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REVIEW OF THE AGRICULTURE SECTOR

REPUBLIC OF CHAD

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ACRONYMS

AAA	*L'Agro Action Allemande*
ACORD	*Association de Coopération et de Recherche pour le Développement*
ACRA	*Association de Coopération Rurale en Afrique*
ADB/BAD	African Development Bank/*Banque Africaine de Développement*
AICF	*Action Internationale contre la Faim*
APICA	*Association Pour la Promotion des Initiatives Communauté Africaines*
BDL	*Brasseries du Logone*
BDT	*Banque de Développement du Tchad*
BEAC	*Banque des États de l'Afrique Centrale*
BELACD	*Bureau d'Études et de Liaison d'Actions Caritative et de Développement*
BGT	*Boissons Gazeuses du Tchad*
BGMT	*Boissons Gazéifieés du Moyen Chari*
BIEP	*Bureau Interministériel des Études et de la Programmation*
BIAT	*Banque Internationale pour l'Afrique au Tchad*
BTCD	*Banque Tchadienne de Crédit et de Dépôt*
CCCE	*Caisse Centrale de Coopération Économique*
CEFOD	*Centre d'Étude et de Formation pour le Développement*
CFDT	*Compagnie Fransaise de Développement du Textile*
CFPA	*Centres de Formations Professionnelles Agricoles*
CILONG	*Centre d'Information et de Liaison des ONG*
CILSS	*Comité Inter-État de Lutte contre la Sécheresse au Sahel*
COTONTCHAD	*Société Cotonnière du Tchad*
CRA	*Centre de Recherches Appliquées*
CTT	*Coopérative des Transporteurs Tchadiens*
DEFPA	*Direction de l'Enseignement et de la Formation Professionnelle Agricole*
DPV	*Direction Protection des Végétaux*
ECU	European Currency Unit
FAC	*Fonds d'Aide et de Coopération*
FAO	Food and Agriculture Organization of the United Nations
FCFA/fCFA	*Francs, Comptoir Financier Africain*
FF	French francs
FIR	*Fonds d'Investissement Rural*
FHI	Food for the Hungry International
IBRD	International Bank for Reconstruction and Development (World Bank)
IITA	International Institute of Tropical Agriculture
INADES	*Institut Africain pour le Développement Économique et Social*

IRCT	*Institut de Recherches du Coton et des Textiles Exotiques*
MDR	*Ministère de Développement Rural*
MEF	*Ministère de l'Économie et des Finances*
ME	*Ministère de l'Élevage*
MPC	*Ministère du Plan et de la Coopération*
MMERE	*Ministère des Mines, Énergie, et des Ressources en Eau*
MCT	*Manufacture des Cigarettes du Tchad*
OFNAR	*Office National des Routes*
OMVSD	*Office de Mise en Valeur de la Vallée de Satigui Deressia*
ONADEH	*Office National de Développement de l'Horticulture*
ONC	*Office National de Céréales*
ONG/NGO	*Organisation Non Gouvernementale*/Non Governmental Organization
ONDR	*Office National de Développement Rural*
ONHPV	*Office National de l'Hydraulique Pastorale et Villageoise*
OPIT	*Office de Promotion Industrielle au Tchad*
ORSTOM	*Office de Recherche Scientifique et Techniques d'Outre Mer*
ORT	Organization for Rehabilitation and Training
PIC	*Périmètre Irrigué du Chari*
ROPANAT	*Réseau d'Observation des Pâturages Naturels*
SAFGRAD	Semi-Arid Food Grains Research and Development
SECADEV	*Secours Catholique au Développement*
SEDES	*Société d'Études pour le Développement Économique et Social*
SIMAT	*Société Industrielle de Matérielle Agricole*
SME	Small and Medium Sized Enterprises
SODELAC	*Société de Développement du Lac*
SONAPA	*Société Nationale de Production Animale*
SONASUT	*Société Nationale Sucrière du Tchad*
SOTERA	*Société Tchadienne d'Exploitation des Ressources Animales*
SPONG	*Secrétariat Permanent pour les ONG*
STEE	*Société Tchadienne pour l'Eau et l'Électricité*
STT	*Société Tchadienne de Textile*
UDEAC	*Union Douanière des États de l'Afrique Centrale*
UNDP/PNUD	United Nations Development Program/*Programme des Nations Uniés pour le Développement*
UNEF/FENU	United Nations Equipment Fund/*Fonds d'Équipement des Nations Uniés*
VITA	Volunteers in Technical Assistance
WARDA	West Africa Rice Development Association

Executive Summary

The Republic of Chad is a landlocked sub-Saharan, sahelian country that lies between 8 and 24 degrees north latitude and 14 and 24 degrees east longitude. At least 1,500 km from the nearest seaport, it covers an area of about 1,284,000 km^2 with an estimated population (1989) of 5.3 million inhabitants. Average population density is around four persons per km^2, which varies enormously from low in the desert north to relatively high in the heavier rainfall areas of the south.

With a per capita income of less than US$ 200 per year, Chad ranks as one of the world's poorest nations. Agriculture, including livestock, forestry and fishing, is the main source of employment in the economy and involves approximately 77 percent of the active population. Agricultural production, which accounts for about 44 percent of GDP, is dependent on the considerable variations in climate from one region to another. Chad's mean annual rainfall ranges from less than 100 mm/year in the north to about 1,300 mm/year in the south. The Saharan zone is desert and only the oases are cultivated. The rest of the area is devoted to extensive livestock, principally camel, production. Cereals and transhument livestock production dominate the Sahelian zone. The Sudanian zone produces the principal cash crop, cotton, and has the greatest potential for cultivation of other crops. The country has a number of riverine resources, mainly due to the Logone and Chari watersheds. Mineral resources remain for the most part unidentified and untapped. Exploitable oil reserves have been discovered in the southeast of the country and near Lake Chad. Exploitation of these reserves should help redress Chad's chronic resource imbalance once a planned mini-refinery is constructed near the Lake.

There is increasing evidence of a breakdown of traditional land management practices in Chadian agriculture. Farmers often evoke the problems of declining fertility, erosion and shorter fallow periods as their main production constraints. Population pressure on the land has increased. The pressure put on the land from the combination of extensive agriculture and the effects of prolonged drought in the 70s contributed to reduction in fallow periods and overexposure of soils to the effects of wind and water erosion. Overstocking of livestock around sedentary villages has also contributed to soil degradation through depletion of the natural vegetal cover.

To maintain or increase production in Chad's fragile soils requires a level of management not currently practiced due to lack of adequate inputs and extension services. Soils are at risk from water, wind, biological and chemical threats. Without access to agricultural research, extension services and training in soil protection and enhancement techniques and to fertilizers, Chadian farmers cannot increase or even maintain soil fertility or productivity and soil and yields will continue to decline.

The current government has developed policies and strategies to achieve food self-sufficiency with irrigation and crop diversification which are hoped to result in the production

of marketable crops for both domestic and export markets. Economic policies were dominated until recently by a statist approach. Parastatal monopolies were created to manage the principal economic activities, and regulations were issued in an effort to control prices, wages, transport, wholesale and retail margins, interest rates and distribution. Many of these regulations are still on the books even though new state policies to liberalize agricultural prices and abolish some parastatals have been adopted. Thus, although prices are now mostly set through the interplay of supply and demand in the market, the majority of small businesses still feel constrained to minimize the scope of their operations lest they fall astray of some unknown regulation. This is particularly true for the very businesses which provide those key up-and-downstream linkages of a commercial agricultural network -- input and machinery supply, credit provision, marketing, transport and processing.

These businesses currently make up the informal sector, which, while pursuing legitimate economic ends, do not necessarily meet the full legal conditions for official status as economic entities. In Chad the urban poor and rural farmers have yet to be integrated into the political mainstream. Their response has been increasingly to retreat into the informal sector which probably satisfies close to 90% of the basic needs in goods and services of the population in many areas.

Farmers and traders need improved access to both markets and factors of production, that is, access to the tools and equipment and the capital to finance them. The availability of either short- or medium-term credit to non-cotton farmers or to farmers outside the cotton zone is so limited as to be practically nonexistent. Access to capital is a problem for farmers and traders in Chad, but it is equally so for the small businessmen and artisans who produce goods and services for them. Infrastructure such as roads must be improved. Maintenance programs need to be continued and strengthened. Reforms in tariff structures which allow easier import of basic transport equipment are needed.

Farmers have shown an inclination to produce surplus crops for sale when markets have been available. They have expressed interest in the purchase of agricultural inputs and the demand for pesticides, tools and equipment and seed and fertilizer constantly exceed supply. They have formed pre-cooperative groups for financial, input procurement and marketing services. Villages in the cotton zone which can afford to invest their own hard earned capital in dispensaries, housing, schools, pharmacies and stores. Traders, especially in regional markets, have shown great ingenuity in maintaining traditional tradeflows despite government prohibition and regulation.

Convincing the government of the wisdom of trade liberalization, tariff restructure, decentralization and the recommended allocation to it of coordination, education, consumer protection, and other, more light-handed functions presents a challenge to donor government economists and marketing experts. The degree of receptivity on the part of the current government, coupled with increasing awareness of the implications of resource base deterioration represents a window of opportunity through which the benefits of reform and restructure could now be introduced.

The primary areas in which donors can maximize this opportunity are in economic advisory services which can demonstrate to the GOC the benefits of trade liberalization, market information dissemination and promotion of small enterprise development, the provision of adequate and appropriate means by which the government can commit to the assurance of a liberalized environment and by facilitating the provision of information and services not currently available to government, traders, business and producers to assist in the development of a dynamic agricultural sector.

Ways in which these objectives can be realized are in the promotion of village groups for land use planning and decentralized infrastructure development, promotion of credit and financial services to village groups and informal sector businesses, promotion of improved and reoriented extension and training services to assist villagers and informal sector businesses in private sector management, the promotion of improved market information and infrastructure and training to develop private sector commerce and continued support of road development to facilitate domestic and regional trade. Information and communication services should be stressed as an integral part of development programs. The village must be considered as an appropriate level for the gathering and dissemination of agricultural production information. Villager groups should be sensitized to the utility of market information and enabled to do more of the basic data gathering involved in agricultural statistics and planning.

It has been observed that African farmers do not really suffer from problems relating to production itself. If the right combination of resources and markets are available, African farmers, like those everywhere, respond with greater production. Clearly this combination is not currently available to Chadian farmers. With trade liberalization and eventual dissolution of monopolies held by parastatals and government agencies, issues will shift to commercial contacts, discovery of sources, quantity purchase to qualify for discounts and similar considerations. There is real potential to increase resource productivity in Chadian agriculture through crop diversification and more and improved marketing activities. The transfer of responsibility from centralized government to producers, traders and transporters represents a long and difficult process, but draws on a human resource base which has a history of response to challenges.

REVIEW OF THE AGRICULTURAL SECTOR
REPUBLIC OF CHAD

Introduction

The Republic of Chad is a landlocked sub-Saharan, sahelian country that lies between 8 and 24 degrees north latitude and 14 and 24 degrees east longitude. At least 1,500 km from the nearest seaport, it covers an area of about 1,284,000 km^2 with an estimated population in 1989 of 5.3 million inhabitants. Average population density is around four persons per km^2, but this varies enormously. In the desert north of the country which accounts for about half of the surface area, the densities are lowest. Population densities in the higher rainfall areas in the south reach 40 persons per km^2.

With a per capita income of less than US$ 200 per year, Chad ranks as one of the world's poorest nations. Its principal exploitable natural resource is its soil. Agriculture, including livestock, forestry and fishing, is the main source of employment in the economy and involves approximately 77 percent of the active population. Agricultural production accounts for about 44 percent of GDP.

Agricultural production is dependent on the considerable variations in climate from one region to another. Chad's mean annual rainfall ranges from less than 100 mm/year in the north to about 1,300 mm/year in the south. The Saharan zone is desert and only the oases are cultivated. The rest of the area is devoted to extensive livestock, principally camel, production. Cereals and transhument livestock production dominate the Sahelian zone. The Sudanian zone produces the principal cash crop, cotton, and has the greatest potential#for cultivation of other crops.

Chad has a number of riverine resources, mainly due to the Logone and Chari watersheds. Mineral resources remain for the most part unidentified and untapped. Exploitable oil reserves have been discovered in the southeast of the country and near the Lake. Exploitation of these reserves should help redress Chad's chronic resource imbalance once a planned mini-refinery is constructed near the Lake.

For the past decade climatic variability and civil unrest have disrupted overall agricultural growth. Chad's current agricultural development policy aims to achieve food self-sufficiency with irrigation and crop diversification. Crop diversification is expected to result in the production of marketable crops for both domestic and outside markets. Livestock resources are expected to become more fully utilized. Maintenance of a secure environment in which to carry out agricultural production and trade and exploitation of a regional comparative advantage in agricultural production could contribute significantly to Chad's economic progress. The following chapters review the current status of Chad's agricultural sector and identify constraints and opportunities for its economic development.

REVIEW OF THE AGRICULTURAL SECTOR
REPUBLIC OF CHAD

I. Overview

The Government of Chad (GOC)

Under a planned restructure of the Government of Chad (GOC), nearly all agricultural sector activities will fall under the Ministry of Rural Development (*Ministère du Développement Rural, MDR*). This is consistent with a sectoral strategy outlined in the *Plan d'Orientation* of December, 1988. Five main sets of activities are proposed for the development of the agricultural sector in the *Plan d'Orientation*:

- **Increased agricultural production**, which includes intensification, irrigation, input supply, research and development, land use planning and crop protection.
- **Increased rural revenues**, which includes storage, marketing and economic policy.
- **Creation of sustainable production**, which includes population growth, soil and water conservation, range management and agro forestry.
- **Government action** which includes administrative reorganization, training of agricultural development staff, farmer training, rural financial services and regional integration.
- **Promotion of rural participation in the economy** which includes extension and personnel training.

The Ministry of Rural Development

The Ministry of Rural Development was created by the merger of the Ministries of the Environment, Food Security and Agriculture. The two former ministries have become Directorates (*Directions*) under the new arrangement. The Ministry thus breaks down into six operational Directorates:

The Directorate of Food Security and Threatened Populations
The Directorate of Environmental Protection
The Directorate of Crop Protection (DPV)
The Directorate of Training and Rural Education (DEFPA)
The Directorate of Rural Works and Hydraulics
The Directorate of Agricultural Statistics (DSA)

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Each Directorate is headed by a Director and coordinated by a General Directorate headed by the *Directeur Général* of Agriculture. The new organization closely approximates the organizational approach currently under development by USAID/Chad, which views the issues of environmental protection and food security as intrinsic to the agricultural sector.

BRA

Bureau des Recherches Agronomiques, (BRA) is located within the Directorate of National Agriculture (in the MDR) where, in 1987, it replaced the Division of Agronomic Studies. Responsible for coordinating all national research activities, it is composed of two divisions, the *Division de Recherches Agronomiques* (DRA), and seed multiplication (DSM). These divisions work in seven research and seed production stations[1] where its research concentrates on crop varietal testing. Its technical staff includes four agronomy and soil science professionals with Ph.D.s, two with M.S.s in agronomy and agropedology and three with B.S.s. Its field staff number between 50 and 60 *conducteurs* and *agents techniques*.

The BRA collaborates with the FAO Seed Production Project for the Sahelian Zone (CHD/87/002). This project has three senior staff, one Chadian and two expatriates. Because the BRA has no budget of its own, its financing depends on the MDR and other institutions. These include the International Development Association for farm equipment credit and the International Fund for the Sciences in sorghum disease and insect research. Several regional and international institutions also contribute through their various training and varietal testing networks. These include:

CILSS	millet, sorghum, maize and cowpeas
IITA	maize, cowpeas and rice
ICRISAT	sorghum and millet
SAFGRAD	maize and cowpeas
WARDA	azolla

In the past, both USAID and *Fonds d'Aide et de Coopération* (FAC) contributed financial assistance to BRA. The FAO/UNDP recently completed a review of agronomic research in Chad with a view to restructuring its entire national research program.

BSA

The Bureau of Agricultural Statistics (BSA) within the Directorate of Agricultural Statistics is particularly vital to the functioning of the GOC agricultural development strategy. It has put together a sampling base for gathering agricultural statistics which will be used to evaluate yearly production parameters. It is also responsible for the management of the *Système d'Information sur le Marche* (SIM), the new market information system.

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[1] Deli, Moussafoyo, Bokoro, Mtimam, Gassi and Baili

DEFPA

The *Direction de l'Enseignement et de la Formation Professionnelle Agricole* is responsible for training in agricultural education and extension training. Created under the MDR in 1979 DEFPA has a staff of 140 specialist (100 men and 40 women). DEFPA programs include mid-level training at the Sarh and Baili schools of agriculture, on-going mid-level training at DEFPA headquarters in N'Djamena and farmer training in 26 *Centres de Formation Professionnelle Agricole* (CFPAs). Farmer training offers subjects such as animal traction, farm management and farmer group formation and operations. Programs for women are oriented to revenue generating technologies such as small mills for cereals, karite preparation, etc. The farmer training programs offer three levels:

One Year Program.

Carried out in Moyen Chari. Training includes animal traction and rural literacy.

Two Year Program.

Takes place in Mayo Kebi. Covers food crops and cotton production. A participating farmer's cotton crop is sold and the revenue used to purchase a pair of oxen, a plow and a cart.

Two Year Alternating Program.

Takes place at the Logone Center and in the villages of participating farmers. Covers various extension themes.

On-site specialized training is also conducted in response to specific demands of institutions on such topics as soil erosion, water management, forestry, etc.

Mobile Training Team.

In 1989, DEFPA initiated a program whereby a team of three specialists from the training centers travel to the neighboring villages in the Sahelian Zone to provide training for the farming population. Topics covered during the training depend on farmers' requests made in earlier discussions with them. This approach complements the work of the *Centres de Formation Rurale* (CFPR) in the cotton zone and makes up for their absence in the Sahel Zone. It also responds more favorably to the socio-economic conditions of inhabitants in the region; mainly farmers, herders and craftsmen. Financing is, however, needed for the continuation and expansion of the program so as to involve more specialists from other Ministries.

ONDR

The *Office National de Développement Rural* (ONDR) is a parastatal created in 1965 under the MDR. ONDR is the principal extension institution with responsibilities for technology transfer (with DEFPA), agricultural input supply, credit and farmer associations. Its mandate is nation-wide except for the Lake Chad and Sategui Deressia areas. The National *Direction* in N'Djamena has a staff of about 75. ONDR has focused principally on cotton production in the Sudanian zone. Thus, the Regional sub-*Direction* in Moundou is more active and better staffed than those in Abeche and Faya. This is reflected in the ONDR field structure presented in Table I. The Moundou sub-*Direction* which covers approximately 120,000 km^2, is divided into three *circonscriptions*, each of which is divided into four *secteurs*. The sub-*Directions* in Abeche and Faya are effectively administered from N'Djamena.

The *Conseillers Agricoles* noted in Table I constitute a new category of extension agents who are more highly trained and more aware of the capabilities and needs of the farmers and groups with which they work. Using the "Contact Farmer[2]" approach and working through village associations (*Groupements des Producteurs*), they provide an important means by which to efficiently and effectively disseminate information. This method is similar to the *Délégué Technique* used by the ORT Project in the Ngouri area, in which farmers are trained to repair wells and perform other extension activities. They then assist and give extension advice to other farmers on request.

ONDR activities also include assistance with the formation of *Associations Villageoises* (AV), provision of credit for agricultural equipment mainly through the AVs, assisting farmers to market their produce and other extension related activities. Recent focus has been oriented increasingly toward food crops.

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[2] The "Contact Farmer" approach requires that the extension agent work closely with selected, influential farmers in the community. The Contact Farmers provide extension guidance to neighbors.

Table I
ONDR Extension Personnel

Level	No./Zone Sudanian	Sahelian	Saharan
Circonscription *Ingénieur Agricole*	3	3	0
Secteur *Ingénieur Agricole* *Conducteur Agricole*	12	6	2
Sous Secteur *Conducteur Agricole* *Agents Techniques*	68	24	1
Zone de Vulgarisation 2 yrs high school, 2 yrs Baili Ag School	350	32	10
Conseiller Agricole	43		

Note: In addition to the agents listed, 12 *Formateurs* and about 50 *Prevulgarisation* agents supervise pre-extension trials.
Source: ONDR

IRCT

The *Institut de Recherches du Coton et des Textiles Exotiques* (IRCT) was created in 1946 with its headquarters at Babedjia. Originally conceived for research on cotton, since 1982 its program also includes food crops. Sections concentrate on cotton improvement, agronomy, crop protection and food crops improvement, each staffed by three scientists except the food crops improvement section, which has two. Two entomologists will join the program in 1992. The station is well equipped and continues to receive French financial as well as technical assistance.

Since 1987, food crop research has concentrated on sorghum and striga. About 400 local sorghum strains have been collected and are being assessed. The research stresses the importance of incorporating local germplasm in its crop improvement programs. A new cotton variety (VII) may soon be released.

SODELAC

The *Société de Développement du Lac* (SODELAC), was created in 1975 as the principal extension agency for the Lac and Kanem Prefectures. It was originally created to manage 1200 ha. of polders in the Bol area on Lake Chad. In 1976 it implemented a 200 ha. irrigation scheme to support double cropping of maize followed by single cropping of cotton and wheat. Since the civil disturbances of 1979, the total irrigated cultivation in this area has fallen to around 120 ha. and all donors except the African Development Bank have withdrawn. SODELAC now pursues a conventional, low level, extension approach in the wider Kanem-Lac zone. Extension activities for wadi cultivation, including the ORT Project in N'Gouri now probably outnumber those for irrigated polder farming.

Farmers in the Lac zone experimented with potato production, but were unable to market their produce efficiently. Production directly organized by SODELAC has been discontinued, but the Lac area still provides a significant portion of N'Djamena's potato supply (Abdelwahid et al., 1989).

Construction of an irrigation canal is expected to receive financial support from the Arab Development Bank in 1991. The canal is multipurpose, to irrigate approximately 1800 ha. and to provide barge access to Bol.

OMVSD

The *Office de Mise en Valeur de la Vallée de Satigui Derressia* was set up in 1976 to develop 10,000 ha. of gravity flow irrigated rice production along the Logone River. Five thousand hectares were to have been developed in Phase I (1976-80) but only 1500 ha. are cultivable out of 2100 ha. actually developed. Because of inadequate dry season water supply, only one rice crop is grown. Factors contributing to chronically low yields include a combination of poor water control and unavailability of credit and productions inputs. Only a few farmers produce small quantities of okra and onions in the cool season. The operation has consistently failed to meet management and production expectations. Between 1983 and 1986 the UNDP/FAO/FENU provided two billion FCFA to rehabilitate the project's rice mill, buildings, workshops and perimeters. In 1987 FENU contributed a revolving credit of 104 million FCFA for rice marketing. Nevertheless, chronic problems associated with credit availability have plagued OMVSD. Farmers often sell their rice for prices less than the 50 FCFA/kg offered by OMVSD.

TABLE II
OMVS PADDY PURCHASES
FROM PROJECT FARMERS

Year	Tons
1986	2200
1987	518
1988	2500
1989	3200

Lack of an assured rice market compounded by low yields has resulted in credit arrears by OMVSD on input purchases. Table II presents the amounts of paddy purchased by OMVSD over the years. These negligible quantities make economic operation of OMVSD's rice mill impossible (mill capacity is 12,000 tons/year). The current OMVSD debt of 984 million FCFA has caused virtual stagnation of its activities.

Eighteen OMVSD extension agents provide agricultural services to 35,000 farm families in 106 Farmer Associations. Agent qualifications range from *Conducteurs de Travaux Agricoles* to *Agents de Cultures*.

ONADEH

The *Office Nationale de Développement de l'Horticulture* was created in 1985 as an independent extension institution to develop vegetable and fruit production, including transformation, conservation and marketing activities. ONADEH staff includes 11 *Conducteurs de Travaux Agricoles*, 10 *Agents Techniques Agricoles*, one *Agent Agricole* and seven *Moniteurs*. Ten ONADEH agents are also located in Moundou.

Operations, which at best involved the vegetable seed purchase, started in 1986 with German funding. ONADEH has also collaborated with Africare in Gaoui and Nguely. This institution has never been able to fulfil the ambitious tasks it was assigned and donors have become increasingly disinterested.

Currently ONADEH concentrates on the import of French vegetable seeds for resale, mainly to growers around N'Djamena. Since March, 1991, it has also been collaborating with the UNDP/FAO Vitamin A Project.

FIR

The *Fonds d'Intervention Rurale*, is an autonomous, public establishment placed under the aegis of the Ministry of Rural Development. Its statutory mission is to provide financial support, through subsidies or loans, for the construction of productive and social infrastructures in rural areas. FIR is financed by a system of tax surcharges. Credits of over 900 million FCFA in FIR's favor are on account in the national treasury. Although its action program has been established and a public awareness campaign has been ongoing since 1990, operational funds have been blocked by the Treasury for technical reasons.

ONC

The *Office National des Céréales* was originally conceived as a grain stabilization board but was never able to buy or sell enough grain to have an effect on the market. It has been transformed into the principal management unit for a national food security stock. Its only market involvement comes as a result of purchases or sales to rotate the 10-20,000 tons of cereals stocks it holds nationwide. At present its stocks are very nearly depleted. These operations are normally coordinated with food aid imports, and to the extent possible, local purchases are tendered, to local private traders. ONC agents will collect cereals price data in selected markets as part of the SIM.

BIEP

The *Bureau Interministériel des Études et de Programmation*, is an important mechanism for providing liaison for the actions of the various ministries and agencies involved in Chad's development program. BIEP aids the Ministry of Plan and Donor organizations in the elaboration of future projects. It has prepared Master Plans for Lake Chad and Lake Fitri as well as a National Food Security Plan. Most of BIEP's work is on sub-studies and special studies requested by donors or government agencies. These include livestock and marketing studies, cereals price studies and sub-sectoral studies on wheat, rice and vegetables. BIEP has an imposing looking document collection, but is having some difficulty with cataloging it. An ongoing objective has been to do more consulting work in order to recover more operating costs. BIEP has a formidable array of desktop publishing equipment. It receives technical assistance from the FAO.

COTONTCHAD and Cotton Production.

