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International Fertilizer Development Center

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Volume I–Regional Overview
Volume II–Senegal
Volume III–Mali
Volume IV–Upper Volta
Volume V–Niger
Volume VI–Chad
Volume VII–Mauritania

PREFACE

A series of severe droughts in the late 1960's and early 1970's greatly reduced agricultural production in the Sahelian countries of west Africa. The human suffering during that time led to an international focus on the region in terms of food aid and development assistance.

The U.S. Agency for International Development (USAID) was aware of the contribution of fertilizers to food production and the limited fertilizer use in this region. Thus, USAID requested the International Fertilizer Development Center to determine the current capacity and potential of the Sahelian region to produce, market, and use fertilizers. This series of documents is a result of that assessment. Published and unpublished literature was obtained in each country and from international development agencies. Field level interviews were also conducted.

Principal team members were Ray B. Diamond (team leader), Donald R. Waggoner, and Kham Thanh Pham from IFDC along with Hans Braun on loan from FAO. Many other members of the IFDC staff contributed greatly to the report. Bernard Raistrick (consultant from the United Kingdom) and Travis P. Hignett (consultant from the United States) assisted in preliminary collection and analysis of data before the field visits. Josiah Royce (USAID, REDSO/WA) assisted in data gathering during field visits. Appreciation is expressed to representatives of national agencies, USAID, and other international organizations for assistance.

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ABBREVIATIONS USED IN THIS REPORT

FERTILIZERS

N . . . . . Nitrogen
P . . . . . Phosphorus
P_2O_5 . . . . . Phosphate
K . . . . . Potassium
K_2O . . . . . Potash
B . . . . . Boron
B_2O_3 . . . . . Borate
Ca . . . . . Calcium
S . . . . . Sulfur

Fertilizer Formula–% of N-P_2O_5-K_2O by Weight

AS . . . . . Ammonium Sulfate (21-0-0)
DAP . . . . . Diammonium Phosphate (18-46-0)
KCl . . . . . Potassium Chloride (0-0-60)
KS . . . . . Potassium Sulfate (0-0-50)
PR . . . . . Phosphate Rock
SSP . . . . . Single Superphosphate (0-20-0)
TSP . . . . . Triple Superphosphate (0-45-0)
Urea . . . . . Urea (45-0-0 to 46-0-0)
Cotton Fertilizer 18-35-0-7S

MEASURES

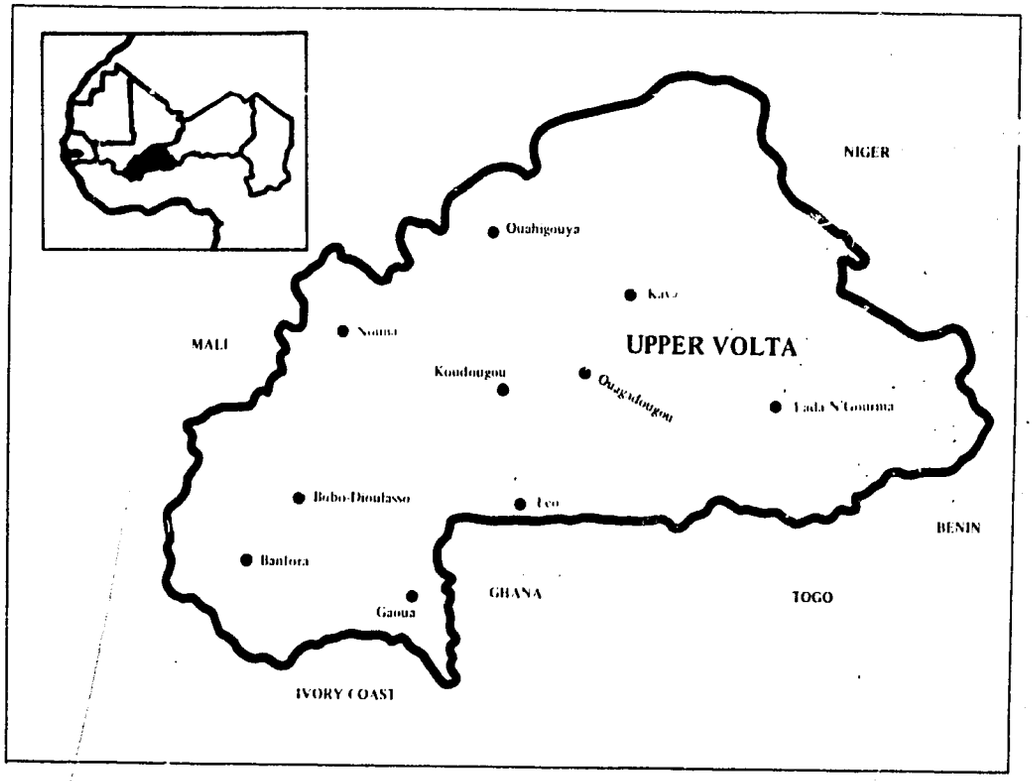
ha . . . . . hectare (2.47 acres)
kg . . . . . kilogram (1 pound = 0.454 kg)
km . . . . . kilometer (1 mile = 1.61 km)
mm . . . . . millimeter (1 inch = 25.4 mm)
mt . . . . . metric ton (2,204 pounds = 1,000 kg)
% . . . . . percent

ECONOMIC AND MONETARY

c.i.f. . . . . cost, insurance, and freight
F CFA . . . . . CFA Franc, currency of the West African Monetary Union (Communaute Financiere Africaine, Franc = US $1 = 225 F CFA)
f.o.b. . . . . free on board
GNP . . . . . gross national product
ROI . . . . . return on investment
WC . . . . . working capital

GOVERNMENTAL AND INTERNATIONAL AGENCIES

AVV . . . . . Volta Valley Authority
BND . . . . . National Development Bank
CFDT . . . . . French Textile Development Company
CIDA . . . . . Canadian International Development Association
FAC . . . . . Development Aid Agency of the French Government
FAO . . . . . Food and Agriculture Organization
FED . . . . . European Development Fund
GOUV . . . . . Government of Upper Volta
IBRD . . . . . International Bank for Reconstruction and Development
IFDC . . . . . International Fertilizer Development Center
IRAT . . . . . Research Institute for Tropical Agronomy
IRCT . . . . . Research Institute for Cotton and Textile Fibers
IRHO . . . . . Research Institute for Oil and Oil Crops
MRD . . . . . Ministry of Rural Development
OFNACER . . . . . National Cereals Office
ORD . . . . . Regional Development Organization
RAN . . . . . Regie Abidjan-Niger
SAFGRAD . . . . . Semi-Arid Food Grain Research and Development
TVA . . . . . Tennessee Valley Authority
UDV . . . . . Voltaic Democratic Union
UNIDO . . . . . United Nations Industrial Development Organization
USAID . . . . . United States Agency for International Development



SUMMARY OF FINDINGS

1. The series of droughts in the late 1960's and early 1970's drastically reduced cereal production in Upper Volta.

2. Cereal imports reached 170,000 mt in 1974 although domestic production about met domestic demand in 1975.

3. Average cereal demand is projected to increase by 25,000 mt annually between 1975 and 1980 and 27,000 mt annually between 1980 and 1985. Urban demand will account for about 25% of the increased food requirements.

4. If domestic food production is not increased, potential cereal deficits could reach 125,000 mt in 1980 and 270,000 in 1985.

5. Constraints on increased food production are low levels of fertilizer use; lack of mechanization; unimproved technology; and unstable crop prices.

6. Agronomic research shows consistent cereal responses under continuous intensive cultivation to N and P, but less consistent responses to K and S.

7. Very little agronomic work has been done on farmers' fields; much more is needed. It appears that fertilization with N and P

is desirable, but S and K only on a selected basis.

8. Further agronomic evaluation of D'Arli and Kodjari PR for direct application is needed to determine their suitability for use in crop production.

9. The current transportation network, if maintained, appears adequate for moving increased quantities of fertilizer to the more populated areas. Improved or new roads are needed to service new production areas.

10. Estimated 1975 fertilizer nutrient consumption is 3,100 mt. Annual nutrient consumption is projected to reach about 5,600 mt in 1980 and 12,400 mt in 1985.

11. The use of imported fertilizer versus importing grain, assuming a grain:yield response of 10 kg grain per kg of nutrient, can save Upper Volta 4.3 F CFA in foreign exchange for each F CFA in foreign exchange spent for fertilizer. That is, 1,000 mt of imported fertilizer nutrients, costing 101 million F CFA, could yield 10,000 mt of grain valued at 435 million F CFA delivered to Ouagadougou.

12. Establishing a bulk blending plant at Bobo-Dioulasso and importing fertilizer materials to blend mixed grades locally can save $564,000 per year by 1980 over importing the mixed grades.

13. Phosphate reserves of more than 100 million mt are estimated to exist in eastern Upper Volta. Detailed characterization is needed to determine potential uses for the ore.

RECOMMENDATIONS

1. Begin a coordinated soil fertility project in liaison with current research and extension groups to obtain on-farm information of crop responses to fertilizer nutrients (including PR).

2. Establish a bulk-blending and bagging facility at Bobo-Dioulasso, either for domestic use or in cooperation with Mali to supply both countries.

3. Conduct a study to characterize and determine potential uses of PR from the various deposits in eastern Upper Volta.

4. Conduct a feasibility study of mining and grinding of PR at Kodjari.

5. Conduct a study to assess the status and needs of extension, credit, and crop marketing institutions.

6. Initiate a study of the effects upon regional and national economies of alternate price stabilization and equalization on agricultural inputs and crops in Upper Volta.

7. Conduct a comparative analysis of social costs and benefits from

expanding land area in production versus increasing productivity per unit of land.

8. Conduct a study of ways to improve statistical reporting in agriculture including the possibility of remote sensing.

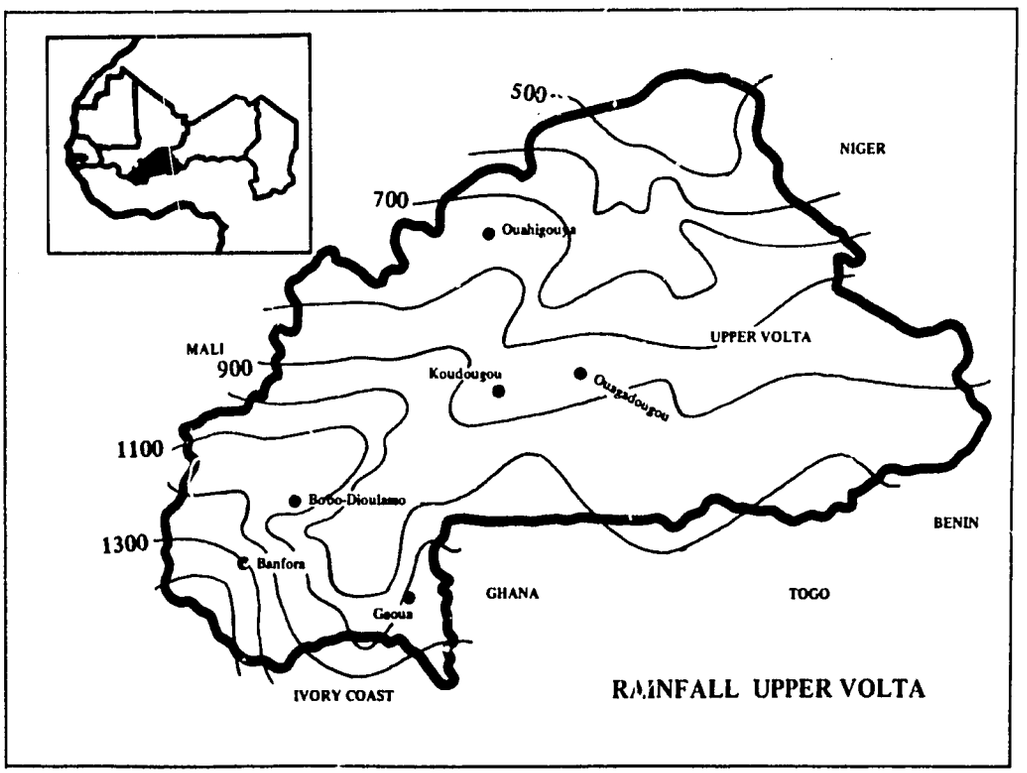
INTRODUCTION

Upper Volta is located between 6°W and 2°E longitude and 10° and 15°N latitude. It is landlocked by Mali on the north and west; Ivory Coast, Ghana, and Togo on the south; and Benin and Niger on the east. The land area is 274,200 km^2 (106,560 mi^2). In 1976, population was estimated at 5.57 million.

Physical Characteristics

Most of Upper Volta lies in the Sudan vegetative zone. Trees of 8-15 m height occur individually intermixed with smaller trees, bushes, shrubs, and grasses. Annual rainfall ranges from 500 mm in the northeast to 1,500 mm in the southwest. More than 100 mm of rainfall per month occurs in 4-5 months of the year with the maximum occurring in August.

Most soils are classified as ferruginous tropical. Sands covered by laterite crusts are extensive in



the northeast, southwest, and central regions. Soils of southern and eastern Upper Volta were developed from granite, gneisses, and schists.

Political Characteristics

Upper Volta achieved independence in 1960. At the time of independence, the dominant political party was the Union Democratique Voltaique (UDV). Upper Volta continued as a one party state until 1966 when the military took control of government and suspended political parties. In 1970, a constitutional referendum and a general election were held. The UDV won a majority of the national assembly seats; Gerard Ouedraogo became prime minister, and Joseph Ouedraogo became national assembly president.

From 1970 until 1974, Upper Volta had one of the few multi-party systems in Africa. Elections were scheduled for 1974, but because of a deadlock between the three leading politicians, a military coup led to a suspension of the constitution. The military, under General Lamizana, formed a "government of national renewal."

Upper Volta's government is currently run by a council of ministers combining both military and civilian members. General Lamizana is president of the council of ministers and head of government. In late 1976, a government commission was drafting a new constitution for Upper Volta.

Cultural Characteristics

The population is composed of several ethnic groups: Mossi (50%), Western Mande (16%), Senoufo (7%), Grunshi (6%), Falani (6%), Lobi (5%), Gourma (5%), and Busansi (5%) (1). French is the official language. Several Sudanic dialects are also spoken. Twenty percent of the population is Moslem. Christian and animist religions are also present.

In 1975, 91% of the population lived in rural areas. Typically, people live in communities of straw-roofed huts and clay dwellings set amid millet fields. Land is assigned to extended families by a tribal or village chief. Slash and burn land clearing and shifting cultivation are practiced for crop growing at subsistence levels. Many Voltans have migrated to Ivory Coast and Ghana in search of employment.

Economic Characteristics

Almost 90% of the population in Upper Volta derives its livelihood from livestock raising and subsistence farming. The agricultural sector accounts for more than 90% of Upper Volta's economic activity. GNP totaled $490 million in 1974 or about $85 per capita (2). Average gross product for the rural sector is estimated at $35 per capita (1/2 of national average) and only about 40% of this is cash income. The export sector is small, accounting for 14% of GNP in 1974. Principal exports were livestock (35% of total exports) and cotton (24% of total exports).

Government spending was greater than income through 1966. The government has corrected these deficits and has shown budget surpluses since 1967. Total foreign aid assistance, however, has been running around $40-50 million per year in recent years.

Upper Volta's financial stability has become increasingly precarious as a result of recent trade deficit. In 1974, imports were valued at 43.1 billion F CFA while exports contributed only 15 billion F CFA (the 28.1 billion F CFA trade deficit is a 67% increase over that of 1973). To date, the trade deficit has been more than offset by foreign aid, French pension payments, and earnings sent home by the nearly one million Voltaics working outside the country.

