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INFRASTRUCTURE DEVELOPMENT IN THE SAHEL

IN SUPPORT OF

BASIC HUMAN NEEDS ASSISTANCE

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PREFACE

The House of Representatives Committee on Appropriations in its Report No. 95-1250 of June 1, 1978 to accompany the Foreign Assistance Appropriations for FY 1979 required AID to submit to it certain information to accompany its appropriation request for FY 1980.

Recognizing the low level of development in the Sahel region, the Committee report stated that there is a special need for developing an effective infrastructure. AID was requested to look into the overall need for infrastructure projects in the Sahel Development Program to determine the level of funding necessary to finance projects of this type and the Committee expected to be informed on this matter in the coming year's hearings.

The Committee further ordered that AID design the infrastructure projects to complement light capital technologies and benefit rural small farmers wherever possible. Any funds requested for large infrastructure projects should be accompanied by demonstrations that:

- they have been compared to smaller scale alternatives and that the choice of the large-scale project is justified;
- the majority of benefits of river basin developments will accrue to small producers with secure land tenure;
- the projects will not lead to the further spread of endemic diseases or create new health problems; and
- the full potential of small-scale, decentralized energy technologies will be utilized.

SUMMARY

This report examines the potential contributions of road transportation and controlled irrigation in accelerating the development of the Sahel. The conclusion is reached that significant new work will have to be undertaken in the Sahel over the next several years if, in this century, the present cycle of poverty is to be broken and the bulk of the peoples of the region lifted above their present low-income subsistence existence. Without greater attention to the provision of roads and irrigated land, agricultural production will continue to stagnate and it will become increasingly difficult to meet the basic human needs of the rural poor.

Thus, we envision in our planning for future fiscal years joining with other donors in providing a modest share of the financing for specific road and irrigation projects where it has been determined that their absence acts as a critical constraint to achieving basic human needs objectives for the poor majority in the countries concerned. Some current examples of how this constraint operates in the Sahel are described in Chapter 7. We will be working with the CILSS and the Club du Sahel as they develop their planning for these activities.

AID does not propose to finance any new projects at the expense of its currently planned programs already focused on the rural poor. Only a small percentage of the funds in our FY 1980 budget request is allocated to major construction -- \$5 million for partial financing of the Kayes-Nioro Road in Mali which relates directly to the AID food production and marketing efforts to assist the small farmers in that

country. Additional projects will be included in our FY 1981 and future fiscal year Presentations to the Congress.

## I. The Sahel and the AID Mandate

The Sahel, with an area of approximately 70 percent that of the United States, has 30 million inhabitants. Of these, approximately 12.5 percent are nomads and 80 percent are rural whose existence depends on food produced essentially in a rainfed agriculture economy. Annual rainfall in a large part of the region ranges between 12 and 32 inches and long droughts are causes of famine and ecological disaster. Following the drought-induced famine in 1972 and 1973, international organizations and individual donor countries provided food and emergency aid to the region. Since 1974 the United States has provided over \$135 million in emergency and regular food aid through the P.L. 480 Title II Program and \$100 million in Disaster Relief Funds for emergency assistance, relief and rehabilitation, and short-term project assistance.

AID, since FY 1974, has committed \$150 million in functional and special Sahel funds for the Sahel and intends to obligate \$75 million in FY 1979. Official development assistance from all Western and OPEC sources between 1974 and 1977 totalled \$3.7 billion. Most of this development assistance was expended for projects in agriculture development, education, health, rural access roads and small-scale rural water supply. Under its interpretation of the New Directions legislation, AID has allocated the bulk of its resources to efforts aimed at providing services to the poor majorities in developing countries.

Studies by AID, CILSS, Club du Sahel, and others have been made to identify the constraints preventing the Sahel countries from moving toward self-sustaining economies despite the increased annual inflow of foreign aid in recent years.

In 1976, a "Report to Congress on a Proposal for a Long-Term Comprehensive Development Program for the Sahel" was prepared for AID by an eleven-member multidisciplinary team. Their investigation concluded:

1. that without a fundamental alteration in the systems of food production, the people of the Sahel, just to survive, will require even greater quantities of international aid;
2. a transformation of the area's productive capacity was possible only through the long-term development of the major river basins; to accomplish this, adequate infusions of international development assistance must be forthcoming;
3. that these programs will need a heavy investment in roads and communications and in human resource development; and
4. these investments will require several decades before full returns can be realized.

