	27.3	11.5
A	27.1	11.1
S	28.7	11.2
O	30.3	10.1
N	29.4	8.2
D	30.3	6.1
Year	30.7	9.8

Mean 20.3

Mean Diumal Range 21.0

Days are warmest in March-April and coolest in July-August. Nights are relatively warm from February through September and cool from November through January. Frost is not expected to occur in the Project Area.

b. Air Pollution

No serious air pollution occurs on the thinly populated site at present. There is some seasonal pollution resulting from yearly burning of pastures and a minute chronic amount due to domestic fires.

2. Land

a. Physiography and Topography

At the commencement of the field surveys, the mapping unit of the Ministry of Land Reform and Administration supplied contact prints, a photomosaic, and topographic maps (1:250,000). A detailed ground survey has also been conducted of the proposed Project Center and Development Farm. The location of the Project Area is shown in Figure 1 and a detailed map of the site in Figure 2.

The Project Area as a whole lies approximately between the 1500 meter contour line on the northeast and the 1400 meter contour on the southwest.

The Project Area is part of lengthy valley formed by erosive action of the Didesa River and its tributaries. The surrounding highland plateau elevations average 2000 meters or more while the valley floor elevations average range from 500 to 700 meters lower. The valley lands form a complicated system of low hills which border and interrupt grassy plains with scattered trees and shrubs sloping gently towards the river. Numerous Didesa River tributaries, some with near perennial flows, frequently dissect the plains.

b. Geology and Soils

No detailed geological study was included in the current study. According to references consulted ("An Atlas of Ethiopia" by M. W. Mariam and "The Geology of Ethiopia" by P. A. Mohr) and as confirmed by mineralogical laboratory study of decaying rock samples at the Royal Tropical Institute at Amsterdam, the area forms part of the Tertiary Trappean Lava

composed largely of basalts and basaltic tuffs.

Soil samples collected in the Project Area during February and March, 1975 were analyzed by the soils laboratories of the Ministry of Agriculture in Addis Ababa and the Royal Tropical Institute of Amsterdam. Based on their work plus field studies, a description of the soils can be compiled and summarized as follows:

Parent material and climate do not vary within the Project Area, consequently soil formation and differentiation has primarily been influenced by three environmental factors: slope, aspect, and drainage. On the hills, red and brown inceptisols have developed covering 52.2 percent of the area. The red soils, in general occupying the steeper hills, represent the most advanced stage of soil formation. The brown soils of the more gently sloping hills have undergone a weaker weathering. On the slightly sloping plains and in the basins, black, brown and dark gray vertisols which have been enriched through lateral movement of groundwater from the higher lying hills, have formed on 27.5 percent of the area. They are brown on relatively well drained plains, and dark gray to black in basins with poor external drainage. Adjacent to the Didesa River and its main tributaries, alluviums have been deposited and at the foot of some hills, especially those close to the Didesa River, colluvial material has settled resulting in the presence of gravelly clay. Alluvial and colluvial material comprise 16.6 percent of the project area, and scattered steep hills account for 3.7 percent.

A soils map emphasizing the area proposed for immediate settlement is presented in Figure 3 using a key fully explained in the Resource Report.

A soils capability map has been compiled in the course of the present study in connection with the Resource Report and is presented in Figure 4, indicating the agricultural potential of each part of the Project Area. Explanation of the key may be found in the Resource Report. For the present purposes the mountainous intrusions and riverine soils are considered essentially uncultivable due to slope of former and periodic waterlogging of latter. The black-gray soils require drainage at present too expensive to consider,

although their agricultural potential following drainage and the enforcement of proper tillage methods is considerable.

All red-brown soils in the Project Area are considered adaptable to cultivation though not without serious limitations due to erodibility and past erosion damage. Recommendations for preservation of maximum productivity of these soils will be listed in the impact section of this report.

3. Water

a. Surface Water

The chief source of water for the Project Area is the Didesa River with its intermittent tributaries. Stream runoff has been observed since November 1960 at the downstream end of the Project Area at a station known as "the Didesa River near Arjo" measuring a drainage area of 9,486 square kilometers, and operated by the National Water Resources Commission.

The mean annual runoff for the years 1960 through 1973 is 4686 million cubic meters, an amount equivalent to 148 cubic meters per second average discharge and to 494 millimeters yield from the drainage area. During this period annual runoff has varied from about 3409 million cubic meters or 359 millimeters yield in 1972 to 6860 million cubic meters or 723 millimeters yield in 1961. As a rule, the mean annual yield from the basin is about 25 percent of the mean annual precipitation.

The runoff is lowest from February to April, increases with accelerating rapidity from May to July, reaches its maximum in August or September, then begins to recede until it reaches a low level early in the following year. Annual floods are not abrupt since they are due to the result of daily successive rains. The estimated 50-years flood discharges for thirteen branches of the Didesa River above Arjo has been calculated in the course of the present study and given in the Resource Report. The greatest flood of record with regard to momentary peak discharge was about two meters above top of bank at the gaging station.

Mean monthly and annual flows (in cubic meters per second for 1960 to 1973 at the Arjo Station) are as follows:

J	F	M	A	M	J	J	A	S	O	N	D	Annual
19	12	9	13	41	105	308	465	418	265	78	35	148

Minimum 24-hour discharges at the Arjo Station were recorded as low as 0.44 cubic meter per second on March 9, 1971 and as high as 13.0 cubic meters per second on March 29, 1966. Although calculations made in the course of the present study and presented in the Resource Report indicate that only one chance in ten exists of a low flow of less than 1.1 cubic meters per second, such conditions were measured in two years, 1971 (0.44 cubic meters per second) and 1973 (0.73 cubic meters per second).

Water quality data based on samples collected in the Didesa and Ambelta Rivers are now being analysed. The degree of potability of the water will be assessed.

b. Ground Water

A survey of ground water resources was not included in the scope of the present study and no definite information exists with regard to quantity or quality of ground water supplies in the Project Area. It is known that some of the project soils retain water well, but the location and analysis of usable aquifers properly belong to a future stage of the project.

4. Ecology

a. Terrestrial Ecology

The plant communities of the Project Area show a mosaic distribution largely correlated with soil types and other environmental factors. Climatic conditions are uniform over the entire site and thus are expected to have little effect. Measurements of the significant soils factors and their correlation with floristic conditions have been made in some detail in the course of the present study and are given in Appendix A (Ecology) of the Resource Report. A summary of plant community variations may be expressed as follows:

The red-brown well-drained inceptisol area, largely on hilly sites, is dominated by the tree species Combretum glaucescens which prefers well-leached soils with good movement of air and water within the soils. In the less well-leached soils it may be accompanied by Acacia sieberiana, which is dependent upon a higher soil cation content. In more well-leached areas,

C. glaucescens may be associated with Acanthus eminens, Desmodium sp., Becium obovatum and other species.

In those red-brown soil areas too poorly leached to support Combretum, Ficus exasperata is the most dominant tree. In better leached areas, this species fails to establish itself in competition with Combretum and fails to prosper in even more poorly leached areas possibly due to lack of nutrients.

A few well leached soil areas may be dominated by Grewia mollis rather than either of the two preceding species. Guizotia scabra is another locally common species.

The waterlogged black and dark gray vertisols are characterized by a variety of grass and sedge communities with relatively few trees. Among shrubs which are characteristic of these habitats are Rhoicissus erythrodes, Tephrosia sp. and Grewia sp. aff. pubescens.

Common grasses of both soil types are Hyparrhenia cymbaria, Imperata cylindrica, and Panicum spp. Sporobolus pyramydalis is specifically characteristic of the black soils.

At present, the red soils, free of waterlogging, though relatively low in nutrients, are planned to be converted to agricultural uses so that most of the vegetation initially replaced will be of the Combretum - Ficus type. The black soils will continue to be used largely for pasture purposes.

The red-brown and black-gray soils areas have both already been much affected by the customary annual burning and its resultant consumption of organic soil material and resulting in a flora adopted to fires. As will later be described, it is also believed that far more extensive cattle grazing in the recent past has radically altered native plant communities.

Within the Project Area there is a narrow belt of riverine forest about 200 meters in width bordering the Didesa River and less (sometimes only one row of trees) on its tributaries. Due to the prolonged rainy season, the difference between hillside and riverine forests is less here than might be expected. The characteristic tree species include the trees Mimusops kummel, Acacia sieberiana, Acacia lahai, Albizia schimperiana, Entada

abyssinica, Flacourtia indica, Ficus sycomorus, Cordia africana, Diospyros abyssinica, Milletia ferruginea and the shrub Calpurnea aurea.

There is also a small amount of hillside forest present on a few mountainous intrusions into the site. This forest is in strong contrast to the lowland forest assemblages.

Large wildlife is sparse on the project site. This is probably due to the relatively recent use of the area for large scale cattle grazing and associated pasture burning. Since there is little natural highland grassland in East Africa, few species seem to be primarily suited to this habitat, most being primarily forest inhabitors. It is not believed that any rare or endangered species are present, although a few Nile crocodiles (Crocodilus niloticus) are known to occur in the Didesa River.

Among the mammalian species recorded in the Project Area or adjoining it were anubis baboon (Papio anubis) vervet and colobus monkeys (Cercopithecus aethiops and Colobus abyssinicus), porcupine (Hystrix sp.) white tailed mongoose (Ichneumia albicauda) spotted hyena (Crocuta crocuta) aardvark (Orycteropus afer) warthog (Phacochoerus aethiopicus, and oribi (Ourebia ourebi). Some other large animals, such as lion, leopard, and giant forest hog have been reported near Chara or Arjo and may at times enter the project area.

Lists of typical plants (including weeds of cultivated patches), large and medium-sized mammals and birds have been compiled by the staff of the Faculty of Science of the National University as a result of visits to the Project Area. The information is found in Appendix A (Ecology) of the Resource Report.

Further consideration of the mutual effects of the proposed project and the present plant and animal life on each other will be reserved for the impact section of this report.

Unfortunately no published information appears to be available on possible crop pests in the area. According to literature references the most important pests of maize and sorghum at Bako are stalk borers such as Busseola fusca and Chilo partellus and silo pests such as Sitophilus zeamais.

The most frequent rodent crop pests in many parts of Ethiopia are Rattus rattus or Rattus norvegicus. The latter has been reported as near to the Project Area as Gimbi. Fungus infestations of pearl millet, broadbean, and celery have been reported from Kefa, Jima, and Bako, respectively.

b. Aquatic Ecology

No detailed study of the ecology of the Didesa River or its tributaries seems to be on record, nor was one within the scope of the present study. The area may however, be assumed to be relatively little affected by the little local use to which it is put (purely as a source of drinking water). There are populations of hippopotamus (Hippopotamus amphibius) and crocodile (Crocodilus niloticus) present. The presence of crocodiles implies that of a large fish population which might be used as a protein source for the settlers.

B. Human Environment

1. Socioeconomic Profile of Indigenous People

a. Demographic Characteristics

In Buno Bedele Awraja of Ilubabor Province, within which the Project Area is entirely contained, the population is about 246,000 of which 64,500 reside in the woredas of Bedele and Borecha, which contains the Project Area. For the awraja as a whole, the population density is 43 per square kilometer. These statistics are compiled from data of the Central Statistical Office.