Although the industrial sector is currently responsible for less than 10% of the country's GNP, it is growing at a faster pace than most other sectors. This sector is receiving

increasing attention from the government in an effort to diversify the economy.

In general, the investment climate in Upper Volta is quite favorable. The country has a liberal investment code which grants tax and custom exemptions (up to 25 years in certain cases), tariff protection, eased foreign currency restrictions, and guaranteed arbitration. The government is pursuing a policy designed to increase Voltaic control of domestic businesses and financial activities. In most cases, Voltaics must hold more than 50% of the stock in a business.

POPULATION AND FOOD NEEDS

Population

The country's population in 1975 was estimated by FAO at about 6 million (table 1), although a December 1975 census found 5.57 million as the resident population. The population growth rate in recent years has averaged about 2.4%/year. The urban population has been increasing at twice the rate as population growth rates in rural areas. Approximately 54% of the population is between the ages of 15 and 65 (table 2).

The population is unequally distributed in Upper Volta. The average overall population density is 18 persons/km^2 (table 3). The central area of the country is the most populated; Yatenga has 43 persons/km^2 and Ouagadougou 35 persons/km^2. The

Table 1. Estimated Population and Growth Rates in Upper Volta (3)

Section of Population	1970	1975	1980	1985	1990
Total, 1,000 persons	5,384	6,058	6,883	7,850	8,993
Rural, % of total	92.8	91.7	90.5	89.2	87.7
Growth rate preceding 5 years					
Total, %/year		2.4	2.6	2.7	2.7
Rural, %/year		2.2	2.3	2.3	2.4
Urban, %/year		5.3	5.4	5.4	5.4
Growth rate of active population preceding 5 years					
Total, %/year		1.9	2.1	2.2	2.3
Rural, %/year		1.5	1.6	1.7	1.7
Urban, %/year		4.9	5.0	4.9	5.1

Table 2. Estimated Distribution of Population of Upper Volta by Age Groups (4)

Age Group, Years	Population, 1,000	Population, % of Total
Under 4	958	18
5-14	1,353	25
15-39	2,098	38
40-64	870	16
Over 65	147	3

western portion is less populated (range 20.6-9.8 per km^2). The eastern portion is the least populated region (range 7.0-6.0 per km^2).

Total Food Requirements

Food requirement projections for Upper Volta are based on FAO data. Two methods have been used for the projection through 1990 (3). One projection (L) assumes that average per capita private consumption levels will remain constant and forecasts food increases based on population changes. The other projection (H) includes elasticity of demand changes, based upon a 1% annual increase in per capita food expenditures and consequent preference changes in food purchases. Neither projection differs much in magnitude from the other.

Table 3. Estimated Distribution of Population of Upper Volta by Region, 1972 (4)

Region and ORDs	Population, 1,000	Density, No./km^2
Western		
Bobo-Dioulasso	326.4	11.5
Dedougou	479.4	16.2
Diebougou	360.0	20.6
Banfora	180.0	9.8
Central		
Ouagadougou[a]	847.6	35.1
Yatenga	531.5	43.2
Kaya	592.6	27.8
Koudougou[a]	719.3	27.9
Koupela	272.6	30.2
Eastern		
Sahel	259.6	7.0
Fada n'Gourma[a]	287.1	6.0
TOTAL	4,856.1	17.9

[a]Without city population.

Estimated food consumption per capita through 1990 is shown in table 4. Per capita consumption of rice, wheat, maize, fruit and meat are projected to increase slightly, while starches such as cassava, sweet potato, and yam will remain relatively constant.

Estimated food requirements for 1975-1990 are shown in table 5. Cereal requirements could increase 28-30% over the 1970 level by 1980; 49% by 1985; and 67-70% by 1990. By 1975, food production had again reached pre-drought levels of 1961-65. Estimated food requirements for major cereals over 1975 levels are shown in table 6. Demand for major cereals is expected to increase an average of 25,000 mt per year between 1975 and 1980. Approximately 270,000 mt of additional cereals will be required between 1975 and 1985.

Urban Food Requirements

A distinction between urban and rural food demand is important in analyzing potential food demand. With large areas of potentially cultivatable land out of production, subsistence type farming (which currently accounts for most of cereal food production) can expand to meet rural food demand. In contrast, urban food requirements must be supplied through some form of commercial agriculture (domestic or imports).

Urban food requirements were derived for major cereals using FAO (H) per capita consumption projections and urban population growth rates (table 7). Urban food demand for millet, sorghum, maize, and rice is expected to increase at a rate of 4,500 mt/year between 1975 and 1980 and at a rate of 5,800 mt/year between 1980 and 1985.

Cereal Supply Situation

Upper Volta has the potential to be self-sufficient in the production of millet, sorghum, maize, and rice,

Table 4. Estimated Levels of Food Consumption for Upper Volta (3)

Commodity	Estimated Consumption, kg/capita/year[a]				
	1970	1975	1980	1985	1990
Millet/sorghum	129.8	130.8	131.0	130.7	129.7
Rice	4.1	4.3	4.5	4.7	4.9
Wheat	4.3	4.6	4.9	5.2	5.5
Maize	10.8	11.0	11.2	11.6	11.8
Yam	3.9	3.9	3.9	4.0	4.0
Sweet potato	5.0	5.1	5.2	5.2	5.3
Cassava	4.6	4.7	4.7	4.8	4.8
Beans/peas	20.2	20.6	21.1	21.5	21.9
Vegetables	11.7	12.1	12.5	12.9	13.3
Peanut	5.8	5.8	5.9	6.0	6.1
Sugar	2.0	2.3	2.5	2.8	3.0
Fruit	6.1	6.3	6.4	6.5	6.6
Meat	9.1	9.7	10.3	10.9	11.7
Fish	1.5	1.6	1.7	1.8	2.0

[a]Figures for 1970 are estimated actual consumption and others are based upon an elasticity of demand.

Table 5. Estimated Food Requirements in Upper Volta, 1975-1990 (3)

	Estimated Food Requirements, 1,000 mt[a]								
	1970	1975		1980		1985		1990	
Commodity	L	L	H	L	H	L	H	L	H
Millet/Sorghum	699.0	786.5	792.2	893.6	902.0	1,019.2	1,025.8	1,167.6	1,166.4
Rice	22.0	24.8	25.9	28.1	30.8	32.1	36.7	36.7	43.9
Wheat	23.0	25.9	27.6	29.4	33.5	33.5	40.7	38.4	49.7
Maize	58.0	65.3	66.9	74.1	77.8	84.6	90.9	96.9	106.5
Sweet Potato	27.0	30.4	30.8	34.5	35.6	39.4	41.1	45.1	47.8
Cassava	25.0	28.1	28.4	32.0	32.6	36.5	37.5	41.8	43.4
Yam	21.0	23.6	23.7	26.8	27.1	30.6	31.1	35.1	35.8
Beans/peas	109.0	122.6	125.1	139.3	144.9	158.9	168.4	182.2	196.5
Vegetables	63.0	70.9	73.4	80.5	86.2	91.9	101.5	105.2	119.9
Peanut	31.0	34.9	35.4	39.6	40.8	45.2	47.2	51.8	54.9
Sugar	11.0	12.4	13.7	14.1	17.2	16.0	21.6	18.4	27.3
Fruit	33.0	37.1	37.9	42.2	43.9	48.2	51.0	55.2	59.6
Meat	49.0	52.2	58.7	62.6	71.0	71.5	86.3	81.8	105.4
Fish	8.0	9.0	9.7	10.2	11.8	11.7	14.4	13.4	17.7

[a]L is based upon per capita consumption at estimated level of 1970 and H is per capita consumption based upon elasticity of demand.

Table 6. Estimated Increased Requirements for Major Cereals Over 1975, Upper Volta (3)

Food[a]	1980	1985	1990
	- - - 1,000 mt- - -		
Millet/sorghum	109.8	233.6	374.2
Maize	10.9	24.0	39.6
Rice	4.9	10.8	18.0
Total	125.6	268.4	431.8

[a]Based upon FAO projections considering elasticity of demand.

Table 7. Estimated Urban Requirements for Major Cereals in Upper Volta, 1975 to 1990 (3)

Food[a]	1975	1980	1985	1990
	- - - - 1,000 mt - - - -			
Millet/sorghum	65.7	85.7	111.2	143.6
Maize	5.5	7.3	9.9	13.1
Rice	2.2	2.9	4.0	5.4
Total	73.4	95.9	125.1	162.1

[a]Based upon FAO projections considering elasticity of demand and assuming urban consumption pattern similar to national pattern.

even though it has depended on cereal imports to supply domestic food demand. The changing cereal supply situation for the early 1960's and recent years is portrayed in table 8.

The per capita supply of cereals has ranged from 148 to 181 kg/person since 1970, averaging 167 kg/person for the period. Adjustments for milling of rice and the typical losses gives an average annual supply of cereals of 150 kg/person which is reasonably close to FAO estimates of consumption. Imports rose markedly in 1973 and 1974. Cereal imports (including grain relief aid) increased to 170,000 mt in 1974.

Reports from Upper Volta indicate that production in 1975 has again reached 1961-65 levels. Total population, however, has increased 30% over this same period. To maintain the per capita consumption levels attained in the early 1960's production would need to be increased by about 290,000 mt over anticipated 1975 production levels.

With average cereal yields of 500 kg/ha, an additional 580,000 ha would need to be brought into cereal production under present technology. As an alternative, 29,000 mt of fertilizer nutrients (assuming a response of 10 mt of grain/mt of nutrient) could also produce the needed 290,000 mt of additional grain.

Table 8. Population and Cereal Supply Situation in Upper Volta, 1961-1974 (2, 5)

Crop	1961-65[a]	1970-71[a]	1972	1973[b]	1974[b]
	-Cereal Production, 1,000 mt-				
Total	956	957	871	829	699
Rice Paddy	34	36	30	32	25
Maize	100	61	59	58	50
Millet	300	328	266	253	220
Sorghum	514	528	512	481	400
Other	8	5	4	5	4
	Cereal Imports, 1,000 mt-				
Total	14[a]	25	41	108	170
Wheat	8	22	34	14	21
Rice	3	2	<1	<1	-
Maize	1	1	6	22	24
Other	2	-	1	22	30
Grain Relief Aid	-	-	-	50	95
	Cereal Exports, 1,000 mt-				
Total	-	-	-	-	-
	Total Supply, 1,000 mt-				
Total	970	981	912	937	869
	-Per Capita Supply, kg/person				
Total	208	181	163	163	148

[a]Average annual rate.
[b]Includes grain relief aid.

The estimated c.i.f. cost of imported sorghum at Ouagadougou was 43,000 F CFA/mt or 12.5 billion F CFA for 290,000 mt. The imported cost of nutrients is considered to be 101,000 F CFA/mt or 2.9 billion F CFA for 29,000 mt. While fertilizer use, without the appropriate cultural practices, would not produce a 10 to 1 yield response, the difference in foreign exchange requirements between imported food (12.5 billion F CFA) and imported nutrients (2.9 billion F CFA) makes increased fertilizer use an attractive alternative in augmenting cereal supply.

The mix between settlement of new lands and programs to expand productivity on existing croplands needs further study. It appears that Upper Volta can best increase crop production through an expansion of cropland and increasing productivity per unit of land.

The cultivated area in Upper Volta can increase through either subsistence or commercial types of farming. It is anticipated that cultivated area will expand as the rural population increases. Subsistence farming feeds only the immediate population and leaves little surplus for export outside the immediate area. Commercial type farming requires increased agricultural production per worker, though greater use of animal traction, fertilizer, and improved cultural practices will be required.

FOOD PRODUCTION

The droughts of the late 1960's and early 1970's have greatly restricted agricultural production. The 1972 to 1974 average production of most crops was 80-85% of 1970 production. It is anticipated that production in 1975 approximately regained the levels of 1969 and 1970. The population index has been increasing steadily while indices of food and agricultural production have been decreasing since 1970 (table 9).

Upper Volta's second 5-year plan (1972 to 1976) provided for 30% of total investment for the agricultural sector. Objectives are: self-sufficiency in food crops, increased production of export crops, settlement of river valleys freed of river blindness with people from the populated central regions.

Agricultural Policy Institutions

Rural development in Upper Volta is the responsibility of Ministry of Rural Development (MRD). Detailed planning, policy decisions, and supervision of all agricultural activities are directed by MRD. The organization contains various technical departments (including Agriculture, Forestry, Livestock, Hydraulics and Equipment, and Rural Education) and Regional Development Organizations (ORD). A Coordinating Committee for Rural Development was established in 1974 to provide coordination of planning at the national and local levels and coordinate assistance to ORD's from the technical departments.

There are 11 ORD's which are geographic administrative units covering the country. ORD's are

Table 9. Indices of Population, Agricultural, and Food Production, Upper Volta (5)

Year	Indices[a]				
	Population	Food Production	Agricultural Production	Per Capita Food Production	Per Capita Agricultural Production
1961	96	83	83	86	86
1962	98	96	97	99	99
1963	100	100	100	100	100
1964	102	111	111	109	109
1965	104	109	109	105	105
1966	106	112	113	106	106
1967	108	115	116	107	108
1968	111	117	120	106	109
1969	113	116	119	103	106
1970	115	117	110	102	104
1971	118	110	113	94	96
1972	120	104	107	86	89
1973	123	87	90	71	73
1974	126	75	77	60	61

[a]World--1963 = 100.

autonomous organizations responsible for extension activities, agricultural credit, marketing, and rural infrastructure (roads, wells, and dams).

Development projects are organized within ORD boundaries and generally recognize the farm as a unit (table 10). Thus, projects cover cash crops as well as food crops to some degree.

Agricultural Marketing

There is no organization established at the national level for the supply of agricultural inputs. The French Textile Development Company (CFDT), a private company, essentially imports all agricultural supplies. ORD's have the responsibility for procurement and delivery of agricultural inputs. Most supplies (seed, fertilizer, pesticide) go to cotton farmers and CFDT distributes to them. CFDT also provides fertilizer to ORD's and they deliver to farmers other than cotton growers.

Crop marketing is handled by CFDT and ORD's. CFDT collects, processes, and markets cotton produced by cooperating farmers. ORD's are designated as the sole buyers of cereals and the National Cereals Office (OFNACER) is obliged to buy from the ORD's. OFNACER was established in 1971 to attempt to stabilize prices. OFNACER purchases, stores, resells grain, and distributes relief food supplies It is estimated that no more than 15% of cereals production is marketed and a large part of this is marketed through private merchants. Therefore, OFNACER has not had a marked affect upon stabilizing prices of cereals.