COTONTCHAD is a mixed (government/private/foreign owned) company that is solely responsible for purchasing, processing and marketing of cotton. Cotton is Chad's main cash crop and occupies a central role in the economy, where it contributes 80 percent of export earnings and 13 percent of crop production. It also provides income for about two-fifths of the country's population and absorbs about 60% of domestic credit. The decline of cotton prices on the world market from 850 FCFA/kg in 1984 to 300 FCFA in 1986 affected most of Chad's economic sectors as well as its banking system (World Bank, 1988). It was during this same time that management problems caused production costs to rise by 70 percent. This led to drastic measures including the setting of production quotas (100,000 tons), staff reductions (50 percent) and improved management and cost control.

As in other cotton producing francophone countries, almost all development efforts have focused on cotton. Food and other non-cash crops have received little attention. It was only after drastic declines of world cotton prices that Chad viewed crop diversification as a means to stabilize farmer incomes, food production and foreign exchange earnings.

Although cotton yields and fertilizer use have increased over the years, their correlation has not been steady (Table III). Animal traction is practiced by about 90% of cotton farmers (ONDR, 1991), but average farm yields are low when compared to those obtained by the IRCT at Bebedjia (>2 t/ha.) as well as by farmers under similar rainfall conditions (800 mm/yr) in Mali, Burkina Faso and Cameroon. Table III shows that cotton production in Chad is more a function of area planted than of intensity of agricultural practice.

Table III
Cotton Production

Year	Total Area (000 Ha)	Area Fertiliz. (000 Ha)	% of Total	Production (MT)	Yields (kg/Ha)
1967	298.4	26.2	8.8	101.6	341
1968	295.4	34.4	11.7	116.7	401
1969	291.2	44.1	13.9	108.5	359
1970	301.6	40.6	13.5	94.7	314
1971	301.9	41.9	13.9	108.5	359
1972	255.6	44.7	16.2	104.0	378
1973	269.0	54.8	20.4	114.4	425
1974	272.1	75.0	27.5	143.6	528
1975	336.5	127.4	37.9	174.0	517
1976	318.8	131.4	41.2	147.4	462
1977	284.0	120.3	42.4	125.3	441
1978	267.3	137.1	51.3	136.9	512
1979	179.8	100.3	55.8	91.3	508
1980	166.5	70.9	42.6	85.7	515
1981	133.9	56.2	42.0	71.4	533
1982	137.7	76.0	55.2	102.1	741
1983	175.8	97.6	55.5	158.5	902
1984	141.9	77.8	54.8	98.7	695
1985	147.4	94.5	64.1	99.5	675
1986	124.1	66.7	53.8	89.5	721
1987	147.7	68.7	46.5	127.8	865
1988	199.4	87.8	44.0	137.4	689
1989	184.7	116.2	62.9	151.1	818
1990	206.5	NA	NA	156.4	757

Source: ONDR

As a result of the decline in world prices for cotton, COTONTCHAD has tried to limit production at set levels. For 1988, 1989 and 1990, quotas were set at 115,000, 130,000 and 145,000 MT respectively, although these limits have consistently been exceeded (Table III). This shows farmer tendency to produce to the maximum once assured of reliable production and marketing arrangements.

Other GOC Ministries and Agricultural Activities

Several other ministries directly influence activities in the agricultural sector, especially in terms of marketing and trade policy. The ministries and significant activity in the agricultural sector are summarized below.

Ministère du Plan et de la Coopération

This ministry has overall responsibility for coordination of other government organizations and donor community actions with regard to development strategy. Under the *Plan Intérimaire*, which ended in 1988, most planning was done on a regional basis and conditioned on access to donor funding (eg. BAD funded a Master Plan for the Sudanian Zone, The GTZ funded development plans for the Ouaddai and Mayo Kebbi, etc.). With the publication of the *Plan d'Orientation* in December 1989, the "tools" of Chad's future development have been identified. These are:

- The delineation of a coherent series of national development options
- Elaboration of development strategies by sector
- The establishment of a three year investment program

The Ministry is currently receiving assistance from an FAO consultant in updating the *Plan d'Orientation.*

The *Centre de Recherches Appliquées* (CRA) was originally created in 1987 under the Ministry of Education. Charged with cataloging all national and foreign scientific information into a computerized retrieval system, it has been trying to reconstitute the research documentation dispersed and damaged by the civil disturbances of the late 1970s and early 1980s.

CRA receives financial assistance from FAC and is located in the former ORSTOM (*L'Office de la Recherche Scientifique d'Outre-Mer*) premises. Because of their complementary roles, CRA works closely with both BRA and BIEP in computer documentation and training.

The Ministère de l'Élevage et des Produits Animales

Government services to the livestock and rangeland subsector fall under the tutelage of the Ministry of Livestock. The actual provision of these services is under the purview of:

1) *La Direction de l'Élevage et des Services Vétérinaires*
2) *Le Laboratoire de Recherches Vétérinaires et Zootechniques de Farcha.*

Two principal services, *le Service des Productions Animales* and *le Service d'Agropastoralisme*, lie at the core of livestock and rangeland resource management and monitoring. Monitoring of rangeland productivity and computations of grazing capacity is conducted by the *Réseau d'Observation des Pâturages Naturels* (ROPANAT) in liaison with the Famine Early Warning System (FEWS).

By June 1990, 18 data collection staff members were operating 40 observation sites in the Sahel. Twelve additional sites are foreseen for 1991. The *Direction de l'Élevage et des Services Vétérinaires* comprises 162 *cadres supérieurs*, 30 *cadres moyens*, and 400 *cadres d'exécution*. It is the key implementing organization of *le Projet National d'Élevage* which receives IBRD, FAC and FED financial support.

Coordination of livestock marketing within the six member-states of the Central African Community is a central theme of the *Communauté des Bétails et de la Viande et des Ressources Laitières*. This organization will initiate its activities during 1991. It is presently in the process of locating office space in N'Djamena.

Ministere des Mines, Energie et des Ressources en Eau

Water supply is the responsibility of the Ministry of Mines, Energy and Water Resources. Water comes principally from developed wells drilled into shallow aquifers. Well development, pump installation and maintenance and the monitoring of ground-water resources lie under the purview the *Office National de l'Hydraulique Pastorale et Villageoise* (ONHPV). The *Office* comprises four divisions separated according to task and well type: drilled wells, traditional wells, maintenance and services which maintain equipment and manage personnel. The *Direction* has a staff of about 40 of which 25 to 30 are engineer grade. It receives financing from the IBRD, FED, BID, PNUD, *Caisse Centrale* and FAC.

Monitoring and forecasting of weather and streamflows is done by the *Direction des Ressources en Eau et de la Météorologie Nationale* which also falls under the tutelage of the *Ministère des Mines, Énergie et des Ressources en Eau*. The *Direction* operates 120 rain gauges, 13 agrometeorological stations, 15 synoptic stations and 54 stream gauges (including 12 recording gauges) throughout the country. It collaborates with a regional project for improving access to agriculturally-related weather information, AGRHYMET (headquartered in Niamey), as well as with the FEWS project. Its present constraints center on the inability of isolated field posts to communicate rainfall and other data in a timely manner due to lack of radios and lack

of equipment to replace damaged stations. Its staff numbers about 40 of which six are engineering hydrologists, three are agrometeorologists and eight are *techniciens supérieurs*.

Ministère de l'Économie et des Finances

Two key directorates which have implications for policy reform are located in the Ministry of Economy and Finance. They are the Directorate of Commerce (*Direction de Commerce*) and the Directorate of Customs (*Direction des Douanes*). Both of these organizations retain strong prejudices toward centralized administration and regulation. Customs is also one of the primary sources of fiscal support for the state (over one-fourth of total government fiscal receipts), which makes any kind of tariff reduction appear to be an effective cut in these revenues.

The Donor Community

International assistance, both bilateral and multilateral, plays a large part in the development of the Chadian agricultural sector. Chad's entire investment budget is financed by foreign assistance. Indeed, the GOC has had difficulty in creating sufficient fiscal mass to finance all of its recurrent expenditures. This is in large part due the dependence of the fiscal system on taxation of commercial transactions, especially imports and exports. The financial crisis in the cotton sector has had a deleterious effect on this situation in that COTONTCHAD has been exempt from export tax payments during its restructuring. With a return to profitability in this sub-sector, serious consideration needs to be given to re-fiscalization of COTONTCHAD.

The major participants in the development of the Chadian agricultural sector and their programs are as follows:

The World Bank

The Bank resumed lending operations in Chad in 1985. Since then ten loans have been approved for a total of $257 million. These have focused on the livestock and transport sectors and the cotton sub-sector. Interventions in the latter have been primarily for the restructure of COTONTCHAD. The Bank has facilitated dissolution of a number of parastatals and state monopolies (SOTERA, MAGAVET, CTT), and has pressed the government for further liberalization of input supply markets and easing of import restrictions on key factors of production. Discussions on a restructure of the UDEAC tariff system are ongoing between the Bank and the six member states.

The Bank provides support for ONDR's *Cellule Recherches-Action-Développement* which is experimenting with new multidisciplinary team extension approaches. It is also involved in ONDR's emerging land use planning (*Gestion des Terroirs Villageois*) section. The large livestock development project is bogged down in institutional problems relating to the establishment of priorities among planning, animal health and marketing activities.

FAO/UNDP

The total UNDP program budget for Chad is around $41 million. Interventions in the agriculture sector, with technical assistance provided by FAO, are in the areas of agricultural production, food security and locust and grasshopper control. Programs in the transport, livestock, and forestry sectors directly touch on the agriculture sector through effects on the resource base and market infrastructure. FAO provides financial and technical support for the Gassi seed farm, OMVSD, and ONADEH. It is providing expatriate technical staff, equipment, and logistical support for BIEP. The truck fleet assembled by UNDP/FAO to transport emergency food aid has become an important element in the transport sector.

The World Food Program (WFP)

The WFP manages food aid imports and distributes it, partially through three small projects: school lunches, vulnerable group feeding and food for work. Africare's watershed management and refugee settlement project in the Abeche area has utilized food for work resources. Around 46 percent of World Food Program food aid imports is of U.S. origin.

European Community

Fonds Européens de Développement (FED) has concentrated its efforts in two geographical regions: the Chari River between N'Djamena and the Lake (*Périmètres Irrigués du Chari*, PICs, small irrigated perimeters) and the inter-riverine zone of the Logone and Chari (support for ONDR food crop extension). The "Sixth FED Program" (*Sixième FED*) also finances support activities in livestock (range management training at Farcha Laboratories), water supply, roads, health and education. Efforts in the "Seventh FED" with a budget of 101 million ECUs, to begin in 1992, will extend FED more toward the Sudanian Zone and will emphasize training and support for village organizations.

Fonds d'Aide et Cooperation (FAC)

FAC is the French bilateral aid arm. Project related aid is funneled through it, while most loans and subsidies are managed by the *Caisse Centrale de Coopération Économique*. These two organisms disburse nearly 60 percent of French bilateral aid to Chad. Total aid over the last five years has amounted to nearly 500 million FF, or about 30 percent of total aid to Chad from all sources. Twenty six percent has gone to rural development, and another four percent to research. The largest portion (34 percent) has gone to infrastructural development. Three quarters of French aid is in the form of non-reimbursable grants and subsidies.

In the agricultural sector, 30 to 35 percent of total French aid to Chad goes to support for ONDR. An effort is being made to diversify this aid and direct more of it to areas other than the cotton zone. A current priority of FAC is promotion of *Groupements Agricoles* and diversification of their activities. A few French NGOs, such as AFDI, are involved in this as well. FAC would like to focus its operations more on the up and downstream aspects of agriculture as time goes on. The IRCT research station in Bebedjia is being enlarged to

accommodate a role as a polyvalent eco-zone station. No other such facility exists for the Sahel and Sahara Zones, but FAC is exploring the possibility of rehabilitating and enlarging the Farcha station to this end.

GTZ/KFW

GTZ is the technical assistance arm, while KFW is the financial management arm, of German bilateral development aid. German aid is targeted to two regions: the Mayo Kebbi and the Ouaddai-Biltine. Regional development plans for each region are in preparation, and regional offices of the Ministry of Plan have been set up in the three prefectures through German aid. Projects include village water supply and *micro-réalisations* in the Mayo Kebbi, and wadi development and livestock in the Biltine. There is also a small professional education component involving the assignment of three technical assistants to the *Collège d'Enseignement Technique* (CET) in Sahr. Total German aid amounts to around 50 million DM per year. Three German Volunteers have been assigned, one each, to the DSA in N'Djamena, the *Direction de la Promotion Féminine* and to a *Centre de Conseil Agricole* in the Mayo Kebbi.

USAID

The USAID program can be broken down into three distinct phases, corresponding to periods in the evolution of Chad's development needs since the end of the civil disturbances of 1979-82. The first period, 1982-85 was dedicated to reconstruction and recovery assistance. In this phase most assistance involved emergency food aid for displaced war victims and those suffering from famine. Food for work activities played a prominent part in USAID operations and it was at this time that a number of U.S.-based PVOs first began to play a significant role in U.S.-funded development assistance to Chad.

The second phase, 1986-89, was a transitional period. Aid took on a more project-oriented approach, while keeping the accent on food security. Projects begun during this period included the Lake Chad Agricultural Development and Farmer Training Project (ORT), the Irrigated Agriculture Development (CARE), and the Ouaddai Rural Development Project (Africare). The emphasis during this phase was on agricultural production projects. These were executed by PVOs which had already garnered considerable experience in Chad by virtue of their roles in the previous relief and rehabilitation activities.

Experience with these production-oriented projects showed that the lack of marketing opportunities was a central constraint to increasing production. At the same time, the government and other major donors were moving toward a development strategy which recognized the need to strengthen and develop product markets. This has been reflected in USAID project execution by the re-orientation of many of the previous projects to marketing themes. The CARE project was split in two, giving rise to the Kim Agricultural Marketing Project and the Kanem Pumps and Agricultural Marketing Project. The ORT and Africare projects have both added marketing components to their activities. A new ACDI Fruit and Vegetable Marketing Pilot Project was begun in 1990. A new flagship marketing project, the Agricultural Marketing and Technology Transfer Project (AMTT) has recently been approved

with a financial envelope of $10.2 million over 5 years. It will focus on agribusiness development and marketing policy reform.

Continuing activities include the PL-480, Title III Program, Emergency Locust and Grasshopper Control and Rodent Control and Research. Two regional projects, the Famine Early Warning System (FEWS) and Sahel Water Data Network and Management Project, are scheduled for termination in 1992 and 1993 respectively. Road maintenance and repair through technical and institutional support for OFNAR has been a primary focus of the USAID/Chad mission. A five-year road repair and maintenance program ending in 1993 is underway. Construction performance by private foreign construction firms has been satisfactory, but participation in repair and maintenance work by smaller, local private companies has been minimal.

Non-Governmental Organizations (NGOs)

The primary objective of the numerous local and international NGOs which operate in Chad is to develop and promote village-level programs to increase food production and improve socio-economic welfare. To this end, agricultural and health projects usually receive priority. Activities are coordinated by an interministerial committee assisted by a permanent secretary (*Secrétariat Permanent des ONG*, SPONG) in the Ministry of Plan. An independent organization, CILONG (*Centre d'Information et de Liaison des ONG*), also serves this same purpose for the NGOs. Most NGO actions are initiated at the village level and work closely with national development institutions (ONDR, SODELAC, etc.). There are about 44 NGOs in Chad. Table IV lists the main ones involved in agriculture. The locations of projects managed by U.S. NGOs are indicated on the accompanying map.

Table IV
Source of Finance/Areas of NGO Agricultural Activities

NGO	Financial Source	Area
SECADEV	Europe, Canada	Chari, Lake Fitri, Bousou, Ouaddai
Africare	USAID	Miskine, Gaoui, Mideknine, Ouaddai
INADES	NA	Moundou, N'djamena
AICF	France	Guera, Salimat
CARE	USAID,FED	
	OXFAM	Bongor, Sarh, Kanem
ACRA	Italy	Moyen-Chari
F.H.I.	Switzerland	Guera
AAA	GTZ	Ouaddai, Biltine, Mayo Kebbi
ACORD	Britain	Bokoro
ORT	USAID	Ngouri
APICA	Switzerland	Sudanian Zone
VITA	USAID, World Bank	N'djamena, Moundou

The Private Sector

Major Enterprises

Agro-industrial production is at the core of Chad's small industrial base. All of the five largest industrial enterprises are involved in the transformation of agricultural products in one way or another as Table V shows.

Table V
Major Enterprises

Business	Ownership				Employees
	State	Local PS	Foreign Gov't.	Foreign PS	
COTONCHAD	75%	6%	2%	17%	1,225
SONASUT (sugar)	83%	-	-	17%	1,600
MCT (tobacco)	15%	-	-	85%	135
BDL (brewery)	-	-	-	100%	230
STT (textiles)	27.5%	-	37.5%	35%	650
STEE (utilities)	81%	-	19%	*	420

* 19% of STEE is owned by *Électricité de France*, a mixed, private/state corporation.
Source: World Bank

Two of these companies (BDL and MCT) use mostly imported raw materials. A third (STT) is really an ancillary operation to the all important cotton sub-sector. The principle of import substitution on which these industrial firms were founded was compromised from the outset. BDL and COTONTCHAD operate at a profit, but SONASUT and STT suffer from chronic management and technical problems. In spite of this, they continue to benefit from protectionist measures instituted by the government. SONASUT-produced sugar is higher priced than the imported product, stimulating considerable smuggling of sugar from neighboring countries. The persistence of an import substitution policy in the face of chronic inefficiency engenders high social costs and detracts from the efforts needed to identify and exploit Chad's real comparative advantages.

Small and Medium Scale Enterprise

Many of the 12 next largest firms are also engaged in agriculturally related transformation or commercial activities. Several of these are parastatals (ie. SONAPA, *Abattoirs de Farcha*) and are slated for privatization or restructuring in the near future.

Table VI
Medium Sized Enterprises

Name	Business	Ownership	No. Employees	Turnover (Mln. fCFA)
BGT	Soft Drinks	Private (84% Foreign)	45	700
SIMAT	Ag. Machinery	Mixed (49% State, 20% loc.P.S., 31% Foreign)	40	200
SAC	Construction	NA	NA	NA
SONAPA	Livestock Prods.	Parastatal	50	100
CYCLOCH AD	Bicycles	NA	22	NA
Abattoirs de Farcha	Slaughter	State	NA	325
SETUBA	Construction	NA	NA	NA
Imprimerie du Tchad	Printing	Private	45	523
Imp. Nat. du Tchad	Printing	State	35	NA
Air Tchad	Airline	Mixed	60	1,500
Tchadipeint	Paints	Private (40% For.)	18	240
Ets. Kaliffa	Petro.& Const.	Private	NA	NA

Source: *Chambre Consulaire du Tchad, Annuaire des Sociétés Industrielles et Commerciales du Tchad*, Edition 1987-88.

Even in the small enterprise category (5-15 employees) of the formal sector, agro-industrial activities are minimally important, as Tables V - VII indicate. Agro-industry, is

largely a function of the numerous micro-enterprises of the informal sector, where the vast majority of production, transformation and marketing activities (both urban and rural) take place (see below).

Table VII
Small & Medium Sized Enterprises: Formal Sector*

Activity	No. Businesses
Agri.-Livestock	11
Commerce	350
o/w Import/Export	(220)
Industry, Artisanat, Construction	110
Services	105
Total	**576**

*Source: Hamida & Gerry. Figures include only businesses registered with the N'Djamena Chamber Consulaire, holding voting memberships.

Micro-Enterprises

Manufacture of many small consumer goods and related repair work is carried on by a number of small and medium scale industrial enterprises located in the rural areas. Others, such as mat weavers and grain merchants, purchase their product in whole or in part from well established sources in the countryside. Enterprises of this type have existed in towns and villages throughout Chad and the neighboring countries of the region for centuries. Specialization in the manufacture of the tools needed for agricultural production originated long ago and has become intimately integrated into not only the economy, but the social fabric of rural life. Many of these crafts; blacksmithing, carpentry, weaving, etc.; have evolved into full-time workshops with relatively sophisticated manufacture and repair facilities. In the cotton zone, for instance, many blacksmiths are able to make complete plow-sets and some are equipped to do welding jobs of varying complexity. For the most part, however, rural manufacturing retains the characteristics of a craft or artisanal operation.

The most common form of business transaction for these enterprises is a direct contact between the artisan and his customer for a specific item, which is effectively made to order. Moreover, most artisans are also farmers. It is not surprising, therefore, that production of

small consumer goods, tools and other implements should be organized in a way very similar to subsistence agriculture. Village, family and acquaintances are extremely important to enterprise survival and development. Small rural industry, like farming and commerce, operates according to its own economic logic, and not according to that of state fiscal or trade regulations.

These small manufacturing and trading enterprises also provide a considerable proportion of the consumer goods purchased in rural areas. Many of these enterprises are simply small workshops and are located in secondary cities or population centers and over half have two or fewer employees (Brown & Green, 1989, see also World Bank, 1989). The labor force in these firms is often made up of a large proportion of apprentices. Indeed, a characteristic of manufacturing enterprises in Africa is that approximately half the labor force of small, informal sector businesses is made up of apprentices (Liedholm and Mead, 1987).

In secondary population centers like Moundou, Bongor and Sarh a number of individuals operate small-scale agricultural processing operations on either a part-time or full-time basis. Small vertical hammer mills (with a typical capacity of 300 kg/hr powered by nine to 12 hp engines or five to 7.5 kW electric motors) are generally used to grind millet and sorghum. Certain larger operations even have two or more machines in their workshops and can mill other products such as groundnuts, dried tomatoes, okra and shea nuts. There are some 25 - 40 machines in operation in Moundou according to one miller interviewed there. OPIT counted over 350 mills in N'Djamena alone. Most villages in Chad have access to small, privately owned mills. Millers operate on a job lot basis and there is a significant underutilization of available capacity. The overwhelming majority of mills in operation in Chad are imported from Nigeria, often "informally". There is also a limited capacity (mainly in N'Djamena) to mechanically dehull coarse grains. There is an even more limited number of rice mills in Chad, mainly in the Bongor area. However, most processing of agricultural products in the cities, as well as the countryside, is done by hand.

An additional concentration of small, informal sector enterprises found in Chad is the service sector. The personalized support network which characterizes small-scale industry extends to this sector as well. Indeed, many service enterprises have close ties to various workshops as they often supply materials, transport finished products, or in rare cases, market the output of artisans. There are a large number of petty, mostly unlicensed traders operating from the small shops and market stalls of the cities and in the various surrounding villages.

A 1989 study of 207 small and micro-enterprises in N'Djamena found that these businesses are universally privately owned. Initial investment costs are nearly always born by the owner. Government and banks or other money lenders play little or no role in the finance of small businesses (Brown & Green, op. cit.). The situation in Chad is similar to that in other West African countries where "the government continues to create policy distortions that favor specific individuals or industries by restricting entry or by providing them with special protection" (Grant, 1988, p. xii., see also, Yumeseva, op. cit.). The kinds of equipment imported by large firms are easily recognized as capital or production goods and can benefit

from advantages for those items in tariff codes. Small producers utilize inputs that are not easily distinguishable from consumer goods (e.g., sewing machines or outboard motors) and are taxable at higher rates. At the same time, inefficient parastatals like SONASUT are granted extensive protections, at the expense of consumers and small traders.

By and large, the only source of start-up capital outside of personal funds which plays any significant role in small business is loans from friends, acquaintances or relatives. Moreover, on an operational level small firm owners tend to lack access to adequate supplies of working capital. In part this is due to the nature of the small enterprise, where family and business assets often become comingled. More often, however, it is due to a lack of access to an adequate financial services network and the high cost of maintaining inventories in the face of limited demand. Products are typically made on order, usually with an advance stipulated to finance the purchase of materials. Demand for goods and services, as was pointed out earlier, is greatly limited by the relatively small disposable incomes of consumers. Small manufacturers and traders spend an inordinate amount of time waiting for customers. "Numerous studies have shown that for most small producers, particularly those in rural areas, the most important problem which they face is one of finding markets for their output" (Liedholm and Mead, 1987).

There is also a strong correlation between agriculture and small and medium sized enterprises. Both upstream and downstream linkages tie the two activities together: small rural workshops provide and repair the tools farmers need for subsistence production and the small surpluses produced by farmers provide the incomes which permit them to buy these tools and other small consumer goods. Thus, higher agricultural incomes should serve as a potent stimulus to accelerated production of small goods and equipment and enlarged provision of services such as transportation and marketing. Moreover the linkages are mutual, in that trading and artisanal production activities can provide access to the supplemental income necessary to get through a harvest shortfall. Thus, policies which affect agricultural output can be as important for small and medium-sized enterprises as tariff and banking regulations. Government policies which enhance agricultural terms of trade vis-a-vis other sectors (especially large-scale manufacturing) can generate increased demand for the products of small commercial and manufacturing firms, particularly agro-industries.

II. Agricultural Production, Development and Policy Orientation

Agricultural Production

Agricultural production in Chad remains a function of the eco-climatic makeup of the country, especially as regards the major commodities. Table VIII indicates the relative amounts of land in production by zone. Although considerable variation exists in the kinds of tertiary crops grown, the information in the table shows that the Sahel zone is essentially a cereals producing area, while the Sudanian zone is more diversified. It is also the locus for production of the principal cash crop, cotton.

Table VIII
Land Use for Agriculture
(000 Ha. unless otherwise indicated)

Zone	Rural Pop. ('000)	Total Area	Area Cult.	o/w Cer-eals	Cotton	#Farms ('000)	Farm Size (Ha.)
Sahel	2,000	55,280	550	535	-	250	2.2
Sudan	2,200	13,000	1,000	650	100	250	4.0
Sahara	100	60,115	-	-	-	NA	NA
Total	4,300	128400	1,550	1,185	100	500	3.1

Source: Extrapolations based on OMVS and L. Berger, Int., 1990.

Food Crop Production

Table IX presents production figures for main crops while Annex C shows rainfall and total cereals production in Chad. The validity of crop yield data is difficult to assess due to extreme fluctuations caused by variation in rainfall amounts, especially in monthly distribution, which is more critical than total annual amount. However, in years with high rainfall and even distribution over the growing season, Chadian farmers produce enough food crops to feed themselves and their urban neighbors. In bad years, as in 1983 and 1984, food reserves are reduced if not depleted and prices rise. However, even in good years farmers may not have surpluses for sale, since prices then fall drastically. In this case farmers tend to produce less the following year(s).

