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Agricultural Sector Assistance Strategy For Upper Volta

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PREFACE

The purpose of this report is to formulate and recommend an agriculture sector assistance strategy for AID in Upper Volta for the period 1983 to 1988. In accordance with the terms of reference, the excercise consisted of the following activities:

- Description of the agriculture sector;
- Specificaction of target groups;
- Analysis of constraints to increased production; and
- Preparation of a sector assistance strategy.

The final stage of this effort was the preparation of a PID for an Agriculture Sector Program Grant covering the 1983-88 period.

The information gathering and analysis for this report was carried out in Upper Volta by a nine-person team during seven weeks extending from October to December 1981. The members of the team were:

- Roger Poulin, macro-economist and team leader;
- Elon Gilbert, agricultural economist;
- David Gow, rural sociologist;
- Warren Leatham, irrigation engineer;
- James Ogborn, agronomist;
- Albert Sollod, animal production specialist;
- Fred Sowers, environmentalist;
- Roger Steinkamp, agricultural extension specialist; and
- Thomas Stickley, agricultural economist.

All of the team members were provided by Development Alternatives, Inc. under an IQC, except Fred Sowers who was under a personal services contract with USAID/Ouagadougou.

A preliminary draft of this report and the PID were left with the AID Mission in early December. The final draft of the PID was completed in Washington by Roger Poulin, David Gow, and Thomas Stickley in December and sent to USAID/Ouagadougou in early January 1982.

This report, which contains the Agriculture Sector Assistance Strategy, but not the PID, was finalized and translated into French in Washington during January and February. The report is divided into three parts:

I. Background on the agriculture sector and the rural population.

II. Analysis of constraints to increased production.

III. Recommended USAID sector assistance strategy.

Readers familiar with Upper Volta and concerned primarily with the policy and program implications of the analysis are referred to Part III which includes a brief summary of the analysis and findings of Part II.

The cooperation of USAID/Ouagadougou and the Ministry of Rural Development was excellent and invaluable in the preparation of this report. The team wishes to express special appreciation to the USAID Program Office and the Direction d'Etudes et Projets in MRD for the dependable logistic support and useful insights, guidance and suggestions that were provided during our stay. The assistance of the SAFGRAD and ICRISAT staffs in Ouagadougou and Kamboinse is also gratefully acknowledged.

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LIST OF ABBREVIATIONS

AID	- U.S. Agency for International Development
AP/CFDT	- Association pour la Participation/Compagnie Francaise pour le Developpement des Fibres Textiles
ARCOMA	- Atelier Regional de Construction de Materiel Agricole
ATA	- Agent Technique Agricole
ATS	- Agent Technique Specialise
AVV	- Autorite des Amenagements des Vallees des Volta
BCEAO	- Banque Centrale des Etats de l'Afrique de l'Ouest
BOAD	- Banque Ouest-Africaine de Developpement
BND	- Banque Nationale de Developpement
CAP	- Centre Agricole Polyvalent
CCCE	- Caisse Centrale de Cooperation Economique
CEAO	- Communaute des Etats de l'Afrique de l'Ouest
CERCI	- Centre d'Experimentation sur le Riz et les Cultures Irriguees
CFJA	- Centre de Formation des Jeunes Agriculteurs
CILSS	- Comite Permanent Interetat pour la Lutte Contre la Secheresse Au Sahel
CIMMYT	- Centro Internacional de Mejoramiento de Maiz y Trigo
CIP	- Commodity Import Program
CNCA	- Caisse Nationale de Credit Agricole
COREMMA	- Cooperative Regionale de Montage de Materiel Agricole
CRTA	- Centre de Recherche sur les Trypanomiares Animales
CRTO	- Centre Regional de Teledetection de Ouagadougou
CSPPA	- Caisse de Stabilisation des Prix des Produits Agricoles
CSRA	- Comite Specialise de la Recherche Agronomique

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CTAS	- Conducteur de Travaux Agricoles Specialises
CVC	- Conseil Villageois de Centre
DAF	- Direction d'Alphabetisme Fonctionnel
DEP	- Direction d'Etudes et de Projets
DFJA	- Direction de Formation des Jeunes Agriculteurs
DFSA	- Direction de la Formation Scolaire Agricole
DGRST	- Direction Generale de la Recherche Scientifique et Technologique
DIRC	- Direction des Institutions Rurales et du Credit
DSA	- Direction des Services Agricoles
DRD	- Departement de Recherche et de Developpement
ENESA	- Ecole Nationale d'Elevage et des Industries Animales
FAC	- Fonds d'Aide et de Cooperation
FAO	- Food and Agricultural Organization
FDR	- Fonds de Developpement Rural
FED	- Fonds Europeen de Developpement
FSU	- Farming Systems Unit (SAFGRAD)
FSR	- Farming Systems Research
GDP	- Gross Domestic Product
GERDAT	- Groupement d'Etudes et de Recherches pour le Developpement de l'Agronomie Tropicale
GERES	- Groupement Europeen de Restauration des Sols
GJA	- Groupement des Jeunes Agriculteurs
GOUV	- Government of Upper Volta
HER	- Direction de l'Hydraulique et d'Equipement Rurale
ICRISAT	- International Crops Research Institute for the Semi-Arid Tropics

IDA	- International Development Association
IDR	- Ingenieur de Developpement Rural
IFAD	- International Fund for Agricultural Development
IFDC	- International Fertilizer Development Corporation
IFPRI	- International Food Policy Research Institute
IGHV	- Institut Geographique de la Haute Volta
IITA	- International Institute of Tropical Agriculture
ILCA	- International Livestock Center for Africa
IRAT	- Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres
IRCT	- Institut de Recherches sur le Coton et les Textiles
IRFA	- Institut de Recherches des Fruits et Agrumes
IRHO	- Institut de Recherches sur les Huiles et les Oleagineux
IRRI	- International Rice Research Institute
ISP	- Institut Superieur Polytechnique
ITA	- Ingenieur de Travaux Agricoles
IVRAZ	- Institute Voltaique de Recherches Agronomiques et Zootechniques
MRD	- Ministry of Rural Development (Ministere du Developpement Rural-MDR)
MSU	- Michigan State University
OCP	- Onchocerciasis Control Program
OFNACER	- Office National des Cereals
ONBI	- Office National des Barrages et de l'Irrigation
ONERA	- Office National de l'Exploitation des Ressources Animales
ORD	- Organisme Regional de Developpement
PAPEM	- Point d'Appui de Prevulgarisation et d'Experimentation Multi-locales

RDF	- Rural Development Fund
RHV	- Republique de Haute-Volta
RMWA	- Resident Mission, West Africa (World Bank)
SAED	- Societe Africaine d'Etudes et de Developpement
SAFGRAD	- Semi-Arid Food Grain Research and Development
SNS	- Service National des Semences
SOFITEX	- Societe des Fibres et des Textiles
SOSUHV	- Societe Sucriere de la Haute Volta
SOVOLCOM	- Societe Voltaique de Commercialisation
SWID	- Strengthening Women in Development
TVS	- Training and Visit System
UNDP	- United Nations Development Program
URCOMAYA	- Union Regionale pour la Commercialisation Maraichere de Yatenga
UVOCAM	- Union Voltaique des Cooperatives Maraicheres
VDF	- Village Development Fund

PART I

BACKGROUND

PART I

BACKGROUND

INTRODUCTION

Upper Volta is a Sahelian country classed as one of poorest of developing nations. However, its environment is not uniformly Sahelian, nor is the country without significant potential for agricultural development. It possesses ecosystems ranging from the near arid in the north to the sub-humid in the south. Within its borders is a diversity of peoples who have successfully developed economic and social systems adapted to the natural resource base.

Part I of the agricultural strategy report explores this variation in Upper Volta's natural, cultural, economic, and institutional landscapes. The purpose of this exposition is to lay the groundwork for the constraint analysis presented in Part II, which leads to the overall and AID-specific agricultural strategy recommendations in Part III, the concluding portion of the report.

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CHAPTER ONE: THE NATURAL RESOURCE BASE

The most important factor in Upper Volta's agricultural development potential is great diversity of the environment. The monotonous savanna, as it is so often described, in fact contains a myriad of micro-habitats, each offering its own productive potential. Herders, farmers, and their production systems are finely tuned to these differences, as must be any strategy used to introduce changes successfully. While recognizing the importance of these many and diverse land units, it is still possible to outline their general patterns.

THE CLIMATE

Upper Volta is characterized by a wet-dry tropical climate. Seasonal alteration occurs as moist tropical air masses give way to the dry, subtropical high pressure air masses of the Sahara. As a result, there is a single rainy season between May and October followed by a dry season of about equal duration. Cooler temperatures accompany the early part of the dry season which becomes progressively hotter during the period from March through May.

In general, rainfall decreases 100 mm per 100 km from south to north. Total precipitation varies from over 1200 mm in the extreme southwest to under 500 mm in the north. The growing season ranges from more than five months in the southwest to less than three months in the Sahel. The regions with lowest rainfall also experience the largest climatic variations, both within a single season as well as from year to year. While there is a general correlation between total precipitation and soil moisture available for plant growth, it is the intensity and spacing of precipitation that determine whether a harvest is successful or not within the uncertain conditions of Upper Volta's rainfed agriculture.

VEGETATION

Natural vegetation parallels the latitudinal variations identified with annual precipitation. The map in figure I shows average rainfall levels in the different regions of Upper Volta. The country can be divided into three principal vegetation types: Sahelian (less than 600 mm of annual rainfall); Sudanian (600 to

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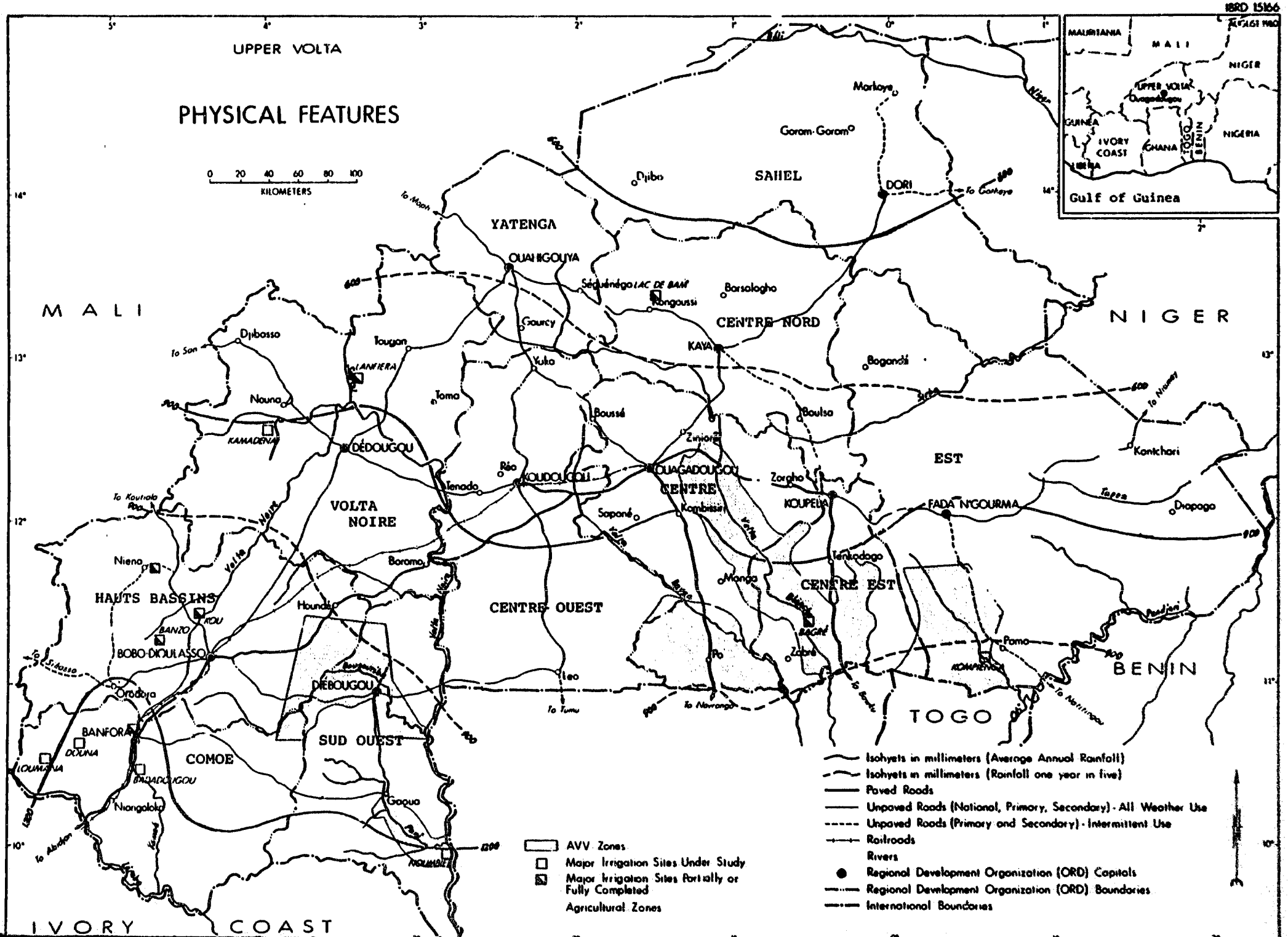
Figure 1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PHYSICAL FEATURES
UPPER VOLTA
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KILOMETERS
MALI
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BENIN
TOGO
IVORY COAST
SAHEL
YATENGA
CENTRE NORD
EST
VOLTA NOIRE
HAUTS BASSINS
CENTRE OUEST
CENTRE
CENTRE EST
SUD OUEST
COMOE
Gulf of Guinea
MAURITANIA
GUINEA
GHANA
NIGERIA
Dori
Goram-Goram
Djibo
Ouahigouya
Kaya
Ouagadougou
Koudougou
Dédougou
Fada N'Gourma
Koupela
Tenkodogo
Bobo-Dioulasso
Banfora
Diébougou
Gaoua
Boulsa
Bogandé
Kantchari
Diapaga
Pama
Tougan
Djibasso
Nouna
Toma
Boussé
Zorgho
Manga
Po
Léo
Nanoro
Sapouy
Kombissiri
Ziniaré
Bagré
Zabré
Nieno
Houndé
Banzo
Orodara
Niangoloko
Boromo
Tenado
Réo
Gourcy
Yuko
Barsalogho
Kongoussi
Séguénéga
Lac de Bam
Kamadena
Lanfiera
Koumbia
Komponiéga
Isohyets in millimeters (Average Annual Rainfall)
Isohyets in millimeters (Rainfall one year in five)
Paved Roads
Unpaved Roads (National, Primary, Secondary) - All Weather Use
Unpaved Roads (Primary and Secondary) - Intermittent Use
Railroads
Rivers
Regional Development Organization (ORD) Capitals
Regional Development Organization (ORD) Boundaries
International Boundaries
AVV Zones
Major Irrigation Sites Under Study
Major Irrigation Sites Partially or Fully Completed
Agricultural Zones

950 mm); and Sudano-guinean (950 to 1200 mm). The divisions are not sharp but form a gradient in which some species are present in all zones. As one moves from the wetter southwest to the more arid north, the woody forest canopy generally decreases in density and the herbaceous undergrowth becomes progressively less dominated by perennial grasses and increasingly characterized by annual vegetation.

The Sahel is composed of steppe vegetation dominated by thorn scrub (Acacia, Balanites) and annual grasses (Cenchrus, Brachiara), except in bas-fonds where deeper soils and water concentrations permit the growth of larger tree species such as the baobab (Adansonia digitata) and the caicedrat (Khaya senegalensis). Perhaps the single most noteworthy aspect of sahelian vegetation is its extremely nutritious composition as forage for grazing animals.

As rainfall increases to the south, the sudanian area becomes a predominantly agricultural zone where the natural vegetation has been largely altered by man's activities whether inadvertent or intentional. Useful and abundant species include Acacia albida, the kapok (Bombax costatum), karite (Butyrospermum parkii), nere (Parkia biglobosa), baobab, and the caicedrat. Grasses include both annuals and perennials, although perennials would be much more predominant without farming and grazing pressures. Brush species such as Combretum micranthum also prevail on indurated lateritic crusts.

The "parkland" quality of this landscape reflects the fact that the vegetation, drastically altered and to some degree managed by the human population, is an important aspect of the region's grazing and farming systems. Two of the agricultural regions specified in this analysis, the central plateau and the east, are encompassed by the sudanian zone's climate and vegetation. They are distinguished from each other more by population density and ethnicity than by ecological differences. Each zone's specific characteristics are discussed in the farming systems section.

The sudano-guinean zone supports a considerably denser woody canopy. While some sahelian and sudanian tree species persist in this zone, more tropical species begin to appear, especially in gallery forests along waterways and isolated areas relatively untouched by agricultural activity. The resulting forest-savanna mosaic is largely maintained by the frequent occurrence of bush fires. Fire has selectively encouraged some species while distorting the growth forms of others. The herbaceous undergrowth has adapted well to fire. Although dominated by perennial grasses, it also supports a large annual grass component. The southwest as an agricultural region is approximately bounded by the 1,000 mm isohyet. It is favored by higher rainfall, a longer growing season, and to a lesser extent, better soils.

SOILS

Soils, climate, and vegetation are all interrelated ecosystem components. Many of Upper Volta's soils were formed under ancient climatic conditions. The predominant ferruginous tropical soils are almost certainly paleosols formed under an ancient and more humid climatic regime. The large expanses of sandy soil in the Sahel indicate that fossilized dunes moved southward during the drier tropical climate associated with Pleistocene glaciation. It is upon this earlier inheritance that Upper Volta's present agricultural production is dependent.

Tropical ferruginous soils, which cover over half the country's total area, are low in soluble bases, particularly phosphorous. They are easily eroded and subject to crusting. Their moisture retention capacity is fair, except where they are either degraded or shallow and laying upon lateritic hardpan. Their agricultural potential is mediocre, but higher than the associated thin gravelly laterites. Although best left as rangeland, they are frequently cultivated where population densities are high.

The south's eutrophic brown forest soils offer the highest agricultural potential overall. Their physical and chemical properties are both favorable to cultivation, but their distribution is limited. Vertisols and hydromorphic clays common to valleys and bottomlands are also more abundant in the southwest.

RIVER VALLEYS

River valleys present a special case for agricultural development in Upper Volta, partly because hundreds of thousands of potentially arable hectares are not presently cultivated. However, the lack of redistributive capacity of Upper Volta's rivers--that is, water is not transferred from relative surplus to relative deficit areas--limits development in the drier regions. Only the Volta Noire has year-round flow. Irrigation potential is limited both by the lack of favorable dam sites and rapid siltation rates.

Opening "new lands" in southern Upper Volta's river valleys has been an important facet of the nation's agricultural development strategy. The Amenagement des Vallees des Volta (AVV), a parastatal agency, is responsible for planning and settling about 30,000 km^2 along major waterways including Volta Blanche, Volta Rouge, and Volta Noire. The lands have recently been freed of onchocerciasis, historically a barrier to permanent settlement. Some of the soils with highest agricultural potential are found in these areas.

SUMMARY

The country is now and will continue to be heavily dependent upon agricultural production, but the resource base offers only modest potential. Soils are mediocre in fertility and many are highly susceptible to erosion. Rainfall is highly variable. Run-off is high especially in more densely cultivated areas. The potential for expanding irrigated agriculture appears limited. On the positive side, sizeable areas of the country are only sparsely populated (under 10 persons per km^2), allowing considerable scope for expanding cultivated land.

Only one-third of the surface area is suitable for cultivation. Virtually all the remaining two-thirds of the total surface area is suitable only for forestry and rangeland uses. This indicates a need for improved integration of animal, crop, and tree production.

The Southwest has the highest agricultural potential and is the closest to external markets. The Central Plateau is densely settled and becoming increasingly degraded. With no more land available, there is a high probability that cultivation will become excessively intensive. The East offers an environment similar to the Central Plateau except in the extreme southeast where seasonally inundated bottomlands are common. However, the area is much more sparsely populated. The Sahel is a rangeland of highly potential productivity, but the increase in human and livestock population densities beyond the zone's carrying capacity has led to over intensive land use and, in turn, progressive degradation of the environment.

CHAPTER TWO: THE AGRICULTURE SECTOR

GENERAL CHARACTERISTICS

In 1978, the last year for which national income accounts are available, agriculture accounted for 38 percent of the Gross Domestic Product (GDP). This broke down into 24 percent for crops, 10 percent for livestock, and 4 percent for fisheries and forestry. However, these figures underestimate the importance of the agriculture sector to the Voltaic economy. Ninety percent of the population directly depends upon agriculture for its livelihood. Much commerce and transport sector activity is also based on the marketing of agricultural products.

However, unlike many other developing countries, Upper Volta's industrial sector is not significantly affected by changes in agricultural production. Processing of agricultural products is not a major activity in the formal industrial sector. Exports of livestock and crops generally account for 90 percent of total exports. Cotton and oilseeds make up the bulk of the trade in crops.

Upper Volta's agricultural production takes place on small farms under conditions of low and variable rainfall. Production systems are largely traditional with little use of animal traction or modern inputs. Some technical innovations have been adopted in the country's southern regions. These are described in the chapter on rainfed agriculture in Part II. Ninety percent of the area cultivated is in cereals, from which only 15 percent of production is marketed. For the country as a whole, cereal production is about 1.1 to 1.2 million metric tons in a normal rainfall year, mostly sorghum and millet.

Other Voltaic food crops include yams and cassava, mostly in the southern regions, and vegetables throughout the country. In addition to cereals marketed for domestic consumption, the major cash crops are cotton, groundnuts, shea nuts, and sesame. The combined production of these crops rarely totals more than 150,000 metric tons. Except for groundnuts, these crops are grown primarily for export.

As discussed in greater detail later, traditional agricultural production systems provide very low rural incomes. Although data is limited, it can be estimated that most farm households do not earn more than $10 to $20 cash income per capita in years of normal rainfall (all prices in current U.S. dollars). There is considerable variation around this norm, with some farms in the northern part of the central plateau earning no cash income and farms in cotton growing areas earning up to $100 per capita.

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Livestock production is second to cereals cultivation as the major agricultural sector activity. Most livestock products, except dairy products, are marketed. In the central and southern areas livestock provides cash incomes over and above subsistence needs, but in the north households which do not grow enough to meet their minimum needs use from earnings livestock sales to buy cereals.

Although most of Upper Volta's cultivated area is devoted to food grains, the country is barely self-sufficient in food. Using the U.N. Food and Agricultural Organization's (FAO) estimated cereal requirement of 185 kg per capita, and assuming that seeds and waste make up 10 percent of production, Voltaic production equaled nutritional requirements in four years since 1970, was deficient in four years, and exceeded requirements in two years (1974 and 1976).

Not only has production not kept pace with nutritional requirements, it has generally been below effective demand as well. Retail prices for millet and sorghum in Ouagadougou, the only area for which data is available, have tripled since 1975. When production falls below requirements, the difference is partly filled with food aid which has averaged about 50,000 metric tons annually since the early 1970s. Commercial food imports are mostly wheat, flour, and rice, all destined for urban markets.

GEOGRAPHIC DISTRIBUTION

To get a full understanding of Upper Volta's agricultural sector, it is necessary to examine regional differences. As already noted, there is a substantial difference in rainfall and soils from south to north. There is also considerable variation in population density relative to available resources.

The most significant of these differences is shown in table 1. The first five ORDs (Organismes Regionales de Developpement) making up the Central Plateau have twice the population density of the other ORDs. Yatenga, the ORD with the highest density, also has the lowest rainfall of any ORD except the Sahel, which is primarily a livestock-producing area. All the ORDs on the central plateau have food grain deficits during normal years except for the Centre ORD which produces cereals as cash crops for the Ouagadougou market. Farmers in these ORDs also plant over 90 percent of their cultivated area in cereals. The next most important crop is groundnuts, which are grown on about 5 percent of the area planted.

Table 1. Regional Distribution of Rural Population, Arable Land, and Cereal Production: 1975

ORD	Rural Population (000)	Rural Pop. per km^2 of Arable Land	% of Arable Land Cultivated	Cereal Prod. per Rural Inhabitant (kg)
Centre	762	103	56	237
Centre Est	402	124	43	167
Centre Nord	626	102	39	180
Centre Ouest	740	92	38	161
Yatenga	493	141	70	135
Est	403	26	13	228
Volta Noire	633	68	29	298
Hauts Bassins	270	23	17	424
Comoe	186	24	12	420
Bougouriba	358	50	18	233
Sahel	354	36	14	109
Total	5,227	59	27	223

Source: GHV, Le Programme Substantiel d'Action, 1980.

At the other extreme are the southern ORDs: Volta Noire, Hauts Bassins, Comoe, and Bougouriba. They have the highest rainfall, best soils, and lowest population density. Volta Noire and Hauts Bassins, with about 18 percent of the population, account for 80 percent of the cotton production. This is particularly significant since most modern practices adopted in Upper Volta--animal traction, fertilizers, pesticides--are in cotton-growing areas. All southern ORDs also have food surpluses in normal years with Hauts Bassins and Comoe producing over 400 kg per capita. The southern ORDs' higher productivity is also reflected in the differences in cereal yields per hectare: almost 700 kg per ha in the south compared to about 450 kg per ha on the Central Plateau.[1]

Thus, most of Upper Volta's population live in areas that are currently deficient in food grains, support very few cash crops, and have limited potential for increased production. The northern region's deficits are filled with surpluses from the south and, as described in more detail later, the resources needed to purchase grain are obtained primarily from remittances of migrants to Ouagadougou and the Ivory Coast and from livestock sales. As table 1 indicates, there are large areas of unoccupied arable land both in the east and south. This has led to a steady migration of farm families from the central plateau to the southern ORDs. However, the total numbers have not been large so the plateau's population continues to grow and large areas remain unused in the south.

RECENT PERFORMANCE AND SHORT-TERM PROSPECTS

Since the early 1970s agricultural production has been declining in relation to total GDP. Agriculture dropped from about 50 percent of GDP to 38 percent as a result of the 1970s drought and then increased to about 43 percent in 1980. Within the agricultural sector livestock production now accounts for 15 percent of GDP compared to 13 percent in 1972, while crop production is 24 percent of GDP, down from 28 percent in 1972.

Production figures for selected crops are shown in table 2. The major factor determining production in any given year is rainfall, but there are nonetheless several discernable trends. The traditional crops--millet, sorghum, and groundnuts--have been experiencing the slowest growth. Food grain production has been growing at slightly less than the 1.7 percent population growth rate.

Cotton production, on the other hand, has more than doubled since the early 1970s, primarily as a result of large development projects in the southwestern part of the country. Production increases combined with high world market prices meant cotton accounted for well over 40 percent of export earnings in 1976 and 1977. Earnings dropped sharply in 1978 and 1979 as a result of declining production and an even larger drop in world prices. During these two years Upper Volta sold its cotton on the world market at below cost.

Table 2. Production of Selected Crops (000 metric tons)

	Millet & Sorghum	Maize	Rice	Groundnuts	Cotton
1970	941	55	34	68	24
1971	973	55	36	66	28
1972	912	59	30	60	33
1973	734	58	31	63	27
1974	1,075	62	36	65	31
1975	1,000	62	40	80	51
1976	1,123	46	41	87	55
1977	960	50	23	85	38
1978	1,025	101	32	70	60
1979	1,040	105	47	70	75

Sources: FAO, Production Yearbook. For 1979, GOUV, MRD, "Bilan Provisoire de la Campagne Cerealiere, 1979-80. Cotton figures are from SOFITEX.

Weak cotton performance was partly compensated for by the livestock sector's recovery. It once again accounts for almost half of Upper Volta's export earnings. The basis for this recovery is the increase in animal numbers following the drought and strong demand for livestock in the Ivory Coast and Nigeria.

Although groundnut production was about 70,000 metric tons annually in the late 1970s, exports have dropped to less than 1,000 metric tons per year. This compares with exports of 10,000 to 20,000 metric tons per year in the early 1970s. The reason for the export drop is that Upper Volta is no longer able to compete on the world market. According to knowledgeable observers, the quality of the groundnuts needs to be upgraded and marketing arrangements must be made more effective. Even with these changes, Upper Volta is at a disadvantage compared to more efficient, less isolated groundnut producers such as Senegal and the Gambia.

Prospects for rapid growth appear limited in the immediate future. The problems are not on the demand side. As already noted, Upper Volta is slightly deficient in food grain production during normal rainfall years, which indicates room for production increases. On the export side, the demand for livestock, cotton, and oilseeds is expected to be moderately strong in the medium term. At present the southern part of the country has the best potential to respond to these demand pressures. New agricultural practices that have led to increased productivity and incomes in cotton-producing areas will continue to spread, but the financial, institutional, and infrastructure constraints that have slowed the adoption of new technologies in the past remain and will prevent rapid production growth from occurring.

In the short run, prospects in Upper Volta's northern, low-rainfall areas are less promising. There are no technical packages that can be adopted by large numbers of farmers in these areas. Since most of the rural population live in these areas the implication is that productivity increases for a large proportion of Voltaic farmers are unlikely in the near future. This means that disparities between the densely populated north and sparsely populated, but more productive, south can be expected to increase in the short term. This can be expected to lead to some increase in migration out of the Central Plateau, but given the traditional reluctance of the Mossi, the predominant ethnic group in that region, to migrate to other parts of Upper Volta, it is unlikely that the increase will be substantial.

CHAPTER TWO FOOTNOTE

1 Except where otherwise noted, data in this section was obtained from the GOUV document, Programme Substantial d'Action, 1980.

CHAPTER THREE: THE RURAL POPULATION

NATIONAL OVERVIEW

In 1975 Upper Volta had a population of just under 6 million people, 91.3 percent living in rural areas. In the past 30 years the population has increased 2.5 million, from 3.6 million in 1950 to 6.1 million in 1980--a 70 percent increase. If the population continues to grow at its present rate, there will be a further 60 percent increase by the year 2000.

Infant mortality is extremely high: 40 percent of Voltaic children die before their fifth birthday. The most prevalent diseases are measles, tuberculosis, meningitis, gastro-intestinal ailments, leprosy, tetanus, onchocerciasis, and schistosomiasis. These diseases kill or severely impair the health of tens of thousands of Voltaics every year. [1]

Upper Volta has one of the highest illiteracy rates in the world--around 95 percent. Only 16 percent of primary age children attend school and only 2 percent attend high school. Dropout rates at both levels are high.

One goal of the Government of Upper Volta (GOUV) is self-sufficiency in basic foodstuffs. This goal is not always met due to climatic and rainfall constraints. During 1972-74, the worst years of the drought, only 73 percent of the population's daily caloric needs and 56 percent of its protein needs were met. In 1975 there was an improvement and the level reached before the drought--190 kgs of cereal per capita--was regained. Production was again low in 1976 and 1977. There was some improvement in the following two years and by 1980 food intake returned to 1975 levels.

There are more than 50 different ethnic groups in Upper Volta. They live in four distinct geographical areas which are largely determined by rainfall and thus agricultural potential. In order to best examine this social, cultural, and ecological mix, the discussion will be divided into the following parts:

- The Central Plateau;
- The Eastern Region;
- The South and Southwest;
- The Sahel; and
- Migration.

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THE CENTRAL PLATEAU

Population

The Central Plateau includes the ORDs of Ouagadougou, Koudougou, Kaya, Yatenga, and Koupela and approximately 58.5 percent of the total population (see Appendix 7). While several ethnic groups including the Peul and Gourunsi are found here, the most numerous and important are the Mossi, Upper Volta's largest ethnic group. The central plateau is the most densely populated region of the country. Density ranges from 31.1 inhabitants per km^2 in the Koudougou ORD to 47.5 per km^2 in the Koupela ORD.

The increasing population pressure on the land has steadily reduced and in some cases eliminated the amount of time land is left fallow. In the case of Yatenga, for example, 71 percent of all arable land is cultivated during the cropping season. This has increased soil erosion and decreased soil fertility. The main safety valve for relieving population pressure has been out-migration, both seasonal and permanent.

The Farming Household

The most important production unit is the extended family, the zaka, which forms part of a budu or clan claiming descent from a common ancestor. The zaka usually consists of the household head, his wife or wives, unmarried children, and married sons who have not yet established their own homes. While the size of this extended family can vary considerably, the average number of household members for the Mossi is around 10.

Although population pressure is important in determining farm size, an average 5 ha, labor availability is even more important. Labor is a critical constraint and there is a strong correlation between family size and farm size: the larger the family, the larger the labor force and the greater the area of land that can be worked.

The extended family cultivates plots around the compound and in fields both in the village and the bush. Corn is cultivated on the compound plot while sorghum and millet are grown on village and bush fields. Cereals as well as peanuts, sesame, okra, and cotton are grown on small collective plots controlled by the compound head and farmed by the whole family.[2] Individual plots are farmed by women, usually wives of household heads, and to a lesser extent by the sons.

The produce from the collective family fields goes to the household head who is responsible for providing all family members with the morning meal. The produce from the woman's field goes primarily to her. She is responsible for furnishing the condiments for sauces accompanying the cereals as well as contributing to the evening meal. In times of need she is expected to supplement the family's food from her personal reserves. The proceeds from selling her produce and any other activities she may engage in, such as preparing and selling dolo soumbala and karite, are used to dress herself and her children, pay taxes, buy cooking utensils, and participate financially in family ceremonies. [3]

Not surprisingly, women spend more time in the fields than men. One study indicated that women contribute 53.6 percent of the labor required to cultivate 1 ha, while men contribute 46.4 percent. Women are also expected to care for small livestock, collect fruits and herbs, and perform the standard "wifely" activities of fetching water, carrying wood, grinding corn, and preparing meals.[4]

Virtually, all households maintain livestock as part of their farming system. Small ruminants and poultry are common and often sold when a need for cash arises. Better-off families invest in cattle which are often maintained by Peul herdsmen. The herdsmen keep the milk and manure from these animals and occasionally receive gifts of millet or cash from the owners, particularly if the entrusted animals are male.

Access to Land and Land Tenure

When the household head dies, control of the fields passes to the eldest son. He is responsible for seeing that his father's widows as well as his own brothers have enough land to work. Nevertheless, equitable land distribution is virtually impossible. As each son marries and starts his own family, there is correspondingly less family land per person. Moreover, the eldest son has priority over his younger brothers when choosing the fields.

Given the intense pressure on land in certain parts of the Mossi Plateau and the resulting impossibility of inheriting enough land to support a family, farmers respond in two ways: they borrow land or migrate. If a farmer has more land than he can cultivate, he will often be willing to lend it out. To refuse a request for land from someone in the same clan is to risk serious punishment from the ancestors. In a study of three Kaya ORD villages, 52.2 percent of the land cultivated by farmers in the sample was borrowed. The longer a household works the borrowed land, the harder it becomes for the proprietor to reclaim it.[5]

If borrowing land is not possible, then the Mossi migrate as families within Upper Volta or as individuals externally, particularly to the Ivory Coast. Internal migration is primarily

towards the west and southwest where the resident population will give them usufruct rights to land for a specified time period.

Once that period expires, the migrants must find land elsewhere. With no incentive to improve the land, the migrant may work the land to death, causing what one author has termed le pillage foncier.

Income

Studies done in the early 1970s indicate that about one-fourth of per capita cash income on the Mossi Plateau may come from migrant remittances (see table 3).

Table 3. Sources of Per Capita Cash Income on the Mossi Plateau (1972-73)

Activity	Income (CFA)	% Income
Agriculture	1,130	35
Livestock	750	23
Handicrafts	210	7
Salaries	440	14
Sale of Processed Goods	340	10
Trade	370	11
TOTAL	3,240	75.7
Migrant Remittances	1,040	24.3
Grand Total	4,280	

Source: Jean-Louis Boutillier, Andre Quesnel et Jaques Vaugelarde, 1977. "Systems Socio-economiques, Mossi et Migrations". Cah ORSTROM, Ser. Sci. Hum., Vol. XIV, No. 4, p. 377.

Total farm income, including consumption of home-produced food and goods, is estimated to be 6,000 to 8,000 CFA per capita per year. Thus per capita income is around 10,000 to 12,000 CFA per year.[6]

THE EASTERN REGION

Population

The Fada ORD occupies 18 percent of Upper Volta's total land area but contains only 7 percent of the population--approximately 413,000 people. Although the overall population density is 6.8 inhabitants per km^2, there is considerable variation within the region. Well over 50 percent of the population is concentrated along the region's western boundary. The rural population in this densely populated area has the same characteristics as the central plateau's population.

According to a recent survey, the best lands in the eastern region, located in the east and the southeast, are presently underpopulated for the following reasons:

- High incidence of diseases such as malaria, onchocerciasis, and trypanosomiasis;
- Lack of transportation infrastructure; and
- Prohibition of settlement in areas set apart as wildlife preserves.[7]

Approximately 72 percent of the population is Gourmantche and the remainder are Peul and Mossi. While the Peul have not been assimilated, Mossi immigrants have tended to intermarry with Gourmantche and to a certain extent, adopt their language. The Mossi are concentrated in the western part of the region and there is some indication that inter-ethnic friction increases with the number of Mossi immigrants.

There is also some evidence of a relationship between ethnic affiliation and openness to change. Michigan State University (MSU) researchers found that Mossi farmers were more likely to adopt animal traction. A survey of small-scale enterprises found that Gourmantche entrepreneurs were evenly divided between owning traditional enterprises such as blacksmithing, carpentry, pottery, and weaving and newer enterprises such as tailoring, grain milling, and baking. In contrast, the Mossi, Peul, and Hausa were much more likely to own these newer enterprises.[8]

The Farming Household

Eastern region villages are composed of a group of compounds, each containing one or more households. A compound may have more than one household head, but one of them is also usually the compound head. The household's distinguishing characteristics are that its members live in the same compound, eat from the same cooking pot, and share the responsibility of living together.

Chiefs traditionally exercised considerable authority and the paramount chief, the Yenbiga, answered only to God. However, the central government has taken over much of the chief's authority. But the village chief is still the leading citizen in his home community and arbitrates any land disputes involving his and other family groups within the village. Like his neighbors, he only has rights to land owned by himself and his family.[9]

Most compounds have one or more principal fields planted primarily in sorghum and millet. These fields are owned by the compound head and farmed by all household workers for a fixed part of the day, usually in the morning. The grain harvested from these fields is controlled by the compound head who is responsible for providing enough grain to last through the following year's harvest. In addition to these family fields, most household members have one or more individual plots that they are free to cultivate during the afternoon. These crops are sold and proceeds used to buy personal items such as cloth, kitchen ware, and small livestock.

A 1977 survey conducted among some of the best Gourmantche farmers indicated that households cultivate an average of just over 7 ha divided among family members as follows:

- The head of the household controls 67.6 percent (4.8 ha);
- The women in the household control 16.9 percent (1.2 ha); and
- The other men in the household control 15.5 pecent (1.1 ha).

However, all three groups grow both food crops (sorghum and millet) and cash crops (soybeans, peanuts, and rice). The compound head has to ensure that his household members have enough food reserves for the year and that taxes are paid. If harvests are poor, he may have to buy sorghum or millet from other family members. Since he rarely has much surplus cereal to sell, he relies heavily on the sale of "cash" crops--42.7 pecent of which were planted by compound heads in this particular sample.[10]

Better farmers tend to cultivate more land since they attract more members to their households. There is little reason to believe that the ratio of land cultivated by different household members is not similar for average farm families. A random sample conducted by MSU indicated those families using traditional technology had 7.75 members and planted 80 percent of their 4.3 ha in sorghum and millet.[11]

Access to Land and Land Tenure

Unclaimed and uncultivated land can be cleared and sown by anyone. In this way a farmer can establish permanent rights to that land. If a farmer wishes to cultivate a piece of fallow land claimed by someone else, he must ask the owner for permission. Since land is basic to survival, it is usually loaned out to those who ask on the understanding that the owner can reclaim it at any time. The borrower can never own the land and is usually not permitted to plant trees since the trees would then belong to him and, by association, so would the land shaded by those trees.[12]

In many villages the earliest settlers own much of the surrounding land and newcomers are often obliged to borrow. In the MSU study referred to earlier, 12.4 percent of fields were established on unclaimed land whereas 27.3 percent were established on borrowed land.

Income

Data gathered in 1978-79 from a sample of farmers using traditional technology provided the information on income shown in table 4.

Table 4. Household Income for Families Using Traditional Technology in Fada: 1978-79.

Value of Major Income Components	Average Rainfall		Drought Area	
	(Value CFA)	(%)	(Value CFA)	(%)
1. Crop Production	78,022	69.1	75,572	90.5
2. Livestock Raising	-1,970	-1.7	5,818	7.0
3. Crop Trading	175	0.2	942	1.1
4. Agricultural Transformation	528	0.5	702	0.8
5. Other Income Sources	36,359	32.0	511	0.6
Net Farm Income (1-4)	77,355		83,026	
Net Household Income	113,714		83,537	
Net Household Income per Capita	17,049		9,461	

Source: Vincent Barrett. et al, 1981. "Animal Traction in Eastern Upper Volta: A Technical, Economic, and Institutional Analysis." East Lansing, Michigan: Michigan State University, Department of Agricultural Economics. Draft. p. 117.

Two things are particularly striking about these income figures. First, non-agricultural activities can play an important role in the household economy. The three most important non-agricultural activities in Fada are cloth weaving, blacksmithing, and pottery. Three others--furniture making, cloth dying, and tailoring--have fewer operators and are more concentrated. However, over 20 percent of households are involved in such activities.[13] Second, only a very small proportion of agricultural production is sold: 8 percent in the average rainfall area and 11.5 percent in the drought area.[14]

While the sorghum crop was very poor in the drought area, this failure was balanced by a reasonable harvest of rice, groundnuts, and riadi, a quick-maturing millet.

In 1975 a major effort was undertaken to introduce animal traction in the ORD. A total of almost 1,800 oxen and donkey units were sold during 1975-80. An exhaustive evaluation of this component, comparing animal traction farmers with hoe farmers, concluded that animal traction:

- Increased the area cultivated per active worker by 10 percent;
- Doubled the acreage planted in cotton, peanuts, soybeans, and rice on small fields;
- Increased the yields on cash crops but had no effect on cereal yields;
- Reduced the labor input required per cropped hectare; and
- Increased the net farm income of an active worker using oxen by 16 percent.[15]

While the animal traction program has had a small but favorable impact on production, productivity, and income, it still has a long way to go if it is to be acceptable to the small farmer. Significantly, the area where the program has had its greatest impact was the one with the longest exposure to animal traction.

WEST AND SOUTHWEST

This region is the most agriculturally important due to its greater rainfall and higher soil fertility. It is also the most developed of the four regions. The four ORDs of Volta Noire, Hauts Bassins, Comoe, and Bougouriba have 1.7 million inhabitants --approximately 28 percent of Upper Volta's total population--with a density of 19 inhabitants per km^2. There are many important

ethnic groups living here including the Bobo, Dafing, Samogho, Lobi, Dagari, and a steadily increasing number of Mossi immigrants. Dioula is used as a common language in much of the area.[16]

Indications are that the various agricultural projects implemented here have significantly increased per capita production of agricultural products, per capita incomes, and total agricultural production over the past 20 years. These changes have resulted from a combination of:

- In-migration;
- Use of improved inputs, particularly animal traction, improved seeds, and fertilizer; and
- Some shifts in crop mixes, notably from other crops into cotton and maize.

Nevertheless, there is considerable variation within the region. In the Bougouriba ORD, for example, the World Bank estimates per capita income from agriculture to be around 8,000 CFAs. However, income for those who grow root crops goes up to 18,000 CFAs per capita. For the Volta Noire and Hauts Bassins ORDs, per capita income estimates range from 12,000 CFAs in the north to 20,000 CFAs in the central section.[17]

In general, the household is the basic production unit and includes the household head, his wife or wives, his children, and younger relatives. Strict sexual division of labor is uncommon and, in many of the ethnic groups, women have fields of their own. While women are a crucial labor force element ,there appears to be a more equitable sharing of labor than in other regions. This reflects the fact that farming is more remunerative here, good land is still relatively plentiful, and younger men are thus less inclined to migrate.

As a result of a succession of agricultural development projects in the region--the West Volta Cotton Project, the West Volta Agricultural Development Project, the West Volta Food Project, and the Bougouriba Agricultural Development Project--a variety of organizational interventions have been implemented in an attempt to work more effectively with small farmers.

Such interventions have resulted in the formation of cooperatives, credit unions, 4-C Clubs (coeur, cerveau, corps, and cooperation), cereal banks, cotton marketing groups (marches auto-geres) and village groups. The number of village groups in Volta Noire and Hauts Bassins grew from eight in 1974 to 313 in 1980 with an average of 29 members each.[18] Informal groups have also been formed under the training and visit system (TVS) introduced by the World Bank.

THE SAHEL

The Sahel, Upper Volta's least known and least understood region, has an estimated population of 375,000, 10 inhabitants per km^2. The determining factor here is rainfall. Not only does it come in reduced quantities, but it also comes irregularly. Over the past 10 years there have been four years in which rain fell as expected, four in which there was insufficient rain in some areas, and two in which the whole region suffered. The basis of the economy is livestock, both cattle and small ruminants. In 1980 there were an estimated 360,000 head of cattle and 800,000 small ruminants in the Sahel ORD. Agriculture is practiced on a very limited scale. The area cultivated per family is around 2.5 ha and yields of cereals are only 200 to 300 kg per ha.[19]

The Peul are the dominant ethnic group together with their former vassals, the Rimaibe. There are also the Tuareg and Mossi. In very general terms the population can be classified into nomadic, semi-sedentary, and sedentary groups. Most Peul in Upper Volta's Sahel are semi-sedentary.[20]

Both nomadic and semi-sedentary Peul share many characteristics. First, both groups are more oriented toward producing milk than beef. While cattle are sold, their sale is generally in response to certain pressing financial needs. Second, the long dry season makes it impossible to live on milk all year round. Consequently they need to obtain or cultivate millet. Third, both groups need to be mobile in order to take full advantage of the Sahelian environment. Fourth, their herds are constituted in the same manner. The herd managed by the household head contains many animals that are not his own. By the same token, part of his herd will be cared for by friends and relatives. This dispersal facilitates effective environmental use. Finally, both groups believe that nobody owns pastureland, natural waterlands, or ponds. In contrast, wells are owned by those who dig or commission them, thereby conferring on the owners de facto rights to adjacent pastures.

Two major characteristics distinguish semi-sedentary from nomadic Peul: the practice of transhumance and the practice of agriculture. Transhumance has evolved from the combination of agriculture with pastoralism. It involves long-distance herd movements in the rainy season under the guidance of a small number of herders. Herds are usually taken to regions which cannot be grazed during the dry season due to lack of surface water. Since herders have no women with them, most milk is fed to the calves. The nomads, on the other hand, process the milk into soured milk and butter and exchange them for things they need.

During this period the sedentary members of the Peul family cultivate millet and tend those animals which have not gone on transhumance. Fences made from thorny branches are often errected

to keep cattle out of fields. These activities make demands on the labor force which restrict the amount of land that can be cultivated. In cases where the local population is primarily farmers who own few cattle, the Peul herds, small as they may be during the reainy season, can become an increasing source of friction between the two groups. One partial solution is to split the herd and send a large part of it to spend the rainy season with Peul relatives in the bush.

Peul women, both nomadic and semi-sedentary, are responsible for milking and preparing milk products, building and taking down homes, preparing foods, fetching wood and water, and looking after children. The nomadic women are responsible for selling milk and butter in order to buy grain and other essentials. In the case of the semi-sedentary women, the markets are limited and they are more self-sufficient. However, they do sell some milk products.

This process of semi-sedentarization is a relatively new phenomenon resulting primarily from three factors: the end of military action and conquest; the illegality of the use of slaves or serfs to produce millet; and the progressive absorption of the Peul economy into the broader context of West Africa. Riesman has argued this adaptation is preferable to the nomadic life primarily because it makes more effective use of the Sahel's environment. People in the Sahel cannot live entirely from agriculture. Those who do must have a year's supply of food to carry them through. However, those with cattle can supplement cereals with milk and move quickly if the rains fail. In the last resort, cattle can be sold whereas land cannot.[21]

MIGRATION

Mention has already been made of migration's important role in the Voltaic economy, particularly migration from the densely populated Mossi Plateau. In broad terms the migrants are of two types: young single males who go out of the country and young married couples who either search for new lands elsewhere in Upper Volta, particularly in the west and southwest, or move to the cities. However, the number of young men leaving the country exceeds that of internal migrants by a ratio of 10:1.

In 1972-73 ORSTOM undertook an extensive survey of population movements on the Mossi Plateau and calculated that over 15 percent of the total population--21.7 percent of the men and 9 percent of the women, about 344,000 people altogether--had emigrated. However, by including migrants who had settled some time earlier in the Ivory Coast together with their children who were born there, the total goes up to 470,000.[22]

The primary reason for migration is economic. The Mossi Plateau is characterized by irregular and often insufficient rainfall. Moreover, there is little productive activity for six months of the year. When harvests are poor, out-migration increases as demonstrated in table 5.

A second reason for the heavy out-migration is the desire to be independent. By staying at home a young man is heavily dependent upon his father. Many married couples do not receive their own land until the husband is in his mid-thirties. Any money he earns may well be monopolized by older males. By migrating, a young man has more freedom and virtually complete control over the money he earns.[23]

Although migration alleviates pressure both on the land and in family granaries, it aggravates the growing season's chronic labor shortage. There are indications that it is the already overworked women who have to compensate for the absent males. The major advantage migration provides for the home village comes in the form of remittances. As mentioned earlier, these remittances account for about one-fourth of cash income per capita on the Mossi Plateau.

Many observers of Voltaic migration have noted the non-productive uses to which returning migrants often put their savings. In the early 1970s an average migrant would save $100 per year which would be spent in the manner shown in Table 6.

The young returning migrant is virtually forced to spend his savings in conspicuous consumption. Village elders monopolize certain economic networks and since the migrant has no social status, he is not allowed to participate. This holds true for purchasing cattle. Since he has no land of his own, the returning migrant has little interest in investing, for example, in animal traction or some similar potentially productive activity.