Agricultural Credit

Agricultural credit to farmers is granted through ORD's. The National Development Bank (BND) loans money to ORD's at 5.5% interest. ORD's, in turn, lend money to farmers. Collection for seasonal credit has been good, since most goes for cotton

Table 10. Characteristics of Regional Development Organizations (ORD's)–Upper Volta (4, 7)

Region and ORDs	Area Cultivated--1972 Total (1,000 ha)	% of Total Area	Rainfall mm/yr	Development Projects Sponsor	Management	Potential
Central						
Ouagadougou	352.1	14.6	750-1,000	FAC	SATEC	Poor
Yatenga	218.4	17.8	600-700	FED	BDPA	Very Poor
Kaya	275.9	12.8	650-800	FAC	CFDT	Poor
Koudougou	342.3	13.0	800-1,000	FAC	SATEC	Mediocre
Koupela	124.5	13.8	700-1,000	Gov't	(CIDR (CIDA (CFDT	Poor
Eastern						
Sahel	133.0	0.4	400-700	-	-	Poor
Fada n'Gourma	147.7	3.1	700-1,000	AID, UNDP	AID, UNDP	Mediocre
Western						
Bobo-Dioulasso	157.7	5.6	1,100-1,200	IBRD	CFDT, IRHO	Good
Dedougou	239.6	8.1	800-1,100	IBRD	CFDT	Fair
Diebougou	143.2	8.2	1,000-1,200	IBRD	CIDR	Good
Banfora	87.0	4.7	1,200-1,400	FED	(Planned)	Good
Total	2,221.4	8.2				

growing and credit payments are deducted at the time of sale of cotton. However, more than 90% of the 1972 equipment loans was overdue. The credit ORD's receive from BND is guaranteed by the government. ORD grants seasonal loans for a period of 6 months for which the farmer pays 10% interest per year. Farmers must make a 50% down payment on 1-year equipment loans and a 35% down payment on 2-year loans. Farmers are charged 11% interest on 1-year equipment loans and 8% on 2-year loans. ORD is fairly free to make seasonal loans, but BND makes the final decision on all equipment loans.

Agricultural Prices

The government policy on pricing of cereals has a primary objective of stabilizing prices and a secondary objective of lower consumer food prices. The Ministry of Commerce and Industrial Development sets prices--producer, industrial, and consumer. The official buying price for millet, sorghum, and maize is 22 F CFA/kg and the selling price is 37 F CFA/kg, although, in actual practice, prices have fluctuated greatly and generally have been low. Agricultural prices for Upper Volta shown in table 11 are about 2/3 of those in Senegal.

Upper Volta has attempted marketing schemes--through cooperatives and licensed traders. The ORD's now have a monopoly on buying grain and OFNACER has a monopoly on selling grain. Each of these organizations can license traders to act in their behalf. ORD's pay traders 1 F CFA/kg for collection and OFNACER sells to traders at 1.5 F CFA/kg less than the consumer price.

Fertilizer Costs and Prices

The cost of cotton fertilizer (18-35-0) in Upper Volta has increased greatly during the last 5 years as shown in table 12. Fertilizer cost and rate of subsidy in recent years are shown in table 13.

Cotton fertilizer was sold to the farmer for 35 F CFA/kg of material in 1973-75. This has resulted in subsidies of 31, 42, and 72% during 1973, 1974, and 1975 crop years, respectively. Anticipated cost of the cotton mix is 74 F CFA/kg for 1976. The subsidized farmer price was expected to remain at 35 F CFA/kg.

Cost:price ratios for crops and forms of fertilizer subsidized and unsubdized in 1975 are shown in table 14. The ratios range from about 2 to 4 for the subsidized farmer cost of fertilizer, indicating that sufficient incentive exists in some cases to adopt fertilizer.

Crop Production

Upper Volta has about 8.9 million ha of potential cropland. Of the potential cropland, 4% receives less

Table 11. Producer Prices for Crops in Upper Volta (4, 7)

	Minimum Producer Prices, F CFA/kg				
Year	Millet/Sorghum	Maize	Rice	Peanut	Cotton
1970	12	13	19	18	32
1971	12	13	19	18	32
1972	12	13	19	19	32
1973	14	15	21	21	32
1974	22	22	30	22	35
1975	22	22	-	-	-

Table 12. Cost of Cotton Fertilizer (18-35-0), Upper Volta

	Cost at Ouagadougou[a]			
	Material		Nutrient	
Year	F CFA/mt	$/mt	F CFA/mt	$/mt
1971	39,940	173.65	75,358	327.64
1972	42,700	185.65	80,566	350.28
1973	50,986	221.68	96,200	418.26
1974	60,454	268.84	114,064	507.25
1975	140,990	613.00	266,019	1,156.60
1976	74,000	321.74	136,623	607.06

[a]CFDT, Ouagadougou.

Table 13. Fertilizer Cost and Rate of Subsidy in Upper Volta, 1973-1975 (8)

Material	1973	1974	1975	1976[a]
	Cost, c.i.f. in Upper Volta, F CFA/kg			
Urea	40	47	-	-
SSP	31	35	-	-
KCl	37	35	-	-
KS	38	40	-	-
DAP	55	58	-	-
18-35-0-7S	51	60	124	74
	Farmer Price for Material, F CFA/kg			
Urea	38	38	38	-
SSP	28	28	28	-
KS	50	50	50	-
DAP	55	55	55	-
18-35-0-7S	35	35	35	35
	Farmer Price for Nutrient, F CFA/kg			
Urea	82	82	82	-
SSP	156	156	156	-
KS	104	104	104	-
DAP	86	86	86	-
18-35-0-7S	66	66	66	66
	Rate of Subsidy, % of Actual Cost			
Urea	5	19	-	-
SSP	10	20	-	-
KS	-32	-25	-	-
DAP	0	5	-	-
18-35-0-7S	31	42	72	53

[a]Estimated price through CFDT.

Table 14. Cost:Price Ratios for Crops and Forms of Fertilizer, Subsidized and Unsubsidized, Upper Volta, 1975

Crop	Fertilizer to Supply Recommended Rates	Cost:Price Ratio	
		Subsidized Fertilizer	Unsubsidized Fertilizer
Millet/sorghum	Urea + DAP	3.9	4.3
Rice	Urea + DAP	2.9	3.1
Peanut	Cotton mix	2.9	10.4
Cotton	Cotton mix	1.9	6.7

Table 15. Cropped Area, Yield and Production in Upper Volta (5)

Crop	Area Harvested 1,000 ha	Yield kg/ha	Production 1,000 mt
		1961-1965	
Cereals, total	1,954	490	956
Rice paddy	45	756	34
Maize	160	624	100
Millet	728	412	300
Sorghum	999	514	514
Sweet potatoes	17	2,108	35
Cassava	6	5,500	31
Cowpeas, dry	301	235	71
Groundnuts in shell	111	526	59
Sesame seed	20.2	235	4.7
Seed cotton	42	160	7
Tomatoes	2	6,204	14
Onions, green	<1	15,019	5
		1970-1974	
Cereals, total	1,890	456	862
Rice paddy	36	889	32
Maize	84	686	58
Millet	731	382	279
Sorghum	1,030	476	490
Sweet potatoes	12.4	2,258	28
Cassava	5	5,200	26
Cowpeas, dry	240	254	61
Groundnuts in shell	135	439	59
Sesame seed	29.5	173	5.1
Seed cotton	87	377	32.8
Tomatoes	3.3	4,691	15.4
Onions, green	<1	13,339	5.4

Table 16. Trends of Crop Production, Upper Volta (5)

Crop	Production, 1,000 mt					
	1961-65	1970	1971	1972	1973	1974
Cereals, total	956	1,032	881	871	829	699
Rice paddy	34	34	37	30	32	25
Maize	100	55	66	59	58	50
Millet	300	378	277	266	253	220
Sorghum	514	563	493	512	481	400
Roots and tubers	88	94	94	90	65	60
Sweet potatoes	35	34	34	32	20	20
Cassava	31	30	30	30	20	20
Yams	23	30	30	28	25	20
Pulses	138	135	125	120	100	95
Cowpeas, dry	71	65	60	60	50	55
Groundnuts in shell	59	68	66	60	63	40
Sesame seed	4.7	6.3	4	5.6	5	4.5
Seed cotton	7	32	45	35	28	24
Cottonseed	4.2	20.2	18	20	14.7	12
Cotton lint	2.3	10.9	10	12	9.8	8
Tomatoes	14	16	15	17	17	12
Tobacco leaves	0.8	0.8	0.8	0.8	0.8	0.6

than 350 mm of rainfall/year, 28% from 350 to 600 mm, 29% from 600 to 800 mm, and 39% more than 800 mm (3). Around 2.4 to 2.7 million ha or less than 30% of the potential cropland is cultivated annually. FAO estimates a potential for irrigation of 190,000 ha. Presently 4,000 ha is under controlled irrigation and 14,000 ha under partial irrigation or uncontrolled flooding. Irrigated land is increasing at a rate of around 400 ha/year. Estimated development costs range from $2,000 to $4,000/ha (4).

Crop area and production in Upper Volta declined between the period 1961 to 1965 and 1970 to 1974 (table 15). Yields of millet and sorghum decreased while rice and maize yields increased. Average production for 1961 to 1965 and annual production since 1970 are shown in table 16. Recent droughts and fluctuating producer prices have been the cited reasons for the decreases. However, tables 15 and 16 show a steady decline rather than the temporary fluctuations which would be anticipated due to drought associated with certain years.

Agricultural production in the densely populated central section of Upper Volta is mainly subsistence agriculture. Millet, sorghum, fonio, and peanuts are the principal crops. Market oriented production of cotton, sorghum, and peanuts is found in western Upper Volta.

Pattern of Land Use

The Department of Agricultural Services estimates that there are 510,000 farms in Upper Volta for an average of 5.26 ha/farm (9). The average size of a rural family is 9.7 persons. The average distribution of crops per farm is shown in table 17.

A recent survey of the Fada ORD area covered by one extension

agent found an average farm size of slightly lower than 4.5 ha (10). The area was distributed among crops as follows: 3.2 ha of sorghum/millet, 0.36 ha of maize, 0.04 of rice, 0.05 ha of cowpea, 0.06 ha of peanut, and 0.22 ha of cotton. Crop distribution for this survey in Fada ORD as well as estimates for Diebougou ORD are shown in table 18. In Diebougou ORD, the mean farm size is estimated at 4.8 ha (11).

Table 17. Estimated Average Distribution of Crops per Farm, Upper Volta (9)

Crop	Surface Area ha	Surface Area %
Sorghum	1.90	36
Millet	1.52	29
Maize	0.24	5
Rice	0.17	3
Fonio	0.18	3
Cowpea	0.18	3
Peanut	0.35	7
Cotton	0.37	7
Other	0.35	7

Cotton production is under the best crop management system in Upper Volta. Some characteristics of cotton production are shown in table 19. There were 110,000 farms growing cotton and the average surface area was 0.55 ha/farm (12). In 1974, of the 61,520 ha of cotton grown, 14% had animal traction, 33% was fertilized at an average rate of 88 kg/ha, and 54% was sprayed with insecticide at least once. Animal traction was greatest in Kaya and Ouagadougou. A greater percentage of growers in Bobo-Dioulasso and Dedougou used fertilizer and insecticide and planted earlier than farmers in other areas. Average yields were highest in these two ORD's. In ORD's with more than 1,000 ha of cotton, average yields ranged from 85 to 849 kg of seed cotton/ha. Other than cotton, few measured crop yields were found for farm conditions. The yields reported in a Fada ORD study are shown in table 20.

Mesnil reported that in Yatenga ORD, under traditional cultural practices, millet yields were 645 and 780 kg/ha in 1965 and 1967 and sorghum yields were 1,020 and 1,140 kg/ha (14). Montgomery reported that a survey of 46 farmers not using fertilizer in 1971 showed average yield of 465 kg/ha (average both millet and sorghum) (8).

Rice yields in the Kou Valley Irrigation Project were reported to be 4.0 and 3.0 mt/ha for the first and second crop of a year (15). In "Operation Terroir-1971," rice yields without fertilizer in bottomlands ranged from 924 to 1,870 kg/ha (16).

IRAT has worked on a model farm with 4.4 ha of cropland near Saria since 1969 (17). There are six per-

Table 18. Estimated Distribution of Land Area by Crops in Two ORD's, Upper Volta (10, 11)

Crop	Surface Area, % Diebougou ORD	Diebougou Dagari Group	Diebougou Lobi Group	Fada n'Gourma Diabo
Millet/Sorghum	86	77	82	66
Cotton	2	10	-	2
Peanut	9	6	-	13
Rice	1	-	4	-
Yam	1	-	9	-
Cowpea	1	7	5	18

Table 19. Characteristics of Cotton Production in Upper Volta (12)

Region and ORD	Area: Cultivated	Area: Traction		Area: Fertilized		Area: Insecticide[a]		Fertilizer Rate When Used	Seeded Before June 30	Seed Yield
	1,000 ha	ha	%	ha	%	ha	%	kg/ha	%	kg/ha
Western										
Bobo-Dioulasso	19.9	2,380	12	11,224	56	16,266	82	96	65	849
Dedougou	16.5	2,592	16	5,206	31	12,371	75	66	70	547
Diebougou	4.0	26	1	563	14	660	16	101	50	264
Central										
Ouagadougou	3.5	757	22	309	9	791	23	91	30	163
Kaya	9.4	2,618	28	209	2	581	6	106	16	85
Koudougou	7.5	85	1	2,460	33	2,191	29	93	25	273
Koupela	0.2	-	-	-	-	-	-	-	-	89
(AVV)	0.2	-	-	200	90	220	100	100	-	453
Eastern										
Fada n'Gourma	0.3	-	-	-	-	-	-	-	-	230
Total	61.5	8,458	14	20,171	33	33,080	54	88	47	497

[a]Area receiving at least one spraying. Most received 2 and some 5 sprayings.

Table 20. Crop Yields in Fada n'Gourma ORD (13)

Crop	Community Development Projects	Diabo	Namounou
	kg/ha		
Millet	642	364	575
Sorghum	923	428	550
Maize	830	-	-
Rice (paddy)	1,772	-	-
Peanuts	631	740	1,030

sons (three active) on the farm. Development was phased to bring one ha per year under improved technology, over four years, arriving at distribution shown in table 21 by the fifth year. Yields of seed cotton and peanuts have averaged about 1,300 kg/ha, rice 1,500 kg/ha, and sorghum more than 2,000 kg/ha.

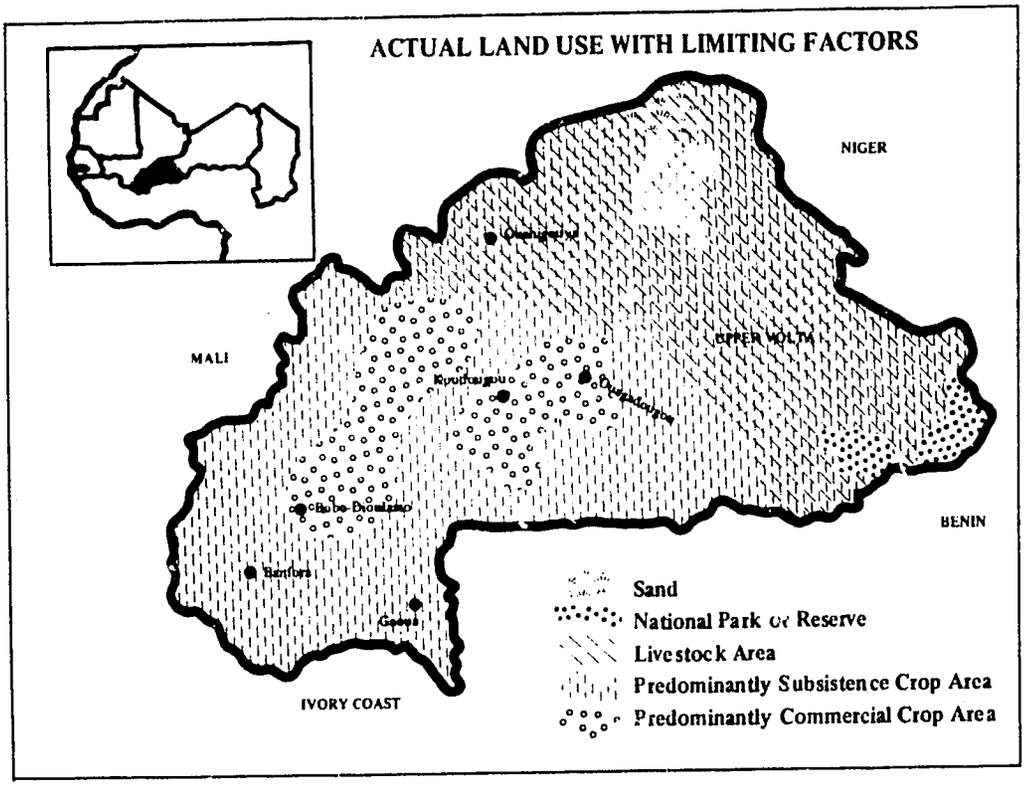
Estimated crop areas by ORD's are shown in table 22. Generally, drier ORD's have over 90% of cultivated land in cereals and wetter ORD's have under 80%.