Table IX
Estimated Crop Production
(MT)

Crop	1987/88	1988/89	1989/90	1990/91
Millet	215,450	312,600	247,300	172,300
Sorghum	267,500	385,200	383,900	283,600
Berbere*	34,850	#	#	54,700
Rice	42,100	59,900	63,700	59,800
Maize	27,600	+	+	31,000
Wheat	1,100	11,500	1,200	3,300
Total Cereals	588,600	769,200	696,100	604,700
Groundnuts	92,740	133,100	141,300	NA
Sesame	10,000	13,000	12,500	NA
Onions	45,000	47,000	50,000	NA
Cotton	112,000	137,500	151,000	164,000
Sugar Cane	239,000			

Source: ONDR
* Dry Season Sorghum
# Included in Sorghum production
+ Included in Rice production

Yields in the Sudanian Zone, with conditions more favorable for agricultural production, are generally higher than in the Sahelian Zone, except for maize. This is probably because in the Sahelian Zone maize is grown under irrigated conditions in wadis and in flood recessional sites where soils are generally rich in organic matter. Groundnut yields have tended to increase in both zones and may be partly attributed to the use of improved varieties. Sesame yields in the Sudanian Zone also almost doubled in 1988 and 1989, while those for rice tripled. A government marketing scheme for sesame failed to produce any positive results, however, because the buying agency, SOCOTRAF, was unable to honor its transport and price contracts with farmers.

When compared with yields in Malian and Senegalese regions which have rainfall comparable to that in the Sudanian Zone, yields in Chad are lower. Use of improved varieties of food crops, organic manure and cotton/cereal rotation is lower among Chadian farmers than their Malian and Senegalese counterparts. Cotton/cereal rotation has shown a positive influence on cereals production both in Mali and Senegal due to the residual effect of fertilizer applied on

the cotton crop. However, soils composition in these areas is not exactly comparable to composition of those in Chad.

Cereals requirements for Chad are variously estimated at anywhere from 700,000 to 800,000 tons per annum, depending on the per capita consumption rate applied. A BIEP cereals consumption study in the Sudanian Zone arrived at a figure of 183 kg/annum (Table X, BIEP, 1988). Cereals production in the Zone is sufficient to satisfy this per capita consumption level in most years. The Sahelian and Saharan Zones, on the other hand, incur deficits of production over their theoretical cereals consumption levels. The difficulty in establishing a generally accepted cereals consumption level is related to the difficulty in determining with any real accuracy actual cereals production. Serious work needs to be done to reinforce the capability of the extension services to do effective crop reporting and production statistics in Chad. At the present time these duties fall to the BSA, which handles the statistical analysis, and the ONDR, which gathers the information in the field.

Cassava, taro (*Xanthosoma sagitifolium*), voandzou, sorrel (*Hibiscus sp*) and cowpeas are also grown in pure stands or in association with other crops. They are a source both of food and extra revenue for many farm families. Cassava is of particular importance because it is drought resistant, requiring moisture mainly during the first three months, and can grow in impoverished soils. Agricultural practices used in Chad for these crops are not well developed. For example, taro density and ridge orientation at Kim were observed to be inappropriate.

Table X
Cereals Consumption in the Sudanian Zone
(kg/capita)

Prefect-ure/Crop	Moyen Chari	Logone Orient.	Logone Occid.	Tangile	Mayo Kebbi	Avg.
Mil/Sorg.	100.0	160.2	218.9	121.9	138.3	128.5
Rice	0.4	0.4	2.2	18.3	14.6	8.0
Fonio	-	-	22.3	10.2	7.3	6.9
Maize	1.8	4.8	1.5	4.7	6.2	4.4
Prepared Dishes	14.4	14,9	31.8	23.4	28.1	22.3
Home Brew	14.2	25.9	31.0	18.1	11.8	17.7
Total	130.6	205.4	216.9	196.6	206.3	187.8

Source: BIEP, Socio-economic Survey, 1988.

Vegetable Production

Vegetable gardens are common in the urban centers, large towns and certain villages close to these centers. There are different types of gardens:

- Those that are situated along the banks of rivers and lakes and are cultivated by both men and women
- Small gardens in low lying areas (wadis)
- Those located in proximity to villages and watered from wells

Production in the last type of gardens is done mainly by women, organized in "*groupements*" and often assisted by NGOs (see Table IV). These gardens are important in crop diversification and as a source of food supplement to the daily diet and income of the farm family.

Among the main vegetables grown are eggplant, carrots, cabbage, onions, tomatoes, okra, cucumber, cauliflower, spinach, bell and hot peppers and string beans. Production and yield figures are scanty and management level varies depending on, among other factors, market possibilities. ONADEH, whose responsibility it is to assist these farmers in production and related activities has not been able to fulfill that role due to inadequate financial and material support and misappropriation of the limited resources allocated to it. It may be more effective to conduct vegetable gardening extension work through ONDR and the various ONGs and private sector organizations than to utilize scarce fiscal resources in a restructuring or rebuilding of ONADEH.

The production of vegetables for sale on the local market represents a notable evolution in the marketing activity of the sub-region. Farmers on the numerous small irrigated sites around N'Djamena have increasingly turned to vegetable production in order to realize the economic value of these sites. The small urban markets in N'Djamena and other secondary urban areas have thus far provided the main outlet for local production. In addition, as production has increased and prices have declined, tastes have changed and the local market has been able to absorb more vegetable production.

Many areas have begun to specialize in the production of specific products, such as onions in Abeche or dried tomatoes in the Salamat. These concentrations are an indication of the potential that diversification could provide if given the proper environment. Table XI gives an idea of the production possibilities for vegetables in various parts of Chad.

Table XI
Vegetable Production
(Partial Results, 1988)

Zone	Number of Producers	Area (Ha)	Production (MT)	Main Product
N'Djamena	1,260	300	3,050	Tomato, Okra, onion,
Sudanian	1,020	135	1,530	Tomato
Kanem	650	160	3,200	Onion, tomato
Lac	500	125	1,230	Okra (dried)
Salamat	NA	4,800	7,400	Dried Tomato
E. Sahel	NA	3,800	54,000	Onion(43000T)

Source: BIEP, *Les Fruits et Légumes: Une Voie de l'Avenir*, Sept., 1989.

Most vegetables are produced during the cooler dry season when growing conditions are optimal. As a result some markets are showing increasing signs of having reached the limits of their current absorptive capacity for vegetables. Farmers report precipitous drops in prices for certain items (ie. tomatoes) and seasonal oversupply. New techniques will have to be adopted, such as specialization, staggering production more broadly across seasons, cold storage, drying and growing less perishable crops (i.e. onions, bananas).

The state horticultural extension agency, ONADEH, is hampered by an almost complete lack of resources. It should be dissolved and its best agents integrated into ONDR. In the final analysis, the essential factor in horticultural marketing will remain improved access to wider markets through upgrading transport (air freight) and infrastructure (cold storage facilities) and lowering costs of production to enhance Chad's competitiveness vis-à-vis other regions.

Fruits and Agroforestry

Chad has a potential to grow and produce a wide variety of fruits in the Sudanian Zone, around irrigated projects and in low lying areas (wadis) that have adequate moisture. The many mango trees seen in N'djamena and in the south of the country are merely indicative of the potential of this subsector, as can be seen from Table XII which details the approximate size of the fruit subsector in Chad.

Table XII
Fruit Production
(1988)

Number trees				Production (MT)		
Zone	Mango	Citrus	Guava	Mango	Citrus	Guava
N'Djamena	1,240	5,100	715	250	510	35
Sudanian	31,000	5,400	7,200	6,200	550	360
Kanem	75	4,300	440	*	*	*
Lac	250	1070	900	66	525	67
E. Sahel	37,000	3,000	16,000	7,400	315	800
Guera	12,225	4,000	4,300	2,450	400	215

Source: BIEP, Les Fruits et Légumes: Une Voie de l'Avenir, Sept., 1989.

Among the fruits that can be grown, in addition to mangos and bananas are avocados, plantains, papayas, oranges, grapefruits, etc. These fruit trees, if incorporated into the farming system, can act as windbreaks, provide organic matter, food for humans and revenue for the farm family. The review team visited a progressive farmer, growing about 20 different crops of fruit trees and vegetables outside of N'djamena. He has numerous management and technical problems, which he seemed reluctant to admit. Perhaps this was because he was doing his best with the limited resources at his disposal. The most limiting factor to the expansion and further commercialization of the fruit subsector at present is the lack of suitable, improved cultivars.

There are certain wild fruits and trees that are widely utilized on an artisanal basis to provide diversity to the diet and for condiments. Some of these have possibilities for improving the farming system for sustainable production and for revenue. These are karite, nere, neem and *Acacia spp.*

Production System Typology

Four main types of production systems function in Chad: Upland rainfed, Flood recession, Wadi, and Irrigated agriculture. Many farmers pursue two or more forms, as well as livestock production, all of which compete for resource allocation. Minimizing risk from environmental calamities as well as maximizing labor returns are farmers' rationale for diversifying and mixing farming activities. The interrelationships that exist among these farming practices must be understood in order to devise activities aimed at increasing sustainable crop production. The four production systems are summarized below.

Upland Rainfed Agriculture

The rainfed agriculture production system depends directly and entirely on rainfall and is predominantly practiced in the Sudanian Zone where rainfall is adequate (Annex C). The slash and burn agricultural cycle begins in March and April with cutting, burning and tilling. Sowing commences with the first rains in May and June. Crops and varieties grown include sorghum, millet, maize, rice, cotton, sesame, groundnuts, cowpeas, cassava, taro and voandzou. Planting a variety of crops is a risk avoidance strategy and responds to climatic and soil variabilities. These crops are grown in pure stands or in associations. Most common associations are millet/sorghum/cowpea; millet/groundnut/cowpea/voandzou; sorghum/groundnut. Other than for the cotton crop, practically no fertilizer is used.

Upland agricultural soils range from sandy loam to clay loam and have low to medium cation exchange capacity. Because clay and organic matter content are generally low, soil fertility is maintained by a system of crop rotations, intercropping and fallow.

Dune cultivation is a type of upland farming practiced in the dryer parts of the Sahelian Zone where millet is the main crop. Crop failure is common due to erratic rainfall.

Wadi Agriculture

Wadi agriculture is practiced mainly in inter-dunal depressions (wadis) located in the Sahel. During the rainy season rainfall and runoff supply moisture, but year-round production is made possible by irrigation from shallow wells (1-8 meters deep) using a shadouf. A single shadouf is capable of irrigating up to 0.25 ha. Slightly less area may be cultivated during the rainy season, when rainfall makes it possible to devote more resources to dune cultivation. Wadi soils range from sandy loams to hydromorphic clays. Sustained production is maintained by a combination of crop rotations and limited use of organic manure. Several crops are grown according to the following agricultural calendar:

- June to September
  Sorghum, maize, okra and cassava
- October to December
  Carrots, tomatoes, onions, garlic and eggplant
- January to May
  Millet, okra, cowpeas, tomatoes, onion and cabbage

The duration of the sorghum variety is 90 days and yields may approach two tons/ha when a motorpump is used and one ton/ha with a shadouf. The duration of the millet variety, ligui, is 60 days with yields of about 200 kg/ha. This millet variety can be a good forage crop. Each wadi may have 10 to 15 production units, each farmer occupying about 0.12 ha/wadi. The basic farm production unit has seven to nine members. Farmers often work several plots, some of them in different wadis.

A variant of this form of agriculture is practiced in the oases of the B.E.T. (Borkou Ennedi-Tibesti) Zone, with three main categories of crops produced (BNUS, 1990) as follows:

- Fruits - Dates
  Grown in association with irrigated crops like wheat from shallow wells and small dams

- Cereals and Field Crops - Wheat, alfalfa, lucern, sorghum and millet yields are estimated at 200-250 kg/ha under traditional farming but range from 0.5 to 1.0 ton/ha under irrigation. For wheat, yields are estimated at two to three tons/ha with irrigation

- Vegetables - Grown in a crop rotation system involving millet/wheat/vegetables. Some of the vegetables grown are onions, pepper, tomatoes, melons, okra and potatoes. Cowpeas, string beans are also grown.

Cropped area per farm family is about 0.25 ha and seeds are mainly local varieties. Yields for date palms range between 40 and 100 kg/tree (BNUS 1990). Mangoes are also grown. Organic manure is applied to improve soil structure and fertility, thereby maintaining sustainable crop production. Dates are widely sold on the N'Djamena market and throughout northern Nigeria. The extent to which they are marketed to other areas (eg. southern Libya, Sudan) is not well known. It is conceivable that dates, like gum arabic, make a significant contribution to the regional, as well as local economy. However, the parameters of the trade in these two products are not well known and the businessmen who deal in them are quite secretive about them. Some small effort has gone into exploring the possibilities for processing dates for export, but so far nothing has come of it.

Flood Recessional Agriculture

Flood recessional agriculture is practiced along river and lake banks, e.g. the Mayo Kebbi, Salamat and Lake Chad. As flood waters recede in October, farmers dig shallow holes and transplant their crops, often a large grain, 80-day sorghum variety known as Berbere. Soil moisture storage depends on chemical and physical properties of the soil. Soil fertility is maintained by the silts and organic debris deposited by the flood water.

Aside from planting and harvesting, this type of agriculture requires little labor input and conflicts little with upland crops. Planting density is low (3,600 stems/ha) as are the yields (700-900 kg/ha). Nonetheless, this is a very important form of agriculture because its delayed planting and the ability of Berbere to survive on residual soil moisture allows for a second harvest during February or March. This harvest often comes just at the time when prices of conventional rainfed crops are beginning to rise.

Irrigated Agriculture

Irrigated farming is a comparatively new production system in Chad. It requires more labor for bunding and levelling of field plots and construction of irrigation and drainage canals as well as more capital inputs than the other systems. Theoretically, the potential of irrigated agriculture exceeds that of alternative systems given that the plant is assured of adequate soil moisture and forms of macro and micro-nutrients become available due to chemical and structural changes brought about by flooding the soil. Irrigated farming is labor intensive and requires high levels of management, capital and other inputs.

Irrigation in Chad evolved through three types of initiatives:

- Private — Represented by Dagarmassa and Mandjafa. This type is widespread, practiced throughout Chad. The owner is in a position of authority to make management decisions on his own. Most of these are, thus, commercially oriented.

- Village — Gaoui and Saiman. Gaoui started independently in 1940 and became a main supplier of vegetables and fruits in N'djamena. Saiman (*Périmètres Irrigués du Chari*, PIC) was a series of World Bank projects dating from 1976 to 1979. Farmers were assisted by ONDR in land cultivation, input supply and extension services.

- Centrally Administered
  Casier B in Bongor and SODELAC polder cultivation. Project implementation for Casier B was managed by Taiwan (1965) and the People's Republic of China (1973). These efforts were interrupted by civil unrest in 1979 and have never fully recovered.

A type of controlled flood recession agriculture somewhere between irrigation and flood recession is practiced in the Lake Chad area at Guini and Bol. Dikes were constructed on the mouth of the polder by Central Administration. These can be opened and closed to allow water to enter and to stop its entry as desired. Decrease in rainfall over the years has led to the modification of this production system towards that of wadi cultivation. Wadi type cultivation of the polders is particularly effective since the water table in the polders is higher and thus more area can be cultivated. The average area cultivated per farm family with five active members is approximately 0.02 hectares, but a family may have several plots in different polders.

Polder crops include potatoes, wheat, maize, onions, pepper, okra, garlic, tomatoes, cucumbers and eggplants. Seeds are acquired primarily from the local markets. Vegetables are grown principally for sale, while the other crops are for family consumption. Sustainable production is maintained mainly through a combination of the silts brought in from the lake when the dikes are opened, crop rotations and some application of organic manure.

In addition to polder farming, farmers also practice recessional agriculture and livestock raising. The latter two activities are given priority, since they require less labor and other inputs (ARD, 1988). Polder irrigation is used mainly for security purposes in the event of deficit rainfall conditions.

Of the systems above, extension support to farmers was best where irrigation systems were incorporated into projects such as at *Casier* B and Saiman. However, the recurrent costs of extension, water management and other subsidies made total production costs prohibitively high. The basic farm-gate cost of irrigated rice produced in Chad is well above the CIF price of imported rice in N'Djamena. Current prices for domestically produced rice are 200-220 fCFA/kg. in the N'Djamena market, while imported rice sells for 180-200 fCFA/kg.

The Chadian government began emphasizing modern irrigation following the 1973 drought. In 1983, Chad began a rehabilitation program of its existing irrigation schemes, including wadis, polders and flood recession areas. Assistance was received from various financial and development agencies (ONDR, OMVSD, SODELAC and NGOs). By 1985 almost 5,000 ha. were under irrigation. By 1986, because of management deficiencies only 8,800 ha. out of a developed 10,000 ha. were cultivated (World Bank, 1989). In general, medium and large scale irrigation projects in sub-Saharan Africa have performed poorly for reasons ranging from faulty engineering design to poor management. An FAO review suggests that poor economic returns and inadequate farmer participation in design and management act as major constraints to the success of irrigation projects (World Bank, 1989).

Recent irrigation programs initiated by ORT, CARE and Africare in Chad have shown positive results with irrigation (USAID, 1990). Both male and female farmers irrigate vegetables and fruits from shallow wells either using small motor pumps or by hand. In certain locations and for certain Chadians (ie. in the Mayo Kebbi), irrigation both ensures food supply and provides revenue for the family. Several key problems remain, among them:

- Lack of credit
- Lack of appreciation of potential/possibilities by farmers
- High cost of pump sets and other inputs
- Lack of markets and market information
- Inadequate extension service

In summary, irrigation has worked best on a small scale and through private ownership. Useful research, extension and marketing objectives would be to develop and demonstrate good irrigation practices for small private plots, growing high value crops and supported by private sector credit and supply services.

Policy Issues

Costs of Production

Table XIII presents theoretical crop budgets using local prices for the main field crops grown in Chad. It shows that returns to all factors of production in cotton farming are low and that costs per kg produced for input use are high. With the technology presently available, the returns to fertilizer and AT use in millet, sorghum and cotton production do not provide a clear advantage over not using them. For cotton, a 637 percent increase in cost of production (for seed, fertilizer, AT, etc.) results in a mere 20 percent increase in income per hectare and a decrease in income per kg. produced of 37 percent. The advantage of fertilizer use and animal traction for sorghum and millet is even less clear. An 850 percent increase in investment results in a 25 percent increase in income per ha. and a decrease of 38 percent in income per kg. produced. (Table XIII) The higher yields obtained from using inputs on maize and especially onions result in concomitantly higher revenues per unit of production factor. This is reflected in the fact that relatively higher proportions of these crops are marketed -- up to 80 percent in the case of onions (personal communication, farmers in the ORT improved gardening and marketing scheme).

For most of the traditional field crops, it seems clear that fertilizer response throughout most of the area is not what it should be in order to make widespread use economically viable. Whether this is due to deficiencies in the available technical package, present cultural practices or structural problems in soils is not clear. The present trend indicates that a process of "soil mining" is going on in the most productive agricultural areas of the country. With maize, onions and some other vegetables, the principal problem seems to be the difficulty in obtaining access to the inputs necessary to achieve their relatively higher yields. IRCT is just beginning to confront this issue in its research and development agenda. The Second Contract-Plan has proposed modifications in cotton extension to include pilot operations in village land use management (*Gestion des Terroirs Villageois*).

Cotton production still represents the *force motrice* of the Chadian agricultural sector. Raw cotton production has edged past 150,000 metric tons in the last two years. COTONTCHAD has made a concerted and apparently successful effort to restructure after the financial crisis set off by the fall in world market prices. Savings from personnel cutbacks and closings of unproductive facilities, combined with a recovery in cotton market prices and a favorable dollar/CFA exchange rate have resulted in net profits in the last two years operation. While costs of production are high and returns per unit of input low relative to other cropping alternatives, farmers continue to grow cotton. This is essentially because the vertically integrated organization of the cotton sub-sector provides them with key elements that other cropping systems do not -- an assured market, credit, inputs, animal traction equipment, etc. Achieving the goals of increased production, crop diversification and increased marketing of agricultural products other than cotton will require policies that tend to assure this same integration, but without the vertical controls of the cotton sub-sector. The Chadian private sector clearly has a role in this process.

Table XIII
Crop Budgets (fCFA)

	Millet/Sorghum		Rainfed Crops/Maize		Cotton		Irrig Onion
	Trad	Imprvd	Trad	Imprvd	Trad	Imprvd	Motop
Yield (kg)	400	800	750	1,300	450	850	18,000
Labor Use (man days)	75	90	80	90	120	110	200
Crop Value	22,000	44,000	45,000	78,000	36,000	68,000	810,000
Fert., seed,etc.							
Traction	0	7,000	0	14,000	2,000	17,500	22,500
Hired Labor	0	10,000	0	10,000	0	10,000	0
Tools	0	1,200	0	1,200	0		1,750
	2,000	2,000	2,000	2,000	2,000	2,000	60,000
Total Costs of Production	2,000	19,000	2,000	26,200	4,000	29,500	84,250
Income per:							
Hectare	20,000	25,000	43,000	51,800	32,000	38,500	725,750
Man Day	267	278	540	575	267	350	3,600
Kg. Produced	50	31	40	40	71	45	40

Source: ONDR, BRA, Personal communication April-May, 1991

Agricultural Technology Transfer

An appropriate system for the development and transfer of new production and marketing technologies to users is lacking in Chad. The technology packages presently available are generated without much prior reconnaissance of the farming systems practiced in Chad. Current packages include, among others:

- Improved crop varieties
- Cultural practices (fertilizer application, use of organic manure, soil and water conservation methods, planting density, crop associations and rotations, etc.

The process assumes that both extensionists and farmers are directly involved from the onset, so that the technologies developed address farmers' most pressing needs, taking into consideration their resource capabilities. Unfortunately, most technologies that have been developed and released to farmers in Chad have often not followed that process.

In Chad, technology transfer takes place at the lowest extension level (*Vulgarisateur*), often with little or no on-the-job supervision from the top. This lack of supervision, compounded by inadequate technical training, leads extension agents to respond by spending over 50 percent of their time on credit, input supply and marketing of cotton. In the case of the Sahelian Zone with no cash crop, agents may simply spend most of their time on area and crop reporting.

Moreover, the classic extension approach of simply delivering the goods to the farmers, who are often considered not to have an understanding of their environment and farming practices, is still predominant. The exceptions are NGOs, which maintain a village-level approach to project identification and implementation. The lack of consultation with farmers in extension management decision-making has invariably resulted in breakdowns in the implementation process. It has also led to the development of crop varieties that are often unsuitable under farmers' conditions. Consequently, the desired results are not obtained. An example of this is ONDR's current broad/blanket promotion of line-sowing technology. Results of grain yields obtained in comparative studies of line versus broadcast/random sowing have not been conclusive. The technique should have been tested conclusively before extension. If extended at this stage, it should have targeted farmers with AT equipment, since it allows for easier performance of certain cultural practices only when AT or mechanized equipment is used.

This inability of extension agents to recognize and find solutions to simple production problems was noted during review team field visits. For example, during the visit to wadis at N'gouri, there was more than adequate cassava planting material. Therefore, the extension agent should have advised the farmers to use only the lower half of the stems for planting since this section is more matured physiologically and would therefore produce higher yields. This was not done. In addition, crop residue close to the windbreaks/edges of the field should have been either plowed in during land preparation or burned and incorporated in the soil to improve its

structure and fertility. Such leftover residue will eventually harbor both pests and rodents. Rodents were, in fact, reported to be a problem in those wadis. In the case of the Koyom irrigated rice perimeters, there was no water in some of the plots which could result in drastic yield reductions if it were during flowering time. The occurrence of blast (*Pyricularia oryzae*) reported in those perimeters is likely due to this periodic absence of water in the plots, as this disease has not been noted beyond those perimeters. Blast is generally only a problem on upland rice.

The lack of on-the-job supervision, often combined with inappropriate systems of training and the absence of incentives even for productive extensionists does little to increase the effectiveness of the extension system. Women who produce a large share of the vegetable crop and provide a substantial amount of the labor in agricultural activities receive little or no attention as there are no female extension agents in the Chadian development institutions. The present Chadian institutional approach to extension is inadequate to respond to farmers problems and aspirations.

There are several new initiatives which, if properly coordinated, could improve technology transfer to Chadian farmers. These are producer groups (*Groupements des Producteurs*) in both the Sudanian and Sahelian Zones, the recently constituted *Cellule recherche/développement* multidisciplinary team at ONDR and the recently initiated pre-extension trials and mini-dose programs in both Sudanian and Sahelian Zones. The pre-extension and on-farm trials are mainly varietal and intercropping experiments carried out in farmers' fields with extensionist supervision. The objective of the trials is to evaluate performance of the varieties and complementary practices under farm conditions to obtain feedback from the farmers. If the technology receives a favorable response from the farmers after two to three years of testing, it is recommended and communicated to other farmers with comparable conditions.

Agricultural Research/Development/Marketing Linkages

Certain fundamental linkages, both within the agricultural sector and between it and other sectors must be taken into account in the establishment of agricultural policy. For instance, increasing the marketing of agricultural products implies an increase in production as well. This, in turn implies an increase in the availability of factors of production -- fertilizers, machinery, chemicals, credit, etc.

Since the links in the agricultural production chain are interdependent, research, development and marketing must be in place and in harmony if extension is to be effective (Roberts, 1989). While Chad's agricultural development policy speaks of increasing food crop production, its actual focus is limited to the main cash crop, cotton. This is evidenced by the fact that Chad's only effective research organization is the IRCT, and that the activities of COTONTCHAD and ONDR dominate extension themes in the Sudanian Zone. Research, input distribution, credit, animal traction, extension service infrastructure and marketing programs are

all linked to the production and sale of cotton, with much less emphasis on traditional food crops such as sorghum, millet, maize and rice.

Responsibility for agricultural research, extension, development and marketing for food crops in Chad is relegated piecemeal to a number of agencies and is poorly coordinated. This is evidenced in the programs of BRA, ONDR, ONADEH, SODELAC, DPV and OMVSD, some of which only touch on food crop production and others of which have overlapping programs. Unfortunately, projects financed by donor agencies have rarely targeted food crop production and marketing.