However, the project site itself is sparsely populated. Apparently there was once a larger population which afterwards diminished as the result of an influx of malaria and animal trypanosomiasis which forced the population to migrate to the highlands above the natural habitat of the malaria mosquitos and tsetse flies. Since that time, population pressures have forced some farmers to re-enter the lowlands. The present population of the Project Area is estimated at 1500 or about 4.4 per square kilometer. Field surveys carried out during February and March, 1975 indicate that six persons per household is the average and that about 250 farm families are presently residing within the project boundaries. Of these, about 165 families are located near the dry season track from Bedele through Chara to Kolosuri Mountain and here occupy about 100 square kilometers or one third of the total Project Area.

b. Cultural Characteristics

According to traditional claims, the Shankilla people inhabited the Didesa Valley exclusively until approximately one hundred years ago. In the mid nineteenth century, the first Oromos began to settle and soon predominated. Since then the Shankilla have adopted the Oromo language and customs and for practical purposes, are no longer an identifiable ethnic group within the Project Area.

The Oromo like other Ethiopian groups have developed several customary strategies of communal labor. This may help make cooperative farming projects and provision of social services acceptable to the local population. Most Oromo farmers belong to one or more "associations" whose members help each other doing such difficult tasks as building houses, plowing, or harvesting. The member receiving such assistance will provide the group with drink in return for their labor and will, in turn, help the others when so requested.

The heterogeneous nature of religious beliefs and influences was shown during the field survey. About seventy percent of those interviewed professed to be Christian, twenty-five percent Muslim, and the balance pagans. The survey indicated that religious constraints play an unimportant role in the daily life of the farmers.

The average farm family of six is composed of the father, two wives, two children, and one other relative. The average age of the family head is forty-eight and more than seventy percent of the families had moved into the area in their own or their fathers' lifetime, most from Buno Bedele and Arjo Awrajas. Most moved because of desire for fertile land, presence of relatives already on the site, or exhaustion or unsuitableness of previous land cultivated.

Sons, on reaching maturity, may migrate to other areas while daughters tend to remain near their parents and marry within the community. These factors contribute to the predominance of polygamous marriages.

The village chief is elected by vote of all adults upon the death of his predecessor. His position is largely honorary and ceremonial.

On important matters, the chief usually consults with the village elders. These elders arbitrate disputes, or if unsuccessful seek help from the mutual assistance organizations.

The main diet of the Project Area inhabitants consists of grain such as maize, finger millet, and sorghum as well as some leguminous seeds, and very occasionally, meat. Bread and beer are made from grain.

Personal aspirations of the individuals approached stressed good health and possession of cattle and land for themselves; education, a government position, and wealth for their children; and schools, hospitals, new agricultural schemes, and modernization of facilities for their villages. They expected direct help from the government in providing them with better living conditions and that the Provisional Military Administrative Council, by its land reform proclamation, would assure them sufficient land.

c. Economic Characteristics

The average farm family is entirely engaged in either farming, housework, or tending livestock, and no member obtains appreciable income from any outside source.

Farmers on holdings of 1.75 hectares or less consume practically all of their harvests and only generate cash income through occasional sales of livestock, butter, poultry, garden vegetables, and small amounts of grain. Farmers on larger holdings have additional surpluses for sale and/or barter.

On a percentage basis, the distribution of yields for all holdings between on-farm consumption and marketing or bartering were computed for the present study as follows:

Crops	On-Farm Consumption (%)	Sales/Barter (%)
Maize	80	20
Sorghum	75	25
Millet	70	30
Chick Peas	25	75
Noug	70	30
Teff	70	30
Berbere	25	75
Haricot Beans	80	20
Others	50	50

On a weighted average basis, approximately seventy percent of production yields were consumed on the farm, and thirty percent went to market primarily for bartering.

The gross value of crop production within the Project Area for the 1974-1975 agricultural year was E$34,000. The value for cattle production was E$13,000, making a total production value of E$47,000. The value of market sales and barters was E$10,000 and the net cash return to the area after tax and rent payments amounted to E$4900. The values have been summarized by crop in the course of the present study and the data may be found in the Resource Report.

The gross value of the average farmer's harvest amounted to E$135. He sold or bartered E$40 of this total during the year and applied the income towards the purchase of or trade for spices, other food and clothing. In addition there is an average of fifteen percent losses on that portion of on-farm consumption (about eighty percent) which goes into storage, amounting to approximately E$12 per year per holding.

The average farm family obtains its major source of cash income from value received from occasional sales of cattle, butter, or poultry. For such a family, milk and eggs are considered as dietary supplements but surplus butter and chickens as market items. About E$51 is thus obtained per year of which E$20 traditionally used to go for taxes and farm rental.

There is a small cottage industry in cotton spinning by women and cloth weaving on hand looms by men. There is also the sale of beer made from local grains on market days. No specific quantities of returns can be assessed for these activities.

In all, the average family cash returns for 1974-1975 amounted to E$71 per year and to E$17,750 for the whole project area.

The weekly Sunday market at Chara attracts itinerant traders from Bedele with salt, spices, herbal medicines, cloth, ready-made clothes and shoes. Farm families bring surplus grain, garden vegetables, butter, eggs, cattle, sheep, goats and chickens. However, most transactions are barters between locals who exchange surplus livestock, maize,finger millet, sorghum, teff, berbere, and noug.

2. Land Use

a. Agricultural

Of the total of 34,330 hectares of land contained in the Project Area, field and aerial observations indicate that approximately 600 hectares or 1.5 percent are occupied by cultivated lands and their associated villages with about 2400 hectares more or 7.0 percent consisting of land utilized at least periodically for grazing. Agriculture is presently confined to the red-brown soils due to relative ease of plowing,relative absence of human diseases, and better drainage, while grazing is practiced on the black-soil pastures. However, it is estimated that approximately 29,410 hectares or 89% of the project area is potentially amenable to some form of agriculture.

Because of its importance in understanding current land use, a more detailed description of present agricultural and stock raising activity in the Project Area will now be given.

Project Area fields are near or adjacent to the living quarters of the farmers. Each individual farmer cultivates an area varying from 0.25 to 5.0 hectares (average of 1.75 hectares), although many expressed a desire to cultivate up to ten hectares. Roughly equal percents of holdings were composed of a single or of two parcels. Major reasons for unfavorably small plots,

according to farmers, were the weakening effect of human and animal diseases such as malaria and trypanosomiasis and damage to crops by animals.

Since March, 1975 all rural land has become government property and private ownership abolished.

The principal crops grown are maize, sorghum, finger millet, chickpea, teff, and berbere, with minor amounts of cotton, haricot beans, noug, garden vegetables and citrus. The average farmer sows three to five crops. In addition, gourds, bananas, papayas, and citrus may be grown in home gardens without watering.

In late winter or early spring fields are burned. This has the advantages of aiding plowing by reducing stubble, destroying insects and weed seeds, and keeping wild animals away from houses, but also the practice dissipates soil nutrients and promotes soil erosion, which could be retarded by conservation plowing.

Crops are planted at the onset of the rains and are normally harvested after the heavy rains have subsided. All plowing is done by oxen as soon as the soils soften. Plowing stirs the soil without turning it over, resulting in a trashy tillage which serves as a light mulch and helps reduce soil erosion. Harrowing, sowing, weeding, harvesting, threshing and storage are done by hand with all capable members of the family participating in most cases (although threshing and berbere cultivation are women's work).

No source of chemical fertilizers, insecticides, herbicides, human or veterinary medicine, or improved seeds exists in the Project Area. Farmers retain seeds from previous crops or borrow them and use little manure (while recognizing its value) due to scarcity of cattle.

Although variation in measures used and cooperative methods of farming make it difficult to calculate the average yields, they are believed to be low by national standards, due to a number of reasons including inferior seed, poor cultivation practices, loss to insects, birds, etc., and inefficient methods of harvesting and threshing.

Storage facilities are small circular sheds on legs made of sticks plastered with mud on the inside and covered with a removable thatched roof. Storage losses due to rats, insects and mildew average fifteen percent with a range of five to fifty percent. For this reason, farmers are unwilling to harvest, thresh or store more grain than is likely to be preserved.

It is estimated on the basis of field studies that the livestock population of the 250 holdings on the Project Area totals about 1250 cattle (average of five per holding, ranging from zero to eighteen), 500 sheep and goats (average of two per holding, with goats preferred), and 2750 poultry (average of eleven per holding).

Cattle are mostly of Zebu stock and vary in size according to the quality of grazing. Cattle are usually grazed on the black soil valleys between the Didesa River tributaries. As the dry season progresses, cattle are grazed communally first on field crop residues, then on the adjacent burned lands, usually beginning in the higher areas since these dry and are burned first. Each night they are returned to the village compounds and kept penned. Grazing time per day decreases as the distance from village to pasture increases with the season. Only natural sources of water are used, no wells being dug.

The dominant grasses are Hyparrhenia spp. These make good grazing immediately following burning or new growth following rains, but quickly become fibrous and unpalatable. Some species may also inhibit nitrogen fixation in the soil. No pasture management is practiced apart from the annual burning, nor are principles of selective breeding of cattle practiced or understood.

Milk and butter are used and sold respectively by the farm families often to the detriment of development of calves. In addition, oxen labor is utilized and an occasional barren cow or surplus heifer sold.

Health of cattle is poor due to trypanosomiasis, and other diseases and parasitic infections, as well as poor nutrition. Livestock at an elevation of 1300 to 1500 meters is sparse and unhealthy, but rapidly improves at higher elevations such as near 2000 meters at Bedele.

b. Forest and Grassland

Land remaining in natural grassland and forest vegetation totals 31,300 hectares or 91.5 percent of the project area, although most has been gravely affected by past over-grazing and periodic burning. Most of this area (26,300 hectares or 76.5 percent of the Project Area) is potentially cultivable. The remainder consists of riverine forest and water surface (3700 hectares or eleven percent of the Project Area).or of mountain forest. (1300 hectares or four percent of the Project area).

c. Residential

The only permanent residences are those mentioned above in part (a). No village surveyed contained fewer than ten or more than forty households. The residential area included therefore is miniscule.

d. Commercial

No Project Area space is used primarily for commercial purposes. The nearest customarily used facilities involve the weekly market at Chara, on the border of the Project Area.

e. Historical,Archaeological or Culturally Significant Sites

Due to the past depopulation of the site and the insubstantial nature of structures erected by the known innabitants, it is not believed that there are any sites of special archaeological, historical, or traditional importance in the Project Area.

3. Public Services

a. Public Health

Public health services are nonexistent within the Project Area at present. The nearest clinic, dressing station, and pharmacy are at Bedelo which is fifty kilometers from the Project Center via the existing dry weather track through Chara, or twenty five kilometers on a direct line up steep escarpments.

Many debilitating diseases which seriously affect health and limit labor activities are evident. The prevalence of endemic malaria has been a primary cause for exodus from the Upper Didesa Valley and a major constraint to spontaneous resettlement. Malarial mosquitos are especially a problem during the rainy season when stagnant water abounds and

farming activity is at its peak. Most people are bitten at night or while performing weeding operations or other farm activities.