The OECD 1978 "Review of Development Cooperation" considered the lack of adequate social and economic infrastructure to be a serious impediment to such priority goals as expanding food production and providing social services to the rural and urban populations. "This lack", it states, "a legacy of past neglect, should now be met by a decade of concentrated infrastructure and institutional investment. Without such an investment programme of stepped-up foreign assistance,

most of . . . Africa south of the Sahara . . . will continue to be without the solid foundation on which to build future economic advance."

The AID Policy Paper of March 1978, "A Strategy for a More Effective Bilateral Development Assistance Program", includes among the major elements of this strategy:

1. assisting the poor to increase their incomes through raising their productivity and access to productive resources; and
2. increasing the availability of and access to goods and services to meet basic human needs.

Based on these considerations the paper concluded that "the United States must support those efforts by the developing countries which contribute to economic, social and political advancement of the developing world." Accordingly, the challenge to the donor community is to design development programs in the Sahel which maximize the beneficial impact of economic advancement on the greatest number of the poor. AID, in turn, is striving to utilize the potential of the small farmer to expand food production and to increase the income of the rural population.

## II. Agricultural Development in the Sahel

To increase food production and assure regional security, the Sahel must develop a stable and expanding agriculture. To do so,

1. it must be made resistant to the vagaries of climate and freed from the disastrous results of the recurrent drought; and
2. the small farmer must have both the means and the incentive to expand his production beyond his subsistence needs.

These conditions have been hindered by:

1. the lack of sufficient controlled irrigation to provide water for year-round crop production independent of the region's low and irregular rainfall; and
2. the lack of a network of all-weather roads to transport production inputs and services into the rural areas and agricultural produce out to markets and population centers.

The difficulty faced by the Sahel countries in developing self-sustaining economies with the existing infrastructure can best be appreciated by examining the geographic characteristics and population dispersion of the region.

The area of the Sahel, 2.04 million square miles, is about 70 percent that of the U.S., but with a population of only 30 million divided as follows:

| <u>Zone Description</u> | <u>% of Total Area</u> | <u>% of Population</u> |
|-------------------------|------------------------|------------------------|
| Desert and semi-desert  | 66                     | 10                     |
| Dryland arable          | 29                     | 75                     |
| River valley            | 3                      | 10                     |
| Urban and ex-urban      | 2                      | 5                      |

Three-fourths of the population is engaged in dryland farming on the arable land covering 29 percent of the land area, in most years yielding only enough food for subsistence. Only 10 percent of the population lives on that 3 percent of the area which can obtain river flow water either by flood recession or by irrigation methods suitable only for short seasonal cultivation.

To make matters worse, the Sahel, in common with all of Africa, lacks all-weather roads which permit communication between the rural areas and population centers. There is, therefore, little incentive for farmers to grow crops for the market even where climatic conditions are favorable. The high cost of transporting crops to market areas and the high rate of spoilage makes locally grown crops less competitive with imported foods in coastal areas. Scarce foreign exchange and development resources are, therefore, expended for food imports which further inhibits local agriculture development. To remedy this situation, the Sahel countries must improve their irrigation and transportation infrastructure.

A large amount of financial assistance is still needed from the international aid community to bring to fruition the plans for the Sahel in the areas of road transportation and water resources development, even if we consider only the basic initial work needed to create conditions for a viable agricultural economy. For these two sectors alone, the Club du Sahel estimates that at least \$1 billion in additional funds are needed to finance the near-term needs. In addition, Club plans for rehabilitation and expansion of rail, water and air transportation call for the expenditure of an additional \$650 million during the same period.

### III. Road Transportation

There are, today, about 50,000 miles of roads and tracks in the Sahel. Of these, over 31,000 miles are inadequately maintained or not maintained at all, and over 6,000 miles are in a deteriorated condition. In addition, there are 1,800 miles of railroad with obsolete rolling stock and poor operating management. Of the 50,000 miles of roads in the Sahel, only 21 percent are all-weather -- 11 percent are paved, 1 percent are gravel and 9 percent are earth roads. The remaining 79 percent are either dry-weather earth roads or simply tracks.