Consequently, the limited amount of available research (e.g. improved varieties of seed for food crops) relevant to current production systems often remains "on-shelf" instead of being made available to farmers. Attempts by the state to carry out both production and marketing for rice, coarse grains, cowpeas, sesame and vegetables have been unsuccessful because of poor organizational structure, mismanagement and inadequate infrastructural and financial resources. Planning and management of the production-marketing chain needs strengthening and better coordination in order to foster productive partnerships between researchers, extensionists and farmers. More fundamentally, production-marketing programs for food crops require incorporation into the overall national policy process.

Spread of Impacts/Benefits of Transferred Technologies

Despite the inadequacies and limitations of the Chadian extension service structure, its composition and its approach to extension, certain technologies have been introduced and a wide range of impacts/benefits obtained. Obviously such benefits are neither always quantifiable nor are they always a direct consequence of a given technology introduced. For example, several NGOs have introduced and promoted vegetable production, in some cases in combination with improved water lifting and irrigation methods and/or nursery and seedbed preparation. Introduction of vegetables in the farming system improves the nutritional content of the farm family diet which in turn leads to improvement in health status and results in increased productivity.

Income generated from the sale of vegetables indirectly increases staple food availability as farmers do not need to sell cereals for cash at critical periods to meet family needs. Vegetable leftovers and trimmings can also be fed to livestock and the manure produced by the animals incorporated into the soil to improve its structure and fertility. The incorporation of organic manure in the soil minimizes soil nutrient depletion and erosion, resulting in a more sustainable production system.

Upgraded wells also improve the health of both humans and livestock while the extra available water can be used for irrigation. This is especially important in the Sahelian Zone where moisture is the single most limiting factor to agricultural production. First year results from the CARE tubewell hand pump introduction show the tubewell to be more effective in

water lifting than the traditional shadouf, especially in the surrounding villages in Noukou (USAID, 1990).

Calculations of net revenues earned by farmers who have adopted NGO introduced technologies are contained in the respective final evaluation reports of USAID projects (USAID, 1990). Satisfactory results were obtained by farmers growing the improved rice variety IR 46 in the CARE supplementary irrigation project, as shown in the Table XIV. Differences in yields reflect levels of management which can be greatly improved through effective extension, credit and input supply services. Africare is reporting gains derived by farmers through crop diversification from 1989 test plots amounting to 8903 fCFA (USAID, 1990). The ORT project has had good success with improving the productivity and revenue possibilities in wadi agriculture in the Kanem. In general, the NGO approach, though often limited in scope, has proven to be a more effective means of developing appropriate technologies than more broadly based and better funded extension approaches.

Managing Local Resources

A notable sign of evolution toward farmer managed input provision has been the development of Producer Groups (*Groupements de Producteurs, GP*). These evolved primarily from village cotton marketing groups, *Marches Auto-Gères* (MAGs), which have been actively promoted by COTONTCHAD and ONDR. Producer Groups have taken charge of the management of cotton sales in a large portion of the Sudanian Zone. In return for organizing the weighing, grading, and sale of their own cotton production, these associations are granted a rebate (*ristourne*) of 5% of the value of their crop to do with as they choose. Other types of *groupements* have sprung up alongside these *groupements* and in many areas outside the cotton zone. As Table XV shows, the formation of these groups has gone far beyond the management of cotton marketing.

Groupements Villageois, other than AVs are classified according to their function, sector of activity, and/or male-female membership. There are six types, as follows:

- ***Groupements de Base*** (male or female). These are usually organized around a specific activity and a specific part of a village population (often a *quartier*, or neighborhood). An example would be the women's gardening group in Ere. There are an estimated 12,000 of these nationwide.

- ***Groupements d'Intérêt Pastoral*** (GIP). There are approximately 75 of these, located mostly in the Sahelian Zone.

- ***Groupements de Défense Sanitaire*** (GDS). There were around 700 of these at one time, but an unknown number have ceased to function. Their chief goal is to establish and maintain a village pharmacy.

- Other *groupements* are formed around specific occupations, such as *Groupements de Pêcheurs* (fishing), *Groupements de Maraîchers* (truck gardening), *Groupements d'Artisans Ruraux* (blacksmithing, carpentry, etc.) and *Groupements de Commercialisation* (eg. in the ORT Project). The number and location of these groups is not well known.

Table XIV
Farm Production and Revenues in Four CARE-Chad Supplementary Irrigated Rice Perimeters

	1986	1987	1988	1989	1990
	KOYOM				
Grain Yield t/ha	4.6	3.7	2.8	1.3	4.1
Production kg/farmer	694	372	409	149	654
Net fCFA/farmer*	58,018	31,099	34,192	12,456	54,674
	KIM				
Grain Yield t/ha	3.9	1.5	2.9	1.7	
Production kg/farmer	520	192	322	308	
Net fCFA/farmer	45,916	16,954	28,433	27,916	
	KOLOBO				
Grain Yield t/ha	2.2	4.5	0.5	1.9	2.6
Production kg/farmer	87	303	18	275	251
Net fCFA/farmer	7,839	27,300	1,622	24,778	22,615
	DJOUMANE				
Grain Yield t/ha	4.2	4.8	5.7	4.2	4.7
Production kg/farmer	166	360	533	511	752
Net fCFA/farmer	16,368	35,496	52,554	50,385	74,147
	MOUROUP				
Grain Yield t/ha	3.3	3.9	2.0	3.3	
Production kg/farmer	64	249	164	315	
Net fCFA/farmer	5,766	22,435	14,776	28,382	

Source: CARE-Chad, 1991
* After payment for production inputs. Price of paddy varies from perimeter to perimeter and period of year.

Other collective activities promoted by ONDR and some NGOs, such as village storehouses, security stocks and cooperative cereals marketing have met with mixed success. The essential constraint to activating these associations beyond cotton marketing is the development of a management training approach appropriate to village realities. For example, some aspects of village life are eminently communal; decisions on land use, construction of social infrastructures and construction of civil works such as rice perimeters or drainage works. Others are very individual; what to produce, when to sell, investment of personal funds. Organization of village groups should be careful not to confuse communal goals such as building a dispensary with individual goals such as income and food security. Certain NGOs, like ORT, NCBA, and CARE, have excellent track records in management training of village organizations and have done an admirable job of drawing these distinctions.

Table XV
***Groupements Villageois* (GV)**

Zone	Groupements	Associations Villageois	Unions
Sudanian, Cotton	10,062	1,209	4
Sudan, non Cotton	1,000	-	-
Sahelian	1,500	-	-
Total	12,562	1,209	4

Source: Couvreur & Ndjonkou, *Mission de Consultation pour le Diagnostique Sectoriel et l'Assistance à la Formulation de Stratégies et Programmes, Rapport de Mission*, UNDP/ILO, Nov., 1990.

Groupements Villageois legal status is often vague. Organization and operation of these groups is technically regulated by the national cooperative legislation. Since most GVs were formed spontaneously, largely in response to market pressures (need for access to factors of production and credit), they barely resemble true cooperatives. It is for this reason they are often called "pre-cooperatives". Some government and extension people feel that the outdated cooperatives legislation needs to be rewritten to accommodate these groups. Current cooperative legislation is so complicated and restrictive that most coops are not officially registered. A more effective solution might be to simply give local organizational statutes the force of law whether they be written or verbal.

Another promising initiative has been the interest among some organizations in the in new extension techniques such as village land use management. This approach is given some priority in COTONTCHAD's Second Contract Plan (see, *Comité de Réflexion*, 1990). A basic tenet of this approach is the training of producer groups to do more of the routine extension tasks like input sales and distribution. This would leave more time for a more highly trained and motivated rural development cadre to work directly with the village to inventory its resources

and develop a plan for their rational exploitation. The concept is being espoused by the National *Direction* of ONDR, but has thus far only been tried out in the cotton zone where 43 *Conseillers Rurals* have been assigned. Another approach, called *Recherches-Actions-Développement* differs only in that the emphasis of the extension team would be directed toward identifying and solving the village's technology related problems. In each case, the broaching of this process implies the establishment of an appropriate legal framework which would include private sector participation.

III. Natural Resource Management

Natural Resource Status and Trends

For the purposes of this review, natural resources are considered to consist of climate, soil, water and vegetation. In analyzing these resources, the elements that have an impact on them including livestock, fuelwood harvest and agriculture are also considered.

Farmers and pastoralists in Chad long ago evolved agricultural systems which successfully used and conserved natural vegetation, soils and landscapes as well as responded to climatic variances and uncertainty. These systems, shifting cultivation and transhumant pastoralism, achieved environmental equilibrium because land was available for new fields to be tilled or for new pastures to be grazed. Farmer and pastoralist demands on soil fertility were light. After a period of use, most land reverted to a bush fallow or pasture until either soil fertility or forage was again suitable for use.

Today, population, economic and political pressures have altered this pattern. Fallows have been shortened or have been abandoned entirely. Cotton, introduced as a cash crop, has encouraged soil resource depletion. Livestock populations have exceeded grazing capacities and their invasion of planted or communal fields and water supplies has resulted in conflict. Urban population concentrations have seriously depleted natural fuelwood supplies. Shortfalls in seasonal precipitation since the 1960s have led to an apparent southward shift of Chad's bioclimatic regions. Land areas which experience recurrent drought have expanded.

Not only is the amount of rainfall less than pre-1960 levels, but the duration of the rainy season and hence the growing season is less. Farmer risk is increasing due to a rise in climatic uncertainty as seasonal precipitation levels shift downward. Successfully intensifying land use to adapt to these conditions requires an adjustment of crop characteristics and cropping and grazing practices to reflect the reality of a persistent dry cycle in the agricultural climate.

Bioclimatic Regions and Climatic Resources[1]

Three principal savanna bioclimates occur in Chad; the Sahel, the Sudan and the Guinea. They lie in a series of roughly parallel bands running east to west. The Sahel and Sudan savanna are semi-arid whereas the Guinea savanna is subhumid. Annex B shows their locations

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[1] A problem in researching the impact of drought on agriculture is the variety of classification systems which different authors apply to Chad's bioclimatic regimes. Cheval, in 1900, described three broad zones which he named Guinea, Sudan and Sahel. Subsequent researchers during the late 1950s added subdivisions to these categories (Kowal and Kassam, 1978). In Chad, most of the scientific literature retains Cheval's modified classification. Other documents, most notably those from the GOC and the donor community, designate bioclimatic boundaries according to a variety of schemes. These are inconsistent with standard usage and run the risk of confusing agricultural planners.

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based on long-term data and characteristic criteria. Annex B also shows a downward shift of regional boundaries reflecting, among other factors, recurrent drought since the 1970s. Table XVI gives the correspondence between politico-climatic designations used by the GOC and the bioclimatic regions used in this report.

Table XVI
Correspondence Between Politico-Climatic Designations and Bioclimatic Regions

Province	Politico-Climatic Designation	Bioclimatic Regions: From Long Term Data	Recent Trends
Batha	Sahel	Southern Sahel	Transition N/S Sahel
Biltine	Sahel	Southern Sahel	Northern Sahel
Chari Baguir	Sahel	Sudan Savanna	Southern Sahel
Guera	Sahel	Sudan Savanna	Trans.Sahel/Sud.
Kanem	Sahel	Southern Sahel	Northern Sahel
Lac	Sahel	Southern Sahel	Northern Sahel
Ouaddai	Sahel	Southern Sahel	Southern Sahel
Salamat	Sahel	Sudan Savanna	Sudan Savanna
Mayo Kebbi	Sudan	N.Guinea Savanna	Sudan Savanna
Tanjile	Sudan	N.Guinea Savanna	N.Guinea Savanna
Logone Occid	Sudan	S.Guinea Savanna	N.Guinea Savanna
Logone Orien	Sudan	S.Guinea Savanna	S.Guinea Savanna
Moyen Chari	Sudan	N.Guinea Savanna	N.Guinea Savanna

The Sahel Bioclimate

The Sahel bioclimate extends from 12 to 18 degrees latitude where it provides a transition from desert to Sudan savanna. Only the southern Sahel is suitable for rainfed agricultural production. Its northern boundary begins where there is sufficient minimum rainfall to meet the water requirements of 75-day millet, or at about the 350 mm annual rainfall isohyet. Its southern boundary lies at the 550 mm isohyet.

The Sudan Bioclimate

The Sudan bioclimate lies south of the Sahel between isohyets of 550 and 880 mm annual rainfall. This region is normally about 280 to 300 km wide, but is experiencing compression from the north due to southward intrusion of the Sahel. The amount of rainfall and its greater reliability and duration (100 to 140 days) allows a range of crops to be grown. Unlike the Sahel, rainfall exceeds potential evapotranspiration and can be stored as groundwater. Good

agricultural yields depend upon timely and early sowing and cultivar selections that match the rainy season's short duration.

The Guinea Bioclimate

The Guinea bioclimate has the highest agricultural potential of the three. Because of its diversity, it is divided into two zones at the 1500 to 1600 mm isohyet. In this zone water surpluses exceed potential evapotranspiration. The average rainy period lasts from 140 to 200 days.

Criteria for Bioclimate Identification and Implications

Identification of boundaries for the above bioclimatic regions depends on analysis of rainfall data. Annex C shows mean annual rainfall developed from long-term data for Chad. It also shows rainfall trends from 1940 to the present for each of the above bioclimates (data taken during the 1980 war years are not yet available). Each of these time series shows the influence of continuing, below normal rainfall since the late 1960s or 1970s.

Analysis of long-term trends for sub-Saharan savanna regions shows little reason for optimism. For the droughtier bioclimates, mean annual rainfall is probably an overly-optimistic estimator of land suitability for agriculture. Rainfall distributions are skewed and the distribution mode rather than the mean is probably of more immediate interest to farmers. To improve matching between crops and rainfall, agricultural planning should in part rely on frequency analysis of rainfall data in order to define its reliability and drought risk.

Monthly rainfall measured at ORT's project site at N'Gouri near the northern boundary of the southern Sahel savanna illustrates the problem described above. In the words of one farmer, "We used to get two crops of millet every three years, now we get only one." In the course of three consecutive years, 1987-89, only one millet crop was harvested. Although both 1987 and 1989 showed promising rains during June, they were followed by shortfalls during July. August for both years yielded good rainfall, but September rainfall was too low to allow adequate crop development. Only 1988 showed a consistent trend in rainfall and is considered historically a good year, though rainfall data from Ati (Annex C) show 1988 to be considerably below the good years of 1945 through 1965.

One reason that agricultural risk is high at N'Gouri and other areas within the Sahel is that throughout the year potential evapotranspiration exceeds rainfall. Table XVII shows the moisture storage capacity needed to meet evapotranspiration demands for the various bioclimatic regions, revealing a continual deficit in the annual water budget that is typical of the Sahel bioclimate. Table XVII relates rainfall to potential evapotranspiration for each bioclimatic region and gives the relative amount available for soil moisture storage and dry-season use. Only south of the Sahel does rainfall provide a surplus. Only in the Guinea savanna is this important enough to be interesting for agriculture and perennial crop production.

An important result of insignificant soil moisture storage during the dry season is its effect on perennial vegetation. Because soil moisture storage is only 0 to 11 percent of annual rainfall for the Sahel and Sudan savanna (Table XVII), insufficient moisture is available for perennial plants to survive extended drought. In the 1960s, *Acacia tortillis* and *Balanites aegyptiaca* extended as far north as 15 degrees 30 minutes north latitude. By 1975 all ligneous and perennial species had disappeared above the 15 degree parallel (UNDP, 1989). Recent observations indicate drought-related mortality of Acacia as low as the 12 to 13 degree north latitude.

Table XVII
Magnitude of Available Soil Moisture Storage to Meet Evapotranspiration Demands of Different Regions

Bioclimatic Region	Mean precip. (mm/yr) [P]	Mean Evapotransp. (mm/year) [ET] Wet Season	Dry Season	P - ET Wet Seas (mm/yr)	% Surplus P to meet Dry Seas. ET
South. Sahel	475	500	1400	-25	-
Sudan Savanna	740	670	1130	120	11
N. Guinea Sav	1090	780	770	310	40
S. Guinea Sav	1450	940	410	510	124

Source: Kowal & Kassam, Agricultural Ecology of the Savanna-A Study of West Africa, 1978.

Soil moisture deficits in the Sahel and Sudan savanna create a high degree of risk for tree planting programs. Risk elimination requires irrigation and control of competition. Forest replanting costs, including weed control and watering, in the zone surrounding N'Djamena are 400,000 FCFA/ha (personal communication, 1991, *Direction des Forêts et de la Protection de l'Environnement*). Because of pronounced aridity and the disproportionate effects of minor shortfalls in rainfall on survival and productivity, the Sahel and Sudan savanna are unsuitable for large scale plantation afforestation.

Productivity of Vegetation

Since 1983 satellite-based technology under the FEWS project has been available to appraise the productivity of Chad's vegetation. From this information a vegetative index value is computed for specific locations. The index is a measure of the response of vegetation to weather (FEWS, 1990).

Vegetative index values computed for Chad (Annex D) show a rapid flush of growth starting with the onset of rains in May. This rapidly peaks in August after which follows a steep

recession leading into the dry season. This pattern is typical of bioclimates dominated by annual vegetation. The width of each band is indicative of the duration of seasonal rainfall and the cropping cycle. Its height gives an idea of vegetation amount and vigor. The magnitude of dry-season low values shown in the Annex gives an indication of the abundance of perennial ground cover. Both Bousso and Moundou show increases since 1988 of minimal vegetation index values, and may indicate an improvement of perennial vegetal cover in the lower Sudan and Guinea savannas. The pronounced shoulder on the recessionary portion of the index curves for Ati may be caused by a mid-season break in the rain pattern similar to that shown for N'Gouri during 1987 and 1989. Vegetation which responds to early rainfall would flourish, die back or become dormant during a dry spell, and then partially regrow during a second rainy period (Personal communication, FEWS, 1991).

Vegetation index values as well as rainfall are reflected in crop surface area statistics. Annex E shows annual cropland by bioclimatic region. Crop area in the north of Chad is strongly rainfall dependent. In the south this dependency is less evident. Most of crop surface variability occurs in the Sudan and Sahel bioclimates where drought plays a major role in plant survival. In the Sahel, crop surface reductions during 1984 which coincided with expansions in the Sudan savanna could have been war related. A reduction of cropland and vegetative index in the vicinity of Bousso during 1988 may have been caused by waterlogging.

Soil Resources

Intensification of agriculture within Chad and the sustained maintenance of its productivity depends largely on soil fertility. Fertility is the soil's ability to supply nutrients and water to enable crop development and growth, and relates to both its chemical and physical properties. Soil fertility differs widely throughout Chad, showing variations according to bioclimate, relief, parent material and management.

Were it to depend solely on rainfall and temperature, the boundaries of Chad's soils would correspond very closely to those of its bioclimates shown in Annex B. However, minor changes in relief greatly affect drainage, soil erosion and deposition in ways that modify soil formation. Areas where these factors particularly influence soil development include the floodplains of the Middle Chari and Logone Rivers, Salamat and the Bahr Erguig overflow plain tributary to the Chari.

There are at least four regional soil maps of Chad. Of these, ORSTOM's 1968 "*Carte Pédagogique du Tchad*" drawn at 1:1,000,000 scale is the most detailed for regional planning purposes.

Soil Orders Found in Chad

At least five soil orders are found in Chad. These include Alfisols, Oxisols, Vertisols, Inceptisols and Aridisols. Soil moisture regimes in the northern two-thirds of the country are aridic, the remainder ustic. Soil temperatures in the Sahara are hyperthermic. Below the Sahara they are thermic (Wambeke, 1982).

Aridisols extend east and southward from the shores of Lake Chad where they border the Sahara. They are formed under a hot and dry climate with rainfall rarely exceeding 500 mm/year. Their parent material is probably aeolian in origin. Weathering and leaching are slight, so that these soils retain appreciable amounts of silicates which may cement into a duripan if mismanaged. Their physical properties are good but will deteriorate rapidly on cultivation. Soil chemical properties are moderate. Because of low rainfall, their best utilization is probably extensive grazing.

Extending northeast from Lake Chad along the channel of the Bahr el Ghazel and also south along the floodplains of the Chari and Logone Rivers lie areas of **Vertisols**. These are dark colored heavy clay soils that expand on wetting and are formed from basic materials under poor drainage conditions. The clay, though fertile, is hard and difficult to work. These soils are rich in calcium but may be deficient in phosphate. Because they have only small amounts of organic matter, total nitrogen levels may be insufficient for more than moderate crop yields. Their development depends on the ability to maintain the unstable soil aggregates that form on cultivation and the provision of effective drainage. The control of salt formation in the Bahr el Ghazel and nearby wadis is also important.

Alfisols dominate south and east of the Vertisols, primarily in the southern Sudan and Guinea savanna bioclimates. They may form an association with Inceptisols towards the center of their zone where soils are poorly drained and regularly inundated. Such associations are probably strongly correlated to relief. Alfisols are zonal soils developed under 500-1200 mm/year rainfall and sharply marked dry and wet seasons. They are highly weathered and laterised by the loss of silica.

Oxisols are climatogenic soils that lie in high rainfall areas in southern Chad, Formerly they would have been considered high forest soils and represent a further stage of weathering from Alfisols. They are deeper and more dependent on soil organic matter to retain their apparent tilth and moderate fertility. Poor management causes them to rapidly lose their good qualities and degenerate into a sticky, heavy clay.

The above classification is very general and refers only to soil orders which occur in agricultural areas of Chad. Similarly, the map which shows their location (Annex F), is intended to give only an impression of their distribution and is not suitable for planning purposes. Important variations which occur in these soils are not discussed.

All of these soils are extremely fragile. With the exception of Vertisols, all are chemically poor to very poor. Kaolinite dominates the clay fraction in the cultivated layer but is subject to leaching and downward translocation. Organic matter is very low, giving most soils a limited exchange capacity. Phosphate deficiency is common and other soil nutrients may be below levels required for high crop yields. Areas where recessional agricultural is practiced appear to receive some benefit from plant and algal residues deposited by receding water. Most soils are poorly buffered against changes introduced by farming and require careful management. Low buffering capacity of the soils could cause nutrient deficiencies which result from excessive fertilizer applications. High and frequent doses of ammonium sulfate could reduce soil Ph to levels unsuitable for crop growth.

Physical Condition of Soil and Structural Development

Soil physical condition in Chad is generally indicative of weak structural development. Soil aggregates are usually small and unstable when wet. When cultivated, pore size distribution changes so that soil moisture storage is more related to texture than to structure. Soils tend to form surface crusts early in the season that may impede moisture penetration and gas exchange, increase runoff and discourage seedling emergence. Clays and organic residues are readily mobilized by rain splash and washed away, causing the soil surface to become lighter and less fertile. This process can be accelerated by ridge cultivation and raised beds as practiced in some areas of southern Chad. There is a seasonal rise of the water table in low-lying topography and on lower slopes which often causes water logging. Crops may lodge, roots die and fertilizer and soil nutrients wash away.

Continuous farming of tropical soils under low management inputs invariably leads to soil impoverishment and steady-state, low levels of production. Not only do yields decline, but farm labor requirements may increase due to the need for additional weeding. Annex G causes concern as it shows Chad's per capita cereal production has already achieved a state of low-level, continuous, non-improving output. The Annex shows cereal production which responds mainly to rainfall, but at a rate that appears to be decreasing with time. It indicates that, based on production and population data since 1969, average per capita cereals production is only 140 kg/person/year. BIEP (undated), in a survey of Chadian households, measured cereal consumption in the cotton zone to be 187.8 kg/person/year, an average shortfall of nearly 50 kg/person/year. Annex G exposes a scenario typical of degraded soils which require considerable time, energy and investment to improve.

The risk of climate-related soil degradation in Chad varies from high to very high. Soil degradation processes of primary concern include water and wind erosion, loss of organic matter (biological degradation), leaching of bases (chemical degradation), and soil salinization and sodication. Wind erosion dominates the arid north of the country. Water-caused soil erosion, biological and chemical degradation all rate high to very high in the south. Although climate-related soil salinization and sodication risk is uniformly distributed throughout Chad, its main

occurrence is in the Sudan savanna and the Sahel in areas which have high water tables or poor irrigation management.

Water-Caused Soil Erosion

The risk of water-caused soil erosion is so high in the southern half of Chad that it deserves special consideration. One reason that African agriculture is so often unable to match its climatic potential is because of farmer inability to control soil erosion, particularly under conditions of continuous cropping. The impact of soil erosion on crop yields depends on the nature of the soil, particularly its depth, stability and inherent fertility. Table XVIII shows soil loss tolerances developed for agricultural planning in temperate climates. It shows that, depending on rooting depth and substrate, the regenerative processes of temperate soils can tolerate up to 11.2 t/ha/year soil loss. This indicates several shortcomings in tropical agricultural regions. First, soil fertility tends to concentrate near the soil surface, causing severe crop yield declines if the soil surface is lost. Secondly, crop rooting depths tend to be less in the tropics than in temperate areas. Third, Chad's most important agricultural soils, particularly the Alfisols, tend toward shallowness. Very likely, soil losses in excess of two to three t/ha/year will lead to continuing crop yield declines until a steady-state, minimal yield level is reached, e.g 400 kg/ha/year of maize or sorghum.

Controlling Water-Caused Erosion.

Although numerous methods exist to control water-caused soil erosion, their applicability and acceptability to Chadian conditions are unknown. Examples of potentially suitable erosion control include runoff control, mulching, composting, rotational cropping, intercropping, grass strips, grass bands, contour tillage, tied ridges, agroforestry, alley cropping, etc. Chad experiences widely varying erosion processes that are strongly relief dependent. With a relatively low agricultural topography, several different techniques may have to be used within a short distance on the same field. As an example, contour tillage near summits could probably benefit water conservation and crop yields on southern Alfisols. Conversely, these same fields suffer from an excess of water on their lower slopes and require runoff control and drainage.

Given the means at hand and taking into account the technical skills of farmers and extension personnel, the wisest approach is to promote soil conservation through the back door. Rather than promote a soil conservation message, Chad should adopt simple techniques that increase yields and, at the same time, conserve soils. The message promoted by extension personnel and teachers should continue to emphasize agricultural production, but only using technology and plant materials in which soil conservation is intrinsic to the method. Examples of suitable technology in order of complexity include planting to optimal densities, grass strips and bands, mulching with crop residues before the onset of rains, agroforestry, contour tillage, and alley cropping.