Jigger fleas are always present, entering skin cracks on bare feet or under broken toe nails, thus destroying living tissues and exposing them to infection. Tuberculosis and other pulmonary diseases such as pneumonia and influenza are also common. All residents also carry and have lived continually with a load of internal parasites.

Human trypanosomiasis has been confirmed in Gambela Awraja and tsetse flies capable of serving as its vector are known to exist in the Didesa Valley. Therefore a possible outbreak of sleeping sickness is an ever present threat.

Of equal importance as a contributing factor to poor health is malnutrition since this exposes the weakened individuals to severe infection.

Water borne diseases such as schistosomiasis are not definitely known to exist in the Project Area but should be considered when planning use of Didesa water.

Development of health care and disease prevention facilities are therefore of prime importance to the success of any settlement project and are fully discussed in the Project Description.

b. Educational/Agricultural Extension Services

Educational facilities are entirely absent within the Project Area boundaries although some householders send their children to the Ministry of Education primary school at Chara. There are also Zemacha camps, staffed by university students and high school seniors engaged in expanding rural education opportunities, established at Bedele and Chara and plans for school construction within the project area are in progress.

The nearest Institute of Agricultural Research stations to the Project Area are located at Jimma to the south and Bako to the north. These may be future sources for agricultural instruction to project settlers.

c. Transportation

At present the Project Area is virtually inaccessible from the nearest all weather roadways, of which Route 5 (Nekemte to Addis Ababa is approximately sixty kilometers to the north and Route 7 (Addis Ababa to Jima) and Route 43 (Metu to Bedele to Jima) are approximately fifty kilometers to the south. Route 5 is asphalted from Addis Ababa to Hagere Hiwot and gravelled the rest of the way. Route 7 is asphalted from Addis Ababa to Giyon and gravelled the rest of the way to Jima. Route 43 is asphalted from Jima to Agaro and is scheduled to be asphalted as far as Bedele. An all weather Bedele - Arjo - Nekemte feeder road has been funded.

At present a dry-weather track leads from Bedele to Chara to Kolosuri Mountain and another follows the future Bedele - Arjo - Nekemte road route. Both tracks traverse rolling or hilly country and cross a number of stream beds. Four-wheel drive vehicles may be used during the dry season except for the Arjo - Bedele route.

Truck transport charges have been estimated to average E$0.013 per quintal per kilometer for transporting surplus produce to market, assuming all weather improved roads. The cost may be as low as E$0.01 per quintal per kilometer if a full load can be carried both ways, or as high as E$0.015 if a full load is carried only one way. For unimproved roads, costs may be E$0.02, E$0.03 or more per quintal per kilometer.

d. Water Supply and Wastewater Disposal

The sole source of water supply in the Project Area at present is the Didesa River with its tributaries. No ground - water wells are known and no organized facilities for wastewater disposal exist.

e. Solid Waste Disposal

There are no organized facilities for solid waste disposal in the Project Area.

f. Utilities

There are no public services available to the Project Area. The nearest telecommunications service and post office are in Bedele as are the nearest Christian and Muslim religious facilities.

g. Police/Fire Protection

The nearest police post is at Chara on the border of the Project Area.

III. Probable Environmental Impact of Project Implementation.

A. Primary and Secondary Impact of New Settlement, Introduction of New Residents.

1. Natural Environment

a. Air

Air quality is not expected to undergo a significant change even at the density of population expected with full project settlement. However, some increase in domestic fires and possibly in extent of pasture burning will inevitably accompany a population increase. The possibility of air pollution due to blowing dust if erosion control methods are not enforced is discussed in later sections of this report.

b. Land

There is not expected to be any severe effect on soils caused by construction of settlers' quarters. Some soils may erode from areas cleared of all vegetation for the purpose of village construction. In itself this is unimportant since these areas are not intended to support crops in any case. Construction must always be confined to the red-brown soils since the characteristics of the black-gray types (expanding and sticky when wet, cracking and hardening when dry) make them unsuitable for homesteads, villages, and other infrastructure (in particular, roads) although roads may have to traverse them in places.

c. Water

The Project Center and Demonstration Farm will be served by a water supply system providing water by pumping from the Didesa River. These uses would undoubtedly cause some diminution of river flow. However, the estimated requirements of 156,000 cubic meters per month amounts to less than one percent of the 24 million cubic meters average flow for March, the month of lowest flow.

Each project village is expected to draw its own supply from convenient ground water sources. At the time of settlement, instructions must be enforced to insure that settlers dispose of possible polluting wastes in such

a manner as to avoid contaminating ground water supplies. The final population of the area is not expected to be large enough to generate large amounts of polluted wastewater.

d. Ecology

Settlement inevitably involves the clearing of much of the natural vegetation from the project villages together with elimination of much of the associated wildlife. It should be understood, however, that the present plant and animal communities of the project area are "natural" only in a relative sense, the area having been much affected by relatively recent large scale grazing and by continuing annual burning of vegetation. The main effect of settlement as such will be the increased clearing of land for villages and associated facilities.

The territorially far more extensive effects associated with agricultural development and disease control will be discussed in the relevant section of this report.

One effect of settlement, which should be watched is the sanitary or health question of increase in flies, rats or other organisms commensal with man. Any necessary measures of sanitation,such as supervision of waste and garbage disposal and enforcement of rules concerning house sanitation, etc. needed to control these organisms need to be enforced.

2. Human Environment

a. Socio-economic

Surveys of characteristics of potential new settlers indicate that most would derive from three sources.

Some landless peasants whose recent ancestors have evacuated the Didesa Valley as a result of human and animal diseases have expressed an interest in returning if conditions improve. Although the number of such settlers would be relatively small, resettlement difficulties would be minimized by their traditional ties to the valley, cultural similarities to present inhabitants, and retention of a life-style suited to local conditions.

Local highlanders presently inhabiting lands surrounding the Project Area are expected to volunteer to relocate in the new settlements.

attracted by the government services to be provided. These too would have much in common with the present settlers, and a past history which would have reasonably well prepared them for understanding of and cooperation with the project goals.

The third source of immigrants would derive from the pool of landless and part-time employed laborers from the area of Jima, Agaro, and other large neighboring towns. These people would be for the most part, though not necessarily exclusively, of Oromo origin, and hence cultural conflict with the local population would be minimized. However, their urbanized past would no doubt create some problems in their adjustment to their new environment and to the older settlers. A lack of past experience with community labor groups may also create some problems in adjustment to working with a cooperative. Very careful testing for motivation of this element of the settlers and detailed guidance in enabling them to adjust will be necessary. Those individuals who have recently been forced to abandon agricultural land and are anxious to resume farming would be best.

Preliminary surveys indicate that the majority of new settlers, at least in the initial stages will be unmarried or newly married people and thus the average new settler family would include one or two adults, with one or no children.

For reasons of public health, new settlers need to be carefully screened before admission. However, most new settlers should be in better health than the present valley inhabitants since they will derive from areas free of malaria. This means that they must be carefully instructed in means of prevention and treatment of diseases that may be new to them.

Increased crowding of settlers deriving from a wide geographic area always provides an opportunity for communication of diseases, hence there will be a need for the medical facilities planned as well as care in disposal of sanitary wastes. Imported clothes, furniture, food, etc. should be examined for the presence of rats, ticks, etc. Each immigrant himself should be subjected to a rather thorough health inspection.

In almost all cases, Ethiopian land settlement schemes have attracted more applicants than could be accommodated. It is not anticipated that the present plan will fail to do the same, or that applicants will be inadequate for the initial settlement phase.

Nor is it believed that the decrease in size of the available temporary-labor force in the area will have any adverse effect on the local economy since the applicants for such work (chiefly coffee picking for at most three months per year) usually far exceed those actually able to find employment. It may even be beneficial in increasing the opportunities for the remaining applicants for coffee picking employment.

During the time of preparation of the Project Area for settlement by activities such as road building, similar services to those outlined above will be needed for the temporary labor force many of whom are expected to volunteer as permanent settlers.

b. Land Use

Increased settlement of the Project Area will render largely obsolete the present arrangement of villages and cultivated lands, since the present population will be largely submerged in the flood of new arrivals and all residents will be reorganized into peasant associations. This will not necessarily have a disorganizing effect since most current residents have no long traditional tie to their present holdings nor is their yield so good presently as to make moving a burden. Moreover, the present inhabitants interviewed expressed willingness to share the Project Area with new settlers provided that they themselves were not discriminated against in terms of services provided. The necessity for careful choice of village sites is to be emphasized, however, since they are likely to become rather permanent. There are no legal questions of land tenure to be adjudicated since all rural land in Ethiopia now is government property.

c. Public Services

Figure 5 should here be referred to for a summary of facilities planned for the Project Area.

The massive influx of settlers will require a vast increase in public service facilities, now totally absent in the Project Area proper.

Facilities for protection of public health are most important for success of the project, especially since many new residents will be unfamiliar with precautions against eg. malaria and animal trypanosomiasis, unknown in the highlands surrounding the Project Area. It is intended to establish several health stations for monitoring of the health of the project settlers. An intensive campaign against malaria, including spraying and the dispensation of prophylactic drugs is planned. Careful instruction in these health matters will be given to all settlers.

Since most of the new settlers will be young unmarried or recently married people, it is to be expected that the need for primary educational facilities will increase sharply some years after the initiation of the project. As outlined in the project description, plans exist to meet this need.

Plans for improved transportation facilities surrounding the Project Area have also been outlined in the project description, as have the plans for surveying and mapping the Project Area, providing water for villages and Project Center, and providing police protection. Implementation of these plans on schedule is of utmost importance for uneventful accommodation of settlers.

Specific facilities for disposal of waste water or solid wastes is not considered necessary in view of the relatively low population of the Project Area and the low level of wastes expected to be generated. However, instruction in and enforcement of sanitary regulations to prevent the creation of health hazards or public nuisances will be an important part of settler preparation.

B. Primary and Secondary Impact of Increasing Agricultural Production

1. Natural Environment

a. Air

There will be some increase in air pollution as a result of use of project machinery, increased supply of crop stubble to be burned, and domestic fires of any non-farmers attracted to the Project Area, such as merchants or

dependent families of settlers. However, the projected population density of the area is still expected to be low enough to give no problem in dispersal and dilution of pollution. This does not negate the advisability of such steps as plowing in instead of burning crop residues in order both to control air pollution and benefit the Project Area soils. Alternatively, they might be used as animal food.

b. Land

Most project soils are susceptible to erosion and some to compaction as well moreover, most will require extensive application of fertilizer. All this necessitates careful instruction of potential settlers and supervision of their cultivation practices.

If land on slopes were to be cultivated without the use of proper techniques, accelerated erosion would certainly occur. On all slopes of five to ten percent, project management must provide undisturbed contour strips at suitable vertical intervals or better still, terrace all slopes. Terracing should eventually improve the situation by allowing horizontal levelling of the land between terraces. On slopes of two to five percent less radical measures are needed but all operations should be made to follow contour lines.

Some suggestions can be made with regard to all project soils. Tillage should occur as soon as rains have sufficiently penetrated the soil and before runoff can occur to aggravate erosion. Relatively poor rates of vertical infiltration may be improved by early tilling or mulching following harvesting. Operation with heavy machinery should be minimized to avoid compaction.