As one illustration of the significance of these figures, we can compare the mileage of non-urban all-weather roads in the U.S. and the Sahel, as follows:

|                                  | <u>Total All-<br/>Weather Miles</u> | <u>Miles/<br/>Inhabitant</u> | <u>Miles/Sq. Mile<br/>of Area</u> |
|----------------------------------|-------------------------------------|------------------------------|-----------------------------------|
| U.S. (continental)               | 3,200,000                           | 0.01                         | 1.1                               |
| New York State                   | 66,361                              | 0.004                        | 1.4                               |
| Sahel (excluding<br>desert area) | 10,500                              | 0.0004                       | 0.01                              |

Thus, the U.S. has 320 times as many miles of all-weather road as the Sahel, 50 times the miles per inhabitant and 100 times the miles per unit area of the Sahel (even excluding its desert area). New York State alone has over 6 times the miles of all-weather road of the Sahel, 10 times the miles per inhabitant and 140 times the miles per unit area. The mileage of non-urban all-weather roads in New York State, in fact, exceeds the mileage of roads of all types including tracks in the Sahel. The density of all types of roads in Africa, including feeder roads and tracks, in relation to total land area, varies between a low of one mile of road per 2,500 square miles of area in the Sudan (about 90 percent desert) to one mile per 10

\*The total size of the continental United States is 2,957,000 square miles and the Sahel is 2,040,000 square miles.

square miles in Rwanda, whereas the Sahel has one mile of road per 100 square miles of land area.

With so poor a system of all-weather roads the marketing of produce from an expanded agriculture becomes difficult and uneconomical. The rapid deterioration of vehicles and their upkeep and repair raise the cost of transporting produce from the farm, reducing the profit margin and incentive. These costs also contribute to raising the price of production inputs as well as consumer goods and social services basic to improving the lot of the rural population. Even the provision of the most elementary health care and education becomes difficult and a burden on the area's limited human and financial resources.

One example of the constraint on rural development resulting from the inadequate road system is the plight of the livestock sector. The major livestock market for Sahel cattle is in the coastal population centers; but the high cost of transport and the loss of weight of animals on the long trip over bad roads makes local meat less competitive in the coastal cities with meat imported from Europe. This results in both lost income to the grower and a lost opportunity to earn foreign exchange for the economy. Further, the growth of the livestock industry is impeded.

The Club du Sahel and the Sahel countries have identified some 3,900 km. of first-priority primary, secondary and feeder roads for new construction or rehabilitation which are essential to the general development of the region and which should be carried out in the decade of 1980-1990 at an estimated cost of \$980 million.\*

\*Of this total, \$500 million has been committed by various donors.

The relative importance to the region of all-weather roads can be judged from the Club du Sahel and host country breakdown of the 3,900 km. of first-priority roads. The proposals call for the expenditure of \$656 million for 1,368 km. of primary all-weather roads and \$288 million for 2,135 km. of secondary all-weather roads, as opposed to only \$30 million for the construction of 397 km. of dry-weather feeder roads.

#### IV. Irrigation and River Basin Development

The Sahel contains some 60 million hectares (150 million acres) of arable land. Of this total, about 12.6 million hectares (31.5 million acres) are under rainfed cultivation, primarily in areas where rainfall varies between 12 and 32 inches per year. Only 600,000 hectares (1.5 million acres) are under irrigated or flood recession cultivation. The balance, or four-fifths of the arable land of the Sahel, is unused.

The one-fifth of arable land that is under cultivation is farmed by traditional methods subject to the vagaries of scarce annual rainfall and recurring droughts. All this despite (a) the existence of plentiful water in the large river basins of the Senegal, Niger, Gambia, Casamance, Chari-Logone and Volta Rivers which together could provide irrigation for four million hectares (10 million acres), and (b) other sources of water which could irrigate another 10 million hectares (25 million acres). Thus, the 13 million hectares presently under cultivation in the Sahel could be increased by an additional 14 million hectares with controlled irrigation.