Crop Production Projects

In Upper Volta there are both integrated rural development and crop production projects. ORD's are responsible for the projects. Examples of rural development projects are Bougouriba Agricultural Development Project (Diebougou ORD) funded by IBRD (11) and Fada ORD Rural Development Project funded by USAID (10). These projects are designed to increase agricultural and livestock production, train extension and ORD staffs, improve roads, and increase ORD capability in delivering agricultural inputs and collecting farm output. Plans for the Bougouriba Project are to introduce improved production technology for 7,000 ha of new cotton area, 2,000 ha of sorghum, 4,000 ha of maize, 2,000 ha of peanut, and 2,750 ha of rice. In the Fada ORD project, plans are to involve 4,000 families in an intensified development scheme by 1980. With the average farm size at 4.5 ha, a total of 18,000 ha is anticipated to be involved in growing millet, sorghum, maize, peanuts, and cowpeas.

Table 21. Distribution of a Model Farm With 4.4 ha of Cropped Land, Saria, Upper Volta (17)

Crop	Area, ha	Labor, Days		Average Yield, kg/ha
		Oxen	Manual	
Cotton	0.8	7.2	142	1,283
White Sorghum	1.6	17.2	82	2,064
Peanut	0.8	8.8	170	1,356
Red Sorghum	0.4	3.8	20	2,551
Rice	0.4	2.0	73	1,555
Garden	0.4	2.0	30	-
	4.4	41.0	517	-


ACTUAL LAND USE WITH LIMITING FACTORS
NIGER
MALI
UPPER VOLTA
BENIN
IVORY COAST
Sand
National Park or Reserve
Livestock Area
Predominantly Subsistence Crop Area
Predominantly Commercial Crop Area

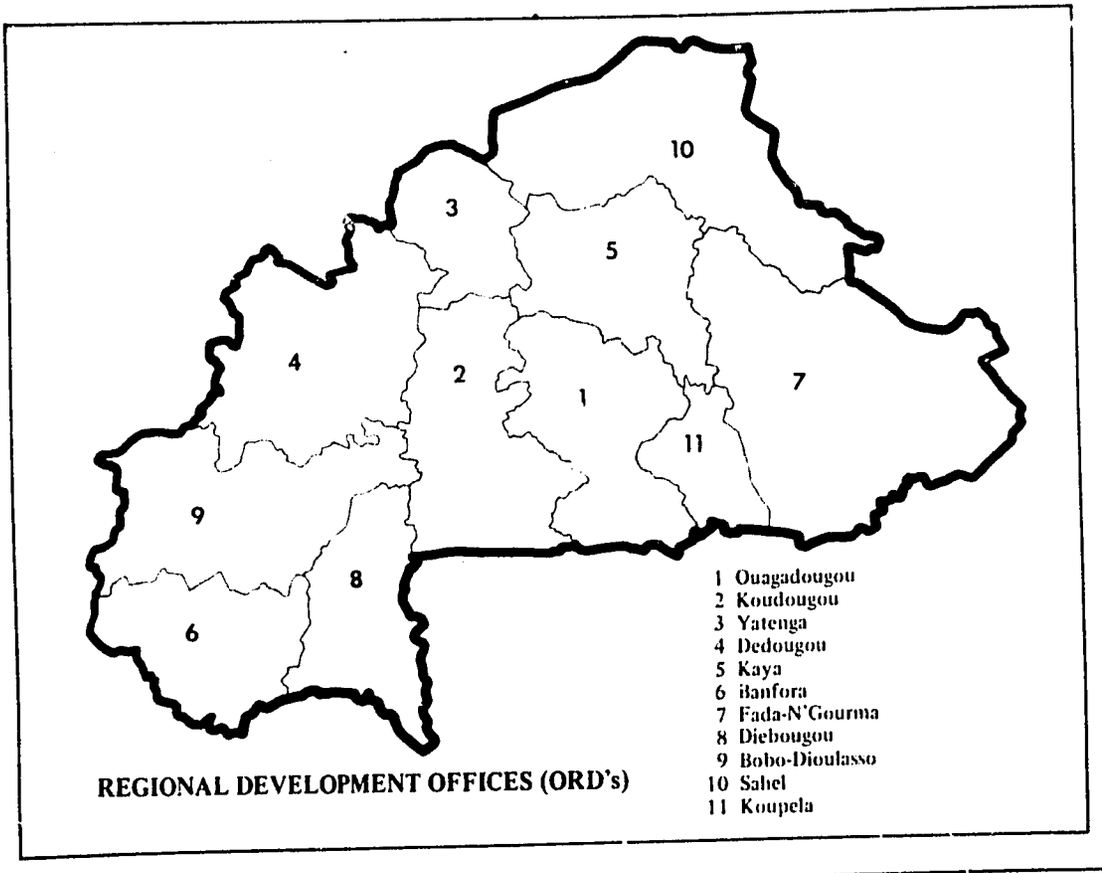

1 Ouagadougou
2 Koudougou
3 Yatenga
4 Dedougou
5 Kaya
6 Banfora
7 Fada-N'Gourma
8 Diebougou
9 Bobo-Dioulasso
10 Sahel
11 Koupela
REGIONAL DEVELOPMENT OFFICES (ORD's)

Table 22. Estimated Total Cropped Area and Area of Major Crops for ORD's in Upper Volta (11, 12, 16)

Region and ORD	Estimated Cropped Area, 1,000 ha			
	Total	Cereal	Peanuts	Cotton
Western				
Bobo-Dioulasso	150	105	11	20
Dedougou	240	200	11	16
Diebougou	200	140	16	4
Banfora	90	70	8	-
Central				
Ouagadougou	490	390	15	4
Yatenga	220	205	9	-
Kaya	290	240	22	9
Koudougou	430	345	8	8
Koupela	130	100	18	-
Eastern				
Sahel	140	130	-	-
Fada n'Gourma	190	155	17	-
	2,570	2,080	135	61

A project to improve peanut and rice production is being undertaken in Banfora ORD with funding by FED and People's Republic of China. The Republic of Germany is funding a crop production program in Dedougou ORD and donated fertilizer in 1974 and 1975 valued at 2.2 million Deutsche mark. Yatenga receives FED funding for a peanut and cereal production project.

An ambitious resettlement scheme which involves introduction of improved crop production technology is operated by the Volta Valley Authority (AVV). The AVV reports to the Ministry of Rural Development and operates across ORD boundaries. The schedule for area to be placed under production is 26,500 ha by 1980 and 60,800 ha by 1985.

AGRICULTURAL RESEARCH

Agricultural research is under the responsibility of the Director of Agricultural Services, Ministry of Rural Development. Technical assistance for agricultural research is conducted under contract to the government by the Research Institutes of: Tropical Agronomy (IRAT), Oil and Oil Crops (IRHO), and Cotton and Textile Fibers (IRCT). IRCT has eight professionals assigned to stations at Saria, Farako-Ba, and Mogtedo; IRHO has three professionals assigned to Saria and Niangoloko; and IRCT has three professionals assigned to Ouagadougou and Bobo-Dioulasso. A new

Table 23. Fertilizer Recommendations in Upper Volta

Crop	Nutrient Rate, kg/ha					
	Light Dose			Heavy Dose		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Sorghum	41	50	-	64	50	30
Millet	41	50	-	41	50	30
Maize	55	50	-	64	50	30
Rice (rainfed)	41	50	-	110	50	30
Rice (irrigated)	41	50	0	110	46	30
Cowpea	9	18	-	18	35	36+s
Peanut	9	18	-	18	35	36+s
Cotton[a]	18	35	-	50	52	30

[a]Cotton fertilizer is 18-35-0-7S-1.1 B_2O_3.

agricultural experiment station is being established in Diebougou with support from IBRD. General fertilizer recommendations of the research institutes are shown in table 23.

Crop Response to Fertilizer

It is generally admitted that for small farmers to use fertilizers, the value of the last increment of yield increase must be twice the cost of fertilizer needed to produce the increased yield. This calculation is called the marginal "value:cost ratio."

In this report, average value: cost ratios are used to indicate the profitability of fertilizer use. When using average value:cost analysis, ratios somewhat greater than 2 would be necessary to provide an economic incentive to the farmer to adopt or increase the use of fertilizer.

Several reports of agronomic research were reviewed for suitable crop response data for regression analysis (17-22). Data for experiments in which there was a zero nutrient treatment and at least 2 positive nutrient rates were pooled and fit to a quadratic function. Optimum N rates were determined for sorghum, maize, and rice for several cost:price ratios, including some similar to the prevailing ratios that currently exist in Upper Volta for subsidized and unsubsidized fertilizer. Data on other crops and nutrients are insufficient to be meaningful for regression analysis.

Montgomery found that value:cost ratios at recommended levels of nutrients were slightly greater than 2 for millet and sorghum (8). However, Montgomery found that value:cost ratios for rice were greater than 5 at recommended rates.

Sorghum--The yield response and monetary returns found for the analyzed experimental data from trials conducted by IRAT between 1964 and 1974 are shown in table 24. The response gives a value:cost ratio of 2.4 for N applied at the optimum rate of 68 kg/ha. This resulted in a yield increase of 656 kg/ha of grain sorghum or 9.6 kg of grain/kg of N. The recommended light dose of N (41 kg/ha) and heavy dose (64 kg/ha) resulted in value:cost ratios 2.98 and 2.50, respectively. The return is 2:1 even with a cost:price ratio of 5.0. The present producer price (22 F CFA/kg of

Table 24. Yield Response and Economics of N Fertilization of Sorghum, Upper Volta

Cost:Price Ratio	N Rate, kg/ha	Yield Increase kg/ha	Yield Increase kg/kgN	Value: Cost Ratio
	For economically optimum N levels			
3	74	676	9.1	3.03
4	68	656	9.6	2.40
5	62	629	10.1	2.02
	For recommended N levels[a]			
4	41	487	11.9	2.98
4	64	638	10.0	2.50

[a]N at 41 and 64 kg/ha are recommended for light dose (popularization) and heavy dose (intensification), respectively.

Yield response equation: $Y = 15.287\ N - 0.0830\ N^2$.

sorghum grain) and the subsidized fertilizer price (38 F CFA/kg of urea) appear to be sufficient to provide an incentive to farmers to use N for sorghum production if farmers can obtain a response of 8 to 10 kg of grain per kg of N.

The mean yield response of sorghum to P_2O_5 in experiments conducted at Saria, Farako-Ba and Nandiala between 1962 and 1970 is shown in table 25. Under these conditions, P fertilization at the level of 50 kg P_2O_5/ha for sorghum was profitable (value:cost ratio of 2.37) even with the P_2O_5 cost/kg at 7 times the price of a kg of sorghum. This 7:1 cost-price relationship is approximately equal to the situation in Upper Volta in 1976 where unsubsidized nutrient cost was about 140 F CFA/kg and the producer price for sorghum was 22 F CFA/kg. At subsidized prices (cotton fertilizer, and urea) and present sorghum prices (cost:price = 3), the above data give value:cost ratio of 5.53 at the rate of 50 kg P_2O_5/ha. A farmer response only equal to 50% of the experimental response obtained, still will give a return of more than 2.

Generally, the K experiments for sorghum show no response for the first 4 to 6 years. A long-term experiment at Saria showed no response in the first 5 years. During the next 5 years, the mean response showed that 50 kg of K_2O/ha/year gave a response of 451 kg of grain/ha (table 25). With 9.0 kg of grain produced per kg of K_2O, the value:cost ratio is 3.00 at a cost:price of 3. A response equal to 2/3 of the experimental response would give the farmer a return of 2 times the cost of investment in K.

Available survey data indicate that on-farm response of millet and sorghum to fertilizer is only 3 to 6 kg of grain per kg of N plus P_2O_5 (8, 14, 16). Data were not documented well enough to determine the nature of yield-limiting factors.

Maize--The agronomic response to N and monetary returns in 22 experiments are shown in table 26. Both light and heavy doses of N appear to provide a reasonable return to the farmer.

For the recommended light dose of N, 17.4 kg of maize grain was obtained

Table 25. General Agro-Economic Analysis of P and K Experiments for Sorghum and Maize in Upper Volta

Nutrient Rate, kg/ha	Mean Yield, kg/ha	Incremental Yield Response, kg/ha	Incremental Yield Response, kg/kg	Value:Cost Ratio at Cost:Price Ratios of 3	4	5	6	7
				- - - - - - - $/$ invested - - - - - - -				
		P_2O_5 for Sorghum						
0	975	-	-	-	-	-	-	-
50	1,806	831	16.6	5.53	4.15	3.32	2.77	2.37
100	1,958	152	3.0	1.00	0.75	0.60	0.50	0.43
		K_2O for Sorghum						
0	1,228	-	-	-	-	-	-	-
50	1,679	451	9.0	3.00	2.25	1.80	1.50	1.29
100	1,849	170	3.4	1.13	0.85	0.68	0.57	0.49
		P_2O_5 for Maize						
0	1,447	-	-	-	-	-	-	-
30	1,916	469	15.6	5.20	3.90	3.12	2.60	2.23
60	2,088	172	5.7	1.90	1.42	1.14	0.95	0.81
90	2,259	171	5.7	1.90	1.42	1.14	0.95	0.81
120	2,330	71	2.4	0.80	0.60	0.48	0.40	0.34
		K_2O for Maize						
0	2,886	-	-	-	-	-	-	-
25	3,367	481	19.2	6.40	4.80	3.84	3.20	2.74
50	3,277	0	0	-	-	-	-	-

Table 26. Yield Response and Economics of N Fertilization of Maize, Upper Volta

Cost:Price Ratio	N Rate, kg/ha	Yield Increase kg/ha	Yield Increase kg/kg N	Value: Cost Ratio
	For economically optimum N levels			
3	93	1,228	13.2	4.40
4	88	1,210	13.8	3.45
5	84	1,192	14.2	2.84
	For recommended N levels[a]			
4	55	958	17.4	4.35
4	64	1,050	16.4	4.10

[a]N is recommended at 64 and 110 kg/ha for light dose (popularization) and heavy dose (intensification), respectively.

Yield response equation: $Y = 23.47\ N - 0.1104\ N^2$.

for each kg of N used; this gave a value:cost ratio of 4.35. The heavy dose was also profitable, based upon the experimental results. The optimum level of N for these trials using the market price of maize and subsidized fertilizer prices was 88 kg/ha yielding 13.8 kg of grain per kg of N with a value:cost ratio of 3.45.