Fertilization will be necessary for soil improvement for some years. However, the abundant rain and speedy rate of leaching is expected to prevent salinity from being a problem.

c. Water

Runoff from project farms entering the Didesa River is considered likely to be insignificant in quantity, especially since cultivation

will not occur on the alluvial soil or river vegetation belt. Rather, runoff would speed the continuing process of washing soil and nutrients downgrade into the black soil valleys. Suggestions have already been listed in part (b) for preventing excessive loss of soils or nutrients.

Pesticides (such as DDT), herbicides, and fertilizers might all cause problems if excessive concentration of their toxic or nutritive elements were to collect in the Didesa River or its tributaries. The scope of the problem might vary greatly and conceivably the entire downstream area could be affected to one extent or another. To prevent unpredictable results from occurring, toxic residues must periodically be monitored at sites above, adjacent to, and below the Project Area with the purpose of working out a spraying and fertilizing regime which will avoid or minimize damage to the aquatic ecosystem, in areas downstream from the project. The waters must also be watched for any signs of eutrophication due to excessive fertilizer pollution. The rapid flow of most stretches of the main Didesa (though some quiet pools occur) should aid greatly in preventing build-up of pollutants. Nevertheless, efforts should be aimed at keeping the river safe under low flow conditions when danger of toxic or nutrient accumulations is greatest. Spraying with pesticides is expected to be heaviest during periods of high flow however.

The impact of all these agricultural activities with regard to ground water deserves future consideration when more is known of local ground water resources. Waste disposal, crop spraying, use of fertilizer, etc., must be planned with the goal in mind of no or minimal contamination of ground water, especially village water sources.

d. Ecology

Clearing of land for crops will eliminate most of the present vegetation and wfidlife from the site only leaving those which easily adapt to the environs of cultivation.

Important side effects of the use of pesticides are certain to occur in the fauna surrounding the Project Area. Although it is difficult

to predict which species will be most affected it seems clear that high-order consumers (that is, those many steps advanced in the food chain) and species metabolically active enough to metabolize stored pesticide residues rapidly tend to be most quickly affected. In the past birds feeding on smaller birds and on large fish have been the most frequent victims. Organochloride contamination of their food supply may cause a number of symptoms ranging from death, to sterility, to behavioral abnormalities. Organochloride compounds may be stored in body fats to be released catastrophically when fats are metabolized under conditions of stress.

In an area devoted to intense agricultural production, it is much less important to prevent effects on local wildlife (though the usefulness of some species as controls on crop pests and scavengers should be recognized) than to prevent injury to human settlers or consumers of project-raised foods and to limit or prevent destruction of ecosystems beyond the project boundaries. Spraying techniques and schedules must be considered with these two goals in mind in order to prevent unacceptable levels of contamination of workers or food and to avoid far ranging effects on Project Area environs.

Insect pests should be watched for signs of developing resistance to DDT or other pesticides used, and a second choice kept in reserve if possible. Since nothing is known about the presence of subsoil crop pests (such as nematodes or soil fungi) in the Project Area, it is not impossible that subsoil pesticides may have to be used against them.

Introduction of improved seed for crops should greatly improve yields and, hence, profits for the project farmers. However, strains to be used need to be carefully selected to avoid use of high-yielding types which nonetheless are poorly adapted to local conditions or require more care than the project farmers can be reasonably expected to provide.

One unfortunate result of cultivation of a new area is an increase in numbers of plants, animals and microbes dependent on cultivated crops and consequently, when numerous, harmful to the farmers' interests.

There are however, a number of means in addition to the previously mentioned use of sprays that can be used to minimize adverse effects.

All seeds, plants, plant parts, livestock and pets entering the area should be subject to inspection and, if necessary, treatment to avoid introduction of parasites or diseases.

A clearing of a 1.0 to 1.5 kilometer strip surrounding the Project Area should be made in order to build a barrier against harmful weeds and eliminate shelters for insects, rodents, and other vermin. Such a barrier may not by any means be complete but it will have a notable effect. This clearing may be done in conjunction with tsetse fly control operations.

Storage facilities must be improved. Many weevils, moths, and other insects as well as rodents destroy or defile vast quantities of stored grain. Insecure storehouses may form permanent reservoirs for these pests. To a lesser degree, trash heaps, abandoned houses, etc., may also harbor vermin including human disease vectors and their presence on the project site cannot be tolerated.

Weeding is expected largely to be carried out by hand. Crops must be protected against wildlife in and adjacent to the Project Area. As already mentioned, the clearing of a 1.0 to 1.5 kilometer belt around the Project Area should deter rodents as well as larger wildlife, such as monkeys, wildpigs, hyenas, etc., from approaching, since these animals usually dislike crossing open spaces. The deterrent could be made stronger, if finance permits, by constructing a bordering fence around the cleared area and inspecting it regularly for breaks. Such a fence should extend far enough underground to deter burrowing animals.

Penning of cattle, sheep, and goats at night (as presently practiced) within the village should eliminate the already slight likelihood of losses due to large carnivores such as hyenas.

Damage from small carnivores in the Project Area may be minimized by such measures as using only secure hen coops and having

vaccine available for men or domestic animals in case of rabies outbreaks. A population of small carnivorous species beyond the immediate neighborhood of cultivation may well be beneficial in reducing the number of rodents, small birds, etc.

Damage to crops due to birds is most difficult to prevent. Perhaps destruction of nearby nesting sites and cooperative efforts to prevent bird flocks from alighting or feeding are the most reliable methods although use of sprays on nesting or roosting sites has sometimes given good results.

Monitoring of river-borne pesticide residues, as mentioned in part (c) is especially important if the Didesa River fish are ever intended to be exploited as a food source, since organochloride residues accumulate in large carnivorous fish and relatively small deposits may make fish unfit for human consumption.

Aside from pesticide effects, impact of the project on the aquatic biota is likely to be minimal with one possible exception. There is evidence that hippopotami aid in maintaining the productivity of a river by manuring the water and releasing nutrients by stirring up bottom sediments. Since hippopotami are incompatible with large scale agriculture, this source of nutrient will disappear from the immediate vicinity of the Project Area. Nevertheless, the effect may be slight if hippopotami populations remain in the rest of the Didesa River.

Although wildlife populations of most of the Project Area would probably not justify the reservation of any large amount of land primarily for wildlife, a forested area on the uncultivable escarpment could be considered for this purpose. The colobus monkey (Colobus abyssinicus) should be considered in this connection as in many parts of Ethiopia it is overexploited for its fur. An area of two hectares is sufficient to support a typical family of four to ten. Plants of the genera Akocanthera, Ficus, Celtis and Combretum comprise most of their diet.

2. Human Environment

a. Socio-economic

Since the three crops being proposed for the initial phase of the present project (maize, sorghum, and chick pea) are among those most frequently raised there now, not much change in the dietary picture of the Project Area at present need occur directly. However, the indirect effects of higher profits for sale of increased surpluses may encourage increased purchase of more protein rich grains such as teff, barley, or wheat (maize and sorghum being low in protein). Presumably the ability to purchase any available consumer goods will also be increased to one extent or another.

The economic benefit should be further increased by the improvement of storage facilities and consequent decrease in loss of stored grain.

Completion of the proposed new road system will also render transport of goods to market much easier and make sales for money rather than barter more common. Economic benefits should extend to one extent or another along the whole new road system.

b. Land Use

As the successive peasant associations are formed, a much larger portion of the Project Area will be brought under cultivation than is the case at present. This, together with the cooperative efforts of much larger numbers of people than inhabit any Project Area village at present, will be the main changes in existing patterns of agricultural land use. There will also be new experiences for the settlers, such as use of machinery in cultivation, use of pesticides, soil conservation measures, use of improved seed, etc. No extraordinary problems are foreseen in training settlers to these practices, since Ethiopian peasants are described as adaptable to new techniques, but the need for an agricultural extension staff, such as outlined in the project description is emphasized.

A number of presently unemployed or partly employed laborers from the Jima area will be among the settlers. If they can be

acclimated to project life, a double social benefit of decreasing the number of urban unemployed, and increasing Project Area food production will result. Some of them already have a fairly recent peasant background.

c. Public Services

The project description, projected arrangements for provision of water supply and other utilities such as machinery, credit, transportation and storage facilities, and marketing assistance has been outlined. It only remains here to indicate that provision of these facilities at the appropriate phase of settlement is essential in order to extract maximum benefit from increased crop production.

C. Primary and Secondary Impact of Livestock Program.

1. Natural Environment

a. Air

Air quality is expected to be unaffected by the cattle project. No food but the natural grasses or crop residues is to be used and no cattle products will be processed in the Project Area and so two possible sources of air pollution will be excluded. The possibility of air pollution due to raising of dust by cattle is best discussed in the next section.

b. Land

The possibility of soil disturbance caused by cattle must be one of the factors considered in arriving at an optimum herd size which must be enforced. Although the area usable for pasture is quite extensive, only areas within each project village should be used which allow cattle to feed for a reasonable time between morning arrival and evening departure. The reduction of soil nutrients due to annual burning of humus must also be considered in arriving at a desirable measure of dry matter production. The frequency of burning, however, will not increase from its present once-per-year level.

c. Water

Ground or surface water sources may be contaminated with pesticides used in spraying cattle as well as in crop spraying. However,

the concentration of cattle in a small area for treatment makes control of spread of pesticides much easier than is the case with crop spraying, given proper training of operators and functioning of machinery.

d. Ecology.

Methods of better management of pasture should be explored if the present quality of cattle on the project site is to be improved. Especially some means, preferably labor-intensive, of eliminating fibrous weeds without periodic burning which dissipates some soil nutrients, exposes ground to sun and wind, and destroys soil-replenishing legumes, would be useful. However, pending such tedious labor, burning is necessary to prevent Hyparrhenia grasses from becoming hard and unpalatable and encourage fresh growth. This may enable more palatable and rarer species such as Themeda triandra to survive in competition with Hyparrhenia.

Considering the present paucity of both wildlife and cattle in the Project Area, together with the facts that wildlife numbers must further diminish and cattle numbers be controlled during project development, it is not conceivable that the total pasture area will serve as a limiting factor or that significant competition between cattle and wildlife for the total resource could occur.

Diseases such as trypanosomiasis, rinderpest, foot and mouth disease, anthrax, and rabies may all be communicated from wildlife to cattle or the reverse. Elimination of the insect vectors such as tsetse fly together with inspection and vaccination of all cattle entering the Project Area will much reduce the danger. So will the inevitable retreat of wildlife as project settlement proceeds although there seems no likelihood that contact between wildlife and domestic stock can ever entirely be prevented. The enforcement of stocking limits will help reduce parasite infestation of pastures.

2. Human Environment

a. Socio-economic

Since the present inhabitants of the Project Area already

utilize milk for food and butter both for food and sale, no new food item will be added to their present menu. However, the supply of milk and butter may be increased either if cattle nutrition is improved or improved breeds can be maintained in the Project Area.