At present only one major dam exists in the Sahel -- the Markala, a low dam upstream of the interior delta of the Niger River, in Mali. Another dam in Mali, the Selingue, is now under construction on the Sankarani, a Niger tributary, upstream from Bamako. The cost of the remaining major dam construction for the four basins of the Senegal, Gambia, Niger and Volta Rivers is estimated at \$1,130 million at 1977 prices. To fully utilize the water made available from the structures for irrigation in the Sahel would require an investment of an additional \$4,000 million at 1977 prices over the next two decades for land

preparation and the construction of accessory irrigation structures (canals, dikes, pumping installations).

The Club du Sahel estimates that in the next 20 years, if funds are made available, 940,000 hectares could be placed under controlled (all-year) irrigation which would yield two crops per year. About one-fourth of this area could be irrigated within the next two-three years for double cropping without the need for new dams to be built. By constructing water control projects, another one-fourth of this area could be in operation between 1983-1990 and the remaining half brought under cultivation between 1991 and 2000. Estimates of the cost of this work are not presently available.

Even if the necessary sums were available, it would be unrealistic to expect controlled irrigation agriculture to expand to the areas envisaged in the next 20 years without the technical personnel both to manage and operate the water control systems and, just as importantly, to extend the new farming methods to the rural population who will be the main beneficiaries. This will require setting up the necessary institutional framework for training, credit and marketing. An estimated \$1.5 billion would be required in the 1980-85 period for this purpose alone, of which something less than \$1 billion has been committed by various donors.

V. How Infrastructure Development Assists in Providing Basic Human Needs

To realize basic human needs objectives, there must be a growth in the economy that provides for the growing production and supply of basic goods and services and a pattern of distribution of income that enables the poor to obtain the goods and services it needs. Increasing the amount of income in the hands of the poor will result in better satisfaction of their basic needs. But, even in these cases, explicit government action will usually be required to increase the supply of and access to services which governments furnish, such as education, health, agricultural research and rural infrastructure<sup>1</sup>.

In other words, to be sustainable, a development strategy in support of basic human needs requires broad-based economic growth in which the widespread productive participation and benefit of the poor are essential features. In the Sahel this means that river basin development and road construction -- insofar as they are essential to the productive participation of, and benefits to, the poor -- become a requisite for the development of the rural economy and permanent improvement in living standards of the poor majority. How this operates in the transport and irrigation sectors is explained below:

1. Road Transportation

As has been shown, the Sahel's road network ranks among the lowest in Africa. The Africa network, in turn, ranks among the

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<sup>1</sup>"A Strategy for a More Effective Bilateral Development Assistance Program", AID Policy Paper, March 1978, p. 9 (emphasis added).

lowest in the world. For the development of an agriculture economy that will return a profit to the small farmer and bring about an increase in his standard of living, the farmer must be able to move his produce to market at a reasonable cost. An all-weather road network linking the farmer with market centers is a key factor in providing an incentive for increased crop production. A road system so hazardous as to cause delays or vehicle breakdowns will result in spoilage of produce, high transportation costs, and make the farmer's product more costly to buy. Incoming goods, such as equipment, fertilizers and seed are made excessively expensive and, to the extent the farmer can buy them, raise production costs and act as a disincentive to increased production.

Improvements in the road network will, therefore, provide the following economic benefits to the farmer and the rural population in general:

- a) increase competition in the transport industry, thereby lowering the costs of transporting production inputs to the farm and produce to the market;
- b) provide a strong incentive to farmers to increase crop production to take advantage of favorable prices;
- c) lower food costs in the population centers, thereby diminishing the need for costly food subsidies;
- a) improve the diet of both the urban and rural population through an increase in the varieties and quality of crops grown;

- e) contribute to regularizing the supply of farm products and thereby improve the prospects of their processing either for export markets or as import substitutes;
- f) reduce the region's foreign exchange expenditures on imports of food; and
- f) free foreign aid resources now devoted to direct food aid for development of the agricultural sector.