Wind-Caused Erosion

Wind erosion is having a severe effect on farm and livestock productivity in the Sudan and Sahel bioclimates. As with water-caused erosion, wind erosion relates to factors of climate, soil, topography and management. In the Sahel, millet farming in combination with overgrazing in high risk areas is seriously reducing land stability. In the Sudan savanna, grazing sorghum stubble and harvesting firewood is increasing wind shear on bare soils. Once stable dunes are reactivating and starting to invade wadis. Dust storms are becoming more prevalent. Surface soils are becoming coarser, the finer-sized particles being removed by wind. As soils become coarser their water holding capacity lessens, perennial vegetation dies and seedling establishment becomes more difficult.

Table XVIII
Soil Loss Tolerances
(t/ha/year)

Rooting Depth (cm)	Soil Loss Tolerance (t/ha/year)	
	Renewable Soil*	Non-Renewable Soil#
0 - 25	2.2	2.2
25 - 30	4.5	2.2
50 - 100	6.7	4.5
100 - 150	9.0	6.7
150+	11.2	11.2

* Soil with favorable Substrata that can be renewed by tillage, fertilizer, organic matter, etc.
\# Soil with unfavorable substrata such as rock or weathered material.
Source: McCormack & Young, "Technical and Societal Implications of Soil Loss Tolerance", in Morgan, ed., Soil Conservation Problems and Prospects 1981.

Controlling Wind-Caused Erosion.

Management objectives to reduce wind erosion are similar to those used to counter water erosion: soil surfaces require protection, soil organic matter content needs improvement, resistance to wind shear needs to be increased by creating conditions that favor perennial vegetation establishment and survival. To accomplish this, important improvements in agricultural practices in high risk areas are necessary. Millet farming in the Sahel where crops fail two years out of three is inconsistent with principles of agricultural sustainability. Livestock numbers in these same areas need to balance grazing capacity as evidenced not only by vegetal biomass and theoretical computations, but also soil condition. Grazing of cereal stubble in the Sudan zone requires control to reduce the present rate of wind shear.

Biological Soil Degradation

Biological soil degradation is a function of microbiological activity, which itself is a function of temperature and soil moisture. The immediate result of biological degradation is the loss of organic matter, the main consequences of which are physical soil degradation, loss of nutrients, and an increase of runoff and erosion. It has its greatest risk in the Sudan and Guinea savannas; elsewhere within Chad it is moderate. Loss of organic matter can result from soil erosion, but here we are more concerned with its loss as a result of mineralization of resistant organic matter or humus. The rate of organic matter decay varies according to soil texture, being faster in sandy soils than in clay. In this way biological soil degradation operates as a synergetic process with soil erosion, each combining with and contributing to the other.

Controlling Biological Soil Degradation.

The key to the control of biological soil degradation is to manage soil organic matter. Deficits of soil organic matter occur when biomass productivity is below that required to maintain humus levels. In Chad, biomass deficits commonly result from land clearing as well as competing demands for above-ground products: wood and sorghum stems for fuel and construction materials, forage for livestock, wood for dead fences, etc. In addition, mechanized and animal-drawn implements, in order to be effective, require more complete land clearing than does manual tillage. Comparing productivity values in Table XIX and taking into account demands for fuelwood, construction timber, and forage (see below) demonstrates that Chad has entered into a sustained period of declining soil biomass. An increasing number of farmers are returning only below-ground plant residues to the soil. Soil accounting methods are available to compute the monetary cost of biological soil degradation in terms of lost productivity. For now, however, it is probably safe to assume that, at the national level, it far exceeds the value of the meager fuelwood and construction timber stocks gleaned from an increasingly desertic landscape.

Chemical Soil Degradation

Chemical soil degradation is concerned with the loss of bases (Ca, Mg, K, Na) and soil nutrients through leaching. This is a particular problem in Guinea savanna areas involving soils with free drainage and low cation exchange capacity. The loss of bases leads to soil becoming more acid, possibly to the detriment of plant growth. In the south, this could lead to long-term reductions of cotton yields because of cotton's relatively narrow optimal soil Ph range.

Under natural savanna and using traditional farming systems, most soil Ph values range between 6.0 and 6.8 (Kowal and Kassam, 1978). This level is maintained by a low rate of base removal associated with low productivity, the return to the soil of some of the crop residues, the effect of burning and the absence of mineral fertilizers. In addition, fallow periods provide for the transfer of nutrients from the subsoil to the topsoil to make up for losses during the period of cultivation.

Under continuous cropping, soil reaction tends to fall in proportion to the intensity of cultivation and the application of ammonium sulfate and urea based fertilizers. Soil buffering capacity diminishes and nutrient imbalances may occur. Exhausted soils generally have low Ph values.

In Chad, fallow periods appear to be increasingly less important to agriculture than in the past. ONDR estimates that 55 percent of cotton farmers use a fallow lasting at least 4 years and that 31 percent practice continuous cultivation (Personal contact, ONDR, Moundou). A. Young, in his 1987 study, estimates fallow requirements for tropical soils. He provides cropping factors (ratio of time in crop production to total years including cultivation, fallow and ley) for a number of different soils, climatic zones, and agricultural intensities. Assuming that cotton producers in southern Chad have achieved a transitional agricultural development that is midway between low and intermediate input levels, Young shows that fallow periods for Alfisols should last between five and seven years out of 10; for Inceptisols they should last between four and five years. Except in isolated circumstances, these requirements are not currently met in Chad. Given the trend towards continuous cropping, technological improvements that mimic the effect of a bush fallow (e.g. alley cropping) will become increasingly important to Chad's agricultural economy.

Salts in water and soil, if excessive, cause plant moisture stress similar to drought. They can occur in several forms, each requiring different management strategies. Soil salinity involves the interaction of both soil and water and the capillary migration of dissolved ions towards the soil surface. The greatest problem areas appear to include the Sudan savanna and southern Sahel where depths to the water table are shallow or where irrigation water quality is poor or irrigation is mismanaged. Crop tolerances to soil salinity vary. Examples of tolerant crops include cotton, sorghum and date palm. Intolerant crops include cowpeas, carrots, onions, radishes and citrus fruits.

Many of Chad's wadis contain deposits of natron, a hydrous sodium carbonate variably associated with sulfur, and are not suitable for agriculture. The natron appears to date from the geologic past when Lake Chad was larger and the present-day oases were polders. It is surface-mined and sold throughout Chad and the region as a livestock supplement and condiment.

Soil salinity varies both in time and in space. Water tables rise during the rainy season, bringing salts closer to the surface. Capillary rise in most wadi soils is about 38 cms (Eberschweiler, 1990), enough to bring salts to the surface where the depth to groundwater is shallow.

These wadis lie over a dual ground-water system composed of a shallow, unconfined local aquifer separated by a thin layer of siltstone from a deeper, more abundant regional aquifer. In many areas the quality of regional aquifer water exceeds that of the local aquifer, offering considerable opportunity for improved irrigation management and leaching of soil salts.

Water Resources

Chad's principal water resources include its fluvial systems and related floodplains and lakes, principally Lake Chad and Lake Fitri, and its ground-water systems. Most of its surface water originates outside of Chad in high rainfall areas within the Central African Republic. Much of its groundwater is fossil in origin. Fluvial systems which originate in the Sudan and Sahel bioclimates are largely ephemeral. Their principal contribution is ground-water recharge to Quaternary aquifers.

Water Sources and Characteristics

Rivers

The Chari and the Logone are Chad's largest rivers and supply 95 percent of the inflow to Lake Chad. About equal portions of their combined basins lie in Chad and the Central African Republic (257,238 and 207,158 km^2 respectively). Smaller contributing watersheds lie in Cameroon and Sudan. Their principal source is the Eastern Adamawa in the Central African Republic where rainfall exceeds 1,400 mm/year.

The hydrology of these rivers is complex because of vast floodplains which not only receive seasonal overflows, but also transfer water out of the main watershed and into other tributary basins or, much further downstream, back into the parent channel. Because of low channel slope, hydrographic degradation (wandering of water from one fluvial network into neighboring systems) is common, and complicates the task of relating measured discharge to its destination. Below Miltou the Chari overflows its right bank to enter the Bahr Erguig which rejoins the Chari above Mailau. Downstream of its confluence with the Logone at N'Djamena, floodwaters overflow the right bank into the Serbewel which flows into Lake Chad. On the Logone River between Lai and Logone-Gana the right bank overflows until Bailli. Between Ere and Bongor floodwaters overflow the left bank to enter the Mayo Kebi and thence the Benoue (outside the Lake Chad Basin). Between Bongor and N'Djamena, seasonal floods inundate vast plains known as the Grand Yaeres from which they eventually enter Lake Chad. Depending on discharge and intermediate storage, travel time between N'Djamena and Lake Chad can occupy up to two months (Vuillaume, 1981).

Evaporation and infiltration losses, as a percentage of discharge, are higher during flood years than during droughts because of the propensity of peak flows to occupy flood plains. Median peak discharge of the Chari River at N'Djamena is 3,690 m^3/s. Mean daily flow is 1,260 m^3/s contributing 39.7 billion m^3 into Lake Chad.

A time-series analysis of the Chari River at N'Djamena show the flows mimic rainfall, and show a continuous series of below normal discharge since the late 1960s. Due to its large watershed, subbasins of the Chari river system often operate as stochastically independent entities. Chari River peak flows are known to submerge tributaries and cause their flow direction to reverse as in the case of the Mayo Kebbi.

At this time most of the water resource development projects influencing discharge of the Chari and Logone Rivers are outside of Chad. Within Chad the Sategui-Deressia irrigation project on the right bank of the Logone River is not yet complete. Its feasibility study, completed in 1972, envisaged implementing up to 10,000 ha of paddy cultivation projects (Linoli and Maidengue, 1987). The work started in 1975 but was interrupted in 1979. Activities were re-initiated in 1986 but later suspended (UNEP, 1989).

Floodplains

Chad's floodplains are the source of tremendous environmental benefit, providing recessional agro-pastoralism, fish habitat, wildfowl refuge as well as flood storage and abatement. Since the 1960s, numerous plans have been developed to channelize flows directly into Lake Chad. As governments and the public become more knowledgeable, these proposals begin to meet with refusal because of their adverse environmental consequences.

Lakes

Lake Chad is one of Africa's important ecological resources. Not only does it hold significant fish reserves (120 species), it also supports hippopotami, otters, sitatunga (a type of swamp antelope) and numerous wildfowl including migratory birds from Europe (UNEP, 1989). Lake Chad is also the home of the Kuri, the heaviest breed of cattle in West Africa, which often remains immersed in the water for much of the day.

Serious observations of Lake Chad began shortly after Gordon's visit in 1825. In 1830 the lake was virtually dry, but by 1870 had expanded to cover 28,000 km^2. In 1909 its size had shrunk to 12,700 km^2, only to expand once more to 26,000 km^2 in 1963. During 1984 it had shrunk to less than 5,000 km^2 (World Bank, 1987). Studies of lake sediments as well as oral tradition describe a series of lake fluctuations going back as far as the year 1100. Several pronounced, long-duration droughts occurred during the 15th and 16th centuries.

Because of its shallow depth (between 1.5 and 5 m), Lake Chad is sensitive to changes in water inflow as well as to evaporation and seepage. At water surface elevations less than 279 m altitude, a mid-lake barrier emerges between Baga Kawa and Baga Kiskra that divides the lake into north and south segments. Once exposed, "la Grande Barrière" is rapidly covered by dense vegetation that seriously retards inter-lake exchanges during periods of high inflow from the Chari Basin.

Once separated, these two lakes exhibit considerably different characteristics. Water-surface elevations in the southern lake (Kalom and Bol) compared with those of the northern lake (Kindjeria) between 1972 and 1977, for which . During 1985 and 1988, the northern lake was effectively dry (Lemoalle, 1989).

Lake Chad's water balance derives principally from Chari River inflows, rainfall, evaporation and seepage. From Chari River flows measured at N'Djamena, approximately 80 percent can be lost to evaporation and seepage (Pouyaud and Colombani, undated). Although both lakes fluctuate widely, only the northern lake runs a periodic risk of totally drying up. The northern lake recovers only when flood flows from the Chari River are sufficient to fill the southern lake and overtop "la Grande Barrière".

Although Lake Chad is a closed basin, it has remarkably low salinity because of: 1) the absence of limestone in its watersheds and the relatively low dissolved solids content of contributing rivers; 2) processes of biogeochemical sedimentation which reduce dissolved solids content by half; 3) leaching processes which are particularly active in the north lake; 4) mollusks which help regulate calcium ions by their shell formation; and 5) macrophytes which help regulate potassium and silicates by plant growth (UNEP, 1989). When waters recede, marginal salt deposits form, only a portion of which redissolve. Part of these salts are removed by the wind.

Lake Chad water is used for irrigation in polders surrounding its fringe. Canal designs did not anticipate recession of the southern lake to its current low levels and canal intakes are now isolated from the lake surface. As a remedial measure, SODELAC proposes a canal to bring water to its irrigation network as well as permitting barge transport of produce to Nigeria. The disposal of dredged sediment as well as its effect on lake turbidity is unknown.

Current Lake Chad fish yield estimates are variable and probably incorrect. The introduction of nylon gill nets in 1963 completely altered fishing method, intensity, catch size and species caught. By 1971 over-exploitation of *Alestes baremoze* was reported (UNEP, 1989).

Lake Fitri, located 300 km east of N'Djamena, is a microcosm of Lake Chad. With a fluctuating median surface area of about 420 km^2 (its greatest recorded size is 1,300 km^2), the lake plays a pivotal role in the economy and ecology of the area. The lake supplies a catch of about 3,000 t/a of fish (IUCN, 1988). It supplies habitat each year to an estimated 140,000 migratory birds (personal communication, *Direction des Parcs Nationaux*, 1991). During drought recessions it provides forage to numerous herds of livestock.

As with Lake Chad, the level of Lake Fitri depends on seasonal inflows and rains. Parts of its basin may be degrading because of land clearing for agriculture and overgrazing. During the dry season, transhumant herders (46,000 people and 0.5 million cattle) normally remain seven to eight months in the vicinity of the lake. With recurrent drought, an estimated two-thirds of these have moved further south. There is too little forage in the north to feed their livestock. Traditional crops include berbere, kreb (*Panicum laetum*), millet and wild rice (IUCN, 1988).

Groundwater Resources

Chad's groundwater resources vary in terms of quantity, quality, and location geographically as well as within the geological profile. Hand-dug wells have traditionally relied on shallow groundwater contained within quaternary deposits. Boreholes also exploit these same easily accessible aquifers. Deeper confined aquifers in pliocene materials are occasionally developed for high yielding exploitations.

Two broad geotectonic troughs traverse Chad: the Tibesti-Cameroon trough runs NE/SW and the Air-Chad trough runs NW/SE. Their intersection is at Lake Chad (Furon, 1960). These are interesting for high-output boreholes penetrating into pliocene deposits. From a depth of 500 m at Maiduguri, water flow of 16,000 liters/hour with pressure head of nine m has been obtained through 10 cm diameter casing. Flow estimates for 146 artesian wells in Bornu and Dikwa Emirates indicate they are capable of producing 9,100 million liters of water per year (Du Preez, 1961).

Northeast of Lake Chad in quaternary sands lies the Kanem aquifer. This aquifer flows radially from a piezometric dome located at Kimi about 60 kms due north of Bol, and is currently being exploited for village wells and for wadi irrigation. It is upwardly unconfined except for local siltstones underlying individual oases. Its depth to the water table varies from about seven meters east of N'Gouri to about two meters near Lake Chad. Its thickness is about 60 m. Measured water-table levels show a 0.8 m decline in 21 years. Project evaluations show this rate will increase only slightly under projected conditions of increased demand. Water quality for irrigation is excellent (USAID, 1990).

Overlying the Kanem aquifer are many local perched aquifers. These supply irrigation and potable water to oases, and are most frequently tapped using traditional shadoufs operating in shallow, hand-dug wells. As far as can be determined, these aquifers depend totally on rainfall for recharge. They can be close to the surface, sometimes emerging onto fields. Although water quality for irrigation is variable, it is generally less suitable than is water from the underlying aquifer.

Throughout Chad groundwater quality for irrigation varies from admissible to good. Exceptions to this rule include shallow, sodic groundwater underlying the Bahr el Ghazel, groundwater lying between 15 and 17 degrees longitude east-southeast of Lake Chad, and groundwater extending between longitude 17 and 18 degrees and latitude 14 and 17 degrees (BRGM, 1975). As with the Kanem aquifer, regional ground-water table declines have varied between 0.50 to 1.00 meters during the last 20 years (CILSS, 1987).

Resource Use and Degradation

Rangeland and Livestock Systems

Within Chad, vast areas unsuitable for crops are used for livestock production. In other areas, transhumant livestock form a symbiosis with agriculture, foraging crop residues during the dry season, clearing plant material and increasing soil fertility with their waste. Livestock provide the farmer with an opportunity to obtain milk in exchange for his produce.

Population and economic pressures are causing these ancient systems to break down. Livestock numbers have increased from about 3.5 million in 1955 to more than 10 million today. Chad's farm population has increased during this same period from 2.78 million to its present-day level of 4.03 million (computed from statistics in FAO, 1987). Drought and range degradation is forcing transhumant herds further south where they stay for longer periods of time, sometimes remaining throughout the year rather than returning to Sahelian pastures. As land and water become increasingly scarce, conflicts between different user groups become more frequent and the rate of natural resource degradation increases.

Chad's rangeland cannot be analyzed in isolation from its companion resources climate, soil, vegetation and water. The availability and condition of one of these elements affects that of the others. This is becoming increasingly evident as drought and accompanying resource degradation appear to be moving south under environmental stress. The ultimate result is a decline in land carrying capacity for people as well as for animals.

Under normal conditions, savanna rangeland vegetation consists of grassland in unstable competition with trees and shrubs. As was discussed above, this tendency towards disclimax is diminishing in Chad where drought and land degradation are adversely affecting the survival and vigor of perennial vegetation. Northern areas are increasingly dominated by annual vegetation dependent on rainfall timing and amount.

The northern Sahel contains a steppe-like, sparse vegetation in which bare ground separates each tuft of grass from its neighbor. Vegetal cover may represent less than 30 percent of the ground surface. In the southern Sahel, trees become prevalent along water courses and annual grasses form continuous ground cover during the rainy season. In better climates, these same grasses are used as indicators of range degradation. Gillet (1967) reports the association of *Aristida mutabilis* and *Eragrostis tremula* produced 600 kg/ha of dry matter in Chad's southern Sahel. More recent observations confirm this general level of productivity (ROPANAT, 1991).

Thornless forage trees such as *Balanites aegyptiaca* provide a highly palatable, protein-rich leaf fodder that is particularly important during the dry season. *Acacia albida*, a leguminous tree with an active vegetative period during the dry season, produces pods that are used as fodder. In Chad, *Acacia albida* is among the trees whose numbers are declining because of advancing land degradation, fuelwood harvest and drought.

Because of its greater rainfall, perennial grasses such as *Hyparrhenia spp* become important in the northern Guinea savanna. At maturity, *Hyparrhenia* is coarse, unpalatable and low in nutritive value. In this zone during the rainy season the tse-tse fly formerly posed a risk to cattle. With disappearing forest cover, however, tse-tse is becoming less of a constraint.

During the dry season the ground cover is often burned. Within a short period of time bare soil surfaces become covered by an initial flush of unpalatable growth unsuitable for livestock. With the coming of the rains, however, young high protein grasses appear that provide good quality forage. Protein content declines rapidly following the termination of growth during October. Entering the dry season these same grasses become tough and fibrous, demonstrating an inverse relationship that exists between herbage quality and yield. During the early part of the rainy season, herbage quality in terms of protein, fiber, and chemical content is high. The proportion of stem increases during August and September so that although herbage bulk increases, overall quality decreases.

The main constraint to natural forage production in the north Guinea savanna is the seasonal fluctuation in herbage quality and quantity that cannot be controlled or improved sufficiently by simple management such as shrub cutting, burning and the adjustment of stocking rates (Kowal and Kassam, 1978). Although research indicates sown pastures offer promise of improved livestock weight gain, this is unlikely to occur while transhumance maintains its importance in Chad.

The prolonged rainy season in the southern Guinea savanna favors the lush growth of perennial and annual grasses such as *Andropogon spp* and *Hyparrhenia spp*. Although its relatively lengthy rainy season provides the southern Guinea zone with high livestock potential, animal health requirements are a constraint to rangeland development.

Assuming the absence of constraints, the relative productivity of natural pasture for Chad's different bioclimatic zones can be computed from solar radiation and the length of the rainy season. This is important as it gives an upper ceiling against which to compare forage production estimates by the *Réseau d'Observation des Pâturages Naturels* (ROPANAT), Chad's range monitoring service, as well as to evaluate the adequacy of projections computed in project identification and appraisal reports.

Using procedures described by Kowal and Kassam (1978), the following table gives relative rangeland productivity assuming that no constraints such as water supply, soil fertility or management apply. It assumes an average energy conversion efficiency of 0.15 percent developed from measurements in Nigeria. Comparison of these values demonstrates the relative higher productivity of southern rangelands when compared to the droughtier north of Chad. This higher productivity is primarily due to the greater length of the rainy season in the south, and its higher level of solar radiation.

Table XIX
Relative Rangeland Productivity by Bioclimatic Zone

Bioclimatic Zone	Relative Rangeland Productivity (kg DM/ha)
South Sahel	2134
Sudan savanna	2711
North Guinea savanna	3287
South Guinea savanna	3575

DM = dry matter

Comparison of the values given above with those used to estimate the economic feasibility of the Chad National Livestock Project (World Bank, 1988) show the project was founded on an unrealistically optimistic appraisal of Chad's rangeland productivity. In its appraisal, The World Bank estimated an upper limit of dry matter productivity for the northern Sahel of 4000 kg/ha. For the southern Sahel (*zone Sahelo-Soudanienne*) it estimated 6000 kg/ha.

Livestock Numbers and Impacts

Previous sections have commented on processes of land degradation occurring throughout Chad. It has been noted that livestock are not the sole cause of land degradation, but are acting in concert with agriculture and land clearing in high-risk areas to disturb soil and deplete its natural vegetal cover. Livestock population trends and their relationship to the land are further discussed in this section.

Observation indicates large areas of degraded range lying principally in the Sahel and Sudan savanna. This is in agreement with studies by UNEP (1989) in its review of environmental degradation in the Lake Chad Basin, and by L. Berger, Inc. and BCEOM (1989). The causes of degradation are those alluded to earlier: overgrazing, unsustainable farming in high risk areas and the depletion of fuelwood reserves.

Livestock population trends since 1945 (Annex H) show a rapid rise in animal numbers from the late 1950s to the early 1970s which coincides almost exactly with an increase in veterinary services available from 1950 (Annex I). Rainfall was plentiful during these same years. The effects of drought only began to be apparent during the 1960s. Because of plentiful forage and good veterinary care, herds increased to nearly triple their initial number in as little as 10 years.

Chad's successive droughts caused livestock numbers to plummet in 1973 and again in 1984. Population response during the seven years following each drought (Annex H) show that during 1973 to 1979, cattle numbers increased at a rate of 5.4 percent/year while sheep and goats decreased at -1.2 percent/year. During the 1984 drought cattle numbers increased more

slowly, at 2.4 percent/year, while sheep and goats also increased at 3.2 percent/year. This demonstrates a major transformation in the response of livestock to drought. Livestock owners preferred to replace cattle with sheep and goats that are capable of surviving on degraded range. This also shows that animal numbers in Chad fluctuate in response to drought, not to market incentives. The cause of repetitive and abnormal drought-related mortality under conditions of otherwise adequate health care suggest that livestock populations may be excessive.

Table XX presents estimated tropical livestock units (1 TLU = a 250 kg mature cow, five sheep or six goats, etc.) corresponding to herd populations for 1990 in each of Chad's bioclimatic zones. Table XXI takes these numbers and compares them with computed grazing capacities based on World Bank pasture areas, taking into account current degraded grassland productive capacities. The Table assumes one TLU requires 2,500 kg/year dry matter and that 30 percent of the available biomass is to be used. Grazing densities of 14 ha/TLU for the Sahel and Sudan bioclimates used in the Table are close to those computed by de Leeuw and Brinkman (1975) for *Aristida* grasslands in Nigeria. It ignores the effect of competition between livestock and farmers for space, and assumes land is freely available without constraint. The Table shows that overpopulation concentrate principally in the Sahel and Sudan savanna and that animal numbers in these areas require reduction by 1.34 million TLU's if rangeland is to recover and sustainable livestock productivity is to occur.

Current live offtake is approximately 10 percent/year of Chad's cattle population. The *Direction de l'Élevage et des Services Vétérinaires* in the course of interviews for the preparation of this review, stated as its objective the increase of market offtake to 13 percent/year. Were this to occur and assuming a continuation of the present population growth rate of 2.4 percent/year in excess of 10 percent offtake, 12.3 years would be required to bring the population into balance with its sustainable food supply. Mitigating against this objective is the rate of degradation of rangeland resources reflecting, among other symptoms, the apparent southward migration and compression of bioclimatic zones.

The main form of livestock and rangeland management in Chad is transhumant agro-pastoralism, the seasonal movement of people and grazing stock for part of the year combined with some form of semi-permanent farming. Transhumance is a transition between nomadism and settled farming. It emphasizes cultivation and the sale of animals while preserving the sound aspects of extensive grazing. Table XXII gives the relative proportions of transhumant to sedentary herds in different parts of Chad during 1986 to 1987 and confirms the importance of transhumance to rural modes of life.

Transhumance has the objective of minimizing the risk of inadequate forage or water to individual herds and involves the movement of livestock from depleted pastures to areas of relative resource abundance. During the dry season (February to May), herds concentrate on agricultural land where they graze stubble and crop residues. Herders often pay a fee in return for forage, but farmers have been known to request their fields be grazed (IFAD, 1990).