The mean response of maize to P in two experiments at Farako-Ba is shown in table 25. Under present prices of maize and subsidized fertilizer, fertilizer use would be profitable. The first increment of 30 kg of P_2O_5 increased yield by 469 kg of grain or 15.6 kg of grain per kg of P_2O_5. This provides a value:cost ratio of 3.9 at cost:price ratio of 4.

A long-term maize experiment at Farako-Ba showed no response to K during the first 2 years, however, the mean response during the following 6 years was 481 kg of maize grain for 25 kg of K_2O/year (table 25). Response was 19.2 kg of grain per kg of K_2O when 25 kg of K_2O/ha was used. This gave a value:cost ratio of 4.8, at a cost:price ratio of 4. A higher rate did not give additional response. If farmers obtained 50% of the response obtained in these experiments, it would be profitable to apply 25 kg of K_2O/ha at subsidized fertilizer costs. Even at nonsubsidized fertilizer costs, experimental responses are profitable at a rate of 25 kg of K_2O/ha.

Rice--N-rate experiments for irrigated rice were conducted at Kamboinse for 6 years. Responses and returns to applied N are shown in table 27. At current prices, returns to the low and high doses were 22.8 and 14.9 kg of rice per kg of N, giving highly profitable value: cost ratios of 7.60 and 4.97, respectively. Even if 50% of the experimental responses were obtained, farmers would find it profitable to use N at both the low and high dosage rate.

On-farm responses in *"bas fond"* of Konginassa, Sigle-Bakor, and Yargo ranged from 481 to 850 kg of paddy rice for 45 kg of N or 10-19 kg of rice per kg of N (16).

Crop Response to Phosphate Rock--Phosphate rock (PR) from D'Arli was

Table 27. Yield Response and Economics of N Fertilization of Rice, Upper Volta

Cost:Price Ratio	N Rate, kg/ha	Yield Increase kg/ha	Yield Increase kg/kg N	Value: Cost Ratio
	For economically optimum N levels			
2	112	1,645	14.7	7.35
3	107	1,633	15.3	5.10
4	103	1,618	15.7	3.92
	For recommended N levels[a]			
3	41	935	22.8	7.60
3	110	1,641	14.9	4.97

[a]N is recommended at 41 and 110 kg/ha for light dose (popularization) and heavy dose (intensification), respectively.

Yield response equation: $Y = 27.48\ N - 0.1142\ N^2$.

Table 28. Yield Response to PR, Upper Volta (16)

Treatment	Maize at Bane	Sorghum at Linoghin	Sorghum at Saria	Millet at Saria
None	285	1,368	368	617
N + K	814	2,047	690	537
N + K + P (TSP)	1,470	2,117	1,840	1,087
N + K + P (D'Arli light dose)	824	2,232	840	911
N + K + P (D'Arli heavy dose)	932	2,025	768	796

compared with TSP at four locations starting in 1975 (17). Unfortunately, neither the rates of application nor the characteristics of the Arli PR were identified. Yields of maize and sorghum are shown in table 28.

At Linoghin, no response to any source of P was found. In the other three experiments, a good response to TSP was obtained. PR gave no response in maize at Bane or in sorghum at Saria and PR was inferior to TSP in millet at Saria during the first year of application. Previous work by Dumont and Dupont de Dinechin in the mid-1960's showed that Taiba and Togo PR were not as effective as TSP in the first year of application, but were equivalent when used as a basal application followed by maintenance fertilizer (23).

At the present time, the value of Upper Volta PR for direct application is in question. It is not known if the mineralogy or chemistry of these rock deposits are similar. The citrate solubility (a general measure of the reactivity of PR in soil) of Kodjari PR is only about 2.0-2.5%, which is considered to be low reactivity. Further agronomic testing will be needed to determine the profitability of Upper Volta PR for direct application.

FERTILIZER USE AND POTENTIAL

Fertilizer Use

Current fertilizer use in Upper Volta is very low. Generally more than 50% of the fertilizer is used for cotton. Approximately 5,000 mt of fertilizer was used in 1976, an increase of about 2,000 mt since 1971 (table 29). Much of the recent increased apparent use is due to donations of 2,000-3,000 mt of fertilizer in 1974 and 1975.

Estimated nutrient consumption for the period 1972 through 1975 is shown in table 30. The ratio of consumption of N to P_2O_5 is about 2:3 while K_2O use is negligible. In 1975, nutrient consumption was about 1.3 kg of nutrients per ha of cropland.

The distribution of fertilizer by regions is shown in table 31. Most fertilizer is used in the western

Table 29. Total and Cotton Fertilizer Consumption in Upper Volta (8, 12, 16, 24)

Year	Fertilizer Consumption, mt	Cotton Fertilizer, mt
1963	154	30
1964	200	78
1965	391	196
1966	410	227
1967	683	430
1968	1,227	850
1969	1,812	1,351
1970	2,210	1,285
1971	3,159	1,720
1972	2,856	1,500
1973	3,920	1,680
1974	7,418[a]	1,782
1975	5,933[a]	2,500
1976	5,050	

[a]Includes donations.

Table 30. Estimated Nutrient Consumption in Upper Volta (8)

Year	Nutrient Consumption, mt		
	N	P_2O_5	K_2O
1972	545	819	32
1973	792	1,002	182
1974	1,695	1,748	103
1975	1,032	1,698	402

region. By 1972, the Kou Valley rice project was using more fertilizer than some entire ORD's. Bobo-Dioulasso ORD used more than 30% of the consumption in Upper Volta during the period of 1968-1972. In 1975, Bobo-Dioulasso used approximately 2,500 mt of fertilizer, representing nearly 50% of the total used in Upper Volta.

Potential for Fertilizer Use

The real potential for fertilizer use in Upper Volta is very difficult to predict. The actual level of use has been low. Fertilizer has primarily been used for cotton, although some has been used for peanuts and rice. In 1974 only 32% of cotton was fertilized.

The second 5-year plan projected that fertilizer use would reach 9,000 mt in 1976. The study by French Ministry of Foreign Affairs revised the projection downward to 8,400 mt for 1976 while estimating that 11,700 mt would be used in 1978 (16). Both projections were optimistic.

We predict that if the current cost:price relationships between fertilizer and crops continue and ORD's become staffed and equipped to extend improved educational programs in fertilizer use, nutrient consumption could reach 5,500 mt by 1980 and over 12,000 mt by 1985 (table 32).

Increased fertilizer use would primarily occur on farms presently growing cotton (for cotton, peanuts, and sorghum), and in the Fada ORD development project and AVV resettlement projects. This would result in doubling the present consumption by 1980 which is a conservative goal if a real effort is mounted.

In 1980, nutrients could be supplied with 2,200 mt of urea, 5,800 mt of DAP, 1,500 mt of triple superphosphate, and 400 mt of potassium chloride. To provide the S presently recommended for the cotton-mix fertilizer, 2,000 mt of AS could substitute for 900 mt of urea.

The 1985 projected demand can be supplied with 4,300 mt of urea, 6,000 mt of single superphosphate or 2,600 mt of triple superphosphate, 10,000 mt of DAP and 4,800 mt of potassium chloride. If domestic PR is found to be suitable for direct application, it could likely substitute for 1/2 to 2/3 of the phosphate requirement.

Table 31. Fertilizer Use in Upper Volta by ORD (12)

Region and ORD	Fertilizer Use, mt				
	1968	1969	1970	1971	1972
Central					
Ouagadougou	78	98	120	241	219
Yatenga	99	117	251	473	313
Kaya	27	40	70	126	141
Koudougou	112	279	291	306	NA
Koupela	17	-	31	10	7
Western					
Bobo-Dioulasso	133	643	643	943	970
Dedougou	628	390	391	415	397
Diebougou	-	120	76	70	NA
Banfora	133	125	222	305	338
Kou Valley	-	-	115	270	303
Total	1,227	1,812	2,210	3,159	(2,688)[a]

[a]Incomplete data available.

Table 32. Estimated Potential Use of Fertilizer Nutrients in Upper Volta, 1980 and 1985

Crop	Area Fertilized	Nutrient Rate			Nutrient Consumption		
		N	P_2O_5	K_2O	N	P_2O_5	K_2O
	1,000 ha	kg/ha			mt		
				1980			
Cotton	61	18	35	0	1,098	2,135	0
Peanut	30	0	20	0	0	600	0
Sorghum/ maize	10	40	35	0	400	350	0
Rice	3	40	35	0	144	126	0
Sugarcane	2	153	92	120	306	184	240
Total					1,948	3,395	240
				1985			
Cotton	80	20	40	20	1,600	3,200	1,600
Peanut	60	0	20	10	0	1,200	600
Sorghum/ maize	20	40	35	0	800	700	0
Rice	15	60	30	20	900	450	300
Sugarcane	3	150	90	120	450	270	360
Total					3,750	5,820	2,860

FERTILIZER SUPPLY

With the exception of fertilizers bought for specific projects, all fertilizer used in Upper Volta is imported by CFDT. Requirements are determined for the ORD's and the fertilizer is ordered in October from the factory in Abidjan. Fertilizer is received in Upper Volta in December and distribution to ORD's usually is complete by January 15. The material is brought from Abidjan by rail to Banfora, Bobo-Dioulasso, Koudougou, and Ouagadougou. Trucks from CFDT move the material from the railhead to the ORD warehouses as they are collecting cotton and seed. From the ORD warehouse, the fertilizer moves through sector and subsector warehouse to the village warehouse or storage facility. Storage capacity at the railheads and ORD warehouses is considered to be adequate to handle large increases in fertilizer use.

Raw Materials for Fertilizers

Phosphate was the only potential fertilizer raw material found in Upper Volta for which much information was found. Additional references on other mineral deposits are shown in appendix 1.

A dolomite deposit was reported by the Directorate of Geology and Mines, about 30 km west of Bobo-Dioulasso. Dolomite could be useful as a soil amendment to correct soil acidity if it becomes a problem. The location of the deposit may make it economically accessible to Mali and Ivory Coast.

Phosphate--Three deposits of phosphate have been identified in eastern Upper Volta. The deposit located in the area southeast of D'Arli was discovered first (25). Important deposits have been known since 1970 in the region Tansarga-Kodjari, 30 km southeast of Diapaga, near the Diapaga-Kandi road to Benin (26). Recent discoveries (1975) are in the area east of Kodjari at D'Aloub Djouna (27). These deposits probably extend into both Niger and Benin. Estimated reserves and approximate P_2O_5 content of ore from these deposits are as follows:

Deposit	Estimated Reserves, Million mt	P_2O_5, %
D'Arli	3	31
Kodjari	30	26
D'Aloub-Djouna	50-100[a]	29-32

[a]Discussions with Mr. Patain Emile Gamsonre, Acting Director, Directorate of Geology and Mines of Upper Volta, suggest that the reserves here may be closer to 100,000,000 mt.

Although exploration for defining the extent of the deposits and some characterization work has been done on the D'Arli and Kodjari deposits, exploration of the D'Aloub-Djouna deposit is just beginning: German experts are helping with this work.

Two 100-kg samples were brought from the Kodjari deposits by the IFDC study team for testing. Complete chemical and crystallographic studies are in progress. By so doing, estimates can be made of the value of the material for direct application to the soil, manufacture of single superphosphate, phosphoric acid, and triple superphosphates or other materials such as Rhenania phosphate. In addition, an indication can be obtained of the difficulties of beneficiating the ore.

The chemical analyses of the two samples are given in table [illegible]. The solubility in neutral ammonium citrate is 2.3 and 2.4% P_2O_5 for [illegible] 2 and 3, respectively, which indicates that this rock from Kodjari [illegible] be below acceptable reactivity [illegible]its for direct application [illegible] rock has not been used in agronomic tests. Additional characterization work as well as agronomic tests is needed on the various deposits.

A preliminary microscopic examination of 1-kg samples from two pits near Kodjari showed the material to be siliceous phosphorites containing extremely small phosphorite pellets (average diameter of about 50 microns). The matrix is cherty silica and presents several problems in

Table 33. Preliminary Data on Composition of Two Phosphate Rock Samples From Kodjari, Upper Volta[a]

Constituent	Location	
	Pit No. 2	Pit No. 3
P_2O_5, %	26.5	17.5
CaO, %	40.6	23.2
SiO_2, %	26.0	48.3
Al_2O_3, %	2.3	2.7
Fe_2O_3, %	1.6	2.6
MgO, %	0.38	0.15
K_2O, %	0.26	0.32
Na_2O, %	0.15	0.10
C, %	0.40	0.24
S, %	0.07	0.05
CO_2, %	1.1	0.6
F, %	2.4	1.7
Cl, ppm	39.0	18.0

[a]Samples obtained from Patain Emile Gamsonre, Acting Director, Directorate of Geology and Mines. Chemical analysis by Tennessee Valley Authority, Muscle Shoals, Alabama, U.S.A.

beneficiation of the ore to prepare normal commercial concentrates. The small particle size of apatite pellets indicates that liberation by conventional grinding may present technical problems that cannot be overcome. Even if liberation by grinding is possible, the flotation method of concentration of this small phosphate particle size has never been done commercially. However, laboratory tests have indicated it is feasible. Considerable laboratory work is needed on these rocks to determine their potential use. A detailed outline of the test work planned by IFDC is given in the section on potential projects. Actual work will begin in early 1977.

If the deposits in Benin and Niger are proved to be part of or similar to the Upper Volta deposits, the work done on the Kodjari deposit can also be extended to these deposits.

Energy Sources--The preliminary literature survey revealed the possibility of petroleum and gas deposits due to existence of bituminous materials in the Volta depression and west of the Niger river. However, the field team learned through private communication that there are no known indications of exploitable petroleum reserves in Upper Volta.

Production and Plans

Currently, there is no production of fertilizer materials in Upper Volta. However, small-scale production of ground PR for direct application will begin shortly. Mining and grinding machinery has been ordered and was expected to arrive in late 1976. German aid is being used to finance the project. In addition, the assistance of a German expert will be provided to supervise field application and testing of the ground rock.

In 1972, a UNIDO study team recommended the establishment of a bulk-blending facility in Upper Volta for mixing NPK fertilizers (28). As a followup to this study, a German study team has just completed a feasibility study for bulk blending of imported fertilizers. Preliminary indications are that a full-scale blending operation is not feasible at this time.

IFDC has examined the feasibility of a very simple scheme for bulk blending NPK fertilizers based on semi-bulk imports. Details are given in the section on alternate supply schemes.

TRANSPORTATION

International Transportation

Like all landlocked countries in the sub-Sahara region, Upper Volta is burdened with high transportation costs in gaining access to world markets. The primary import/export gates available to Upper Volta are the ports of Abidjan, Tema, Lome, and Cotonou.

The bulk of Upper Volta's international traffic is channeled through the Ivory Coast port of Abidjan. The Regie Abidjan-Niger (RAN) railroad,

which is jointly owned by Upper Volta and the Ivory Coast, extends from Ouagadougou (the capital of Upper Volta) to Abidjan. Total distance via the Ivory Coast route is 1,150 km (29). The railway enters Upper Volta in the southwest and passes through 3 market centers (Banfora, Bobo-Dioulasso, and Koudougou) prior to its termination in Ouagadougou. This is the fastest and most economical international route available to Upper Volta. Trip time via this route is 2 days. Transport cost for bagged fertilizers from Abidjan to various trade centers in Upper Volta are shown in table 34.