During drought conditions in 1972-74 some areas of the Sahel had grain surpluses while famine prevailed in other areas. There were neither the roads nor the organization available to transfer grain from surplus to deficit areas. Even the distribution of food aid in emergencies was hampered by the lack of passable roads and reliable vehicles. Expensive air transport was used to bring food to distribution centers, but in many instances the food got no further because the hungry could not reach the centers and the food could not reach the hungry. In such extreme situations the direct benefits of investment in all-weather roads is evident and the economic justification which may not be quantifiable can be recognized in lives saved and in human energy preserved.

There are also social benefits resulting from easier and better communication between villages and larger centers which can prove important in furthering the well-being and quality of life of the rural population. Inter-village trade provides employment and an environment for the development of small-scale industry

suited to the work habits of the population. The availability of transportation to labor markets provides the work opportunity for women and allows them to satisfy more of the rural family's needs. Health and educational personnel are more easily attracted to those areas served by good communications, and more inclined to stay there.

## 2. Controlled Water Irrigation

Irrigation provides a number of direct benefits to the poor farmer. Traditionally, areas along the Sahel's rivers have been farmed by flood recession methods -- during flood periods the land along the river is inundated and, when the water recedes, the land is cultivated. This type of crop production is seasonal and erratic and in general suitable only for low yield varieties. In drought years the floods are lower, less land is cultivable and crops often fail. Areas distant from the river banks can only be used for dryland agriculture which is at the mercy of irregular and low rainfall. These areas can fail completely in drought years. Even with irrigated perimeters supplied from natural river flow, water in sufficient quantities is not available during low flow or drought periods to cultivate all the area in the perimeter.

River basin development involves water-impounding dams that store flood waters which would normally flow unused into the ocean. By releasing water during low flow periods the dams make water available for irrigated, year-round cultivation of many small

farms which would otherwise yield only sparse crops. Thus, both the riverine farmer and the adjacent dryland farmer are afforded greater security through more reliable harvests of food and cash crops. Canals and conduits can bring water to areas removed from the river banks and transform the erratic dryland agriculture to irrigated farming. In both the riverine and inland areas, yields may be increased through the introduction of higher-yielding varieties of grain. Double cropping would permit year-round cultivation, thereby reducing under-employment. Expanding production would also increase the general demand for labor and tend to push up wages.

A major reason for developing controlled irrigation in the Sahel is to take some of the pressure off marginal rainfall areas. Although those who remain in these areas after others resettle near irrigated land do not benefit directly from the irrigation, they do benefit indirectly. They are able to continue using their present systems of extensive cultivation and livestock raising which would be impossible in the absence of economic opportunities for emigration.

The stimulation to employment may be important, too. As agricultural output grows, there will be expanded employment opportunities in processing and marketing. Similarly, the sectors providing inputs to irrigated agriculture can be expected to increase in size and offer more possibilities for productive employment. The actual extent to which irrigation will generate increased employment opportunities will depend, of course, on the type of

technology employed in the operation of irrigation schemes, the rural industry that may emerge as a result of the agricultural growth and the effective demand for the increased output from both the farms and industry. It is especially important in this regard to design both roads and controlled irrigation systems in ways which optimize the labor contribution to construction and operation.

A multi-purpose dam generating hydroelectric power might be used for mining or urban consumption miles away, and thus not contribute directly to aiding the rural poor. However, the hydroelectric power can be critical in paying for the dams which make downstream irrigation possible, as the history of river basin development has demonstrated.

The investment in river basin development and full water control is, of course, substantial. Initial studies, environmental impact investigations, engineering and construction require many years to complete during which expenditures are made and little in the way of benefits appear. Even when the project is completed not all farmers can benefit at once and the investment costs per farmer may be quite high for those who do not initially share in the benefits directly. However, there is considerable evidence that families tend to share their benefits with those who are less well off within the traditional African social system. This is an important way in which the benefits from infrastructure investment in general can be redistributed.

## VI. Health and Environmental Considerations

Invariably, river basin development changes the natural regime of rivers. As a result there is a potential in the Sahel that a number of health and environmental problems could be induced or aggravated by river basin development. Some of the problems related to water, and therefore to river basin development, include such major diseases as schistosomiasis, malaria and onchocerciasis -- and such environmental hazards as waterlogging and salinization. There are other potential negative side effects such as the displacement of downstream economic activities (e.g., recession irrigation and fishing). Upstream water impoundment may force the relocation of entire villages.