At present only an occasional cow, sheep or goat, usually a sterile or weak cow, is slaughtered for food, however, this may be done more willingly if a regular increase in stock herds can be ensured. In fact, frequent slaughter or sale of stock will be necessary to keep the herd's size consistent with the capacity of the utilized pastures and of village pen facilities.

It seems that the monetary importance of cattle sales, already a disproportionate part of the farmers' cash income, will increase further as a result of the necessity of disposing of more cattle than at present.

b. Land Use

The distribution of land in each peasant association with regard to allocation of cultivated and grazing land is outlined in the project description. The main change in land use will be the necessary greater care taken of pastures as outlined in a previous section. If cattle diseases are strictly controlled, the guaranteed increase of the herd will make regulation of herd size by sales very important.

c. Public Services

The livestock health program and associated facilities intended to maximize value and welfare of the livestock herds has already been described in the project description. It remains only to emphasize once again that these facilities are necessary, as is the elimination or control of trypanosomiasis if the regional cattle herd is to make its full potential contribution to the welfare of the Project Area.

D. Primary and Secondary Impact of Disease Control Programs

1. Natural Environment

a. Air

Air quality of the Project Area as a whole is not likely to be affected by the operations connected with disease control. However, one problem that must be addressed is the danger to humans or livestock from inhaling pesticides insecurely stored, poorly prepared, or carelessly used. Training in safe use of pesticides must be emphasized in the preparation of the project scheme.

b. Land

The possible effects of brush clearance on soil have already been discussed in previous sections of this report. One variation to be considered here is the fact that clearance of some riverine forest and cutting of corridors through the remainder will uncover areas of alluvial soil which may, therefore be washed away during floods or rain which is sometimes heavy enough to cause noticeable erosion. This soil could not be economically used for agriculture at this stage in any case, nor is it obvious that deposition of soil would necessarily be less than erosion during flood seasons. There may be some possibility of gullying in the cleared patches once tree roots no longer hold the soil. If loss of soils or change in shape of river banks are considered important to prevent, grass clumps might be planted (as long as tsetse-harboring brush is excluded) or crude terraces cut on the steep river-banks.

c. Water

The possible effects of pesticide use on water quality have been discussed in a previous section of this report. Of special concern in this connection is seepage into the Didesa River from spraying of riverine forest against tsetse flies. Proper monitoring of pesticide residues and regulation of spraying programs should minimize these hazards.

Brush clearing is also necessary for assured permanent control of the tsetse fly. Spraying alone will not necessarily prevent

reinfestation as long as suitable tsetse habitat remains. The cleared areas planned are a buffer zone around the project area border to an elevation of 1500 meters; the banks of all Didesa tributaries; corridors cut through Didesa River forest; and all agricultural and residential sites. Any consequent effect on water quality would derive from washing of increased silt loads into the river from cleared stream banks, probably only during periods of high river flow or heavy rain, and along the main Didesa rather than on tributaries whose flow is less and sometimes intermittent. It is not considered likely, however, that such a slight increase in silting can have much effect on the river as a whole.

d. Ecology.

The effects of pesticide use and brush control on wildlife have already been discussed in previous sections of this report. The only addition to be made here is again to point out that the riverine forest must be sprayed for tsetse fly and that large areas of it will be cleared completely. This may increase exposure to pesticides of aquatic fauna and fish-eating birds as well as decreasing habitat for river bank wildlife. However, the riverine forest along the Didesa River would not be completely eliminated. It is probably desirable that some of the river-bank vegetation be preserved for its amenity value, since, except for isolated mountain intrusions, it contains the only relatively undisturbed plant communities within the project area. However, it is far from unique since it is identical with forest communities existing over a much wider area.

2. Human Environment

a. Socio-economic

The capacity of the project residents for productive labor will undoubtedly be much increased by elimination or control of malaria or any other prevalent parasitic infestation. This is apparently recognized by the present inhabitants, many of whom considered poor health the main constraint on their present agricultural activities, as well as the main reason

for past immigration from the Project Area to the highlands. Thus, two benefits are sure to result from any significant degree of disease control, improvement in health of the settlers, and increase in agricultural output.

Elimination or control of cattle diseases may also allow improvement of the market value of stock. The present use of oxen for labor will continue, however the value of meat, milk or hides may well be more emphasized, especially if improved stock were available, and the project inhabitants could be instructed in the value of selective breeding. It is also possible that, with elimination of tsetse fly, some more low-lying pastures bordering the tsetse habitat would become available if their proximity to the project villages permitted their use. Veterinary treatment of livestock might also reduce nuisances or health hazards due to flies, ticks, and other inhabitants of cattle pens.

However, the total lack of experience of virtually all inhabitants or prospective settlers in the Project Area with regard to pesticides must be taken to emphasize the need for proper training and supervision in introducing them to pesticide use. There is a real danger to public health from improper storage, preparation, or use of pesticides by the uninitiated. This is particularly so regarding antimalarial spraying in which houses and environs must be repeatedly treated. Both operators and residents must be carefully instructed with regard to proper protection of food, children, animals, etc., during the following spraying operations. Developing insect resistance should also be watched for.

It is no exaggeration to say that elimination of debilitating diseases or marked reduction in their incidence is an absolute necessity for the increase in population and productivity of the Project Area envisioned in the present settlement scheme. As a direct result of the health improvement programs, jobs will be created for a staff of medical personnel but almost all employment connected with the project could be counted on as an indirect effect.

b. Land Use

Ownership of lands cleared and not worked for agricultural purposes (such as riverbank vegetation) is not in dispute since all such land belongs to the Ethiopian government and will be subject to the control of project management.

c. Public Service

The disease control program infrastructure has already been outlined in the project description. It only needs to be emphasized here that the most careful training and supervision is necessary of both settlers and extension personnel to ensure that anti-disease measures have a complete and permanent effect without creating health hazards of their own. Especially this is so when the use of sanitary, prophylactic, and preventive measures are new to most of the settlers.

Improvement of human health is a major prerequisite for obtaining the full potential in labor and productivity from the project site residents, just as poor health is the greatest constraint on their present productivity.

IV. Relationship of Proposed Action to Land Use Plans, Policies and Controls

A. Present Government Policy Concerning Settlement

1. Background[1/]

The average Ethiopian is a poor peasant farmer in a country where 90% of the population are peasant farmers. He lives at the margin of subsistence, and so is vulnerable to setbacks. His basic needs are access to enough land and farm inputs to provide his family with a less fragile subsistence base, and a marketable surplus which will enable him to provide health care, safe water supply, education for his children, roads to his village, etc.

Land reform is intended to increase the amount of land available to the average Ethiopian and to ensure that he reaps more benefit from the land. Land distribution and the elimination of tenancy obligations together with full control of land by peasant associations are intended to prevent control of land and monopolization by a few.

Since the government's development resources are limited, it is necessary that the energy of the peasant farmers be mobilized by politicization and education. Assistance should be given only to groups with special needs, such as pioneering settlers, and should not provide an income or level of services to any group beyond that available to the average Ethiopian.

Peasant associations have registered virtually all land holders and provide a source of information about local conditions. In future settlements, they will undertake collective farming from their inception, and organize such internal project functions as receiving and administering credit for inputs, organizing workgroups, and making community decisions about self-help activities. New lands available for settlement may be former commercial farms, or lands formerly held in reserve by big landlords.

1/ Most of the information in this section is abstracted from the paper by Simpson listed in the bibliography of this report.

Relevant Government Documents are Proclamation No. 78/1976, "A Proclamation to Provide for the Establishment of a Settlement Authority", February 4, 1976, Negarit Gazeta; Proclamation No. 31 of 1975, "A Proclamation to Provide for the Public Ownership of Rural Lands," April 29, 1975, Negarit Gazeta; and a draft settlement policy paper of the National Land Settlement Authority.

2. Objective of the National Land Settlement Authority and of Settlement

Article 17 of Proclamation No. 78 establishes the autonomous National Land Settlement Agency to coordinate all settlement activity and requires all public authorities to cooperate with the agency. The authority's objectives are:

settlement of persons who have little or no land;
utilization of idle land;
alleviation of unemployment problems;
conservation of forest, soil and water resources.

The Draft Paper also describes such objectives as incorporation of settlers into a cash economy, import substitution and production for export.

The attempts to take these objectives into consideration in the planning of the present project have been detailed in the relevant positions of the impact section of this report.

The Authority is governed by a Board of Directors consisting of:

Minister of Land and Settlement (Chairman);
Minister of Agriculture and Forestry (Vice Chairman);
Minister of the Interior;
Minister of Labor and Social Affairs;
Commissioner of Planning;
Commissioner of Relief and Rehabilitation,

under the direction of a General Manager. It has the responsibility to identify and inventory areas suitable for settlement, prepare and implement general settlement policy, and short- and long-term programs, and to oversee all

public and private settlement activity and take them over when necessary.

Proclamation No. 78 states, "settlements shall be undertaken on land which is not occupied or utilized by any person or organizations and, with the consent of the government, or land which the Authority considers will give better economic and social results".

The Draft Paper asserts that the Authority will assist in alleviating the causes of under-utilization of land such as isolation from markets and disease as well as supporting costs of relocation and settlements, formation of marketing and credit associations, or advice and encouragement for using improved agricultural techniques. It is believed that such extraordinary aid will be required in the present project.

Proclamation No. 78 states further "a settler will be allotted land sufficient for his maintenance in accordance with the Public Ownership of Rural Lands Proclamation" (31 of 1975). Specifically:

> Article 4 - Distribution of Land to the Tiller
>
> (3) The amount of land to be allotted to any farmer family shall not exceed ten hectares (1/4 of a gasha).
>
> (4) The amount of land to be allotted to farm families shall, as far as possible, be equal in size. The size may, however, vary according to the productivity potential of the land.
>
> (5) No person may use hired labor to cultivate his holding. (Exception is made for the elderly, widows, and orphans).
>
> Article 5 - Prohibition of Transfer of Land
>
> No person shall by sale, exchange, succession, mortgage, antichresis, lease or otherwise transfer any land acquired under the provisions of this proclamation. (Provision that on the death of the holder, the right to use the land is passed to one family member).

Also, settlements will be laid out in a village pattern, not a house-on plot-pattern.

Whether or not settlement costs shall be recovered partially or totally from settlers shall be determined on a project-by-project basis.

3. Policy Guidelines for Settler Selection

According to Proclamation No. 78, priority of settlement will be given to persons residing in the general vicinity of the settlement site.

The Draft Paper adds that in highly congested areas, priority will be given to individuals within or from the region surrounding the settlement project.

Proclamation No. 78 defines "potential settler populations" as:

persons with small or no land;

unemployed persons who reside in urban areas;

nomads desirous of being settled;

persons who need to be settled for various other reasons.

Beneficiaries of settlement programs shall be persons from the above categories "whom the Authority deems capable of participating in the program after consideration of age, health, and interest".

The Draft Paper gives the following criteria:

a person willing and interested in making his living from agriculture;

a person with agricultural background;

a person from the age of 18 to 45;

a person who is healthy;

a person who will abide by the rules and regulations of the Authority and who will accept the obligation to develop.

These are the principles that must be applied to the Didesa Project, and which have been considered in the planning process as described in the relevant sections of the present report.