This lack of opportunity in the home village, which may have been one of the major reasons for migrating in the first place, is reinforced by the fact that most migrants work at unskilled jobs while abroad. Few return with work experience that can be considered relevant to home village development. This pattern holds true for many other countries including Greece, Spain, Italy, Ireland, Mexico, and North Yemen.[24]

Table 5. Rate of Mossi Plateau Out-Migration by Sous-Prefecture and Region

Sous-Prefecture and Region	Migration Rate per 1 000: 1961-73	% of Farmers Reporting Adequate Harvest: 1971-72
Ouahigouya	41	11
Gourcy	45	21
Seguenegua	20	10
Yatenga	35	13
Kongoussi	18	21
Other Sous-Prefectures	6	40
Kaya	8	36
Koudougou	15	33
Yako	27	25
Koudougou	19	30
Ouagadougou	2	46
Koupela	2	54
Bissa	2	59
TOTAL	11	41
Av. for 6 Sous-Prefectures Reporting Highest Migration	27	22

Source: Boutillier et al, op. cit., p. 370.

Table 6. Utilization of Savings by Average Mossi Migrant

Purpose	Percentage
Clothes, Watches	44
Bicycles	18
Goods, Ustensils	4
Cereals	5
Livestock	4
Other Goods	3
Taxes	17
Commerce	4
Agriculture	1
	100

Source: J. M. Kohler, 1972. Les Migrations de Mossi de l'Ouest. Travaux et Documents No. 18. Paris: ORSTOM.

CHAPTER THREE FOOTNOTES

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CHAPTER FOUR: AGRICULTURAL INSTITUTIONS

REGIONAL DEVELOPMENT ORGANIZATIONS

In Upper Volta the agricultural development program can be divided into national and regional activities. In 1966 the government established ORDs to provide agricultural services, primarily extension, at the regional level. In 1975, the ORDs' role was redefined as integrated rural development, and they were assigned responsibility for creating regional development plans and coordinating development activities in their respective regions.

In practice, however, most ORD activities were confined to the agricultural sector. In 1980 a GOUV commission on ORD reform found that most ORDs did not have the capacity to implement, or even coordinate, activities outside of agriculture. It was recommended that their mandate be limited to agricultural development, and this appears to have been accepted by the government.

There are 11 ORDs in Upper Volta (see Figure 1 for geographic boundaries). Each ORD is divided into geographic districts (secteurs), subdistricts (sous-secteurs), and extension areas (zones d'encadrement) to provide farmers with agricultural services. The ORD field staff at the farm level (encadreurs) are basically extension agents but are also responsible for input distribution, credit, marketing, and organization of farmer groups.

The ORD field staff is supported by a headquarters staff organized into service areas. A typical ORD includes the following services: crop production, livestock production, community development, cooperatives and credit, rural construction, planning and economic analysis, and administration and finance.

Five of the 11 ORDs have been receiving substantial donor assistance: Hauts Bassins, Volta Noire, Comoe, Bougouriba, and Fada. Of the rest, two will begin receiving significant assistance shortly-- Centre Ouest and Centre Nord--and four have yet to receive commitments for major support--Centre, Yatenga, Centre Est, and the Sahel. In view of the GOUV's limited financial resources, ORDs not receiving donor support can provide only the bare minimum in services to farmers in their regions.

THE MINISTRY OF RURAL DEVELOPMENT (MRD)

The MRD's role is to implement agriculture programs at the national level and provide support to the ORDs. The ministry is organized into departments (called directions). Four of these provide direct support to the ORDs: the Department of Agricultural Services, the Department of Livestock Services, the Department of Rural Institutions and Credit, and the Department of Young Farmer Training. Chapter Nine further discusses the responsibilities and activities of these departments.

There are two other important MRD agricultural development activities not directly related to the ORDS. The first is irrigated agriculture, which is the responsibility of the Department of Hydrology and Rural Equipment (HER) and the National Office for Dams and Irrigation (ONBI). The second is development of areas in the southern part of the country that have been cleared of onchocerciasis (river blindness). This is the responsibility of the Volta Valley Development Authority (AVV). HER and ONBI activities consist of large-scale irrigation projects in river valleys and smaller-scale projects in low-lying water catchment areas (bas-fonds). These activities are more fully discussed in Chapter Six.

The AVV was created in 1974 and assigned development responsibility for 30,000 km^2 of oncho-freed land. The program is essentially a highly structured resettlement project that included infrastructure development (social and economic) and a full range of support services for agriculture, small-scale industry, and commerce. Farmers participating in the project (estimated eventually to total 52,000 farm families) are obliged to adopt AVV-recommended farming practices. This and other program aspects are discussed in Chapter Eight.

AGRICULTURAL RESEARCH

Since 1978, agricultural research in Upper Volta has been the responsibility of the Institut Voltaique de Recherches Agronomiques et Zootechniques (IVRAZ) which is part of the Ministry of Higher Education and Scientific Research. The most important rainfed food grain programs are in the Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres (IRAT), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), and the Semi-Arid Food Grain Research and Development Project (SAFGRAD). The most important rainfed cash crop research programs are in the Institut de Recherches sur le Coton et les Textiles (IRCT), the Institut de Recherches sur les Huiles et les Oleagineux (IRHO), the FAO fertilizer trials and the United Nations Development Program (UNDP) Soils Service Project.

Most of the irrigated agriculture research is being conducted by the Centre d'Experimentation sur le Riz et les Cultures Irriguees (CERCI). There are several small livestock stations conducting research on problems related to production of large and small ruminants, pigs, and poultry, but most are inactive due to lack the funds. The major livestock program is in the Centre de Recherche sur les Trypanomiares Animales (CRTA). These research institution activities are further discussed in Part II.

OTHER AGRICULTURAL SUPPORT SERVICES

The institutions described in brief below are discussed at greater length in Part II, particularly Chapter Nine.

Training Institutions

Upper Volta's only institution for degree training in agriculture or livestock production is the Institut Superieur Polytechnique (ISP). For mid-level personnel there is the Centre Agricole Polyvalent (CAP) at Matourkou, the Ecole Nationale d'Elevage et des Industries Animales (ENESA), and training centers for Centre De Formation des Jeunes Agricultures (CFJA) instructors at the Farako Ba and Kamboinse research stations.

Marketing

There are three quasi-public sector organizations involved in agricultural marketing. For cereals, the Office Nationale des Cereals (OFNACER) is responsible for maintaining price stability and food security. In normal rainfall years OFNACER markets about 25,000 metric tons per year out of a total of 150,000 metric tons traded. For export crops, the Societe des Fibres et des Textiles (SOFITEX) handles the marketing and export of cotton and the Caisse de Stabilization de Prix des Produits Agricoles (CSPPA) is responsible for exporting groundnuts, sheanuts, and sesame. Marketing fruits and vegetables for export is handled mostly by the Union Voltaique des Cooperatives Maraichaeires (UVOCOM).

Input Supply and Credit

Most of the fertilizer and pesticides imported into Upper Volta are used on cotton. SOFITEX is responsible for distribution of these inputs to the villages in cotton growing areas. In areas that do not produce large quantities of cotton, SOFITEX sells fertilizers and pesticides to the ORDs, which then distribute the inputs to farmers. Where improved seeds are an important part of

the farming system, mostly in the southwest, the Service National de Semences (SNS), which is under the Direction des Service Agricoles (DSA) in the MRD, produces the foundation seed. Some multiplication of certified seed takes place on SNS farms, but the majority of bulking is done by ORD's with donor support.

Agricultural equipment is either manufactured by the three Ateliers Regional de Construction de Materiel Agricole (ACROMAs) or assembled from imported parts by Cooperatives Regionals de Montage de Materiel Agricole (COREMMAs). The latter are located at the ORD level and, though not officially part of the ORD, are usually very closely linked.

Many agricultural inputs and implements are provided on a credit basis. Until recently most credit programs were funded and administered through the ORDs with some coordination from the MRD's Department of Rural Institutions and Credit (DIRC). In 1979 the Caisse Nationale de Credit Agricole (CNCA) was created to administer all national-level credit. The CNCA depends on ORD credit bureaus to administer ORD-level credit.

PART II

ANALYSIS OF CONSTRAINTS TO INCREASED AGRICULTURAL PRODUCTION

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INTRODUCTION

The constraints to increasing agricultural production in Upper Volta are no different than in other developing countries where most of the population consists of small farmers who mainly produce subsistence crops. These constraints can be categorized as:

- The lack of available technologies for increasing production;
- The problem of long-term environmental degradation;
- Institutional constraints, including the lack of trained manpower;
- Inadequate infrastructure, especially roads;
- The lack of funds for recurrent costs; and
- Ineffective and counterproductive macroeconomic and agricultural policies.

What makes Upper Volta different from many other developing countries is the combination of a meager natural resource base, semi-arid climate, land-locked geographic location, and low level of infrastructure and institutional development. Because of these special problems, achieving self-sustaining agricultural development will be a long-term process extending well beyond the five year time frame covered by this report. This part of the report analyzes each of the critical constraints, discusses the long-term process by which they can be alleviated, and proposes both medium-term objectives and measures to achieve them.

The essential prerequisite to any agricultural development program is the existence of productivity-increasing technologies appropriate to the country's resources and climate. For Upper Volta, as for most of the Sahel, technologies have not yet been developed that can both achieve large production increases (similar to what occurred in "green revolution" countries) and be economically feasible for the country and producers. As the technical constraints are different for each Voltaic agricultural subsector--rainfed agriculture, irrigated agriculture, and animal production--each sub-sector is examined separately in the next three chapters.

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CHAPTER FIVE: RAINFED AGRICULTURE

EXISTING FARMING SYSTEMS

In devising a strategy for agricultural development it is first essential to understand what farm families do and why they do it. Many West African agricultural development efforts to date have failed to consider this perspective adequately. The rather mediocre record of agricultural development projects in the region speaks for itself.

There have been some qualified successes, notably cotton in the case of Upper Volta, where advances occurred despite the lack of a good understanding of existing farming systems. It can be argued these few successes represent good luck--technological packages and marketing services that related reasonably well to existing farming systems, and were sufficiently profitable to induce farmers to alter or adjust those farming systems to accommodate the new technologies.

Most research and development efforts so far have tended to assume that the superiority of improved practices will induce farmers to realign their farming systems to accommodate them. The recommendation that farmers plow their land at the time of the first rain and then plant is a case in point. The effect of such a practice would be either to delay the completion of planting on all land, or to require a reduction in the area planted. Yields may be higher on the land which is both plowed and planted in a timely fashion, but this may not adequately compensate for the reduction in acreage or increased risk of failure for late-planted fields.

Major technological advances can lead to a realignment of farming systems around the new technology. The history of agricultural development in West Africa has demonstrated this time and again. However, for the 1983-88 period only well-established technologies can be used in development. Research on developing such technology breakthroughs should continue, with the hope that they perhaps will provide the basis for major agricultural advances during the latter part of the decade.

Even this may be wishful thinking. The "green revolution" advances in parts of Asia and Latin America are largely inapplicable to Upper Volta at the present time. The major hope therefore lies in evolutionary improvements which can be easily integrated into existing farming systems. Identifying these improvements and their adaptation to local farming systems requires an understanding of the interaction of several factors including: the resources the farm family controls; the farm family's environment (physical, social, economic, institutional); and farm family objectives.

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The limited utility of a fair portion of agricultural research in West Africa to date is traceable to many researchers' failure to understand which constraints were most binding under what conditions in the minds of the farm family. Researchers have often assumed that return to land is the most important criterion for evaluating improved technology. However, returns to labor during the peak labor period and returns to inputs other than land are far more important to most farm families. This is particularly true of the extensively cultivated portions of the family farm where most cereals are produced. High yields are critical only in the case of the relatively small amount of fertile land which exists (the bas-fonds, the compound farms).

The following discussion of Voltaic farming systems is intended to illustrate factors that should be considered in devising an agricultural development strategy, rather than to provide a comprehensive review of the subject. Since the Sahel region in the extreme north of the country is primarily a livestock producing area, it is not covered in this section.

The Central Plateau

The central or Mossi Plateau has a 600 to 900 mm annual rainfall, higher in the south and lower in the north. The plateau's central portion has a single peak annual rainfall of 700 to 800 mm with considerable year-to-year variation. Drought resistance and the ability to produce some crops even in relatively poor years are essential characteristics of the crop varieties farmers grow in the region's northern portions.

The conventional wisdom regarding Mossi Plateau soils is that they are generally poor in quality due to population pressures. Relative to other parts of the country, soils are generally less fertile with a thin layer of soil often covering laterite and hardpan. Drainage is a common problem in bas-fonds soils.

Cursory observations of grass species in the region suggest that soil nutrient depletion may not be as severe as is often suggested. Productive forage grasses such as Andropogon gayanus are still common and may be dominant in fallow land. Species that indicate overgrazing or extreme soil exhaustion such as Sprorobolus are rare.

Most important to note are the variations in fertility levels among fields farmed by a single household unit. Farms often include relatively rich bottomlands (bas-fonds); fields which adjoin compound areas where manure and other wastes are routinely applied; and relatively less fertile bush fields some distance from the compounds. Farmers readily recognize differences in fertility levels and their choice of crops for specific fields reflects these fertility differences.

Farm Family Objectives

While there are unquestionably considerable differences in detail among farm family objectives (a probability that may explain a fair portion of the diversity in farming systems of contiguous compounds and villages), it is reasonably clear that the farm family is mainly interested in improving incomes and avoiding risk.

Food security is a major consideration. However a growing number of Mossi households are dependent upon the market for a portion of their staple food needs. Moreover, production and sale of other agricultural commodities (red sorghum for beer, peanuts, cotton, sesame, roselle, and small animals) still remain important. Together these suggest that food self-sufficiency on a household unit basis may not be as important a consideration in determining the region's enterprise mix as is sometimes asserted.

The fact that the average agricultural work day even during the peak labor period is only 6 to 7 hours (as compared to nearly double that figure in other countries) suggests that activities including leisure and various other nonagricultural pursuits have higher priorities.

Cropping Patterns and Practices

Millet is the most important single commodity throughout the region. Sorghum (red and white) is second followed by roselle which is grown as a border crop on most fields. Although less than half the farmers have cash crops, many farmers produce peanuts, roselle, and cotton (in order of importance) for sale. Millet generally produces less yield than sorghum in an average year, but millet is more likely to produce a crop in a poor year or on poor land. This explains its preeminence in the region. The next two most important crops, peanuts and roselle, are also used in the normal Voltaic diet and have reasonably good drought tolerance.

Virtually all households maintain livestock as part of their farming systems, usually chickens and small ruminants. Wealthier families own cattle which are often entrusted to Fulani herdsmen. There is a growing use of and demand for donkeys for transport and various agricultural activities, particularly cultivation.

Total area under cultivation in a given year averages approximately 7 ha per household although there is a significant variation around the mean. The cultivated area is distributed among an average of 13 fields. Roughly half are large family fields controlled by the household head on which most of the cereal is produced. Nearly all the remaining plots are small and controlled by individual female members of the household (mostly wives of the household head).

A comprehensive discussion of cropping patterns and practices for rainfed agriculture should include the full range of activities commencing with the clearing of land before the rains start in May/June right through to crop harvesting in October/November. However, in the interest of brevity, the following comments focus on the planting and weeding period which extends roughly from June to late July.

It is in this period that the labor constraint is most binding, and the activities and events (the presence or absence of rain) taking place critically affect production levels in a given year. Most proposed improvements (such as improved inputs and cultural practices) discussed in the following section must also be performed during this period. Therefore, the acceptablility of specific improvements will be related not only to their profitability as calculated in conventional financial terms but also to their compatibility with existing activities during this period.

A farm family's basic objective during this period is to maximize total agricultural production (with priority upon staple foods) given the fertility and size of its holdings; the size of the labor force at its command; and its ownership or access to animal traction. Except in the bas-fonds areas, households do not normally commence planting until the first major rain after the end of May. They know from experience that rains before this period are unlikely to be sufficient to support crop establishment.

As many of the large family fields as possible are planted with millet and sorghum. Intercropping these cereals with cowpeas and to a lesser extent groundnuts is common. Planting is normally done with a simple daba hoe without further seedbed preparation or plowing. Planting family fields is followed by planting individually owned bush fields with the same crops, then maize, groundnuts, and earth peas (Voandzeia). Finally roselle is planted as a border crop around the fields.

In the event that the rains arrive late, or some or all of the first planting does not survive due to insufficient moisture after the first planting rains, farmers will alter their planting strategy by replacing longer maturing crops with faster maturing ones.

Farmers do not as a rule plow their land before planting because the plowing operation will significantly reduce the amount of land they can plant immediately after the first major rain. Farmers wish to get as much of their crop planted as quickly as possible after the first rain. This will allow the crops to emerge at the same time as the weeds (rather than after) and thus facilitate timely weeding. Crops planted later also tend to suffer from the particularly unpredictable nature of late season rains.

Farmers commonly plow or cultivate fields before planting only when there has been significant weed growth due to earlier rains. This is particularly true during or before the second planting period. This follows the second planting rains since farm households are normally unable to complete all the planting activities before the soil becomes too dry after the first planting rains.

Farmers apply little fertilizer to crops in the region, but manure and compound wastes are used particularly on compound plots and fields nearest the compound. Millet is less frequently grown on the manured fields because it does not respond as well as other crops to the higher fertility levels. Limited amounts of engrais coton are used primarily for cotton.[1]

Weeding is by far the most time-consuming activity in the farming calendar. The first weeding normally takes place approximately three weeks after planting, followed by subsequent weedings as required. The initial weeding is most important since the weeds compete most strongly with crops at that early period. Farm families do not plant more than can be properly weeded with available family labor even when this can be supplemented by animal traction.

There is currently an increasing demand for animal traction and some evidence, particularly from the Kaya area, that animal traction may help alleviate labor constraints during the weeding period and allow farm families to expand their arable area by at least 20 percent with existing family labor. Additional experience with animal traction is likely to improve the efficiency of the cultivation operation so that the acreage expansion can be further increased. The main constraints to the increased use of animal traction appear to be the inadequate supply of animal traction equipment and an extension package inappropriate for drier areas.

The Southwest[2]

The following discussion of southwestern Upper Volta's farming systems focuses primarily upon the ORDs of Hauts Bassins and Volta Noire where most of the area's population resides. Just as southwestern farming systems differ rather markedly from those in other parts of the country, there is also considerable variation within the region. This is especially apparent from the northernmost portion of Volta Noire, where the annual rainfall is only slightly above 700 mm, down to the extreme southwest corner beyond Banfora, which receives over 1,400 mm.

In contrast to the dominance of a single ethnic group in both the central and eastern regions of the country, the region's ethnic composition is equally complex. While there are at least a dozen important farming systems in the region, which correspond with the ethnic diversity, the following discussion concentrates on the more general elements of agriculture in the area.

Physical Features

Although the Southwest is contiguous with the Central Plateau, its dominant physical features are different in almost every important respect and the resulting impact on the area's farming systems is profound. First, the rainfall is higher. Most of the population lives in areas north of the 1,200 mm isohyet. There is considerable year-to-year variation both in the duration of the rains and their distribution within the season, although rains are generally more reliable than in drier areas. They commonly begin earlier (usually the first planting rains are in mid- to late May) and last through September or even early October.

Second, the Southwest has heavy clay-bearing soils compared to the thin, lateritic sandy soils of the central plateau. Fertility levels are generally higher. Farmers recognize fertility differences and will often have fields some distance from their dwellings to take advantage of better soils. Because of the relatively low population density, farmers do not farm the same land for as many years in succession as on the central plateau. They also leave the land in fallow longer.

Farm Family Objectives

As in other parts of the country, there is ample evidence that rural households are interested in reducing poverty. In general, farmers take advantage of their relatively better endowed region to increase agricultural production by using improved inputs and practices.

Risk avoidance remains an important feature of the region's farming systems, even though there is more consistent rainfall than in other parts of the country. This is reflected by the growing of millet in most southwest regional farming systems, although sorghum and maize consistently give better yields under the range of soil conditions that farmers normally face.

Crops

Sorghum is the most important staple food in the area and most land within the farming systems is devoted to this crop. Long-season millet varieties are also grown throughout the region but are of a decidedly secondary importance. Secondary crops, notably cowpeas, are commonly intercropped with sorghum and millet. There is limited production of pure stand cowpeas in compound plots, primarily by the Mossi migrant communities. Groundnuts are grown in pure stands. Maize has been growing in importance in recent years since the introduction of varieties that produce good yields with recommended fertilizer applications.

Cotton is the area's major cash crop. There was a major expansion in acreage planted until about 1978 when the trend leveled off, and even declined in some areas, in response to unfavorable price relationships with other crops. Cotton is a more important crop in the Hauts Bassins ORD than in the Volta Noire ORD. This appears to be related to differences in the extension and marketing services between the two zones.

Paddy rice is produced on bas-fonds land in progressively increasing quantities towards the south. There are also several large-scale irrigated rice production projects in the area which are reviewed in Chapter Six.

Fruits and vegetables are produced in marketable quantities in the southern part of the zone and exported to other parts of the country and Europe.

Livestock

Cattle are common in the northern tsetse-free zones and often entrusted to Peul herdsmen. In the southern part of the zone trypanotolerant Ndama cattle are prevalent. Use of animal traction (primarily oxen to plow the heavier clay soils) is common and growing in importance even in tsetse-infested zones. In several areas more than half the farm households own draft animals. Sheep, goats, and fowl are kept by most households.

Cropping Patterns and Practices

Since the rains start earlier and last longer, farmers have more flexibility during the planting period than their neighbors to the east and north. The peak labor period is weeding time during June and July. The farming system clearly reflects the importance of returns to labor during this period. The common practice of intercropping cowpeas with sorghum and millet is as much a means of reducing weed competition for the grain crops as a technique to reduce insect damage to the cowpeas.

The common practice of ridging in this area also aids weed control while at the same time reducing mid-season waterlogging. Communal labor groups are important in some areas for weeding operations. The decision to fallow land may be caused as much by increasing insect infestation as declining fertility.

With the onset of the rains in May, farmers often ridge the land by hand or with oxen prior to planting. In the case of land already ridged during the previous season, farmers will frequently split the ridge and form a new ridge in the old furrow. Farmers may also plant directly and then ridge during the first weeding.

The common practice of plowing and ridging contrasts markedly with the Central Plateau where direct planting is normal. It is also important to plant early in the southwest, but the timing is not as critical; farmers are more concerned with how planting operations affect labor use during weeding operations. Thus planting is more spread out and measures such as plowing and ridging are included in farming systems; labor is not a serious constraint during planting. There are also clearly positive returns to thoroughly preparing the seedbeds on the zone's more fertile soils. This is particularly the case with cotton production using fertilizer.

The most common ways to maintain soil fertility are the bush fallow method and use of manures. Crop residues are often burned and incorporated into the soil at weeding time. Fertilizer is used primarily with cotton but is used increasingly on grains, particularly maize, as well.

The only significant crop rotations are cotton/sorghum and cotton/maize. The grain crop benefits from the residual effects of the cotton fertilizer application.

There is a growing use of animal traction for crop cultivation, although this is limited largely to cotton fields and pure stand sorghum and millet. The common practice of intercropping cowpeas and sorghum/millet limits animal-powered cultivation. The use of animal-drawn cultivators is also largely limited to the lighter, sandier soils where one implement will suffice for both plowing and cultivation. The heavier clay soils are normally hand-weeded since two different implements are required for plowing and weeding operations. In addition, the heavier soils are often muddy at weeding time and difficult to cultivate with oxen.

Partly as a consequence of a succession of agricultural development projects in the region, notably the World Bank-financed Projet Coton and the West Volta Agricultural Development Project, there is a much more widespread use of improved practices including fertilizers, improved seeds, and animal traction, than in other parts of the country.

The Eastern Region

The Eastern Region farming systems are essentially the same as those in the Central Plateau. Except for the region's southeastern part which is characterized by heavy soils and relatively high rainfall, farmers face the same conditions as on the central plateau: low and variable rainfall and relatively poor soils. The main crops in this region are millet, sorghum, and groundnuts.

As noted elsewhere, one important difference between the east and center is a much lower population density in the former. This means that development strategies for the future can be based more heavily on extensive farming systems. More details on Eastern Region farming systems can be found in Part I, Chapter Three.

MEANS OF INCREASING DRYLAND AGRICULTURAL PRODUCTION

Rainfed agricultural production can be increased by increasing the area under cultivation or increasing yields per hectare through improved inputs and cultural practices. This section examines area-expanding and yield-increasing measures which are or might be used in the Central Plateau, the Southwest, or the East. The discussion includes a summary of the major constraints to expanded production as shown in a review of each major region's existing farming systems. It also includes specific measures recommended to increase production in each instance.

The Central Plateau

As the preceding description of the Central Plateau farming systems indicates, the constraints facing the expansion of agricultural production are generally more severe than in other parts of the country except the Sahel, which is more suited to livestock production. Population density is both high and growing which has helped to reduce or eliminate fallow land in many areas. There is certainly a scarcity of good quality land, if not an absolute land shortage.

Rainfall is also low and irregular. Soil fertility is poor and possibily declining. Despite the shortage of land and increasing population density, labor availability at the planting/weeding period still emerges as the critical constraint. It is a key factor influencing the composition of the farming system and the acceptability of improved techniques. Currently available improved practices are generally regarded as being least promising for this region.

At first glance, the Central Plateau appears primarily to be an area from which farmers should emigrate. This is in fact happening. Production can be increased by encouraging migration from the central region, where land scarcity exists, to less densely populated, more fertile portions of the country. The effect on food production in the region would be negative since the emigrants often represent the most able-bodied and economically active portion of the population. However, the impact on national agricultural production should be positive at least insofar as those migrating to other parts of the country go into farming.

Although migration is accompanied by many problems (discussed later with reference to the Southwest), such migration clearly represents a means by which individual farm families can increase their incomes through increased agricultural production even without any changes in technology. The movement is probably unavoidable in any event and efforts might best be directed to at least mitigating the expected negative effects.

Halting both soil erosion and the decline in soil fertility emerges as a high priority concern for the Central Plateau. There is growing evidence that current fertilizer recommendations involving the use of engrais coton may actually be aggravating the situation by causing soil acidification. On the positive side, farm-level trials involving fertilizer application and anti-erosion practices have yielded promising results, which might be extended to large numbers of farmers during the 1980s (see Appendix B). Specific measures include:

- Using locally produced rock phosphate, possibly in combination with sulphur, on groundnuts and grains, thereby reducing dependence upon soil-acidifying imported engrais coton; and

- Erecting small ridges (mini dykes) with local materials (soil, rocks, grain stalks) on eroded slopes to catch and retain soil (discussed in Chapter Eight).

These actions can be strongly complemented by expanding groundnut and cowpea production in rotation with grain crops. In the case of groundnuts, research has indicated a highly profitable first year response to a mixture of rock phosphate and elemental sulphur. Residual effects of the rock phosphate will increase grain yields an average 7 percent per season over a three-year period. This does not take account of the possible beneficial effects of the groundnut crop on subsequent cereal crops through nitrogen fixation.

Research has indicated that significant cowpea yield increases are both possible under Voltaic farm conditions and attractive to farmers when grown in pure stand using pesticides. Although these results should be regarded as indicative rather than definitive, they are sufficiently promising to recommend widespread preextension trials on farmers' fields.

Key to the success of these proposed measures is the expansion of market prospects for groundnuts and cowpeas. Both are common elements in Voltaic diets and represent potentially important low-cost protein sources to counteract infant malnutrition. However, major growth in regional groundnut and cowpea production would require improved access to external markets, particularly in Nigeria where demand is already strong and growing. The required improvements in transport and marketing arrangements are discussed in Chapter Ten.

These measures need not aggravate existing seasonal labor constraints during the planting and weeding period. The application of rock phosphate would take place only once every three to five years, particularly if a rotation involving groundnuts were used. In fact, expanded grain legume production may partially alleviate seasonal constraints through the addition of flexibility in planting periods and weed suppression practices. However, expansion of grain legume production would imply a reduction in acreage devoted to grains. Farmers may be reluctant to consider this at first despite the likelihood that grain production could be maintained through increased soil fertility and higher yields.

For this and other reasons, the inclusion of animal traction becomes a key element in any strategy to improve Central Region agriculture. While acknowledging the general scarcity of land, the use of donkey or bovine traction will enable individual farm families to expand acreage now under marginal cultivation. Equally important, animal traction gives farmers the additional flexibility to plant and weed in a more timely fashion. Research has shown this to be of significant importance in determining yields.[3]

Specific practices either currently used by farmers or showing promise in farm-level trials include:

- Preplanting land scarification using a houe manga to facilitate line planting and obtain better moisture retention and improved seeding establishment;

- Plowing land to remove early weed growth prior to planting where necessary;

- Inter-row cultivation (in some areas farmers plant "on the square" so that crops can be weeded in two directions at right angles); and

- "Tie ridging" and bunding to encourage water conservation.

Research is also proceeding on refining an animal planter which can combine planting and preplanting scarification operations. There are several further refinements in animal traction equipment as well as animal draft husbandry considerations which should be given high priority attention by research and extension programs if the use of animal traction in the central region is to be sustained and expanded. Appendix C has a further discussion and specific suggestions in these areas.

A final element of the central region improvement strategy is the selective application of striga control measures, as detailed in appendix E. The current research effort to identify striga-resistant grain varieties is promising, but may not yield results suitable for extension to farmers until the late 1980s. In the

interim the application of pre-emergence herbicides appears feasible, especially if coupled with the previously discussed practices that are aimed at increasing soil fertility and yields.

The Southwest

The southwestern region is generally better endowed than the central region in terms of climatic and soil conditions and access to markets. These attributes are already being exploited through several major agricultural development projects dealing with rice, cotton, livestock, and sugarcane, as well as food crops. A key feature of the strategy to increase regional production involves alleviating the labor shortage during the planting and weeding period, and increasing returns to labor inputs by the use of, improved practices.

As already noted, national agricultural production can be increased through farm family migration from densely populated low fertility areas to underutilized, higher fertility areas in the southwest, even without any changes in existing farming practices. Mossi farm families are in fact moving into the Southwest in large numbers from the Central Plateau.

One negative aspect of this development stems from the fact that migrants do not have recognized rights to the land they occupy. Thus there is little incentive for them to use practices that prevent soil erosion and increase soil fertility. A continuation of current migration levels is also likely to increase competition between migrants and current inhabitants for good quality land.

While migration is therefore desirable as a means to increase short-term agricultural production, government policies and programs might focus on limiting certain adverse effects of migration. There should be some formal recognition of migrant land rights, at least for a sufficiently long enough time to remove the disincentives associated with an insecure tenure. Efforts should also be made to encourage migrants to move into areas that have plentiful land available, and away from areas that are already showing some pressure (such as portions of Volta Noire and Koudougou). This might be facilitated through expansion and improvement of the road network in selected areas.

Providing intensive support services to migrants, as in the case of the AVV, may not be economically justifiable in most instances. However, special attention should be given to the accommodation of new migrants in existing regional developing projects. Migrants might be directed toward areas currently served by development projects in which existing extension programs could aid in their establishment in new homes. This should serve to enhance the returns to both migration and the development project with very few incremental costs.

The agricultural strategy team generally endorses efforts to expand cotton and maize production. The development of intensive cotton production, mainly in the Southwest, is a major contribution to the Voltaic economy and has had an important impact on agricultural incomes. It depends upon the use of imported fertilizers insecticides, and, to a lesser extent, animal traction.

The value of the exported crop pays for these inputs, but it is possible that their use is not entirely in the interest of either the environment or the population's overall health in cotton-growing areas. An average of 400,000 liters of insecticide was imported during 1974-79. In 1980 30,000 liters of endrin/DDT were imported. This formulation is banned entirely in the United States. At least one other insecticide appears to have a high mammalian toxicity which would disqualify it for application by hand-held sprayer in the developed world.

The fertilizer also has a composition that causes soil acidification. When acidifying fertilizers are used in intensive production packages to grow high-value cash crops, the acidification does not normally have a directly harmful effect upon the soil because the package recommendation insists on the use of 5 to 10 tons of organic manure every two to three years.

However, unless the farmer has access to cheap animal feeds which do not originate on the farm, the organic manure has to be made at the expense of the fertility of the rest of the arable and fallow fields which are not used for intensive cropping. The ill effects of the acidification are therefore more likely to result in a fairly lowering of fertility than in dramatic sterilization of particular areas, as demonstrated experimentally at Saria (see Appendix B).

Maize is grown as an intensive production crop with imported (and subsidized) fertilizer. The yields, as high as 5 to 6 tons per ha in a favorable season, are satisfactory and profitable to the farmer at the subsidized cost of the fertilizer.

However, subsidization of fertilizer applied to maize is probably unjustified. It should not be necessary to subsidize a modified rock phosphate-based mixture in order to obtain profitable yield responses (see Appendix B).

Future trends in the energy cost of fertilizer manufacture are, on balance, likely to increase crop profitability and total crop acreage with little, if any, reduction in cropping intensity. The increased cost of nitrogen fertilizer will make intensive maize production less profitable but maize's natural advantages in this zone are likely to maintain its profitability and lead to a steady production increase. It is expected that the availability

of a nonacidifying nitrogen fertilizer will promote the intensification of production without so marked an increase in crop area. A considerable increase in livestock production is also likely to develop in response to the increasing volumes of crop residues.

As in the central region, consideration should be given to expanding groundnut production in rotation with sorghum and millet. Current technology strongly favors maize production over other rainfed crops in the Southwest. The overall efficiency of the area's agricultural production can be enhanced by expanding maize production at the expense of sorghum and millet. However, sorghum and millet are likely to remain important farming system components for the foreseeable future.

The expanded use of animal traction offers the most feasible means of alleviating seasonal labor constraints and increasing returns to labor. Bovine traction is being used to advantage in the heavier soils characterizing the region. Credit appears to be less of a constraint to expanded animal traction use than in the central region. Availability of traction equipment to meet local demand is a continuing problem (see Appendix C).

Since bovine traction can be used without serious erosion or adverse animal health effects, even in the extreme southwestern portion of Upper Volta around Banfora, there does not appear to be an urgent need to substitute herbicides for animal-drawn cultivators to improve weed control. However, for particularly heavy soils where cultivation with animals is very difficult, the application of soil-active herbicides may be appropriate for cotton and maize (see Appendix E).

Rainfall generally exceeds 900 mm per year in most of the Southwest. The earliest rains are not normally so intense and runoff is not such an acute problem as in the central and northern regions. There is still a yield benefit to be obtained from planting early, but this is partly compensated by the greater benefit obtained in this zone from thorough seed bed preparation and the resulting improvement in weed control.

It is also more common for fertilizer to be used on crops in this zone. This reduces the benefit from early planting and places a premium on good early weed control. The use of the inter-row weeder with oxen is often followed by molding up the soil with an ox-drawn ridger. The total package of early plowing supplemented by inter-row weeding and followed by ridging has been observed to give excellent weed control in cotton and maize in the Southwest. Both crops can be planted some weeks after the rains have started and are normally heavily fertilized (see Appendix C).

The Eastern Region

A major constraint to expanded agricultural production in the eastern region is its distance from major markets and the limited coverage of the existing road network. In constrast to most of the country, the East offers potentially significant returns in terms of increased production to investments in an improved and expanded road network. The completion of the main trunk road linking the eastern region with Ougadougou in the west and Niger in the east should help give the region improved access to other regions and neighboring countries.

Of special interest in this regard would be the effect of improved access to the large and expanding Nigerian market for basic foodstuffs. Road improvements in the East would also considerably lower the costs of rock phosphate delivered to all portions of Upper Volta, and thus further enhance the profitability of this key ingredient in efforts to improve agricultural production.

Aside from the availability of land and marginally higher rainfall, the constraints facing expanded agricultural production in the eastern region are very similar to those in the central region. These include labor scarcity during the planting and weeding period and the absence of an attractive technical package.

The improvement measures suggested for the central region are generally applicable to the East. However, the profitability of expanded groundnut and cowpea production appears to be particularly sensitive to improved access to markets, primarily in neighboring countries such as Nigeria. Expanded use of animal traction equipment also emerges as an attractive element to the improvement package since it would help to alleviate the labor shortage during the planting and weeding period and would permit expanding the acreage under cultivation. Ample land is currently available in the region for such expansion in contrast to portions of the central region.

The eastern region is the site of a large development effort to be launched in 1982 with participation of the International Fund for Agricultural Development (IFAD) and other donors including the U.S. Agency for International Development (AID). The agricultural sector assistance strategy team generally endorses the approaches proposed for this project. In view of the considerable documentation already available on current farming systems and development prospects for the area, it was decided to omit a detailed elaboration of development strategies for this area from the present report.

Research Aimed at Expanding Rainfed Agricultural Production

With the exception of southwestern cotton and maize production, efforts to expand agricultural production throughout the country are not likely to occur without some combination of better access to markets and more profitable and improved practices which can be readily integrated into existing farming systems. Further testing and refinement of promising practices at the ORD and sector levels is also required to verify (or refute) most recommendations. In this regard, continued support for agricultural research is vital--both the more traditional discipline and commodity-oriented agricultural research, as well as adaptive or farming systems research at the farm level.

Agricultural research is currently carried out by an assortment of international, national, regional, and local programs by various research organizations including ICRISAT, SAFGRAD (OAU/STRC), and IRAT whose operations within Upper Volta come under the general jurisdiction of the Institute Voltaique de Recherches Agronomiques et Zootechniques (IVRAZ). In addition, an increasing number of projects contain research components, often of an adaptive nature.

While these efforts promise to have a growing positive impact upon measures to improve Upper Volta's agricultural production in the years ahead, there is a need for greater coordination among them. Formal and informal mechanisms to improve coordination among farming systems research activities at the national and ORD levels are discussed in Appendix A.

It is envisaged that the results from the various farming systems research activities will have an increasingly profound effect on various research institute programs in ways that will enhance the relevance of future research results. Appendices B, C, D, and E explore aspects of current research results and future prospects with reference to soil fertility, animal traction, varietal improvement, and herbicides.

Although many of the measures discussed appear promising from a technical perspective, in most instances there is insufficient information to determine economic and social feasibility. The farm-level trials being carried out by various farming systems activities as discussed in Appendix A are of critical importance in this regard.

CHAPTER FIVE FOOTNOTES

1 Engrais coton is the fertilizer mixture recommended for cotton production in the southwestern part of Upper Volta. It is by far the most widely available fertilizer and is often used on crops other than cotton. R. Swanson, Household Composition, Rainfall and Household Labor Time for Planting and Weeding: Some Observations and Recommendations (Document No. 4, SAFGRAD/FSU, Ouagadougou, January 1981); and Peter Matlon, Local Varieties Planting Strategies, and Early Season Farming Activities in Two Villages of Central Upper Volta (ICRISAT, Ouagadougou, June 1980).

2 In preparing this section, extensive use was made of existing studies, notably Reconnaissance Surveys in North and West Upper Volta by John McIntire, "Village Studies Report No. 3" (ICRISAT West African Economics Program, Ouagadougou, 1981); and "Etudes de Factibilite du Projet de Developpement Agricole Ouest Volta II" (SATEC, Paris, Juin 1981), as well as discussions with representatives of the Hauts-Bassins and Volta Noire ORDS.

3 Since it is not possible to cultivate intercropped grain legumes and cereals using animal traction, a delay in planting grain legumes until after the first cereals weeding might be considered in inter-crop situations.

CHAPTER SIX: IRRIGATED AGRICULTURE

INTRODUCTION

Approximately 9,000 ha are under irrigation in Upper Volta of which about 60 percent is under full water control. Double cropping is practiced on about one-third of this area. One of the main irrigation projects is near Banfora where 2,600 ha are devoted to sugar cane with full and highly efficient irrigation methods. Kou Valley, Niena-Dionkele, Sourou, and Banzon have 940, 400, 150, and 300 ha respectively under irrigation. The remaining areas are comprised of small projects in valley bottoms (bas-fonds) often in connection with small storage dams where mostly flood recession irrigation prevails. Many of the approximately 250 small dams are not being used to their full potential.

PRESENT SITUATION AND FUTURE POTENTIAL

Land Resources

Fernandez-Bustos made an overview of existing and planned irrigation projects in 1975. He estimated potentially irrigable areas on the basis of available water and soil as shown below. This potential was confirmed by Upper Volta's Direction de l'Hydraulique et d'Equipement Rurale in 1976.

LOCATION	IRRIGABLE AREA (ha)
Volta Noire	35,000
Volta Rouge	10,000
Volta Blanche	37,000
Banfora	14,000
Southwest Plains	22,500
Small Dams	12,500
Bas-Fonds	21,000
TOTAL	152,000

The gross area of soils that might be suitable for irrigation in the upper Volta Noire Valley (from the Kou tributary downstream to the region of the Sourou emissary) amounts to about 200,000 ha. Water resources here are the limiting factor with a 1 billion m^3

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median annual flow, falling to half that amount for the 10-year dry flow. Construction of one or more regulation dams would enable a little over 30,000 ha of land to be irrigated.

Further downstream at Noumbiel the water resources increase to about 6 billion m^3 in a median year. A feasibility study of the hydropower potential was completed for this site (Sofrelec, 1978), but the irrigation potential of this development is marginal at best due to unsuitable soils.

A detailed feasibility study of irrigation potential in the Volta Blanche Basin (SOGREAH, 1978) shows that some 30,000 ha could be irrigated with the water resources of this non-perennial stream provided that a storage dam is built in Bagre not far upstream from the Ghana border. The median flow of the Volta Blanche in the vicinity of Bagre is 1 billion m^3 whereas the 10-year dry flow is only 425 million m^3. Some hydropower will be produced at the dam, but much of it will be needed to pump water to irrigation areas since they are mainly situated above the pond elevation.

It is further estimated that 15,000 ha of land could be irrigated for paddy rice in the Komol, Volta Rouge, Bougouriba, and Poni river valleys. The potential for traditional irrigation is estimated to be 30,000 ha (EDIAFRIC, 1978).

Irrigation potential based on these studies is therefore indicated as 110,000 ha with a water requirement of 2.5 billion m^3 per year. Surface water available in Upper Volta is probably two-to-three times greater than this amount if ungauged short distance flow is accounted for.

Water Resources

There are three water-bearing geological formations described in a 1976 report by BRGM:

- The continental terminal covering over 11,380 km^2 with an estimated annual recharge of 430 million cubic meters.
- The basement complex covering over 225,360 km^2 with an estimated annual recharge of 3.77 billion m^3.
- Primary and precambrian sandstones covering over 32,290 km^2 with an estimated 1.96 billion m^3 of annual recharge.

The estimated annually rechargeable volume of ground water would thus appear to total over 6 billion m^3 per year. However, tapping this resource would be limited to very small individual schemes in parts of the country not having access to larger-scale irrigation development from surface water resources. The nature of the aquifers would undoubtedly limit individual withdrawal by wells to small amounts, thereby restricting irrigation possibilities to very small-scale developments.

Using the estimated irrigation potential of 110,000 ha, 2.5 billion m^3 per year of water resources will be required. Compared to the present area of 9,000 ha irrigated with 154 million m^3 per year, this indicates 8 percent of potentially irrigable land is now developed of which only 60 percent is under full irrigation. Full irrigation has therefore been realized on only 5 percent of the country's total potential.

Established Systems

The more structured irrigation systems developed to date (those systems having an organized network of water capture, conveyance, and distribution facilities), have been primarily for rice production. The one exception is the 2,600 ha Banfora project which is entirely devoted to sugar cane under plantation management.

According to World Bank mission investigations, current domestic rice production comes from traditional sources (76 percent), swamplands (8 percent), and irrigated project areas (16 percent). Traditional rice growing is generally carried out in swamps in low-lying areas with impeded drainage and where flood recession irrigation is practiced. In the absence of water control, production from these areas is unreliable. Land preparation, weed control, and other cultural practices are only perfunctorily performed.

Seed is of the Gambiaka variety and the crop is basically regarded as a bonus to producing other crops in upland areas. Yields from these areas are expected to be 1 ton paddy per ha. Swampland irrigation, with water control developed by installation of protective dikes, polders, and distributaries have yields of up to 3 tons of paddy per hectare. The irrigated areas yield between 3.5 to 4.5 tons of paddy per hectare with the possibility of two crops per year.

Out of the firmly estimated total potential of 110,000 ha of irrigable land (some estimates are as high as 150,000 ha), there are an estimated 30,000 ha of swamplands suitable for development. Over 3,000 ha of swamplands in small schemes of up to 20 ha each have been developed under the IDA-financed Rural Development Fund (RDF) I and II projects. Development costs for swamplands vary from $3,000 to $5,000 per ha while costs for more conventional irrigation projects vary from $9,000 to $12,000.

Farmers are responsible for appropriate farm infrastructure, including well-graded fields that permit uniform water application; efficient inter-field distribution systems; well-developed soil profiles; and perhaps some mechanization that permits more timely farming practices to be applied.

Intermediate or long-term credit is usually required to develop such infrastructure. The farmer also needs technical assistance to establish appropriate farming systems on the farm. This frequently takes the form of advice and counsel on more modern agricultural practices, especially water management, in order to obtain improved yield levels. Certain institutional services which are normally supplied at government cost, are needed to provide some farmer access to credit, agricultural schools, and research stations, as well as other governmental service organizations.

Farmers are also faced with recurring production costs for good quality seeds, fertilizer, and other agricultural chemicals; tools and implements; fuel for machines or feed for animals; and in most cases water charges. Small farmers usually require short-term production credit to amortize these costs.

Finally, local support enterprises are needed to handle the harvested crop. The basic elements of the support system are transport, storage, processing (where required), and marketing.

Cost and return analysis points up the need to increase production levels on existing irrigated lands. Based on calculations in recent feasibility studies, the cost of large-scale projects can be estimated at $10,000 per ha, of which $6,000 represents foreign exchange. Annual recurring costs approximate $535 per ha of which 54 percent or $288 is foreign exchange. Transport, processing, and marketing add a foreign exchange requirement of approximately $170 if moderate tonnage estimates are used.

Thus, for every hectare of land brought under irrigation there is an initial foreign exchange requirement of $6,000 and a $458 annual requirement for prooduction costs. At an interest rate of 8 percent and a 25 year return period, the annual payback required to retire the original $10,000 investment is $611.

Added to this are the annually recurring local currency costs of $247 for production and $270 for supporting services. Therefore the total annual cost for providing, operating, and supporting a hectare of land for irrigated rice production in a large networked system is an estimated $1,128.

Imported rice at a 64 percent paddy conversion equivalent would cost $288 per ton (450 x .64). For import substitution to be economic two crops per year with yields of more than 2 tons per ha per crop would be needed. The break even point for the lower cost ($3,000 per ha), large-scale controlled flood recession projects would be 2 tons per ha for one crop per year. The design for improved small-scale irrigation in bas-fonds would require an initial investment of $1,000 per ha. With a life expectancy of only 10 years the bas-fonds design would need a production level of approximately 1.5 tons per ha with one crop per year to break even.

Summary of Constraints

The most important constraints to further developing irrigated agriculture are:

- The high investment cost relative to returns;
- Less than adequate user organizations for managing and maintaining irrigation facilities;
- Inexperience of farmers and advisers in modern water management principles; and
- Inadequate processing and marketing infrastructure.

As seen in the foregoing analysis of order-of-magnitude costs, the first listed constraint can only be overcome by higher productivity. It is unlikely that development costs will be lowered in the future.

The second constraint, inadequate user organizations for managing and maintaining irrigation facilities, creates a situation in which accelerated degradation of irrigation works occurs. Additional financing for rehabilitation will often be required, which reduces economic return and may render the system uneconomic. Also, water delivery services become less reliable as the system degrades. Farmers become more reluctant to invest in costly chemical inputs and weed control, which results in depressed production. In some cases water delivery to a portion of the parcels must be terminated. Overgrowth of vegetation in drainage ways restricts the escape of excess waters, which then tend to saturate the water profile causing waterlogging and a potential for salinization.

The lack of irrigation management skills is the third critical constraint. While hydrologists can determine water availability, hydraulic engineers can select sites and design facilities, and the public works service can construct the irrigation systems, all of their activities lead only to the delivery of water to farmers' fields. Optimum use of the delivered water for crop production requires derivation of site specific soil-water-plant management practices which may vary from place to place according to soil type, climatic conditions, and crop variety. While improvement in general irrigation management will occur as experience is gained by farmers, the refinements in practice needed to achieve attractive net returns for farmers will require skilled irrigation scientists and technicians. The latter are not currently available in Upper Volta. Further, the country does not yet have the institutional capacity to produce irrigation scientists. Nor does Upper Volta have a sufficient number of qualified candidates for foreign training to meet the demand for technical manpower that an accelerated pace of irrigation development would create.

Even if the institutions and individuals who could perfect the irrigation management guidelines were in place, the development of farmer training programs to transfer skills would be required. The programs tried to-date have not greatly affected the management practices of Voltaic farmers. Compounding the difficulties of the design and implementation of an effective irrigation management training program are: the radical shifts in annual activity patterns required by the change from a wet-season cropping cycle to a year-round and more labor-intensive systems; the increase in management intensity and capital investment per unit land area on parcels much smaller than the rainfed fields; and the crop variety restrictions imposed by centrally operated schemes.

These problems are intensified when emigrants from remote and environmentally different areas are introduced into irrigation projects under resettlement programs. When combined with the current and projected shortages of experienced irrigation specialists and farmers all of these factors indicate that expansion of irrigation schemes should be pursued slowly and carefully.

The fourth constraint, inadequate processing and marketing infrastructure, can and should be resolved in the near term for irrigation projects that already exist. One issue that needs to be resolved pertains to the feasibility of large-capacity, centrally located mills for rice compared to smaller-capacity, dispersed-location mills. There is also the issue of who should manage processing and transport (private interests, government parastatal interests, or the production cooperative societies). Overriding these specific issues is the need for clear marketing policy geared toward guaranteeing the outflow of products at a profitable producer price in order to create the incentives for stabilization of rice supply to the national market.