Over the past few years AID has become increasingly sensitive to development-induced health and environmental hazards. In the Sahel, AID is providing technical assistance to the CILSS Health and Ecology units to formulate health impact guidelines to increase understanding of the potential health effects of development activities. The guidelines are intended to be sufficiently comprehensive to allow planners to make sound judgments on the negative effects relative to water control and appropriate prevention measures.

Much of the technology already exists for controlling or avoiding adverse effects on health. For example, some of the measures for avoiding or coping with schistosomiasis (snail vector) and malaria (mosquito vector) are:

1. chemical elimination of the vectors (however, molluscicides or larvicides may cause other biological damage);

2. treatment of infected persons with selected chemotherapeutic agents;
3. reduction or elimination of breeding sites by:
  - a. filling and draining collection points for water; or
  - b. lining irrigation canals, weeding canals and banks where snails breed and placing screens in pipes and ditches to restrict movement of snails;
4. protection of human population:
  - a. screening in dwellings against mosquitoes;
  - b. health education for proper sanitation practices to prevent the spread of schistosomiasis by infected persons;
  - c. health education and services to prevent the introduction or spread of malaria and onchocerciasis.

AID follows an approach aimed at several areas in an effort to reduce the negative health effects of development projects, i.e.:

1. pre-project assessment of expected negative health impacts and required prevention and control measures;
2. health surveillance after implementation to monitor actual health impacts;
3. control and prevention measures designed into the project;  
and
4. assistance to local governments to manage long-term surveillance, prevention and control operations.

Diseases like schistosomiasis and malaria are endemic in the Sahel.

There is, therefore, an obligation by the host country and the development

community to act responsibly to prevent the spread of disease as a result of their development activity. But because there are so many factors beyond the control of the host country or donors which can cause a disease to spread, it would be unreasonable to state categorically that the incidence of an endemic disease will never increase. What is expected is that (a) the health and environmental hazard aspect of each project will be comprehensively and objectively evaluated; (b) the project will be rejected if adequate precautions cannot be incorporated; and (c) if found to be acceptable, precautions and countermeasures will be integrated into the project.

The evaluation may, of course, show that, while more extensive irrigation could facilitate broader distribution of a disease vector, it could also improve health conditions by increasing incomes, improving diets and introducing safe drinking water supplies. Thus the evaluation is based on a broad understanding of the development relationships and incorporates a span of criteria which reflect the complexity of the total undertaking.

VII. Why and Where Should the U.S. Participate in Sahel Infrastructure Financing

Since the inauguration of the "New Directions" policy AID has not participated in the construction financing of large projects such as major dams or roads. It was believed that:

1. enough financing by other foreign assistance donors was available to take care of infrastructure needs for general economic development;
2. there was little or no "trickle down" of benefits to the rural poor from such projects; and
3. the relatively modest aid budget was better spent on programs providing a more direct link to the rural poor.

As a result, U.S. assistance to the Sahel since 1974 has been focused on the traditional approaches to meeting basic human needs, recognizing the long climb that is involved in achieving regional self-sufficiency and improving the livelihood of the Sahelians. However, as pointed out in the March 1978 AID Policy Paper cited above: "If country commitment is strong enough to assure that the benefits of development assistance will actually support rather than subvert programs toward basic needs objectives, U.S. assistance could expand to include activities which, though they may operate more indirectly, are necessary to meeting basic needs over the longer run."<sup>2</sup>

River basin development and road construction projects, if carefully selected meet this criterion in the Sahel. Specifically, a system which provides controlled water supply for year-round irrigation will, when

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<sup>2</sup>Ibid., p. 36.

placed in operation, further the needs of the rural population being served by an AID "basic human needs" program. Similarly, a major road which improves the access of farmers to markets or increases the availability of needed goods and services to poor people meets the basic human needs aspect of AID's assistance strategy. In such cases, the particular structures must be provided to overcome the constraint in meeting the basic human needs of the affected group.