B. Effects on Population Distribution

The successful accomplishment of the present project will cause a desirable shift in peasant population to the Didesa Valley from the surrounding

overcrowded highlands. It is important to ensure that the promise of large amounts of government assistance does not attract such an excessive number of settlers from the surrounding areas as to decrease their agricultural production. If necessary, this result could be avoided by choosing, in collaboration with local peasant associations, only a fixed number of settlers, preferably from among the most needy, from each association. The total area devoted to productive agriculture should thus be increased, and not merely shifted in location.

Any shifting of population from the local under employed urban populations to the Project Area would also be beneficial provided that individuals most likely to suceed as settlers are chosen.

To an extent not precisely definable, the non-agricultural population in the neighborhood of the Project Area will also be shifted in response especially to the new transportation facilities planned. New opportunities will exist for commercial dealings and cheap transportation of goods. It may also be expected that some members of settler's families will take up residence near their kin.

C. Conflicting Uses

There are no known plans by any Ethiopian Government Agency for any use of the Project Area that would conflict with that described in this report. Specifically, there are no known plans to zone any of the Project Area or adjoining territory for wildlife or forestry purposes. Thus no conflict appears to exist between the project and the policy of any Government department.

V. Alternatives to the Proposed Action

A. No Action

This alternative would have only one advantage - it would avoid any environmental or social disturbances consequent on possible failure of the currently considered project. However, the project area at present contains neither a pristine natural ecosystem nor a healthy, economically well developed human community. In fact, the present situation of the Project Area, as outlined in a previous section of this report, is sufficiently unsatisfactory environmentally, socially, and economically that there seems no compelling reason for accepting this alternative.

No action would simply allow the present unhealthy conditions to continue with the possibility of the project area serving as a reservoir for human or animal diseases (although the surrounding highlands would probably not be affected).

B. Postponing of Action

Postponing of action would have approximately the same effects as the no action alternative described above. However, it could be expected that population pressures would continue to drive some additional settlers into the Project Area and thus unorganized and uncontrolled development would continue without benefit of any rational plan.

C. Conversion to Livestock Production

Livestock raising is a traditional part of the life-style of the present inhabitants of the Project Area and this will continue to be the case under the present development scheme. However, it would be possible, if considered desirable, to convert the project area entirely to intensive livestock production.

It is estimated that about 10,000 livestock units per 5,000 hectares would be supportable in the Project Area. One important necessity before pastures could be fully exploited, however, would be construction of stock ponds in order to allow watering of large herds. It is estimated that at least eight

stock ponds of five to ten meters average depth and one to two hectares in surface area, each supplying 300 cubic meters of water per day, would be required for the entire Project Area. Ponds would be sited near the 1,400 meter contour, and no more than ten kilometers apart at a total cost of about E$1,000,000. However, the total amount of water drawn from the Didesa River in connection with the cattle project would be even less than needed for proposed agricultural development.

The environmental impact of development for cattle grazing would not differ much from those associated with the present settlement scheme. Such plan elements as brush clearance, human and animal disease control, and construction of project villages would be equally necessary in either case and have about the same environmental consequences. Even more care than with the present project would have to be given to avoid damage or depletion of pastures. On the other hand, the level of population density or of skilled labor required of the project settlers might be considerably less.

However, the production of cattle would not serve the purpose of massive increase in food production as envisioned in the present project, and which requires increase and improvement in grain crops. Nor would it serve the social purposes of settling so many landless individuals. Some of the more useful features of a cattle rearing program, such as the increase in farmer cash income from cattle sales and increase in butter and milk production will, in fact, form secondary features of the plan presently under consideration.

D. Other Food Production Alternatives

Other possibilities for animal food production, such as poultry raising or establishment of a Didesa River fishery would even less fulfill the goal of massive increase in food production. However, production of poultry or eggs is not excluded as a minor part of the present scheme and a fishery could be introduced if further ecological study of the Didesa River warrants it, and the residents of the Project Area show potentiality for fishery work.

E. Wildlife

As has been indicated in previous sections of this report, wildlife in the Didesa River Project Area is relatively scarce, nor are environmental conditions presently favorable to its rapid increase, even if agricultural use were to cease. Therefore, there seems no reason to zone any significant part of the Project Area for wildlife purposes, although, as mentioned earlier, some of the uncultivable mountain forest patches might be considered as possible reserves.

F. Expansion of Agriculture

Although it is not at present considered economical to extend agricultural activities beyond the red-brown soil areas, possible future utilization of other soil types is not at all excluded and thought has been given to the techniques and expense that would be necessary.

There would be some additional environmental effects from drainage of the black soils. The flow of water in the Didesa River would increase by about two percent due to loss of some 8000 hectares of valley storage. Also, drainage would create a favorable environment not only for crops but for associated crop pests. An increase in population of weeds, insects, rodents, etc. must be foreseen and guarded against.

There may also be some agricultural potential in the alluvial soils bordering the Didesa River. However, annual flooding would have to be prevented and the means of doing so are considered unreasonably expensive as well as likely further to impede drainage from the rest of the project soils. For these reasons, it is not considered likely that most alluvial soils will ever be worth exploiting agriculturally. However, some small areas could be used, after tree and brush clearance, for small scale irrigation operations powered by portable low lift pumps, making very careful use of residual soil moisture and late rains. The crops most likely to be raised would be vegetables, cucurbits, and horticultural crops.

It seems that the best use to which the Project Area can be put in the near future is that of an increased source of agricultural crops, and this is the major use envisioned in the current project.

VI. Probable Adverse Environmental Impacts Which Cannot Be Avoided

Among the inevitable effects of agricultural settlement are an increased level of air and water pollution. In the case of the Didesa River area, continued sparse population of the Project Area will minimize these effects.

In the case of air pollution, burning of pastures, greater number of household fires, etc. are expected to raise pollutant levels by an insignificant amount with the worst effects probably being confined to the period immediately following pasture burning. Actually, extensive pasture areas are presently being burned by the project residents. Such practices as plowing under, rather than burning, crop residues would further lessen adverse effects.

Pollution of the Didesa River could be a much more serious problem since the whole water supply of the Project Area and many adjoining areas as well derives from the river. The main threat here would come from use of pesticides with perhaps minor damage being done by discharge of human wastes or fertilizers. Damage to water quality or to the aquatic ecosystem can be avoided or minimized by the monitoring of water quality downstream from the project area, in order to keep concentrations of DDT or other pollutants at a tolerable level, especially during conditions of low river flow. It may be necessary to regulate spraying quantities and schedules to minimize impact.

Fertilizer use or human wastes are not likely to make a major contribution to river pollution, but, on the other hand, village water supplies in wells or impounded areas may require protection since isolated relatively stagnant water bodies would be more likely to undergo bacterial contamination and eutrophication. Proper placement of water sources will be part of project planning.

It is not considered that any inevitable adverse impacts on soils used for crops need occur. Provided soil conservation practices recommended in an earlier section of this report are carefully followed, the soil situation

may gradually improve. However, the burning of pasture, necessary if woody forms of Hyparrhenia are not to dominate the grazing areas, will probably have a deteriorating effect on soil nutrients. Careful regulation of grazing will be necessary in order to ensure that cattle can be supported at a level that will not cause progressive deterioration of pasture soils. Use of manure or fertilizer might also be considered.

Most of the present wild plant cover and larger wildlife will be gradually eliminated from the Project Area. This is inevitable if intensive agriculture is practiced on the site. However, none of the local biotic communities have any exceptional aesthetic, economic, or scientific interest, having already been much depleted by grazing and burning.

Some threats to health may be anticipated both from moving highland settlers into the malaria zone and from creating peasant villages with dense populations. In a previous section of this report, the steps taken to safeguard public health are outlined. All health programs will be controlled by the Bedele Office of the Ministry of Public Health. Included will be health inspection of new settlers (Government policy requires that settlers be of good health), elimination of insect vectors, provision of prophylactic drugs, establishment of health services on-site, and instruction of settlers in sanitary means of waste disposal, etc. These methods should prevent either debilitation of new settlers by diseases present on the project site or increase in incidence of diseases which may be carried either by settlers into the site or be common to both present and new residents. In fact, proper care should gradually reduce frequency and severity of malaria, tuberculosis, parasitic infestations, etc. Animal health plans, outlined in a previous section of this report, should provide similar veterinary guarantees.

It will be noted that all mitigating measures discussed above are presently envisioned as part of the project scheme and will have no effect on project costs.

VII. The Relationship Between Local Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivities

If it is granted that the most productive long-term use of the Project Area is intensive agricultural production , and since the present plan involves the removal of very little land from agricultural use (only about 2000 hectares for non-agricultural use and Project Farm), there is no apparent conflict between short and long-term uses of the Project Area. Even the non-agricultural land could be converted to agricultural use and will be used for supportive purposes such as settler residences and Project Farm buildings.

There will be some temporary environmental degradation due to noise, dust, etc. during the process of construction of roads, Project Farm facilities, etc. This degradation will be very local and short-term. Except for some school buildings, all major construction will end in Project Year 3 and most must be completed earlier to ensure success of the project. Once the facilities are open to their final use, such disturbances will end and the long-term benefits of the roads, Project Farm buildings, human and animal health facilities, water supply system, schools, police post, etc. will continue indefinitely. No barrier exists to any conversion of the land to grazing or any other use if this is desirable.

VIII. Irreversible and Irretrievable Commitment of Resources

Surprisingly few commitments of resources except for the economic costs of the project are expected to occur. Probably the sections of riverine forest (about 350 hectares) which require clearing for tsetse fly elimination will not readily regenerate, even if the site is abandoned, but most of the rest of the area is covered by plant communities and soils typical of disturbed areas, and would likely return to the same condition if agricultural development as envisaged in the present plan were terminated or curtailed.

Likewise no irreversible commitment of water or soil resources would occur, any effects on either being transitory. At this stage no large scale drainage, irrigation or other alteration of natural patterns is proposed. Pesticide effects on soil or water ecosystems would persist for some time after cessation of spraying but not necessarily permanently.

Nor is any permanent alteration of the way of life of the local people likely. Settlers will derive from local peasant populations or urban unemployed and changing either of residence or of type of employment from agriculture to wage-earning is not precluded if such change should appear desirable.

IX. Bibliography

Agren, G. 1972. Chemical and Biological Evaluation of Protein Quality in Ethiopian Crops and Diets. Acta. Soc. Med. Upsal. 75: 257-265.

Bolton, M. 1973. Notes on the Current Status and Distribution of Some Large Mammals in Ethiopia. Mammalia. 37: 562-586.

Corbet, G.B. and D.W. Yalden, 1972. Recent Records of Mammals (Other Than Bats) from Ethiopia. Bull. British Mus. (Nat. Hist.) Zool. 22: 213-252.

Dunbar, R.I.M. and E.P. Dunbar. 1971. Ecology and Population Dynamics of Colobus guerera in Ethiopia. Folia Primatologia. 21: 188-208.

Golato, C. 1972. Septeriosi del Sedano in Ethiopia. Riv. Agric. Subtrop. Trop. 66: 66-68.

Golato, C. 1972. Ruggine della fava (Vicia faba L.) in Ethiopia. Riv. Agric. Subtrop. Trop. 66: 302-306.