These constraints are not likely to be resolved in the near term, thus inhibiting the development of irrigated agriculture.

IRRIGATION INTERVENTIONS PROPOSED FOR UPPER VOLTA

Optimizing agricultural investment returns is not a matter of choosing between rainfed and irrigated agriculture, but rather of determining how to use both types of agriculture in the most beneficial and efficient manner.

A strategy for overcoming the constraints discussed in the previous section would have to carefully define near- and long-term objectives. Prior to investment in large projects systems, testing needs to be carried out to:

- Derive a feasible package of technical practices that would produce higher returns from irrigation, and thus generate acceptance by Voltaic small holders;

- Define incentives to encourage irrigation cooperatives to assume control and management of the irrigation system, production program, and marketing arrangements with the goal of becoming a self-managed, self-sustaining, production-oriented cooperative; and

- Investigate the restructuring of government irrigation and water resource organizations to create a single authority responsible for irrigated farming policy, which would set goals for irrigation development more in line with Upper Volta's financial and technical resources, and assign responsibilities for project implementation.

The short-term development strategy should continue to emphasize, and even accelerate, the development of small-scale projects. The low-cost bas-fonds improvement being done under the auspices of the IDA-financed Rural Development Fund appears to be a more cost-effective approach for achieving short-term production goals. Moreover, these small-scale projects are more conducive to farmer participation in the development stage as well as in follow-up management and operation activities, thus increasing the likelihood of sustainability.

Strengthening the technological base for developing water resources in Upper Volta should be both a short-term and long-term activity. There is a need to create an increased capacity for producing technicians in engineering, agronomy, and soil science. Additional training and short in-service refresher courses for all existing as well as future staff are also needed to build a stronger technical base in irrigated agriculture. A more effective farmer training program also needs to be developed.

Intermediate to long-range objectives for irrigated agriculture should be determined on the basis of optimizing returns relative to investments. Within the limitations imposed by the existing constraints, crop selection and management practices should be aimed at ensuring the highest and best use of each land capability class. Full development of the estimated 30,000 ha of swamplands for rice production, for example, could add an additional 100,000 tons of paddy to the present 50,000 ton output if on-farm production techniques were improved. This would constitute a substantial portion of the additional rice production requirement needed for the year 2000.

Improving water use efficiency on all irrigation schemes, particularly those projects in the more upland areas where diversification to crops other than rice would be practiced, should also be a goal. Depending upon favorable cost/benefit analyses, even systems which incur energy costs higher than gravity systems, such as sprinkler irrigation on field crops

(except rice) or drip or trickle irrigation for vegetable, fruit, and other high-value crops, could be viewed as desirable long-range modernizations.

Trials of solar-powered pumping systems are too inconclusive to date to make projections over the short and intermediate term, but the recent improvements offer hope for introduction of these technologies at reasonable long-term costs.

CHAPTER SEVEN: LIVESTOCK PRODUCTION

INTRODUCTION

The variety of Voltaic ecological conditions presents the opportunity to develop site-specific agricultural strategies. Most livestock production systems are already integrated with farming activities. The integration may be economic, as when surplus income from farming is invested in livestock, or conversely, when herders plant a small plot of grain crop to ensure their food supply. Integration may also be through energy flow, as when crops are fed to livestock or livestock supply work or manure for farming activities.

The latest Livestock Service estimates of livestock numbers were based on data obtained in 1976. The total livestock populations are shown in table 7.

The Livestock Service estimated that from 1977 through 1981 herds have been increasing at the following annual rates: cattle, 2 percent; sheep, 3 percent; goats, 3 percent; swine, 3.5 percent; and poultry, 2 percent. Although the reliability of these figures is uncertain, experience in other West African countries where rigorous surveys have been carried out indicates that such extrapolated data do provide reasonable estimates of actual animal numbers.

Table 7. Total Livestock Populations in Upper Volta: 1976 (000's)

Cattle	2,550
Sheep	1,648
Goats	2,472
Poultry	10,200
Swine	154
Donkeys	200
Horses	70
Camels	6

Source: GOUV Livestock Service, 1976.

Production parameters such as offtake rates and mortality losses have not been widely or systematically measured. Judging from a few studies done in northern Upper Volta and other West African countries, the figures usually given for herd or individual animal productivity may be underestimated, especially when applied to extensive pastoral production systems. Table 8 gives calculations which may therefore be low but still provide some indication of the magnitude of annual livestock production.

Table 8. Annual Livestock Production in Upper Volta: 1981

	1981 Herd Size (10 million)	Offtake Rate (%)	Offtake Numbers (1000/head)	Production (1,000 tons) Meat	Offal	Milk	Eggs (10 million
Cattle	2.82	11	310	32.6	8.2	68	-
Sheep	1.91	25	478	6.7	0.9	30	-
Goats	2.88	25	720	7.9	1.3	-	-
Swine	0.18	60	108	2.7	-	- -	
Poultry	11.25	110	12,375	9.8	-	- 12	

Source: GOUV Livestock Service, 1981.

Livestock also contribute significantly to the economy by providing transportation, farm work, manure, and hides. Livestock provide flexibility in habitat utilization, economic security, and investment opportunities. Thus for individual stock owners and producers, animals are worth more in terms of lifestyle and survival value than market values would indicate. It would be misleading to place a total value on the national herds based only on the animals' current market prices.

Present herd growth rates may be higher than the growth rates for internal consumption. Without an increase in export demand, there may be an erosion in the profitability of livestock production over the next decade. A principal factor which may prevent this decline is the rapid growth of the Nigerian economy. Nigeria's anticipated long-term dependence upon imported meat should help to sustain a demand for Voltaic livestock.

CONSTRAINTS TO LIVESTOCK PRODUCTION

Intensive Livestock Production Systems

Intensive livestock production systems are those in which carbohydrate or protein concentrates are fed to livestock in a specially constrained, artificial habitat. This increases the rate at which energy is converted to meat, milk, and animal by-products. Intensive production systems are logical when there is a ready supply of feeder animals, a surplus of high quality crop by-products or grain, and a demand for the products. Profitability is then limited by high capital costs and the costs of management and maintenance.

Agricultural by-products available in Upper Volta include cottonseed and cottonseed cake, molasses, brewery wastes, and brans. Of these, only molasses and cottonseed are being produced in large quantities. The main question about utilizing them is opportunity cost. Plans for converting molasses into fuel alcohol are being considered and, given the high cost of imported gasoline, could be more profitable than livestock feeding.

Top quality cottonseed is currently processed for oil. Then it is sold to the local oil processing plant at a government-fixed price which makes oil production profitable. If the price were deregulated and the seed sold on the open market, the relative profitability of intensive livestock feeding and oil production would be close.

There is a limited demand for the more tender, higher fat meat produced in feedlots, and most Voltaics would not perceive this type of meat as being of a higher quality. In fact, it may have a lower nutritional value than meat produced by foraging animals. Therefore, feedlot production would not be a logical component of a strategy to develop food self-sufficiency for Upper Volta.

Upper Volta has had two cattle feeding operations. Both have performed poorly. Inefficient management and poor rates of gain have resulted in net losses at one feedlot (ONERA) and very low profit at the other (SODEXPAD). The high initial cost of constructing feedlots is unjustified by this performance level.

Intensive dairy production requires high-producing, metabolically demanding cattle in order to obtain the production efficiency necessary to compete with global milk sources. In turn, these cattle require a highly technical support system that provides excellent animal husbandry conditions.

In order to develop dairy production in Upper Volta, forage production and milk processing and marketing structures would all be required, and the system would have to be developed from

scratch. Even if milk production and milk marketing subsidies were eliminated in developed countries, it is uncertain whether Upper Volta could produce milk efficiently enough to compete with international prices.

Recent milk import levels have varied between 24,000 and 80,000 metric tons per year, most in the form of food aid. Since most of this milk has been given free to school children and hospital patients, the demand has been artificial and would drop precipitously if milk were supplied by unsubsidized local dairies. In any case, replacing this amount of milk would require installing between 100 and 200 dairies and entail an astronomical investment.

Sheep, poultry, and swine can also be reared in intensive production systems, but they require high quality feeds, good husbandry conditions, and intensive health programs. Feed rations, especially for swine and poultry, may require balancing with high quality feedstuffs which could be used to feed people or more profitably exported overseas.

In summary, donors should be cautious about future investments in intensive livestock production systems. High investment costs, low profitability, lack of a technological base, and the poor distribution of benefits suggest that alternatives should be sought for livestock subsector development.

Semi-intensive Livestock Production Systems

Semi-intensive livestock production systems are those in which animals are kept on or near a farm plot and fed a combination of natural forage, crops or crop by-products, and some high energy or protein supplements which may be purchased. The production rate is slower than in intensive production systems but semi-intensive systems have distinct advantages.

Farm crops and by-products which might otherwise be wasted may be channeled into productive use and, if cattle are reared, may provide valuable work (traction) and manure. The use of family labor during the farming off-season keeps the overhead costs of semi-intensive systems low. In addition, equitable benefit distribution among the Voltaic agricultural community is easier to achieve than with other types of production systems.

Many semi-intensive Voltaic production systems are "traditional"; that is, they have evolved without the direct assistance of development interventions. Included in this category are village-level production of small ruminants, cattle, poultry, and swine.

Animal production in these systems is very inefficient in terms of energy utilization per unit of product obtained. More efficient production could be obtained by increasing the levels of health, husbandry, and nutrition in these systems, but it is unclear whether the resulting production increases would exceed the value of the added inputs including labor.

There are three particular areas of concern which may impede the development of semi-intensive production systems. These are animal health, labor availability, and culturally linked perceptions about the importance of animal production. Establishing veterinary protocols which would maintain the necessary health levels will be a problem. Diseases are numerous and they have not been well-defined in terms of cause and epidemiology. Merely establishing village pharmacies in order to distribute veterinary commodities would not produce increased animal health levels; field-oriented studies on disease patterns would be also required to ensure the adequacy of their operations.

Labor availability is also a problem. Traditional production systems require such a low labor input level that modifying these systems may require a significant restructuring of family labor allocations. Production systems need to be developed that would not interfere with farming and other established activities. Animal production systems which could be "put on hold" during periods of peak labor demand would be especially worthwhile.

The last important constraint is that of culturally linked perceptions. That is, would farmers view animal production to be important or interesting enough to expend the necessary effort, and would their peers view these efforts with admiration, diffidence, or contempt? The likely key to breaking down cultural constraints is profitability, but not enough socioeconomic analysis has been done to define the required levels of profitability or recommend production systems with assured profitability.

Interdisciplinary field studies in socioeconomics, animal production, and health are required. Since studies would require repetition on a location-by-location basis, consideration should be given to establishing an interdisciplinary Voltaic research team to continue the research efforts after an effective study protocol has been developed.

In addition to the intensification of traditional livestock production systems, there are several non-traditional livestock activities that have merit. These include farm fattening (embouche) programs, animal traction, and village dairy production. Embouche and animal traction programs are so closely linked to farming activities that they do not constitute production systems by themselves. They should be added to crop production systems as complementary activities in order to achieve a balance between high-quality by-product forage production and use.

In particular, animal traction should be considered an integral component of farming system development. Increased agricultural production eventually may become the major factor in increasing animal production, and farming systems research should almost always include the integration of animal production with cropping.

The development of village-level dairy production may be worthwhile as long as it, too, is also compatible with the evolving crop production systems. Particular attention should be given to peri-urban villages with a view toward eventual commercial milk production. Donors who choose to pursue this should also assist the government in improving the technical and support services necessary to sustain efficient production.

There are several developing models for village milk production in Senegal, Kenya, and Ethiopia, for example, which may be applicable to Upper Volta. Research on village milk production undertaken by the International Livestock Center for Africa (ILCA) should be carefully followed.

Extensive Livestock Production Systems

Extensive livestock production systems are those where animals are reared on undeveloped natural rangelands or fallow lands. Foraging patterns may include both grazing and browsing, and livestock species may be segregated or mixed. These systems are exploitative; minimal effort is made to improve the primary productivity of foraging areas beyond their natural capacity. Supplementary feeding may be done on a seasonal or ad hoc basis but usually only in quantities necessary to prevent excessive production losses during periods of stress.

In Upper Volta at least 50 percent of the land surface area is covered with natural rangeland which is best suited for extensive livestock production. This rangeland presently constitutes Upper Volta's largest resource for livestock production. Although its relative importance may decline as agricultural production increases, its best potential use for sustained productivity will continue to be in extensive livestock enterprises.

Another 40 percent of the land surface is presently in fallow, and although this is less productive than previously uncultivated rangeland, it is nevertheless profitably foraged. Some of the fallow land should never have been cultivated in the first place but due to high population pressure was farmed at the expense of sustained productivity. Restoration of these areas would probably raise the total natural grazing/browsing resource to about 60 percent of the land surface area.

Major Production Zones

In Upper Volta four production zones can be differentiated by the types of extensive production systems they support. These zones are the sahelian zone, the central plateau, the tsetse fly belt, and the sudano-guinean sylvopastoral zone.

The Sahel

In the sahelian zone individual production strategies are defined by the mix of ruminant species (sheep, goats, cattle, camels) which a herder keeps. In turn, the herd mix defines the optimal habitats to be exploited by the production system. Types of production strategies include browsing, grazing, or both, and they may be supported by a small cropping program or seasonal integration with extensive cropping systems.

It is important that donors attempting to improve sahelian zone production recognize that the various herding strategies interact. A positive change in one production system may have negative repercussions on other systems, in which case overall land and animal productivity may decrease. For example, current efforts to encourage all sahelian zone herders to undertake some amount of grain farming may produce negative effects by lowering the efficiency of grassland harvests and forcing more herders to use browsing habitats. Donors should proceed very slowly and with clearly defined objectives when attempting any changes in production systems.

In the Sahel there are two major biological constraints to increased productivity. These are poor animal health and lack of protein in forage during the dry season. The diseases that reduce production efficiency are likely to be numerous, as demonstrated by studies in central Niger, and these diseases have not yet been sufficiently defined in the Voltaic Sahel. Studies to identify the diseases should also determine herder perceptions about specific diseases in order to formulate interventions the herders will accept.

Donors should help develop a cost-effective extension system in which herders are able to apply herd health interventions to their own animals as an integral component of their overall herd management responsibility. This will be the only practical way to overcome the logistical problems of providing health support to migratory production systems. Currently there is probably no way to relieve seasonal protein deficiency except with concentrates such as cottonseed which are not cost-effective. Attempts at hay or cultivated forage production should be coupled with interdisciplinary production system studies to determine how these innovations can be applied.

Soil fertility is also a limiting factor in the Sahel, at least in areas receiving more than 500 mm of annual rainfall. However, research in Mali has shown a negative cost/benefit ratio to application of fertilizer.

Animal breeding programs are unlikely to increase productivity in the Sahel. Herders already select animals on the basis of performance characteristics such as milk output and frame size which are important production goals. However, in years with bad rainfall and poor primary production, the highest producing and therefore the most metabolically demanding animals are the ones that suffer most. Thus, there is a dynamic balance between productivity and resistance to environmental stress which limits improvements through breeding.

The second production zone, the central plateau, has a high population of both livestock and people. Grain stalk residues and fallow provide considerable livestock forage, but herds are also sent on transhumant migrations in order to forage natural grazing lands. Extensive agriculture and herding have caused widespread soil degradation and reduced productivity.

The Central Plateau

The major objectives for increasing livestock production are to restore a balance between animal numbers and forage production and allow or facilitate the regeneration of degraded areas. Animal health is also likely to be poor because the high concentration of animals facilitates the transmission of contagious diseases and leads to the localized buildup of parasites and microbes. Efforts to improve animal health may not be rewarding, however, until improvements are made in management and nutrition.

The Tsetse Fly Belt

The third production zone is roughly between the 800 and 1,000 mm isohyets and includes the edge of the tsetse fly belt. As on the central plateau, extensive herding is integrated with agriculture so that crop residues and fallow provide important forage sources for livestock. However, there is also considerable natural rangeland which allows grazing between the farmed areas.

Parts of the south and east still have considerable unexploited rangeland that can be used for livestock production, but these areas are rapidly being settled. Both herders and farmers are moving in and creating a dynamic situation in which production strategies are evolving. There are elements of both accommodation and antagonism between farmers and herders, but in general the acquisition of land tenure through farming favors the farmer and limits the options for developing productive herding strategies.

However, this is also the zone where the introduction of range management innovations is most likely to be feasible and productive. Several factors favor success: herding strategies are fluid and not yet fully institutionalized; the area is not yet overpopulated with people; and the herders' production goals are somewhat commercial (in contrast to the Sahel where subsistence imperatives demand rigid production goals). Of particular interest are the grazing trials being conducted by AID's Niger Range and Livestock Project. Its production-oriented grazing trials have been successful in achieving a balance between per hectare and per animal productivity.

Water resources are scarce in the east and limit the availability of rangeland otherwise suitable for grazing. This is a zone with relatively low rainfall but high vegetation biomass so that brush and range fires are particularly severe and destructive. Fire breaks are costly and inefficient and ways must be sought to convince residents to control and limit fires themselves.

In the tsetse fly belt there are both trypanotolerant and nontrypanotolerant livestock breeds. It has been estimated that 40 percent of the cattle are susceptible Zebu, 25 percent area resistant West African Shorthorn, and 35 percent area a Zebu-Shorthorn mixture. Due to the influx of Fulani herders, the percentage of Zebu cattle is increasing. No comparable figures are available for sheep and goats, but there is probably a higher percentage of trypanotolerant than nontrypanotolerant breeds.

The importance of trypanosomiasis in this zone is difficult to determine. Animals move in and out of tsetse fly-infested areas, and herders may develop management schemes which avoid most of the flies. Studies in Nigeria have shown that when extensive herding can be seasonally integrated into agriculture, trypanosomiasis becomes relatively unimportant. These findings are not generally known in Upper Volta, and the economic importance of trypanosomiasis is probably overestimated by both donors and the Livestock Service. It is important that proposed range management schemes allow sufficient scope for herders to avoid tsetse flies.

A major effect of trypanosomiasis is that it obscures and prevents the proper diagnosis of many other infectious diseases. Neither Livestock Service agents nor herders are able to differentiate trypanosomiasis from other diseases such as anaplasmosis, babesiosis, and the helminthoses. Herders request and receive many doses of prophylactic and curative drugs for their animals, but no one knows whether the drugs are still effective or whether drug-resistant strains of trypanosomes are widespread. Nor is it known how often these drugs are used for nontrypanosomal diseases for which they are ineffective.

The entire issue of the epidemiology, chemoprophylaxis, and treatment of trypanosomiasis in relation to herd management and production needs to be clarified by interdisciplinary field studies before practical cost-effective interventions can be introduced. A general herd health survey leading to the development of an effective extension system would be rewarding. It should be possible to improve animal health significantly, thereby improving production efficiency. An extension system based on animal health and having integral herder participation could provide a foundation for introducing other innovations such as range management and supplemental feeding.

The Sudano-Guinean Zone

The fourth livestock production zone is the southwestern sudano-guinean region. This zone is dominated by farming cultures which keep livestock as scavengers, but there is also extensive interstitial herding which has been increasing since 1973. The zone contains 15 to 20 percent of Upper Volta's total cattle population.

Approximately 55 percent of the cattle are trypanotolerant savanna West African Shorthorn. The remainder are equally divided between Zebu and Zebu-Shorthorn mixtures. In the extreme southwest, up to 75 percent of the cattle are Shorthorn. Most of the sheep and goats are trypanotolerant breeds.

One of the major factors limiting extensive animal production in this zone is the limited labor that can be expended on herd management. The region has high agricultural potential and a long cropping season, and the opportunity cost for providing labor to care for large herds in the nonfarming areas is high. In fact, low per animal productivity in this zone is more likely to be a result of inefficient management than of endemic trypanosomiasis.

The immigration of herders from the north is providing some needed labor, but cultural and socioeconomic factors still limit livestock development. The trypanotolerant Shorthorn cattle which do best in this zone are small and have not been bred over the years for milk production. Consequently they do not serve very well as milk cows, which is important to women in herding families. There is also peer pressure to keep larger cattle, and herders who keep Shorthorns may be teased about "keeping a herd of swine". Management requirements tend to be proportional to herd size, so a herd of 60 Shorthorn cows, for example, would need about the same management as a herd of 60 Zebu cows, even though the former is a smaller production unit.

Finally, there is a market preference for Zebu cattle, and small Shorthorns receive a price disproportionately less than their true food value.

Despite Shorthorn cattle disadvantages, donors should support increased production with this breed. There is no evidence that Shorthorns are less efficient beef producers, and, given Zebu cattle's susceptibility to trypanosomiasis, the Shorthorns are probably more efficient producers in the tsetse fly-infested areas. Selective breeding can be done to increase both cattle stature and milk production in indigenous herds. The cost effectiveness of pursuing this line of livestock development should be very good given the high cost of tsetse fly control and the inefficiency of chemoprophylaxis.

The nutritional value of forage in the southwestern sylvopastoral zone is low even though the standing biomass is high. Since rainfall is high, there may be some scope for introducing nonindigenous forage species and rock phosphate fertilization in an effort to improve pastures. However, this changes the nature of production systems from exploitative to semi-intensive, and it is uncertain how far one should go in this direction. Improved range management would probably be more cost-effective, and efforts should probably be concentrated toward achieving this goal.

Animal health could also be improved by acquiring a better understanding of the specific diseases that cause production losses. Helminth infections are thought to be important, especially in causing calf and lamb mortality, but field studies have not verified this. A helminthosis control program was initiated in Upper Volta a few years ago but it was prematurely conceived and not very effective. Numerous other problems in animal health could be alleviated, but a cost-effective delivery system must be developed first.

SUMMARY AND RECOMMENDATIONS

Intensive Production Systems

Increased meat production by intensive livestock production systems would not support progress in securing food self-sufficiency through the small-scale producer. In light of past performance, capital invested in feedlots would not be recoverable. The expenditures would not be justified in terms of the quality or quantity of food produced.

Semi-Intensive Production Systems

Significant increases in livestock production require both corresponding increases in crop production and finding ways to remove the constraints of labor, animal health, and cultural perceptions.

Animal production innovations should be introduced through the farming systems approach. Donors should be cautious about supporting backyard fattening programs that either do not fit well into evolving farming systems or rely on feeds not produced on the farm. After worthwhile livestock components are identified, credit programs to small-scale producers should include provision for buying and rearing the animals. Village milk production would be worthwhile in terms of food production, and this should not be overlooked in farming systems development. In terms of production efficiency, it would be better to maintain a milk cow rather than a meat-producing animal in the farmyward.

Nonruminant production systems should not be strongly promoted until it is known how much feed can be reasonably diverted away from the human population.

Extensive Production Systems

Efforts should be made to increase the efficiency of traditional production systems and develop adaptable range management procedures to ensure sustained productivity. Land use regulations should be negotiated locally by producers rather than imposed through a centrally defined agro-sylvopastoral code. The government would be unable to enforce such a code in any case.

Group ranches or any other type of ranching scheme should be given a lower priority than developing less formal schemes which require less social engineering to maintain or increase land and animal productivity. Interdisciplinary efforts should be made to coax traditional systems into productive accommodation with the new realities of population expansion and agriculture.

Forage production will probably be required to sustain efficient animal production if production systems become more constrained. However, this would change the exploitative nature of extensive production systems and it may not be cost effective on a wide-scale. Donors should pay more attention to the ways cultivated forage can fit into production systems rather than promote the production of forages which may have no economically sound application.

Animal health improvements would provide concrete gains in production efficiency. Given the difficult logistics of providing health interventions to extensive herding systems, it would be necessary to develop a system based on herder participation (veterinary *secourisme*). Field training would be required in order to develop effective interaction among Livestock Service and herder agents (*secouristes veterinaires*). The system should be based upon herd health rather than individual animal diagnosis and treatment in order to maximize cost-effectiveness.

CHAPTER EIGHT: ENVIRONMENTAL CONCERNS

INTRODUCTION

Attention to the Sahelian environment increased after food production and distribution systems were disrupted during the early 1970s drought. Drought and famine were believed to be associated with the perceived desertification taking place in the Sahel. In the ensuing years of intensified foreign assistance, considerable progress has been made toward clarifying the fundamental nature of the "Sahelian disaster", yet quantitative data on ecological change in Upper Volta are difficult to obtain.[1]

It is nonetheless clear that there has been a qualitative change in the resource base and its productivity. Farmers and herders in the Sahel and Mossi Plateau consistently refer to a variety of problems: intermittent streams that formerly flowed year round, falling well levels, shortened fallow periods, abandoned land, shrinking forests, disappearing game, an increasing lack of forage and water conservation, poor animal condition, and lowered milk production. Overcutting trees, overfarming, and overgrazing interact to cumulatively reduce Upper Volta's food production potential.

It is understandable that both government policies and individual production strategies have favored short-term production increases over long-term environmental stability. It is only when ecological problems become acute and their negative consequences directly felt, that concrete steps toward their resolution can be expected, either at the government or household level.

This stage has been reached in parts of the country. Halting soil erosion, for example, has become the first priority of ORD policy in Yatenga, yet in 1981 villager demand for erosion control outstripped the government's capacity to provide assistance by about a 2 to 1 ratio.

Given the severity of the environmental problems, popular awareness, and the willingness to take action, short-term assistance (1983-88) can be justified. This discussion focuses on those aspects of environmental problems that the Ministry of Rural Development (MRD) is responsible for solving. Conservation programs in Upper Volta as in other parts of the world require government and donor subsidization. Despite awareness of changes over time, both economic feasibility studies for various projects and microeconomic decision makers treat natural resources as a constraint rather than as natural "capital" spent at the expense of future productivity.

Nonetheless, in order to ensure continued villager support and interest, current programs should be designed to provide tangible benefits such as increased yields, forest products, or improved animal productivity. The success of environmental programs will equally depend upon collaboration with the rural population at every stage of implementation and, where possible, in the design of programs as well.[2]

RANGE DEGRADATION

It is difficult to isolate precisely the causes of Upper Volta's range degradation. Like other environmental problems, it began locally and has only recently become a general problem in the Sahel and central plateau. Declining range productivity is a product of a combination of factors, including excessive and poorly timed rangeland burning; agricultural expansion into marginal areas (often with high erosion potential) that should be reserved exclusively for grazing and forestry uses; excessive fuelwood removal from bush areas; and unchecked use of permanent water sources.

The consequences of these largely demographically induced changes has been to interrupt the seasonally balanced movement of animals under traditional management. Given the interwoven nature of these different elements, an increase in animal numbers beyond carrying capacity is but a single element in the complex equation affecting the productivity of Upper Volta's rangelands. This section will focus on the potential for direct intervention in the rangeland ecosystem. Table 9 shows the relative distribution of Upper Volta's arable and range lands by ecological zones.

A program to address the problems of range degradation must focus on three sets of constraints: socioeconomic, technical, and budgetary and institutional.

Socioeconomic Constraints

Livestock has become the principal means for many sedentary farmers and urban dwellers to invest and increase their capital. The new investors have increased the number of commercial animals on the range but have not developed a parallel interest in the efficiency of capitalization.

Livestock has proven to be an effective hedge against inflation. Cattle prices increased six-fold between 1970 and 1980, while the price of food grains only increased 2 to 3 times In addition, herds multiply and young animals grow in weight as well as value. This has made livestock doubly attractive as an investment option while complicating rangeland management.

Table 9. Relative Distribution of Upper Volta's Arable Land and Rangeland by Ecological Zones

Ecological Zone	Surface area (1,000 ha)		
	Arable	Range	Total
Sahel	980	2,405	3,700
Sudan	4,575	9,504	14,500
Sudano-guinean	3,360	4,336	9,000
TOTAL	8,915	16,245	27,200

Source: FAO, 1976.

At the same time, farming populations and cultivated land area have dramatically expanded in the Mossi Plateau and Sahel regions. Such expansion has consequently reduced range resources, often in key areas such as dry season pastures. This expansion has also taken place precisely in those areas of densest animal concentration. Herding populations have little land security and have lost land as the dominant sedentary groups have expanded. Agricultural expansion in the Sahel has taken place in the dune areas and bas-fonds which previously comprised the choicest pasturage. This expansion is equally associated with forest cutting, a general increase in runoff, and a consequent reduction of forage availability.

It has become increasingly difficult for the traditional subsistence herder to survive under the constraints this land intensification is creating. Among other things, it is constraining his chief adaptive strategy--mobility. Pacification of the countryside has taken away the herder's most effective means of reconstituting his herd when lacking sufficient breeding stock. Concentration of wealth is apparently taking place among herders which could affect efforts to agree upon common range access regulations.

These elements--increased nonherder investment in livestock ownership, overall land intensification and environmental destruction, and an increasing imbalance within the pastoral society's social structures--have disrupted traditional range

management and made its replacement exceedingly difficult without prior establishment of a comprehensive basis for national-level environmental management.

Such a basis might be institutionalized in the long term by establishing an agro-sylvopastoral code. Only in zones where range degradation and animal populations are still minimal and land tenure is more flexible do possibilities for immediate action offer a reasonable potential for success.

Technical Constraints

The available technical programs directed toward reversing range degradation require further adaptive research. Existing approaches can be classified into two broad categories. Range management attempts to reorient herding decisions according to ecological principles. Range improvements involve direct attempts to alter the habitat and include such measures as natural pasture enhancement, mechanical manipulation (ripping, scarification, and bush removal), and seeding. However, seeding has seldom proven cost effective, particularly without proper range management being practiced to maintain the improvement.

The principal indicator of degraded range in Upper Volta is the abundance of large denuded surfaces where regermination of even hearty annual grasses is impeded. The potential for restoring such surfaces has attracted considerable attention. Both the FAO and the FED (Fonds Europeen de Developpement) currently operate range improvement programs in the Sahel, and AID's "Environmental Sector Assessment" advocated further involvement in this geographic zone.

The most thorough research results to date are those obtained by the CIDR Sahelian Program.[3] CIDR efforts have demonstrated that regeneration was far more remarkable when sahelian rangelands were rested than when attempts to rip and reseed were attempted.

However, severely denuded surfaces do not regenerate with protection alone. Numerous trials were made to determine germination and survival rates under different mechanical treatments to soil surfaces (which included packed and sealed sand, gravel, and clay). Spectacular results were obtained after one year, followed by high mortality for both herbaceous and woody species. After three years, soil and plant growth conditions returned to their original state where even annual grasses failed to germinate.

Another attempt using contoured mini-dikes as water catchments, both with and without seeding, yielded better survival rates in the unseeded plots after four years. Given protection, these areas could be fully restored. Without protection, erosion continued until all traces of the dikes had disappeared.

As in the case of the recently completed Village Livestock Project, the need to protect fallow areas and the lack of a rural code to enforce such protection have presented major obstacles. Further sociocultural research is needed to clarify how such protection could best be achieved. While cost figures for soil trials are not available, given the less than conclusive results it is clear that this type of activity must be continued as adaptive research and not as a technical package ready for widespread diffusion.

The situation is considerably different in the south's higher rainfall areas. Few studies exist which use the same criteria for determining biomass in different rainfall zones. Range resource surveys carried out by the Village Livestock Project determined standing biomass for two zones of about 600 mm and 950 mm annual rainfall respectively. Biomass ranged from 200 to 1,000 kg per ha in the drier zone to 1,400 to 1,600 kg per ha in the wetter area, reflecting significantly different animal production possibilities. According to a 1976 FAO report, about 60 percent of these areas is best suited for range development compared to less than 40 percent for agriculture.

Recent attempts to improve rangeland productivity focused on improving pasturage by introducing exotic forage species, particularly perennial legumes. Adequate data are not yet available to determine the cost effectiveness of these interventions, but results to date have been rather discouraging. The potential for forage species appears greater in special agronomic situations such as in irrigated perimeters and the AVV zones. Research in this direction should be pursued in conjunction with animal traction and farming system programs.

Unpublished findings at the AVV experimental center of Sondre Est indicate some potential for seeding natural pastures with Stylosanthes hamata. Ground is scarified using a tractor in a cross-hatched pattern at a cost of 4,000 to 5,000 CFA per ha and anticipating a 12.5 percent increase in carrying capacity.

If successful, this technique could prove to have potential. Success is partly dependent on effective fire suppression which can only take place with extension support and villager participation. Program needs for building institutional capacities are discussed in the livestock section of this analysis. The basic conclusion is that sound range management must precede widespread interventions when improving rangelands.

Institutional and Budgetary Constraints

The Livestock Service is a rural network of regional offices and rural agents. Its primary emphasis has been on delivering basic animal health measures. However, recent policy changes and training reflect a growing consideration of other aspects of animal production.

The Department of Animal Production has recently expanded to include a suboffice of pastoral management. Its staff will have the capacity to design and implement range management and coordinate programs. Personnel consists of several livestock engineers and one U.S.-trained range manager. Previous constraints to implementing range programs based on lack of counterparts appear to have been resolved, given the Livestock Service's current and probable future funding levels.

External donor support will be required if these essentially field-trained technicians are to be able to carry out their tasks. The new pastoral management office is a secondary priority in relation to ongoing programs, which are themselves facing severe budgetary constraints.

In sum, the GOUV's institutional capacity to deal with range degradation problems and apply range management systems is limited. For this reason a nationwide program is not feasible. A pilot region should be chosen in which to develop this capacity and test the technical package. From a technical standpoint it remains to be tested whether controlled grazing practices can in fact be implemented to improve the present open range policy.

Moreover, direct transfer of range management as practiced in the semi-arid zones of the United States is ill-advised and has produced very little in the way of positive results when tried in Upper Volta or other parts of the Sahel. Range-type operations have proven extremely costly and more often than not counterproductive. Recent research findings both of a socioeconomic and ecological nature have also demonstrated that locally evolved systems are more efficient and ecologically conservative than previously supposed. This has especially proven to be the case in zones where farming is clearly of secondary importance (such as in those with 400 to 500 mm of annual rainfall).

SOIL EROSION

Current Status

Degradation of soil resources constitutes one of the most fundamental constraints to agricultural development in Upper Volta. Once degraded, soil fertility and structure can be restored only at great cost, effort, or both. Soil losses to runoff are permanent. Unless sound soil conservation practices are incorporated from the outset into the agricultural development packages for each region, the seriousness of this constraint could greatly increase as new lands are brought under cultivation and subjected to the same pressures as those on the central plateau.

The proportion of fragile ferruginous soils in the AVV zones reaches about 70 percent. Existing soil maps indicate this percentage of fragile soils is not much lower in the Eastern ORD and the southwest. Projections for the increased productivity of Voltaic agriculture in both the long and short term all assume constant or increasing yields and no loss of productive land. This assumption can be made only if a major effort is immediately placed on the soil and water conservation programs in the central plateau and subsequently in less degraded areas.

Agriculture on the Mossi Plateau faces low and declining soil fertility and a deteriorating soil structure. Soil losses caused by increased runoff accelerate erosion, particularly of clay particles and organic matter. Impoverished sandy soils are frequently all that remain. Declining yields contribute to reducing fallow periods which have been nearly eliminated on many portions of the plateau. Land is cultivated continuously until it is finally abandoned.

Poor soil moisture retention capacity is typical under such overfarmed conditions. In drier years and when rains are poorly spaced, crop production declines due to artificially induced drought.

Increased runoff has also resulted in a widespread lowering of water tables, causing wells to run dry and increasing tree species' mortality. Bottomlands where water collects are excessively flooded and thereby rendered more difficult to manage. Lost topsoil not carried away in rivers is often deposited in the bottom of local barrages, reducing the reservoir's effective life through siltation.

In advanced states of degradation agricultural potential is virtually eliminated. Some farmers in the Kaya region report cultivating soils with yields of 50 to 100 kg per ha. Underlying lateritic hardpans are exposed and soil surfaces are sealed by a nearly impermeable crust.

Data on soil erosion are incomplete but indicate the problem's gravity. A six-year study (1973-78) in the Linoghin region (Koupela ORD) recorded a soil loss of 16.2 metric tons per ha annually. Runoff in the same site was recorded at 44 percent. By contrast, erosion in the nondegraded but higher rainfall zone around Po (near the Ghana border) was only 2 metric tons per ha annually.

An important yet unanswered question concerns the effect of animal traction on erosion. In 1979 Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres (IRAT) research indicated slightly more erosion: under traction 4.09 metric tons per ha annually compared to 3.69 metric tons, without traction.

The cause is undoubtedly linked to how, and not whether, animal traction is used. The project leader for the Kaya Soil

Conservation Project has observed major erosion increases on local farmers' fields due, he feels, to poor techniques and training. Animal traction packages are discussed in greater detail in Chapter Five, which examines the technical constraints to rainfed agriculture.

One of the most effective control measures to reduce erosion is to maintain high organic matter levels in the soil. The use of crop residue for fuel, animal feed, and building materials has greatly limited its availability as mulch. Possibilities for increasing organic matter include manuring and agroforestry. They are discussed in the sections on deforestation and rainfed agriculture.

Existing Programs

The national soil and water conservation program was started in early 1960 and has subsequently passed through several phases. Its activities have been largely directed toward the portions of the Mossi Plateau where erosion problems were the most severe. The first of these programs run by the Groupement Europeen de Restauration des Sols (GERES) applied graded bench terraces to over 120,000 ha, principally in Yatenga.

These open-ended terraces were designed to break surface flow and redirect it down the slope into grass-covered runoff channels. Heavy equipment was used in conjunction with local village labor. After construction was finished, all activity ceased. The terraces, never explained to the villagers, were not maintained. The project was essentially a failure.

It was succeeded by FDR I which instituted a program of total catchment contour terraces. The goal was to ensure maximum soil and water conservation. However, trapping all water in a series of closed terraces at 40 to 60 cm contour intervals increased the contour terraces' susceptibility to break, thereby actually threatening to increase erosion. About 1,000 ha received this treatment between 1970-76. The system was poorly implemented. Terraces failed to follow contours and were not maintained.

The design was radically changed for the second phase of the program. FDR II covered nearly 10,000 ha in five Mossi Plateau ORDs. The new system consists of open-ended contour dikes. Erosion control is achieved by reducing slope length and hence velocity of surface runoff. Water retention (infiltration) is enhanced only to the extent velocity is reduced and where water collects in narrow bands behind the dikes. Water is allowed to escape out the end of the dikes into drainage channels. This is considered acceptable since erosion is associated more with sheet wash and less with gullying. However, gullying problems have been increasing, and a separate but complementary program to stop gullying was initiated during the course of FDR II.

Studies documenting the effectiveness of the system, even in the short term, remain tentative and inconclusive. Early trials indicate an increase of as much as 150 kg per ha in grain yields and a 22 percent reduction in erosion. Further and more strictly controlled research is needed to determine the system's capacity to increase yields and infiltration and reduce soil loss. ICRISAT has undertaken several test plots in treated fields.

A major constraint to the widespread application of anti-erosion measures is that the existing program does not sufficiently harmonize with what farmers can and are willing to do. This places an added burden on the extension agent. The use of tractors in the FDR program gives the farmer a feeling that he cannot do without external assistance. On many soils, hand-tools would certainly accomplish the same task less expensively with equal effectiveness.

Yet even the hand-tools needed to maintain the installations were delivered to only 65 percent of the sites treated under FDR II. Demand has increased rapidly for the intervention, but villager motivations are obscured by the project's association with food aid delivery. Effective erosion control should hold enough villager interest to not require give-away programs in return for support. The ORD's capability in terms of topographic equipment has been strained by the growth in demand. Work quality has suffered. Emplacements are confined to fields on the lower slopes. The upper slopes where 50 cm contours are more densely spaced and runoff begins are infrequently treated.

Perhaps the most serious criticism of the FDR project is its failure to take into account indigenous anti-erosion efforts, such as the stone dikes already used by central plateau farmers. Hundreds of thousands of hectares are partially protected by these indigenous stone dikes. Where the FDR project dikes have been constructed in fields, the rock dikes are either ignored or destroyed. This counterproductive approach overlooks a tremendous source of villager involvement and extension outreach potential--possibly the foundation for an improved technical package in the next phase.

One positive dimension of FDR III is the greater emphasis on stabilizing the contour dikes with vegetation (*Andropogon gayanus*, *Euphorbia*, *Balsamifera*, and so on). This will also serve to reduce wind erosion. The emphasis on factors other than construction ties in well with several very promising adaptive research projects being implemented by nongovernmental organizations.[4] In these programs, truly innovative approaches are being developed which warrant expanded support. Input from these small programs may then serve to modify the national project in ways that reduce costs (dependence upon topographers and tractors) and thereby improve their potential acceptance.

FORESTRY

Current Status

The presence or absence of woody vegetation has a direct effect on yields obtained under traditional farming systems common to most Upper Volta. In 1976 the FAO estimated that yields begin to decrease when the woody vegetation cover is less than 25 percent. The principal functions of trees in this capacity are to protect soil from wind and water erosion and in some cases temper the field's microclimate.

Trees used for food production are protected both in traditional systems and under Voltaic law. However, where demographic pressures are most strongly felt this source of food has been partially exploited for firewood. Woody browse, rich in protein, phosphorous, and carotene, provides the basis of the diet for much of the country's livestock herd during the dry season. Yet herders continue to cut tree branches at a rate exceeding an individual tree's regenerative capacity.

Until recently savanna resources were characterized by abundance. Women who formerly exchanged sauce ingredients freely among themselves now part with them only through commercial transactions. Firewood prices have doubled and tripled in many parts of the country over the past decade. In Ouahigouya a donkey cartload of wood that cost 350 CFA in 1970 cost 1,750 CFA in 1979.

Firewood is the primary source of energy for most Voltaic families. It meets roughly 90 percent of a typical family's energy demand, but at a cost of 20 to 30 percent of the household income (in urban areas). In small towns and rural areas this cost is often expressed as labor. Women (and increasingly men) spend increasing amounts of their time collecting firewood. Women in less favorable locations may spend 12 to 18 hours per week collecting firewood at distances of up 10 km from their compounds. This labor demand, while somewhat flexible, nevertheless continues throughout the cropping season.

The firewood shortage is not equally distributed. It naturally tends to be concentrated in and around large towns, cities, and rural areas where population growth and the expansion of cultivated areas have correspondingly reduced forest reserves (Yatenga and Kaya regions, for example). In 1980 Winterbottom calculated that the savanna overall is regenerating wood resources slightly faster than the current rate of consumption.

However, areas where demand has outstripped wood supply and a downward spiral in ecosystem productivity has been initiated are rapidly increasing. FAO's 1981 estimates are more pessimistic. Recent calculations place the annual production of the country's

forest at 5.4 million m^3 and the total demand at 6.8 million m^3 per year. In some areas millet stalks are replacing wood as a fuel source, at questionable costs to soil fertility and structure.

Until now the response to the deforestation crisis has been inadequate. Some progress has been made in designing more efficient woodburning stoves. These stoves have the potential of reducing fuel consumption by as much as 50 percent. With many inexpensive and effective models available, the primary obstacle to their diffusion has been a lack of coordination between different government agencies. More effective use of female ORD extension agents will be necessary to succeed in attaining widespread adoption of the stoves.

Reforestation

Many reforestation activities fall into the domain of the Ministry of the Environment and Tourism. Detailed programs for addressing the constraints pertinent to its programs are elaborated in AID's 1981 "Environment Sector Assessment". Where forestry efforts involve the agricultural population's participation, actions should be considered in the context of agricultural sector planning. Coordination and cooperation among the different ministries and between ORD personnel and local forestry agents is generally poor, thereby hampering activities in the rural milieu.

Given the complexity of land availability, access of different groups to land and tree resources, seasonal labor constraints to forestry activity, uncertainty of tree tenure, and local power structures, rural reforestation must be carried out in the context of an overall farming systems approach to rural development.

Agroforestry

Of Upper Volta's three leading agricultural exports, only cotton is a field crop. The other two, shea butter and livestock, use noncultivated indigenous resources. Shea butter is an oil derived from the kernal of the karite tree, which exists in commercial densities as a result of the longstanding traditional practice of its selective preservation when clearing land for cultivation. These three products accounted for 83 percent of foreign exports in 1977.

The indigenous systems of food production integrate strategies of field, forage, and tree exploitation, yet our research and understanding of these systems tends to separate each activity from the whole. Farming systems research, for example, has paid scant attention to the role of trees in affecting yields. Research to date on the effect of interplanting Accacia albida and

food grains is insufficient. One study (cited by Reeb, 1980) indicated yields that were 50 percent higher on interplanted fields than on surrounding unwooded fields.

Further research needs to be carried out on the impact of tree roots on erosion rates, subsoil nutrient recovery, and soil permeability. The destructive impact of heavy rains on soil surface structures has often been noted, as has the ameliorating effect of tree foliage in reducing this negative impact. Given production limitations due to soil moisture deficiencies, a greater emphasis on field microclimatological research and its application in improved farming systems is needed.

The feasibility of windbreaks and the optimal spacing of interplanted trees for different soil types are also unknown. Both firewood shortages and the stabilization of anti-erosion dikes were noted as constraints. More research needs to be done on the coppicing qualities of different shrub species. Suitable species could be used which provide firewood, stabilize dikes, and reduce wind erosion in fields.

Agroforestry efforts are hampered by our incomplete understanding of how tree tenure operates in different regions and among different ethnic groups. For example, nere trees (locust bean) are an important producer of edible pods that become available during the soudure hunger period. In the Kaya area only chiefs can plant and harvest nere trees.

Tree planting to improve fields is also discouraged by farmers who have lent their fields to neighbors or relatives because they fear such improvements will weaken their claims on the fields. Among ethnic groups who do not possess the lands they cultivate (such as the Rimaibe in zones dominated by the Peul, or the Mossi in many areas into which they have migrated), there is a reluctance to plant trees on the part of the farmers or sanctions against such activity on the part of their hosts.

RIVER VALLEY RESETTLEMENT

Traditional Settlement Patterns

The contrast between relatively densely populated upland areas and virtually unsettled river valleys immediately adjacent to them has prompted much comment, in view of the considerably greater agricultural potential of the valley soils. Settlement of these areas was avoided, it seems in retrospect, because there was no need to settle there. The extensive cultivation methods employed on grassy uplands were sufficient to meet perceived needs. In addition, the river valleys were, and to a lesser extent still are, comparatively insalubrious. In particular, onchocerciasis, trypanosomiasis, malaria, other diseases, biting insects, and wildlife all discouraged settlement.

Another reason offered for unsettled bottomlands is that they were once settled and subsequently abandoned for disease reasons. Recent research by Hervouet (1977) and Lahuec (1979) has done much to clarify the issue. Both argue that settlement in the Volta river valleys increased during the early twentieth century in the period following colonial conquest. This settlement primarily represented an attempt by some farmers to escape the imposition of colonial taxes and forced labor policies. The liberalization of colonial policy in the 1940s included the reconstitution of Upper Volta, the abolition of forced labor, and freedom of movement. After this time valley settlements were "abandoned" primarily for the health reasons already cited.

However, the interest in encouraging cotton production in Upper Volta persisted and in the late 1960s, even before the Onchocerciasis Control Program (OCP) was initiated, Upper Volta commissioned French assistance to study possibilities for the region's development. The formulated plan involved resettling farmers from the Mossi Plateau, where soil erosion and population pressure were increasing. The first settlers began arriving in 1973 and the process has continued since then. In 1974 the government created a state agency, the AVV, to take full control of all resettlement activities on over 30,000 km^2.

Environmental Issues

The settlement of these zones raises several environmental issues which may develop into serious problems. They center first on the ecological soundness of the technical package being advocated, and second on human health, specifically the uncertainty of the OCP's long-term success. These issues were not studied in depth during the preparation of this report, but their investigation is a necessary complement to donor support of AVV resettlement activities.

The AVV mandate demands that settlement programs minimize ecological damage and maintain soil fertility. The technical package revolves around intensive cotton production using modern inputs, including animal traction and imported chemical fertilizers. About 70 percent of the soils in the AVV region are the same tropical ferruginous soils as those found in the Mossi Plateau. These are highly susceptible to erosion and acidification. The AVV program requires the use of engrais coton and N.P.K. fertilizer which, despite short-term production increases, destroy soil fertility by inducing long-term acidification.

Animal traction, particularly plowing, can be expected to increase soil erosion unless conservation methods such as contour plowing and ridging are properly used. The number of extension agents is considerably higher in the AVV zone than for the rest of the country, but it is not clear they have been effective in conveying proper soil conservation methods to farmers. The AVV

package was modified several times between 1973 and 1977, in light of the results of AVV field trials already discussed in the soil erosion section.

The preceding section noted the potential benefits of agroforestry. The AVV program advocates clear cutting and then destumping agricultural fields. Lost trees are to be replaced by imported exotic species planted in woodlots. Some villages are experimenting with windbreaks.

These comments pertain to the AVV package as already conceived. Murphy and Sprey (1980) have shown that AVV farmers are not following certain aspects of the program aimed at ensuring its ecological soundness. They cite farmers' failure to respect fallow periods and their tendency to omit legumes in the prescribed crop rotation system. They also note the need for direct soil conservation techniques to be incorporated into the farming package. This had not been done in their study area.

Cotton growing makes use of pesticides. Until 1978 an endrin DDT mix was used. Currently nuvacron is recommended with four annual hand sprayings of 12 liters per ha. Potential hazards to human health call into question the appropriateness of both the products and methods used in their application. No research is being done on using integrated pest management techniques. If pest problems increase, accelerated spraying schedules may eventually render cotton growing uneconomical. The dangers of the cotton "pesticide treadmill" have been repeatedly demonstrated in other parts of the world.

The eradication of onchocerciasis cannot be taken as a given. Its control seems to be 100 percent effective in Upper Volta at present. No new cases have been detected for several years, but the disease has not yet been eliminated in the humid tropical areas nearer the coast. If for some reason spraying were stopped before this is accomplished, OCP experts report that reinfestation of Upper Volta by the Simulium vector is virtually certain. Onchocerca volvulus is a filarial nematode which has a life span of 15 to 20 years, a fact making long-term vector control an absolute necessity if success in eliminating the disease is to be achieved.