Table XX
Livestock by Bioclimatic Region, 1990

Province	Cattle	Shp/Goats	Horses	Donkeys	Camels	Pigs	Est. TLU
Sahara							
BET	0	620	360	0	70,600	0	88,813
Sahel							
Batha	695,900	964,500	25,700	33,970	78,800	0	
Biltine	23,300	42,170	9,540	39,300	58,560	0	
Kanem	173,980	301,180	9,950	16,730	6,080	0	
Ouaddai	416,720	259,870	20,150	53,350	119,270	0	
Lac	521,880	427,990	37,900	22,540	87,760	0	
TOTAL	1,831,780	1,995,710	103,240	165,890	350,470	0	2,836,424
Sudan Savanna							
Ch/Bagui	811,800	969,440	25,600	50,180	59,700	1,160	
Guera	545,130	180,250	17,800	27,900	59,700	0	
Mayo-Keb	104,400	492,180	1,840	11,780	0	6,090	
Salamat	347,700	542,460	4,700	8,000	8,340	0	
TOTAL	1,809,030	2,184,330	49,940	97,860	127,740	7,250	2,474,493
North Guinea Savanna							
Log. Occ.	69,790	132,660	5,050	0	0	1,370	
Moy. Cha.	463,820	168,850	3,980	0	0	2,680	
Tanjili	52,330	123,990	10,050	0	0	1,370	
TOTAL	585,940	425,500	19,080	0	0	5,420	688,780
South Guinea Savanna							
Log. Or.	70,550	156,820	6,120	0	0	1,160	107,061

Source: Modified from data in: *Direction de l'élevage et des services vétérinaires. 1991. Rapport annuel, 1990: Statistics*, N'Djamena. 72 pp.

Table XXI
Grazing Capacity

Zone	Pasture Area (Mil ha)	Est. Av. Annual Yield (kg DM/ha)	Total Avail. Forage (Mil kg)	Theo. Grazing Capac. (Mil TLU)	Actual LStock Pop. (Mil TLU)	Ratio Actual to Theo. Capac.	Grazing Density (ha/TLU)		Req. to bring w/in Capac. (Mil TLU)
							At Capac.	Actual	
Sahara	50	25	1,250	0.15	0.09	0.60	333	556	
Sahel	32	600	19,200	2,30	2,84	1.23	14	11	0.81
Sudan	23	600	13,800	1.66	2.47	1.49	14	9	0.53
N. Guinea	15	1,000	15,000	1.80	0.69	0.38	8	21	

Source: L. Berger International., "*Enquête sur la Situation de l'Elevage Bovin, Ovin, et Caprin au Tchad*", in IFAD, 1990.

During the height of the dry season (May to June), herders often break limbs from forage trees to make leaves accessible to their animals. This reduces tree resistance to fire and insect damage and is a contributing factor to Chad's deforestation. During the rainy season large numbers of transhumant herds move to pastures in the north. At the rainy season's end, herders improve their pastures by burning over-mature, standing grass e.g. *Andropogon spp*, and repeat their cyclic movements, returning to the south.

As was indicated previously, poor pasture development during the wet season in the north coupled with scarce land resources in the south is beginning to affect this ancient system. Traditionally, relationships between transhumant pastoralists and farmers are based on contracts that cover herding village livestock and exchanging farmer products for meat, hides and milk. These contracts have a long history of development but are coming under pressure because of the arrival of "new" herds into the south. Many of these herds are not only travelling further, but are remaining for longer periods of time. Goats are beginning to make up a larger component of these herds and their damage to private trees is creating tension between farmers and pastoralists. IFAD (1990), during its preparation of the *Rapport d'Identification Générale*, registered village complaints about destruction of fields by wandering herds. It also quoted a 1987 study on women's needs which noted the existence of conflict. During late 1990 government intervention was required south of N'Djamena to quell disturbances between farmer and pastoral groups.

One obvious means of reducing animal populations in Chad is by increasing livestock sales. Marketing, a component of most of Chad's various livestock projects and action plans, is functioning less well than other project elements (Personal contact, World Bank, 1991). One possible cause is weaknesses in the design of procedures and infrastructure necessary to advance animal sales.

Traditionally, market development requires livestock holding grounds, watering points and access roads. These various components are being unevenly addressed in Chad.

Table XXII
Proportion of Transhumant to Sedentary Herders and Livestock (%), 1986-87

Zone	Herders		Cattle		Sheep & Goats	
	Trans-humant	Seden-tary	Trans-humant	Seden-tary	Trans-humant	Seden-tary
1. Biltine, Ouad Batha, Guera, Salamat	56	44	73	27	52	48
2. M.Kebbi, Lo-gone OC, Lo-gone OR, Tan-djile, Moyen Chari	14	86	22	78	15	85
3. Kanem, Lac, Chari Baguir	36	64	53	47	35	65
Chad Total	**40**	**60**	**44**	**56**	**41**	**59**

Lack of improved management of natural pastures is a serious shortcoming of Chad's National Livestock Strategy. Transhumant herds pose considerable risk of conflict if unpolitic measures are introduced for their control. There is significant potential for pasture improvement by encouraging herd management and, where rainfall and soils permit, introducing selected annual grasses and forage crops.

Livestock services to transhumant herds require analysis of exactly where herder societies are in terms of social evolution. Worsening rangeland resources in the Sahel and Sudan savanna is already forcing them to adopt quasi-sedentary life styles in southern Chad. Modification of land tenure in ways that grant pastoralists improved rights of land possession is important to encourage their investment in the future. Advantage needs to be taken of the considerable skills these people have in livestock management, but in ways that encourage reasonable herd sizes that lie within the sustained productive capacity of the land and its vegetation. Given the current situation, this holds little potential for immediate impact on the livestock economy. In the longer term, it is important that field staff begin now to gain experience in pasture management and grass trials and experimentation.

Forest Resources

Woodland production retains an essential niche in the savanna ecology as well as an importance to rural and urban populations. Because of complex relationships between trees, soil, water and climate, forests will continue to be important not only to meet fuel needs, but also to help maintain soil fertility, supply fodder and, through its effect on albedo, influence the radiation balance which seems to be one of the component factors in continuing drought.

Savanna forests, because of the low value of their timber, slow rates of growth, fire hazards and generally high management costs, have not received the same attention given to southern, more humid forests. Savanna woodlands are normally in a state of disequilibrium with rangeland. Under natural conditions and without the influence of man, savanna bioclimates revert to open scrub forest. In Chad, however, land clearing for farms, gleaning fodder from trees and repetitive grassland burning is causing savanna forests to give way to an increasingly barren landscape. Very little data are available on the general state of Chad's forest resources. The FAO, in 1981, conducted a country by country regional evaluation of Africa's sub-Saharan forest areas. Since that date, no intensive nation-wide forest inventory has been done.

Table XXIII gives forest classifications used by the FAO as well as surface areas and locations. Sixty-two percent of forests in Chad are dominial. The Table recognizes five different forest types: closed broadleaved forest, productive (using the industrial sense of the word) mixed forest/grassland association, unproductive mixed forest/grassland association, forest fallow and shrubs and open forest. Present forest areas today are probably much changed from the values given in Table XXIII. In the absence of a post-war forest inventory, no one accurately knows the current extent of Chad's standing timber.

Forest composition varies radically from one bioclimatic zone to the next. In a steppe-like landscape, small, broadleaved shrubs and trees dominate the Sahel and Sudan savannas in association with tall grasses such as *Andropogon spp*. Examples of trees found in this forest type include: *Balanites aegyptiaca*, *Acacia seyal*, *Acacia Senegal*, etc.

Between the southern Guinea and the Sudan savannas lies a large open woodland made up of trees which, at maturity, reach eight to 10 meters tall. Examples of species within this forest type include *Prosopis africana*, *Khaya segalensis*, and *Parkia biglobosa*. This forest type appears to prefer highly weathered soils such as Alfisols and Oxisols.

Alongside perennial and intermittent rivers such as the Chari, Bahr Erguig and Logone one finds dense, closed forest formations. Component tree species include *Tamarindus indica*, *Acacia caffra*, *Ficus capensis* and others. Away from the immediate vicinity of the stream bank this forest type gives way to more open, drought resistant types.

Natural forest growth in Chad reflects the conditions dominating each bioclimate. Relative forest growth potential is similar to that computed for rangeland in the preceding section, except that radiation conversion efficiencies are higher, possibly because of the effect of canopy depth. Kowal and

Kassam (1978) propose woodland energy conversion efficiencies on the order of 1.13 percent for savanna forests compared with rangeland which was measured at 0.15 percent. This gives savanna woodland about nine times the potential productive capacity of rangeland.

Despite this relatively high climatic potential, natural forests generally show extremely low growth rates. Growth rates of plantation forests are not comparable to those of natural, open woodland. Within the savanna, managed plantations offer incremental yields at least 10 times higher than those of natural forests (Kowal and Kassam, 1978).

Annex J gives incremental yield estimates by province for each bioclimatic zone and forest type. The Annex assumes natural rather than plantation woodlands. In terms of incremental volume, the tables found in the Annex suggests that most of Chad's total available wood supply comes from its unproductive forest/grassland associations and shrublands. Most of this yield is from the Sudan savanna. The contribution of closed broad-leaved forests and productive forest/grassland associations to Chad's wood budget, because of their small surface area, is low in comparison to more plentiful but less productive forest types.

Table XXIII
Forest Types and Surface Area

Forest Classification	Surface Area (1000 ha)		
	In Forest Domain	Not in Forest Domain	TOTAL
Closed Broadleaf	500	-	500
Productive Forest/ Grassland	2,500	-	2,500
Unproductive Forest/ Grassland	10,500	-	10,500
Forest Fallow	800	-	800
Shrubs, Open Forest	2,750	7,000	9,750

Source: FAO, 1981, Tropical forest resources assessment project, Rome.

During his 1983 study of Chad's forestry sector, A. Zaki estimated total fuelwood consumption to be 2.2 million tons/year (0.64 m^3/person/year). The FAO, in its 1981 study, estimated it to be between two and 3.5 million tons of which 25 percent was used in urban areas. Table XXIV also gives Chad's wood consumption for fuel and other uses and compares this with the above values computed

for annual incremental growth. In Kanem and Lac provinces the Table shows that estimated fuelwood requirements exceed growth. This suggests that standing timber, albeit only shrubland types, is being removed at a rate leading to denudation. In many other provinces the ratio of requirement to growth exceeds 0.3 and may indicate the effects of concentrated urban demand.

Nationwide, the Table shows that Chad's wood requirement represents 23 percent of annual incremental yield, suggesting resource sustainability. This masks the issue of local wood availability, however. Transport inadequacies mean that wood being produced in areas where it grows well is not reaching markets where local deficits occur. In its 1989 inventory of women's activities, BIEP showed that nearly half of the individuals it surveyed traveled between five and 25 km in their search for fuelwood. Four percent traveled more than 25 km. In 1982, M. Keita estimated that only 15 percent of Chad's population had easy access to fuelwood and that 64 percent experienced critical shortages.

Zaki (op. cit.) estimated per capita fuel requirements in N'Djamena to be 1025 kg/year fuelwood and 400 kg/year charcoal, or about twice the rate of rural fuelwood consumption. This figure probably also includes industrial fuelwood supplies for brick kilns and bakeries. During 1983, between 500 and 600 tons of fuelwood entered N'Djamena daily. The population of the capital in 1977 was 210,000, giving a daily consumption rate of about 2.5 kg/person or 950 kg/person/year. Initially, much of this supply came directly from standing timber in the immediate vicinity of N'Djamena. Zaki observed that agricultural clearing had removed all forest vegetation for a radius of 35 kms around the capital.

In an effort to address N'Djamena's fuelwood deficit, the GOC with donor support embarked on a project to create a *ceinture verte* around the city. Greenbelt is a misnomer as it actually comprises three discontiguous blocks of woodland, two to the southeast of the capital and another to the west-northwest. Including blocks dating from the early 1950s, a total of 848 ha had been reforested by 1979. The project's original objective had been to plant 2,600 ha between 1969 and 1974 (Souleres, 1991). Nationwide forest plantings during this same period of time totaled five thousand ha (FAO, 1981).

Zaki (op. cit.), assuming a growth rate of 4.5 m^3/ha/year, demonstrated that N'Djamena's fuelwood demand exceeded sustainable supply from the greenbelt by about seven times. In an expansion of the original project, current proposals are to enlarge N'Djamena's green belt to nearly 2,000 ha by the year 2003 (Souleres, 1991). Assuming Zaki's calculations are correct, sustainable fuelwood supplies require about 7,000 ha. Zaki describes conflicts over land use between forestry and agriculturalists during the execution of the original project. Presumably, land use conflicts between forestry and agriculture remain a source of trouble today, and demonstrate a need for planning, particularly in forests near urban areas.

Wildlife Resources

Chad has 133,871 km^2 of protected areas, including 4,140 km^2 of national parks, 110,800 km^2 of wildlife reserves, 14,931 km^2 of dominial forests (*forêts classées*), and 7,994 km^2 of hunting reserves (Table XXV). When combined, these areas represent 10.4 percent of Chad's total land area (*République du Tchad*, 1991). Their distribution ranges from desert to forest (Annex J) and reflects the climate, soils and natural vegetation already described above. The composition of resident wildlife, though understood to be highly varied, is unknown today due to the effects of war and trespass.

Although attempts at a wildlife census were made in each of Chad's national parks and several of its wildlife reserves during the late 1980s, the data are unreliable. Chad estimates its current elephant population to be 2,100. Other experts maintain its upper limit does not exceed 1,500. Still others believe that war and strife have caused most of Chad's elephants to leave the country altogether.

During the course of these attempts, disquieting observations were made of the effects of trespass, homesteading, grassland fires and other disturbances that reduce the effectiveness of many of Chad's wildlife reserves. Aboutelfan appears to be greatly modified by intruders. In Binder Lere, competition between livestock and wildlife is excessive. Mandelia, originally created for the protection of elephants and other large mammals, has lost most of its wildlife population.

Lake Fitri, a registered biosphere reserve, is the object of considerable study by the IUCN. Livestock trespass is so severe that Chad is considering reducing its status to that of wildlife reserve (personal contact, *Direction du Tourisme des Parcs Nationaux et Réserves de Faune*, 1991). Zakouma National Park receives FED financial assistance. The *Direction du Tourisme des Parcs Nationaux et Réserves de Faune* receives financial support from FAC.

Natural Resource Policy and Strategies

A recurrent theme in the preceding text is the complexity of Chad's natural resources. Chad is composed of large land surfaces, different bio-climates, complex hydrological regimes and often subtle yet important variations of relief. Natural resource degradation is similarly complex; identical processes and forces behaving differently according to minor changes in their situation. Remedial schemes that simplify these complex, interrelated issues not only risk failure, but could actually accelerate resource degradation.

In order to assure acceptance from the farmer and pastoralist community, efforts to improve Chad's natural resource situation require strategies that improve returns to resource users and which do not degrade the resource base. This will require the formulation of strategies in which resource conservation is intrinsic to the method. Motivation rather than repression is a key theme, not only to assure acceptance, but also to improve the quality of farmer and pastoralist inputs over the long term.

Table XXIV
National Parks and Reserves

Name	Prefecture	Date Established	Surface Area (000 ha)	No. Permanent Wardens
National Parks				
Zakouma	Salamat	7 May 63	300	34
Manda	Moyen Chari	19 Mar 65	114	34
Wildlife Reserves				
Binder Lere	Mayo Kebbi	24 May 74	135	17
Bahr Salamat	Salamat	29 Feb 64	2,060	34
Siniaka Minia	Guera	May 61	426	8
Ouadi Rime-Ouadi Achim	Batha	10 May 69	8,000	-
Fada Archei	B.E.T.	7 Oct. 67	211	-
Aboutelfan	Guera	20 May 55	110	-
Mandelia	Chari Bag.	7 Oct. 67	138	17
Biosphere Reserve				
Lac Fitri	Guera	NA	160	-

Current Efforts in Natural Resource Protection

In its desire to resolve these matters, Chad has embarked on three principal efforts: 1) the control of desertification, 2) the improvement of livestock and rangeland, and 3) the improvement of agriculture. This section will first address these central themes using material from Chad's "*Plan directeur de lutte contre la désertification*" (1989) and in project documents from "*le Projet national d'élevage*". It will then review current GOC strategy, policy and available means regarding the roles of:

- Agriculture in soil degradation and its effect on long-term food self-sufficiency
- Forestry in land degradation and fuelwood supply
- Park management in preserving wildlife habitat and populations

Control of Desertification.

Previous sections described land degradation occurring in different parts of Chad. Land degradation, when it reaches irreversible levels, is known as desertification. While the term implies deserts, its reference is more in terms of severity than in actual fact. Desertification applies equally well to humid as to arid climates and is a risk to agriculture in southern Chad as well as in the Sahel and Sudan savanna bioclimates.

Chad's strategy for controlling desertification is expressed in its "*Plan directeur de lutte contre la désertification*" (*République du Tchad*, 1989). This plan owes its origins to a collaborative effort involving the GOC, CILSS and UNSO, but it is merely a statement of intention. It contains no enabling legislation, implementation calendar or budget. The executing agencies are those ministries and directions concerned with land management: *Ministère du Développement Rural* (agriculture), *Ministère de l'Élevage* (livestock and range), *Ministère du Tourisme et de l'Environnement* (forestry, and national parks and reserves).

Chad's objectives in controlling desertification are contained in a general statement of the need to establish food self-sufficiency and correct the consequences of drought. In fulfilling these objectives, Chad's strategy follows central themes of natural resources protection, national land-use planning, government institutional development, and food production improvement.

Component activities embodied in each theme describe how Chad hopes to implement the plan's objectives. Potential activities include improvements in public education, brushland fire control, vegetation management and protection, resource monitoring, etc. Many of these activities were conceived in the absence of detailed knowledge of the dynamics of degradation and many of them are contradictory. Under present conditions, many of them will exacerbate rather than control desertification. The plan's lack of budgetary commitment or implementation calendar deprives it of the means for its execution. Despite the plan's many good intentions, desertification in Chad continues.

Livestock and Rangeland Improvement.

Government livestock and rangeland services operate principally from support provided by the *Projet National d'Élevage*. This project owes its origins to a FAO/CP identification mission conducted in 1986 and appraised by a joint World Bank, ADF, FAC and DGIS mission during 1987. Project inception occurred in 1989. It is implemented by the *Ministère de l'Élevage*.

The Project's objective is to strengthen Chad's livestock sector, principally by increasing livestock production, producer income and government revenue on a sustainable basis. This is to be achieved through a combination of policy reforms and investments, principally by increasing access to animal health services and other inputs and also by increasing merchant access to export markets. A subsequent objective is to improve rangeland utilization and resource management. These themes echo the perceived mandate of the *Direction de l'Élevage et des Services Vétérinaires*, notably animal health care, animal production, extension, personnel training and monitoring.

However, there are serious shortcomings in GOC or donor ability to either implement programs or reach stated objectives. Since Chad lacks a *code pastoral* that obligates the government to provide management of its dominial rangelands, the mandate of the *Direction de l'Élevage et des Services Vétérinaires* derives more from tradition than from conceptual intent. Numerous licenses and permits are required for the export of meat and cattle. Theoretically, these requirements have been replaced by a single permit known as a "*patente*" (personal contact, *Direction de l'Élevage et des Services Vétérinaires*, 1991). In a day of searching the team was unable to receive any guidance from within Chad's ministries about the procedure required to obtain a "*patente*". Therefore, it is assumed that the older system, though replaced *de jure*, remains *de facto*. So far as individual pastoralists are concerned, the easiest road to market continues to be by avoiding government controls and agents.

The *Direction* has achieved considerable success in improving animal health in Chad. Much of this success, however, has detracted from other achievements that should have occurred concurrently with improved health services, particularly in areas related to livestock nutrition. Improved vaccination campaigns, in part, led to livestock populations that exceed grazing capacities. This led to rangeland deterioration and in much of the Sahel increased desertification. In this respect the project falls far short of fulfilling its mandate. Improvements are not sustainable in that livestock numbers do not equate to grazing capacities.

Statements made by the World Bank during its project evaluation proved puzzling. The evaluation team stated that it saw no signs of resource degradation in the Sahel and Sudan savannas and, to the contrary, vegetal resources were being underutilized by 10 to 15 percent (IFAD, 1990, p. 32). This statement is in direct disagreement with observations by UNEP (1989), L. Berger, Inc. and BCEOM (1989).

Rangeland monitoring is being implemented by ROPANAT using satellite information obtained under collaboration with FEWS. This information is coordinated with information from ground plots to compute dry matter production and grazing capacities. Review of information gathered during ROPANAT's first year shows data inconsistencies. More recent information appears to be more accurate and probably shows the results of a learning curve. The World Bank, during the course of its Staff Appraisal of the *Projet National d'Élevage*, observed a surfeit of personnel within the *Direction*. In addition, it no longer supports overseas degree-level training within this sector (personal contact, BIEP, 1991).

Lacking from the current land-use assessment equation is a relationship between land condition and grazing capacity. Livestock reductions will be required if resource sustainability is to be achieved. Balanced herd populations could be achieved in as little as 12 years if marketing offtake were to increase from its present level of about 10 percent to 13 percent per annum. Weighted against this adjustment is the fact that natural resources are degrading under the pressure of too many animals. Locally, this means that degraded, natural pastures should be retired until they can recover. This cannot happen without a dedication of resources, personnel and recognition of its importance.

Agricultural Improvement.

Annex K shows that steady state, low yield agriculture is already commonplace and that Chad is not now meeting its per capita cereal requirements. The trend illustrated in the Annex is typical of degraded tropical soils which are losing their capacity to respond to inputs. Considerable change is required if Chad is to turn this situation around. The current extension approach focuses on production. It views soil conservation as a non-monetary activity which is somehow good for the farmer as well as the environment. This approach is anachronistic to Chad's need to achieve sustained food self-sufficiency. Sufficient land to support shifting agriculture no longer exists. Chad's farmers are going through the transition from low to intermediate levels of agricultural development, principally by adopting extensive agriculture with the use of animal traction. They now need to intensify these efforts by adopting land husbandry practices that combine concepts of crop production with methods that improve soil organic matter and control soil erosion. Some of the ways this can be done include seeding to correct densities, mulching, and implementing alley cropping to duplicate the effects of a bush fallow.

Agriculture, Soil Degradation and Food Self-Sufficiency.

The means by which land husbandry practices can be incorporated into Chadian agriculture is through farmer improvement through education and awareness of consequences of continued abuse. The standard extension package in Chad does not adequately promote soil protection and improvement, due to lack the means or training necessary for extentionists as well as the absence of the essential linkage between adaptive research and training that makes extension effective. In addition, Chad's considerable variability in agricultural climates and landscapes hinders the transposition of improved technology from one area to another.

Forestry, Land Degradation and Fuelwood Supply.

Woodlands play key roles in agriculture and pastoralism by recycling soil nutrients, supplying fuel and providing dry season fodder. In Chad, the *Direction des Eaux et Forêts* is responsible for managing 16,550,000 ha of dominial forests including 864,000 ha of *forêts classées* (FAO, 1981). Forestry activities are financed in part from taxes applied to the cost of charcoal and fuelwood (about seven and five percent respectively). Project activities such as N'Djamena's green belt are often donor funded.

As with the *code pastorale*, there is no *code forestière* in Chad. Evidence, based on other African countries which have such codes, suggests that the situation would not be significantly different if Chad did have one, due to lack of enforcement resources. Complicating the picture in Chad is an overlay of conflicting forest ownership. Conceptually, much of Chad's woodlands belong to the state. Perceptually, these same areas belong to villages, though possession (not ownership) may be allocated to one family and actual use to another. Jurisdictional access to forests governed by law may be quite different from traditional access rights and runs the risk of introducing conflict when "new" people such as transhumant herdsmen enter an area.

Virtually every document describing forestry activities in Chad contains an identical list of decrees and ordinances pertaining to the *Eaux et Forêts*. Some of these, such as *Arrêté* no. 510/SF of 8/8/55 which encourages reforestation, are now neglected. Others regulate taxes for various

woodland products. The mandate of *Eaux et Forêts* seems singularly undefined other than by tradition. Intensive silvicultural management applies principally to *forêts classées*, and even these suffer trespass. Extensive management theoretically applies to dominial forests, but understaffing limits its practice. More often, the nature of forestry activities is perceived as repressive enforcement activities such as levying of fines for infractions, taxing woodland products and limiting access to classified forests.

The means available to *Eaux et Forêts* are limited in comparison to management needs. Its has less than 40 engineer-level foresters and about 40 technicians and aides. This means that there is one forester for every 21,600 ha of classified forest or one for every 41 km2 of dominial lands. While staffing appears to be adequate, lack of transport and equipment limit their access to the field.

The current state of woodland production in Chad was compared against demand reveals that although sufficient annual growth occurs nationwide to meet wood requirements, local shortages occur, particularly near the larger cities. Much of *Eaux et Forêts* activities are spent in trying to satisfy demand, often against very difficult odds. A case in point is N'Djamena's green belt where reforestation costs are high and wood yield is low to moderate. By comparison, wood grows quite well in southern Chad. Rather than pursue difficult reforestation activities near N'Djamena, it may be more economically feasible to produce fuelwood in higher rainfall areas, reducing it to charcoal before shipping it northwards.

The question remains whether or not *Eaux et Forêts* is fulfilling its mandate. The FAO (1981) estimates that Chad is losing about 80,000 hectares of closed, broadleaved forests every year. Government officials imply that the rate is even higher. Given the area under its mandate, the question is appears unfair. It may be more reasonable for the GOC to decide which areas it has the capacity to manage and then to manage those areas well.

Park Management to Preserve Wildlife Habitat and Populations.

National parks and nature preserves fall within the domain of the *Direction des Parcs Nationaux et Réserves de Faune*. The *Direction* mandate is to manage approximately 10 percent of Chad's surface, yet it is so underfunded and understaffed that it does this in name only. The preceding section described how several reserves suffer trespass problems and at least one appears to have lost its large mammal population. The *Direction* training school at Manda lies in ruins (*République du Tchad*, 1991).

There is no clear charter outlining the rationale for *Direction* existence, obligations or objectives. The statutory framework supporting the *Direction* concentrates mainly on the levying of fines for hunting infractions. Its annual budget is less than US$ 50,000. It receives FED financial assistance for Zakouma National Park as well as technical assistance from FAC. It maintains close liaison with the IUCN, WWF, UNESCO and other organizations for support as well as guidance. The *Direction* is made up of four *Sections*: management and conservation, eco-biology and capture, anti-poaching and personnel.