Iwamoto, I., I. Toda and T. Wonde. 1972. Incidence and Clinical Manifestation of Onchocerciasis in Endemic Foci of Ilubabor Province, Ethiopia. Trop. Med. 15: 36-45.

Kenneth, R. 1973. Plasmoporra penniseti sp. nov., a Downy Mildew of Pearl Millet in Ethiopia. Trans. British Mycol. Soc. 60: 590-593.

Lemma, A., W.A. Foster, T. Gemetchu, P.M. Preston, A. Bryceson and D.M. Minter, 1969. Studies on Leishmaniasis in Ethiopia. I. Ann. Trop. Med. Parasitol. 63: 455-472.

Mariam, M. W. 1970. An Atlas of Ethiopia.

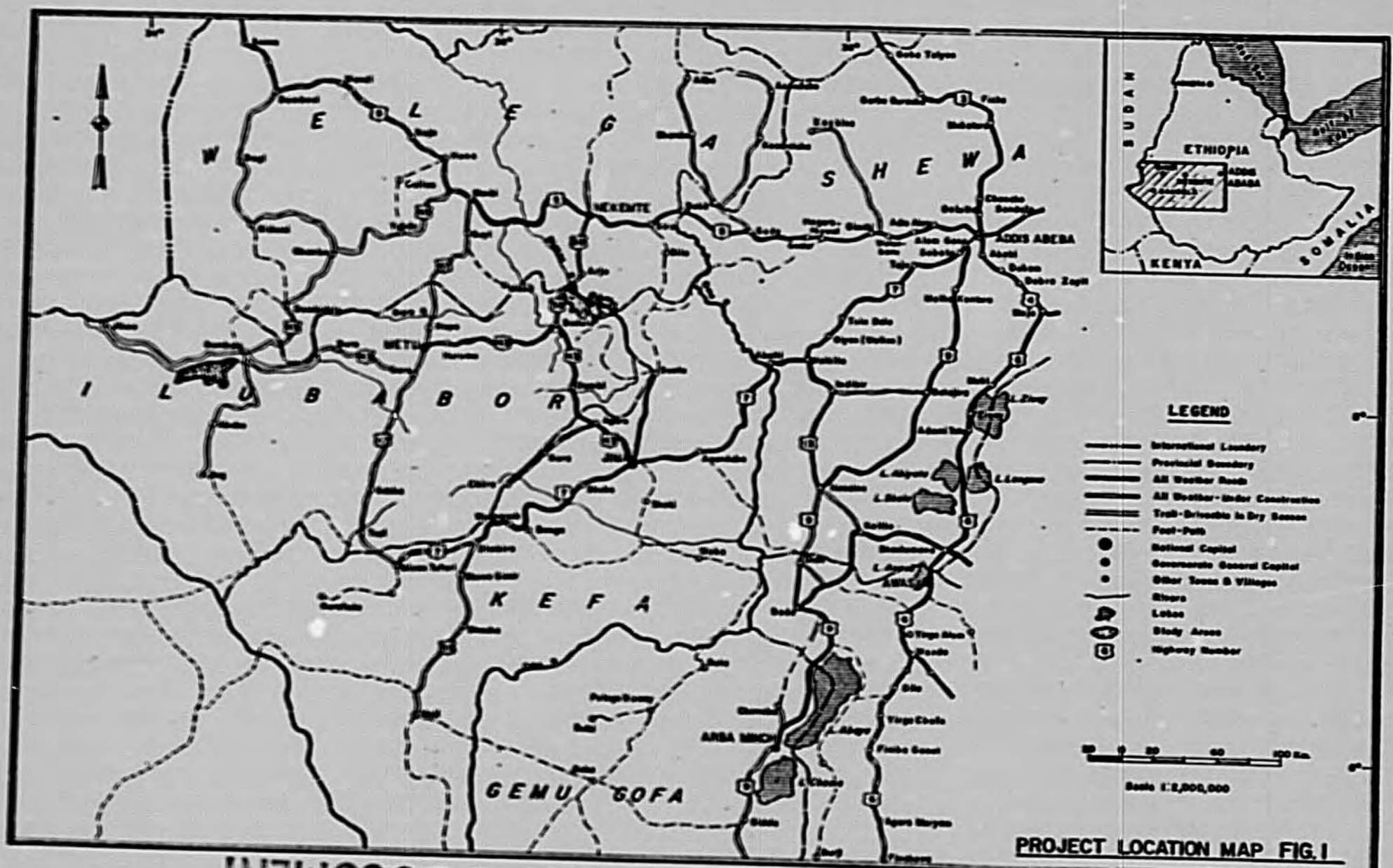
Mohr, P.A. 1970. The Geology of Ethiopia.

O'Connor, C.T. Jr. 1967. The Distribution of Anopheline Mosquitos in Ethiopia. Mosquito News. 27: 42-54.

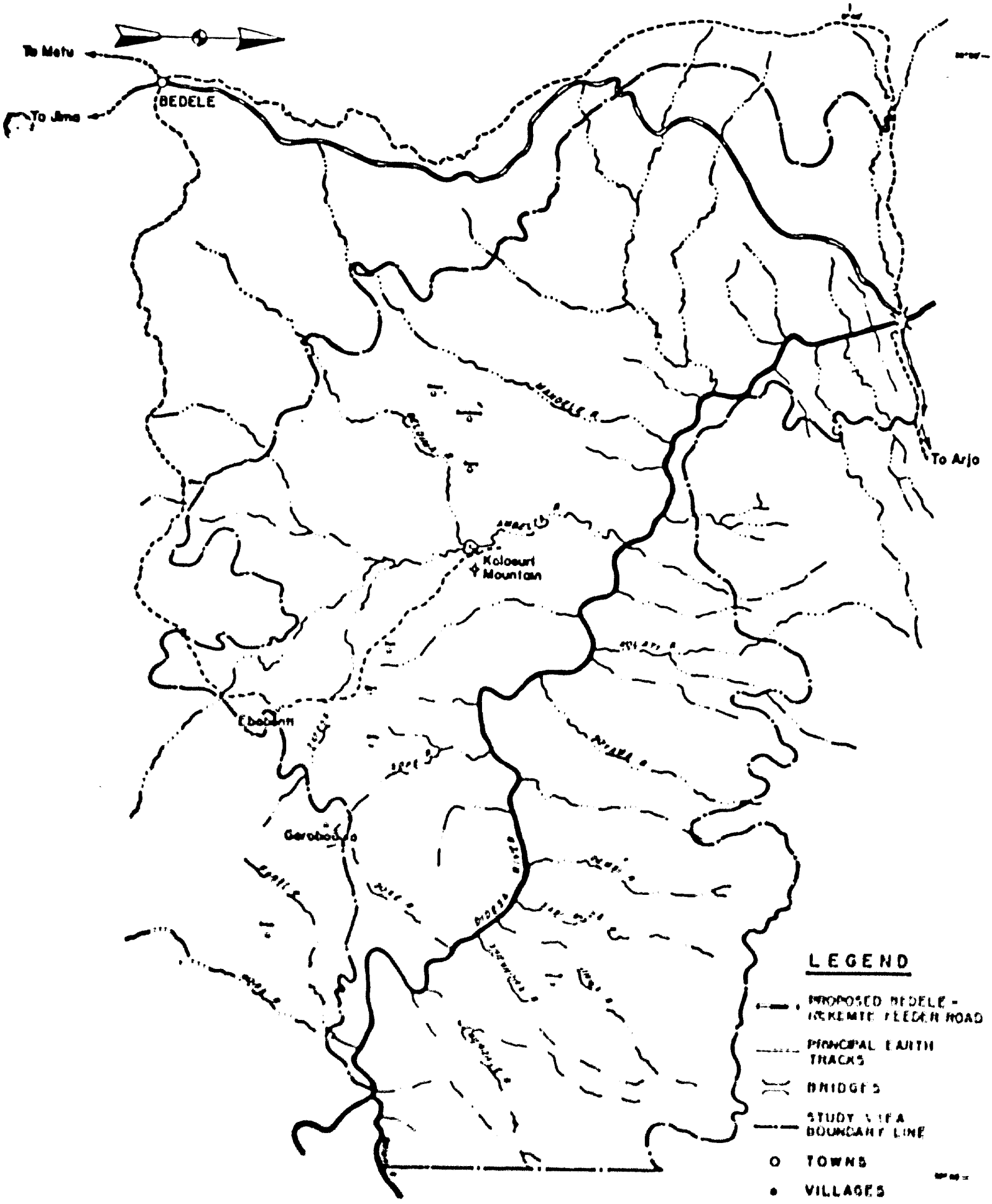
Schaller, K.F. 1971. Zur Leischmeniasis in Aethiopia. Z. Tropenmed. Parasitol. 22: 235-242.

Schmutterer, H. 1971. Contribution to the Knowledge of the Crop Pest Fauna in Ethiopia. Z. Angew. Ent. 67: 371-389.

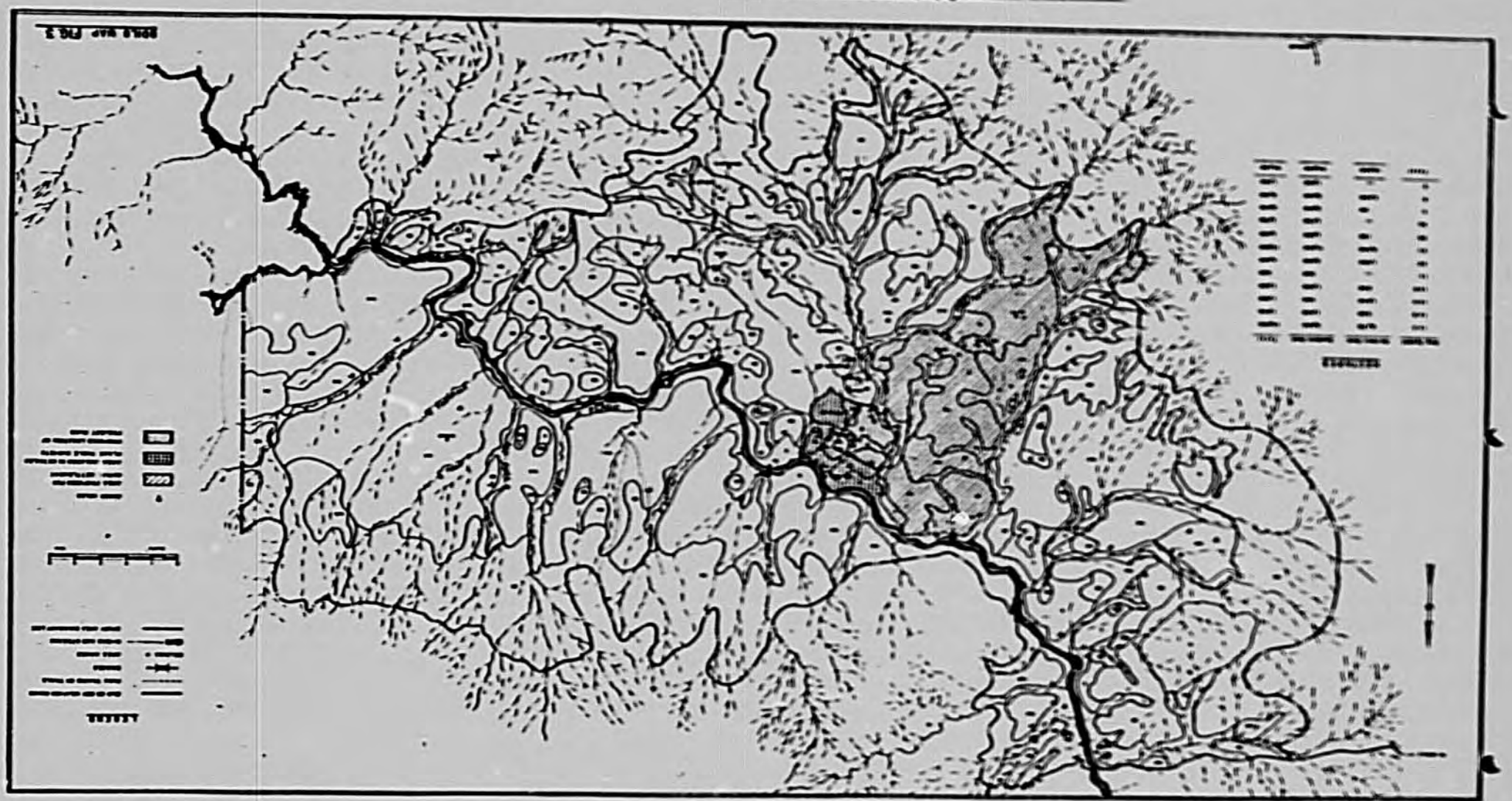
Simpson, G. 1976. Government Policy on Settlement and Potential Settlers for the Upper Didesa Project. Prepared for United States Agency for International Development.