The ecological impact of pesticide spraying is beyond the scope of the present discussion. However, it is important to recognize that OCP-used insecticides kill natural predators as well as the Simulium vector. Recolonization by the vector would thus be facilitated were spraying to be discontinued prematurely. Moreover, the increase in erosion and runoff as well as the proposed creation of the new Kompienga and Bagre dams are or will be creating habitats favorable to the Simulium black fly.

The current strategy is to establish dense populations in the riverine zones (within 11 to 16 km of a breeding habitat) to diffuse the possibility of spreading infection, assuming that a few

flies remain. A large number of bites per person are necessary for disease transmission to occur. Dense settlement, it is believed, would spread the number of bites among a sufficiently large population to suppress contamination.

A final caveat should be added. As the Simulium population decreases and control measures continue, the possibility of breeding immunity to chemical agents increases. In such an event, reinfestation would probably be much more difficult to reverse.

Although measures are now being taken to avoid this possiblity (such as rotating control agents and controlling over-eradication) it nonetheless suggests a conservative attitude should be taken toward Volta river valley settlement. Extensive land uses such as livestock production (especially in view of herd and herder mobility) may be more justifiable in the short to medium term until the OCP's long-term effectiveness becomes more assured.

OTHER ENVIRONMENTAL ISSUES

The potential for developing profitable irrigation programs is discussed in the irrigated agriculture chapter. Human health problems are not considered in that section; therefore, a few examples are mentioned briefly here. Since the Vallee de Kou irrigation program's inception, malarial incidence has greatly increased among the settlers and in the surrounding population. Schistosomiasis has been reduced in former marsh areas but probably compounded in the region of the upstream reservoir.

Schistosomiasis also poses problems to the small-scale dam program being implemented through the Office National des Barrages et de l'Irrigation (ONBI). Health problems have not been adequately assessed when developing such environmental modifications. Most feasibility studies fail to even mention potential impact on human health. This is particularly striking in the case of small dams where the installations' benefits to the rural populace have frequently been minimal.

The CILSS overview of second generation projects to develop irrigated agriculture in Upper Volta makes no reference to disease-related problems.

In addition to health problems, reservoir lines are reduced by accelerated erosion, thus implying the need for associated watershed management, better planning, or both. Small dam projects, despite recent programming improvements, tend to treat the activity as a separate construction and engineering problem. Extension efforts relevant to both irrigated agriculture and human sanitation may or may not be forthcoming.

CHAPTER EIGHT FOOTNOTES

1 Climate changes, human land use intensification, and political economy are put forth in various forms as explanatory mechanisms for the drought and famine. Comprehensive reviews in the following works indicate that data on climatic change are insufficient to warrant definitive conclusions for the long term. J. Charney, "The Dynamics of Deserts and Drought in the Sahel" (GARP Publications Series, No. 16, 1975), pp. 171-176; D. Calby et al, Drought in Africa II (London: International African Institute, 1977); and UNCOD, Desertification: Its Causes and Consequences (New York: Pergammon Press, 1977). CRTO (Centre Regional de Teledetection de Ouagadougou) data could add to the effort to monitor environmental and climatic change.

2 The analysis of environmental constraints in this section is necessarily brief. For an in-depth analysis of environmental conditions and issues in Upper Volta see: USAID "Environment Sector Assessment" (USAID/Ouagadougou, 1981).

3 CIDR: L'Elevage Bovin dans la Sous-Prefecture de l'Oudalan (Gorum-Gorum 1980).

4 CILSS: Development of Irrigated Agriculture in Upper Volta, Sanel" (December 1979:44).

CHAPTER NINE: AGRICULTURAL INSTITUTIONS

INTRODUCTION

An essential element in the transition from traditional subsistence to modern commercial agriculture is the existence of an institutional framework to support the changes taking place. Such institutions include agricultural research, extension, input distribution, credit, marketing, and local organizations. These institutions also require support in the form of training institutions and strong planning and management capacity from the MRD.

Upper Volta's research institutions were discussed in Chapter Five. In general, they are well established and fully functional. The main additional activity required, adaptive research, can be carried out by the existing institutions and incorporated into the extension system discussed in the next section. This chapter looks at the key agricultural institutions other than research, and recommends measures that could be taken to improve their effectiveness.

EXTENSION SERVICES

Extension in Perspective

Extension education is a term used quite freely but rarely specifically defined in its entirety. The French word vulgarisation has the notion of popularizing an idea or technique which is by definition a top-down approach to education. In the context of this strategy paper, extension will be treated as a continuing education system which, rather than attempting to popularize an idea, puts at the farmer's disposal the decision-making tools which will help him cope with his environment and improve his quality of life. The farmer is a full partner in the learning experience. It is not a matter of deciding what the farmer needs and then convincing him to accept it, but rather making knowledge and resources available to him so he can take advantage of them.

Along the same lines, the extension agent can misconstrue the concept of sensibilisation. When an idea has little or no success in a community, several factors are usually involved. Nonacceptance may result from the agent's insensitivity to the community's felt needs or the inappropriateness of the proposed intervention. Extension should be a dynamic process of human interaction which constantly evolves as the environment in which it takes place changes. The agent should be prepared to handle this and not view such interaction as a threat.

Another dimension of extension work is its linkage to formal educational institutions at work in the community. General education in the community forms the base for extension work and makes it more effective. An educated population is more open to new ideas and better able to comprehend them. Many times extension agents can find the classroom a convenient and effective vehicle, not only for the diffusion of new ideas, but also to keep the local instructor abreast of the latest agricultural developments.

This will become increasingly important as Upper Volta moves towards a vocational training emphasis in primary schools and carries it through into higher education. On the other hand, primary and adult literacy instructors could play an important role in preparing written materials for the agent to use in extension efforts. The foundation of local collaboration between agents in the field starts with the example set in the ministries.

Although extension may introduce new ideas and ways of doing things, adopting new practices is usually easier and faster when existing social structures are used as much as possible. Organizing new groups is not an activity in or of itself. Usually groups will form where appropriate to the task. Similarly, not all villages may choose the same way of handling a specific activity. What one village may prefer to do as a group the next may prefer to do on an individual basis. Local extension agents need to be flexible in their approach to allow for the uniqueness of each village. The extension organization must also be flexible to allow the agent to do this.

Finally, the time frame for initiating change in farming practices is often totally unrealistic. Time constraints often predispose a project to failure before it has time to take effect. One example is U.S. adoption of hybrid seed corn (which can double average corn yields) by a literate population. Despite obvious benefits, it took 30 years for this innovation to be accepted. To expect sweeping changes in traditional agriculture over a five-year time span or less is to be discouraged and disillusioned. All too often extension is blamed for failures when it was not really given a chance to work. As stated before, extension is an ongoing process in which results may be a long time in coming.

Change often requires a germination period before more widespread acceptance occurs. Farming is a high risk occupation and farmers consequently attempt to minimize risks whenever possible. They are not being stubborn, but prudent, when they wait and watch for a few years before adopting a new technology--and then they may be cautious in their approach. Constant effort and patience are the trademarks of a good extension agent.

In sum, extension is an information service among research bodies, other sources of information, and the general public. The local agent is a resource person who needs technical support both

in terms of good technical packages and subject matter specialists. Local initiative is the key to extension success. Credit, inputs, and marketing are best left to other agencies or the private sector. Extension is a vital collaborator with other educational institutions in the community, and as such needs to be sensitive to their functions.

The Present Situation

In describing the present situation, extension will be used in its broadest sense to include not only the extension staff responsible for disseminating new ideas and practices at the ORD level, but also those educational institutions which have a direct impact on the local population. In this sense extension is defined as the entire information and education system responsible for communicating improved farming practices and providing feedback to the research institutions responsible for developing improved technologies.

The Regional Development Organizations (ORDs)

The ORDs were started in 1966 as an attempt to decentralize agricultural development. Initially the focus was on the technical and economic aspects of rural development. Only in the mid-1970s did the government adopt the concept of integrated rural development which included marketing, functional literacy, local organizations, and certain types of infrastructure. Although social services were not included, the ORDs became responsible for both agricultural extension and a wide array of other services involved in agricultural and rural development. In 1979 a commission to review ORD activities found they were overextended. Their role was subsequently revised to include only functions directly related to agricultural production.

The ORD headquarters staff is composed of the following divisions: crop production; animal production; physical works; community development; economics, statistics, and planning; credit and finance; and administration. Figure 2 presents an organizational chart for the Ouagadougou ORD. Other ORDs are organized along similar lines.

For extension work the ORDs are divided geographically into sectors, subsectors, and extension cells consisting of several villages. The extension hierarchy at the ORD level consists of civil service grades ranging from A through D. Category A includes all university-trained ingenieurs who occupy posts at the ORD headquarters level including the directorship. Category B agents are typically found as sector chiefs and carry the title of Conducteur de Travaux Agricoles Specialises (CTAS) or Agent Technique Specialise (ATS). Currently these agents follow a three-year agriculture course upon completion of the BEPC in secondary school.

Categories C and D are called Agents Techniques Agricoles (ATAs) and are commonly found in the position of subsector chiefs. They follow a four-year program at Matourkou, Dinderesso, or ENESA upon completion of the troisieme level in secondary school (equivalent to the tenth grade in the United States). They basically learn the same subject matter as a CTAS but on a simpler scale.

The local extension worker or encadreur is a contract employee of the individual ORDs and does not have civil servant status. Each ORD is responsible for training its encadreurs. At present there is no standard core methodology given extension workers. Consequently there is considerable variation in the quality of encadreurs within and among ORDs. They usually have a sixth or eighth grade education followed by less than one year of agricultural training.

The extension staff is responsible not only for disseminating improved technologies but also for administering credit, distributing inputs, and creating farmer groups. Because the extension staff is small compared to the number of farmers that must be reached, various extension methodologies have been developed to increase the staff's effectiveness.

In the Eastern ORD, for example, farmer groups are formed to receive extension advice and agricultural credit, including loans for animal traction. Improved farming practices are demonstrated in a collective field which group members farm. In the Hauts Bassins and Volta Noire ORDs a form of the demonstration farmer approach has been adopted. As will be discussed later, further efforts are needed to increase the cost-effectiveness of ORD extension programs.

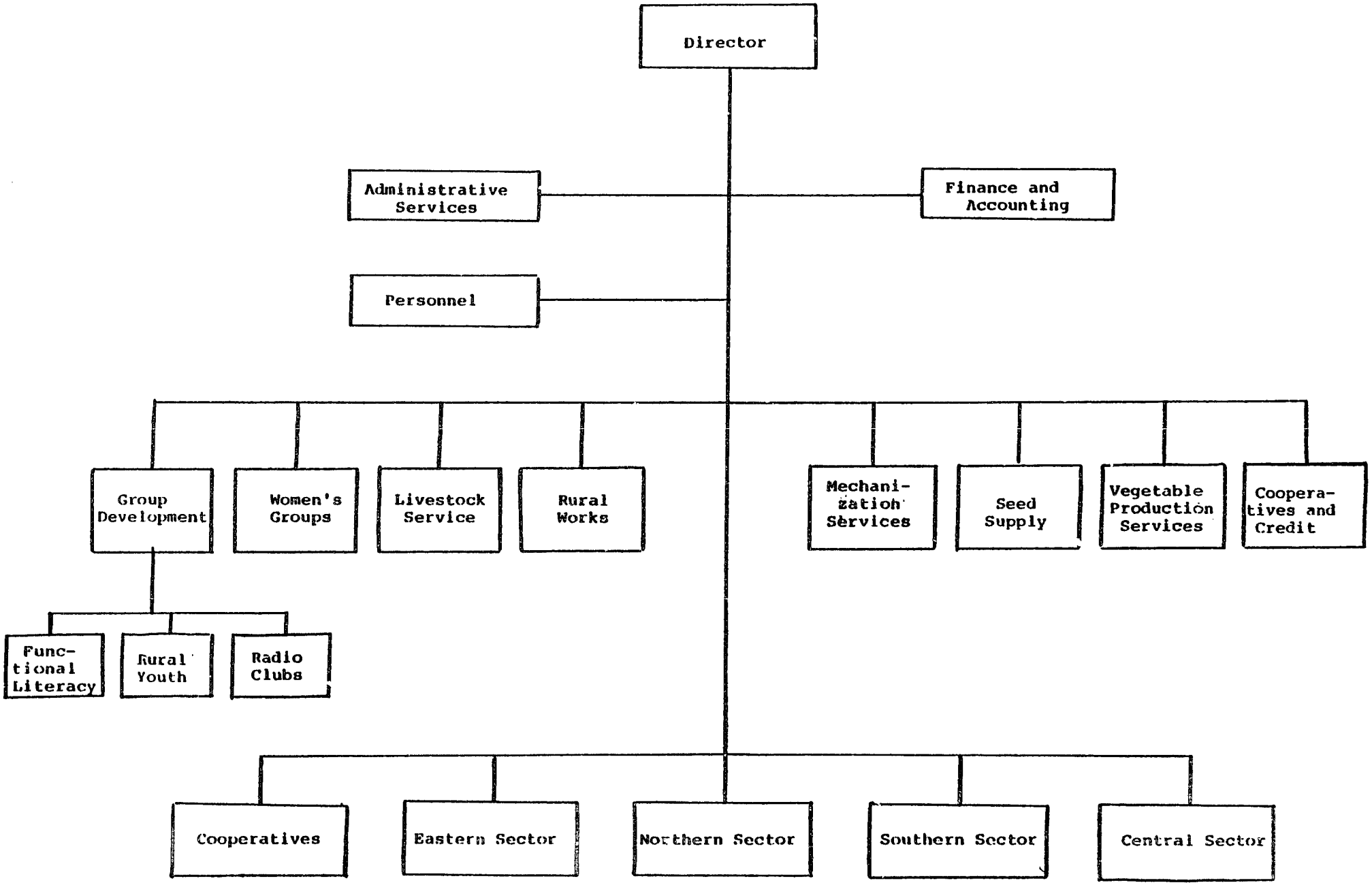
The Ministry of Rural Development (MRD)

The MRD is responsible for providing support for the ORDs at the national level. The MRD departments (called directions) that either provide supporting services or participate in extension are briefly described below.

Department of Agricultural Services

The Direction des Services Agricoles (DSA) includes the following services: crops; fertilizer, seed, and pesticides; and quality control of vegetable products. Although DSA is responsible for providing technical support to the agricultural extension program, this has proven difficult in practice due to the lack of direct linkages between DSA and the ORDs.

Figure 2. Organization of Ouagadougou ORD



Department of Livestock Services

The Livestock Service has traditionally concentrated on animal health. The national director coordinates programs of research, animal production, and meat and food inspection. The field service is oriented toward vaccination campaigns and deals little with other livestock production problems. Following the 1974 reorganization, its field service was put under ORD responsibility. Then in mid-1980 the Livestock Service was centralized once again at the national level. Although the national office is responsible for technical supervision of animal production and extension programs, these will continue to be implemented through the ORDs.

Training for Livestock Service staff is biased towards veterinary medicine. In 1980 there was only one livestock production specialist in the whole service. Most of the other 31 professional-level staff were veterinarians. Field agent (veterinary nurse) training emphasizes prophylactic treatment of cattle. The division is currently making plans to include animation as part of its functions. This would mainly involve forming herder groups to be the counterpart of village groups organized elsewhere.

The Department of Rural Institutions and Credit

The Direction d'Institutions Rurales et du Credit (DIRC) has focused on organizing villagers into groups (animation) to provide marketing, credit and social services. It also provides general support for ORD community development bureaus. A major DIRC responsibility is to train local animateurs. The training program consists of an initial six-week workshop followed by an in-service training workshop.

DIRC activities are of importance to the entire agricultural extension program since most recent government agriculture programs have been organized around village group formation. The success of these groups is dependent to a large extent on the ways in which they are formed and supported.

Department of Young Farmer Training

The Direction de Formation des Jeunes Agriculteurs (DFJA) is responsible for overseeing the training of young farmers in centers (CFJAs) throughout the country. The DFJA's purpose is to teach farmers between the ages of 12 and 16 vocational agriculture, mathematics and literacy in their local language and French. The school also attempts to instill civic duty and open students' minds to new ideas.

The agricultural portion of the curriculum is a combination of the "learning by doing" and discovery methods of teaching. In the morning students work in school fields using animal traction and other techniques. Toward noon they meet with the teacher to discuss the morning's activities and lessons to be drawn from them. The afternoon contains three 45-minute periods on the other three aforementioned topics which are taught in a fairly straightforward lecture-response manner. One day each week is reserved for follow-up activities at the students' homes.

The school is based on a three-year cycle. Students are recruited every three years with the aid of the conseil villageois du centre (CVC) which is the CFJA's link with the local community. The CVC also ensures regular attendance and may help manage money the school makes from the sale of its agricultural produce. At present there are between 625 and 700 centers in Upper Volta with a staff of around 1,100 and roughly 15,000 students.

The CFJAs are intended to be self-supporting, except for state-paid teacher salaries. The revenue generated from school fields should be sufficient to cover the schools' operating expenses. Unfortunately, most schools cannot meet expenses because their land is of poor quality or they lack inputs such as fertilizer and insecticides when they are needed.

Department of Functional Literacy

The Direction d'Alphabetisme Fonctionnel (DAF) has four responsibilities:

- To train literacy teachers at the local level. Training includes transcribing the national languages (Pula, Maure, Dioula, Gourmantche) and group dynamics;
- To produce and furnish teaching materials in the national languages;
- To follow up and evaluate literacy programs; and
- To study the rural environment.

Although there are no standard lexicons in the five national languages at present, no restriction is placed on producing materials using the national orthography. At least in theory, material in the national languages can be produced quickly and in quantity.

The course the DAF staff offers to local literacy teachers consists of six days of transcription training, six days of teaching methods, and six days of mathematics and evaluation. Literacy teachers are largely from the local area and supported by

their home community. The three main characteristics sought in these teachers are discipline, dynamism, and knowledge of the community. In principle, literacy training can be a cost-effective way of increasing the local population's ability to absorb and retain information.

Training Institutions For Extension Staff

There are three levels of extension personnel training in Upper Volta. The highest training level is provided by the Institut Superieur Polytechnique (ISP) at the University of Ouagadougou. Currently it has two tracks, one of five years and the other of three. Within each track there are three options: agricultural studies, animal husbandry, or forestry.

Students spend the first year together studying common subjects and in the second divide into their respective tracks. In the third year they divide into the three different fields mentioned above. Those who continue into the fourth year are given additional specialized training and in the fifth year spend 10 months in the field after which they write a memoire and defend it before a jury prior to receiving their degree.

ISP graduates fill positions at the ministry level in Ouagadougou and in ORD headquarters, including directorships. The ISP program can produce 10 to 20 ingenieurs per year, most of them in agriculture.

For mid-level training the most important institution is the Centre Agricole Polyvalent (CAP) at Matourkou. This is the only school for mid-level extension agents in Upper Volta. It offers two degrees. The highest is a Conducteur de Travaux Agricoles Specialises (CTAS) which is a three-year course offered to secondary school students who have completed the BEPC (twelfth grade). Their curriculum consists of two years of basic training in general agriculture and one year of specialized training. They fill positions in the MRD, ORD headquarters, and as extension service sector chief.

The second degree is the Agent Technique Agricole (ATA). This is a four-year course offered to students who have completed tenth grade. ATA training is similar to the CTAS' training but at a simpler level. ATAs are generally qualified to fill the position of ORD subsector chief. Matourkou currently graduates about 30 conducteurs and 35 agents per year.

Extension agents who wish to specialize in forestry or livestock transfer to the forestry school at Dinderesso or the Ecole Nationale d'Elevage et des Industries Animales (ENESA) after their second year at Matourkou. The main role of ENESA is to train veterinary nurses (infirmiers veterinaires) for the

Livestock Service. In recent years it has also started training assistants d'elevage and agents techniques. This lower-level training is oriented toward animal health care but also includes some animal husbandry.

The two teacher training centers for the CFJA program are Farako-Ba and Kamboinse. Farako-Ba is currently producing between 40 and 50 graduates every two years. These new teachers are high school graduates who receive two years of training at the center. Until now Kamboinse has been principally involved in retraining agents who were part of the Rural Education System (the predecessor to the CFJAs). Additional dormitories have been built to start training women with an expected output of 30 to 35 teachers per year.

At the third level of training for encadreurs, animateurs, and animatrices, short-term non-degree training is offered by the ORDs, DIRC, and two private non-profit training institutions, CESAO and INADES. The only effective ORD encadreur training is in the four ORDs that receive major donor assistance (Bobo-Dioulasso, Dedougou, Bougouriba, and Fada N'Gourma). The other ORDs have neither the staff nor funds to conduct even minimally adequate training courses.

Both the ORDs and DIRC use CESAO and INADES to train their field-level personnel. INADES specializes in field workshops and correspondence courses in subjects related to agriculture and extension. CESAO offers six- to twelve-week courses for field agents and villagers in subjects dealing mostly with group formation, cooperatives, trainer training, and preventive health practices.

Measures to Increase the Impact of Extension

Except for the southwestern part of the country where an improved technical package based on cotton production has been successfully extended, the ORD extension programs have had strikingly little impact on farming systems and farmer productivity. There are two principal reasons for this.

First, there is no technical package available that significantly increases production and is widely and easily applicable to areas north of the 900 mm isohyet. There are technical innovations that are known to increase productivity and adapt to Voltaic farming conditions. However, factors that determine farming systems vary so greatly throughout the country that extending those technical innovations is a slow process requiring continuous adaptive research activities that are part and parcel of the extension program. It is clear the technical packages available for farmers in the country's lower rainfall areas must be improved and adapted to farming conditions prevailing in those areas. This problem is discussed at length in Chapter Five.

The second major reason is that the existing extension programs do not reach many farmers. There are too few extension agents and the ORDs do not have the funds necessary to either increase their numbers or, in most cases, even provide the existing staff with the necessary logistical support to work effectively. Since most farmers are not reached by the extension program, it is not surprising they do not adopt the new technical packages being recommended.

The following section will discuss measures to increase the extension program's effectiveness and impact. It needs to be emphasized at the outset that a significant increase in the size of the extension staff is not a viable option. As already noted, funds are inadequate to support ORD extension staffs even at their present levels. Considerable donor support is needed to cover the operating costs of existing programs, and this is likely to continue for the foreseeable future.

Upgrading Extension Staff Skills

At present there are many centers responsible for training extension agents. Which center is used is left up to the individual ORDs. In some cases they opt for training their own agents. This haphazard approach results in significant differences in staff qualifications.

Donors as well as ORDs are the culprits in creating this menagerie. Individual projects want agents trained to their specifications to carry out specific duties as outlined in their proposals. As a result, salary scales differ and create conflict among agents. ORDs are left holding the bag upon termination of project funding.

In addition, agents trained in special areas for a specific project are often not qualified to seek employment in other ORDs without retraining. So the first step is for donors and ORDs to standardize the training given to all extension agents. Retraining these agents will upgrade their professional qualifications and lead into the next or simultaneous phase of shifting more responsibility to the villagers.

Agents essentially need to become trainers of trainers. They need to train local people selected by villagers how to serve the villagers. The core elements of such training already exist in the country. The task is to bring these elements together into a cohesive core extension methodology.

Equally important is helping agents to understand the nature and process of change in rural society. Existing training centers such as CESAO, INADES, Matourkou, Farako-Ba, Kamboinse, and other pilot centers set up in various projects should help develop a

core extension methodology and strategy. By upgrading agents instead of adding numbers, more funds should become available to support the existing agents. Many agents are frustrated due to a lack of materials. Good will and methodology mean little if logistical support is lacking.

The second phase of this proposed revision on extension methodology is for the retrained agents to work with representatives selected and paid by village groups or groups of villages. The only criterion for these local agents is that they be functionally literate, which may result from attending adult literacy classes, the CFJA, primary schools, or private schools. The government agent's role would be to train the local agent who would eventually become responsible for village work.

In-service training and upgrading of personnel is an absolute necessity now and for the foreseeable future. One of the greatest disincentives for agents and teachers is professional stagnation. Workshops tend to be expensive, but literature could be produced on a regular basis to help and encourage people in the field. Properly done, this can provide the answers necessary to resolve problems and issues confronting staff at all levels. People stationed outside Ouagadougou now have little professional stimulation.

The only institution in Upper Volta that is currently suitable for training extension staff on a large scale is the Centre Agricole Polyvalent at Matourkou. However, this institution is facing serious problems which limit its effectiveness. Most of these are related to policy and administration.

The urgent need is for the MRD to make firm policy decisions regarding the status of Matourkou and how it should be operated. Once this has occurred, there appears little doubt that donor assistance will be available to enable Matourkou to fill its role as the main training center for mid-level agricultural manpower.

Linkages Between Extension and Research

Extension agents need a technical package which has been tested and proven to be technically and economically viable for the specific zone in which they are working. Without this their credibility can be severely damaged in the community, and scarce resources will be wasted on fruitless extension efforts.

At present, linkages between extension and research are virtually nonexistent. To some extent this problem is being addressed by creating adaptive research centers in many ORDs. As described elsewhere, the main thrust of these activities is to adapt new technologies to actual farm conditions. To complete the

process, however, the extension staff must become involved in the work of the adaptive research centers. That is, extension agents should be involved in monitoring and analyzing the results of the ORDs' technical staff. In this way they would have a much better understanding of the technologies being disseminated and the conditions under which they should or should not be adopted.

Linkages Between Extension Service and Villages

The "we and they" mentality which pervades most extension efforts slows the process of information diffusion. Such a mentality becomes a wedge between the agent and the villager. The agents should see themselves as equal partners in their efforts to increase production and well-being. Demonstration plots kept by encadreurs when they were students may help them understand the techniques they will be demonstrating or teaching, but they may have little to do with understanding the rationale behind farmers' thinking--the crucial element when introducing new farming practices.

Similarly, observing local farmers at work will probably not yield an in-depth understanding of rural culture and values. Studying rural sociology may provide a framework for students to think about rural life, but there is nothing which can substitute for real farming experience. This link will be more firmly established when paraprofessionals can be selected and employed by individual villages or groups of villages.

The elitism found in many extension agents can also be a symptom of top-down extension strategies. Encadreurs who feel like pawns, controlled and told what to do by their superiors, are unlikely to be motivated to establish close village ties. Their ties and loyalties lie with the organization that employs them. Helping encadreurs plan and carry out programs for which they are individually responsible and backing this up with work-related evaluations will help establish this vital link.

The Role of CFJAs

The CFJAs are currently oriented toward giving vocational agricultural training to illiterate youths between the ages of 12 and 16. After three years of training in agriculture, mathematics, the local language, and French, the students are supposed to form a groupement des jeunes agriculteurs which is the youth counterpart of the groupement villageois.

With time, the nature of the CFJAs will have to change as educational reform takes effect and the primary school system becomes more relevant to the rural population's needs and desires. The new centers will most likely become schools for a higher

level of agricultural training, since students will be coming to them already literate and with a knowledge of certain fundamentals. This means that within the next few years plans must be made to revise curriculum content and upgrade teaching skills.

One of the most effective ways to help the extension service become more effective is to increase the ability of its clientele to absorb and retain information. This can be partly accomplished through the CFJAs and the functional literacy program for adults. There is no reason why support of these two important institutions cannot be tied in with other extension support efforts.

For example, one of the greatest CFJA needs is to obtain farm implements. Since the CFJAs are self-supporting and generate income from their school plots, perhaps a credit system could be arranged through the Caisse Nationale de Credit Agricole (CNCA). The GJAs are similarly in need of credit.

The greatest need for the functional literacy program is to have material for students to read. Producing extension bulletins in the national languages on appropriate agricultural topics would be a great help, and the extension program and CFJAs would also benefit from this.

Such education reform will need collaboration from the technical agricultural services as more practical and vocational matter is incorporated into the curriculum. Here again cooperation in producing extension materials in the national languages would be a great help.

Summary

There are essentially four steps that can be taken to increase the effectiveness of the agricultural extension program (including the CFJAs) without significantly increasing the number of agents or operating costs.

- Stronger technical support is needed so the extension staff has continuous access to the information required to address problems confronted in their work.

- Adaptive research needs to be made part of the extension program, so that technical packages are suited to actual farming conditions, and the extension staff can become more knowledgeable about the applicability of different technical innovations to specific farming systems.

- The impact of ORD extension agents can be increased by using village-level paraprofessionals.

- The first three measures imply that ORD extension staff must receive additional training. On the one hand, they need to be able to receive information from the technical services and adaptive research program and incorporate it into their work. On the other hand, their role would become one of training, supervising, and providing technical guidance to village-level paraprofessionals who would be primarily responsible for dealing with individual farmers.

For the longer term a strengthened extension service should be complemented by efforts to increase the rural population's ability to receive and act on new information. This can best be accomplished by increasing the literacy of rural youth and exposing them to new agricultural ideas through strengthened CFJAs.

INPUT SUPPLY AND CREDIT

The Present Situation

Input Supply

A key element when introducing new technologies to small farmers is the availability and timely distribution of the necessary equipment and inputs. In Upper Volta this involves:

- Importing equipment, raw materials for equipment, and fertilizers;
- Domestic manufacturing of equipment and, of particular interest in Upper Volta, rock phosphate production;
- Distributing inputs, primarily by the private sector and ORDs; and
- Providing credit to farmers for purchasing these inputs by CNCA, the ORDs, and village groups.

Animal traction equipment is both imported and produced locally. The ORDs and private farmers procure the foreign equipment from private suppliers. There is no significant import duty on this equipment.

Animal traction equipment is made locally from imported raw materials at three ARCOMAs (Atelier Regional de la Construction de Materiel Agricole) in Ouagadougou, Bobo-Dioulasso, and Tenkodogo and assembled at CORREMMAs (Cooperative Regionale de Montage de Materiel Agricole) located at the ORD level.

Both types of institutions are constituted as self-financing public entities. In theory the COREMMAs keep accounts separate from the ORDs, although the ORDs are financially responsible for the workshops under present arrangements.

The ARCOMAs, on the other hand, benefit from considerable external financing from the Conseil de l'Entente, the Swiss, and the CEAO. The subsidy on current operations takes the form of technical assistance and concessional loans for working capital. The ARCOMAs have a liquidity problem because the ORDs are late in paying for equipment they received in earlier years. (Previously CNCA paid suppliers of agricultural inputs directly and treated these payments as loans to the ORDs.) The ARCOMAs have the capacity to produce 22,000 plows per year. In 1981 the farmers requested only 6,000 plows, but the ARCOMAs were unable to satisfy even this small number, since their liquidity bind prevented them from buying the raw materials needed to produce the plows.

In Upper Volta the distribution of agricultural inputs to farmers has historically been sluggish. Animal traction equipment might arrive as much as a year after the farmer bought his oxen. The equipment delivered might have a vital piece missing. Spare parts might be unavailable. Traction animals may have died due to lack of vaccinations.

In the case of fertilizers, insecticides, and spraying equipment, SOFITEX's present primary distribution arrangements adequately meet cotton production requirements. The system is particularly efficient since it maximizes the use of the same storage and transport infrastructure for inputs used for cotton crop collection. However, SOFITEX is primarily interested in importing inputs used in cotton production.

On a much smaller scale, DSA procures the ammonium, chloride, sulphur, and potash needed for peanut production. Independent private traders can be counted on to import modest quantities of these inputs if they are profitable relative to other goods, and if they do not have to compete with subsidized prices from official suppliers.

Although the need for locally produced rock phosphate is great, the phosphate mines near Diapaga produce only a fraction of the amount the country needs (about 2,000 metric tons). Future increases in rock phosphate production from these mines will be in direct proportion to the effectiveness of demand, as expressed in the provision of financing, transport, and storage facilities.

Similar problems occur with other seasonal inputs. Not only do fertilizers often arrive too late, but pesticide use is hampered because spraying equipment is often unavailable or inoperable. ORDs frequently have an oversupply of seasonal inputs which they may have paid for but not resold. Input suppliers consequently refuse to make further deliveries, since they have not yet been paid for the previous year's delivery.

Despite these problems, all the elements for input distribution exist. The quantities of these inputs are insufficient in many cases and the delivery may be late, but the elements are there. Measures that need to be taken include: refining the ORD system; increasing the amounts of available inputs; and more smoothly coordinating the different links among the agencies involved in delivering inputs from suppliers to consumers.

Credit

Most inputs are sold to farmers on credit. Until 1980 the ORDs administered this credit, but there were many problems with this system. Loan repayment money was mixed with other ORD funds and ORD accounting systems had difficulty sorting this out when revolving credit funds were needed for relending to other farmers.

Poor records of old loans also made it difficult to pursue delinquent loan repayments, so loan repayment rates were poor.[1] The 5.5 percent interest rate charged for both short-term and medium-term loans was far too low to cover the full cost of lending, so there was no possibility of maintaining a viable credit activity.

In response to these problems, the GOUV established the CNCA in October 1980. Subscribed capital to the CNCA has been set at 1.3 billion CFA, with 650 million CFA paid during the first year. The government and other public institutions (such as CNDI and CSPPA) hold 54 percent of the equity with the remaining 46 percent owned by the French Caisse Centrale de Cooperation Economique (CCCE), the Central Bank of West African States (BCEAO), and the West African Development Bank (BOAD).

In 1981 CNCA (along with BNC, BICIA, and BIV) lent SOFITEX about 3 billion CFA for fertilizer (on a nine-month loan) and about 4 billion CFA for marketing cotton (on a six-month loan). Statistics on medium-term credit given to the ORDs for animal traction credit were not available, but 600 million CFA had been budgeted for this purpose in 1981. Capital for credit to farmers for agricultural inputs was not a constraint in 1981, but raw materials for making animal traction equipment were a constraint because of the ARCOMA/COREMMA liquidity problems discussed earlier.

Many of the ORD credit problems were solved with the CNCA's creation. Loan money in each ORD was transferred to a separate bank account, thereby solving the problem of commingled funds. A new system of accounting and controlling individual loan accounts was introduced. However, this system is still complicated and is operated manually, rather than with the computerized system installed in Fada and the AVV.[2]

The more systematic accounting procedures installed by CNCA in each ORD have improved loan collection follow up and consequently loan repayment rates. Although the interest rate has been raised to 11 percent, it still does not cover the full cost of CNCA lending, since the inflation rate alone is at least 10 percent. This leaves only 1 percent to cover administration and loan default costs.[3]

Administration costs are high because each farmer's loan is handled as a separate account in most ORDs. In the Hauts Bassins (Bobo-Dioulasso), however, ORD loans for agricultural inputs are being given to village groups which relend to their individual members. This technique reduced CNCA administrative costs for each beneficiary.

Measures to Improve Input Supply and Credit Programs

Input Supply

The inputs called for in the technical package should come from domestic raw materials and use domestic manpower for assembly and delivery as much as possible. For animal traction equipment, this would mean reducing the importation of preassembled equipment that local blacksmiths and welders could assemble just as well and cheaper.

Most of the responsibility for this assembly should be shifted to the private sector. This is already done on a small scale by blacksmiths all over Upper Volta. In the AVV, for example, the AID-sponsored Village Development Fund (VDF) has given loans to blacksmiths to buy raw materials. They use these raw materials to make plows identical to those being produced by the ARCOMAs and COREMMAs.

An appropriate ARCOMA and COREMMA role would be to perform only those manufacturing or assembly services that local blacksmiths cannot perform more efficiently. ARCOMAs and COREMMAs should also function as private sector competitors when importing raw materials for resale to local blacksmiths.

A strategy of import substitution for fertilizers would mean using phosphates from local phosphate mines, plus other plant nutrient sources available locally. For weed control this would mean maximizing the use of animal traction weeders and minimizing the reliance on imported herbicides.

The strategy for producing inputs should maximize the use of abundant resources (labor) and minimize the use of scarce resources (capital for imported equipment). Fertilizer mixing plants, for example, can be either fully mechanized using

exclusively imported equipment and relying heavily on imported petroleum products for fuel, or partially mechanized, making heavy use of the abundant labor resources for some steps of the process.

Input Delivery

The strategy for delivering inputs should follow that suggested for transporting agricultural products as discussed in the marketing section. Heavy trucks should deliver inputs to centrally located delivery points such as ORD, sector or subsector headquarters, where the entire load can be delivered in one stop.

Distributing these inputs to individual villages should be done with locally available donkey and ox carts. Not using large trucks for village deliveries would reduce the demands on motorized transport while the use of underutilized donkey and ox carts would be increased. This would help make donkey and ox carts, purchased as part of the animal traction package, more profitable.

Inputs should then be delivered to village groups which would be responsible for delivering them to individuals in each village. This would help reduce the administrative burden of the ORDs or parastatal or private agencies which have delivered inputs to individual farmers in the past.

The timeliness of deliveries can be improved by streamlining the process of estimating demand, placing orders, producing or importing the inputs, and delivering them to the sector or subsector level where village groups could take over distribution responsibility. CNCA is well aware of these persistent problems and has begun taking measures for expediting the different steps involved.

For animal traction equipment, the problem is further complicated by the ARCOMA/COREMMA cash bind and management problems. These particular difficulties require management improvements within the ARCOMAs and COREMMAs, higher sale prices, and shifting some production to the blacksmith level.

The Credit Program

CNCA already has a well-developed structure for making loans to ORDs to lend to village groups. The objective is to establish a system similar to what has already been started in the Hauts Bassins (Bobo-Dioulasso) ORD.

There village group members sign a collective loan contract. The ORD treats this as a single loan to the group. The group takes responsibility for distributing the inputs to its members, collecting payment at the end of the season, and then repaying the loan in one lump sum to the ORD credit section.

The tedious (and, if performed by CNCA or ORD staff, expensive) work of making and collecting loans to individual members is the responsibility of group leaders. If the group has 20 members, the administrative burden and associated administrative costs to the lending institution have been reduced twenty-fold by making one group loan instead of 20 individual loans.

An additional incentive for village groups to administer loans could be provided if they were given part of the interest rate for their services. In fact, a pyramid interest rate structure has been proposed. If CNCA charges the ORDs 11 percent interest, the ORDs should charge village groups about 13 percent. The 2 percent margin would pay for their services and the village groups could then charge farmers about 15 percent to allow a 2 percent margin to cover their services in turn. In this way each level has the potential to cover the credit program's administrative costs.

The system in which CNCA makes loans to ORDs, which lend to village groups, which then relend to farmers, should reduce each level's administrative burden, thereby helping to make the lending program sustainable over the long run. Contributing to sustainability is the improvement in repayment rates that would be expected from the moral guarantee (group liability) of the loans to village groups.

One reason the proposed strategy insists on using the CNCA facilities to handle financing on all credit for farm inputs and marketing, is due to its simple but superior structure for controlling loans and following up on village group repayment. This insistence on village group repayment is perhaps the single most important factor in sustaining village groups as strong and growing rural institutions.

To further strengthen CNCA control on loan money distributed (in the case of cash for traction animals or cereal banks) and repayment money received, the number of levels the money passes through should be reduced. Instead of having repayment money pass from borrower to village group treasurer, to extension agent, to subsector chief, to sector chief, to chef de bureau de credit (at the ORD headquarters) to the CNCA bank account in the commercial bank branch at the ORD level, it is recommended that the money pass only from borrower to village group treasurer, to chef de bureau de credit (at the ORD headquarters), to the CNCA bank account.

High on CNCA's priority list should be the addition of savings accounts. As village groups start to build up their treasuries, they look for institutions in which they can deposit their money for safekeeping and investment earnings.

Credit is not an agricultural production input by itself, but the means by which the technical production package's physical inputs are made available to farmers. As such, credit is a support service which should itself be self-supporting. Interest income should exceed the expenses of administrative costs, repayment defaults, and inflation (on owned capital) or interest (on borrowed capital). Otherwise the bank's capital erodes and fewer and fewer funds are available for lending.

The proposed strategy is intended to improve the input distribution that the technical package needs, without adding to the administrative costs of the government institutions involved. The ORD extension agents' workload and CNCA administrative load will both have been lightened by village group input and credit distribution. Shifting input manufacturing and delivery to the private sector would further reduce the parastatals' administrative burden, while simultaneously raising private entrepreneurs' incomes.

MARKETING, PRICES AND FOOD SECURITY

Introduction

This section discuss the Voltaic marketing system's efficiency in moving agricultural products from producer to consumer, and its ability to provide farmers and consumers with appropriate marketing services and fair prices without being a heavy governmental burden. The marketing system elements outlined here are pricing, transport, storage, finance, market information and food security.

Farmers who have adopted a technical package and increased cash crop production of, for example, rice, soybeans, peanuts, or cowpeas, often later find out they are unable to sell their products easily or at a decent price. A strategy to increase cash crop production for export must be accompanied by adequate market outlets to prevent this problem from recurring.

Products consumed domestically do not face the same problem. These products usually have a buyer, although the price may be low at certain times or in certain places. If the domestic or international demand exists and the farmer is not able to sell his product, then the marketing system itself is a constraint.

Price Stabilization

There is a a belief in Upper Volta that the only way to stabilize cereal prices is to buy large quantities of cereals at fixed prices. This implies that funds are available to buy those quantities of cereals coming into the market at that price; that

the price is fixed at a level satisfying all market supply and demand forces; and that a single parastatal agency has the capacity to manage all the complex financial, transport, storage, and accounting aspects of such price stabilization activity.

However, there are other interventions the government could support that would be less difficult to manage and as, or more, effective in stabilizing prices than OFNACER has been. These interventions include: suply of price information, transport development, storage development, and increasing grain trader competition. If farm producers know what prices are being paid at different markets throughout the country, and have the chance to either transport their products to markets paying higher prices or store their products until prices improve, price fluctuations will diminish.

In addition, if there is vigorous competition among grain traders to buy grain from farmers, farmers will naturally sell to the trader offering the highest price.

Voltaic village groups are now managing cereal banks in increasing numbers. These cereal banks have the effect of competing with traditional grain traders. Without this competition, farmers have been obliged to fight famine during the peak of the soudure by a vente en herbe arrangement with a grain trader. A grain trader thus buys a crop before harvest at terms unfavorable to the producer, and pays the producer in advance either in cash or kind (cereal for the family to eat).

This is not to say the grain trader is the enemy of either producers or consumers. Grain traders perform valuable services for both. They not only move grain from surplus to deficit areas, but also provide credit services and often sell farm production inputs in exchange for grain. Whether or not these traders are exploitative depends on whether the amount they earn unreasonably exceeds the costs (transport, storage, storage losses, risk of loan nonrepayment, and opportunity cost of the capital) incurred.

How grain trader earnings are measured must also be considered. For example, how much did a grain trader earn on loaning one sack of millet worth 10,000 CFA to a farmer in June, who repaid the loan in December with two sacks of millet worth 5,000 CFA each? Some would argue the farmer paid 100 percent per year because a loan of one sack of millet was repaid with two sacks. Other would argue no interest was earned by the grain trader since a loan in kind worth 10,000 CFA was repaid in kind with grain worth 10,000 CFA at the time of repayment.

Grain merchant earnings have to be analyzed on an annual basis. The sack of millet worth 10,000 CFA loaned in June one year could become two sacks of millet worth 20,000 CFA available for lending in June the next year. In one year the grain trader

has earned 10,000 CFA on his original investment, less annual expenses incurred in connection with the three sacks of grain in question.

These expenses would need to be deducted from the 10,000 CFA gross earnings to get the net earning on the original 10,000 CFA investment. If these costs totaled 2,000 CFA, then the earnings on the investment of 10,000 CFA were 8,000 CFA or 80 percent.

The gap between buying and selling prices depends on natural forces such as:

- How soon after the harvest one buys and how late one sells before the next harvest;
- The supply/demand situation of one year compared to another; and
- Where one buys (distance from heavy demand areas).

Policy considerations in setting price floors and ceilings may try to merge different and often conflicting interests. These include:

- A fair (high) price to producers;
- A price spread great enough to cover grain trader (OFNACER) operational costs; and
- Relative emphasis on the needs of the rural poor compared to those of urban consumers.

If an agency wants to get involved in fixing cereal prices it must try to balance natural forces and policy interests. It is very difficult to do this any better than free market traders can, when they operate with good information and an adequate transport system.

OFNACER's operating costs per kilogram of grain sold, both in absolute terms and as a percentage of sales, vary widely. In the 1980-81 fiscal year, costs were as low as 2.1 CFA per kg sold and 3 percent of sales volume in Kaya, and as high as 72.5 CFA per kg sold and 67.6 percent of sales value in Koupela. Compare the 1980-81 Koupela cost with Koupela's 1978-79 cost of 5.9 CFA per kg and 11.5 percent of sale value, and it is easy to see the impact that sales volume has on OFNACER's operating expenses.

Enger pointed out that a higher volume of cereal must be handled to cover OFNACER's costs of operation, administration, depreciation, and transport.[4] At the same time OFNACER's volume is increased, village groups could be encouraged to take over some of the high-cost village-level operations of buying, and

collecting, storage, and transport, thereby shifting to OFNACER the lower-cost, higher-return functions of bulk storage and long-distance bulk transport. This would also allow OFNACER to reduce its number of employees.

Upper Volta produces roughly 1.0 million metric tons of cereals each year, of which about 150,000 metric tons enter marketing channels. From the 1980 crop it was estimated that OFNACER handled about 2,500 metric tons (about 1.5 percent).[5] Cereal banks handled an estimated 3,300 metric tons (about 2 percent). The former was handled at a high governmental cost and the latter at a very low governmental cost.[6] The rest, about 95 percent, was handled by the private sector during the 1980-81 season.

Cereal banks are established to provide the farmer with an alternative to selling to the grain trader at harvest time. Village groups operate cereal banks that buy cereal when the price is lowest (just after the harvest) and store it until the price is highest (at the peak of the soudure) when the cereal is sold back to the villagers for cash or on credit.

The cereal bank thus competes with the grain trader. If the village group's cereal bank buys cereal from farmers at prices a little higher than the free market price, sells cereal back to the villagers at a price a little lower than the free market price, and still realizes a profit from the price markup, a farmer belonging to the village group will have benefited three times. He received a higher price for his produce; paid a lower price for cereal bought for consumption; and belongs to the group making a profit (and the group decides how it uses the profit to benefit all group members).

The cereal bank experience in Upper Volta is described in detail in Satana's recent report.[7] Building on this experience and increasing the number of these cereal banks would serve to increase competition with private grain traders and help stabilize prices.

Transport

Parastatals such as OFNACER, UVOCAM, SOFITEX, and SOSUHV that try to maintain a fleet of trucks, are faced with the realities of high maintenance costs due to bad roads and the high cost of spare parts and fuel. SOFITEX estimates it has a cost of 800 CFA per km for 10-ton trucks (about 80 CFA per ton per km). UVOCAM estimates its costs range from 150 CFA per ton per km (for 1-ton trucks) to 26 CFA per ton per km (for 20-ton trucks) when the trucks run full. OFNACER feels it needs a 14 CFA per kg markup on all cereal handled to cover its costs of transport, administration, and storage (if a least 60,000 tons of cereal are handled; if less, then a greater markup is needed).

Not only are costs high but motor pool management is also very complex. It includes dispatching vehicles, trying to arrange backhauls, and preventing vehicle misuse and gasoline theft. Such motor pool management problems increase transport costs.

Another problem SOFITEX faces is the large amount of time its trucks are not operational. There are about five months of each year (June through October) when the capital invested in its fleet of trucks is not providing any return. The opportunity cost of this inactive capital is a loss to the business. All this helps explain why the cost of running motor pools is a heavy burden on government and parastatal agencies in general, and marketing firms in particular.

On the other hand, oxen and donkeys at the farm level are underutilized as traction animals. The return on animal traction investment would be improved if traction animals were productively used for a longer period of time each year. Moreover, the season of most intense farm product transport (November to April) is the time when traction animals are not busy working on farm land. They are also in good physical condition in November, due to the availability of natural forage.

An analysis of current costs illustrates the advantages that may accrue from the use of draft animals for local transport. OFNACER announced it would pay 61 CFA per kg for millet and sorghum at the village level in 1981. This price is broken down as follows: 50 CFA to the producer, 3 CFA for the sack, 4 CFA commission to the village group, and 4 CFA for transport to the village. At the time of the announcement, OFNACER had distributed 190 million CFA, in installments of 250,000 CFA per village group, to 760 of Upper Volta's strongest village groups. This was enough for each village group to buy about 50 sacks of cereal.

To fill a 30-ton truck OFNACER would have to visit six villages, most in remote areas served by long roads in bad condition. This would take three days from Fada to Diapaga and the six villages. If donkey and ox carts were used to transport the 300 sacks to one central collection point in Diapaga, it would save OFNACER two days of time, the wear and tear on the trucks over the bad roads, plus the extra gasoline consumed.

Theoretically, free market forces push cereal prices higher nearer points of greatest demand, and the price covers production costs plus transportation costs. Without interference from any government agency in setting prices, there will be a natural tendency for cereal transporters to be paid for transport services performed in moving cereal from production points to points of more concentrated demand. This process would provide an incentive to the owner of a pair of oxen and a cart to put his resources to work, moving cereal in the general direction of markets that provide higher prices.

Sherman points out that the main influence on prices appears to be the Ouagadougou market. Transport and handling costs seem to dictate local market prices.[8] Farmers appear willing to transport grain to more distant markets if they feel the price spread is greater than transport costs.

However, if OFNACER sets both the cereal and the transport price, there is no incentive for donkey or ox cart owners to haul cereal beyond the village collection center. If OFNACER insists on setting prices and still wants to provide this incentive, it should then set prices progressively higher nearer the centers of greatest demand. The higher prices would by the transport savings by OFNACER trucks.

Therefore a possibility exists to:

- Reduce demand on the OFNACER truck fleet and, consequently, the problems associated with a big motor pool;
- Increase the incentive for the private sector (including village groups and individual donkey or oxen cart owners) to participate in cereals transport; and
- Increase the return on animal traction investments.

Storage

The main determinant of storage requirements during 1983-88 will be government policy on food security stocks. To the extent that greater reliance is placed on village- and farm-level storage and on imports to ensure food security, less OFNACER storage capacity will be needed.