Table 34. Rail Transport Rates From Abidjan to Trade Centers in Upper Volta, 1976

Destination	Rate, $/mt
Banfora	27
Bobo-Dioulasso	29
Koudougou	38
Ouagadougou	40

The shortest route from Ouagadougou to the sea is via the port of Tema, Ghana. Total distance using this route is 845 km and requires truck and water transportation. This route has been used very little by Upper Volta in international trade. However, transport cost (about $50/mt) and trip time (3-4 days) do render this a potential alternative to the Ivory Coast route. Frequent cargo transfers and the use of water transportation increase travel time and escalate delivery prices.

Other routes which may be used in accessing world markets pass through Togo and Benin. At present, these routes are not of great importance in Upper Volta's import/export activities. Both routes are more costly, more time consuming, and less reliable than the previously discussed routes. The value of the Benin route may be enhanced considerably if the railway, now terminating in Parakou, is extended to Kandi (Benin) or to some point nearer the Upper Volta border. The feasibility of extending the rail line to Niamey, Niger, is also under consideration.

Domestic Transportation--Upper Volta's internal transportation is primarily by road. The infrastructure consists of about 9,000 km of hard surfaced or gravel surfaced roads and about 8,000 km of tracks. The network of primary roads, approximately 4,450 km, radiates from the centrally located capital, Ouagadougou, and from the main commercial center, Bobo-Dioulasso. The key market areas in Upper Volta are linked by hard surfaced roads and all are within 250 km of one of the major market centers (Ouagadougou and Bobo-Dioulasso). The use of truck transportation provides economical and swift access to the nearby markets. Maintenance is carried out only on the primary network; hence secondary roads have deteriorated to little more than trails and are passable only to heavy trucks and four-wheel drive vehicles and only during the dry season (30).

Road transportation in Upper Volta is controlled by the transport union. Table 35 provides an estimate of the transport cost and distances to key local markets. The current transportation system is capable of serving the domestic demands for travel and distribution.

Upper Volta has no navigable waterways and only one railway, the RAN railroad which is jointly owned with the Ivory Coast. Approximately 520 km of the RAN line is in Upper Volta. The railway intersects the major market center of western Upper Volta (Bobo-Dioulasso) and terminates in Ouagadougou. Railheads are also located in Banfora (85 km south of Bobo-Dioulasso) and Koudougou (100 km west of Ouagadougou). Although the railway has been primarily used in international marketing, domestic utilization of the line is increasing.

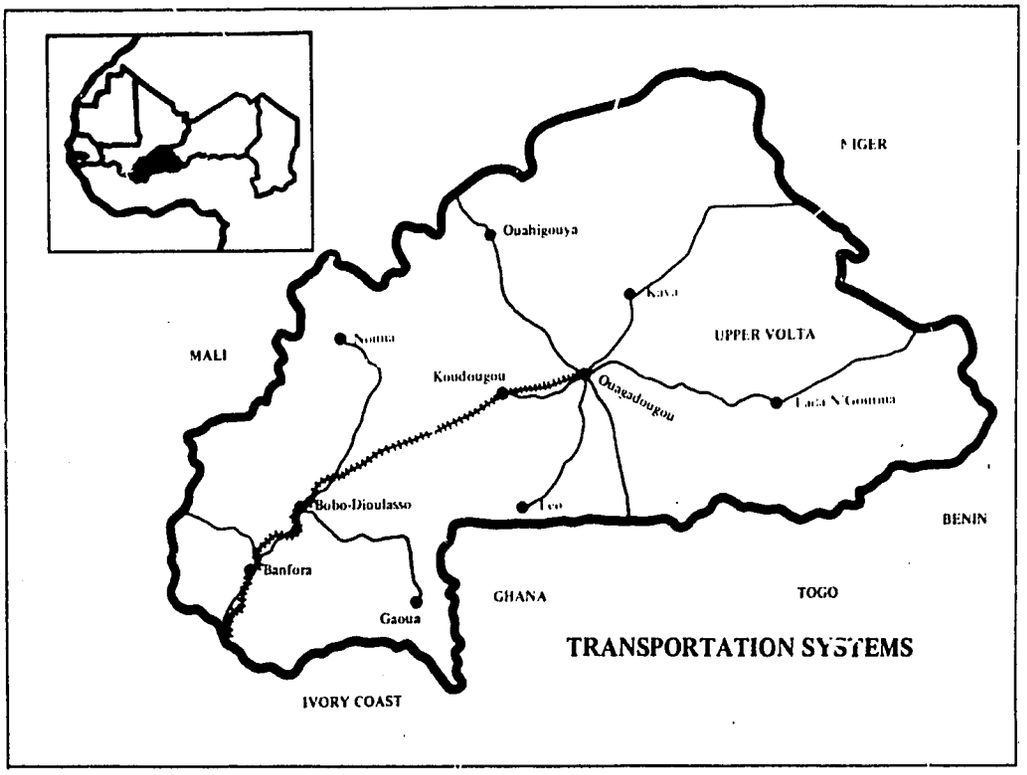


Table 35. Truck Transportation Rates in Upper Volta

From	To	Mode	Distance	Estimated Transportation Cost[a]
			km	$/mt
Ouagadougou	Fada-N'Gourma	Road	223	20.97
Ouagadougou	Kaya	Road	98	11.31
Ouagadougou	Ouahigouya	Road	181	17.72
Ouagadougou	Koudougou	Road	97	11.23
Ouagadougou	Leo	Road	165	16.49
Bobo-Dioulasso	Banfora	Road	85	10.33
Bobo-Dioulasso	Gaoua	Road	212	20.11
Bobo-Dioulasso	Nouna	Road	238	22.13

[a]Includes handling estimated at $3.74/mt.

ALTERNATE SUPPLY SCHEMES

The level of fertilizer use in Upper Volta is low--5,000 mt of material in 1976. The cotton mix (18-35-0-7S) accounts for about 50% of the total material. Because of the small volume orders and the specialty nature of the cotton mix, fertilizers delivered to Upper Volta cost $80 to $100 per mt more than world prices plus freight.

Fertilizer costs can be lowered in Upper Volta by importing in 1-mt containers, bagging and blending at Bobo-Dioulasso. If local PR is found to be feasible for direct application, this source of material may reduce the cost even more.

PR Mining and Grinding

The suitability of local PR in Upper Volta for direct application has not been adequately defined. The Federal Republic of Germany has granted aid to establish a small-scale PR mining and grinding facility at the Kodjari deposit. This facility is expected to be in operation early in 1977. In addition, technical assistance is being provided to help conduct agronomic tests. If the results of agronomic tests prove favorable for use of ground Upper Volta PR for direct application, such deposits may provide a relatively cheap source of P_2O_5 for farmers.

Bulk Blending of NPK Fertilizer

A simple, low-technology type blending facility could be used to provide the NPK mixtures needed in Upper Volta. Raw materials would be brought in 1-mt containers from Abidjan via railroad to Bobo-Dioulasso for blending and bagging. Also, straight nitrogen materials, such as urea, could be received in this way for rebagging. The system from the receiving port through blending and bagging is shown schematically in figure 1. Figures 2, 3, 4 and 5 are photographs of unloading and filling of the 1-mt containers.

The facility would be located in Bobo-Dioulasso close to the railhead. The mixer would have a capacity of 3 mt with the capability of producing 12 mt per hour. Variations in the annual rate would be obtained by simply varying the number of hours operated.

The raw materials received at Bobo-Dioulasso could be stored in the containers. A forklift would transfer material from the containers to small bins. A small payloader would transfer material from the bins to the blending system. Material from the blender would transfer to a small mechanical bagger and to truck loading. The entire operation could be under a shed, in an existing building

or even outside. This very simple operation has an estimated capital investment of about $172,000. Estimations of the raw materials and operating costs for an annual rate of 6,000 mt per year of the cotton grade are given in table 36.

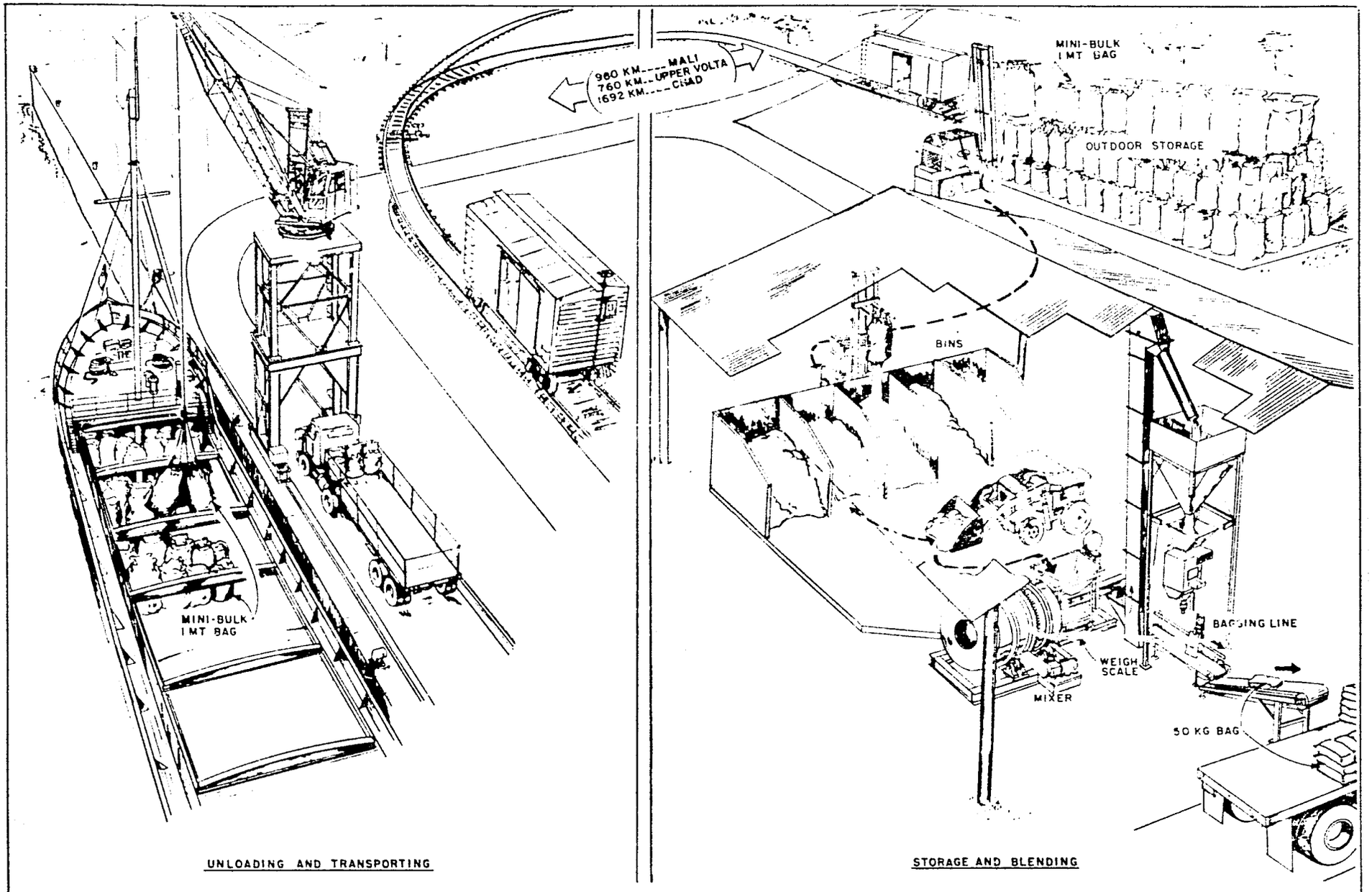
The calculations indicate that the cotton grade can be produced for approximately $224 per mt, allowing a 20% return on investment. For comparison purposes, the same grade delivered at Bobo-Dioulasso for the 1976-77 season cost $318 per mt or $94 more per mt. Based upon a demand projection for 6,000 mt of cotton fertilizer in 1980, the potential annual savings from this method would be $564,000. Potential foreign exchange savings would be somewhat greater.

The anticipated savings justify the installation of the small facility at Bobo-Dioulasso. This plant could also produce approximately 12,000 mt per year for use in the cotton-producing area around Sikasso in Mali. The details of this operation are included in Volume I--Regional Overview of this report.

Table 36. Bulk Blending in Upper Volta–Production Costs for 18-35-0-7S in Plant of 12 mt/h Capacity

Plant Location	Bobo-Dioulasso
Operating Rate, mt/yr	6,000
Investment, $	172,000
Working Capital (Cost of 1/2 of annual production), $ MM	0.6
Grade	18-35-0-7S
Raw Materials	$/mt
18-46-0, $216.28/mt at Bobo-Dioulasso	164.59
AS,[a] $121.77/mt at Bobo-Dioulasso	24.96
Subtotal	189.55
Fixed and Variable Costs	
Electricity, gasoline, etc.	0.15
Operating Labor	0.70
Maintenance (5% of equipment cost)	1.05
Depreciation (15 years)	1.91
Taxes and insurance (2% of investment)	0.57
Supplies (20% of mtce.)	0.22
Overhead (100% of labor)	0.70
Interest (8.5% of 1/2 investment)	1.22
Bags	10.00
Product loss (2% of raw materials)	3.79
Subtotal	20.31
Total Production Cost	209.86
Interest on W.C. (8.5%)	8.50
Ex-Factory Cost	218.36
With 20% ROI[a]	224.09

[a]AS is ammonium sulfate and ROI is return on investment.



BULK BLENDING SCHEME FOR
(1) UPPER VOLTA – MALI, (2) MALI, (3) UPPER VOLTA AND (4) CHAD

Figure 1.