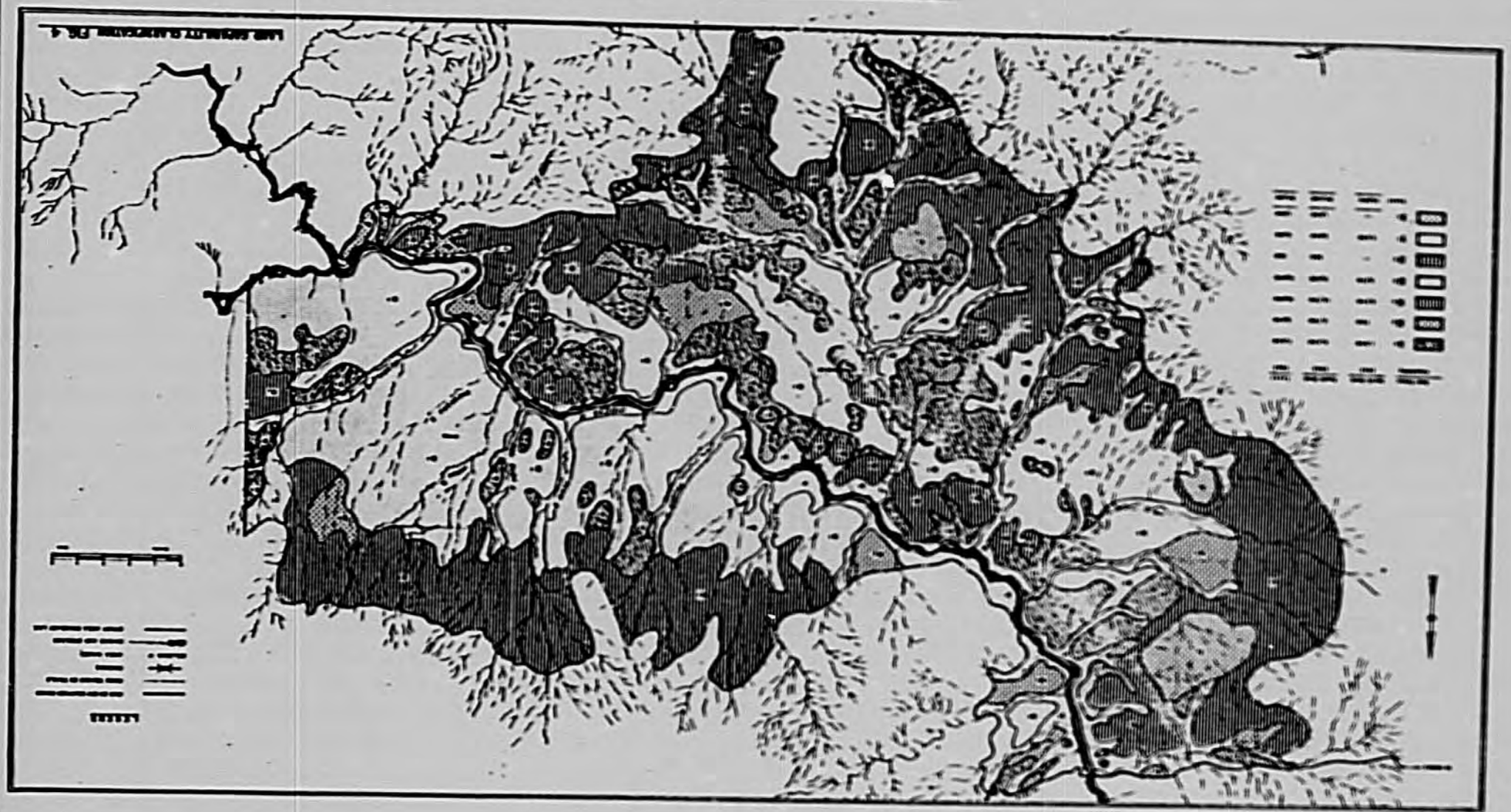


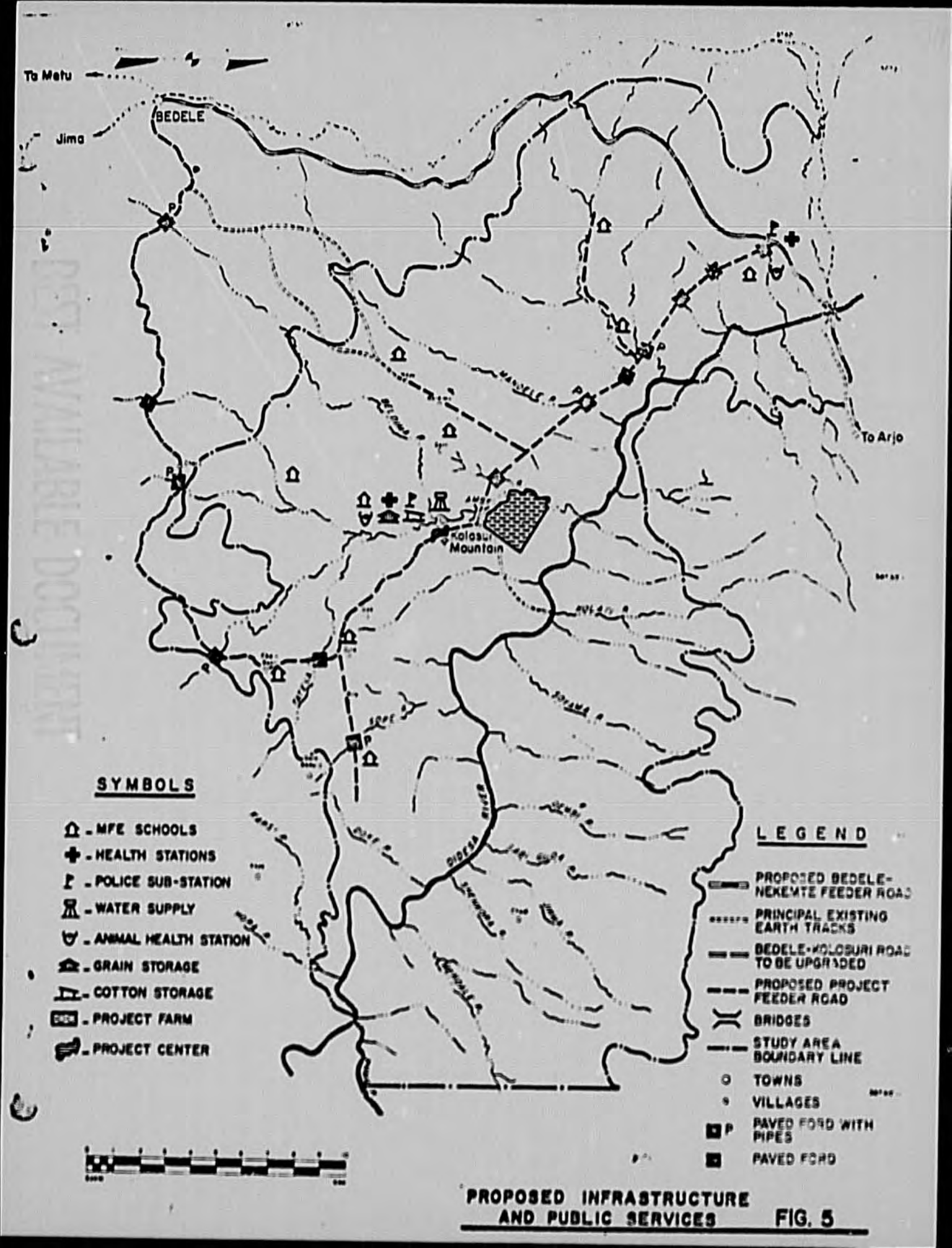
PROJECT LOCATION MAP FIG. I



STUDY AREA LOCATION FIG. 2







PROPOSED INFRASTRUCTURE AND PUBLIC SERVICES FIG. 5

Figure 6

REDUCED MATRIX EVALUATION,
ENVIRONMENTAL IMPACTS CAUSED BY PROJECT

	Alteration of Ground Cover	Burning	Flow Modification	Highway and Bridges	Barriers, incl. Fencing	Product Storage	Erosion Control and Terracing	Fertilizer Application	Trucking	Weed Control	Insect Control
A. Physical and Chemical Characteristics											
Soils	+3/4	2/7		2/1			+4/7	+4/8	1/2		2/3
Surface Water			1/1					1/1			
Water Quality										3/2	4/2
Recharge			1/1								
Air Quality		1/4									1/1
Erosion	1/2			2/1			+6/8				
Deposition	2/1						+4/2				
B. Biological Conditions											
Trees	8/8										
Shrubs	8/8										
Grass		+6/8									
Crops	+9/9						+5/7	+5/6		+2/3	
Barriers	+7/7				+8/10					+2/1	
Corridors	+2/5			1/3							
Birds	3/8										3/3
Land Animals	3/8	-2/4									2/3
Insects	8/9										+7/7
Barriers	+5/7				+8/10						+2/4
Corridors	+1/4			1/3							
C. Cultural Factors											
Grazing		+7/8									
Agriculture	+9/9				+8/5		+5/7	+5/6		+2/3	+5/5
Residential											+2/3
Commercial				+8/8		+5/4			+6/5		
Cultural Patterns						+2/1	+2/4	+2/1		+1/3	+1/3
Health and Safety	+4/7	3/3	+2/5		+5/8						+5/5
Employment				+5/2					+1/2		
Population Density				+6/5							+2/3
Transportation Network				+9/9					+2/4		