Certain criteria should be met by these projects before they become eligible for AID financing:

1. the projects, on completion, must provide direct benefits (e.g., controlled irrigation water, improved access) to areas in which AID or other donors, under Club du Sahel auspices, are making an investment in basic human needs assistance;
2. the projects will induce measurable improvement in lives of the peoples in these areas substantially greater than would occur with existing AID and other donor assistance;
3. there are no smaller scale alternatives which could provide comparable benefits to the rural poor;
4. the influences on the social, health and physical environment have been carefully examined and all possible precautions taken to prevent or minimize human and ecological damage;
5. the project has been coordinated with other donors in both its planning and financing aspects.

Some illustrative examples of projects in transport and irrigation now under consideration in the Sahel which appear to meet these criteria are as follows:

1. Road Transportation

- a. Kayes-Nioro all-weather road in Mali. This is a 247 km. road in Mali's First Region bordering on Mauritania and Senegal. The road will be a five meter wide unpaved hard surface road and cost an estimated \$15,000,000. This amount includes \$10,450,000 for road and bridge construction (average \$42,300/km.) and \$2,000,000 for road building equipment.

Mali's First Region is one of the country's poorest and most isolated. Although it has water resources, being located between two sources of the Senegal River, its agriculture potential is undeveloped due to inadequate road infrastructure. The area between Kayes, the capital of the region, and the market center of Nioro to the northeast is at present served only by dry-weather tracks.

The Kayes-Nioro road construction is a top priority of the GRM and will provide access to the region so that basic human needs activities may be mounted. Multinational financing will be required. The proposed road will directly impact on three major development activities:

- Operation Kaarta, CIDA financed, is a \$30 million rural development program affecting about 300,000 people in the agricultural and herding sectors. (Successful implementation is dependent upon the proposed road.)
- Operation Lac Magui, AID financing, eventually a \$7.5 million integrated crop and livestock development

affecting about 100,000 people. (Successful implementation is substantially dependent upon the proposed road.)

-- Operation Kayes-Nord, Saudi financed, is a livestock production project impacting on some 160,000 people.

(Successful implementation facilitated by proposed road.)

- b. Koupela - Fada N'Gourma - Niger Border Road. This is a \$60,000,000 project for upgrading 230 km. of a regional road connecting Upper Volta and Niger through realignment, paving and construction of drainage structures. FED, Saudi Arabia and the Arab Fund are considering cooperating in financing this project. Additional funding of \$10,000,000 is required.

This road is part of the East-West trans-Sahelian highway and also forms a part of the Lome-Niamey, north-south network.

It is a regional road with which Eastern ORD feeder and secondary roads connect to provide better access to markets and centers of services to the rural areas. The present road is now in a degraded condition and is almost completely impassable in the rainy season from July through October.

The major beneficiaries from this upgrading project would be the rural population in eastern Upper Volta who would gain year-round access to markets.

The road will facilitate and complement the rural development programs in the Eastern ORD area now being financed by AID and other donors. There are approximately 420,000 inhabitants in this region on the fringe of the Sahelian zone who will benefit

from more reliable access to markets and population centers. Specifically, some 15,000 farm families now included in AID's Eastern ORD Integrated Rural Development Project will be direct beneficiaries.

## 2. River Basin Development and Controlled Irrigation

- a. The project for construction of the Manantali and Diama dams in the Senegal River Basin. An enormous fund of detailed information has been collected and numerous studies carried out over the years on water resources in the Sahel but in only a very few cases have these led to master plans for the rational development of the river basins. One such master plan is that for the Senegal River Basin. Its development has been undertaken by the OMVS, a regional body comprising Mali, Mauritania and Senegal.\*

The OMVS is now planning the construction of the Diama and Manantali dams, the first on the Senegal River delta and the

\*AID now contributes to the following programs in the Senegal River Basin in cooperation with the OMVS, as follows:

- A \$6.2 million, five-year Agronomic Research project to develop capacity for carrying out adaptive research for the river basin area. Other donors are UNDP, U.K., France, Italy and Canada.
- A \$13 million, three-year project for Data and Institutional Development to assist OMVS with technicians, staff development and data collection to facilitate planning and management of the development activities in the Senegal River Basin. Other donors involved are France and IBRD.
- A grant of \$3.5 million to assist in environmental studies and strategies for use in design and implementation of river-basin projects.

second on the Bafing River, one of the main sources of the Senegal River. Assuming these dams can be in operation by 1986, anywhere from 255,000 hectares to 375,000 hectares can be brought under year-round irrigation by the year 2000 according to one estimate, while a more conservative estimate suggests 255,000 hectares could be achieved by the year 2025.