Figure 2. Attaching Hooks to Bags in Ship's Hold

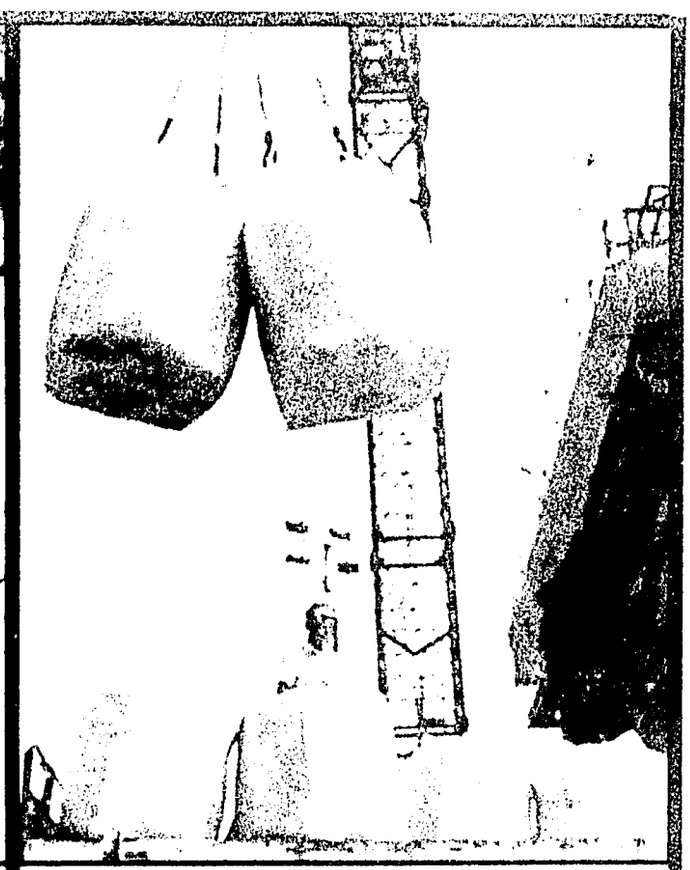


Figure 3. Transferring 1-mt Bags to Truck

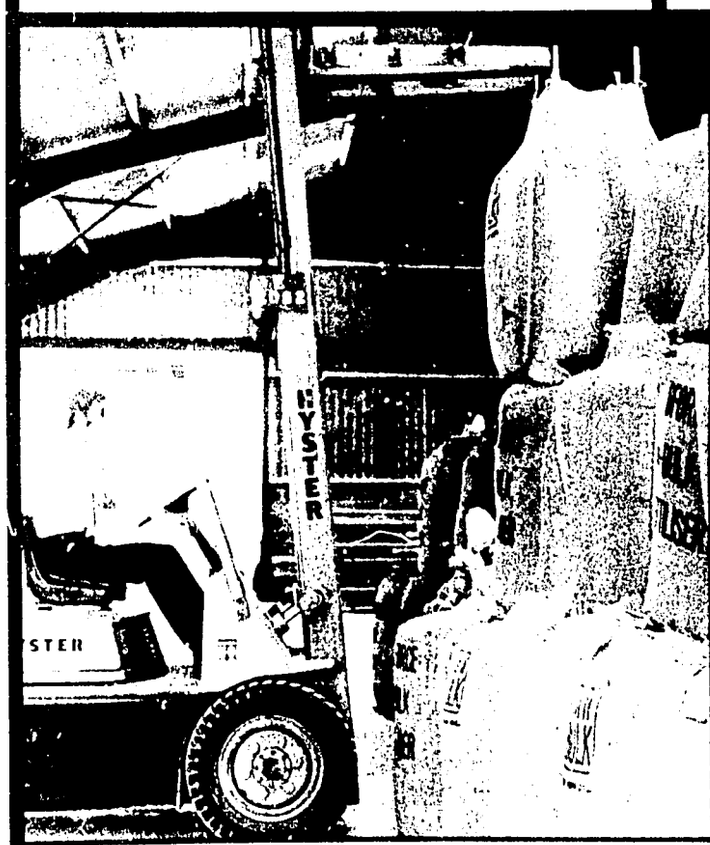


Figure 4. Stacking 1-mt Bags in Storage Area

Figure 5. Filling 1-mt Bags from Bulk Shipment

POTENTIAL PROJECTS

Upper Volta can become relatively self-sufficient in food production. Much of the potential agricultural land is not in use. Much of this land can be brought into production, although some only at high cost. Also, there are the social problems of resettling people from densely populated areas to new lands. In the short run, Upper Volta's agricultural productivity can be increased significantly by the use of improved production practices on current cropland.

Transformation of subsistence farming into commercial agriculture is the key to meeting present and future food requirements. Essential to this process will be market development, more production incentives, new technology, and the increased availability of necessary farm supplies and equipment. A key input in such a development program will be fertilizer, currently only used in limited quantities.

Processed fertilizers can be imported in semi-bulk containers and blended or simply rebagged to supply fertilizers at lower cost than the present system of importing finished fertilizers. Upper Volta has PR deposits of more than 100 million mt of ore. The PR from the various deposits has not been sufficiently evaluated for direct application or for use in chemical processing. Current and 10-year projected fertilizer demands do not warrant the development of chemical processing facilities.

Adoption of fertilizer involves more than just the ability to accurately recommend and supply fertilizer. A stable price relationship between the value of yield gain and cost of fertilizer application must provide an economic incentive to the farmer. Even when this relationship appears to be economically favorable, the farmer may still be reluctant to adopt fertilizer. Extension education and fertilizer response demonstrations are important in assisting the farmer to more accurately evaluate the benefits and risks of fertilizer use.

The following project recommendations are suggested to accelerate the use of fertilizer in Upper Volta:

Soil Fertility Project

A fertilizer trial and demonstration program is needed in Upper Volta to obtain data and demonstrate response for major crops at various levels of on-farm management. Method of land preparation and tillage; varieties; plant population; timing of seeding, weeding, and harvesting; soil

type and soil moisture need to be correlated with crop response to fertilizer.

Domestic PR may offer a cheap means of supplying P_2O_5 if it is found to be suitable for direct application. The effectiveness of Upper Volta PR in providing plant nutrients needs to be determined for the major crops under varying soil and moisture conditions. Phosphate rock should be tested in comparison with other standard PR and soluble phosphate fertilizers. Research findings can then be incorporated into an extension education and demonstration program which can advise farmers on new production practices.

IFDC recommends that an expatriate team of production specialists be assigned to Upper Volta to work closely with existing research and extension organizations to obtain crop response data and demonstrate responses to farmers. Project team members would be responsible for agronomic and economic research on crop response and for training nationals in methods of agricultural research and extension education. The term of the project is 5 years. A detailed description of the proposed project is contained in appendix II.

Phosphate Rock Characterization

In excess of 100 million mt of PR reserves exist in eastern Upper Volta. Little work has been done on the characterization of these ores. The chemical and mineralogical characteristics of the PR found in the various deposits differ. An examination of the PR of Upper Volta is needed to determine their potential for use as a fertilizer.

IFDC recommends a study to determine the quality and ultimate use of the PR in Upper Volta. Details of the proposed study appear in appendix II. Samples will be examined for chemical composition, ore texture, crystal structure, and mineralogy. Results of these tests will indicate the value of these materials for direct application to the soil, manufacture of chemical phosphates such as superphosphate, triple superphosphate, phosphoric acid; or thermally treated phosphates such as Rhenania phosphate, or other materials.

Preliminary examination of samples shows the phosphate exists in a very finely divided state mixed throughout a massive cherty matrix. Therefore, liberation of the phosphate from this matrix can pose some major problems. Several approaches will be studied for liberation of the phosphate.

Feasibility of PR Mining and Grinding

Mining and grinding of PR on a small scale is not widely practiced in the world. However, since transport cost for importing fertilizer into Upper Volta is so high, use of locally available materials is attractive even on a small scale. Timely availability of a cheap source of P_2O_5 would benefit the small farmers and lead to increased crop production. The development of an indigenous resource would provide employment for local labor and also be an excellent starting point for future extension of industrial fertilizer activities.

Although the suitability of Upper Volta PR for direct application has not been verified, IFDC recommends that the feasibility for mining and grinding of rock from the Kodjari deposit be studied. In conjunction with agronomic evaluation and characterization studies, the mining and grinding feasibility study will give a fairly complete identification of the potential of the deposit as a fertilizer raw material.

A study team consisting of a mining engineer and a mechanical engineer experienced in design of grinding equipment should visit Upper

Volta to determine the feasibility of mining, grinding, and bagging the PR. Detailed discussion with appropriate government agencies, visits to the deposits and possible plant sites, development of a mining plan, development of basic design of the process and equipment (including costs), would be key elements in such a study. This study must be conducted in close liaison with the geological assistance group from the Federal Republic of Germany. See appendix II for additional details.

Bulk Blending of Fertilizers

Upper Volta is currently importing about 5,000 mt per year of finished fertilizer materials. A simple low-technology type of bulk-blending facility could be used to supply needed NPK mixtures at a lower cost than imported finished fertilizers.

IFDC recommends the installation of a bulk-blending facility at Bobo-Dioulasso. Raw materials would be shipped to Abidjan in semi-bulk 1-mt containers and then transported to a storage facility in Bobo-Dioulasso. The recommended bulk-blending and bagging operation has a capacity of producing 12 mt per hour.

IFDC recommends an expatriate team consisting of a mechanical engineer and a chemical engineer to work with Upper Voltan counterparts in planning a system to handle 1-mt containers, designing plant layout and writing equipment specifications. The consulting engineers would then assist Upper Voltan engineers in initial assembly and startup activities. The term of the project is one year. See appendix II for additional project detail.

Public Policy Studies on Price Stabilization and Equalization

Fertilizer use is highly dependent upon the relationship between the cost of fertilizer and crop prices.

IFDC recommends that alternative public policies on price support and cost subsidization be studied to determine public policy effects on fertilizer adoption, food production, and overall economic development. IFDC recommends that one expatriate economist work with Upper Voltan economists from the appropriate planning organization to carry out the study. The term of this project is six months. See appendix II for additional detail.

Others

Some other potential projects or studies not included in detail, but which appear to be worthy of investigation are:

1. Study the status and needs of supporting agricultural institutions supplying services in extension education, credit, crop marketing, and input supply.

2. Study methods for improving statistical reporting of information on crop areas in production, yields, and fertilizer nutrient use by crops and areas. The possibility of incorporating aerial sensing into a crop reporting system might be considered.

3. Consider, as a part of the feasibility study for the mining and grinding facility and the preinvestment study for bulk blending or as a separate study, establishing an organization to handle import, production, and distribution of fertilizer. Items that need to be studied include: type of ownership, number of agricultural inputs to be handled, organizational structure, staff training needs, and equipment and building needs.

Estimated Budgets

The estimated foreign exchange

requirements for the budgets for the recommended projects are:

Project	Budget
Soil Fertility, 5 Years	$2,350,000
PR Characterization	53,000
Feasibility of PR Grinding	31,000
Bulk Blending	293,000
Public Policy	31,000
	$2,758,000

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APPENDIX I

FERTILIZER RAW MATERIAL DEPOSITS

IN UPPER VOLTA

UPPER VOLTA

References	Composition of Samples	Location	Other Information
Mem. BRGM 1963, No. 10, p. 182	Pyrites. Sometimes with galena and chalcopyrite	N.E. of Pilimpikou	Frequent occurrence
Ditto, p. 184	Monazite	Zoungou	This is found in the East of the country.
Trav. Labs. Sci. Terre 1975, 8, No. 10, p. 61	13 raw samples were in the range P_2O_5 27-32% SiO_2 26-34 CaO 36-50 Al_2O_3 1-2 Fe_2O_3 1/2-1-1/2	D'Arli, S.E. of Kaabougou (runs into Benin, see this country)	Reserves large, see below also.
Industries et Travaux d'Outremer 1975, 256. 277-8.	P_2O_5 27-31%	D'Arli. Further deposits exist in the region. Kodjari-Tansanga	In 1973 the D'Arli deposit was estimated at 2.7-4 million tons of the analysis given--as sampled, with no washing or selection.
Reference 1	Pyrites	Dacola, Pouny, and Batondo	In basic rocks
Isv. VYSSH. UCHEB. ZAVED., NEFT GAZ 1972, 15(11) 3.	Bituminous materials as indicators of gas and petroleum fields	In the Volta depression and West of R. Niger.	This may be partly in Ghana. The paper is in Russian.

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APPENDIX II

RECOMMENDED PROJECTS

SOIL FERTILITY PROJECT--UPPER VOLTA

Fiscal year proposed for financing: FY 1978

Priority and Relevance

A goal of AID support in West Africa is to assist in increasing food production, particularly to restore balance between production and demand. Major emphasis is being placed on this goal by AID through support of Semi-Arid Food Grain Research and Development (SAFGRAD) and country and sectional crop production and/or integrated rural development projects. Specifically, AID is funding the Eastern ORD integrated development project. Other agencies are funding crop production projects most of which involve some cereal production.

Requirements for millet and sorghum, primary food crops, are projected to increase 110,000 and 234,000 mt by 1980 and 1985 over 1975 food requirements. To help meet these needs, basic and applied research programs are being implemented to develop and distribute drought tolerant varieties adapted to the soil and climatic conditions and to study cropping systems suitable to the area. These programs are much needed and are essential to bring about improved crop production. In addition, other measures are needed to improve crop yields and expand production.

Research on experiment stations has shown good cereal response to fertilizers, particularly N and P.

Very limited agronomic testing of PR from the D'Arli deposit has been done and no testing conducted of PR from other deposits. Data are needed, particularly under farmer conditions, to determine the volume of Upper Volta PR for direct application.

Farm level information is scarce for cereal response to fertilizer. Limited data indicate on-farm response to low levels of application is only about 5 kg of grain/kg of N plus P_2O_5. To maximize the response to fertilizer, improved production practices at the farm level must be implemented. Little is known about farmer attitudes toward acceptance of improved cultural practices. Efforts have been made to introduce changes without much success. The lack of widespread acceptance in many cases may be due to the lack of farmer knowledge, bottlenecks in the delivery system for inputs, limited availability of credit at economical interest rates, inadequate input/output price relationships, and unstable market demand.

Project Description

Each crop specialist would be responsible for conducting 30 to 40 crop production trials or demonstrations of a design suitable to measure the effect of individual plant nutrients, crop variety, plant population, timing of planting and harvesting, soil preparation, and incorporation of residue or manure application. Long-term experiments would be established to determine the effect of crop rotations and the value of residual fertilizer.

Individual trials with PR would be conducted for 3 to 5 years to determine the immediate as well as residual effect. The trials would include equivalent rates of P_2O_5 applied as TSP and PR and the lowest rates of PR with supplemental TSP. In all trials and demonstrations, soil samples would be obtained and analyzed for attempts at correlation of yield response and levels of soil test P and possibly other characteristics. Arrangements would be made for proper analysis of samples at research station laboratories. Rainfall (quantity and distribution) would be recorded at or near each location.

The economist would coordinate statistical and economic analyses of project results, develop practical farm budgets for various cropping and economic situations, and serve as field advisor for a graduate student conducting adoption studies and changes resulting from crop production program.

The study by the graduate student would include documenting at the village level: kinds and number of farmer contacts; availability of credit and other inputs; input and output prices; price fluctuations; availability of markets; acceptance and implementation of new practices; and effect of these on production, labor requirements, and economic well-being. The study would attempt to define the relative importance of various inputs of a crop production program upon the diffusion, acceptance, and implementation of improved cropping practices.

Training sessions would be conducted for extension personnel covering how and why various things are done. In addition, training sessions would be held for cooperating farmers before trials are established, during the growing season, during harvest, and after harvest.

AID and Other Relevant Experiences

AID has funded many applied research, crop production, and extension training projects. The soil fertility project has particular relevance to the SAFGRAD project since it contains an action program to strengthen national institutions and to provide immediate benefits to Upper Voltan farmers.

Beneficiary

Principal beneficiaries of the project are Upper Voltan farmers. Through better defined crop response data and better informed extension advisors, farmers are more likely to increase crop yields and produce more for the time spent for production.

Feasibility Issues

Present farmer price for 50 kg of each urea and DAP (55 kg of nutrients) in Upper Volta is 4,650 F CFA. If a response of 10 kg of grain/kg of nutrient is obtained, the yield increase is 550 kg/ha. Using 22 F CFA/kg as the grain price, the value of the increased yield is 12,100 F CFA/ha or 7,450 F CFA/ha above fertilizer cost.

On the national basis, fertilizing 10,000 ha of millet or sorghum would require 550 mt of nutrients and result in 5,500 mt of additional grain. Estimated economic farmgate value of sorghum based upon world prices, margins, and freight is 37,800 F CFA/mt which gives an economic farmgate value of 208 million F CFA for the additional grain produced from 550 mt of nutrients. These nutrients supplied as urea and DAP would cost 55.6 million F CFA delivered to Ouagadougou (based upon world prices plus freight). Using the same rate for domestic freight and margins

as for grain (these add 6.2 million F CFA), 550 mt of fertilizer nutrients delivered to farms costs 61.8 million F CFA). Thus, there is the potential that each million F CFA spent on fertilizer can yield grain to replace 3.4 million F CFA in grain imports.

Other Donor Coordination

International Bank for Reconstruction and Development (IBRD), Fonds Europeen de Developpement (FED), Fonds d'Aide et de Cooperation (FAC), United Nations Development Program (UNDP), and AID are presently funding crop production projects and/or research and extension activities. The Federal Republic of Germany, Canadian International Development Association (CIDA), and Ford Foundation may be interested in funding for this type of project.