Satana shows that many of the Voltaic cereal bank programs give loans only to buy cereal, leaving the storage problem up to the village groups.[9] In the early life of a village-run cereal bank project, the village group typically appeals to the good will of group members who own buildings usable for grain storage to make these buildings available.

This good will runs thin after a year or two, and then the group must either pay rent or construct its own buildings. If the rent offered is fair, villagers not only make existing buildings available for the village-run cereal bank, but will also construct more buildings for the group to rent. This system is certainly easier to manage than a government-run program to build massive grain storage warehouses.

Enger confirms that farm-level storage is important by noting that long-term speculative storage appears to occur only among village farmers.[10] Other storage appears to be short-term.

It is proposed that village groups continue to rent village-level storage facilities, at a price high enough to serve as an incentive for villagers to build more storage facilities for cereals and other agricultural products, as well as production inputs. These storage facilities would be available to village groups, OFNACER, CSPPA, UVOCAM, or any other parastatal or private grain trader willing to pay the rent. This would reduce the management burden on OFNACER, the ORDs, and other agencies managing storage facilities, and also increase the country's storage capacity.

Finance

Financing agricultural product marketing could be handled many ways. The financing of cereals marketing, for example, could be handled through the ORDs, OFNACER, or commercial banks to private grain merchants, or through CNCA to village groups for cereal banks. The current ORD organization has reduced the ORDs' role in marketing cereals from what they held under the previous government. OFNACER has had problems managing its cereals marketing funds in the past. Commercial banks already make loans to grain traders: this is a functioning structure which could be enlarged upon easily. However, financing cereals marketing through CNCA to village groups for cereal banks appears to be the most appropriate strategy for the government to pursue.

CNCA already has the basic structure for decentralized lending to, and loan collection from, village groups through its credit agents in each ORD (with bank accounts separate from the ORDs' accounts). Currently CNCA is using this structure to make loans to farmers for farm production inputs. The structure could easily be adapted to handle the finance of village cereal banks managed by groups.

Currently OFNACER advances money to village groups to buy cereal that it will later collect. But the advantage of using the CNCA over other possibilities for financing cereals marketing is that CNCA has clear working procedures, which are effective in getting village groups to assume collective liability for loan repayment. CNCA also has effective controls account at all levels. The one reservation about CNCA is that it currently uses manual accounting methods that must be replaced by computerized methods.

Market Information

Economists commonly make the recommendation to improve market information services in developing countries. Usually this suggestion includes collecting and disseminating price (and possibly volume) information from major markets throughout the area under consideration.

This would help in Upper Volta, but unless more attention is given to complementary measures enabling traders and farmers to act on this price information (transport, storage, and credit), it is unlikely to have much of a positive impact, especially for private marketing channels.

There is a need to understand better the ways in which traders and farmers now make decisions about purchases and sales, as a basis for the development of market information services and complementary measures to improve market functioning. Sherman's recent study on marketing and storage in the Manga area is useful in this regard, although many questions on how traders make decisions are still left unanswered. Such questions might be included in the proposed marketing studies to be carried out with AID support.

One possible approach to improve marketing information services might be the following:

- Provide a radio network to transmit price, and possibly volume, information among markets. It would include base operations in the large urban market. Extension agents would report prices in various rural markets. The base operation would be equipped with display mechanisms to indicate current prices in various markets, together with other relevant information such as volumes, road conditions, and transport availability.

- A radio network might be made available for traders to communicate with one another. Often large traders in urban markets operate through a system of agents who are sent out to buy or sell grain in rural markets. Such agents are given specific instructions on purchase prices. These instructions are difficult to change because of communication problems. The radio network would allow large traders to confer with their agents and change instructions in view of market information.

- A further measure which might facilitate a larger trader response to market information would be a fund transfer service. The buyers might get money from the nearest CNCA branch. Agents are commonly sent to rural markets with cash to buy grain, the amount of grain they buy being limited by the amount of cash they carry. The radio network might be used to transfer funds between traders.

- The radio network might also serve transporters by alerting them to the presence or absence of adequate transport in specific markets. The radio network might also communicate bookings made by rural market traders and agents to urban center transporters.

The last three services would be provided to traders for a fee.

Food Security

Upper Volta's food deficit runs between 50,000 and 100,000 metric tons per year.[11]

According to Enger, OFNACER's storage capacity is approximately 43,000 metric tons for stabilization stocks and 34,500 metric tons for security stocks.[12] Of the latter, 10,000 metric tons are in portable butyl silos and 24,500 metric tons are in permanent structures, with 5,500 metric tons of additional capacity planned.

OFNACER would eventually like to maintain a 75,000 metric ton reserve for food security. It already has a German commitment to provide 30,000 metric tons, and needs 45,000 metric tons in additional capacity from other donors.

To stabilize prices, OFNACER plans to buy 40 percent of Upper Volta's 150,000 metric ton marketable surplus, or 60,000 metric tons per year. It figures it needs a 14 CFA per kg markup on a minimum of 60,000 metric tons to cover its operational costs.

Enger's recommendation that OFNACER discontinue its differentiation between stabilization and security stocks should be adopted. OFNACER should also seek to maximize the quantity of grain it handles, but do so by acting as a mixture of profit-maximizing grain trader and parastatal agency responsible for maintenance of security stocks.

It is not essential that OFNACER handle 40 percent of the market to stabilize prices, but under the present system it probably needs to handle 60,000 metric tons of cereal to pay its expenses. If it could shift the village-level buying, storage, and transport services to village groups (in the sense of commercants agrees of the Conference des Cadres), OFNACER could start to eliminate some of the higher cost aspects of transport, storage, and village-level personnel. Then the institution's viability could be assured with a lower volume of activity.

A food security program can be handled in several ways.

- It may handle food either produced domestically or imported.
- Imported food may be from either grants or purchases.
- Food may be either given or sold to consumers.
- Food may be sold to consumers by either the public or private sectors.

The source of the 60,000 tons over the five-year period (1981-85) is shown in Table 10.

Table 10. Projected Food Stocks, 1981-85

Year	Primary Collection: Quantity (Metric Tons)	Primary Collection: Financial Needs (Million CFA)	Food Aid (Metric Tons)	Revolving Food Security Stock (Metric Tons)	Annual Total (Metric Tons)
1981-82	30,000	2,500	20,000	10,000	60,000
1982-83	40,000	1,400	10,000	10,000	60,000
1983-84	40,000	470	10,000	10,000	60,000
1984-85	50,000	1,500	--	10,000	60,000
1985-86	50,000	1,350	--	10,000	60,000
Total	210,000	6,220	40,000	50,000	300,000

Source: Extrait du Rapport de Synthese, Conference des Cadres du Developpement Rural, 15-17 Juin, 1981.

Regardless of the choices made on each of these possibilities, there are certain management aspects that food security program administrators must deal with directly:

- Transport;
- Storage;
- Accounting and control; and
- Impact on prices and incentives to farm producers.

Transport and storage can be handled as already discussed. If accounting and control are adequate, then losses or misuse of food in transit and storage can be minimized. Administrators should therefore seek the most efficient sources of both transport and storage. It is just as important to get food to those who would not otherwise be buying any food on the market, as it is to get food to the needy. That is, if the food distributed under the food security program substitutes for food that would have been purchased on the market, it effectively competes with food products entering the market and tends to force prices down--a disincentive for producers.

OFNACER is equipped to store limited amounts of food security stocks, but needs assistance in making sure its food goes only to the neediest. Here again the integrity of village groups and their chosen leaders can be used to relieve the administrative burden of local distribution and control as well as local transport and storage. Food distributed through government fonctionnaires soon becomes treated as a supplement to what fonctionnaires perceive as low salaries, rather than as food for the hungry people they are supposedly serving. Food delivered directly to a village group would be less likely to be mishandled this way.

If domestic production is high enough to permit building a food security stock with local rather than imported cereals, CNCA could then finance the stock's build up with loans to village-run cereal banks. If the cereal banks are financed by loans rather than grants, the capital could be recovered and, if well administered, become a revolving fund that could alleviate the recurring cost burden to government of decentralized stock maintenance.

Summary

The following strategy emerges from the preceding discussion on marketing, prices, and food security. Shift part of the responsibilities for marketing to the private sector, which includes village groups. Village groups could participate in transport, storage, and distribution at the local level. They could also serve as collecting agencies for products bought by SOFITEX, CSPPA, UVOCAM, and OFNACER.

CNCA could serve as the lead financial institution. Its structure could be used to make and collect village group loans. The parastatals could have a reduced role in the whole process, behaving very much as competitors in the private sector.

OFNACER should be given a chance to prove its competence as a marketing institution through reduction in its scope of operation. It could be the receiving agency for food security imports, only for the short time needed to get food to the local areas for distribution through the village group structure.

Also, if OFNACER has capital reserves for price stabilization activities, it could use them to buy cereal when the price falls below a certain level. These purchases would be announced on the national radio by the price information service on days when the MRD feels the government should intervene. This intervention point would vary as supply/demand situations unfold, rather than trying to estimate an official floor price for the whole season. This would also reduce the expectation that OFNACER would buy all cereal offered at the "support" price.

Better price information and more market outlets should result in higher prices to producers. Greater efficiency in transport and storage should lead to lower consumer prices.

Finally, village groups should complement the work of marketing through parastatals by relieving them of some burdens of collecting products for marketing, local transport, and local storage. SOFITEX uses four different methods of buying cotton from producers:

- Usine Carole: The producer delivers directly to the factory.
- Marche Autogere: Village groups receive 2,750 CFA per metric ton for collecting, weighing, and trading cotton for SOFITEX collection in the village.
- Classique: SOFITEX pays wages to selected village residents to grade and weigh the cotton. An extension agent then pays for the cotton to be collected at the village by SOFITEX.
- Chargement Paysan: SOFITEX sends a truck directly to the cotton field.

It is the second of these methods, marche autogere, that is becoming more important. It simultaneously serves as an activity that strengthens village groups.

Development of marketing services for agricultural products does not necessarily mean enlarging government or parastatal institutions. In fact, the principles of decentralization and reduced recurrent cost burdens imply just the opposite--a reduction in size of government and parastatal institutions. It is in this spirit that the shift to the private sector and village groups has been proposed as the strategy for improving marketing services to farmers.

A Note on Livestock Marketing

Traditional Voltaic livestock marketing systems are decentralized and, in general, operate efficiently with minimum government intervention. Individual markets connected in networks by traveling merchants serve as both intermediate and terminal sales points. There is a parallel traditional system for poultry marketing. The systems work efficiently and anti-competitive practices are minimal. There is no reason why they cannot evolve to accommodate changing patterns of domestic consumption and export.

There is a lingering misconception that herders and merchants have trade policies that are irrational and do not exert demand-side pull to increase commercial production. Some of the examples cited are buying animals by the head rather than by weight, and buying thin animals rather than fattened ones. There are sound economic reasons for these practices which do not need to be described here. One can also find counterpart practices in developed countries where such commercial policies would be considered "modern".

The introduction of weighing scales would be unsuccessful, as already demonstrated by ill-conceived attempts elsewhere. Merchants and producers would only view this as a governmental ploy to obtain further control of the marketplace.

Donors should contemplate only minor interventions. These might include improving existing stock routes or establishing new markets in conjunction with local livestock projects. However, producers and merchants will avoid new marketplaces if they are developed with too much nontraditional infrastructure and subject to above-normal governmental regulation.

Governmental livestock revenues are about four times more than the annual expenditures made through the Livestock Service. Little money is recycled in order to improve production in the subsector. However, the difference is more than redressed through foreign aid contributions.

The largest source of governmental livestock revenues comes from export taxes. These are extremely high: since 1975 they have increased by 250 to 600 percent, much more than the general rate of price increases. The head taxes for each livestock species now amount to: 8,892 CFA for cattle; 2,223 CFA for sheep; 1,778 CFA for goats; 2,117 CFA for swine; and 53 CFA for poultry.

There is no evidence of how these taxes have affected livestock production and profitability in Upper Volta, or whether they have reduced animal export to the point of lowering consumer prices. The Livestock Service would like further export tax increases, in order to inhibit private international livestock trade. It would also like to shift the export function to ONERA, the parastatal agency responsible for processing and exporting animal by products.

This is unlikely to be effective, since existing prices are already high enough to provide strong incentives for private cattle export on the parallel market. Increased taxes would reduce official private exports, but unrecorded exports would probably increase.

ONERA's livestock processing activities are capital-intensive and do not lead to a widespread distribution of benefits. Furthermore, since ONERA's inefficient operations are unprofitable, it is unlikely they would contribute significantly to the national economy in the near future.

Donors should help the government formulate sound economic policy for livestock marketing. Efforts should be made to limit governmental control of the marketing process in order to increase that subsector's profitability. Externally supported economic policy advisers may be able to develop a constructive dialogue among concerned governmental agencies.

CHAPTER NINE FOOTNOTES

1 For more detailed discussion of the causes of loan repayment delinquency, refer to: Thomas Stickley and Eduardo Tapsoba, "Loan Repayment Delinquency in Eastern O.R.D. of Upper Volta" (Paper presented at Workshop on Rural Financial Markets and Insitutions, Wye College, Wye, England, June 1979).

2 This computerized management system is more fully discussed in: Thomas Stickley, "The Computer--An Appropriate Technology for Managing a Viable Agricultural Credit System in a Low Income Country--Upper Volta" (Paper presented at American Agricultural Economics Association Meeting, Champaign-Urbana, Illinois, July 1980).

3 For more detailed discussion see: Thomas Stickley, "CNCA--The National Agricultural Credit Bank of Upper Volta (Caisse Nationale de Credit Agricole)--An Appraisal of Its Organization and Policies" (Washington, D.C.: Development Alternatives, Inc., December 1980).

4 Warren J. Enger, "An Analysis of the Marketing Position of the National Cereals Office (OFNACER) Upper Volta" (Washington, D.C.: Ronco Consulting Corp., October 1981).

5 Ibid.

6 Suha Satana, A Comparative Study of Cereal Banks in Upper Volta (Washington, D.C.: Development Alternatives, Inc., 1981).

7 Ibid.

8 Jacqueline Sherman, "Crop Disposal and Grain Marketing in the Manga Region of Upper Volta--A Case Study" (CRED, Ann Arbor, Michigan: The University of Michigan, February 1981).

9 Satana, 1981.

10 Enger, op. cit.

11 FAO/WFP: "Report on the Cereal Situation--Republic of Upper Volta" (FAO/WFP, Rome, March 1981).

12 Enger, op. cit.

CHAPTER TEN: TRANSPORT INFRASTRUCTURE

Rural road development is the most important infrastructure need in the time frame of this sector assistance strategy. The primary road network is being improved and now appears to be adequate for handling most long distance movement of agricultural products, largely cereals and cotton. But secondary and tertiary roads are still a big constraint to the transportation of agricultural inputs and products.

In addition to the traditional primary, secondary, and tertiary road classification, a more useful classification in relation to movement and maintenance of transport vehicles for agricultural inputs and products would be:

- All-weather roads that do not damage vehicles;
- All-weather roads that are hard on vehicles; and
- Roads that are not passable in the rainy season and are hard on vehicles.

The Banfora/Fada N'Gourma, Koupela/Bawku, and Ouagadougou/Po roads are of the first type. These are shown on the map in Figure 1 (page 5). All other roads shown on the map are of the second type and nearly all roads not shown on this map are of the third type.

Farmers depend on roads before the rainy season for delivering inputs. After the rainy season the roads are needed for transporting their products from farms to markets. The rainy season is also the soudure period when all-weather roads are needed to move subsistence food (cereals) from surplus areas to deficit areas, and from food security stocks to those who need the food.

A cost/benefit analysis of upgrading the third type of roads almost always shows costs exceeding benefits. The cost of upgrading and maintaining the roads is greater than the benefit of measurable reductions in vehicle destruction, time lost getting vehicles unstuck, the value of alleviating human suffering, increased agricultural production, and price increases in products for producers due to moving products from surplus to deficit areas.

However, a more favorable result from the same cost/benefit analysis would come from a strategy of barrier-removal rather than upgrading of the entire road. It costs less to reinforce only ditch crossings than to upgrade the full length of a road.

The GOUV Ministry of Public Works provided the following cost estimates. The cost of installing a radier (reinforced ditch crossing, not a bridge) is 200,000 CFA per meter if done by the

Ministry of Public Works, and 1 million CFA per meter if done by a private contractor. A 20-meter crossing would cost 4 million CFA. The cost of installing a laterite piste (unpaved road) would be 4 million CFA per km (including all radiers but not including bridges) if done by the Ministry of Public Works, 13 million CFA per km if done by a private contractor. The Ministry of Public Works estimates that 150,000 CFA per km is needed each year to maintain a piste in good condition. These 1981 estimates should be expected to increase at the rate of 10 to 12 percent annually.

These estimates can be applied to an example of a third type of road: the 104-km road from Fada N'Gourma south to Pama. This road would need about 10 radiers to become an all-weather road. If the work were done by the Ministry of Public Works it would cost 40 million CFA to install ten 20-meter radiers. If the entire 104 km were to be transformed into a laterite piste, it would cost 416 million CFA or more than 10 times the cost of installing the 10 radiers. The cost of keeping the old road in good condition for 10 years would be 15.6 million CFA (10 x 104 x 150,000).

If 416 million CFA were available for improving the third type of roads, the different ways the money could be used include:

- A 104-km road could be transformed into a laterite piste for the full 416 million CFA. This would leave nothing for recurring maintenance costs in following years.

- Ten roads of similar characteristics could be transformed into all-weather roads by installing radiers at a cost of 400 million CFA. This would leave 16 million CFA for maintenance, or enough to maintain one of these roads for one year.

- Two 104-km roads could be transformed into all-weather roads by installing radiers at a cost of 80 million CFA. This would leave enough to pay the recurring costs of maintaining these two roads for 10 years each.

The strategy recommended would be the one in which the limited funds available would be used to open up the maximum number of kilometers of roads; where barriers would be removed to convert the third type of roads to the second. This would be preferable to a laterite piste for the full length of a road. Using this strategy means either the second or third alternatives would be preferable to the first.

The other key aspect of a rural road strategy is that such roads should only be constructed or upgraded in areas where they constitute a clear constraint to increased agricultural production. Rural roads are expensive to build and maintain, and can become a serious strain on government revenues if they do not stimulate the production and revenue needed to justify the initial investment and cover recurrent maintenance costs.

As already noted, in the case of rural roads it is very rare for these resources to be generated from user savings. Revenues must come from agricultural production increases that would not occur in the road's absence. This can happen in areas where farmers are producing mostly for subsistence, not because there is no capacity to produce more but because timely marketing is difficult.

Production increases can also occur when farmers in densely populated overcropped areas are able to move into adjacent areas as infrastructure constraints are removed.

Finally, rural roads are crucial to the delivery of new technologies and improved agricultural services aimed at increasing production above subsistence levels. In these cases the absence of adequate roads can remove the incentives for adopting the new technologies and increasing cash crop production.

CHAPTER ELEVEN: LOCAL ORGANIZATIONS AND RURAL DEVELOPMENT

THE CURRENT SITUATION

Local organizations are commonly regarded as the most practical and effective means of achieving local participation and working toward self-sustaining development. Such organizations can play potentially positive roles in the rural development process by acting as vehicles for:

- Two-way flows of technical information which both reinforce individuals who try new approaches and break down barriers between groups or individuals;
- Minimizing risk and practicing economies of scale;
- Adapting project activities to local conditions;
- Achieving greater political and economic clout for local people by exercising influence over local administrators and asserting claims on government;
- Sustaining project benefits; and
- Coordinating and spreading the benefits of outside assistance.[1]

By the same token, however, local organizations can also be used as vehicles for controlling and regulating the rural population.

In Upper Volta there are currently many local organizations working at the village level in both social and productive activities. From this experience certain lessons can be drawn and incorporated into an agricultural development strategy for the 1980s.

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Top-Down Blueprint Approach

In many development activities, the government portrays itself as all-knowing and all-providing. In order to take advantage of the services proferred (production credit is a case in point), small farmers are instructed to form local groups. To a certain extent this is putting the cart before the horse since outsiders are then telling farmers what their needs are and how those needs can be satisfied.

This approach has been widely practiced where a "proven" technical package has been identified and efforts are made to disseminate it as quickly as possible. Examples include irrigated

rice and cotton cultivation or the introduction of animal traction. With no effective small farmer participation beyond passive acceptance of the proferred services, there is little meaningful feedback on the impact of there packages. In this way, farmer organizations serve ORD interests rather than those of their members.

Lack of Local Resource Commitment

In many cases food or something similar is used as an incentive to encourage farmers to form groups. While this may be desirable in cases of severe hardship and to help those who would otherwise suffer, it is self-defeating strategy in the long run, since it encourages passive dependency.

The international donor community, motivated by a well-meaning but misguided desire to alleviate suffering, must bear some of the responsibility for this. Examples abound where local groups have refused to exercise their own initiatives to solve some pressing problem, knowing that sooner or later some outside agency will come and solve it for them.

On the other hand, many villagers are told that if they wish to obtain services they must form a group and engage in some productive activity such as a collective field. The income from such fields can then be used to finance other activities, such as cereal banks. However, these fields are often on the poorest land and are cultivated last. Hence yields are often low, defeating the intended purpose.

Duplication and Fragmentation

Various agencies, both governmental and private, work with local groups at the village level. This often leads to duplication of activities and an over-emphasis on small, functionally specific groups. While such groups are initially important, their range of activities could be expanded as their capacity and interest in implementing additional activities grow.

Linkages with various agencies are important since, in theory at least, they provide local groups with some choice and perhaps a little leverage. In the long run, however, the time and effort expended in developing and maintaining multiple linkages leads to inefficient use of the scarce resources available to groups.

Social Versus Productive Activities

Present government interventions at the village level are a mixture of social and income-generating activities. Hard-nosed purists argue for emphasizing income-generating activities that, if successful, can help finance and maintain social services.

However, this implies the local population does not know what its needs are and that, once again, an outside expert has to come and tell people what they really need. The government's priorities may be to improve well-being by increasing productivity; the local population's may be to improve the quality of life by having more amenities. The conflict in priorities can quickly vitiate efforts to create production organizations.

Further, given the uncertainties and risks associated with farming in Upper Volta, rural people may downgrade farming as a way of life for their children, and express preference for schools that teach children skills for use in urban areas or outside this country. Consequently there is a need to improve living conditions in rural areas as well as to develop technical packages that ensure a better return from farming. Hence it may be incumbent upon the ORDs to negotiate with the local population to establish some common priorities as a prelude to group formation.

To Sensitize or Not to Sensitize

Sensibilisation is to Voltaic development rhetoric what participation is to American development rhetoric: if only there were more of it, then rural development would really take off.

Briefly, the process by which an encadreur works with the local population is divided into four phases:

- Sensibilisation: making small farmers aware of any ideas, innovations, or inputs which can be part of rural development;
- Animation: creating the necessary organizations and structures;
- Vulgarisation: extending the innovations; and
- Surveillance: monitoring small farmers to ensure they are implementing the proposed changes in the proper way.[2]

But this is not enough, since it once again implies a passive rural population waiting to be "sensitized" into action. What is required is to create local capacity to generate resources, implement activities, and thereby work toward some minimal definition of self-sustaining development.

Social Cohesion and Accountability

The impression is often given that villages exhibit a high degree of social cohesion and homogeneity when there may well be ethnic differences, lineage differences, and differences based on

access to resources, particularly land. A classic example of this is provided by Matourkou's experience in Bare, a village outside Bobo-Dioulasso.[3]

The project's goal was to resettle some young farmers from Bare on neighboring village lands and introduce a variety of new agricultural techniques including animal traction. The village consisted of 250 families living in two quartiers with nine chefs de terre.

Matourkou was unaware that there was no unified authority, that lineages had complete autonomy, and that there was continuous conflict over which lineage had arrived in the area first. Furthermore, the young men felt their parents took advantage of them by making them work for virtually nothing. Although the elders always presented a unified front to outsiders, they could not agree on which land, if any, to give the young men. Matourkou compromised by helping the village build a school. In return, one quartier agreed to provide land, but only for its own young men.

While efforts to enlist the support of the traditional leadership are important, ways must also be found to make leaders accountable or they may well keep the benefits for themselves. A case in point is URCOMAYA, a vegetable marketing cooperative in Yatenga. A 1978 review of this project commented favorably on the fact that both small farmers and prominent businessmen, some with considerable political clout, were active in the organization.[4]

Shortly afterwards, it was discovered that some of these worthy citizens had been embezzling cooperative funds. Removing these leaders and rebuilding confidence in URCOMAYA took several years.

Pity the Poor Encadreur

The failure of many development interventions at the local level is often blamed on the encadreur. The recent literature on extension staff is highly critical: "poorly trained, poorly motivated, poorly supervised, and poorly served by logistical supply systems."[5]

The encadreur in Upper Volta is likewise damned as "overworked; undersupervised; poorly trained, supplied, and motivated; and often not suited for village life."[6]

Prospects and incentives for the encadreur are typically bad. Often it becomes more important to please immediate superiors than do good work in the field. They yield to the bureaucratic emphasis on documenting facility completion, farmer training, or fund disbursement rather than concentrating upon the impact of such activities. Without different incentives there is little to

encourage the encadreur to look beyond procedural compliance. Just as the small farmer wishes to minimize risk, so does the encadreur.

The Role of Women

Rural women are expected to perform multiple roles in Upper Volta. At the minimum, they are expected to perform a three roles: productive household member; homemaker; and woodcutter and water carrier. One important factor in women's favor is a certain degree of financial independence based on cultivating their own plots, transforming certain products, and producing various handicrafts.

If the government is sincere in its attempts to achieve food security, raise productivity, and increase the rural population's well-being, then women must be included in this process--not only for reasons of social welfare or equity, but also because they are critical to achieving those objectives. Women are both an important element in the agricultural labor force and small farmers in their own right. They often have more experience operating in a cash economy than men.

In the 1970s the emphasis on women was restricted primarily to women's interests as defined by the government: literacy and education. Since 1978, however, increasing emphasis has been given to income-generating activities and ways in which these activities can be made more efficient. These include gardening, small ruminant husbandry, handicraft manufacture, and food processing, which have always been traditional interests of women.

One relatively successful activity is the introduction of women-run cereal banks. One AID-financed program, Strengthening Women in Development (SWID), has been operating since 1979. SWID has financed 24 cereal banks in the ORDs of Fada, Koupela, Loudougou, and Bougouriba.

In contrast to some other groups involved in cereal banks, these groups include both men and women and both are represented on the management board. Loan size varies according to the management capabilities of the village group involved. Emphasis is placed on promoting the role of women in management and marketing.[7]

Over the past few years government policy has been to work with women's groups through volunteer paraprofessionals (animatrices). They are selected by the village women and serve as the principal link between village women and development programs. Older women are usually selected for the following reasons:

- They are more respected;
- They have more time, since their childbearing years are finished; and
- They are sedentary and thus less likely to travel.[8]

The motivation to undertake this sort of work derives from two sources: respect from the villagers and the moral obligation to serve the village.

From experience to date, certain factors appear crucial to successful implementation of a strategy that works through women paraprofessionals. First, the local chief's support or at least tacit approval is essential. Without this, women's projects will founder. On the other hand, however, the chief's approval may be purely self-serving: he may be the sole decision maker and his family the sole beneficiaries. The same holds true for husbands who must also give their approval. A way to counter this potential opposition is to incorporate the chief (or his representative) and representatives from the men's group or committee into the project.

A second important factor is the village's development level, something increasingly taken into consideration in village-level activities. This is a rough measure of development potential in terms of demonstrated initiative, generation and commitment of local resources, management capability, and the like. It serves as an indicator of the feasibility of proposed intiatives and the pace at which they can be implemented.

Crucial as the role of the animatrice is, she is only as good as the support she gets from her supervisors, an observation that applies to everyone working at the village level. At this level nothing can replace close supervision and training during the initial years when women are learning to manage and dispense funds.

Nor should the political implications be ignored. What was intended to decrease women's work loads and increase their organizational capability may well be taken over, maintained, and controlled by men or local elites, unless accountability is built in from the beginning.

Resettlement: Kou Valley and the Volta Valley Authority

A special role of local organizations concerns resettlement schemes. In an attempt to alleviate the population pressure on the Mossi Plateau, the government has introduced several resettlement schemes. One of the oldest is the Rice Growers' Cooperative in the Kou Valley just outside Bobo-Dioulasso. This

irrigated rice project was financed, built, and implemented by the Taiwanese in the early 1970s. There are presently 900 settler families there, many of them Mossi, growing two crops of rice a year on their 1-ha plots.

A 1978 case study of the cooperative indicated that while families were satisfied with their economic well-being, they were far from satisifed with their social well-being. Although nominally a cooperative, members felt that the whole structure was very authoritarian and more akin to a state farm or agribusiness. They also felt that no one took them seriously, and that their suggestions concerning variations or improvements in the standardized technical package were completely ignored. Over the years productivity has fallen dramatically as a result both of the use of an inappropriate type of fertilizer, which increased soil acidity, and poor maintenance of the irrigation system.[9]

A more ambitious scheme with more potential is the Volta Valley Authority (AVV). Created in 1974, the AVV is a state agency with full control over 30,000 km^2 of onchocerciasis--freed land in southern Upper Volta. This is almost 12 percent of the country in an area where annual rainfall averages between 800 and 1,000 mm.

AVV has the following objectives:

- To relieve population pressure on the Mossi Plateau by settling a total of 52,000 families in the Volta valleys (20,000 in rainfed agricultural lands and 32,000 in irrigated); and

- To produce a regional cereal surplus through the introduction of improved farming techniques.[10]

At the end of 1979 there were approximately 1,700 families settled in 47 villages throughout the 10 blocks constituting the AVV. The settlement rate was much slower than expected, due to a lack of suitable candidates in the early years, and management problems in preparing and identifying land for cultivation.

Land is allocated according to an AVV-established labor index. A typical family with 3.6 labor units receives 10 ha to be cleared over a five-year period. Five hectares are to be cultivated and rotated in the AVV-stipulated manner. Each family also has a 1-ha garden plot where they can plant whatever they like. AVV makes credit available to purchase production inputs and animal traction.

The farming regime imposed includes the following components:

- Cotton cultivation;

- Animal traction;

- The use of improved seeds, fertilizers and pesticides;
- Mono-cropping, sowing in rows, and thinning; and
- Crop rotation.

The principal cash crop, cotton, is extremely labor-intensive, and the longer farmers stay in the AVV, the less land they plant in cotton: from 43 to 50 percent in the first year, to 38 to 42 percent by the fourth year.[11] Since there is plenty of land available, farmers prefer more extensive cultivation which gives them more security.

The average gross agricultural income per unit of labor was stable from 1977 to 1979. Individual income did not expand as the AVV had planned, mainly due to population growth. This growth is due to both natural reproduction and the influx of relatives arriving from the home village. Family size was 8.2 in 1979. In 1979 gross income per unit of labor was higher for smaller families, who also tended to cultivate a larger area per unit of labor. Average net agricultural income per unit of labor varied considerably from block to block--from a low of 38,100 CFA (16,729 CFA per capita) in Kaibo Sud to a high of 72,100 CFA (31,654 per capita) in Bane.[12]

In AVV's earlier years an intensive top-down approach was used, with one extension agent per 25 families. Agents instructed, if not actually ordered, families on how to proceed in their productive activities. One group suffering as a result were settler women who were given no fields of their own, had to work up to 15 hours a day, and had few resources to pursue their handicraft activities. Women now have small plots. However, these are much smaller than those on the Mossi Plateau and the women rely heavily on the household head to provide them with cash. At least among the Mossi settlers, the household head now has almost complete control over decisions concerning production and distribution.[13]

Until 1980 there was little indication that settlers, like their Kou Valley counterparts, were given any opportunity to participate effectively in decisions made that affected their lives. This should come as no surprise since the AVV, at least in 1979, was hierarchically structured, and employed 1,108 people (650 permanent and 400 short-term Voltaic employees, 20 Voltaic technicians, and 38 expatriate technical experts) to work with 1,700 families.[14]

Since 1980, however, steps have been taken to ameliorate this situation. One such step has been the creation of village groups and block committees through which funds can be channelled to finance productive activities at the individual village and block levels. The goals of this project, the AID-financed Village Development Fund (VDF) are to:

- Serve a large number of farmers;
- Improve nutrition;
- Increase agricultural production;
- Strengthen village groups; and
- Employ labor-saving technology appropriate to village life.[15]

In 1980 many of these village groups were new and inexperienced, took little initiative to promote VDF projects, and did not fully understand what to do with loan defaulters. The extension agents responsible for promoting new VDF activities and providing support for existing ones were similarly hamstrung by lack of training and assistance from their superiors in the AVV structure.

Recommendations were made to improve this project and implemented shortly thereafter. They included actions to:

- Decentralize administration;
- Establish effective control through efficient accounting;
- Train members in business management; and
- Strengthen the village group movement.

In 1981 an economic analysis was conducted of the various VDF-funded projects: cereal banks, village stores, grain mills, credit and savings unions, and individual projects.

The conclusions reached included the following:

- The cereal banks' recordkeeping is improper, incomplete, and not taken seriously.
- Group management causes problems for village stores. Once the loan is approved, the group often disintegrates and the project comes to a standstill.
- The choice of a motor-driven grain mill may not be the best selection, particularly in terms of repair and maintenance.
- Credit and savings unions offer great potential for mobilizing rural savings.
- Individual projects involving carpenters, mechanics, and blacksmiths offer potential for creating backward and forward linkages.[16]

While an approach of this sort has some way to go in building local capacity to plan and manage such projects, it does offer some concrete examples of untapped village-level potential.

PROPOSED STRATEGY TO IMPROVE VILLAGE DEVELOPMENT ACTIVITIES

The MRD is committed to working more closely with local groupings such as groupements villageois, groupements feminins, groupements des jeunes agriculteurs, credit groups, cereal banks, marketing groups, and so on. In order to make these groups more effective, the following is recommended.

Changes in Approach

At the present time the MRD cannot work with all local groups: there are simply too many of them. Criteria must be established to select those to work with, preferably on a geographical basis. Suggested selection criteria should include the organization's resource base, its ability to mobilize the local population, its leadership quality, and its demonstration of initiative. In a country such as Upper Volta, where there is some commitment to equitable development, a balance should be struck between those organizations with the greatest potential and those with the greatest needs.

Criticisms were made earlier of the tendency to push a top-down, blueprint approach. Its inverse, a completely bottom-up approach with the government attempting to satisfy all villager needs, would be equally self-defeating. What is required is some middle ground whereby the MRD and village groups can negotiate what they wish to do.

In practice this would mean identifying village needs with villager participation, and laying out the various alternatives including all the costs, commitments, and potential benefits involved. Such an approach may involve an element of "horse-trading" as the government agrees to support some social activity in return for the village's support of some productive activity.

The local population is more likely to participate in development initiatives if, from their perspective, they obtain tangible, relatively immediate benefits by doing so. In this way the confidence and ability to undertake more complex, longer-term activities can be created.

In this context simple and small are not advocated as ends in themselves. When resources are dispersed widely to fund numerous small activities, limited management capability may be spread so

thin that it is depleted instead of being enhanced. This can also reduce the chances that any of these activities will become self-sustaining, since technical dimensions will be ignored, benefits hijacked, and lessons lost.

Generating a Local Resource Commitment

Generating a resource commitment from the local population is desirable for several reasons. First, the government does not have the resources to support all worthwhile development initiatives. Requiring an initial resource commitment indicates this is not going to be another government "giveaway" program. Second, the act of making a resource commitment will make the contributors more concerned for the development initiative's success than they might otherwise be. Finally, such a commitment will provide a concrete indication of how interested the village is in a new initiative.

Such commitments can be either in cash or kind, and can be generated in a variety of ways: from membership fees, quotas determined by family size, or recycling project benefits. This process is already underway in Upper Volta and should be implemented on a broader basis.

Dealing with Elites

If equitable development is to occur, there must be a redistribution of resources within society--and the potential for conflict increases accordingly. Local organizations are potential sources of power, and the purpose in creating them may well be to help their members challenge entrenched interests.

In one form or another, the leaders of the most important factions, elites or otherwise, must be included in local organizations. Some leaders will have obtained their positions as a result of their ability. Consequently the skills and experience they can bring to development may be crucial. They may also often be those best placed to take advantage of development initiatives.

Some leaders may be motivated to help their fellow villagers out of enlightened self-interest; others because they need a certain local constituency to support and implement their views. Whatever their motivation, local leaders, particularly chiefs and elders, are going to be represented if not over-represented in any decision-making process.

In cases where little cohesion exists and there is conflict between groups, it may be better to have different projects for different groups or to implement a project important to one group but which cannot be completed by any one party working alone.

The key is for leaders to be made accountable to both ORD personnel and organizational members. Such accountability will be more effectively enforced if incentives and sanctions are determined and applied not, only from above but also from below. Consequently all members must have access to organizational activities and records. In a society where illiteracy is so high, such records will be somewhat rudimentary. Nevertheless, efforts must be made to help members understand them.

Building Organizational Capacity

There is at present a lack of local-level organizational skills, particularly those required for organizing meetings, reaching consensus, choosing capable leaders and making them accountable, keeping records, and handling funds. Requirements for a capable organization include but are not limited to the following:

- Organizational skills such as the ability to forge effective links with other organizations;
- Information for decision making and the ability to use this information;
- Ability to attract and absorb resources;
- Ability to generate and effectively manage resources from the organization's own income-generating activities;
- Staff or stable membership; and
- Processes for solving problems and implementing decisions.[17]

Given the MRD's decision to grant local groups legal status, there is every indication to believe the MRD is serious in its intent to delegate more responsibility to local groups. If so, then building organizational capacity should be at the top of its priorities, or self-sustainability will never be achieved. As this capability evolves, the ORDs can begin to channel funds directly to local organizations.

This already happens on a limited scale by providing credit for specific activities. Over the long term, however, thought should be given to providing funds (as loans or matching grants) directly to the village to finance development activities under its jurisdiction. It might be argued that such funding may undermine the possibilities for self-reliance. However, if properly administered, such funds can be used to improve organizational capability and stimulate income-generating activities, two necessary conditions for achieving self-sustainability. The Voltaic experience with such activities, particularly with credit groups, cereal banks, and VDF activities, should be built upon and elaborated.

Criticism of the duplication and fragmentation of village-level development activities has already been noted. What the ORDs should be aiming for is some form of village-level consolidation. Not that this implies that one organization would then do everything, but rather that it would begin to coordinate the various village groups to achieve a more rational division of labor.

This is not something that can be forced. It has to evolve over time as the need and interest arise and local capacity to undertake this type of responsibility develops. But it would be through a village-level council of this sort that funds for development activities could be channeled. Without resources, such a council would lack leverage and be ineffective.

Paraprofessionals

As mentioned elsewhere in this report, Upper Volta suffers from two chronic institutional constraints inhibiting effective rural development: recurring costs and lack of trained personnel. One approach that can partially alleviate these constraints is to use paraprofessionals. Although they have been used to a limited extent in women's projects, they have not been utilized in agricultural development per se.

Nevertheless, one point should be made very clear. Paraprofessionals are not a panacea for all agricultural sector problems any more than better qualified encadreurs and animateurs are. For such people to be effective, strong supporting linkages must be established among them and the ORDs and among the ORDs and the MRD.

Recent Cornell University research on the role of paraprofessionals produced the following conclusions. First, paraprofessionals can provide services that would otherwise be unavailable at a relatively low cost. Second, they are able to stimulate broad community involvement. Third, paraprofessional programs can be innovative, by either modifying traditional roles or providing entirely new services to the local population. Nevertheless, such programs often suffer from defective design, inadequate training, and above all, inadequate support.[18]

Care should also be taken not to confuse a paraprofessional program with the World Bank's Training and Visit System (TVS) presently being implemented in southwest Upper Volta. Under this system an encadreur works with individual contact farmers who communicate what they have learned to any interested neighbors. The encadreur also visits neighbors' fields and tries to solve any problems that may have resulted from following his advice.

Part of TVS' appeal is that it is orderly and rational. At least in theory, it permits supervisory personnel to know exactly where their encadreurs are and precisely what they are supposed to be doing on any given day during the growing season. It also means that the "contact farmer" plays the role of a passive conduit for information.

A recent TVS evaluation by the Societe Africaine d'Etudes et de Developpement (SAED) made the following points:

- The encadreur and his contact farmers are only as good as their back-up support.
- The approach does not permit the encadreur much flexibility in dealing with any unforeseen problems that may arise.
- Farmers tend to resent the "favorite son" treatment given to the contact farmer.[19]

A paraprofessional program would differ greatly from this. The paraprofessional (male or female) would be accountable to both the encadreur and the farmers who select him. Back-up support, particularly in the form of inputs, would be facilitated by the village group taking over is responsibility. Paraprofessionals would not select the farmers with whom they would work: farmers would seek the paraprofessionals.

Nevertheless, there are many unknowns involved in designing and implementing a program of this sort. For example:

- Who would make the best paraprofessionals?
- Should they be paid?
- What control would the villagers have over them?
- How broad should the paraprofessionals' responsibilities be?
- What sort of training should they be given?[20]

It is therefore crucially important that the program be flexible enough to test and select approaches adapted to specific contexts. The introduction of a standard "model" would be self-defeating from the outset.

CHAPTER ELEVEN FOOTNOTES

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10 Josette Murphy and Leendhert H. Sprey, The Volta Valley Authority: Socioeconomic Evaluation of a Resettlement Project in Upper Volta (West Lafayette, Indiana: Purdue University Department of Agricultural Economics, 1980), p. 1.

11 Murphy and Sprey, op. cit., p. 42.

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14 S. P. Reyna, Impact de l'Autorite des Amenagements des Vallees des Volta (Abidjan: REDSO/WA, 1980), pp. 52-56.

15 Thomas Stickley, Credit Consultancy Contract of AVV, Upper Volta's Oncho-Freed Areas' Village Development Fund (Washington, D.C.: Development Alternatives, Inc., 1980).

16 Satana, op. cit.

17 Honadle et al, op. cit., p. 189.

18 Milton J. Esman et al, Paraprofessinals in Rural Development (Ithaca, New York: Cornell University, Rural Development Committee, 1980), p. 91.

19 SATEC, op. cit., Tome II, Annexe No. 6.

20 These and other issues are discussed in more detail in Esman et al, op. cit., pp. 108-128.

CHAPTER TWELVE: RECURRENT COSTS

INTRODUCTION

The reason why the GOUV is unable to cover the recurrent costs of its agriculture program is that at the national level, total requirements for government expenditures exceed total revenues. There are ongoing requirements for administration, defense, and social and economic services that consistently add up to more than the government can generate.

The gap can be reduced to some extent by improving the mechanisms for revenue generation and increasing the efficiency of government programs, but the only long-run solution is to increase the tax base. This requires increasing production and incomes.

For Upper Volta, sustained production and income increases cannot be achieved in the short term. Its literacy rate is one of the world's lowest; the pool of skilled manpower is small; development institutions and economic infrastructure are undeveloped; and most important of all, the country's meager resource base and remote land-locked geographic location make growth and development extremely difficult.

The investments needed to address these basic constraints are essential first steps in the development process, but will not themselves lead to significant increases in production, incomes, and government revenues in the short or medium term. This means there will continue to be a recurrent cost gap for the foreseeable future.

Based on past experience in Upper Volta and other Sahelian countries, the usual outcome of a recurrent cost gap is underfunded and ineffective development programs. However, in some cases donors finance recurrent costs, often in the form of second phase development projects.[1]

The only effective way of addressing the problem of recurrent costs is at the macroeconomic level. Measures to reduce expenditures in one project or ministry, or increase revenues in one sector, can have little or no net impact if waste, inefficiency, and inappropriate development and fiscal policies are continued for the public sector as a whole.

However, such policy issues are beyond the scope of this report. This section will discuss the nature of the recurrent cost problem in the agriculture sector, and explore ways of alleviating it through actions that can be undertaken at the

sector level. The measures recommended in this section should be undertaken in the context of government-wide efforts to increase efficiency, reduce waste, and improve the allocation of resources in the public sector.

THE OVERALL SITUATION

Voltaic agricultural programs are seriously underfunded by almost any standard. In 1981 the MRD accounted for only 6.5 percent of the national budget. This compares to allocations of about 20 percent each for general government administration, defense, and education. Furthermore, the MRD share of budget expenditures has been steadily declining since 1970.

In practical terms this means that resources are far from adequate to carry out even existing programs effectively. In 1981 92.5 percent of the MRD budget went for salaries, and 7.5 percent for all other expenditures. The comparable percentages for the total GOUV budget were 78.6 and 21.4 respectively.

The effects of this imbalance are evident in all programs. Virtually all programs not receiving recurrent cost financing from donors are unable to carry out their assigned responsibilities effectively, due to the lack of logistical support. The most obvious deficiency is the lack of fuel and vehicle spare parts. This forces many MRD employees to sit unproductively in their offices when they should be out in rural areas.

However, there is also a serious lack of office space, office equipment and supplies, documentation, and minimal in-service training. The result is not only reduced effectiveness, but also low morale and, therefore lack of initiative. All have consequences extending beyond the performance of specific tasks.

One issue that arises in connection with the gap in recurrent cost financing in agriculture is whether the GOUV's fiscal policies are causing a net resource outflow from the rural sector. In strictly fiscal terms this does not seem to be happening. In FY 1981 the budget showed 1.4 billion CFA in revenues from the rural sector (1.3 billion CFA in export taxes, 45 million CFA in livestock head taxes, 33 million CFA in fees for livestock services, and 25 million CFA in fees for agricultural services). There were about 2.5 billion CFA in expenditures, indicating a net inflow of 1 billion CFA into the rural sector.

When price and subsidy policies are taken into account, the situation is less clear. Low producer prices can be a means for transferring resources out of the rural sector. The GOUV does have a policy of low producer prices for both cereals and export crops. For cereals, the official producer prices are not effectively enforced, since private trade is permitted at free market prices.

However, the official cereal marketing organization, OFNACER, receives food aid, some of which is distributed in urban areas. If OFNACER distributes 30,000 metric tons of cereals at official prices out of a total of 150,000 metric tons marketed (typical in recent years), the effect is to dampen free market producer prices and, therefore farmer incomes, to the urban consumers' advantage. Data on the price elasticity of supply and demand necessary to assess the magnitude of the resulting resource transfers are not available, but it does not appear that changing GOUV cereal price policies would have much impact on revenues available to finance recurrent costs.

For export crops, there is a margin between producer prices and world market prices. Part of this margin is to cover costs of inputs, marketing, and other support services, and part is for price stabilization. In years of high world prices, therefore, the margin can considerably exceed costs, while in years of low prices, such as the late 1970s, there can be a deficit.

Analyzing the uses made of the differences between producer prices and world prices indicates that most funds are returned to the rural areas in the form of operating costs for the two marketing organizations (SOFITEX and CSPPA), input subsidies, and to a lesser extent, support for agricultural development programs (ORDs, AVV, feeder road maintenance).[2]

Generally, the most important resource transfer from the export crop sector to the urban sector in normal years is the CSPAA-funded wheat flour subsidy (recently ranging from 150 million CFA to 300 million CFA). During periods of sustained high world prices, accumulated surpluses are also used to subsidize general government administration or industrial sector projects.

In summary, it appears that while tax and price policies may result in transfering some resources out of the rural sector, the amounts involved are relatively small. Thus, changing government policies to balance resource flows in and out of the rural sector would not have much impact on the recurrent cost financing problems of agriculture programs.

However, this is not to say that more budgetary resources should not be allocated to the rural sector. Agriculture accounts for over 40 percent of the GDP and provides the main means of livelihood for about 80 percent of the population. Moreover, there is little doubt that sustained growth and development for Upper Volta must be based on increasing the agricultural productivity of small farmers. In the absence of agricultural development, widespread increases in income and quality of life for the Voltaic population will not be possible. This would seem to indicate that agriculture programs should receive more than 6.5 percent of the national budget.

In any event, given the small Voltaic tax base, the large needs of the agriculture sector, and the nonrevenue-generating nature of most agriculture programs, continuous efforts to minimize recurrent costs are necessary. The rest of this section discusses ways of doing this for the national-level agricultural programs, ORDs, and parastatals.

NATIONAL-LEVEL AGRICULTURE PROGRAMS

The FY 1981 operating budgets for the major MRD programs are as follows:

Program	Million CFA
Agricultural Services (DSA)	203.4
Hydrology and Rural Construction (HER)	112.7
Livestock Services	375.5
Young Farmer Training (DFSA)	695.8
Secretary General's Office	411.2
Other	104.3
Total	1,902.9

None of these programs generates revenue except agricultural services (25 million CFA in user fees in 1981) and livestock services (33 million CFA in user fees in 1981).

On the expenditure side, it is generally agreed that most MRD programs are inadequately funded to meet the needs in their respective areas. As already noted, the first requirement is to increase the nonsalary component of the MRD budget, although ideally not at the expense of staff and salaries. There are some possibilities for expenditure cuts by reducing non-productive programs and increasing the contributions beneficiaries make to productive programs.

Specifically, the DSA seed multiplication program and Livestock Service animal health care programs include activities that are of little economic value to the recipients and should therefore be discontinued. The costs of activities worth continuing should be shifted to the beneficiaries as much as possible. Ways of doing this for veterinary services have been discussed in the chapter on livestock production.

Another major area for budgetary savings should be the young farmer training program. If this program is more than a social service and does in fact have economic value for the trainees, the beneficiaries or local communities should assume a larger share of the costs.

On the other hand, certain unmet agricultural sector needs call for increased expenditures. These needs are related to long-term recurrent cost constraints. The first is the need to organize farmer groups to provide services that the government now provides at considerable cost. These include input distribution, credit management, marketing, food security, and feeder road maintenance. Expanding the program to strengthen local organizations will require additional funding for the MRD's Department of Rural Institutions and Credit (DIRC).

The second important need is to strengthen the MRD's planning and policy analysis capacity. This would help ensure that scarce resources are allocated in an economically optimal manner, and that agricultural policies are conducive to maximum increases in production. The result of these changes would be the increased development impact of agriculture programs. This would in turn generate the increased revenues needed to sustain the programs.