Since the water impounded by the OMVS project would be available to most of northern Senegal, a large part of western Mali and the more populated southern portion of Mauritania, about 3,500,000 rural poor could benefit directly from the project. These benefits would be derived not only from the development of year-round agriculture and increased food production but would accrue as well from access roads constructed as part of the river basin project; from development of fisheries in the impounded waters; from the availability of low-cost electric energy; and from employment in industries in the project area. The ultimate beneficiaries of the OMVS river basin development will be small farmers who will be able to develop double crop cultivation independent of the irregular and meager rainfall.

There is, at present, a financing gap of about \$600 million for the construction of the dams and auxiliary flood control, navigation, power generation and irrigation installations, not including investments still to be made in land preparation for the irrigated areas. There are some unanswered questions in this project which counsel further investigation before

full construction is undertaken. By offering to assist in financing the project the U.S. could influence the planning of the project so as to (a) maximize the benefits to the rural population, and (b) provide for the optimum labor-intensive methods in both the construction and operation of the irrigation network and in the application of small-scale, decentralized technology.

- b. Proposed five-year project to expand food production systems of the Office du Niger in Mali in cooperation with the IBRD and other donors. The Office du Niger, created in 1932, is the largest productive enterprise in Mali. It operates an extensive irrigation system with water obtained from a dam on the Niger which raises the river level by about five meters and provides partial river flow control. However, deterioration of the physical structures has led to the loss of a large part of the benefits of the irrigation system. Crop yields dropped to the extent that they were abandoned completely in some areas farmers' indebtedness rose and widespread despondency resulted. In recent years the Mali Government has turned from cotton to more profitable rice production in the area and the farming population, which declined in the 1960s, rose between 1968 and 1977 from 30,000 to 50,000. The government has transferred more than 10,000 hectares to private ownership, has improved some irrigated perimeters by levelling and raised crop prices as an incentive to increased production. To continue the progress in the

region, the Office du Niger requires assistance in the following areas:

- repair of the Markala low dam;
- realignment and deepening of several canals and reinforcement of their dikes;
- rehabilitation of about 15,000 hectares which were abandoned because of poor irrigation and drainage;
- improvement through land levelling of 35,000 hectares of rice fields; and
- construction of a third main water canal to replace pump irrigation by gravity -- resulting in an energy savings.

Under this World Bank coordinated assistance program, present food crop production will be increased by 60,000 MT per year. The income of 4,500 farm families in the area will be significantly increased as will that of an additional 2,500 families who will be settled in the area.

The World Bank has suggested a two-phased financing approach to the Office du Niger project: the first two-year phase, calling for \$4 million, will be focused on preliminary infrastructure works, training and improved management systems. During the second five-year phase, calling for approximately \$43 million, the main infrastructure work on the dam, roads and canals would be undertaken. The IBRD has mobilized sufficient first-phase financing and is currently requesting donor pledges for the second-phase work.

### VIII. Utilization of Small-Scale Decentralized Energy Technology

AID expects that opportunities for utilizing decentralized energy technologies will develop as a result of road and river basin development in the Sahel. Small and medium size pumping installations associated with irrigation can be adapted so as to use solar energy to drive the pumps. Irrigation canals carrying water from the main dam storage areas could be fitted with barrages (low dams) to operate small hydroelectric generators for the local supply of energy to several villages. New techniques utilizing induction generators can be developed to connect several such barrages to form an integrated network for rural electrification. Improvements in the road network will provide an impetus to the creation of village industries which, in turn, could utilize decentralized renewable energy sources.

IX. Concluding Word . . .

It is clear from the above that it will become increasingly difficult to meet the basic human needs in the Sahel unless greater attention is paid to the provision of roads and irrigated land. For this reason, AID will be joining with other donors in future fiscal years in providing financing for specific road and irrigation projects where their absence acts as a critical constraint to achieving our objectives of assisting the poor majority in the Sahel region.