Financial Plan

The annual foreign exchange cost of the project is estimated to be $460,000 or $2.3 million for a 5-year period. In addition, the GOUV would be expected to supply the assistants and field hands for the work as well as office space. It is estimated that about 60% of the salaries budgeted in the first year for technical services would be needed since the project will not be in the field for a full fiscal year. However, support costs will be highest the first year.

Estimated Foreign Exchange Support for Five-Year Project

Technical Services	
Crop Production Specialists - 5 at $45,000 x 5	$ 1,125,000
Production Economics Specialist - at $45,000 x 5	225,000
Support	750,000
	$ 2,100,000
Graduate Student Stipend - 1 at $3,000 x 2	6,000
Support - $17,000 x 2	34,000
Travel - $5,000 x 2	10,000
	$ 50,000
Commodities	50,000
Travel for Specialists, Workshops, Printing and Logistic Support	150,000
Grand Total	$ 2,350,000

Implementation Plan

A contractual agreement will be made with GOUV. The project would be administered by a project coordinator placed in the administration of the Ministry of Rural Development. Very close collaboration would be needed with the managements of ORD's.

Project Development Schedule

Departure, Project Design Team	July 1, 1977
Project Committee Review, Project Paper	October 1, 1977
Review/Approval of Project Paper	December 1, 1977
Project Staff Arrive in Upper Volta	March 1, 1978

PHOSPHATE ROCK CHARACTERIZATION--UPPER VOLTA

Fiscal year proposed for financing: 1977

Priority and Relevance

Extensive reserves of phosphate ore have been identified as follows:

Deposit	Estimated Reserves, mt	P_2O_5 Content, %
D'Arli	3 million	31
Kodjari	30 million	26
D'Aloub-Djouna	50-100 million	29-32

The Federal Republic of Germany has granted assistance for small PR mining and grinding facilities.

There is no current production of fertilizer in Upper Volta nor does current or anticipated demand in the near future seem to warrant production of chemical fertilizer to meet domestic demand. However, phosphate rock (PR) deposits worldwide need to be defined and characterized to provide an assessment of the nature of world reserves.

IFDC has obtained two samples of PR from the Kodjari deposit and begun preliminary analysis. Chemical analysis and characterization of the samples are needed to estimate their quality and ultimate use.

Description of Project

The phosphate in the Upper Volta samples exists in one of the most finely divided states ever observed. In addition, it is thoroughly mixed with a massive cherty matrix. Therefore, liberation of the phosphate from this matrix can pose difficult problems. Several approaches might be used to liberate the phosphate. These are:

1. Simple Grinding for Phosphate Liberation--This entails grinding the entire matrix in such a way that the phosphate is liberated from the silica matrix for further processing or for use as a direct application fertilizer to the soil with no further processing. Such information would be essential if a small cottage industry were to be set up requiring only a very minimal capital outlay.

2. Grinding for Chemical Extraction of Phosphate--This operation would result in a more coarsely ground material, would be less costly, and would result in an ore requiring chemical treatment in order to recover the phosphate. The beneficiated material may be suitable for treatment with sulfuric, nitric, or

phosphoric acid for making such products as single or triple superphosphate. Acid treatments will be conducted to determine potential recovery.

3. Grinding for Physical Liberation Such That the Product Can be Beneficiated by Flotation or Other Means--The objective of this grinding operation will be to produce a product that may not be suitable in its present state for either chemical treatment or direct application, but may be suitable for beneficiation and shipment to another site for further processing.

4. Thermal Modification for Grinding--It is possible to alter through moderately high temperatures (200-400°C) the texture of the rock such that the grinding properties are changed and the recovery of the phosphate rock enhanced. Preliminary experiments, varying the size of grinding and thermal exposure within the range described, will be conducted to determine ease of grinding.

5. Preparation of Thermal Phosphate Fertilizers--Just as it is possible to alter texture of the rock through thermal treatment, so it is possible to enhance the availability of the phosphate itself through such treatments. Studies should be conducted with the two ores at high temperature (1,000-1,200°C) to measure the effects of these treatments on availability of phosphate. The effects of specific additives, such as trona which when treated at high temperatures with phosphate ore yields Rhenania phosphate, should be studied.

AID and Other Relevant Experiences

Unknown.

Beneficiary

The Upper Voltans would benefit from characterization of the PR to determine the most efficient way to utilize it. Processing of local PR for direct application in agriculture could bring immediate benefits through improved fertilization. Chemical processing of Upper Voltan PR may offer potentially longer-run benefits.

Feasibility Issues

Freight costs to deliver fertilizer to Upper Volta are high resulting in extremely high fertilizer costs. Should the indigenous PR prove feasible to use, cost can be reduced considerably.

Other Donor Coordination

The Federal Republic of Germany is funding technical assistance to define the reserves and in agronomic tests of PR for direct application. The above characterization work should be coordinated with the work funded by Germany.

Financial Plan

The foreign exchange cost of the project is estimated to be $53,000.

Estimated Foreign Exchange Support for Project

Analysis of samples	$ 9,000
Grinding experiments	30,000
Thermal treatment experiments	14,000
Grand total	$53,000

Implementation Plan

A contractual agreement would be negotiated.

Project Development Schedule

Time required is 3 months.

FEASIBILITY OF PR MINING AND GRINDING--UPPER VOLTA

Fiscal year proposed for financing: 1978

Priority and Relevance

Reserves of approximately 30 million mt of phosphate rock (PR) exist in the area of Kodjari. The ore contains about 26.5% P_2O_5. Upper Volta is currently using nearly 3,000 mt/year of P_2O_5 or 11,300 mt/year of PR equivalent. Grinding of locally available PR for direct application could be used to supply about 50% of this requirement if the rock proves suitable.

Mining and grinding of PR on a small scale is not widely practiced in the world. However, since transport cost for importing fertilizer into Upper Volta is so high, use of locally available materials is attractive even on a small scale. Timely availability of a cheap source of P_2O_5 would benefit the small farmers and lead to increased crop production. Beginning development of an indigenous resource would provide employment for local labor and also be an excellent starting point for future extension of industrial fertilizer activities.

Description of the Project

Sufficient reserves of PR have been identified in the Kodjari area to support a phosphate industry. Although demand in Upper Volta for P_2O_5 is quite low, there appears to be sufficient demand to support a small grinding and bagging operation.

It is proposed that a study team, consisting of a mining engineer and a mechanical engineer experienced in design of grinding equipment, visit Upper Volta to determine the feasibility of mining, grinding, and bagging the PR. It is anticipated that accomplishment of this objective will require detailed discussion with appropriate government agencies, visits to the deposits and possible plant sites, development of a mining plan, development of basic design of the process and equipment (including costs), and preparation of a report detailing the findings and recommendations.

The time required for the mining engineer is estimated at 3 weeks, 1-1/2 weeks for preparation and report writing, and 1-1/2 weeks in-country. The time required for the mechanical engineer is estimated at 4 weeks, 1-1/2 weeks for preparation and report writing, and 2-1/2 weeks in-country. In addition, a preliminary engineering study (preinvestment) would be carried out by a firm familiar with mining and grinding equipment.

The overall objective of the study should be to review current plans for exploitation of PR deposits in Upper Volta and make detailed recommendations for mining, grinding, and bagging PR for direct application.

Specific objectives should be as follows:

1. Review the plans of the Government of Upper Volta for exploitation of the Kodjari area phosphate deposits.
2. Study the available geological data and the actual mine site and devise a mining plan.
3. Determine the optimum location for the grinding and bagging facility.
4. Recommend equipment components, configuration, and size for mining and grinding the phosphate rock for direct application.
5. Make a preliminary engineering study for a plant to meet the above objectives. This would include major component selection, general arrangement engineering, and an accurate cost estimate for the plant.

AID and Other Relevant Experiences

AID is interested in industrial and agricultural development in developing countries. This study investigates the feasibility of a project dealing with both types of development.

Beneficiary

Small farmers in Upper Volta will benefit from a cheaper source of fertilizer, should the study prove the feasibility of the project.

Feasibility Issues

None. A feasibility study seems to be one of the first steps toward determining the potential use of Upper Volta's PR.

Other Donor Coordination

UNIDO and the Federal Republic of Germany have sponsored studies dealing with fertilizers in Upper Volta. The Federal Republic of Germany is supporting exploration of PR deposits and has granted assistance in establishing a small grinding plant.

Financial Plan

The foreign exchange requirement for the study is estimated to be $31,000.

Mining engineer, 3 weeks @ $1,500/week	$ 4,500
Mechanical engineer, 4 weeks @ $1,000/week	4,000
Support	7,500
Preliminary engineering study	15,000
	$31,000

Implementation Plan

A contractual agreement will be made with GOUV. The study should be conducted in close collaboration with Directorate of Geology and Mines of the Ministry of Commerce, Industrial Development and Mines.

Project Development Schedule

Total time required for the study is 2 months, including the preliminary engineering study.

BULK BLENDING OF FERTILIZERS--BOBO-DIOULASSO

Fiscal year proposed for financing: 1978

Priority and Relevance

Upper Volta is currently using about 2,500 mt/year of mixed fertilizers. All of this requirement is imported as finished materials. A simple low-technology type bulk-blending facility could be used to provide the NPK mixtures needed in Upper Volta at lower costs than the imported finished goods.

Description of Project

Raw materials such as diammonium phosphate, ammonium sulfate, and potassium chloride would be imported at Abidjan in semi-bulk, 1-mt containers. The containers would be shipped to Bobo-Dioulasso. The raw materials would be stored in the containers and fed into a simple bulk-blending, bagging operation capable of producing 12 mt/hour.

AID and Other Relevant Experience

The classical approach to bulk blending is to receive raw materials in bulk into a bulk storage and handling facility. For this project, raw materials would be received in semi-bulk 1-mt disposable containers which would eliminate the need for expensive bulk handling and storage facilities.

Beneficiary

Timely arrival of cheaper fertilizers would benefit the small farmers and lead to increased crop production. Establishment of a bulk-blending facility would also provide an excellent starting point for future extension of industrial fertilizer activities.

Feasibility Issues

Calculations of the cost of producing 6,000 mt per year of a 18-35-0-7S grade at Bobo-Dioulasso are summarized in table 36. Allowing for a 20% return on investment, the ex-factory cost is estimated to be approximately $224 per mt. For comparison purposes, the current delivered cost of the same grade at Bobo-Dioulasso is about $318 per mt or a difference of $94. It is evident that a bulk-blending facility at Bobo-Dioulasso to produce mixed grades for Upper Volta can be justified.

Other Donor Coordination

UNIDO and the Federal Republic of Germany have sponsored studies for bulk blending. These groups might be willing to participate in this project.

Financial Plan

Capital investment required for the facility has been estimated at $172,000. This estimate includes machinery, freight on machinery, spare parts, concrete pads, foundations, and installation. Land and building costs have not been included. In addition, technical expertise will be required to help with the following:

1. Work out details of importing and handling the 1-mt containers.
2. Choose site for location of the equipment.
3. Assist in design of the plant layout and writing specifications for the equipment.
4. Assist in evaluating equipment bids and expediting purchase of equipment.
5. Prepare operating instructions for the facility.
6. Startup of the facility.

Following is an estimate of manpower and associated costs for performing these functions:

Estimated Foreign Exchange Financial Support for One-Year Period

Capital Investment	$ 172,000
Preinvestment Study	18,000
Technical Services	
Chemical Engineer - 1 at $40,000/year x 0.7	28,000
Mechanical Engineer - 1 at $40,000/year x 0.3	12,000
Support	30,000
Subtotal	$ 70,000
Training	
Specialty - 3 at $100/day x 90	27,000
Travel - 3 at $2,000 each	6,000
Subtotal	$ 33,000
Grand Total	$ 293,000

Implementation Plan

A two-man team consisting of one chemical engineer and one mechanical engineer, should visit Upper Volta for 4 weeks to assist in working out details for handling the 1-mt containers. A plant site must be chosen followed by design of plant layout, and writing equipment specifications. Two Upper Voltans should be provided as counterparts to the team. The two counterparts selected should be the two key persons chosen to operate the facility when built. One should be familiar with operation of mechanical equipment and the other with importation and shipping of goods in Upper Volta.

Subsequent visits of the consulting engineers should coincide with the arrival and assembly of equipment, receiving of raw materials, and startup of the facilities.

It is not clear into what institutional framework the bulk-blending operation will be placed. CFDT presently imports fertilizer as well as other agricultural inputs. However, it seems likely that a separate (private or public) agricultural supply organization (either exclusively dealing with fertilizer or covering a wider range of agricultural inputs) should be considered for the operation of the bulk-blending facility.

Project Development Schedule

Choice of Voltan counterparts and arrangement for team visit	July 1, 1977
Initial team study plus final preparation of project details and specifications	October 1, 1977
Bid invitations and bid evaluation	December 1, 1977
Equipment fabrication	February 1, 1978
Equipment delivery	April 1, 1978
Erection and startup	July 1, 1978

STUDY OF PUBLIC POLICIES ON PRICE STABILIZATION AND EQUALIZATION--UPPER VOLTA

Fiscal year proposed for financing: 1978

Priority and Relevance

Fertilizer use level is highly dependent upon the cost-price relationship between fertilizer and a crop although other factors influence fertilizer use. Farmers tend to maximize net returns and do not use fertilizer if returns do not cover the cost plus risks involved.

Generally, a kg of nutrient can be expected to give 8 to 10 kg of cereal grain. At current world prices for grain and fertilizer nutrients, imports of grain would cost 3.5 to 4.0 times the cost of fertilizer to produce the grain in Upper Volta. An in-depth analysis would require consideration of many other factors.

Description of Project

This study would describe alternative public policies on price stabilization and equalization; subsidies for crops, fertilizers, and other related inputs; their implementation; effects upon fertilizer use; and the effects on the

economy of the country sectors and regions. It would furnish guidelines for establishing policies related to fertilizer use which could effectively meet government goals. The study would require one expatriate economist working with one or more economists from the national planning agency. The study could be completed in 6 months.

AID and Other Relevant Experiences

The nature of other studies in this area financed by AID is unknown.

Beneficiary

Agricultural development would benefit rural and urban sectors. Increasing self-sufficiency in food through appropriate agricultural price and incentive policies would substantially strengthen Upper Volta's international positions by helping to correct current balance of payment problems.

Feasibility Issues

Establishing favorable fertilizer product prices could result in increased fertilizer use and increased food crop production, provided other inputs are available for favorable response of crops to fertilizer. Since cost:price ratios have varied over the years, the establishment of clearer guidelines could increase stability in agriculture and contribute to a more sustained trend in agricultural development.

Other Donor Coordination

Unknown.

Financial Plan

The foreign exchange cost of the study is estimated to be $31,000. In addition, the local government would be expected to supply one or two local economists to work on the project.

Estimated Foreign Exchange Support for the Study

Technical Services	
Economist - 1 at $30,000 x 0.5	$ 15,000
Support	10,000
Travel	5,000
Publication	1,000
	$ 31,000

Implementation Plan

A contractual agreement would be made with the local government. The study would be undertaken with the national planning agency. It would require cooperation and assistance from Ministry of Rural Development, Ministry of

Commerce and Industrial Development, Coordinating Committee for Rural Development, and ORD's.

Project Development Schedule

Visit to the country for project negotiation	July 1, 1977
Visit to field for data gathering (2 months)	October 1, 1977
Completion of study	April 1, 1978

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