Two large agricultural programs not reflected in the budget figures are the agricultural research institutes and the AVV. Both are now largely donor-funded, but they have important long-term recurrent cost implications. Research activities are essential but can never be self-supporting, since their impact on production and government revenues is long-term, indirect, and difficult to quantify.

The AVV, on the other hand, is directly oriented toward production. The key to minimizing that program's recurrent costs is to differentiate between largely donor-financed investment costs and the recurrent costs of supporting services and infrastructure that beneficiaries should finance through taxes or user fees.

Associated with such revenue-generating efforts should be a redesign of the AVV program to bring it more into line with what beneficiaries can afford. This means the manpower and financial requirements of such services as extension, input distribution, and credit should be greatly reduced. The alternative would be a program too expensive to maintain. Moreover, the result over time would be a steadily deteriorating productive base, to the point where the initial investment impact would be no longer evident. This report has already discussed this problem as it relates to irrigation projects.

THE REGIONAL DEVELOPMENT ORGANIZATIONS

The ORDs are the outreach component of the GOUV agriculture program. ORD activities include extension, community development, crop trials, seed multiplication, credit, input distribution, data gathering, and planning and economic analysis. Until recently it was the government's objective to make the ORDs self-financing based upon increased production and cash crop marketing.

The only ORDs where this has been partly successful are Volta Noire and Hauts Bassins, where cotton is the cash crop. The cotton is marketed through one organization, SOFITEX, which is able to recover part of the costs of extension and other services through the margin between producer and export prices.

However, in most ORDs cash crop production is not sufficient to support ORD activities. Not even the most profitable export crops can provide a large enough margin to finance all the ORD activities listed above. The GOUV now recognizes this and the ORDs are no longer to be involved in marketing. Except in those cases where ORDs provide and are compensated for services to SOFITEX and CSPPA, ORDs will be financed through the national budget, foreign aid, and user fees.

In the long run the ORDs can be viable only if they provide services whose economic value exceeds their costs. This implies that activities must be carefully selected to ensure they contribute to increased productivity and thus increased revenues. For Upper Volta at this time the southern ORDs should have larger programs than the northern ORDs, because their production impact is greater. In the center and north the ORDs should focus on binding constraints (such as the lack of a technical package and, in some areas, soil degradation) and not replicate the successful but expensive programs in the south.

At the same time it is essential that the burden of certain ORD-provided services be shifted to beneficiaries. The measures needed to carry this out are discussed in the chapter on institutional constraints. ORD extension agents must be supplemented by village-paid paraprofessionals and such services as credit, input distribution, and marketing can and should be assumed by village-level farmer groups.

In those cases where the ORDs supply services that have an immediate impact on production (such as channeling CNCA funds to village groups and assembling animal traction equipment), the full costs of these services should be reflected in the prices paid by farmers. Because many ORD activities do not have an immediate impact on production, there will inevitably be a recurrent cost financing gap for some time. Given the limited resources of the national budget, this implies a continued need for donors to finance recurrent costs.

PARASTATALS

Unlike programs administered directly by government agencies, the parastatals are revenue-generating and, in principle, supposed to be financially self-sufficient. The most important of these parastatals and their main responsibilities are:[3]

- SOFITEX: cotton marketing;
- CSPPA: marketing export crops other than cotton;
- OFNACER: cereals marketing;
- CNCA: agricultural credit;
- ARCOMA and COREMMA: farm equipment manufacturing; and
- ONERA: processing and marketing animal products.

Only SOFITEX and CSPPA, which the GOUV uses as a means of taxing the export crop sector, can be considered financially self-sufficient. It is unlikely that any of the other parastatals can become self-sufficient because their main reason for existing is to perform services not remunerative enough to be performed by the private sector.

However, certain measures can be taken to reduce deficits.

OFNACER, ARCOMA/COREMMA, and CNCA have already been discussed in detail in the marketing, input supply, and credit section of Chapter Nine. These organizations need to shift some of their activities to the private sector, more specifically, village groups. OFNACER will always operate at a loss if it has to purchase and sell grain with its own agents and trucks in all of the smallest and most remote villages.

Similarly, CNCA cannot possibly manage thousands of animal traction loans to individual small farmers at a cost covered by the interest rate it charges. Making larger loans to ORDs which then relend to village groups is one way for the CNCA to reduce its credit management costs.

Overall, it is essential for the government to distinguish between deficits related to social benefits that the parastatals provide (which are a legitimate use of subsidies) and deficits due to inefficiencies which should be reduced by reorganization and improved management.

THE ROLE OF DONOR FINANCING FOR RECURRENT COSTS

The measures the GOUV can take to alleviate recurrent cost constraints can be summarized as follows:

- Increase revenues through better tax policies and more efficient collection procedures. There are specific instances where improvements can be made, but for the economy as a whole, taxes as a percent of GDP are close to the maximum, given Upper Volta's small tax base.

- Increase efficiency in the public sector through better management, training, and logistical support.

- Shift as many government services as possible to the private sector and increase the beneficiaries' involvement in service delivery. This relates to input distribution, marketing, food security, animal health care, and implement manufacturing.

- Increase user fees and reduce subsidies. All agricultural support services should be carefully analyzed to determine their subsidy element. Farmers can and should pay for a much larger portion of the costs of extension, animal health care, agricultural inputs, credit management, and road maintenance.

- Increase agricultural sector expenditures by shifting funds out of general administration, defense, and social services.

- Improve development planning and project design. This is aimed at the long term. It is essential that development goals and priorities be carefully defined and that resources are allocated for well-defined realistic objectives. Otherwise it is inevitable that public sector outlays will consistently exceed the revenues generated from any production increases.

- Long-term development policies and priorities should also aim at maximizing private sector response to government programs. This means focusing on constraints that prevent private enterprises from taking advantage of income-generating possibilities. These include timely supply of inputs; adequate credit; passable roads; minimal controls on cereal trade, export crops, and animal products; and economically sound price policies.

As noted in this section's introduction, these measures will not remove the recurrent cost financing gap, because the GOUV's donor-supported development goals call for an accelerated development program to achieve sustained economic growth at some

future time. Since many elements of that program do not have a short-term impact on production and government revenues, ways to cover the shortfall need to be explored.

The only alternatives to donor financing of the gap are the continuation of inadequately funded government programs (similar to what is already happening) or acceptance of a smaller overall development program with correspondingly more modest development goals. In effect, both alternatives imply very little per capita income growth for Upper Volta over the long term.

The simplest way to finance recurrent costs is as part of a project. In Upper Volta most donors are already doing this to a greater or lesser extent, usually during the project's initial investment phase. Such financing is generally accompanied by an agreement for the GOUV's gradual assumption of recurrent costs.

When, as in most cases, the GOUV is unable to pick up the costs, the project either flounders or the donor agrees to continue financing recurrent costs in a phase II project. This is a de facto recognition that the government's inability to finance the recurrent costs of all development programs is a critical constraint to development, and therefore a legitimate use of foreign assistance.

Donor willingness to finance recurrent costs on a project-by-project basis can have a serious adverse effect on the overall development program. In the absence of macroeconomic measures, the recurrent cost deficit could easily increase to one-half or more of total foreign aid flows, thereby reducing funds available for new investments.

However, many of the needed measures are politically difficult to implement (such as reduced subsidies, user fees, shifting funds out of social services into agriculture, and so on). They become even more difficult to undertake when donor financing of recurrent costs reduces the urgency of taking action.

Therefore, the key to addressing the recurrent cost constraint is a joint analysis of the problem by the GOUV and donors. This must lead to a GOUV commitment to reduce recurrent costs, and donor commitments to finance the deficit for a specified period of time. Periodic reviews to assess progress need to be built into such agreements.

Assuming that meaningful policy measures and donor commitments can be worked out at the macroeconomic level, donor financing can take one of three forms:

- Recurrent cost financing of projects, as already described.

- Commodity import programs (CIPs) which involve financing the importation of commodities and equipment needed for development. The imports are sold to public or private

sector users, and the local revenues generated by the sales are given to the GOUV to finance the recurrent costs of development programs. Imports that could be financed in this way include fuel, vehicles and spare parts, fertilizers, and construction materials.

The rationale for this type of assistance is usually balance of payment support. In other words, the imports are intended to fill a foreign exchange gap in countries facing a balance of payments problem. Food aid is a special case that fits into this category. Commodity import programs as such, including food aid, contribute to economic growth when they save foreign exchange. When they do not save foreign exchange, i.e. when they do not substitute for commercial imports, their only effects are to reduce domestic prices--most evident in the case of food aid.

Moreover, when imports are sold in the private sector, the result is to shift resources from the private sector to the government. CIPs have generally been used as a foreign aid tool only in cases where a balance of payments case can be made for them (for example, Kenya and Zaire in recent years).

- Nonproject budget support programs which are aimed at filling public sector resource gaps. These efforts usually support a sector or subsector program and include financing foreign exchange as well as local costs. Thus budget support for an ORD or an animal health care program would include vehicles, fuel, local salaries, per diem, and so forth. In macroeconomic terms, financing imports has the same effect as a CIP program, and financing local costs can be considered as untied balance of payments support. However, the program's basic justification is to reduce a public sector resource gap so as to permit the effective excecution of a specific development program or group of programs.

In Upper Volta virtually all recurrent cost financing is on a project-by-project basis. Assuming that overall goals for the reduction of the deficit can be agreed upon, recurrent cost financing of projects should be increased and supplemented by more broad-based budget support programs.

CHAPTER TWELVE FOOTNOTES

1 For a thorough analysis of the recurrent costs of development programs in the Sahel, see the CILSS/Club de Sahel Study, Recurrent Costs of Development Programs in the Countries of the Sahel, August 1980.

2 See financial statements and Comptes d'Exploitation of SOFITEX and CSPAA for the period 1975-80.

3 For more information on these organizations see the section on agricultural programs in Part I and Chapter Five in Part II.

CHAPTER THIRTEEN: POLICY FRAMEWORK

In general, development policies in Upper Volta are more supportive of small-scale agricultural development than in most developing countries. The overall strategy for agricultural development is clearly oriented toward small farmers. There are no large investments in mechanized farms. Most of the effort to increase agricultural production is based on animal traction, fertilizers, and improved cultural practices.

Similarly, input subsidies (which tend to favor larger farmers) are modest compared to those in other West African countries. Most of the subsidies are for fertilizers and insecticides used on cotton. Cotton farmers pay for these through artificially low producer prices.

There has been an emphasis on cotton-producing areas when allocating resources within the agricultural sector, but this reflects their higher absorptive capacity and higher production potential relative to the northern and central areas. However, there have been clear efforts to shift resources to poorer areas of the country, in order to increase cereal production in regions with food deficits.

As noted in Chapter Eleven, the GOUV does not use fiscal, price, and subsidy policies to transfer large amounts of resources from rural to urban areas. Official consumer prices for cereals are artificially low, but most of the cereals are marketed in the private sector at free-market prices. For export crops, most of the difference between the producer prices and the export prices is returned to the rural sector.

As far as the national budget is concerned, expenditures for agricultural programs considerably exceed revenues from agricultural production. On the negative side, the MRD accounts for only 6.5 percent of budget expenditures, indicating an excessive commitment to other government activities, notably defense and social services. This report recommends that the share of the budget going to agriculture be increased, especially expenditures for logistic support.

The one policy change that would do the most to increase the effectiveness of the agricultural program during the period of the AID assistance strategy is to increase the private sector's role in the agricultural development process, and reduce the role of public sector parastatals. This requires a major shift in the orientation of GOUV development policies. Like most other developing countries, Upper Volta places a heavy reliance on parastatals to perform services in the agricultural sector. The most important of these are CNCA, OFNACER, SOFITEX, CSPPA, and ONERA.

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CNCA and OFNACER have already been discussed in previous sections of this report. CNCA was created to provide credit to small farmers for agricultural inputs and equipment. The main issue concerning CNCA is the interest rate, which will be discussed in connection with subsidies. CNCA is providing a service that almost certainly could not be provided by commercial banks. Its operations are necessarily expensive, which means it is not self-financing.

However, the organization has sound policies for eventually achieving financial sustainability. Most rural credit management is being decentralized to the village group level, which puts certain responsibility on the borrowers and cuts CNCA's operating costs.

Unfortunately, OFNACER is not moving in the same direction. The roles of OFNACER, cereal price stabilization and food security, are clearly very high priority GOUV concerns. At present, the approach to addressing these concerns seems to be to give OFNACER an ever-increasing role in cereal marketing. The goal is to have OFNACER handle 40 percent of cereals marketed in Upper Volta by 1986. Determined efforts to achieve this goal, if accompanied by increased controls on private trade, would have a serious negative impact on the efficiency of grain marketing in Upper Volta.

Only slightly less importantly, OFNACER will continue to have high operating costs for the foreseeable future. Even with decreased operating costs, it is unlikely ever to become financially self-sufficient because of strong political pressures to keep OFNACER's selling price low, thereby ensuring that the margin between the producer price and the consumer price will never be enough to cover overall costs.

On the positive side, Upper Volta has a policy of permitting private sector cereal trade. There is also a policy of encouraging village-level cereal banks, which could play important roles in both price stabilization and food security. These are measures that, if continued, would reduce OFNACER's role and make it more manageable. Additional efforts that could be taken to stabilize prices and increase food security using the private sector are discussed in Chapter Nine.

SOFITEX and CSPPA are also agricultural marketing organizations, but are exclusively responsible for export crops. An important role of these organizations is to stabilize produce prices in the face of sharply fluctuating world prices. In theory, the farmer and economy fare better if surplus export earnings are accumulated during years of high world prices and used to support produce prices during years of low world prices.

In practice, SOFITEX and CSPPA have roles that are much broader than price stabilization. SOFITEX oversees all aspects of cotton production and marketing, beginning with extension and input distribution and ending with exportation. CSPPA is responsible for all other export crops but is involved only in buying and export. Both organizations have monopolies, although private traders are licensed to purchase from farmers on their behalf.

Over the years producer prices have been set so that both SOFITEX and CSPPA earn considerable profits. Most of these profits are returned to the rural sector in the form of input subsidies, support for ORDs, and rural investments. Thus export crop producers are taxed through low producer prices to pay for agricultural programs.

The net effect of these arrangements is to distort market forces (thereby causing some misallocation of resources), and reduce the marketing system's efficiency by largely eliminating private sector competition. However, just as policies are never optimal in any country, it may well be more important to the GOUV to have an easily administered rural revenue source, and a system to reduce fluctuations in export earnings, than it is to optimize the productivity of the export sector.

The MRD does not now have the capacity to undertake the types of analyses needed to make basic policy decisions concerning agricultural development strategy. Although it is unlikely that such a capacity can be developed in the medium term, it should be possible to strengthen the MRD planning office (Direction d'Etudes et de Projets) so that it can commission the studies needed to make policy decisions and interpret the findings of these studies for top-level decision makers. An improved capacity to anlayze policy is needed, not only to determine the private sector's proper role in agriculture, but also to enable the GOUV to make informed decisions about price and subsidy policies, marketing, interest rates, and the allocation of public sector resources.

PART III

AGRICULTURAL SECTOR ASSISTANCE STRATEGY

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CHAPTER FOURTEEN: FOREIGN ASSISTANCE REQUIREMENTS

INTRODUCTION

GOUV agricultural objectives are to achieve food self-sufficiency and security and increase incomes and living standards of the rural population. These goals are to be achieved primarily through increases in small farmer productivity.

Although the GOUV does not now have an official agricultural development plan, the MRD recently carried out a planning exercise (Conference des Cadres). The results are due to be published in the form of goals and programs for agricultural development in the 1980s. That report's conclusions were discussed orally with MRD officials and, along with the analysis in Part II, provide the basis for the foreign assistance requirements discussed in this chapter.

The section starts with a discussion of the potentials and needs of each major subsector: rainfed agriculture, irrigated agriculture, and livestock. Then it discusses critical sector-wide constraints: environment, institutions, transport, and recurrent costs. Each constraint is analyzed and measures to alleviate them are recommended.

The most critical constraints in determining the size and content of the agricultural development program during the 1983-88 period are: the available technologies; shortage of trained manpower; and lack of funds to finance the recurrent costs of development projects. The essential prerequisite for any program to increase small farmer production is the existence of technical packages that not only increase production but are economically attractive to the farmer as well.

As will be discussed in greater detail, there are technical packages that can be introduced to farmers at this time. However, most of these are applicable in the southwestern part of Upper Volta. Some marginal productivity increases appear possible for lower rainfall areas, but further adaptive research is needed before interventions to increase production can be initiated on a large scale.

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Manpower and recurrent cost constraints add up to a problem of absorptive capacity. Until the stock of trained manpower is upgraded and expanded, there can be little increase in the size of the overall agricultural development program. Perhaps more serious and urgent is the lack of funds for recurrent costs. The agricultural program's operating costs already exceed the government's financing capacity. Thus many development projects are ended before their objectives are achieved. More important, most public sector employees work well below capacity because of inadequate logistical support.

In view of these constraints, the foreign assistance requirements identified in this report assume the need to minimize increases in medium-term agricultural programs. When new and expanded activities are required (such as adaptive research), they should receive donor support. In general, however, the most urgent need during the 1983-88 period will be for foreign assistance to address the critical bottlenecks limiting the effectiveness and impact of existing programs. Such assistance will provide the basis for a long-term agricultural development program consistent with the country's needs and available resources.

SUBSECTOR POTENTIALS AND NEEDS

Rainfed Agriculture

This subsector accounts for most of Upper Volta's production. Despite the low level of productivity and the semi-arid climate, rainfed agriculture is the key to achieving food self-sufficiency and increased rural incomes for the foreseeable future. There are at least four sets of possiblities and needs, each corresponding to the country's major agro-climatic zones.

In southwestern Upper Volta (below a line running from Dedougou to Po) where rainfall is more abundant and reliable than elsewhere, production potential is higher and improved technologies are already available. This area already has a cereals surplus and accounts for most of the cash crop production. It also includes most of the highly productive onchocerciasis-freed areas being developed by the AVV.

During the 1983-88 period the GOUV's objectives in the southwestern region's should be to increase existing food surpluses and diversify cash crop production, thereby reducing the region's heavy dependence on cotton. A determined adaptive research and extension effort is also needed to find an economically feasible alternative to the acidifying engrais coton by the mid-1980s.

Technical packages that can achieve significant and widespread production increases have not yet been developed for the central plateau, which is characterized by low rainfall, poor soils, and relatively high population density. This area's medium-term objective should be to maintain its per capita food production without further soil degradation. The basis for this improved performance will be donkey traction and, possibly, the use of rock phosphate fertilizers on groundnuts.

However, even this objective will require a major element of adaptive research. Research should focus on animal traction, including better plowing and weeding equipment, and ways of introducing better soil conservation practices and increased cowpea and groundnut production into existing farming systems. Efforts to increase production of these crops will not only provide the basis for increased incomes but could also be the means for making animal traction and fertilizer use economically feasible in this agriculturally marginal region.

In the sparsely populated eastern region, the technical package is based on the use of animal traction to expand areas under cultivation. Considerable adaptive research has been carried out under the AID-financed Phase I Integrated Rural Development Project. Thus much is already known on how animal traction and associated cultural practices fit into existing farming systems. Production-increasing technical packages developed and tested on farmer fields during Phase I are available for more widespread dissemination to farmers.

At present the eastern region is self-sufficient in food grains, but there is very little cash crop production. During the 1983-88 period the main objective should be to increase millet and sorghum production using animal traction. Other realistic, but in volume terms less important, objectives would be to increase rice production in bas-fonds; groundnut production in the northern area; and cotton, maize, and cowpea production in the southern area.

The potential for the latter crops is greatest in the eastern areas because of their proximity to Nigerian markets. Programs to increase production of a marketable surplus in the eastern region will need to include improvements in transport infrastructure. Poor transport currently appears to be a critical factor inhibiting production increases.

Upper Volta's fourth climatic area is the Sahel, where meagre rainfall currently permits only marginal subsistence production of crops. This region's major economic activity is livestock production.

Foreign assistance requirements for rainfed agriculture include:

- Continuation of basic agricultural research on semi-arid crops in close cooperation with international research centers. This research represents continued efforts to identify high-yielding cereal varieties that will bring about a major increase in agricultural productivity in the northern two-thirds of the country.

- Considerable expansion in adaptive research. This research should be based upon the use of existing crop varieties and aim at increasing the returns to labor which, in Upper Volta, is the binding constraint to increased production.

  Continued support is also needed for the ICRISAT Economics Program and the SAFGRAD Farming Systems Unit. At the regional (subnational) level, donors will need to support adaptive research in the context of ORD programs. ORD-level research programs will have prime responsibility for carrying out trials in farmers' fields and creating linkages with the extension service. The ICRISAT and SAFGRAD programs should have responsibility for overseeing the ORDs' adaptive research activities from a technical standpoint and maintaining liaison with agricultural research stations, especially Kamboinse, Saria, and Farako Ba.

- Continuation of donor support for ORD programs to disseminate improved technologies already adapted to Voltaic soils and climate. Priority areas for production programs are in the west and southwest, including the AVV areas, where production-increasing interventions are known to be technically and socioeconomically feasible.

  In other parts of the country the technical innovations known to be feasible should continue to be disseminated. In most instances these innovations are based on animal traction and adopted when they increase returns to labor and relieve the most critical constraint to increased production: the shortage of labor for weeding.

  However, it is recommended that programs to disseminate the new technologies (extension, input distribution, and credit) not be greatly expanded during the period covered by this strategy statement. The existing programs are already excessively expensive in terms of recurrent costs. Moreover, partly because many elements of the recommended technical packages need further adaptive research, these programs are not achieving their desired results.

  The emphasis during the 1983-88 period should be on adding a farming system research dimension to the extension program, thereby increasing the chances that improved technical practices will be extended in a way most consistant with the socioeconomic needs and desires of farmers.

Irrigated Agriculture

This subsector's objectives consist of developing and maintaining small-scale irrigation systems, primarily in the bas-fonds, and a large-scale irrigation network. The former is closely related to rainfed agriculture and usually developed in the context of ORD programs. The technical packages for agricultural production around improved bas-fonds are known, although further adaptive research is needed to determine which land uses make optimal economic sense from the farmers' perspective.

The long-term potential for large-scale irrigation in Upper Volta is significant (over 100,000 ha). The GOUV has a goal of developing 2,000 ha per year, but at least for the medium term, the technical and management constraints are overwhelming. Experience with existing projects indicates that a viable large-scale irrigation project requires a level of technical knowledge, management capacity, and institutional support that does not now exist in Upper Volta. Attempts to increase irrigated areas before these critical constraints are overcome are certain to lead to large losses of the country's scarce development resources.

It is recommended that short-term objectives be limited to:

- Increasing yields on existing irrigation schemes;
- Developing farmer institutions capable of operating and maintaining irrigation systems;
- Regularizing the organization of GOUV policy and planning to maximize effectiveness;
- Instituting a multi-level training format within the government's technical service organizations; and
- Accelerating small-scale irrigation development.

Achieving these objectives would establish the basis for long-range irrigation development. This would consist of:

- Full development of 30,000 ha of swampland for rice production by using controlled flood recession irrigation;
- Upland irrigation development for diversified cropping at a pace in line with Upper Volta's financial and technical resources; and
- Improvement in irrigation efficiency by modernizing irrigation methods.

There are indications that other donors are or will be participating in activities related to the five short-term interventions. The World Bank-financed Rural Development Fund (FDR) has

shown interest in national-level institutional development to facilitate administration between financing and implementation organizations. The Netherlands has been approached for assistance in training staff to prepare and implement irrigation projects, and bas-fonds development will continue under the FDR's third phase. These projects should address three of the five short-term problems listed above.

The other two problem areas, increasing yields on existing irrigation schemes and developing farmer institutions capable of operating and maintaining irrigation systems, could be addressed under a single project of modest scope. Within a five-year period the project would develop important technological and management approaches for the operation of irrigation systems under Voltaic conditions.

Guidelines for designing such a project should focus on measures that farmers themselves can adopt and carry out: how to manage a common interest cooperative; procurement, distribution and sale of production inputs; group responsibility for irrigation system maintenance and repair; enforcing weed control; group harvesting; crop handling and processing; and crop production, marketing and storage. Expatriate assistance should consist of an experienced co-op manager, a production and marketing agronomist, and a water management engineer. Short-term consultants would also be needed in accounting, marketing, and milling.

The Moctado Project, 120 km from Ouagadougou, is an example of a project that would lend itself to testing and developing the techniques to be adopted. The project needs rehabilitation due to inadequate maintenance. The area could conceivably be considerably expanded using the present water supply (low dam reservoir) if good system maintenance and efficient water use practices were carried out. A proper drainage system would permit the re-use of excess waters to cultivate additional short-season crops in downstream areas.

The development of a technical package for productive farming on irrigated land, in concert with the derivation and incorporation of a workable farmer-managed production and marketing enterprise, would help resolve Upper Volta's two principal constraints to irrigated agriculture: low returns on development investments in irrigation, and poor management and maintenance of irrigation systems after their completion.

Until irrigation water use efficiencies are substantially improved, higher profitability attained, and system management arrangement perfected, the priority for irrigation development should be for lower-cost, short-gestation, small-scale projects. Otherwise, investments in irrigated agriculture will not be as profitable as those in rainfed agriculture.

Livestock Production

The GOUV considers the livestock subsector critical to Upper Volta's long-term growth and development. It is critical not only as a source of cash income for rural families, but also as a source of foreign exchange, government revenues, and expanded employment in processing industries.

However, livestock production is presently characterized by largely traditional practices and low productivity. GOUV objectives are to increase the productivity of traditional herding in the northern, central, and southern parts of the country as well as the commercial exploitation of animal resources, especially in the center and south.

From a technical standpoint, critical constraints in the livestock sector are the low productivity of the rangeland, the scarcity and high prices of agricultural by-products, and animal diseases, both epidemic and endemic. Ways of addressing these contraints are known but not feasible, since the costs to traditional herding systems of carrying out the necessary interventions generally exceed the value of the increased production.

At the same time, the establishment of modern livestock production systems is not possible, due to the high cost of feed production, stemming from low crop sector productivity, and the lack of support services needed to sustain a modern livestock industry. Given the state of knowledge on existing and improved animal production systems, priority attention should be given to extensive rather than intensive systems. Semi-intensive systems (embouche paysane) should be explored in the context of integrated farming systems.

During the 1983-88 period the greatest need is to extend productivity-increasing innovations known to be economically feasible--mainly health care administered by herders--and to carry out adaptive research to identify socioeconomically feasible improvements in animal husbandry and range management practices. These interventions need to be accompanied by an increase in the effectiveness, but not the size, of the livestock service.

This implies the following for foreign assistance requirements:

Multidisciplinary production projects should focus on:

- The development of low-cost annual health delivery and extension (secouriste) systems;
- Organization of producer groups;

- Improved marketing to make production-increasing interventions more remunerative; and
- Adaptive research to identify improved production and range management practices.

Assistance to the Livestock Service should be programmed to:

- Improve technical capability at the ministry level, including the diagnostic laboratory; and
- Increase the effectiveness of veterinary posts through better trained staff and more veterinary supplies. This program has important long-term recurrent cost implications and must be assessed in relation to its long-term impact on production.

SECTOR-WIDE PRIORITIES

Environmental Concerns

Upper Volta's food production systems are being ecologically undermined in the more densely settled regions, particularly the Central Plateau and the Sahel. The principal constraints to sustained production increases are excessive runoff (including unnecessary soil moisture deficits), soil erosion, deforestation, and rangeland deterioration.

Poor water conservation is particularly severe during the irregular rainfall periods typical in the country's northern portions. Soil erosion is associated with high runoff, and adversely affects soil structure by selectively removing clay particles and humus. Erosion problems are compounded by the thin topsoils of the dominant ferruginous tropical soils. An estimated 230,000 to 300,000 ha have already been removed from production.

Deforestation also contributes to local desertification as well as diverting labor toward fuelwood collection and replacement and away from crop production. Organic matter is also removed from fields as grain stalks are substituted for fuelwood. Finally, rangeland deterioration reduces annual forage production upon which both meat and milk production are based.

Soil and water conservation is being addressed largely through the FDR programs. Further research into the effectiveness of technical interventions should be supported between 1983-88. This could be done in conjunction with support to better extension in the form of improved training of both mid-level technicians and encadreurs. Adaptive research which incorporates farmers' use of

stone mini-dikes into the FDR program is needed to ensure the long-term effectiveness of conservation efforts. Experience in Kaya and Yatenga has shown that adaptive research with traditional techniques and materials is producing alternative and more cost-effective methods of water conservation and erosion control.

On-farm trials using these techniques should also be pursued for possibly wider dissemination after the 1983-88 period. Soil and water conservation manpower and institutional needs should be directed toward establishing a Soil and Water Conservation Service under the DSA. Increases in recurrent costs can be avoided by providing specialized agro-ecological training to MRD technicians. They would be responsible for coordinating programs through existing research and extension systems. Support should complement proposed FAO intervention in this field.

Assistance toward reducing the negative consequences of deforestation should be focused on encouraging the widespread use of effective and inexpensive woodstoves, of which there are many. Peace Corps volunteers could demonstrate the relative merits of different stove models.

Reforestation should also be encouraged. Forest service and ORD collaboration should be supported to increase village-level delivery of healthy seedling of diverse species. Individual reforestation efforts show the highest promise. Both basic and adaptive research still need to be done on agroforestry. Trees are extremely important in traditional production systems but have been almost entirely overlooked by farming systems research under current programs.

Reversing rangeland deterioration, while an important objective, should be given a lower short-term priority than introducing sound range management into areas not yet degraded but facing the rapidly increasing settlement of people and animals. A follow-up to earlier AID activity in the Centre Est Department is strongly recommended. Range management should be pursued on a pilot basis, with a strong adaptive research component, and in conjunction with other efforts to extend Livestock Service outreach in a cost-effective manner, such as the use of trained local herders.

AID's Environmental Sector Assessment strongly recommends establishing an agro-sylvopastoral code. Although implementation of such a code should be a long-term policy, support of a draft would serve to overcome many basic data and land classification gaps that inhibit the efforts of many different institutions to manage the country's natural resource base. In this sense its support in the time frame of this strategy can be justified.

Institutional Constraints

The major institutional constraints to increased small farmer production and incomes are in the following functional areas:

- Research;
- Extension;
- Agricultural input supply;
- Marketing agricultural products; and
- Public administration--planning, policy analysis, and management.

The two critical constraints affecting all Voltaic agricultural institutions are recurrent costs and trained manpower. The recurrent cost constraint effectively precludes greatly increasing the number of trained staff working in agriculture. One exception is the need for a relatively small number of high-level professionals to fill positions in research institutes, training institutions, and the MRD's policy analysis section.

What can and should be done for mid-level manpower is to upgrade existing staff. This involves on-the-job training as well as more extended training in Upper Volta and in other African countries. Voltaic training institutions, especially Matourkou, need strengthening. In Matourkou's case, certain policy and administrative changes are needed before additional foreign assistance can be effectively utilized.

Research

Given the basic need to develop technical packages adapted to Upper Volta's semi-arid climate, it is essential that the country's agricultural research capacity be strengthened. As already noted in Chapter Five, this involves continuing the work currently ongoing at research stations, and adding a considerably expanded farming systems research program. During the 1983-88 period existing donor support to research stations should be maintained along present lines, with continuing efforts to increase the relevance of research to Upper Volta's specific needs. These include an increased emphasis on designing animal traction equipment and using nonacidifying fertilizers.

The major new donor effort concerns farming systems research. Support to the ICRISAT and SAFGRAD programs should be continued. At the same time the program of on-farm trials should be greatly expanded. This can be seen either as the expansion of research down to the farm level, or conversely, as building up ongoing

applied research and redesign elements within the extension program. It now appears that the most effective way for donors to support this effort is to ensure that all ORD programs include an adaptive research component.

In the livestock subsector, the key needs are for both epidemiological surveys to make animal health services more focused and cost-effective, and multidisciplinary adaptive research to identify socially and economically feasible ways of increasing herd productivity and reducing range degradation.

Extension

Although the extension program accounts for the largest share of manpower and financial resources allocated to agriculture, it is usually considered understaffed and underfunded. However, it is clear from the financial condition of most ORDs and the Livestock Service that it will be very difficult to expand extension programs in the foreseeable future. This suggests that instead of adding more funds and manpower to existing programs, government and donor efforts should focus on increasing program effectiveness and, if possible, reducing costs.

The analysis in this report indicates the long-term solution to this problem is to improve the technical package being disseminated, thereby facilitating the extension task. The overall approach to rural education and agricultural extension should also be reoriented to make them more effective and encourage farmer participation.

This orientation should include rural youth. Rural primary education would aim at preparing children for subsequent vocational training as well as continued academic education. It would be complemented by strengthening the CFJAs and changing the curriculum to prepare students to understand and act on extension advice related to new technologies.

This strategy's final element is to train progressive farmers to assume the extension agents' role at the village level. In time it can be expected that CFJA graduates that are able to and so inclined would be selected to perform this function. If this proves possible, the role of government-paid extension agents would shift from working directly with farmers to supervising and providing technical guidance to paraprofessionals such as villager-selected farmer agents. This approach could be incorporated into the World Bank's Training and Visit System.

The major medium-term implication of this approach is an urgent need for mid-level manpower training. Specifically:

- Primary school teachers in rural areas will require training in vocational education;

- CFJA teachers must be better trained in agricultural subjects; and

- Extension personnel will require additional training in agriculture as well as in how to work with farmer agents.

The overall objective is to increase the extension program's impact without increases in staff and recurrent costs. This can be achieved only if the technical qualifications of all government personnel involved can be substantially upgraded. A second precondition is that they be properly remunerated and receive adequate logistical support. This means the ratio of salaries to other ORD budget costs must be lowered. This problem is discussed in the recurrent costs section.

Finally, it is important that extension agents have job security and promotion opportunities. ORDs must be willing to delegate responsibility to encadreurs and provide them with the resources to demonstrate their initiative. Unless encadreurs are so encouraged, it is unlikely that they will work effectively with paraprofessionals and local groups.

The situation as described has several implications for donor programs in the 1983-88 period:

- There should be no major expansion in the size of extension staff in the central and northern ORDs until major breakthroughs have occured in technical packages suitable for those areas. This is not likely in the medium term.

- The main focus of new donor programs should be on retraining existing staff. This includes supervisory extension staff (Matourkou graduates), extension agents (encadreurs), and CFJA instructors. As noted in the research section, all ORDs should also carry out adaptive research in close association with the extension program.

- The DIRC will need support to study social issues related to using farmer-agents for extension. Specifically, it will need to study using village groups to select farmer agents, organize their work, and arrange their remuneration. The aim of these studies should be to develop various "models" tailored to local conditions, and to find ways of increasing local-level capacity to initiate and implement activities to increase production and incomes and improve social services.

Agricultural Input Supply

When introducing new technologies to small farmers, a key element is the timely distribution of necessary equipment and inputs. This involves:

- Importing equipment, raw materials for equipment, and fertilizers;
- Manufacturing domestic equipment and, of particular interest in Upper Volta, producing rock phosphate;
- Distributing inputs, primarily through the private sector and ORDs; and
- Providing farmers with credit from the CNCA, ORDs, and village groups.

The system is currently simplest and works best when the ORD purchases imported inputs with its own funds, since input importation and distribution to the ORDs is done almost entirely through the private sector. When equipment is manufactured locally, there are frequent delays and shortages. This is primarily due to the management and cash flow problems of the main suppliers, ARCOMA and COREMMA.

The most important distribution constraint is the lack of trucks and public sector operating funds. The private sector can move goods reasonably well, its main constraint being poor roads. Village groups could also play a much larger input distribution role than at present by acting as intermediate rural area distribution and storage points. This would eliminate the need for ORDs to use scarce manpower and resources to distribute inputs down to the farm level.

The final link in the input distribution chain is credit. The major credit program problems are a shortage of funds and high administrative costs. The second problem is being addressed by using ORDs and village groups to administer loans at the regional and village levels respectively. However, it cannot be expected that costs (including the opportunity costs of capital, administration, and defaults) can be reduced to a level fully covered by the interest rate charged to farmers.

This discussion implies the following needs for donor assistance during the 1983-88 period:

- Management assistance to ARCOMA and COREMMA;
- Assistance to increase rock phosphate production and distribution;
- Additional capital for CNCA, either directly or through ORD programs; and
- Technical assistance to CNCA to address the problem of the high administrative costs of small farmer credit programs.

Marketing Agricultural Products

The goal of any marketing program is to ensure that as the production of marketable surpluses increases, the institutions involved in marketing can move the goods expeditiously and efficiently to prevent gluts, price fluctuations, and their consequent production disincentives. At present the most important marketed crops are cotton and cereals. Cotton marketing is well organized through SOFITEX, and most cereals are marketed efficiently through private channels.

Other cash crops are much smaller in volume. They do not appear to be facing important marketing constraints although there is some evidence that groundnut marketing is not as well organized as it once was. However, it should be pointed out that export crop marketing could be carried out more efficiently, and producer prices would be higher, if the role of the major parastatals involved was limited to price stabilization.

The main marketing problems are related to the GOUV's price stabilization objectives for cereals and food security. The organization responsible for achieving these objectives is OFNACER. So far it has been unable to fill its designated roles. One major reason is the policy context within which OFNACER must operate. The key issues are the degree of price stability that can reasonably be expected under Voltaic conditions, and the relative roles of OFNACER, village storage, on-farm storage, and imports in a well-conceived food security program.

Unless OFNACER is assigned a realistic role in the context of sound price stabilization and food security programs, GOUV objectives will not be achieved and OFNACER's activities could well be counterproductive. The key requirement at this time is to recognize the major role the private sector must play, especially village groups through cereal banks and transport.

Assuming that OFNACER has a role to play in both price stabilization and food security, the organization's most critical needs are recurrent cost financing and improved management throughout the system. Unless both problems are addressed simultaneously, first by increasing the margin between producer and consumer prices and then by tightening management control over finances and management, OFNACER cannot become viable.

The requirement for donor assistance in this effort cannot be determined until OFNACER's proper role has been clearly established. Management and financial assistance to ONFACER will not make the organization viable in the absence of policy changes with respect to cereal price stabilization and food security.

Public Administration: Planning, Policy Analysis and Management

Given Upper Volta's very limited resources, it is critical that the government be able both to establish priorities to optimally use available resources, and have the management capacity to implement high priority programs as efficiently as possible. It is also important to be able to analyze the macroeconomic and agricultural policy issues that have important implications for the achievment of production and welfare objectives. It has become clear in recent years that MRD capacity in all these areas needs to be strengthened. The MRD is currently unable to exercise its responsibilities for overall policy guidance and national-level agriculture program management as effectively as it should.

This situation implies the need for technical assistance and training to strengthen national-level planning, policy analysis, and management capacity. Certain organizational changes to achieve these objectives have recently been instituted in MRD. Their impact could be greatly increased through donor support, including some funding of operating costs.

However, it should be noted that the orientation of the management reorganization is important. The objective should not be to centralize decision making at the top but rather to create more effective linkages between the center and the regions. The MRD should establish policy guidelines and provide the necessary resources, plus technical and logistical support to implement them. Such a policy of "controlled decentralization" would be the most effective way to implement the paraprofessional/local group approach advocated in this report.

Transport

The most important medium-term infrastructure requirement is rural roads. The primary road network is continuously being improved, and now appears adequate to handle most long-distance movement of agricultural products, largely cotton and cereals. Many primary roads outside the cotton growing areas could be improved, but in most cases the traffic flow would not justify the investment.

In general, investments in new or improved roads are justified if the present value of transport costs savings exceeds the costs of the roads. This is rarely the case in Upper Volta. Road investments can also be justified if agricultural production will increase substantially as a direct or indirect result of road construction. The latter point particularly applies to secondary roads. Also, it assumes that where a new road is being built, the technology and supporting services are available to produce marketed surpluses not produced before.

Therefore, the appropriate strategy should be to construct roads mostly in conjunction with integrated small farmer production projects. In areas where the technical basis for a production project does not exist, in other words, where further adaptive research is needed, new secondary or tertiary roads should not be constructed. Such roads would be a poor use of scarce resources. Moreover, if roads cannot be justified in terms of future production increases, it is virtually certain that resources will not be available for their maintenance.

A cost/benefit analysis of upgrading farm-to-market secondary and tertiary roads almost always shows that costs exceed the value of benefits. However, a more favorable result from the same cost/benefit analysis would come from a bottleneck-removal strategy rather than by upgrading the entire road. It costs less to reinforce only ditch crossings than to upgrade the full length of a road.

Recurrent Costs

The underlying cause of the recurrent cost constraint is the nature of the development problems that must be overcome before self-sustaining growth and development can be achieved. The meager resource base, low literacy rate, trained manpower shortage, and inadequate infrastructure base mean that most development program elements in Upper Volta are long-term in nature. Significant increases in overall economic growth cannot be achieved in the medium term. Thus the country's overall development program is unable to generate the resources necessary to keep the program going.

During 1983-88 recurrent cost requirements will remain at least as high as they have been, and will most probably increase. At the same time government revenues are unlikely to increase measurably. If the agricultural strategy and assistance program is well formulated, however, a sound basis for sustained long-term agricultural growth will have been established by the end of this period. Better technical packages will have been developed and key institutions will have been strengthened. Subsequent programs will yield increases in production and government revenues that, assuming sound fiscal policies, will bring the national current budget into balance. In the meantime, however, there will continue to be a recurrent cost financing gap.

The solution to this problem has essentially three elements. The first is to have a well-designed development program. This means that development expenditures should be based on a thorough understanding of development constraints, and investment decisions should reflect an optimal allocation of available resources. Unless a sound development program can be formulated and implemented, development objectives will not be achieved. One side effect of this is that the recurrent cost financing gap will continue indefinitely.

The second element is sound fiscal policies. On the expenditure side, determined efforts are required to ensure that expenditures on government administration and social services do not exceed the government's ability to finance them. To the maximum extent possible the costs of social services should be assumed by the localities and individuals receiving them. Careful attention is also required to increase the efficiency of development programs (especially the ORDs) and parastatals.

On the revenue side, policies should aim to obtain revenues for services received either through taxes or user fees. At the present time this is happening only for extension and input distribution for cotton producers. The greater use of earmarked taxes, such as the gasoline tax for road maintenance, should also be explored.

The final element in addressing the recurrent cost problem is donor financing. The overall approach should be for donors to assess the recurrent cost implications of the development program as a whole, reach agreement with the government on the first two elements discussed above, and make a recurrent cost financing commitment for a least the next five years.

However, it is essential that this be a multi-donor effort closely tied to sound development and fiscal policies on the government's part. Unless the problem is approached in this way, donor financing of recurrent costs will amount to no more than a marginal increase in total resources available to the government, and development programs will continue to be underfunded, as they are now.

SUMMARY OF CONCLUSIONS

The main constraints to what can be achieved in the agriculture sector during the 1983-88 period are:

- The lack of a technical package that can significantly increase small farmer production in the northern two-thirds of the country, where most of the population lives;
- The shortage of trained manpower; and
- The lack of funds to finance recurrent costs.

This indicates that medium-term foreign assistance should focus on breaking the technology constraint, primarily through adaptive research, and increasing the cost-effectiveness of ongoing programs while limiting new and larger programs. The foreign assistance goal during this period should be to increase

agricultural production, where that is possible, and build a sound basis for a long-term agricultural program consistent with Upper Volta's needs and available resources. This implies the following foreign assistance needs for the 1983-88 period:

Development and Dissemination of Technical Innovations

- New technologies that can increase production under Upper Volta's semi-arid conditions and be socioeconomically feasible at the farm level need to be developed. This will require continued donor support for basic agricultural research and considerable expansion of farming systems research.

- Where improved technologies adapted to Voltaic conditions are known, they should be disseminated through donor--supported ORD programs. This can be done on a large scale in western and southwestern areas and in onchocerciasis-freed areas. In other parts of the country a technical package based on animal traction and selected use of phosphate fertilizers can be extended. However, in most instances widespread adoption will depend on farm-level adaptive research.

- There is considerable medium-term potential for bas-fonds development. Donors should support this program either through assisting the FDR and other national-level institutions or in the context of ORD programs.

- Past experience indicates that the technical knowledge, management capacity, and institutional support needed for successfully operating large-scale irrigation schemes do not now exist in Upper Volta. Donor assistance to such projects should be limited to improving existing project management and strengthening the support services needed to make these projects economically viable.

- Possibilities for significantly increasing animal productivity in the medium-term are limited by the lack of technical packages that are socioeconomically feasible at the herder and farm levels. Donor-financed livestock projects during the 1983-88 period should concentrate on pilot activities and adaptive research aimed at developing production and range management practice improvements and low-cost animal health and extension programs. These pilot projects should be complemented by a project to strengthen the Livestock Service's technical support capacity at the ministry level. In view of the overall importance of the livestock sector, these activities should be given a high priority when allocating donor resources.

Natural Resources Conservation

- Soils in certain densely populated parts of Upper Volta are deteriorating rapidly, but technically sound measures have been identified that can reverse this process. Donor assistance to address soil degradation should primarily consist of using adaptive research to build soil conservation practices into existing farming systems. A Soil and Water Conservation Service should also be created in the DSA.

- A second critical problem is the depletion of Upper Volta's forest resources. Two measures should be given high priority during the period covered by this strategy statement. First, efficient woodstoves should be widely distributed. Second, adaptive research and extension to incorporate reforestation into the improved farming systems currently being developed and disseminated should be supplied.

- The most urgent need in overcoming rangeland degradation is to introduce sound range management practices in areas where the range is threatened but not yet seriously depleted. It is also recommended that work begin as soon as possible on preparing an agro-sylvopastoral code.

Institutional Constraints

- Donor assistance is needed both at the national level (ICRISAT and SAFGRAD) and the ORD level to strengthen the institutional capacity to carry out farming systems research.

- Donor assistance to the extension services should aim at increasing their impact without increasing their costs. This calls for a dual strategy. First, the technical qualifications of extension staff (encadreurs and CFJA instructors) must be upgraded and national-level technical support increased. Second, the farmers' ability to understand and act on extension advice must also be increased. This means that donor assistance to the extension program should consist of mid-level manpower training and pilot efforts to find new ways of involving farmers in the extension effort. This latter assistance would be provided through the MRD's DIRC.

- Foreign assistance to institutions involved in supplying and distributing agricultural inputs should include:

  - Management assistance to ARCOMA and COREMMA;

  - Support for increased rock phosphate production and distribution;

- Additional capital for CNCA either directly or through ORD programs; also technical assistance to CNCA in the special management problems related to animal traction credit programs; and

- Policy advice on ways of increasing the private sector's role in import, production, and distribution of agricultural inputs.

- In the marketing area the most critical problems concern the GOUV program to stabilize food grain prices and achieve food security. Donor assistance is needed to determine how these objectives can best be achieved and what OFNACER's role should be. Possibilities for enlarging the role of village group cereal banks should be developed. Following determination of the economic viability of these initiatives, OFNACER will need technical and capital assistance to enable it to implement its program.

- In view of the agricultural program's critical resource shortages, there is an urgent need for the MRD to strengthen its planning and management capacity. Donors can aid this effort by providing technical assistance, training, and some support for operating costs.

- A major element in the GOUV's agricultural development strategy is to reinforce village groups and expand their roles in performing agricultural support services. These services include distributing inputs, disseminating credit, spreading technology, and marketing agricultural products. DIRC and the ORDs will need a stronger community development capacity to implement this program.

Transport

- The lack of rural roads is a serious constraint to increased production in certain parts of the country. However, roads should be constructed or upgraded only in the context of integrated ORD production programs.

Recurrent Costs

- During the 1983-88 period, the agricultural development program in Upper Volta will contain very few self-financing activities. Donors should consequently be prepared to finance a substantial portion of their projects' operating costs, not only during a project's life but for some time afterwards as well. This particularly applies to integrated small farmer production projects at the ORD level.

- However, the only effective solution to the recurrent cost problem requires that it be addressed at the level of the country's overall development program. Many agricultural programs (research, training institutions, rural roads) require recurrent cost financing but will never generate revenues. Their operating funds come from the national budget which is also the source of funds for other economic sector programs as well as social services and government administration.

  Donor strategies for financing recurrent costs must be based on the recognition that, at least for the next 10 years, the recurrent costs of development programs will greatly exceed domestically available funds. Financing this gap must be a multi-donor effort based on clear and candid negotiations with the GOUV on managing public sector resources. In the absence of a concerted effort of this kind, non-project recurrent cost financing by one donor would have little impact on the overall program, and is therefore not recommended.

CHAPTER FIFTEEN: AID SECTOR ASSISTANCE STRATEGY, 1983-88

INTRODUCTION

It is clear from the preceding discussion of overall foreign assistance requirements that there are many critical constraints that must be simultaneously addressed to achieve sustained agricultural production increases. Most interventions to address these constraints are carried out through ORD programs that include extension; credit; input distribution; community development; animal traction equipment manufacturing; and infrastructure, including rural roads and bas-fonds. In most cases, donor support for these activities is provided through integrated agricultural production projects. AID is currently financing such projects in the Eastern ORD, and in the Seguenega sector of the Yatenga ORD.

To achieve their objectives, ORD programs require support from national-level institutions in the following areas:

- Manpower training;
- Research;
- Credit;
- Marketing;
- Infrastructure construction;
- Farm equipment manufacturing;
- National support for ORD extension programs; and
- National support for ORD community development programs.

Past and present AID assistance to the national-level programs includes:

- Seed multiplication;
- Agricultural manpower training at the Institut Superieur Polytechnique and Matourkou;
- Management and financial support for cereals marketing (OFNACER); and
- Support to the Livestock Service for increasing village livestock production.

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AID has also contributed to agricultural research through two West African regional projects: SAFGRAD and IPM. Except for the regional projects, all existing AID projects in the agricultural sector are scheduled to end by 1983.