While the *Direction* lacks a management plan, it does have a *Plan National de Conservation des Éléphants* (*République du Tchad*, 1991) which, if implemented, would be a first step in developing a

plan. While its title implies elephants, it actually addresses all the problems of Chad's parks and reserves and their wildlife. One of the first steps the plan calls for is developing management plans for each of its parks and reserves. There is a drastic need for wildlife census work in Chad, yet at present the means are unavailable.

While Chad has wardens at most of its parks and reserves, staff are severely handicapped by the lack of equipment. Chad's parks and reserves are off the main tourist road and offer little that is not more plentiful at less cost elsewhere. For this reason, cost recovery will remain a continuing problem, at least for the foreseeable future.

Toward Sustainable Land Use

Common or traditional land tenure as throughout Africa is an important concept which should not be overlooked when considering regulating natural resources. Traditions evoked by African common law evolved over centuries of experience in settling land disputes and resource use problems. A common element to these traditions is sustainability, for without resource sustainability the clan or tribe would perish. Another common element is equity or fairness. No individual could have rights of land possession that drastically exceeded the rights of others as this could lead to conflict and social disintegration. A third principle is that of universal application. Individuals followed these laws because it was in their best interest to do so. As a visiting professor of jurisprudence once said while reviewing the natural resource legislation of Morocco, "The best legislation is not that which is written, but that which people follow as a matter of course because it is in their best interest to do so (Personal contact, FAO, 1981)."

The experience in surrounding countries implies that the lack of a *code forestière* and a *code pastorale* in Chad would not make any difference to the state of natural resources. First, Chad's lack of physical means prevents its line agencies from fulfilling their perceived mandates. Secondly, the disparity between conceptual law deriving from decrees and ordinances and perceptual law rooted in traditions and custom creates a confused jurisdictional mosaic in which legal dominance depends on time and place. The presence of a uniform establishes authority which vanishes with the departure of the uniform. Natural resource regulations risk degenerating into forms of perceived repression and risk introducing conflict.

With this background, introduction of still more natural resource regulations would be a particularly specious proposal. Instead, Chad would benefit from decentralized authority in determining resource management priorities. As shown above, Chad contains considerable diversity which makes difficult the task of legislating for the universal benefit of each of its regions. Regional concepts of jurisprudence taking into account local traditions and customs as well as local variations in resource type, quantity and quality appear to offer greater opportunity for acceptance and success.

Table XXV
Land Use: Natural Resource Base Utilization
('000 Ha.)

Zone	Total Area	Crop Land	Fallows	Reserves & Parks	Range & Woodland	Other
Sahel	55,300	550	2,200	11,035	39,015	2,500
(%)	100	1	4	20	71	5
Sudan	13,000	1,000	2,500	1220	7,630	650
(%)	100	8	19	9	59	5

Prefecture	Total Area	Crop Land	Fallows	Reserves & Parks	Range & Woodland	Other
Logone Occid.	870	140	350	50*	275	45
(%)	100	16	40	6	33	5
Chari Baguirmi	8,300	205	820	140	6,710	425
(%)	100	2	10	1	80	7
Salamat	6,300	50	200	2,360	3,365	325
(%)	100	1	3	37	54	5

* 535,000 Ha. of forest reserves are listed for the Logone Occidental. Nearly all of this represents unmanaged, abandoned forest reserves dating from the colonial era. It may be considered to have reverted to traditional use.
Source: Extrapolations based on figures in Louis Berger, International.

This is not to say that Chad's line agencies would not benefit from a formal statement of their charter obligations. Indeed, this should be encouraged. However, in formulating the mandates for the *Eaux et Forêts*, the *Direction de l'Élevage et des Services Vétérinaires*, and the *Direction des Parcs Nationaux et Réserves de Faune*, Chad needs to carefully equate its available means and its ability to recover the costs of those means against what it can actually accomplish on the ground. With this in mind, the extent of its dominial lands exceeds the means available to Chad's natural resource directions for their management.

Vast areas of Chad are physically degrading. Given the limited means available to Chad's land management agencies, data related to the real condition of the resource base are extremely difficult to obtain and their accuracy is questionable. In collaboration with FEWS, satellite information is being used in Chad to help define natural resource condition, extent and quality. This policy of supplying remote-sensing data and assisting Chad with its analysis is an effort which is essential to the ability to understand crop yields and resource base condition. This effort is in its infancy and skills are still

developing. Eventually, Chad should be able to understand in detail the state of its natural pasture, the extent of its forests and the amount of land in crops.

Table XXV shows the best present estimate of the relative position of cropland and fallows with respect to other uses. They demonstrate that the areas most at risk from human and livestock overpopulation are precisely those considered to be the most productive (ie. the Sudanian Zone, particularly Logone Occidental).

Annex G also shows that Chad's per capita agricultural production has not yet recovered from the 1972 drought. Much of this failure to recover is due to soil degradation caused by agricultural extensification without concurrent improvements in land husbandry. The main opportunities for improvement lie not in the usual at-risk population areas, but further south in higher rainfall areas. The problem here is that degradation of these lands will cause the populations they support to enter into the "at risk" category, possibly in as little as 13 to 14 years time. In addition, these areas are receiving an influx of refugees of desertification descending from the north. Lacking experience in traditions supporting the sustainability of Guinea savanna agriculture, these emigrants risk increasing soil degradation rates, in effect importing the processes of desertification into new areas.

In order to understand trends in land degradation, data on per capita crop yields and trends by region is needed. Data such as that found in Annex L could be used to develop trend analysis with supporting text to describe how it relates to land degradation. From these data may be developed a simple, rainfall-based model of indicative crop yields, any residual resulting from the model could be explained as the summation of statistical error and yield reductions related to resource base degradation. In time, changes such as soil improvements should be reflected by changes in residual values computed by the model.

Finally, Chad's natural resource management agencies need insulation from demands imposed by the military. It does an agency no good to use its precious resources to purchase vehicles if they are going to be confiscated by the army. There is considerable desire expressed by Chad's natural resource agencies to begin the work that they feel necessary. They also express frustration that they are often hindered because the military expropriates their resources.

IV. Constraints and Opportunities in the Agricultural Sector

Constraints to Increased Agricultural Production and Trade

Natural Resource Degradation

Soil Degradation

Population, ecologic, economic and political pressures are altering Chad's agricultural environment. In response to these pressures agriculture is undergoing an evolution from fallow rotations to continuous farming. These changes are influencing how farmers manage their land, generally to the detriment of its soil fertility. As one farmer told the review team on a recent visit to the southwest, "We used to get big yields from little fields. Now we only get little yields from big fields." This illustrates precisely how continuous farming of tropical soils under low management lead to soil impoverishment and steady state, low production levels.

To maintain or increase production in Chad's fragile soils requires a level of management not currently practiced due to lack of adequate inputs and extension services. Soils are at risk from water, wind, biological and chemical threats. Without access to agricultural research, extension services and training in soil protection and enhancement techniques and to fertilizers, Chadian farmers cannot increase or even maintain soil fertility or productivity and soil and yields will continue to decline.

Rangeland Degradation

Large areas of range in the Sahel and Sudan savannas are degrading due to overgrazing, unsustainable farming in high risk areas and the depletion of fuelwood reserves. The influx of additional transhument herds into southern areas and replacement of cattle by goats are the results of drought which increase pressure on range resources. Emphasis on animal health services which reduce animal mortality rather than on management of a sustainable livestock production system in livestock projects contributes to rangeland destruction. In the absence of research into pasture improvement, training in sustainable herd management and market facilities such as livestock holding grounds, watering points and access roads, degradation of rangeland will continue and the growth of a truly productive livestock sector will be limited. Failure to address land tenure issues which arise from conflicting demands on land between sedentary farmers and transhument herders hold potential for continuing natural resource and social deterioration.

Forest Resource Degradation

Regional shortages of fuelwood cause denuding of those areas and loss of the beneficial shrubs and trees which provide shade, protection of soil against erosion, recycling of soil nutrients and dry-season forage. The government has neither established adequate fuelwood plantations near urban areas nor encouraged transformation of wood from abundant areas into charcoal which can be more efficiently transported to urban areas in order to halt the decline of the resource base. This also means less productive time available for agricultural activities, due to the inordinate amounts of time spent procuring fuelwood.

Regulatory Environment

The legal framework on which economic activities are based in Chad rests almost entirely on decrees and ordinances promulgated by a government challenged periodically by armed opposition and serious resource constraints. Despite public statements to the contrary, a residual feeling of deep-seated distrust of the commercial trading sector remains on the part of many elements of the national administration and in some decision making circles. Chad has been unable to completely abandon the statist approach to agricultural marketing. Licensing is required to engage legally in grain merchandising, especially for export, and only fully licensed traders have access to the tendering processes for purchasing grain in local markets to replenish security stocks held by the National Cereals Office (ONC). Despite talk of a single permit to replace the nine steps which involve five government entities required to export cattle, no evidence could be found of simplification of the livestock export process.

As fully one quarter of total government fiscal receipts derive from customs duties, reductions in tariffs are seen as a threat to the Ministry of Economy and Finance. Yet, inequities in tariff assessment and imposition favor large enterprises and parastatals to the detriment of the development of agricultural product producers and the small enterprises which provide services to them. Equipment imported by large firms are recognizable as capital or production equipment and benefit from advantages in tariff reductions or waivers. Potential imports by small producers are often not distinguishable from consumer goods and higher tariffs are imposed on them, restraining the import of equipment and goods which could increase production and productivity.

Parastatals and government agencies also benefit from special considerations in terms of import licenses and regulations concerning the import of agricultural inputs. SIMAT animal traction equipment is said to be of poor quality and in short supply. Few small producers can afford to import better foreign manufactured equipment. ONDR holds tax exemption and can import this equipment at more favorable prices, but distributes it almost exclusively to the cotton sector. *Protection de Végétaux* has a monopoly on the import of pesticides. Farmers complain that they can procure the same products at lower cost from local merchants with connections in Nigeria. Some farmers report having purchased useless powder marketed as fertilizer or pesticides. More often than not, inability to afford inputs through legal channels, their lack of availability or the risk involved in purchasing informally are factors which discourage the use of products and equipment which could increase agricultural production.

Further, parastatal privileges for the import, financing and marketing of fertilizers, agricultural chemicals and equipment granted by the government tend to be aimed at cotton production, for which prices have been artificially maintained. At the same time, real opportunities, albeit on a small scale, have become apparent in fruit and vegetable production and there is potential to capitalize on Chad's comparative advantage in the production of cowpeas and sesame. Little has been done on the part of the government to explore or support opportunities outside of the cotton sector.

An overriding problem which plagues all sectors of the economy and serves to thwart development efforts within Chad is the lack of security. At its most devastating, vehicles and equipment procured to further development work are requisitioned by the military - or small businessmen and farmers who have extended themselves and profited are held up and robbed of their hard won gains. On another level, the government has created laws, ordinances and decrees and has obviously spent time and effort to develop policies, strategies and plans, yet it lacks the financial and human resources to enforce or carry out what it has created on paper. This translates into an overall inability to follow through on efforts which have been initiated, a lack of incentive to undertake productive activities and a hit or miss approach to application of rules and laws.

Porous borders and the economic opportunity represented by successful evasion or subversion of customs authority undermines incentive to invest in and build legitimate cross-border trade. A Chadian business group, the *Conseil National du Patronat Tchadien* (CNPT), recently raised alarm concerning customs fraud which deprives the state of its fiscal base and impedes legitimate economic growth (CNPT, 1991). Lack of adequate resources hinders an expressed government interest in enforcement, reform and regularization.

Transportation

The construction of an adequate road network is a high cost but necessary investment of scarce resources. The essential private sector investment in heavy transport vehicles which could valorize the dedication of funds to roads is impeded by the imposition of an average import tax of 42 percent on larger trucks (Yumeseva, op. cit.). The high price of transport vehicles, due in large part to tariffs, also effectively serves to ration them away from distant areas with limited infrastructure, such as the Salamat. Given the investment involved, truckers prefer to concentrate on the better developed roads in the cotton zone and in the import/export corridors from Nigeria and Cameroon where equipment depreciates at a reasonable rate.

Roadblocks on internal transport routes also constrain private transporter participation in the formal economy. Small business people and traders, often women, usually bear the brunt of abuses which such a system tends to create. Barrier crossing fees reportedly accounted for from 30 to 45 percent of the cost of grain shipped to N'Djamena from other parts of Chad. Another study reported that around 45 percent of the price of woven raffia mats sold in N'Djamena was made up of these "supplementary" charges (Hamida & Gerry, undated). Lack

of access to vehicles (ie. high prices due to tariff imposition) and restricted circulation on public highways not only limits the efficiency of road utilization, but constrains a demand for more vehicles.

Private transporters have not participated effectively in the hauling of raw cotton from collection points to the gins. In other Sahelian countries, notably Burkina Faso and Mali, private haulers have eagerly seized the opportunity to participate in this market. In Mali, for instance, the cost of transporting cotton to the factories has actually fallen by 46 percent in the OHV zone since private contract hauling was instituted (OHV, 1990).

Human Resources

Chad's agricultural research and extension services for forage, food crops, fruits and vegetables is inadequate. ONDR, the principal extension institution in Chad with responsibility for technology transfer, agricultural input supply, credit, farmer associations and marketing assistance lacks the personnel to carry out its ambitious programs. The present level of training in agricultural education and extension is not relevant and as a result, the extension agents lack the skills needed to communicate technical information which does exist, to farmers. There are no incentives for those extension agents who are productive. ONDR has concentrated on cotton and despite increased interest in promoting other crops, agents assigned to the Sudanian zone receive preferential treatment and better logistical support than their counterparts in the Sahelian zone.

Cassava, taro, voandzou, sorrel and cowpeas are a source of food and extra revenue for many farm families. Cassava is of particular importance because it is drought resistant and can grow in impoverished soils. Agricultural practices used in Chad for these crops have not been well developed or extended. Marketability dictates the management level for the production of eggplant, carrots, cabbage, onions, tomatoes, okra, cucumber cauliflower, spinach, bell and hot peppers and string beans. ONADEH, whose responsibility it is to assist these farmers in production and related activities has not been able to fulfill that role due to inadequate financial and material support and misappropriation of the limited resources allocated to it. New techniques will have to be adopted, such as specialization, staggering production more broadly across seasons, cold storage, drying and growing less perishable crops (i.e. onions, bananas), yet no agency has shown the ability to do so. Degrees of responsibility for agricultural research, extension, development and marketing for food crops in Chad has been relegated piecemeal to BRA, ONDR, ONADEH, DEFPA, SODELAC, DPV and OMVSD, some of which only touch on food crop production and others of which have overlapping programs.

A generally accepted cereals consumption level has not been established since ONDR and BSA have not been able to come up with reliable data or statistical analysis of existing data. Serious work needs to be done to reinforce the capability of the extension services to do effective crop reporting and production statistics in Chad. The parastatals, SONASUT and STT

also suffer from chronic management and technical problems and survive by way of protectionist measures instituted by the government.

An appropriate system for the development and transfer of new production and marketing technologies to users has not been developed and excludes farmers from the development process. Crop varieties unsuitable under farmers' conditions have been developed. This ignores farmers' resource capabilities and their most pressing needs. Further, technology transfer takes place at the lowest extension level, often with little or no supervision of inadequately trained extension agents. The inability of extension agents to recognize and find solutions to simple production problems was noted during review team field visits. The lack of supervision, combined with inappropriate systems of training does little to increase the effectiveness of the extension system. Women who produce a large share of the vegetable crop and provide a substantial amount of the labor in agricultural activities receive little or no attention as there are no female extension agents in the Chadian development institutions. The present Chadian institutional approach to extension is inadequate to respond to farmers problems and aspirations. NGOs, which maintain a village-level approach to project identification and implementation have been far more successful at transferring improved practices.

Observation indicates large areas of degraded range lying principally in the Sahel and Sudan savanna. This is in agreement with studies by UNEP (1989) in its review of environmental degradation in the Lake Chad Basin, and by L. Berger, Inc. and BCEOM (1989). The causes of degradation are overgrazing, unsustainable farming in high risk areas and the depletion of fuelwood reserves. Chad's objectives in controlling desertification are contained in a general statement of the need to establish food self-sufficiency and correct the consequences of drought. In fulfilling these objectives, Chad's strategy follows central themes of natural resources protection, national land-use planning, government institutional development, and food production improvement.

Lacking from the current land-use assessment equation is a relationship between land condition and grazing capacity. Livestock reductions will be required if resource sustainability is to be achieved. Balanced herd populations could be achieved in as little as 12 years if marketing offtake were to increase from its present level of about 10 percent to 13 percent per annum. Weighted against this adjustment is the fact that natural resources are degrading under the pressure of too many animals. Locally, this means that degraded, natural pastures should be retired until they can recover. This cannot happen without a dedication of resources, personnel and recognition of its importance. Potential activities include improvements in public education, brushland fire control, vegetation management and protection, resource monitoring, etc. Many of these activities were conceived in the absence of detailed knowledge of the dynamics of degradation and many of them are contradictory. Under present conditions, many of them will exacerbate rather than control desertification. The plan's lack of budgetary commitment or implementation calendar deprives it of the means for its execution. Despite the plan's many good intentions, desertification in Chad continues.

Chad's farmers are going through the transition from low to intermediate levels of agricultural development, principally by adopting extensive agriculture. They need to intensify these efforts by adopting land husbandry practices that combine concepts of crop production with methods that improve soil organic matter and control soil erosion. The means by which land husbandry practices can be incorporated into Chadian agriculture is through farmer improvement through education and awareness of consequences of continued abuse. The standard extension package in Chad does not adequately promote soil protection and improvement, due to lack the means or training necessary for extentionists as well as the absence of the essential linkage between adaptive research and training that makes extension effective.

Plant Protection and Postharvest Technology

Insects and disease are known to cause crop damage resulting in losses which range from 10 to 70 percent or more per year. Insecticides, important to most crops and essential for vegetable producers, are virtually unavailable. Periodic aerial spraying has been carried out at the regional level with assistance from international organizations but chronic insect and disease problems require the formulation of an integrated management control program. Chadian extension agents lack the technical training to either design or carry out an effective plant protection program, while the DPV (Department of Crop Protection) has logistical constraints. An assessment of post-harvest losses has not been performed for Chad. Farmers use traditional control measures which employ locally available materials and traditional techniques which need evaluation to determine true effectiveness.

Domestic markets for cereals and other food crops provide little incentive for farmers to produce beyond a subsistence level. Farmers have shown some readiness to produce vegetables in quantities beyond family consumption needs but market information, post harvest handling techniques, transportation and packing, as well as other marketing elements require attention and improvements. Traditional and technically appropriate methods of vegetable and fruit transformation have yet to be evaluated or disseminated countrywide.

Agricultural Inputs and Credit

Agricultural Inputs

The lack of adequate supplies of seed, fertilizer and pesticides for food, vegetable and fruit crops is an impediment to increased agricultural production in Chad. There are no satisfactory arrangements for food crop seed production as there are for cotton. All cotton growers use the improved cotton variety IRMA 96-97 and COTONTCHAD assures seed availability through contract seed farmers. In the case of food crops, however, the demand for seed for food crops far exceeds the supply (Table XXVI). COTONTCHAD and ONDR have a *de facto* monopoly in the importation of vegetable seeds. ONDR stopped producing seed during the 1979 civil war. Its current minidose program, a sort of *ad hoc* seed production

service, requires an evaluation, with follow-up efforts to improve its effectiveness. The FAO seed project performs adaptive research and produces seed exclusively for the Sahelian zone. ONADEH lacks the financial and technical resources necessary to import or produce seeds.

COTONTCHAD is currently the only large fertilizer importer, importing only a cotton mix (*complexe coton*) and negligible amounts of urea which are used on the cotton crop (Table XXVII). These inputs are distributed to cotton farmers by COTONTCHAD in the form of an in-kind crop loan (*Crédit de Campagne*). These credits make up a significant proportion of COTONTCHAD short-term borrowing from local commercial banks. The fertilizers imported

Table XXVI
Quantities of Recommended Seed Available for Sale, 1991 (kg)

Crop	Amt. Avail	Amt. Requested	Shortfall
Sorghum	1,500	4,200	2,700
Millet	1,000	1,615	615
Maize	300	1,410	1,110
Groundnut	800	3,300	2,500
Cowpea	1,360	2,600	1,240
Sesame	250	1,200	950

Source: FAO Seed Production Project CHD/87/002

by COTONTCHAD are delivered by the company, along with the next season's seed requirements, directly to *Groupements des Producteurs*. The cost of the fertilizer, plus interest, is deducted from the value of the cotton sold by each *groupement* at harvest. Most of these transactions are handled by the MAGs, where they exist. Where they do not, COTONTCHAD buying teams calculate the credit repayments. After recuperating the *crédits de campagne*, COTONTCHAD repays its own short-term obligations to the banks.

Nitrogen is usually the most limiting element in plant growth, but tropical soils are also typically low in phosphates, an important field crop nutrient. The imported cotton complex itself hardly meets the lowest fertilizer recommendation for cotton. For example, in 1989, 9,300 tons of cotton complex were imported while the minimum viable level of 50 kg/ha cotton complex would have been 9,235 tons. That means that food crops and vegetables received almost no fertilizer.

Agricultural equipment, mainly for animal traction, is imported by ONDR from abroad or within the region. Most animal traction equipment is used in the cotton zone (Table XXVIII). SIMAT (*Société Industrielle pour la Machinisme Agricole du Tchad*), a state owned company,

claims to be able to manufacture all AT equipment needed in Chad. SIMAT equipment is more expensive and less robust than the imports, thus the resort by ONDR to foreign suppliers. SIMAT argues that because foreign firms offer no after sale service, it provides repair service in addition to modifying equipment for local conditions.

ONDR began a medium-term credit program (two year repayment schedule) to finance equipment sales in 1987. Since its inception farmers in the cotton zone acquired on credit 3,000 plows in 1987, 1,500 plows in 1988 and nearly 5,000 plows in 1989 (ONDR, *Rapport Annuel*, 1990). This represents an increase of 14 percent in the total number of plowsets in the Sudanian Zone

Table XXVII
Types and Quantities (tons)
of Fertilizer Imported and Distributed by COTONTCHAD

Year	*Complexe Coton*	Cost*	Urea	Cost*
1988	5,500	NA	0	-
1989	9,300	1,301	0	-
1990	11,826	943	910	32
1991	16,806	1,311	1,200	52
1992(proj)	17,325	NA	1,375	NA

Source: COTONTCHAD * Million fCFA

since the ONDR's last inventory in 1987. As in the case of short-term credits, loans are granted only to *groupements*, using group solidarity as the sole form of collateral. Repayment rates are reported to be in the area of 95 percent.

Credit

The availability of either short- or medium-term credit to non-cotton farmers or to farmers outside the cotton zone is so limited as to be practically nonexistent. In principle, any farmers organized in a *groupement* are eligible to request credit from ONDR. In practice, it is rarely done. Even in the rare cases when *groupements* have amassed enough cash to buy fertilizers, as happened with the Kim Agricultural Marketing Project, they must arrange delivery themselves. In addition, since fertilizer imports are closely correlated with cotton needs, supplies are often exhausted by the time an order is placed. Kim area farmers have resorted to buying their fertilizers in Cameroon or Nigeria, or doing without.

Access to capital is a problem for farmers and traders in Chad, but it is equally so for the small businessmen and artisans who produce goods and services for them. The formal banking sector in Chad has been aptly described as "superficial" (World Bank, March, 1989, p. 29.). Only two commercial banks are currently in operation, the *Banque Internationale pour l'Afrique du Tchad* (BIAT) and the *Banque Tchadienne de Crédits et de Dépôts* (BTCD). The BTCD has one branch in Moundou, and the BIAT has branches in Abeche and Sahr. Both prefer to lend to large, institutional customers (COTONTCHAD alone receives 60% of all commercial bank credit), and the scope and attractiveness of their savings programs are very limited. The vast majority of their local accounts are in the form of demand deposits (85 percent).

Table XXVIII
Sets (000) Animal Traction Equipment/Areas
Cotton and Cereals, Sudanian Zone

Year	75/76	80/81	84/85	85/86	85/86
Oxen	113	108	122	131	140
Plows	48	59	56	58	63
Carts	11	17	14	14	15
Ridgers	3	5	5	5	6
Weeders	2	2	2	2	3
Cotton (000ha)	197	128	94	112	101
%age*	59	77	66	76	81
Cereals (000ha)	117	206	218	256	295
%age*			38	42	49

* Of total areas using AT
Source: ONDR

To a large degree, banks in Chad are subject to constraints of a purely institutional nature. The system of legal recourse is highly inefficient, at best, making recovery of unpaid loans through seizure of collateral, for instance, almost impossible. There is no system of deposit insurance, either in Chad or in the regional banking system (BEAC). Cronyism in the allocation of loans is a common practice. Furthermore, as has been noted previously, private enterprise suffers from considerable fiscal pressure, making for a lack of incentives to invest with borrowed money.

The National Development Bank (*Banque de Développement du Tchad* or BDT) was closed during the civil disturbances of 1979-83, and never reopened. For all practical purposes it is bankrupt, having made too many loans to parastatals and large private sector firms which

were never repaid. An effort financed by the African Development Bank is underway to reconstitute its loan portfolio. This could offer possibilities for additional term credits. Whether these will be made available to SMEs is another question. A recent evaluation the Chadian banking sector considered the reconstitution of the BDT to be riskier and more costly a venture than the creation of an entirely new financial institution, especially in view of the difficulties of the banking sector in general. (CIFPB, 1990). Table XXIX summarizes the relative position of state ownership *vis à vis* private and foreign interests in the Chadian banking sector.

Table XXIX
Banks Operating in Chad

Bank	Capital	Ownership (%)		Portfolio
	Million CFA	State	Others	Value billion fCFA
BDT	520	58	CCCE 33 BEAC 9	being reformed
BICIT	300	40	BNP 30 SFPOM 31	inoperative
BTCD	440	51	Credit Lyonais 15 BDT 15	29.5
BIAT	600	35	Local Private 14 ATI 51	31.8

Note: SFPOM=Société Financière pour les Pays d'Outre Mer
ATI=Afri Trust International (BIAO)

Operating and medium term capital are frequently cited as the most limited resource for small enterprises. These business produce most of the goods and services used by the majority of the population yet they do not have access to the factors of production or even spare parts or trade goods on an equal basis with their larger competitors. In most areas where irrigation is promoted there is no enterprise which specializes in repair of irrigation pumpsets. Only projects or specially set up *groupements* stock spare parts. Usually pump owners must either buy the parts themselves, in Nigeria or Cameroon, or defray the expenses for the repair shop to do so.