In retrospect, it can be said that an important shortcoming of AID's agricultural program in Upper Volta has been the large number of projects, many having no clear relationship with each other. Not only did this greatly increase the USAID mission's management burden, but it also meant that individual projects were rarely mutually reinforcing. This made it difficult for USAID management to get a good grasp of the overall impact of the program.

The USAID mission has taken account of this problem in deciding to consolidate its program of assistance to the agricultural sector for the period 1983-88. It is this decision that motivated the sector review and analysis in this report, and the formulation of a recommended strategy. Thus the programming of AID assistance over the medium term will be linked directly to a set of objectives within an overall strategy. This concluding chapter spells out those objectives and the types of interventions that are proposed in order to achieve them. A Project Identification Document was drafted separately by the sector review team; it provides considerably more detail on the interventions and their associated inputs, outputs, costs and timing.

STRATEGY OBJECTIVES

The strategy proposed here is primarily based upon the analysis presented in Part II of this report, but is also influenced by:

- GOUV priorities and programs;
- USAID experience in Upper Volta and likely AID/Washington priorities during the period covered by the strategy;
- USAID management constraints;
- Likely funding levels; and
- Programs being financed by other donors.

As noted at the beginning of Part III, the long-term goals underlying the GOUV agricultural program are to achieve sustained food self-sufficiency and security, and increase the rural population's living standards. A major finding of the analysis in Part II is that the key constraints to achieving these objectives in the medium term are:

- The lack of improved technologies that can dramatically increase production in the northern two-thirds of the country;

- The shortage of trained manpower; and

- The lack of funds to pay for the operating costs of development projects.

The results of these constraints show up most clearly in the lack of ORD program impact outside cotton-producing areas. Because these programs are understaffed and underfunded, they are not effective in extending improved technologies. However, the production increases possible from available technologies do not justify increased expenditures on extension. In any event, neither additional manpower nor operating funds are available in the medium-term.

The solution to this problem lies in finding ways to disseminate productivity-increasing technical innovations without expanding ORD field staffs and operating budgets. There is good reason to believe this goal can be achieved during the period covered by the strategy statement. It is also a goal to which AID can make a major contribution.

The specific objective that is proposed for AID agricultural sector assistance during the 1983-88 period can be stated as follows:

- <u>To improve the development and dissemination of productivity-increasing new technologies to small farmers and herders, in ways that help alleviate the country's manpower and recurrent cost constraints.</u>

The proposed strategy for achieving this objective includes:

- Strengthening the MRD's planning and management capacity, to improve policy formulation and help address the long-term problem of recurrent costs.

- Improving and expanding the adaptive research program;

- Upgrading the quality of the extension program, including the CFJAs;

- Establishing effective linkages between extension and research;

- Using village-level institutions to facilitate extension and carry out other activities needed to increase production (credit, input distribution, marketing); and

- Initiating an adaptive research program for livestock production and exploring ways of reducing extension costs.

This strategy implies support at both the national and regional levels. The remainder of this chapter discusses each component of the strategy separately.

NATIONAL-LEVEL ASSISTANCE

Planning and Management

Two overall constraints that seriously hamper programs to disseminate new technologies are the recurrent cost problem and government policies affecting the agricultural sector. The first constraint implies the need for improved management. MRD has created a new office responsible for strengthening and standardizing ORD management procedures. AID support for this effort would be an important element in its program to increase the cost-effectiveness of ORD extension programs.

The impact of extension programs is also greatly affected by constraints to increased production unrelated to extension. Appropriate policy measures can alleviate, if not remove, some of the most pervasive of these constraints, such as inefficient input distribution, poor credit management, low producer prices, and inefficient marketing. Within the MRD, the Direction d'Etudes et de Projets (DEP) is responsible for planning and policy analysis. Assistance to this organization would improve the MRD's capacity to address critical policy issues.

Local Organizations

The serious social and organizational issues related to the formation of local organizations (groupements villageois) to facilitate and expand the agricultural development process calls for increased analytical and implementation capacity in MRD's Direction d'Institutions Rurales et du Credit (DIRC). DIRC should be able to analyze social systems and village-level needs as a first step in developing methodologies for forming groups.

There is also a need for an expanded training capacity, not only for encadreurs and animateurs, but also for village group leaders. The main objective of this DIRC support would be to create village-level organizations that can effectively assume responsibility for tasks now being performed by overworked extension agents. A specific and urgent area of study would be the use of paraprofessionals selected and paid by villagers to carry out extension work under extension agent supervision.

Adaptive Research

The two largest adaptive research activities currently underway are the SAFGRAD Farming Systems Unit and the ICRISAT Economics Program. The other agricultural research stations are also doing work of this kind, but on a smaller scale. It is essential that Upper Volta have an ongoing national-level adaptive research program. Under the varied semi-arid conditions that prevail in this country, research station results are hardly ever directly transferable to the farm level. The capacity to adapt research station findings to farmers' fields on a continuous basis needs to be institutionalized.

Critical Activities Not Proposed for AID Financing

One important element in the effort to increase extension program effectiveness, strengthening DSA, is not part of the AID strategy because it will be included in the FAO program. DSA is the office responsible for providing technical support for ORD extension programs. DSA's present capacity to do this is limited. Essential support activities need to be created. One is a documentation center where all information on extension activities in Upper Volta is kept, including results of farm-level adaptive research. This documentation center should also have the capacity to analyze and evaluate ongoing extension programs. This would be the most efficient way of coordinating the extension programs of different ORDs and sharing the lessons learned.

There are two other national-level constraints critical to successfully disseminating improved technologies, but falling outside of the scope of the proposed AID strategy. One is the need to continue donor support for agricultural training institutions. These institutions affect all aspects of agricultural development. Support to them should be a separate component in an overall agricultural development strategy.

The other key constraint is rock phosphate production. An important conclusion of the analysis in Part II is that rock phosphate has the potential for significantly increasing the productivity of rainfed agriculture throughout Upper Volta. This report recommends it be immediately incorporated into the on-farm adaptive research program, with a view toward including it in the recommended technical packages in the near future. The main constraints to its widespread use are very limited production and distribution capacities. Since a project to increase rock phosphate production extends beyond the scope of this proposed strategy, AID will be able to do little more than encourage the involvement of U.S. private firms or other donors in this endeavor.

Summary

In general, AID assistance to national-level institutions will aim at increasing their effectiveness rather than expanding their programs. It is intended that these organizations, through training, technical assistance, better equipment, and financial support for operating costs, will be able to identify and address critical problems and support field-level operations more efficiently. If this can be achieved, the results will be seen in the increased effectiveness and impact of all ORD programs.

ORD-LEVEL ASSISTANCE

Although strengthened national-level institutions are essential to the more effective development and dissemination of new technologies, they do not have any impact until improvements occur in the ORDs. In fact, it is the lack of ORD program effectiveness that provides the main justification for strengthening national-level institutions. This AID strategy component deals with changes that must take place at the ORD level before their effectiveness can be increased.

This component's basic objective is to increase the production impact of ORD programs with little or no increase in manpower requirements or operating costs. The strategy calls for increasing the cost-effectiveness of the extension program, adding an ongoing adaptive research program closely linked to extension, and strengthening village groups and other local organizations. These three elements are closely interrelated, and must be carried out in an integrated manner to have the desired impact.

Extension

Increasing the cost-effectiveness of the extension program is the most complex element in the strategy. It is proposed that this be done by strengthening the ORD extension staff and complementing it with village-level paraprofessionals (farmer agents). Although in some ways this builds upon the World Bank's experience with demonstration farmers in southwestern Upper Volta, the approach is innovative and will require a determined effort and careful monitoring.

As a first step, ORD extension staff must be upgraded through additional training and better technical support and supervision. They will be expected to have a higher level of technical competence and be able to supervise and provide technical support for village-level paraprofessionals. The selection, training, and support of paraprofessionals will require careful consultation with the villages concerned before initiating any programs.

Part of the effort to upgrade the extension program involves strengthening the CFJAs. These institutions have the potential for significantly increasing the impact of the extension program but they must be made more effective. Teachers need to be upgraded and training objectives more clearly defined.

Adaptive Research

The objective of the second ORD-level program element is to create an ORD capacity to carry out adaptive research on farmers' fields, in coordination with the national-level adaptive research program. The purpose of the research will be to adapt technical innovations to actual farming conditions, with the active participation of the extension staff. In this way technical packages will fit into existing farming systems and extension agents will develop a thorough understanding of why recommended practices do or do not achieve their desired results. Recent ORD program experience (including AID experience in the Eastern ORD), and ICRISAT and SAFGRAD farming systems research findings, confirm that developing and disseminating technical innovations requires continuous adaptive research that is closely linked to extension.

The 1983-88 period is a particularly opportune time for beginning this combined extension program-adaptive research effort. Valuable lessons were learned in Phase I of the Eastern ORD project, and viable technical innovations are being identified and tested on farmer fields by ICRISAT and SAFGRAD researchers. The analysis in Part II also indicates that further improvements (such as the use of rock phosphates) can be tested during the next two years and could well be ready for dissemination during the 1983-88 period.

The ORD-level program proposed here provides an excellent opportunity to disseminate promising technical innovations using well-trained extension agents supported by an effective and practical adaptive research program. Without an ORD-level effort along these lines, there can be no assurance that the proposed strengthening of the national-level institutions would have a significant impact at the farm level.

Village Groups

The third element in the ORD-level strategy, strengthening village groups, is aimed at facilitating the extension effort and overcoming other important constraints to increase production. Present extension agent responsibilities include credit and input distribution, two tasks that village groups could more effectively handle.

Village groups can also play an important role in moving agricultural products from farms and villages to major distribution centers. In recent years AID and other donors have gained valuable experience on the formation and appropriate roles of village groups. Building on this experience should be a critical element in AID's strategy for increasing the cost effectiveness of ORD extension programs.

Summary

At the end of the 1983-88 period, it is intended that the ORD-level activities described above will demonstrate how a better qualified extension staff, paraprofessionals, adaptive research, and more effective village groups can combine to increase the production impact of extension programs. This experience, complemented by stronger national-level support institutions, will have established the basis for effectively developing and widely disseminating improved technologies at a cost Upper Volta can afford. It is also likely that ORD-level activities will have achieved significant increases in production, as a result of the more effective system of technical innovation and dissemination. Some of the new technologies will have also spread to neighboring ORDs where similar farming conditions exist.

ASSISTANCE FOR LIVESTOCK PRODUCTION

The problems associated with livestock production are such that they need to be addressed separately from crop production programs. However, the importance of livestock production to rural households and the Voltaic economy is too great to be ignored. What is needed in the context of the overall strategy proposed here is support for the Livestock Service to develop a low-cost extension system, and create an adaptive research capacity to improve the limited technical packages presently available.

It is recommended that the AID assistance strategy include a livestock component similar to what has been described for the ORDs. A specific geographical area should be selected where animal health and extension services will be provided to herders, using delivery systems that cost less than those currently being used. These activities would be accompanied by adaptive research aimed at identifying improved and economically feasible animal husbandry and range management practices.

Because of the relatively good rangeland conditions that exist in some of the sparsely populated areas receiving 700 to 900 mm of annual rainfall, it is recommended that pilot activities be located in that climatic zone. A multidisciplinary activity of

this type would build on the experiences and findings of the numerous livestock projects and studies that have been carried out in the Sahel, and other semi-arid African areas, since the early 1970s. Because production constraints are now better understood, donor resources can be used more effectively to address them than in the past.

RECURRENT COST FINANCING

Recurrent cost financing fits into the proposed assistance strategy in two ways. First, since all the elements of the strategy will require recurrent cost financing during the implementation phase, AID will be providing this type of assistance at the project level. This would continue existing AID policy in Upper Volta.

Second, as discussed in Chapter 12, Upper Volta faces an overall recurrent cost gap that will need to be partly donor-financed if the country's development objectives are to be achieved. If a meaningful agreement can be reached between donors and the GOUV on nonproject recurrent cost financing, the United States should participate. This could be done in the context of the strategy already proposed.

One element of that strategy is planning and management assistance to the MRD. It is likely that such assistance would include considerable recurrent cost financing for local salaries, fuel and vehicle maintenance, and office supplies. An agreement that involves policy changes and management improvements as described in Chapter 12 would be directly supported by this component of the proposed strategy. Thus the full package of assistance would include:

- A significant amount of nonproject budget support to the MRD (say $2 million per year for five years);
- MRD policy changes; and
- Management assistance to the MRD to provide the capacity to implement appropriate policy changes.

ALTERNATIVE STRATEGIES

The main objective of the proposed assistance strategy is to increase the cost-effectiveness of the extension program in the crop growing areas north of the 900 mm isohyet. This objective implies a priority concern for increasing small farmer production

and incomes in the lower rainfall areas, where most of the rural population lives. The strategy for achieving this objective consists of:

- Strengthening certain national-level institutions that provide supporting services critical for the effective functioning of the ORDs;
- Carrying out an integrated set of interventions in one ORD, aimed at improving the development and dissemination of technical innovations at a cost the country can sustain; and
- Disseminating and improving upon the package of animal husbandry and range management practices that can increase herder productivity in moderate rainfall areas (700 to 900 mm annually).

Based on the assessment of foreign assistance needs already presented, two other modes of agricultural sector assistance merit consideration: exclusive concentration on national-level institutions, or a concentration on areas of highest production potential in the South. The reasons why neither option is recommended for the AID program are presented below.

Exclusive Support to National Institutions

One alternative to the strategy outlined in this report would be to focus all of AID's sector assistance on those national-level institutions that support small farmer production programs in the various ORDs. Evaluations of ORD programs and projects have consistently found that the support provided by national institutions is inadequate. The ineffectiveness of these institutions constitutes a serious bottleneck to increased production; conversely, investments that made them more effective could be expected to have a beneficial impact on ORD programs throughout the country.

For this reason, the option of exclusive support to these institutions was carefully considered for the 1983-88 period. The main reason why such a strategy is not recommended is that most of these institutions receive, or are about to receive, substantial assistance from other donors. In many instances what is needed is not additional assistance, but reorganization, improved management, and better control of recurrent costs.

In general, the agricultural sector assistance strategy team believes the use of AID resources to provide broad-based support to national-level institutions would not effectively address the basic causes of their inadequacies. A more effective approach would be to support selected institutions that are not receiving significant assistance from other donors, but are critical to achieving AID's objectives in agriculture as already described.

Concentration on the South

The second alternative is to concentrate AID resources in the southern areas of Upper Volta where rainfall is higher and production potential greatest. The rationale for concentrating AID assistance in the South is that this is where the short- and medium-term impact of development activities would be greatest. Agricultural programs in the four southern ORDs have already had a measurable impact on production and incomes, and considerable additional potential remains untapped. This applies especially to the sparsely populated areas south and east of Bobo-Dioulasso and the onchocerciasis-cleared areas of the AVV.

There is also considerable irrigation potential in the South which can make an important contribution to Voltaic agriculture in the long run. It is clear that returns to investment and labor and the possibilities for intensive high-yielding agriculture will be higher in the areas south of the 900 mm isohyet than north of it. For this reason, Upper Volta should and does give high priority to the higher rainfall areas in its long-term agricultural development strategy.

Because the southern part of the country has relatively higher production potential than the north, it has benefited the most from development projects as well as private investment. All southern ORDs are well funded, and SOFITEX and its predecessor organizations have devoted considerable resources toward introducing cotton as a cash crop. The region has also benefited from large investments in irrigation for rice and sugar production, and AVV is receiving major assistance from several donors.

Not all programs are as effective as they could be and there continue to be many unmet needs. However, for the same reason that Ivory Coast attracts more resources than Upper Volta, the southern ORDs will always receive more development support than the northern ones. As projects are designed and become ready for implementation, it can generally be expected that donor financing for the South will not be a constraint. Thus the allocation of AID resources to this area would not have as large a net impact on Voltaic development as if they were spent in other ways.

Conclusion

As discussed throughout this paper, there are many important reasons why development activities should be continued and strengthened in the central and northern areas of the country. This is where most of the people live, and there is potential for increasing production, not to mention an urgent need for interventions to reverse soil degradation and declining fertility. The key to solving the area's problems is to find ways to reduce the costs of extension programs and adapt available technical packages to make them more economically and socially attractive to farmers.

This is the approach being proposed in this report. The team is confident that the strategy proposed here will result in programs for the center and north that will have a measurable impact on production, and are sustainable within the limits of available human and financial resources. This strategy is not a substitute for development interventions in the south, but rather a necessary element in an overall agricultural development strategy for Upper Volta.

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APPENDIX A

FARMING SYSTEMS RESEARCH FOR AGRICULTURAL AND RURAL DEVELOPMENT IN UPPER VOLTA[1]

The following observations on farming systems research (FSR) are designed to provoke thought and discussion, particularly among those most directly involved in adaptive research in Upper Volta. These observations can be used as a step toward devising a general FSR strategy acceptable to Voltaic institutions involved with research and extension. Regional and international research program roles are examined as are the FSR components of various donor-funded projects. The purpose is to initiate discussion on how the various parts might better relate with each other.

A "general strategy" need not imply everyone must be doing the same thing. By its nature, much of what is (or should be) carried out under the FSR banner is both location- and institution-specific. Thus different methodological approaches are both probable and in many instances desirable. At the same time FSR activities can benefit from closer cooperation with one another both to avoid unnecessary duplications of effort, something which Upper Volta can ill afford, and share insights, experiences, and observations on methodology.

The institutions involved also have a strong vested interest in mutual collaboration since they all seek to influence both the nature of rural and agricultural development efforts and the priorities set for more traditional applied and basic research activities carried out by regional, national, and international agricultural research institutions.

This appendix focuses on FSR that supports rainfed agriculture's development. Detailed comments on FSR that focuses on livestock and irrigated agriculture are presented separately although there are several similarities in the general approaches proposed. Rainfed and irrigated agriculture and livestock are component parts of the same farming systems in most instances, and the relationships among these subsectors need to be considered to understand specific farming systems and to design and test possible improvements.

The effectiveness of FSR efforts may also depend upon the extent to which they can be simply but substantively related to more general rural development efforts at the village level. Such efforts include measures to improve health and nutrition, education, infrastructure, and social services in general. However, a detailed treatment of how this might be done in Upper Volta is beyond the scope of this discussion.

The appendix begins with consideration of why there is an increasing demand for FSR. The second section of this appendix reviews some of the main FSR characteristics in terms of function and methodology. Since these have been extensively discussed elsewhere, both in general publications on the subject as well as publications specifically related to Upper Volta, a detailed presentation of these approaches would be redundant. In the third section FSR activities, ongoing and proposed by various organizations in Upper Volta, are reviewed. The concluding section examines possible measures to improve the effectiveness of FSR activities in Upper Volta through closer cooperation and linkages among FSR and research and development insitutions.

Why Farming Systems Research?

Until relatively recently, West African agricultural research and development efforts have been organized almost exclusively along commodity and disciplinary lines. Some of these efforts have met with a degree of success as with cotton in Upper Volta. However, with few exceptions, they have not made significant progress in improving the region's basic staple food production.

Research and development efforts have typically focused on increasing yields and net returns per hectare by using some combination of improved seed varieties, fertilizers, pesticides and other chemicals, and associated agronomic practices including the use of animal traction. It was assumed that technical superiority and economic profitability would induce farmers to adopt improved practices. However, the long awaited "green revolution" has yet to reach West Africa.

To be sure, a major reason for the mediocre record to date is the paucity of research results for major staple foods which represent clear advances over traditional agricultural methods. This lack is traceable both to the relative neglect of research on major food crops such as millet and sorghum until the last 10 years as well as the basic problem of overcoming constraints placed on improving plant growth by an environment of low and erratic rainfall, low and possibly declining soil fertility, and widespread poverty.

A growing number of agricultural researchers now seriously doubt whether major progress in improved techniques for staple foods in West Africa comparable to the technical packages developed elsewhere for rice, maize, and wheat is possible in the medium term. Yet research results continue to accumulate and include at least some mildly promising results which may, with adaptation, be useful and applicable in Upper Volta.

The changes one may realistically expect to take place in the region's staple food production over the next 10 years involve a series of gradual or evolutionary steps. The spread of

animal traction is one of the more dramatic examples. The key consideration here is not simply to identify technically and economically feasible innovations but also to integrate them into existing farming systems. Thus it becomes necessary for researchers to understand the existing farming systems' character in order to intelligently and more accurately identify promising interventions.

To understand better why farmers do what they do, the researcher must consider the farm family's environment, their objectives, and their principal contraints. Only then does the often compelling rationality of existing farming systems become readily apparent. This is particularly true of systems found north of the 900 mm rainfall line where most Voltaic farm families live. Their choices are relatively few and the margin for error extremely small. Existing farming systems might be viewed as tried and true survival strategies gradually refined over hundreds of years. At the same time, changes are possible, especially if these changes are attractive to the farmer and easily integrated into the system. In fact, in some parts of the country changes are essential if further environmental deterioration is to be averted.

Accompanying a growing understanding of existing farming systems is a growing appreciation of the differences between systems and the need to devise site-specific intervention strategies. This does not mean that a radically different technical package must be designed for each village or family. It does mean that, with a few notable exceptions, technological packages suitable and acceptable for large areas like "green revolution" technologies are unlikely to be forthcoming. It also means there must be some mechanism to select and try appropriate interventions on an area-by-area basis that draws upon a range of readily available research results.

Finally, there is a need to strengthen the often nonexistant linkages between researchers on the one hand and the extension services and farmers on the other. There must be mechanisms for farmers to participate in the process of developing technologies they are subsequently supposed to adopt. Researchers must learn to listen to their true clients. Contrary to what researchers sometimes think, these clients are not solely their professional peers and funding agencies but the extension services and farmers themselves. FSR addresses all these concerns.

What is Farming Systems Research?

Before discussing what FSR is, it is important to emphasize what it is not. Contrary to what might be implied by the previous section, FSR is <u>not</u> a panacea for problems facing Upper Volta's agricultural development. Some question whether it should even be called "research".

FSR complements but does not replace the range of more traditional research and extension activities. It increases the effectiveness of these activities but would itself be ineffective if they did not exist. FSR does not normally produce research results in terms of improved crop varieties and farming practices. That is the job of the plant breeders and agronomists operating out of research stations. FSR involves selecting practices from among available research results which appear suitable for a specific location and testing the practices under those site-specific farm conditions.

In addition, an extension service, whether operated by the state, groupement villageois, or some combination of both, is required to widely disseminate practices successfully tested at the farm level. Thus, although a technical package's components may not be original, the total package often is and forms a contribution to the overall body of knowledge.

Although there are several FSR variations, most include some version of the following sequence of activities[2]:

- Descriptive stage: Understanding existing farming systems and constraints to expanded production.

- Diagnostic stage: Designing possible improvement strategies which address existing farming system constraints and draw upon available research results.

- Testing stage: Testing the proposed improvements under farm conditions, first with joint farmer and research involvement (on-farm trials), and second with total farmer control (farmer tests).

Although the FSR team's formal task responsibilities normally end with the testing stage, the process is not complete until the successfully tested results are extended to farmers. This is the extension service's responsibility.

Beyond this basic sequence, most FSR versions include the following characteristics:

- The research is multidisciplinary in nature and holistic in its orientation. For practical considerations, only a relatively few factors might be treated as variables with most others treated as parameters. Yet there is an attempt to look at the whole system from a range of disciplinary perspectives to identify the most salient features and their relationships. For example, it might be decided to focus upon planting rainfed crops or on weeding sorghum and millet in view of the pivotal nature of these operations in most Voltaic farming systems. Yet researchers should have both an overview of the entire system as well as a view of the way in which these operations are linked to and affect other system parts.

- Most of the activity is carried out on the farm in close collaboration with farmers and extension agents.

- Although there is considerable debate on the issue, it is generally felt that adaptive research aimed primarily at developing and testing strategies for specific areas does not need to be preceeded by exhaustive base line surveys in each instance or involve the use of sophisticated data collection and analysis techniques. Instead, there is a tendency to rely on what is commmonly referred to as "rapid reconnaisance" techniques which can be carried out with the use of relatively experienced but not necessarily highly trained multidisciplinary teams. More rigorous data collection and analysis is required when the activity's primary focus is to influence research priorities (as will be subsequently elaborated).

Most FSR discussions imply that such activities should preceed extension efforts. However, in most instances extension efforts of some sort are already in progress in most parts of Upper Volta. FSR can serve as a mechanism to assess critically the adequacy of ongoing technical packages as well as suggest and test possible modifications. Thus FSR can also serve to provide an adaptive research component for ongoing projects, provide a link with the research institutions, and continuously upgrade and refine the technical packages.

Current and Prospective Adaptive Research Activities in Upper Volta

Until recently, there has been little FSR in Upper Volta in the sense of efforts to understand existing farming systems and design and test possible improvements under actual farm conditions. Some on-farm trials and demonstrations were carried out in connection with cotton development efforts in the early 1970s, but these were essentially oriented toward a single commodity.

Presently there is a signficant and growing number of FSR-type activities being carried out by regional and international agricultural research organizations as well as national institutions and projects.

A detailed review of each institution's activities is beyond the scope of this discussion. Descriptions are included in the reports of these institutions and projects. The following observations focus on their principal characteristics (orientations and activities) or a range of their FSR-type activities.

Regional and International Agricultural Research Activities

ICRISAT

The Voltaic agricultural research activities carried out by ICRISAT (whose headquarters is in Hyderabad, India) are based at Kamboinse and include a range of applied research activities from plant breeding, agronomy and entomology to soil and water management. ICRISAT's specific commodity focus is on sorghum and millet. ICRISAT's Voltaic activities do not formally include adaptive or farming systems research. However, the work its Economics Program carries out is very much of this nature. Since 1979 the Economics Program staff has been engaged in the following activities:

- A reconnaissance survey of central and western Upper Volta;
- Detailed on-farm surveys that involve farm management data collection in selected villages representative of three distinct climatic zones; and
- Selective on-farm testing of potential improvements for sorghum, millet, and soil and water management practices in collaboration with technical scientists.

The work's major focus is to generally refine research results emerging from the ICRISAT program and help define research priorities.

Farming Systems Unit (SAFGRAD/Purdue University)

The Farming Systems Unit (FSU) is part of a regional program serving 26 countries in Africa's semi-arid tropics. Established in 1979 under the terms of an AID contract with Purdue University, the FSU has carried out a full range of farming systems research activities in several Voltaic locations including villages in the ORDs of Fada, Ouagadougou, Kaya, Ouahigouya, and Bobo-Dioulasso. The multidisciplilnary research team includes agronomists, anthropologists, and agricultural economists. Commodities of specific interest include the whole range of grains and grain legumes found in the semi-arid tropics.

The FSU has designated three of the villages in which it operates as laboratory villages. Detailed socioeconomic and technical surveys were carried out in these villages. These were then used as reference points for designing improvement measures. The FSU is presently concentrating on the on-farm testing of various improvements including applications of rock phosphate, a donkey-drawn planter, pure stand cowpeas with pesticide applications, and improved seed fertilizer packages for sorghum and maize.

The FSU is primarily concerned with designing and testing improvements for extension to farmers in its test site areas. It is working closely with certain other institutions concerned with the extending improved farming practices including the ORDs and a Dutch-supported project in Kaya. The FSU also interacts with fellow scientists in the SAFGRAD program, namely the IITA-staffed maize and cowpea improvement programs as well as ICRISAT and IRAT scientists working on sorghum, millet, groundnuts, and soil and water management practices.

The FSU has formal regional responsibilities to help develop farming systems research throughout the SAFGRAD zone, but to date virtually all activity has been confined to Upper Volta. The first phase of the program will end in mid-1983.

FSR at the National and ORD Level

Except for activities carried out by ICRISAT and FSU, there are no national-level FSR programs as such. However, various organizations including the Fonds de Developpement Rural (FDR) and IRAT, IRHO, IRCT, and ORSTOM do support and carry out farming systems-type work in various parts of the country. In most instances this work involves trials of various farm-level practices and studies of specific technical or socioeconomic aspects of farming systems in selected locations. It does not cover the full range of FSR activities as already discussed. The work is often oriented toward a single discipline or commodity.

FSR activities have recently been initiated or planned at the ORD level in several parts of the country, primarily as components in development projects supported by different donor agencies. The terminology differs from project to project. A common term is PAPEM (Point d'Appui de Prevulgarisation et d'Experimentations Multi-locales). The PAPEMs would be substations under the ORDs with about 10 to 15 ha of land and carry out on-station and on-farm trials of improved practices generated by research institutions.

Under the terms of some projects, notably the IFAD, CCCE, and AID-supported project in the Eastern ORD, FSR activities will be staffed by a multidisciplinary team presumably recruited externally. In other instances units are staffed by local technicians who presumably receive technical direction from research station personnel or subject matter specialists at the MRD or ORD level. FSR-type activities are presently in progress or planned for the Haut Bassin and Volta Noire ORDs in the west (under PDAOV II), Yatenga in the north (FED project), and Kaya-Koudougou in the center (possibly Dutch projects) in addition to the Eastern ORD project already mentioned. IPD and IRAT are also collaborating in a village project in the north which has an adaptive research component.

The exact set of activities to be carried out at the ORD level is likely to depend largely on staff quality, quantity, and inclination. The guidelines in the available documentation are sufficiently broad to accommodate a wide range of possible approaches under the general rubric of adaptive research. In terms of disciplinary orientation, only the Eastern ORD activities and the Dutch project in Kaya/Koudougou explicitly mention a socioeconomic component. The implication in other projects is that the activities will include primarily technically oriented trials. Socioeconomic considerations, to the extent they are considered at all, will be handled as part of monitoring and evaluation (Bureau de Suivi et Planification).

Linkages among these activities and other research and development programs in most instances remain to be defined. Only in the case of the FSU and Kaya project is there close semi-formal collaboration. Divisions or lack of linkages tend to be reinforced by the fact that several different organizations are involved externally and nationally, each with its own particular orientation. There is considerable work in progress which may be of substantial benefit to Voltaic farmers in the near future. However, a fair amount of unnecessary overlap exists.

This is likely to expand as more ORD-level FSR-type activities are launched in the near future. Certainly the organizational linkages existing among program areas do not discourage such overlap. All the basic and applied research as well as some of the adaptive research activities already described fall under the jurisdiction of the Institut Voltaique de Recherches Agronomiques et Zootechniques (IVRAZ). This comes under the Direction Generale de la Recherche Scientifique et Technologique (DGRST) in the Ministry of Higher Education while the ORD-level adaptive research comes under the ORD and the MRD.

IVRAZ recently established several national-level departments or committees organized primarily along discipline and commodity lines to facilitate communication and coordination among Upper Volta's various research activities. One such department, the Department de Recherche de Developpement (DRD), is explicitly concerned with socioeconomic research in general and FSR-type activities in particular. It is envisaged that the DRD will operate partly through a committee composed of various program representatives and meet at least once a year to review results and future plans. ICRISAT and FSU will be represented as will any national-level programs. However, it is not clear how the ORDs will be brought in since these activities are formally under MRD jurisdiction.

Improving the Effectiveness of FSR Activities in Upper Volta

Several factors mitigate against rationalizing FSR activities in Upper Volta which should be noted from the onset.

- FSR is essentially location and institution specific. Therefore, each institution and area should be allowed to set its own agenda. Attempts at coordination would only detract from the major thrust of an FSR activity: to be responsive to and represent the perspectives of its institution and area.

- The economies to be realized through increased cooperation are not that large primarily because each research activity is location and problem specific.

- Much useful cooperation between programs can be achieved through informal and ad hoc contacts which are already taking place. Formal linkages between programs would take years to design and establish and probably not function as effectively as informal contacts.

- If two or more different adaptive research programs with different commodity interests and objectives attempt to "share" the same village or area, they will simply complicate the monitoring of on-farm trials and interpretation of results.

On the other hand, there are several considerations which favor increased cooperation.

- FSR activities generally proceed on the basis of understanding existing farming systems, broadly defined, in given areas. This understanding might be acquired from a comprehensive baseline survey, more rapid reconnaissance surveys, or some combination of the two. The need for baseline surveys depends on the availability and quality of previously collected information and the specific purposes of successive generations of FSR programs.

- As a general rule, FSR programs have carried out their own reconnaissance work or baseline surveys even where they are operating in similar (or nearly identical) environments. Since virtually all FSR efforts draw upon the same or nearly identical data sets as far as existing system descriptions are concerned, and since such baseline survey work tends to be a major consumer of staff time and financial resources, some economies might be realized through sharing some aspects of farming system data collection and analysis operations. However, such conditions may be academic since there is a serious question as to whether additional baseline surveys are necessary in most parts of the country given work already accomplished over the past five years.

- FSR activities in different ORDs are often likely to work on similar problems. Such problems include improvement measures for sorghum and millet that center on

animal traction use or planting and weeding operations in general. Rather than having each ORD rediscover some version of the plow planter and more generally try to design interventions on their own, there could be considerable benefit from increased information flows, both written and through personal contacts among different ORDs and the regional, national, and international programs.

These latter programs are likely to have significantly better access to a broad range of potentially applicable research results from their contacts with scientists both in Upper Volta and at research institutions elsewhere. The regional, national, and international programs can also be of significant assistance in identifying possible interventions to be tested by the ORDs or putting an ORD in touch with a scientist or institution which might be able to help him with a specific issue.

- All FSR activities should ideally provide some feedback to research institutes and be considered during research priority determination. In fact, it is only the regional, national, and international FSR activities which stand much chance of getting their message effectively across to regional, national, and international agricultural research programs.

  There is a natural alliance between regional, national and international FSR programs and ORD- level programs in this regard. The ORDs can not only supply additional evidence that certain innovations are not working but also indicate what areas need additional research. The regional, national, and international programs can communicate this information more effectively to research scientists.

- The ultimate effectiveness of the regional-, national-, and international-level agricultural research activities, of which FSR forms just one part, will be judged on the extent they produce innovations adopted by large numbers of farmers. Research and extension services too often seem content to blame each other for the slow pace of agricultural change rather than devising mechanisms to address systematically the problems impeding village-level progress. ORD-level FSR activities provide the ORDs with a mechanism to influence research priorities and also provide research institutions with a mechanism to greatly assist research results' rapid dissemination.

SPECIFIC SUGGESTIONS

This appendix's purpose is to stimulate discussion among the parties most directly concerned with FSR in Upper Volta. It is hoped some progress will be made to increase the effectiveness of FSR activities generally. The following suggestions are aimed at facilitating such effectiveness.

- The new DRD committee established by IVRAZ to coordinate FSR and socioeconomic research in Upper Volta should first consider some specific proposals to improve the operational linkages among various FSR activities in that country. Of particular concern is how the growing number of FSR activities under the ORDs can be operationally linked to FSR activities at the regional, national, and international level. Operational linkages need not imply formal control or affiliation. Some specific suggestions follow.

- While there are many differences both in orientation and specific operational features of the FSU and the ICRISAT Economics Program, there is also a fairly significant area of potential collaboration. The possibility of a grouping or pooling of FSR-type activities based at Kamboinse at the regional or international level should continue to be explored. The current FSU project will complete its first phase in mid-1983. Thus, consideration of possible changes in the program's focus are timely.

- Regional and international agricultural research programs should continue to be directly involved in village-level studies. This is desirable for several reasons, including the fact that it is difficult to establish credibility of the FSR approach among technical scientists in any other way, particularly when it comes to influencing research priorities.

  The technical scientists working within the commodity improvement programs (IITA/SAFGRAD, ICRISAT, IRAT, and IRHO) are unlikely to accept FSR team suggestions unless they are based upon direct, personal field research at the village level. Village-level studies also provide a mechanism for involving technical scientists in commodity improvement programs in on-farm trials. Involving regional-, national-, and international-level FSR teams directly in village studies is also essential to establish their credibility in the eyes of ORD-level FSR teams.

- At the same time it is not clear that the full range of ICRISAT- and FSU-conducted village-level studies are necessary to achieve their purposes, especially since some villages in the studies are in very similar (although not

identical) ecological zones. Serious consideration should be given to gradually converting village-level extension work outside the laboratory villages under the FSU program to ORD-level adaptive research activities. This is already well advanced in the case of Kaya. Similar exploratory work is underway with reference to Bobo-Dioulasso and could easily be initiated for the Eastern ORD with the launching of the new project.

In the process, the FSU program's emphasis would shift somewhat away from developing and testing site-specific recommendations, a task increasingly assumed by FSR activities in the ORDs, and more toward developing broad and generalized solutions and influencing research priorities. These latter orientations are essentially similar to those of the ICRISAT Economics Program. As such, FSU and ICRISAT may be able to share a common group of villages including all current ICRISAT villages plus some of the FSU laboratory villages.

- It has been argued that coordination between the two programs is difficult because of differences in commodity focus. Although ICRISAT does emphasize sorghum and millet in its mandate, both FSU and ICRISAT use a complete systems approach in their village studies. They draw upon similar but not identical data sets and it is not clear why a mutually agreeable set of data collection procedures cannot be developed.

- It has been argued that the process influencing research priorities requires a rather different approach to village-level studies than that for developing site-specific recommendations. Others have argued that the former is simply a more rigorous and comprehensive version of the latter. The distinctions further pale as one moves beyond baseline studies aimed at understanding the existing systems to developing and testing possible village-level improvements. No FSR program needs to be exclusively one or the other.

- A closer grouping of FSR-type activities at Kamboinse does not need to involve formal institutional mergers. Formal institutionalization of relationships does not ensure operational cooperation. Instead, emphasis should be placed on complementary staffs, commodity coverage, and efficiency both in carrying out village-level studies and interacting with ORD-level FSR activities.

- It is suggested that the tasks and functions of FSR activities based at Kamboinse include the following:

  - Continuation of village-level studies but transfer of non-laboratory village-level work to the ORD-level FSR operations.

- Provision of advisory assistance to the ORD-level FSR-type programs on a range of matters as requested by the ORDs. These would include: designing the scope of work; monitoring and evaluating progress; training staff to do adaptive research in the ORDs, possibly through direct experience in the village-level ICRISAT and FSU programs; assistance in designing data collection instruments and analyzing and interpreting results; advisory assistance in designing on-farm trials and farmer tests and putting ORDs in contact with individual technical scientists in commodity programs where appropriate; generally assisting ORD-level FSR activities to identify possible measures to reduce identified constraints in their specific areas of concern; and bringing the results of the ORD-level work to the attention of technical scientists at the regional, national, and international agricultural research centers to help refine research priorities.

- It is not felt that individuals in Kamboinse's FSR-type programs should work exclusively on village-level studies or linkages with the ORDs. Instead, all staff should be involved to some degree in both. This is desirable due to the advantages of combining the process of identifying research priorities with the process of developing site-specific recommendations. It is also operationally feasible and efficient since the travel involved in monitoring the village-level studies can be combined in many instances with regular visits to the ORDs to review the progress of FSR activities.

- Current FSU and ICRISAT Economics Program staffing is as follows:

	FSU	ICRISAT Economics Program	Total
Economists	-	1	1
Agronomists	1	-	1
Anthropologists	1	1	2
TOTAL	2	2	4

This table is somewhat misleading for several reasons. First, the FSU will soon add a Ph.D. student in agricultural economics who will be responsible for analyzing existing data. There is also a position for a senior agricultural economist under the FSU but it is not clear

when or if this position will be filled. Purdue University has experienced great difficulty in locating suitable candidates.

Second, although the ICRISAT Economics Program does not itself have any technical scientists, there is extensive collaboration with technical scientists working on sorghum, millet, and water and soil management. Third, the ICRISAT program economist is currently dividing his time between the economics program and team leader responsibilities. Fourth, the Accelerated Crop Production Officer (ACPO) under the SAFGRAD program is working closely with the FSU as is the ICRISAT soil and water management specialist.

- In terms of additional staffing requirements, the following might be considered:

  - The FSU should fill the current vacant slot for a senior agricultural economist. The FSU agricultural economist and the ICRISAT Economics Program leader should both be involved in village-level studies and ORD linkages so that one full-time staff equivalent will be devoted to each activity. (This does not mean the work must be divided on an even 50/50 split between the two activities.) It is probably desirable that the ICRISAT economist continue to be primarily involved in village-level studies. This implies that the FSU agricultural economist would work primarily with the ORDs.

  - A similar labor division might be worked out for the anthropologists. It is unclear whether the two anthropologists based at Kamboinse will be required after the conclusion of the current FSU contract in 1983. Instead, an expansion of the use of anthropological/sociological skills at the ORD level might be desirable, possibly involving a more extensive use of Voltaic and foreign graduate students.

  - The FSU program agronomist might work with the ORDs 75 percent of his time, since it is possible and desirable for village-level studies to utilize the range of technical expertise associated with Kamboinse's commodity improvement programs. The agronomist might be assisted by the ACPO funded under the SAFGRAD program. Once again, the ACPO should have some involvement in the village-level studies but this should probably be no more than 25 percent of his or her time. In other words, each year the equivalent of 1.5 full-time person years per year of the agronomist's time would be devoted to working with the ORDs.

- Additional staff might include a specialist in animal traction/agricultural engineering whose work would be roughly divided on a half-and-half basis between village-level studies and the ORD-level FSU work.

- In view of the ICRISAT and SAFGRAD programs' regional focus, some of the services to the national- and ORD-level FSR programs could or should be provided on a regional basis for West Africa. While the ICRISAT and FSU program staffs should be part of a regional network of FSR activities, it is not clear they can contribute significantly to assisting FSR-type activities outside Upper Volta given current and prospective staffing levels. If it is envisaged that additional services be provided to FSR programs in other countries from a regional base in either Upper Volta or another country, additional resources will have to be provided.

- Given the regional character of the SAFGRAD operation, it is expected that special attention will be given to the regional services of FSR-type programs when considering possible future FSU activities. In general, a strict division of responsibility between individuals working primarily on regional FSR programs and those involved in national-level FSR activities carried out under regional and international programs is probably not desirable. For credibility reasons it would be necessary for staff providing regional services to FSR programs to be involved in village-level studies on a part-time basis or at least to have extensive experience in village-level FSR work. Some regional services might be provided on a short- or medium-term basis by outside consultants.

- <u>National-Level Institutions Involved in FSR Work</u>: As noted earlier, there are several other research organizations and development institutions involved in FSR-type work, including AVV, IRAT, FDR, and ORSTOM. It is expected that most will be represented on the IVRAZ committee on FSR and socioeconomic research. It is possible that some additional expertise required for the Kamboinse-based FSR activities can be obtained through informal collaboration with staff members from these institutions, at least in the short-term. A detailed discussion of various possibilities is beyond the scope of this report, but in general it is anticipated that staff members involved in FSR-type work would become members of informal network for FSR activity in Upper Volta.

- ORD-level FSR-Type Activities: All the critical linkages between the FSR activities in the ORDs and the regional-, national-, and international-level FSR activities have already been discussed. The ORD activities' primary focus would be upon developing site-specific recommendations for use in general project and extension activity development. Although it is envisaged that some ORDs will have a full complement of experienced staff, as in the impending Eastern ORD project, most will probably have to depend on relatively inexperienced technical staff.

- In either event, the ORDs will probably benefit from assistance from the regional-, national-, and international-level FSR programs. Such assistance might include secondment of research staff to the ORDs to manage FSR activities. Without strong operational linkages with these programs and directly and indirectly through these programs to agricultural research scientists, the ORDs are unlikely to be effective. At the same time, the responsibility for initiating contact with the regional, national, and international programs remains with the ORDs. The central programs based at Kamboinse might be regarded as a pool of expertise which the ORDs can draw upon as required and available.

APPENDIX A FOOTNOTES

1 The term Farming Systems Research (FSR) is used in preference to the more general term adaptive research.

2 For a more detailed discussion of the common types of farming systems research and its sequence of activities, see E. Gilbert, P. Norman, and F. Winch, 1980. Farming Systems Research: A Critical Appraisal. Rural Development Paper No. 6. East Lansing, Michigan: Michigan State University, Department of Agricultural Economics.

APPENDIX B

SOIL FERTILITY

The farming systems researchers at Komboinse distinguish four types of farm fields. These are:

- The compound garden plot adjacent to the house. This receives household rubbish and animal manure and is highly fertile.
- Village fields which are close enough to receive regular manure applications.
- Village fields which are too remote to be regularly manured and depend mainly on bush fallow for fertility restoration.
- Valley bottom land (bas-fonds) which receives nutrients and eroded soil. This is not only more fertile land with often a heavier soil texture, but also remains moist and permits cropping far longer into the dry season.

Apart from the fourth type, all fields are likely to have a similar pattern of nutrient deficiencies since the organic matter applied on the first and second field types generally derives from crops grown within the closed farming system. Hence the use of organic matter represents the transport of fertility from arable bush or fallow areas toward the farm house. It does not constitute a source of fertility and is not an alternative to genuine fertility inputs in the form of fertilizers brought from outside the farming system.

The emphasis placed on conserving organic matter is not incorrect. However, it can lead to a distortion of the farming system if the farmer is encouraged to spend his resources on making organic manure from material which will make nutrients available for crop growth without any special farmer efforts. When developing traditional farming system improvements, it is more realistic to think in terms of conserving rather than increasing fertility.

In Upper Volta's semi-arid soils, all organic matter rapidly decomposes to humus as the soil dries out and heats up after the rains end. The amount of humus formed is determined entirely by whatever is the limiting nutrient in the soil biomass. This is usually phosphorus in sudano-sahelian soils. Relieving the phosphorus deficiency will lead to an increase in the dry season humus content up to a limit determined by the availability of the next least available nutrient, usually nitrogen. Nitrogen's availability for crop growth is maintained primarily by good husbandry rather than crude additions of inorganic nitrogen in small fertilizer dosages.

The increased yields associated with very early cereals planting are mainly the result of the very rapid breakdown of humus and release of plant nutrients as the soil moistens and cools down. This "Birch effect" stops after the soil reaches field moisture status. It is preferable not to incorporate undecomposed organic matter in the soil at the beginning of the rains since the organisms which decompose this material may compete for the nutrients released by the "Birch effect" and reduce their availability to crops.

The farmers' practice of burning grain stalks on the field or leaving them to rot on the surface is often the optimum practice when phosphate is the limiting nutrient. The only nutrients lost in burning are nitrogen and a fraction of the sulphur.

When acidifying fertilizers are used in intensive production packages to grow high value cash crops, it is unlikely that the acidification has a directly harmful effect on the soil since the package recommendation insists on using organic manure in considerable quantities. Unless the farmer has accesss to cheap feed-stuffs which do not originate on the farm, the organic manure has to be made at the expense of the fertility of the rest of the arable and fallow fields which are not used for intensive cropping. The acidifying fertilizers' ill effects are therefore likely to result in a more rapid lowering of fertility than occurred even in the dramatic sterilization of experimental sites at Saria.

Fertilizer: The Peasant Farmer's Dilemma

In the course of a very limited number of interviews with project development administrators and casual discussions with cultivators on the outskirts of Ouagadougou, certain plausible explanations of why peasant farmers use so little fertilizer in central Upper Volta have been received. It is generally agreed that most peasants know about fertilizer and appreciate the very large increases in production it can achieve.

Despite this, there is considerable reluctance to apply fertilizer or use the recommended dosage. After a decade of intensive advisory activity on the cotton crop, the proportion of the area receiving fertilizer has increased from 16 percent in 1970-71 but was still only 46 percent in 1977-78 and only rose above 50 percent in 1978-79. During the 1977-80 period the FAO reported yield increases of 70 to 110 percent with profitability ratios on the order of 3:1 from using subsidized fertilizers. Yet the peasant farmer is still unwilling to use fertilizer.

The common story was that farmers started to grow cotton in order to gain access to fertilizer. In the first season they achieved dramatic production increases: the poorer the land, the larger the increase. In the second and subsequent seasons the yields gradually declined until they were worse than they were in

the beginning. The farmers then found that their land was permanently degraded and could not be restored even by an unusually long bush fallow. The poorer the original fertility of the land, the more rapidly and irreparably it became degraded. It was alleged that some of the worst cases of erosion started when farmers grew cotton in the 1960s.

The farmers and other non-technical users now "know" that "fertilizer stimulates the soil and then drains it." The worst feature is that the most progressive and responsive farmers are most likely to have suffered in this way. The keenest and most effective extension agents are also placed in the difficult position of having to recommend the use of a material which they soon observe having bad effects after any extended period of use on almost any Voltaic soil type.

The fact behind this phenomenon is that the particular compound fertilizer recommended for intensive cotton production is too acidifying to be repeatedly used on the naturally acid soils of Upper Volta unless the acidifying effect is buffered by applying large amounts of organic manure, rock phosphate, or lime. This has been clearly shown by the classical studies of the IRAT research scientists and their current recommmendations emphasize this.

It is probable that engrais coton was originally imported because it was cheap and concentrated. This reduced transport costs. Many seasons of research have conclusively proved that these commercial advantages cannot compensate for its notorious soil degrading effects, which simultaneously reduce Upper Volta's productive potential and make it impossible for extension agents to advocate fertilizer use. Most undesirable of all, it also prevents farmers from improving their soil's fertility.

Fertilizer Recommendations for Farmers

At present, one of the few unsubsidized and profitable fertilizer recommendations already proven in Upper Volta is the application of rock phosphate to groundnuts. A considerable proportion of this crop is exported from the farm and much of it from the country. However, the use of rock phosphate depletes potash from the soil. The fertilizer recommendation should therefore include sufficient use of this nutrient to ensure it is not depleted. In practice this would result in a mixture of rock phosphate, potassium chloride, and sulphur being recommended as groundnut fertilizer.

Sorghum and millet yields increase considerably due to the residual effects of rock phosphate applications on groundnuts. Since most of the crop will be consumed on the farm and recycled through defecation, it is probably unnecessary for fertilizer to be applied to these crops when the farmer cultivates groundnuts. Farmers who do not grow groundnuts can be advised to apply low

doses of rock phosphate every three or four years. It would be particularly profitable for them to make an application to fallow land the season before it is cultivated.

Cotton and maize are two very profitable crops which are presently produced with high inputs of imported fertilizers. For both crops, the ammonium phosphate in the engrais coton could be advantageously replaced with local rock phosphate (activated as suggested for groundnuts) and additional nitrogen in the form of urea. The exact mixture would require limited research for both crops. This would be justified by reducing the cost of imported fertilizer and eliminating the acidifying effect of the engrais cotton.

Fertilizer Applications

There has been considerable discussion on the best way to apply rock phosphate to maximize phosphate availability in the first season after application. Undoubtedly the two best techniques are first to spread and plow under immediately after the rains end, and second to mix with organic manure before spreading.

Neither of these are possible for the donkey traction farmer fertilizing a bush field. The most feasible technique then is to spread before scarification. This places the rock phosphate particles in intimate contact with the surface soil. Subsequent weeding cultivations improve phosphate release by replacing phosphate-saturated soil around the particles with phosphate-deficient soil. Phosphate release can only take place rapidly when the soil around the particles is damp, but this also coincides with the period of greatest crop root activity.

Direct experimental experience is lacking on Voltaic conditions to date, but it is probable that the presowing surface application produces crop responses in the first season after application that are only slightly inferior to the responses to deep incorporation from plowing. The total crop responses over three to four seasons will be identical on phosphate deficient soils. Thus there is no economic justification for farmers to increase expenditures with additional cultivations solely to improve rock phosphate incorporation during the first season after application.

Although direct experience in Upper Volta is lacking, evidence from similar areas suggests that rock phosphate and sulphur can be used on groundnuts with a small improvement in first-season response. The difference is unlikely to be important on very phosphate-deficient upland soils, but might profitably merit attention on the better bas-fonds soils.

Fertilizer Use Profitability

A 1981 FAO report summarizes the results of 1,967 fertilizer deminstrations done during the 1977-80 seasons. In this report the authors state that engrais cotton imported for use with cotton and used as the basis for most fertilizer applications is recommended as suitable for farmer use when the benefit exceeds the cost by a factor of two. This is the case in Upper Volta when fertilizer is subsidized. The 1981 FAO report summarizes the results of 1,967 demonstrations throughout Upper Volta during the 1977-80 seasons.

As Table 1 shows, several of the fertilizer regimes using imported fertilizer have profit/input ratios exceeding 2.0 when the subsidized prices are used and are therefore considered suitable for extension to farmers. However, the report also shows these ratios all drop to below 2.0 when the estimated world market prices are used. While it seems to be acceptable to subsidize fertilizer prices to farmers growing export crops which will pay the cost of the foreign currency subsidy when exported, the subsidization of fertilizers imported to grow subsistence crops is more difficult to justify.

In fact, the table shows that the only fertilizer application giving a profit/input ratio over 2.0 when unsubsidized prices are used is local rock phosphate on groundnuts. Adoption by farmers of this practice is said to be hindered at present by the low cost of imported fertilizer.

The subsidization of imported fertilizer is producing other undesirable effects. Engrais cotton and urea are both acidifying. If used repeatedly on the poorly buffered acid soils covering the greater part of the country, they will eventually cause the soils to deteriorate to the point where arable cropping is no longer practical. Table 2 shows that, per unit of total phosphate, the local rock phosphate was cheaper in November 1981 than imported materials were a year before. The present subsidization policy therefore actually subsidizes expensive materials which will destroy soil fertility and hinder the adoption by farmers of the only genuinely profitable fertilizer.

The only major advantage the imported soluble phosphate fertilizer possesses is that it gives a more rapid and larger crop response during the first season of application. However, it is technically possible to increase the first season response to rock phosphate by mixing it with a small proportion of acidifying material to promote faster breakdown.

Appendix 2, Table 1. Profitability on Fertilizers in FAO Demonstrations

Crop	No. of Demonstr.	Engrais Coton (kg/ha)	Urea (kg/ha)	Percent Crop Response	Profit/input ratios Subsidized Fertilizer	Profit/input ratios Unsubsidized Fertilizer
Local	607	100	50	72	1.0	1.1
Sorghum		150	50	113	2.3	1.2
Improved	117	100	50	54	2.1	1.2
Sorghum		150	50	93	2.7	1.4
Local	288	100	50	54	1.6	0.9
Millet		150	50	92	2.1	1.1
Local	106	100	150	84	1.6	1.1
Maize		150	100	89	1.8	1.0
Cotton	192	150	0	71	3.1	1.2
Groundnuts	557	140	0	64	3.2	1.9
		250*		41	4.1	2.5

*Rock phosphate used instead of engrais coton.

Source: "Report on Fertilizer Profitability in FAO Domonstrations", FAO 1981.

Appendix B, Table 2. Unit cost of P_2O_5 in Fertilizers at end of 1980

	CFA/kg	Origin	Remarks
Rock phosphate 25%	124*	Voltaic	Normal quality
Rock phosphate 33%	194	Imported	
Triple Super 46%	204	Imported	
Diamm. Phosphate 35%	155	Imported	Price corrected for nitrogen content valued as urea equivalent.
Engrais Coton 23.5%	288	Imported	Price corrected for nitrogen content but includes value of Kcl.

Source: "Report on Fertilizer Profitability in FAO Demonstrations," FAO, 1981.

Note: *Price delivered Ouagadougou, November 1981.

Groundnuts have an important nutritional requirement for sulphur. Experiments in Nigeria and Kenya during the early 1970s showed that a small mixture of elemental sulphur with rock phosphate produced a crop response equivalent to super phosphate. It is probable that a similar technique could be developed with an acidifying material supplying nitrogen. The rock phosphate application rates could then be reduced.

Table 3 shows the results for the first two experiments to examine this possibility in Upper Volta during 1980 (Projet Phosphat, 1981). The results for the 1981 series experiments have not yet been analyzed, but they are known to indicate the same general trends.

Appendix B, Table 3. The Effect of Sulphur Additions to Rock Phosphate

Fertilizer Treatment	Nutrients kg/ha			Crops Yields kg/ha	
	N	P_2O_5		Sorghum Grain	Groundnuts
Rock phosphate normal	22	54	0	1,146	913
Rock phosphate 27% S	22	54	1.5	1,160	1,073
Rock phosphate 55% S	22	54	3.0	1,467	1,060
Rock phosphate 83% S	22	54	4.5	1,301	1,153
Triple super phosphate	22	54	0	1,428	847 (1,062)

Source: "Report on Fertilizer Profitability in FAO Demonstrations," FAO, 1980.

The median dose of sulphur caused a 28 percent increase in sorghum yield, comparable to the yield obtained from the same amount of phosphate applied as soluble triple super phosphate.

The sulphur treatments increased groundnut yields progressively, as anticipated. The yield recorded for the soluble phosphate treatments is almost certainly lower than would normally be expected. The yield extrapolated on the basis of table 1 is shown in parenthesis at the bottom right of table 3.

There was no "without phosphate" control treatment in this experiment. On the basis of the results in table 1, the control yield would have been about 648 kg per ha. This suggests that response to the best sulphur treatment was about 505 kg per ha. At current controlled prices this would have been worth about 30,000 CFA. The cost of the rock phosphate would have been 6,700 CFA. The exact cost of the 4.5 kg of sulphur is not known but is certainly only a small fraction of the value of the groundnut response.

Another operational benefit of the sulphur additive in the rock phosphate is that it permits the mixture to be applied as if it were a soluble phosphate material.

National Policy for Safe Fertilizer Use

It is understood that engrais coton subsidization will be stopped in 1982 in order to permit the importation of other fertilizers. This welcome step is not really sufficient to ensure that safe fertilizers will be imported because nonacidifying fertilizers tend to be less concentrated and therefore cost more to transport. There appears to be a need for a national fertilizer advisory committee comprising the soil scientists and agronomists now doing research in Upper Volta. This committee would draw up an approved list of safe nonacidifying fertilizers which would thereafter form the basis for commercial importation until rock phosphate mixtures become available in sufficient quantity.

The economies possible from the local bulk blending of fertilizers are considerable. Such blending will have to be developed for rock phosphate in the future and there is much to be said for developing this capacity now to reduce the cost of imported material.

Fertilizer Mixing Plants

In 1978 the IFDC recommended constructing a fertilizer mixing plant to enable cheap "straight" fertilizers to be imported in bulk and mixed in appropriate proportions for particular crops. The prospect of the widespread use of rock phosphate blended with different amounts of imported fertilizer makes the provision of local blending plants more urgent. In order to avoid the waste of unnecessarily moving fertilizer materials to and from a single blending plant, it would be expedient to have several plants constructed at logical distribution points. Although the original proposal was for a single blending plant with a capacity of 6,000 metric tons per year, the potential annual use of rock phosphate is 50,000 metric tons.

Soil Nutrient Depletion in Crops

The estimated depletion of soil nutrients when marketable crops are exported from the farm is shown in table 4.

There is considerable loss of calcium and magnesium from leaching as a result of soil acidification when engrais coton is used. There is also an important sulphur loss when this nutrient is not applied during groundnut production.

When rock phosphate is applied, the only important nutrient depletions are of potash and sulphur.

Appendix B, Table 4. Nutrients Removed from Soil during Production of One Ton of Marketable Crop:

Crop	Nutrients			
	P_2O_5	K_2O	CaO	MgO
When no fertilizer is used:				
Seed cotton	8	-	3	1
Groundnut pods	5	8	2	trace
Millet grain	10	11	3	trace
Sorghum grain	5	5	1	trace
Maize grain	10	12	trace	trace
Cowpea grain	3	12	trace	trace
When engrais coton is applied:				
Seed cotton	0	0	80	26
Groundnut pods	0	0	52	17
Millet grain	0	0	11	3
Sorghum grain	0	0	10	3
Maize grain	0	0	9	3
Cowpea grain	0	0	9	3
When rock phosphate is applied:				
Seed cotton	0	10	0	trace
Groundnut pods	0	7	0	0
Millet grain	0	10	0	0
Sorghum grain	0	4	0	0
Maize grain	0	11	0	0
Cowpea grain	0	11	0	0

Source: IRAT, 1980.

The nutrients in the marketable crops are only lost if the crop is exported abroad. Cotton seed (which contains nearly all the nutrients) and cereal grains are almost completely consumed within Upper Volta's national boundaries at present. The nutrients in them may therefore be expected to be eventually recycled onto arable land somewhere in Upper Volta. In contrast, groundnuts are often exported and the nutrients in them are lost from the national resources. When rock phosphate is applied, the loss is confined to potash and sulphur among the macro nutrients (some micro nutrients such as molybdenum are also exported). To maintain the fertility of the national "farm", it is therefore necessary to replace those nutrients known to be exported.

Some nutrients become available for crop growth as a result of soil mineral weathering, but until the magnitude of this replacement is determined, it is prudent to import potassium and sulphur in quantities sufficient to replace the known exported losses.

It is not possible for the nitrogen exported abroad in the marketable crops to be accounted for in the same way. At present most of the nitrogen available for crop growth results from atmospheric nitrogen fixation. Very large percentage yield increases can be obtained with imported nitrogen fertilizer applied to cereals and cotton but national self sufficiency in cereals can be attained by application of rock phosphate alone. This could be achieved with application of less than 50,000 tons of rock phosphate annually.

The use of imported nitrogen fertilizer is probably only justified for crops where the export (or import substitution) value of the crop response exceeds the fertilizer's cost. Cotton is the only crop to which this applies at present, but the production of a larger cereal grain surplus in the future might paradoxically justify importing nitrogen fertilizer to increase the size and profitability of the surplus when exported.

The acidifying nature of engrais coton may be expressed as follows: every 100 kg of engrais coton requires 68 kg of lime equivalent to neutralize the acidifying effect and stop the soil from becoming more acidic. About 50 kg would be dissolved in the soil solution as temporary acidity which might be neutralized if the nitrogen were lost from the system by burning crop residues. Eighteen kilograms would be permanently lost through drainage, leaving the soil permanently acidified by an equivalent amount.

In contrast, a neutral nitrogen fertilizer would not acidify the soil at all and might be expected to add calcium to the soil cation exchange complex, leaving it less acidic than before. The equivalent N as "Nitrochalk" (24.5 percent N) would only solubilize 10.9 kg of lime equivalent as temporary acidity which would all be likely to return to the exchange complex. Rock phosphate does not acidify at all but acts as a neutral buffer stabilizing the soil near PH 7.0 where it is present in excess.

Urea, the cheapest and most concentrated nitrogen fertilizer manufactured, does acidify soil and exacerbates the bad effects of engrais coton. However, it is not strongly acidifying and would cause no serious degradation when used in low dosage with rock phosphate as Christensen suggests (Christensen, 1981). It has been known to damage crops when high dosages are applied to the seedbed and also when used on alkaline soils. The proposed fertilizer advisory committee should consider the advisability of continuing to use urea for intensive crop production in preference to "Nitrochalk" (calcium ammonium nitrate).

Soil Nutrient Depletion by Exported Cattle

Another important Voltaic soil depletion results from exporting livestock. It appears an equivalent of about 5,000 tons of rock phosphate is exported by this means annually.

The Future Rock Phosphate Fertilizer Industry

As suggested in the main text, the first step towards rationalizing Voltaic fertilizer use should be the removal of the subsidy on engrais coton. It is hoped this would be followed by the publication an approved list of fertilizer materials, which should be the only materials authorized for importation and farmer use.

The cheapest fertilizers are likely to be "straights" containing only one or two nutrients such as urea (46 percent N). The International Fertilizer Development Corporation (IFDC) mission showed that mixes of straight fertilizers could be made locally which would reduce the cost of fertilizer delivered to Bobo Dioulasso by about 40 percent. There will still be a need to mix fertilizers for individual crops, so the next step in fertilizer use development would probably be to establish small fertilizer blending plants to serve a particular area's needs.

In their simplest form the "blending plants" could be people with shovels and some sacks. However, it would probably be more cost effective to move to a higher technology based on one-ton containers as the IFDC mission suggested. A consulting team needs to study the feasibility of this development. The team should consist of an industry specialist in fertilizer blending, a sales specialist, and an agronomist. This study should take place in 1982. Its scope of work should include a preliminary review of the rock phosphate research results and a fuller examination of the crop-soil requirements affecting future fertilizer needs.

If possible, the same team should return at the end of the 1983 cropping season when the 1983 rock phosphate experimental results will be available. The scope of work should concentrate mainly upon the future technical use and exploitation of Upper Volta's rock phosphate. The report should be the main document available to American manufacturers considering intervention in the Upper Volta fertilizer market. Progress in developing the sale of locally-blended fertilizer should also be examined.

The recommended preliminary steps can therefore be summarized as:

- Establishment of regional blending plants for the commercial sale of locally mixed fertilizers; and
- Examination of the future form of the rock phosphate industry.

It must be emphasized that there is definitely a potential market for the commercial sale of imported fertilizers. Initially the most profitable area will be the sale of low dosages of cheap straight phosphate fertilizers containing some calcium. Sales campaigns should probably be directed to village groups and projects rather than individual farmers in the first instance. The key would be dedicated salesmanship based on sound technology. Both will be needed to overcome the prejudice against fertilizer resulting from the farmers' experience with engrais coton.

The exact reserves of Upper Volta in rock phosphate are still uncertai, but there is no doubt that a very large sales volume is possible. Christenson envisages applying 100 kg to a quarter of the arable surface every year (50,000 tons). "Fertilization minerale" recommends 400 kg on the whole cotton surface (32,000 tons) as a minimum. At present, only 1,000 tons are being distributed per year.

Certain information still needs to be obtained to ensure the maximum response to rock phosphate. The trace nutrient content (molybdenum in particular) has not been published. It is important to determine what additives are necessary to maximize Nitrogen fixation. The reaction of the rock to other possibly acidifying solubilizers such as urea or ammonium sulphate does not appear to have been examined yet. By the end of 1983 these aspects should be clarified and the attitudes of potential large-scale entrepreneurs towards entry into the fertilizer industry should be clearer.

APPENDIX C

ANIMAL TRACTION

There are two generalizations about animal traction underlying current policies. They are not invariably valid, and national policies based upon them may not be maximizing the potential impact on national and individual farm incomes.

The first generalization is that bovine traction is always superior to donkey traction: therefore all farmers should eventually adopt it. It is alleged that oxen produce more manure than donkeys; donkey cultivations (with the houe manga, an expanding cultivator) promote desertification; and work oxen increase in value as they mature while donkey values decrease.

The truth does not match the myth. First, a donkey eats less than a pair of oxen and therefore produces less manure when stall fed. However, a donkey is very much cheaper to maintain throughout the dry season and releases labor for alternate income-generating activities by the farming family.

In the second instance it is sufficient to note that all practical cultivation methods using currently available equipment are likely to promote desertification in the nutrient deficient soils of semi-arid areas.

Finally, the appreciation in work oxen's value favors their purchase as an investment but does not reduce their day-to-day operating costs. That some farmers who own cattle lodged with herders actually use donkey traction indicates their appreciation of the lower operating costs of this "power unit".

The second generalization is that animal traction "increases yields". While this has been experimentally proven in many West African environments, it is not certain that the deep plowing recommended before sowing necessarily raises farm incomes or is generally practical for Voltaic farmers. The very high cotton and maize yields obtained with the extension packages do not prove deep plowing's profitability because the packages include lavish use of subsidized inputs and heavy manure applications.

In fact, the emphasis on increased yields appears to have resulted in neglect of the proven ability of animal traction to increase the farmers' cropped area when inter-row weeding cultivators are a component of the animal traction package. For example, in 1980 in the Eastern ORD it was reported that while all farmers possessed plows, only a portion of them had weeders.

The agricultural sector strategy team believes it is essential that all forms of animal traction should be evaluated and developed primarily as traction power sources. These need to be matched to farm size and the maximum draft (depth) required by field operations. It is improbable that a particular unit will be optimally adopted to all environments. It is also unlikely that any single system of draft animal husbandry will be practical for all farmers. It is particularly unlikely that the package consisting of bovine traction and stall-fed oxen is appropriate for areas with 900 mm or less of annual rainfall. Its use in these areas may involve farmers in unnecessary expenditures.

Animal traction research and development is being carried out by many different agencies. It has been difficult to obtain a comprehensive view of what is happening. The National Training Centre at Boulbi has research responsibilities, but it appears these are mainly confined to improving the "intensive stall-fed bovine" system. There is a need to improve the process for exchanging information between the parties involved.

Tillage and Weeding Methods in the Sudan Zone

Run-off is a particular problem in areas receiving less than 900 mm of rain per year. The early rains are typically intense. The soil is bare of all cover and forms a hard-to-penetrate crust. Plowing immediately after the rains end undoubtedly alleviates this problem and provides an opportunity for incorporating organic matter, fertilizer, or both. Unfortunately, the cereal crops and cowpea inter-crops most frequently grown in the zone mature after the rains end so the soil dries out and becomes too hard for donkey traction cultivation at that time. It is also exceedingly heavy work for bullocks to plow the land after it has dried out even if it is possible to penetrate deep enough using the standard moldboard plow.

The present advice to ox traction farmers is either to plow after the rains have softened the ground and sow cereal crops late, or to establish crops with hand techniques and use the plow only to prepare the land for groundnuts. Not only does plowing after the rains delay planting the cereals, but in years when the rains are late or short it also significantly reduces the portion of early rainfall which the hoe farmer can use for crop growth. Thus there is a need to develop an ox-traction technique that allows timely sowing while exploiting the oxen's additional power potential.

The donkey-power cultivators are able to sow earlier because they only attempt to break the soil's surface with light scarification. This reduces some potential run-off and does not seriously delay hand sowing. It also partly explains the popularity of donkey traction, even in areas where farmers already own oxen.

The houe manga seems to provide the best-developed equipment for inter-row crop cultivation using donkey power. Indeed, some farmers are known to sow their crops "on the square" so their crops can be weeded in two directions at right-angles. This "cross-blocking" considerably reduces the amount of early hoe weeding but at the price of a complete crop cover later in the season. It should therefore not be practiced in fields with a serious erosion hazard. Early sowing in all zones protects the soil surface by maximizing the crop cover during the later peak rainfall period.

Planting cereals early produces a 30 percent increased yield over a crop sown only one week later. However, there is less advantage to sowing legumes extremely early since they do not need to benefit from the high nitrogen status developed in the soil through the "Birch effect".

Traditional farmers are well aware of the value of early planting and are prepared to risk poor crop establishment by planting during the first "planting rain". This is the first rain day when approximately 20 mm of rain falls after the beginning of the period which local experience shows to be potentially safe for planting. If cereals are planted considerably later than the earlier optimum they are in danger of being attacked by shoot flies and other insect pests. Kamboinse research station reports indicate this is a serious problem when new short-term varieties are planted "late" to ensure their good establishment.

In areas where annual rainfall generally exceeds 900 mm, the earliest rains are not normally as intense as they are in drier zones and run-off is not such an acute problem. There is still a yield benefit to be obtained from planting early, but this is partly compensated by the greater benefit obtained in this zone from thorough seedbed preparation and resultant weed control improvement.

It is also more common for fertilizer to be used on crops in this zone. This reduces the benefit from early planting and places a premium on good early weed control. The use of the inter-row weeder with oxen is often followed by molding up the soil with an ox-drawn ridger. The total package of early plowing suplemented by inter-row weeding and followed by ridging has been observed to provide excellent weed control for cotton and maize in the southwest. Both these crops are suited to being planted some weeks after the rains have started and are normally heavily fertilized.

Water Conservation Agronomy in the Sudan Zone

The hoe farmer has comparatively few options for improving water conservation and reducing run-off. Regular rotational shifts to more fertile fallow land has been the main choice

of the hoe farmer throughout West Africa. In Upper Volta, the ready availability of mineral fertilizer will maximize the value of the rotational shift by increasing crop vigor and protecting the soil surface during the establishment of the first crop. Where specific water conservation earthworks are constructed, the increased fertility will multiply their effect. At present, however, it appears that hoe farmers are comparatively indifferent to the value of cultivation practices that conserve water.

The farmer using animal traction has many techniques available to control weeds and conserve water. Reference has already been made to the operational difficulty farmers experience if they attempt to plow their land after the cereal and cowpea harvest. It should be technically possible to do this if the oxen are provided with improved equipment. A pair of oxen in good condition when the rains end should be able to pull at least a frame with three chisel tines in order to break up the soil's surface crust. Various rotary spiked cultivators could also be used to give just as good soil penetration with less draft (depth) but at the price of less thorough soil cracking below the ripping level. Unless improved equipment is introduced for oxen use, it is unlikely that oxen's considerable power advantage over donkeys can be utilized.

One well-proven technique found profitable in Kamboinse is "tie-ridging". Crops are planted on ridges and the furrowed bottoms are "tied" to make a series of small basins that collect rain and allow it to soak in. Considerable yield increases have been demonstrated at Kamboinse at sites where soils are shallowest and crops suffer most from drought. So far this technique has been tested in experiments where the ties were handmade, but there are several machinery designs enabling ties to be made with animal draft equipment. Introducing several simple tier units for testing at Kamboinse should be given a high research priority.

Profitable Use of Oxen in the Sudan Zone

A typical Sudan zone farm would normally plant about 25 percent of its area in groundnuts. The groundnut hay would be carefully conserved for use at the beginning of the rains.

Farmers' equipment would include: a ripper-tier which can also be used for ridge reduction and drilling crops with a sowing tube; a chisel plow or spiked roller; and an earthmover grader blade. The farmer would probably have a donkey and cart for light transports. The oxen could also pull a sled if a cart was not purchased.

The farming year would start after the groundnut harvest when the groundnut land would be tie-ridged while the ground is still moist. This would be the first land sown in cereals during the

following season. The oxen (which always work on a short yoke, offset when necessary) would then be employed on road grading each morning until after the cereal harvest. The hard cereal land would then be "busted" with the spiked roller or furrow ripped with the chisel plow. The roller would be preferred because of its lower draft. The cereal straw would be left in position as a thin mulch.

The oxen would then retire to the bush until required before the rains. Just before the rains they would be fed with conserved forage and retrained with more spiked roller work to further soften the land. As soon as light rain occurred, the ripper tier would come into service again until the first sowing rain.

With the first sowing rain the ripper tier would be fitted with a sowing tube to rip the tops of the groundnut land and sow the first cereals.

When the land dried out the tier would go back to inter-row work until the next sowing rain, and so on. After all the crops are sown, the ripper-tier would make one pass before hand-hoe weeding and thinning, and another pass when seedling weeds have begun to re-emerge on the ridges. The second cultivation rebuilds the ridges to their maximum height and covers all the seedling weeds. The oxen then rest for about two months until the groundnut harvest. The groundnuts are lifted by running the ripper tier under the row.

The oxen would be employed for a minimum of five months each year. Part of their earth moving would be used for community-funded revenue-earning public works. This is a very important part of the "package".

All of the equipment can be made and repaired by an artisan using a gas welder. It would probably cost about 25,000 to 30,000 CFA altogether (the cost of a standard plow).

This example of an "arid zone farming year" is intended to show how very different such a system needs to be from the "bovine traction package". The oxen are only fed when they have especially taxing work at the beginning of the rains. However, the use of oxen for public works earth moving projects would also require supplemental energy rations.

Animal Traction Maintenance Packages

The current recommended package of practices for traction oxen is well-suited to the conditions of the south and southwest. The oxen are to be kept in a covered barn to reduce their exposure to tsetse attack. They are fed on crop residues and dried bush grasses which are stacked close to the barn. The oxen are kept in

training throughout the dry season and can therefore be regularly used for transport. This facilitates the collecting of dried forage and crop residues at the end of the rains. Large amounts of forage can eventually be used as organic manure, and the farmer is able to genuinely increase his farm area's fertility by buying concentrates such as cottonseed cake.

Because the oxen are kept at the farm, they are regularly handled and remain tame. They are also much more accessible to verterinary services for routine prophylactic treatment.

All of these advantages commend this system for use in areas where the dry season is short and there is plenty of forage. The only disadvantage is that the farming family has to spend a lot of time looking after the bulls and collecting forage. In some circumstances the opportunity cost of the maintenance effort is higher than potential income which could be earned in other ways.

This is apparently not accepted as a major constraint in official thinking. If the high cost is considered at all, it is regarded as an inevitable expenditure justified by the many secondary benefits which the system produces (organic manure, farmer settlement, transport availability, superior medical attention, and so on).

In areas where the dry season is longer and there is less forage, this method of oxen maintenance becomes progressively more difficult. It is reportedly practiced by very few farmers in areas having less than 900 mm of annual rainfall. Inevitably these farmers are forced to adopt a much less intensive system. Typical systems that are progressively less intense include the following:

- The oxen are housed but driven out to graze on crop residues daily. After the crop residues are consumed they are taken out daily to graze in the bush. A competent farmer will provide salt licks throughout this period and keep about two months' conserved forage for consumption during the heavy work period of crop establishment. The oxen need two-to-three weeks of retraining and ration feeding to prepare them for work.

- The oxen are housed only until transport of the harvest is over. Afterwards they are sent to herders to graze in the bush. Then they return to the farm shortly before the start of the next season's rains.

- The oxen are not housed and spend only the crop establishment period on the farm. It is not known whether this system is used in Upper Volta. It is particularly useful for transhumant cattle owners who do some farming. The oxen usually require little annual retraining because their owners herd and work them throughout the year.

The debt repayment burden is often cited as a major constraint to bovine traction adoption. This does not arise in families which already own cattle. Nevertheless, there are many cases of cattle-owning families who actually practice donkey traction. The only logical explanation is that they find it difficult to maintain their oxen on their farm income. The widespread use of donkeys is certainly partly due to their lower maintenance costs. It is also very likely that their draft area capacity better matches the sizes of sudan-sahelian farms.

Donkey maintenance has received much less attention. There are several private donor development projects where the problem may be receiving attention, but it was not possible to obtain details of any recommended "donkey maintenance packages".

It is desirable that the potential of the donkey, which is thriftier, hardier, and develops a higher proportion of its weight as draft than the single ox, should be fully developed as an alternative to the "single ox" concept. The latter may turn out to have too high a maintenance cost for the arid zone farmer.

Existing Animal Draft Equipment

Existing animal traction equipment is designed primarily for use in areas with annual rainfall of over 900 mm. The recommended practices are applicable mainly to cotton and maize. There are also complaints about the weeder's performance (ICRISAT, 1980). Although a plow and a cultivator are available as a set for use with donkeys, most farmers reportedly use the houe manga as their only equipment. This unit has been criticized for its inability to break the surface crust to improve infiltration. The fact that it is very widely used for weed control suggests it is a well-proven unit meriting further development. There is almost no information about the field performance of other donkey-drawn implements.

The plow/ridger unit supplied as standard equipment to all ox traction farmers is a good conventional design.

The triangular weeder unit was designed for use with spring weeder tines. It is probably a satisfactory machine for inter-row weeding in wetter zones despite its already noted problems. It has also been fitted with rigid chisel tines for ripping the soil surface prior to the start of the rains. The original frame was found to be too weak and has now been redesigned and strengthened.

However, the design remains an unsatisfactory adaptation with inherent weaknesses. This is due to the use of vertical chisels with angled points. When the points wear out, they have to be rebent and repointed by the nearest COREMMA depot. The vertical shanks are also subject to constant stresses which will either

bend them or distort the frame. There are many well-developed designs of rigid tine cultivators which have already been developed for exactly the cultivation required. Samples should be imported for field testing with a view toward local manufacture.

Animal traction carts are mostly donkey drawn. This probably reflects the lower operational costs of the "traction unit" rather than any technical superiority of donkey over oxen. The degree of gross overloading frequently seen on donkey carts in fact suggests that the designed capacity needs to be increased to meet current use requirements.

The only readily available seeder is the "Super-Eco". This is a well-proven machine but is expensive and quite complicated. Also, it cannot sow unlinted cotton.

New Equipment Which Might Be Introduced

There is a need to develop an animal traction system which is specifically adapted to the needs of drier areas. It is unlikely that the present range of equipment manufactured in Upper Volta can be adapted for this purpose. There are many suitable designs which could be used and there is a need for an adaptive research program to identify a suitable range of equipment.

Urgent needs that have to be filled before animal traction can be effectively extended in the Sudan zone are:

- Chisel plows which can effectively break up the surface crust before the arrival of the first sowing rain.
- Sowing equipment which, if expedient, can be used to "sow-cultivate" on an unprepared seedbed even before the first sowing rain.
- An effective tier-ripper for use in tied ridges.

All of the listed equipment has already been developed elsewhere. The drill sowing problem was solved thousands of years ago in Asia by the use of the hand-metered "sowing tube". All of the existing equipment can be fitted with a tube by the farmer himself. The method seems to require only publicity and extension.

The most valuable potential use of paired oxen in the Sudan zone is their earth-moving ability. With very simple grader blades, farmers can help maintain roads and build water conservation banks and dams at a time when they would not otherwise be earning revenue. This is a major advantage of paired oxen over donkeys.

A spiked roller can be used to obtain penetration of hard dry soil crusts with a minimum of draft. This can be made most simply with a 44-gallon drum pierced with large bolts. The drum is ballasted with just enough soil to ensure penetration. A single donkey can pull the drum. A high technology riding version with the driver's weight added to the ballast is not much more expensive.

Reference has already been made to the need to introduce ripper tier equipment.

Harnesses

Harnesses seen on donkeys were locally made from miscellaneous materials. Despite their nondescript appearance, the samples examined proved to be well-designed and strong enough.

The double ox-yokes for humped oxen that farmers use were also satisfactory, but it appeared there is no simple or satisfactory technique for yoking oxen without humps at present. The current policy is to develop a crossbreed between the large humped Zebu and the tsetse-tolerant Ndama (without humps) for use in tsetse-infested areas. The alternate policy of importing one of the larger, improved Ndama strains from Senegal or Ivory Coast is said to be politically difficult. Meanwhile, photographs and reports indicate that the ubiquitous "horn yoke" which is both cruel and inefficient is still being used with Ndamas in parts of Upper Volta. Single ox harnesses have been designed for Ndamas which can also be used with paired oxen, however, they are comparatively complicated and expensive.

Single ox traction is now being developed as an intermediate stage between the single donkey and the paired oxen. While this concept has little to commend it, there does seem to be a real operational advantage to maximize the inter-row weeding output from a pair of oxen by using them in turn to work a longer day. An additional expenditure on two single harness sets and extra chains is required to achieve this.

It remains to be proven that an increase in farmer income will occur from the replacement of single working donkey with a single working ox. There are many alternate opportunities for exploiting the great power of a pair of mature Zebu for other profitable operations besides pre-sowing plowing and inter-row ridging.

For all inter-row cultivations the Voltaic farmer is taught to use the "long yoke" so that the oxen are separated by two crop rows and an inter-row. Experience in other countries has shown that "offset hitching" (in which one animal walks in the weeded inter-row and the other in an adjacent inter-row) has many advantages. The short yoke is used for all operations allowing the oxen to develop greater traction and accuracy.

Reconnaisance surveys in 1980 noted the "physical difficulties of passing the tool through muddy soil" when weeding cotton. Experience and some not very clear discussions in the field suggest this was probably due to problems with controlling poorly trained oxen hitched to the long yoke. Molding up the soil which is done later in the season with a (much more easily steered) ridger does not seem to present the same problems even though the effort required is greater.

Manufacture and Supply of Animal Traction Equipment

The general outlines of animal traction equipment manufacture and supply in Upper Volta are better than those in most developing countries. However, there seem to be illogical features which merit comment.

Animal traction equipment consists of two sorts of components:

- Mainframes and attachments which last indefinitely; and
- Parts that wear out.

A logical system of manufacture and supply procures the components in the first category from the cheapest and most efficient source with the minimum expenditure of overseas currency. Components in the second category are best made locally by artisans on customer demand, or should at least be produced in quantity within the country.

In Upper Volta, ARCOMA manufactures mainframe equipment. This is not necessarily the cheapest and most efficient method. At present there are widespread reports of equipment shortages while the ARCOMA factory is reportedly (and observed to be) producing below maximum capacity. It is at least arguable that mainframes and components could be produced in large batches and imported from abroad until the ARCOMA problems are rectified.

It was also observed that most parts of the standard equipment that wear over time are made of high quality steel. These are not manufactured in Upper Volta and cannot be replaced by locally manufactured items. Simple modifications in the existing equipment's design would enable steel wearing parts to be used which could be locally manufactured in Upper Volta.

APPENDIX D

VARIETAL IMPROVEMENT AND SEED MULTIPLICATION

Peasant farmers in West Africa's semi-arid zones typically cultivate a wide range of locally adapted cereal and other crop varieties. These are usually tolerant to local diseases, pests, and drought. Although they are often reputed to have very low potential yields, this is usually incorrect. Potential yields are only low when the environment makes a high yield potential unnecessary. The very late maturing sorghum varieties that produce a whole crop on residual moisture have maximum potential grain yields on the order of 1.5 to 2.0 tons per ha. These are closely correlated with the soil moisture storage capacity in the environments to which they are adapted.

Early maturing sorghum types usually have much higher potential yields on the order of 2.5 to 3.5 tons per ha. These are varieties which normally produce less than a ton of grain per hectare on the semi-arid zones' typically impoverished and drought-stricken soils.

There are so many well-adapted local cereal varieties that it is usually not possible to identify any one local variety versatile enough to be superior to other local varieties over a sufficiently wide area to be worth multiplying in a seed production scheme. Many seasons are usually required before superior new varieties can be produced in breeding programs. However, it is worth emphasizing that long-term breeding programs in other countries have produced new varieties that farmers recognize as superior to all comparable local varieties in every respect over areas of millions of hectares.

Therefore, long-term international breeding programs like those ICRISAT and IITA conduct at Kamboinse should be retained even though there may be no apparent benefit after a decade of breeding activity. Despite the high probability of eventual success, however, the likelihood of an early return on investment in a breeding program is highly problematical.

Breeding Program Objectives

Crop breeders have a wide range of techniques. Given time and resources, they can usually produce new cultivars superior to existing material in almost any environment.

Unfortunately, the objectives for which they are breeding are often not clearly defined. In the past there has been an emphasis on high production "green revolution" varieties developed for use

with a package of high technology inputs. The spectacular failure of some of these package approaches has usually been blamed on the plant breeder involved and distracted attention from the breeders' achievements in producing improved varieties for peasant farming systems.

The breeding objective for countries like Upper Volta needs to be defined so the variety tested is adapted to the modal climate but tolerates extreme climatic variation without complete crop failure. The agronomic system for which the variety is being bred also needs to be well described to the breeders. This is at least as important as palatability and other consumer preference characteristics.

The accurate definition of the breeding objective should be based on a farming systems research program that studies peasant farms where the products of the program are going to be used. The farming systems program should also stimulate novel crop enterprises (such as insect-protected cowpeas). This is particularly important when the novelty is potentially profitable, since experience shows farmers will make fundamental changes in their traditional system to accommodate it.

Multiplication of Improved Varieties

Farmers using the "cotton package" of fertilizer, insecticide spraying, animal traction, and seed dressing are all using recommended cotton varieties. It is probable that other farmers who grow cotton informally for domestic use are also using improved cotton varieties. There is no need to alter this situation.

Maize grown with an extension package of recommended practices is also believed to be an improved variety issued by IRAT (Jaune Flint de Saria). The variety NCB Jaune will probably be recommended for use on farmer fields before 1983. Both these maize varieties will need to be multiplied for large volume sale to farmers during the 1983-88 project period. It is also possible that hybrid maizes IRAT is now testing will be recommended for use during this period.

It is not certain that sorghum varieties will be recommended that are strikingly superior to the equivalent types peasant farmers are already cultivating. The only variety recommended to date appears to have only a limited use in the peasant farming system and may not merit continued multiplication. The present position is equally unpromising in the millet breeding programs.

Given the short period the ICRISAT cereal programs have been operating to date, it is not surprising if they do not appear to be very productive. The IRAT programs also have constraints making it difficult for them to recommend varieties which peasants can use at low fertility levels. However, there will be seven

seasons available for further breeding activity before the end of the period covered by the AID strategy. It can therefore be expected that during the time remaining the breeding programs will produce valuable varieties adapted to low fertility conditions and superior to existing varieties.

Cowpea varieties suitable for intensive production in pure stands with insect protection are certain to be recommended during the strategy period. It is probable that varieties suitable for animal traction and mixed cropping will also be developed. Cowpeas as a second crop is possible when land is developed for micro-scale irrigation. This late-sown crop would be grown on residual moisture and is likely to require high-quality seed produced in considerable quantities.

In summary, maize will need to be multiplied throughout the 1983-88 period and cowpeas will be multiplied in the near future. These activities justify maintaining a national seed service at a scale which would enable it to expand capacity rapidly when new cereal crop varieties suitable for multiplication have been developed.

APPENDIX E

HERBICIDES

The staff at the National Training Centre for animal traction at Boulbi believes that bovine traction can be practiced satisfactorily in Upper Volta's worst tsetse-infested areas. It is also the opinion of the only team member to have examined the highest rainfall environment that there is not a serious erosion problem.

Therefore, there does not appear to be an urgent need to introduce herbicides to improve weed control or protect the environment in the Banfora area. In the event this indirect evaluation proves too optimistic, the appropriate organization to examine the problem would be the IITA farming system unit. It appears that "the minimum tillage" package developed at Ibadan could be used in the Banfora area.

Glyphosate herbicide applied with a wiper technique is one possible way of improving infiltration and reducing run-off in degraded areas of the Mossi Plateau. However, it seems much more straightforward to develop conservation using animal-powered cultivations as the first option. These can dramatically reduce labor requirements for weeding, whereas the "wiper technique" does not.

The only probable economic herbicide uses are:

- Application of soil-active herbicides in cotton and maize fields on heavy land where weeding cultivations are difficult. This is a straightforward development already being examined by the research organizations. No ecological problems are likely to be involved and adoption depends primarily on relative profitability.

- The control of striga in cereals by foliar herbicides.

The hemiparasite weed Striga hermonthica is a major root parasite for all cereals (except paddy rice) in Upper Volta. It probably reduces sorghum and millet yields by at least 15 percent and may actually cause losses of twice this high in dry years.

The main program to control it is the resistance breeding program at Kamboinse. As with all breeding programs, progress is slow but reasonably sure. Eventually a number of immune varieties of sorghum may be developed. There is already much progress in developing improved resistance in sorghum. Meanwhile, it may be cost effective to test herbicidal control in the Farm Systems Research program.

Briefly this technique consists of spraying the whole cereal area with a very low volume (10 'iters per ha) of herbicidal solution when the first striga flower opens. The timing is not very critical but spraying should be completed before the weed has produced ripe seeds. The application is done only once and kills the completely emerged striga population and 90 percent of the potential seed production. Some seed is produced on striga plants which subsequently emerge. It is not usually cost effective to repeat the application on the later emergence.

The operation's benefits include a 20 to 40 percent increase in cereal grain yield and a reduction of the striga seed infestation in soil. This operation was always profitable in Nigeria. The herbicidal solutions used were all very diluted and nontoxic to humans.

Details on this technique can be obtained from the Weed Science Section IAR, PMB 1044, Zaria, Nigeria.

In connection with the IDRC-financed ICRISAT striga control program, there is an urgent need for an agronomist to join the unit and for individual plot sprinkler equipment to be available to provide some measure of environmental control in agronomic experiments. Irrigation could potentially double the speed of the resistance breeding unit by permitting the growth of a second screening generation during the dry season.

AID might consider funding one senior agronomist for the striga program at Komboinse and supporting staff, equipment, and recurrent expenditures for the 1983-84 to 1987-88 seasons inclusive.

AID might also fund the purchase of experimental plot sprinkler units and recording instruments for semi-environmental control in the program.

APPENDIX F

ECONOMIC CONSIDERATIONS RELATING TO THE PROPOSED STRATEGIES FOR RAINFED AGRICULTURE

Time and data limitations did not permit preparation of farm budgets to indicate the financial and economic feasibility of farming practice changes as proposed in the rainfed agriculture strategy statement. Instead, the agricultural strategies assistance team opted to use 1980 budgets prepared by the World Bank as part of the Upper Volta Agricultural Issues Study, which the GOUV is currently reviewing as a point of departure for strategy discussions.

This appendix notes the principal differences between the proposed strategy and the assumptions and conclusions in the World Bank study. It also discusses the probable impacts of these differences upon the economic and financial rates of return. The analysis of 1981 cropping season data from the village studies of the FSU and ICRISAT Economics Program now in progress should provide additional indications of the feasibility of specific practices. Enterprise budgets are also available or in preparation for several areas as part of project design activities.

The following comments focus on the Central Plateau which is both the area in which most of the substantive differences with the Bank report occur and the focus of the proposed future AID-supported activities at the ORD level. The agricultural strategies assistance team generally agrees with the technological packages being used for arable crops in the southwest, but suggests that rock phosphate and sulphur mix with a nitrogen supplement be substituted for the imported engrais coton.

Further tests are required to determine the technical and economic feasibiltiy of such a substitution in the region. Present subsidy policies strongly favor engrais coton in terms of financial returns. However, eliminating fertilizer subsidies and prospective cost reductions in the production and distribution of rock phosphate should significantly reduce or eliminate this differential. The domestic resource cost ratios (DRC) which equal the ratio of the cost of all domestic factors (valued at their opportunity cost) and domestic value added (measured at world prices) should be likewise favorably affected.

The Eastern ORD should be a prime beneficiary of rock phosphate industry development since the phosphate deposits are located there and transport costs will be lower than for the rest of country. However, expanded use of improved practices in the east is likely to depend largely on the price effects of improved transport linkages with the rest of the country and neighboring countries, notably Niger and Nigeria.

The team has proposed the following package for the Central Plateau:

- Donkey traction;
- Cultivation of groundnuts followed by or intercropped with sorghum and millet on an expanded portion of bush farms;
- Application of rock phosphate with sulphur to groundnuts; and
- Cultivation of cowpeas in pure stand using insecticides.

Farm-level cowpea testing using improved varieties and pesticides was initiated during the 1981 cropping season by the SAFGRAD program. An assessment must await data analysis, but field observations and farmer response suggest very positive results with yields considerably more than those realized using traditional practices. The World Bank report does not include budgets for cowpeas.

The World Bank crop budgets assume the use of an oxen traction package, but the agricultural strategies assistance team felt donkey traction was adequate for the light sandy soils characterizing much of the Central Plateau. Donkey traction has the added advantage of lower cost (both capital and recurrent), easier maintenance, and greater efficiency as a means of transport. As noted, donkey traction serves to alleviate the labor constraint during the planting/weeding period and allows for a combination of timelier planting/weeding and an expansion in cultivated areas.

Pre-planting scarification also appears to improve water retention and seedling establishment although effects on yields are very sensitive to early season rainfall patterns. Testing over several seasons will be required. However, most animal traction benefits can be realized using donkeys in the lighter sandy soils. This will favorably affect the World Bank report's productivity calculations even without taking account of returns to transport activities, which can be considerable.

Research results show significant yield increases for groundnuts with applications of rock phosphate and sulphur as detailed in Appendix B. Fertilizer applications to sorghum and millet under extensively cultivated bush farm conditions appear marginal.

However, the residual effects of rock phosphate can increase cereal yields by approximately 7 percent in the second through fourth seasons following a single initial application. This does not take into account possible beneficial effects to soil fertility through nitrogen fixation stemming from groundnut production. Thus crop rotation (groundnuts followed by cereals) and application of rock phosphate to the groundnuts appears attractive and

should improve the financial returns to fertilizer use beyond the World Bank's calculations. Groundnut production for export to coastal markets and outside the region remains unprofitable although using rock phosphate reduces the economic loss. Applying rock phosphate to groundnuts intercropped with cereals also appears attractive although hand weeding is required. Alternatively, relay planting groundnuts after initial cultivation with donkey traction could be practiced.

Additional practices which appear promising include seed treatment, tie ridging for moisture retention, and the construction of mini dykes and bunds for soil and water conservation. Soil and water conservation practices are currently being tested at the farm level to determine their economic and technical feasibility. Donkey-drawn planters are also being field tested, but results to date have not been attractive. Some of these practices can be applied using animal traction, and if field trials prove successful, their application by farmers could further enhance returns to animal traction packages.

The proposed package implies a significant increase in groundnut production through an expansion in acreage and higher yields. The use of donkey traction should enable individual farm families to expand acreage devoted to groundnuts without reducing the area devoted to cereals. Cereal production should also increase from marginally higher yields. However, the package's acceptability depends heavily on the assumption that the national market and markets in neighboring countries can absorb the increased production at remunerative prices.

With data currently available together with results from the 1981 season, it should be possible to construct multiyear farm budgets which will incorporate both the acreage expansion effects of animal traction and yield increases associated with application of rock phosphate to a rotation of groundnut and cereal crops. An initial effort might form part of the project preparation exercise for the proposed support to the ORD du Centre as well as a point of departure for the adaptive research activities under the project.

APPENDIX G

REMOTE SENSING POTENTIAL IN RESOURCE PLANNING

The potential for utilizing remote sensing data for agricultural planning purposes in Upper Volta is enormous and has only begun to be tapped. This appendix discusses remote sensing data obtained by satellite.

An improved capacity to obtain higher resolution aerial photo imagery was developed in a Dutch-funded project which provided the Institut Geographique de Haute Volta (IGHV) with an aircraft equiped with sophisticated aerial survey equipment. Remote sensing data activites are coordinated by the Centre Regional De Teledetection de Ouagadougou (CRTO), a regional institution receiving support from the United States and other countries. Its primary aim is to promote the awareness of remote sensing imagery and its uses to potential West African users. The organization's current focus is on training programs for scientists and planners in the region. Current imagery enhancement capacity is limited at the local level. A receiving station and computer enhancement capacity are expected to be operational by 1984.

Although long-term prospects are most encouraging, some immediate uses could be made of existing capacity. LANDSAT satellites transmit data in different wavelength bands to receiving stations at regular intervals. These data can be processed into either photo imagery or computer tapes. Present CRTO technology requires overlaying data received from each of the four spectral bands in order to obtain a composite photographic image. This makes use of the technology's principal advantage, repetitive coverage, somewhat cumbersome.

Several computer images can be centrally obtained that depict Upper Volta during different seasons over the past decade. The synoptic view afforded (each image is 185 km^2) provides an accurate tool for cartographic purposes at the 1:250,000 scale. This makes it especially useful for mapping large-scale features such as vegetation patterns and geologic features, and improving the accuracy of existing maps. An AID-funded project produced a set of maps for the southern portion of Upper Volta which have proven useful for land-use planning purposes in the AVV zones. These maps are currently being used by the Regional Planning Services in several departments.

Agriculture

Remote sensing imagery's greatest potential is as a monitoring tool. Its use in monitoring crop acreage in Upper Volta is somewhat limited because the unit of resolution, 80 m^2,

tends to obscure micro-variations characteristic of small field size and traditional intercropping. However, it should provide reliable information on the total acreage cultivated at any given time.

This should help in monitoring migration and the expansion of cultivated areas. The environmental sector assessment identified the lack of adequate soils mapping as a constraint to developing an effective soil and water conservation program. Imagery with computer enhancement is accurate for detailed soils mapping at scales up to 1:24,000. LANDSAT data can be combined with ground and other remote sensing data to develop agro-climatological models.

Range Management

Immediate use could be made to identify potentially large range management zones in the southern portion of the country. Broad vegetation inventory data can be obtained but detailed information will require ground checking and use of air photos. The aforementioned AID study for the AVV provides a point of departure. Repeated coverage should be especially useful in studying the distribution and timing of burning as a contribution to the formulation and modification of a national burning policy.

Range trends can also be analyzed by identifying sensitive areas as small as a single pixel and closely following them for changes in moisture content and vegetation cover. On a broader scale, areas of bare ground, erosion, and degradation can be determined and monitored. Combining this information with other sources such as rainfall data could be valuable in building models of sahelian ecosystem dynamics.

Forestry

Since fuelwood is becoming increasingly scarce, LANDSAT data could be used to develop improved sampling methods for determining standing volume. As with range management, monitoring burn areas could improve Forest Service policy and planning capabilities. Agricultural activity in forest reserves could also be monitored.

Water Resource Evaluation

Remote sensing data can be used to assess watershed characteristics to determine areas of concentration for anti-erosion campaigns and, later, to monitor the effectiveness of water conservation measures through assessment of soil moisture content. Ground water exploration and irrigation schemes can also profit from the technology.