Small scale enterprises frequently do not qualify for loans from formal credit sources. Their size and the nature of their businesses are considered too risky for conventional loan programs. Many have no collateral other than their personal tools and their good names. Thus, credit plays a minor role in the financing of these enterprises. Most operations are paid for out

of savings or retained earnings. When credit is needed it is obtained from informal sources, especially in the rural areas.

The one financial institution in Chad which has demonstrated a willingness to serve the credit needs of those small and medium sized enterprises which motivate Chad's economy is VITA/PEP. It has granted 323 loans since 1985, 10 percent of them to enterprises owned by women. Most of these have been for directly "productive" purposes -- agricultural production, transformation, small manufacture, repair shops and services. Increasingly VITA loans are granted for agricultural marketing activities. VITA is also in the process of opening a branch office in Moundou. Lacking legal authorization as a savings institution, VITA offers its clients a quasi-savings option, under which an advance payment is set aside and becomes refundable upon final payment of the loan. A new microenterprise window will soon become operational. A longstanding VITA objective has been to assist informal sector businesses to formalize their activities. It is eager to test the proposition that there are many informal micro-enterprises in N'Djamena that lack only a little capital base to evolve into formal SMEs.

The base interest rate on loans from commercial banks is 11 percent. Various margins add up to an additional 7.5 percent, plus *frais* (fees) which make effective interest rates on the order of 25 percent. It is unclear whether interest rate regulations for commercial banks apply to organizations like VITA or *Coopératives d'Épargne* (CRECs). VITA's rates are at present fixed by the government at a ceiling of 13 percent with a tentative commitment for an eventual raise to 14 percent. It is reported that the BDT will be granted a loan ceiling of 16 percent during its reconstruction.

Agricultural Marketing

Financial Services

Each study of agricultural marketing constraints inevitably arrives at one conclusion: Farmers and traders suffer from a lack of credit (see e.g., Yumeseva, Mock and Hassanein). These demands are almost always expressed in terms of a lack of operating capital and/or medium term credit. A USAID evaluation of Africa-wide credit experiences found that "the real demand among farmers is for increased liquidity. The best method to improve farmers' liquidity is not to offer them more credit, it is to also offer them more savings services and facilities" (Simmons & Herlihy, 1990, p. 20). What is actually lacking in rural areas is adequate access to financial services which include not only credit, but also savings and investment mechanisms. Developing these kinds of instruments will take some re-thinking of traditional extension approaches, as well as the usual project financing procedures.

Some organizations which offer these types of services are already emerging spontaneously in the Mayo Kebbi Prefecture and southern Logone Oriental and Logone Occidental. A number of *Sociétés Mutualistes* have grown up, largely through the efforts of various missionary groups in the area. There are small credit unions, *Clubs d'Épargne et de*

Crédit in the Mayo Kebbi Prefecture. A large proportion of the members of these "clubs" are women. Another group in the Bissi district, calls itself COOPEC *(Coopérative d'Épargne et de Crédit)*. The largest rural savings and loan union is the *Projet Rural d'Épargne et de Crédit aux Logones* which involves over 60 small *Coopératives Rurales d'Épargne et de Crédit* (CRECs). They have put together considerable savings and loan portfolios as Table XXX shows.

Table XXX
Rural Savings and Loan Associations (CRECS)
Logone Oriental & Logone Occidental

S/Prefecture	No. CRECS	Members Men	Members Women	Savings	Loans 000s fCFA	Balance
Baiboukoum	42	1,135	225	4,050	1,070	2,980
Gore	19	335	56	985	235	750
Moundou	3	69	36	420	-	420
TOTAL	64	1,539	317	5,455	1,305	4,150

Source: *Projet Caisse Rural d'Épargne et Crédit aux Logones, Rapport d'Activités Trimestrielles, Mai a Juillet, 1990*

Product Markets

Market Structure for Cereals.

The agricultural marketing situation in Chad is so diffuse that one cannot properly speak of a unified national market. Preliminary spatial price analyses based on data from the FEWS/Chad unit points to distinctly sub-regional behavior in the important cereals markets. Three main areas with different characteristics and orientations can be identified:

- **The Kanem - Lac** area which is characterized by a high degree of price variability. This variability, however, does not seem to be necessarily weather related, indicating a strong probability of demand influence from the wider regional market (ie. Nigeria).

- **The Ouaddai-Batha-Biltine** area, a millet-led market. Cereals prices in this sub-region tend to follow millet, especially upward. Obviously, climatic conditions favor millet. In addition, due to its generally short growing cycle and high survivability, it becomes the grain of first choice for consumption when people begin to sense possible production shortfalls. Onions are a major cash crop in this region and point to a crop diversification strategy tied to purchases of grain as a substitute for cultivation.

- **The Sudanian zone-Southern Guera**, a highly diverse market whose prices tend to lag behind the Northern markets due to higher and more stable production and more possibilities for substitution. Tubers, such as cassava, also are substituted to an unknown extent for cereals in this region. Lagging prices also indicate that this market serves other regional markets (mostly the Northeast).

  Dry season sorghum (Berbere) from the Salamat plays an important role in moderating prices in the Abeche and Sahr areas. This is because it is harvested and comes on the market in February and March, just when prices of ordinary cereals would begin to rise.

To these sub-regional markets should be added a fourth -- the N'Djamena market. The directional tendencies of the prices in Table XXXI, low in the Bongor area and higher as one approaches both N'Djamena and Moundou, show that N'djamena is basically supplied from the Chari-Baguirmi Prefecture.

A significant portion of the N'Djamena food supply comes from Cameroon. Harre, Igue, et al. point out that Kousseri has an inordinate number of boutiques for its population. There are also a number of cereals warehouses and wholesalers. These businesses undoubtedly serve the large N'Djamena market just across the river. Most small consumer goods come from Nigeria and most of the cereals come from the Northern Cameroonian Prefecture of Logone et Chari (Harre, op. cit.).

A July, 1990, study of the cereals market by BIEP confirms this observation. Although the study referred to "unscrupulous" traders, its own three year price movement data show the buying grain from anywhere farther from N'Djamena than the Chari-Baguirmi Prefecture is an extremely risky business. Purchasing grain in Moundou, Abeche or Sarh for sale in N'Djamena would have been a losing proposition 40 percent of the time from 1987-1989, even if the product were held for six months. Within the Chari-Baguirmi area, profits were possible over 80 percent of the time. Immediate sales yielded margins of six to 13 percent and storage brought average profits up to 25 percent. Anyone interested in grain market speculation, however, must take into account competition from the *massos*, women traders who buy quantities ranging from a few sacks to a pickup load year round for immediate resale in the city (BIEP, *Formation des Prix*, 1990).

This sub-regional market behavior implies another relationship. Farmers in the Sahel zone must pursue a food security strategy quite different from those in the south. With per capita cereals production of 100 kg/yr, grain purchases and food aid make up significantly more of their annual consumption requirements. Price data partially indicate this through the variability of cereals prices in the Kanem - Lac sub-region and the lag effect with northern prices (especially for millet) leading those in the south. More research needs to be done on the extent and effects of this difference in strategy.

It seems equally evident that further study also needs to be done on the actual cereals production and consumption levels for cereals by region. There is no doubt that tubers such as

taro, cassava and yams are substituted for cereals in much of the country south of N'Djamena. A BIEP study (undated), posited levels of cereals consumption approaching 200 kg per capita for the Sudanian zone, whereas production per capita for this zone is around 165 kg/yr. An extensive famine early warning coverage which uses methods based on monitoring production conditions combined with localized ground truthing has not noted the existence of long-term food deficits. The present food aid policy for Chad which uses the "Cereals Balance Sheet" method which relies on estimates of production may not be applicable in Chad.

Table XXXI
Spatial Trends of Selected Commodity Prices
(fCFA/kg)

Locality	N'Djamena		Geulending		Bongor		Lai		Moundou		Low	
Commodity	J	S	J	S	J	S	J	S	J	S	J	S
Red	73	73	42	52	54	75	50	77	70	77	42	45
Sorghum	82	82	50	70	50	70	na	71	65	67	50	52
Millet	83	83	57	80	55	77	43	71	80	76	42	63
Berbere	na	na	na	na	71	86	60	80	50	na	31	
Paddy	220	220	174	196	134	165	179	125	139	160	69	12
Rice	na	na	138	175	133	na	na	150	113	100	89	5
Sesame	114	114	na	na	na	na	na	75	80	76	55	10
Maize	na	na	155	167	162	189	144	140	150	95	125	0
Groundnut	na	na	125	na	208	208	na	na	na	na	100	40
Onion	na	na	95	na	111	na	na	na	na	130	63	95
Cowpea												18
												0
												68

* Low price recorded in 12 markets surveyed
Source: Care Chad, "Mercuriale"
Note: J=Average price, June, 1990; S=Average price, September, 1990

This difference in food security strategy points to the importance of transport in the marketing chain. Indeed, "even with the removal of restrictions on the private trade, inadequate transportation infrastructure and weak effective demand may result in gluts in one region not being translated into adequate access to food in another" (Staatz et al., p. 2.). The condition of Chad's nearly 32,000 km of roads and tracks has been sufficiently described elsewhere. "All weather" roads represent less than half this figure. Nevertheless, the importance of roads to market access cannot be overemphasized. For instance, in 1987 the difference in the price of a bag of millet between N'Djamena and the southern Sudanian zone was about 1500 fCFA. Transport costs between the two sites were 3000 fCFA per bag (BIEP, 1990, op. cit.). The fact that the World Bank, USAID, GTZ, Italy and other donors have dedicated considerable aid investments to road construction and maintenance only attests to the need to go further in this direction.

Other Crops

Almost all rural residents of Chad produce part or all of their own food requirements, including such high value items as meat, dairy products and vegetables. Farms are diversified so as to minimize the risks of an unpredictable environment. Grain produced in any one year is stored on-farm to meet household needs over the coming year. Grain will be de-stocked to make room for the next harvest or sold for cash. Many farmers find the need for cash so pressing that they sell much of their crop immediately after harvest. They then frequently find themselves in the position of having to buy grain later in the year when prices are considerably higher. The self-sufficient strategies of the local farming system, together with low rural incomes and a limited urban aggregate demand, combine to create a classic shallow market situation. The generally inelastic demand for food products is compounded by the effects of a quite elastic price response to changes in supply. The wide variations sometimes observed among relatively distant markets and through the course of the year are the most obvious evidence of this situation.

As has been noted above, a wide variety of products are cultivated in Chad. In part these represent farmers' adaptations to climatic conditions (ie. cassava), but many are the result of an active search for alternative sources of food and income. Vegetables in particular are increasingly cultivated for their market potential. Indeed, certain high value crops such as onions and taro are in considerable demand in the regional market. Chadian producers may be in a strong position to exploit their comparative advantage in the production of these commodities if problems of transport and storage can be overcome. There may even be possibilities for the export of fresh vegetables to Europe. However, Chad will have to compete with such experienced producers as Burkina Faso, Mali and Morocco for these markets.

In the absence of access to wider markets through improvements in transport and communications and reductions in transaction costs, marketing will remain a supplemental activity at the farm level. Because of the narrow margins and limited volume, in fact, in the rural areas it is rare to find an individual who specializes in marketing agricultural products. On the other hand, it is equally rare to find someone who is not involved in agricultural marketing at some level. The issue of market development is thus more a question of investments in transportation, infrastructure and technology than in production facilities or even entrepreneurial development.

Terms of Trade

As a landlocked country with a minimal industrial base, Chad finds itself in the position of having to turn to its natural resource base in order to exploit whatever comparative advantage exists to create the exports needed to pay for development and domestic consumption needs. Historically, export receipts have been heavily dependent on the cotton market. Cotton lint makes up 33 percent of total earnings on exports of goods and services. Livestock exports make up an additional 20 percent. Earnings from the former have been perturbed by a fall in the world price for cotton in the mid-1980s and official livestock exports are widely believed to

reflect only about one half at best of the total trade in the regional market. There is hope that modest oil reserves in the southeast and Lake regions will enable the country to eliminate the expenditures due to its current dependence on imported fuel products and even provide a modest export income.

Maintaining high production levels for cotton has been achieved mainly through manipulating the terms of trade between cotton and other agricultural products. As the accompanying table shows, the price of raw cotton, which is fixed administratively, effectively provides an incentive for farmers to transfer productive resources -- mainly land and household labor -- away from food crops and into cotton. The difference in the indices in Table XXXII means that a farmer would have to receive prices for food crops on average 40 percent higher in order for him to devote the same amount of resources as are currently allocated to cotton. The extent of the implicit subsidy to cotton production from the distortions in terms of trade is further shown by the gap between the price indexes for ginned cotton (world market price) and local raw cotton (administered).

It is not surprising, therefore, that farmers in the Sudanian zone have continued to allocate more land to cotton production, even in the face of falling world prices. Nor should it be surprising that yields are relatively low in Chadian cotton production, or that nearly one third of cotton farmers use no fertilizer.

Table XXXII
Terms of Trade
(index, 1983=100)

Year	1983	1984	1985	1986	1987	1988	1989
Food Crops	100	165	117	56	61	81	85
Cotton	100	125	125	123	123	124	124
Livestock	100	82	107	130	109	96	100
Mfg. goods	100	120	118	112	111	117	123
Ginned Cotton	100	126	96	69	63	74	62
Elec/Water	100	100	100	100	100	100	105
Services	100	121	115	98	95	101	107
TOTAL	100	127	116	95	92	98	-

Source: Min. Plan, Comptes Économiques: 1983-1989, Rep. of Chad, Mar. 1989.

Regional Trade Flows

The small population and relative isolation of Chad strongly influence the basic environment in which commerce takes place in the area. The two main conditions which derive from this situation are the regional nature of trade and commerce and the small scale and large number of transactions in the marketing chain. The key element in this chain is the small farmer. She/he provides the agricultural products which feed the small secondary urban population, but he is also the principal market for the small consumer items, either locally produced or imported. In a subsistence agricultural economy nearly all consumers are also producers. In this context, it can equally be said that, in Chad, most producers are also traders. Farmers often sell not only their surplus production, but use the revenues from those sales to buy small consumer items (matches, pots and pans, knives, or other goods) for their own use or to sell to their neighbors in the village.

Trade in agricultural products, especially cereals, and livestock is at the base of regional commerce. There is, in fact, a long tradition of agricultural trade in the region, going back well beyond colonial times (see Harre, op. cit.). Political changes during the colonial and immediate post-colonial periods influenced this trading tradition, but did not fundamentally alter it. A statist approach, granting trading monopolies to certain government agencies and fixing prices for a wide variety of goods, had the effect of driving traditional trade practices underground, contributing to the creation of the informal sector.

However, even at the height of state intervention in the marketing system, certain traditional aspects were maintained which tended to guarantee a place in the marketing system for the small private trader. Most transactions are quite small. Farmers produce small and infrequent surpluses and sell them only when a particular economic need presents itself. The village marketplace is the focus for the vast majority of these transactions. Those economic operators who were able to adapt most efficiently to the small scale and wide dispersion of trading activities were the petty traders who bought only what they could transport and sell. These merchants, many of them women, keep their overhead low and their produce moving and are able to avoid the enormous operating costs which have led to the collapse of state marketing operations throughout Africa.

Although agricultural products form the basis of marketing activities in Chad, a lack of definitive information on current levels of agricultural production hinders the development of realistic estimates of the volume of agricultural products marketed. One source has estimated that up to 50 percent of cereals production is marketed in any one year (Hasseinen and Grassberg), while a later study estimated 30 to 40 percent (BIEP, 1990, op. cit.). The wide dispersion of marketing activities also obscures to some extent an appreciation of its size. Kent, in a series of studies in 1989-90, demonstrated that the existence of a reasonable return and access to a market can stimulate farmers in many different areas of the Sahel to produce a myriad of high value agricultural products (Kent, various studies). In addition, farmers pursue a diversified strategy for assuring household consumption needs which often involves sales of grain at one point and purchases later in the year.

Based on the limited information currently available and the observations made thus far, the conclusion can be drawn that a wide variety of agricultural goods are marketed. Table XXXII attests to the variety of goods presented for sale, as well as the price differential over considerable distances.

These data also show that the movement of grain tends to be towards the urban areas where the main consumer market exists. In the relatively more rural markets, prices of agricultural commodities are uniformly lower. The variety of products available is also less. Nevertheless, there seems to be compelling evidence that Chadian farmers are able to produce a variety of crops at prices which suggest a comparative advantage, especially in the regional market. Comparative price studies in neighboring countries could help to determine its extent.

Trade in most other agricultural commodities produced in Chad is geared to the enormous demands of the Nigerian market. Onions from Abeche, potatoes from the Lac and dried tomatoes from the Salamat are all exported to a greater or lesser extent to Nigeria. Significant quantities of a variety of agricultural products are also traded with Cameroon and, to a lesser degree, the Central African Republic. Unfortunately, this trade is seldom registered in official statistics. Nearly all of it passes through informal channels. The complications of livestock marketing are indicative of this situation and the constraints put on regional trade which are behind it.

It is estimated that northeastern Nigeria annually imports 400,000 to 500,000 head of livestock (mainly cattle) per year. Of this, 65 to 70 percent are of Chadian origin. That means between 300 and 350,000 head, yet official export figures seldom exceed 200,000 head. A 1988 livestock marketing study estimated total exports of Chadian livestock at 355-400,000 head if the 55-65,000 head that end up in Cameroon are also counted (L. Berger Int., 1988). As Table XXXIII indicates, the difference in the value between official and unofficial exports in 1986 and 1987 alone amounted to nearly 12 billion fCFA and 19.5 billion fCFA respectively.

Table XXXIII
Estimate of Regional Livestock Trade
(# Head unless otherwise indicated)

Year	To: Nigeria	Cameroon	RCA	Total (a)	Official (b)	b/a (%)	Value(a-b) mln.fCFA
1986	297000	55000	25000	377000	210000	56	12000
1987	350000	65000	30000	455000	176000	39	19500

Source: Harre, Igue, *et al.* and Republique du Tchad, *Comptes Économiques*.

Until last year, official livestock exports were almost entirely through SOTERA, a parastatal which exercised a monopoly on the export of live animals. With the dissolution of SOTERA, private traders will, in principle, be able to legally participate in the official trade. There is little chance that they will rush to do so since the regional trade in livestock, as with most agricultural commodities, is riddled with a multitude of taxes and regulations which make avoiding the law more profitable than obeying it. For example:

- Internal livestock marketing requires the payment of tax and licensing fees of 400,000 fCFA for a herd of 100 head of cattle. Of this total, 10.000 fCFA (in N'Djamena) to 50.000 fCFA (up country) represents extra-legal "expediting" fees;

- Even after dissolution of SOTERA, nine separate steps which involve five different government organizations are necessary in order to gain legal authorization to export livestock.

- There are 13 separate taxes on various animal products, including 10 relating to exports which go to five separate agencies -- the Treasury, Livestock Service, *Chambre Consulaire*, Bank and Customs Service.

- Taxes and payments on the export of a herd of 100 head amount to 1.6 million fCFA, 400,000 fCFA of which is for extra-legal services.

- It then requires a further expenditure of 875,000 fCFA to get the herd all the way to Lagos. Fees and taxes per head now add up to nearly 25,000 fCFA. (Data extracted from L. Berger Int., 1988).

At least 200,000 head of Chadian livestock annually transit Northern Cameroon on their way to Nigeria. This area has been described as a veritable free trade zone (Harre et al., op.cit.). Other goods from Chad moving through this area include natron, dried fish, cereals, onions, hides and skins. As Annex M demonstrates, customs fees are designed to protect Chadian agriculture from competition and restrict the import of goods for which Chad generally enjoys a comparative advantage anyway. Import taxes on agricultural products are generally low. However, quotas and export bans are randomly applied (eg. on cereals). Obtaining an export license for any commodity is always time consuming and often expensive (see Yumeseva, op. cit.).

There are around 100 important markets in this area, scattered along the Logone River between Bongor and the Lake and across Northern Cameroon to the Nigerian cities of Maiduguri, Mubi and Yola. Many of the frontier markets grew up in response to social and economic relations severed by colonial partition and accentuated by the rigidities of post-independence policies. That these markets continue to thrive is testament to both effective demand and the capacity for trading which exists in the region. In this context, complex governmental licensing procedures and authorizations and the barriers designed to control trade

and capture state revenues in reality constrain trade, state revenues and in the long run, economic development.

Economic insecurity manifests itself in the evolution of livestock marketing. Ownership of a substantial portion of the national herd has passed from the herders themselves to urban, absentee owners. The latter see livestock as a hedge as well as a way to shield assets from the government. As a result, livestock becomes an asset to be maximized. This strategy continues until a crisis forces a selloff, resulting in a sawtoothed growth pattern. This growth maximization strategy may, in fact, lead to a quickening of the crisis cycle, as range resources are mined to promote asset growth.

Regional Economic Integration

The underground aspect of the regional market imposes certain fundamental distortions on commercial activity as well as on agricultural development. Rather than improving the state's ability to collect revenues, the complexity of the present system provides opportunities for abuse as in the case of the cross-border market towns. Larger scale operations and wealthier individuals, better able to pay bribes, have better access to a wider market. Reform of the regional trade regime is necessary, but cannot be done unilaterally. As a member of the Central African Customs Union (*Union Douanière des États de l'Afrique Central*, UDEAC), Chad is bound by its terms. UDEAC trade regulations are at least as complex and restrictive as Chad's. The overlay of UDEAC restrictions on individual state duties creates a truly formidable confusion in regional import/export relations.

The adherence to UDEAC terms constricts simplification or reform of trade legislation by individual members. However, the World Bank is pursuing a UDEAC restructuring based on a regional structural adjustment facility. This SAF is in the preparation stage and negotiations for cross conditionalities have not yet begun. The UDEAC tariff structure as presently conceived seems to have been designed to promote the interests of the more diversified economies of Cameroon and Gabon to the detriment of Chad and the Central African Republic which rely on natural resource exports. Since Chad has an apparent comparative advantage in the export of several agricultural commodities with high regional demand potential (ie. livestock, fruits and vegetables, sesame, and possibly cowpeas), it is ultimately in its best interest to actively promote a UDEAC reform to allow more diversification and open up the regional market to more its products.

Market Information

Information is one of the most critical elements in any marketing system. Farmers as well as traders need accurate information on price movements, product availability and factors which affect production in order to make market decisions. In Africa this kind of information has historically either been lacking or monopolized by a few individuals with privileged access. Yet the utility of information is much higher to traders, producers and consumers who depend on the market every day than to the government and to donors.

Input Markets

Efficient markets for factors of production are as important as unencumbered product markets. Increased marketing depends on adequate production, which depends on increased use of inputs such as fertilizers, agricultural chemicals, equipment and credit. The demand for factors of production is a derived demand. That is, it is derived from the demand for the final product. In a country like Chad, the challenge of market development is:

> "... to decouple household and individual food security from the vagaries of local agricultural production. Reforms and infrastructural improvements aimed at improving the ability of private traders to move food at low cost among regions and improving the functioning of product, service and factor markets to allow the food insecure to earn reliable income streams are crucial. Such improvements must be tied to improvements in productivity in cereals cultivation in order to help drive down the real cost of food to rural consumers." (Staatz et al., op, cit., p. 6.).

Market Linkages.

In effect, linkages must be established among suppliers, producers, traders and consumers. Currently the linkages on the upstream side of the equation are still inhibited by the lack of free markets for factors of production. As has been emphasized, the supply of agricultural inputs and machinery to rural areas of Chad is limited by three factors: 1)the long distances and high transportation costs involved in the importation of these items, 2) the modest incomes of potential customers and 3) the policy constraints to the import and domestic marketing of inputs and equipment. These factors partially explain the slow pace at which the private sector has taken up the supply of inputs after the withdrawal of the state monopoly on fertilizer imports. COTONTCHAD remains the only importer and ONDR is the only effective source of supply. Many farmers complain that the monopoly held by *Protection des Végétaux* (PV) on the importation of pesticides is a real constraint, as they could procure the same product at lower cost from local merchants with connections in Nigeria. As a result, fertilizers and some pesticides are smuggled into Chad from Nigeria and Cameroon and sold in some border markets, although quantities distributed are quite small.

While COTONTCHAD is able to borrow considerable sums for *crédit de campagne*, no credit has been made available to legitimate small private businesses for this activity from either merchants or banks. All of the fertilizers and agricultural chemicals imported by COTONTCHAD are funnelled through ONDR, which is responsible for their distribution and the recuperation of the annual production credits from the *groupements* which buy them. This activity takes up an inordinate amount of extension workers' time. Use of facilitating credit arrangements such as hire-purchase agreements is nonexistent at the moment, as manufacturers, wholesalers and retailers have neither the legal option nor the practical inclination to try such innovative techniques.

In view of the subsistence nature of the local economy, demand for agricultural machinery is very limited. Animal traction is popular in the cotton zone, but machinery produced by SIMAT has been of poor quality and in short supply. The few local blacksmiths who have the capability to produce equipment lack the financial capacity to increase their production. Most equipment must thus be ordered or purchased from distant suppliers and only those importers who hold import tax exemption such as ONDR are able to avoid the high tariffs on this equipment. There is a growing demand for irrigation pumps and grain processing equipment. Although these items are available locally, their price is high due to import duties which exceed 50%. Most of this equipment comes in from Maiduguri (Nigeria) and Maroua (Cameroon), probably through informal channels.

The lack of a more liberal market for agricultural inputs also results in certain operational inefficiencies in the field. Under the present system, fertilizers (and some agricultural chemicals) are consigned to ONDR after importation. ONDR must then manage their storage, sale and distribution. ONDR agents, whose primary task should be the dissemination of information on new agricultural production techniques to farmers, spend a great deal of their time collecting and filling out orders for fertilizers and equipment as well as assuring their delivery and supervising credit allocation and recovery.

Opportunities for AID in the Agricultural Sector

Chad has a regional comparative advantage in the production of a number of agricultural products which include vegetables, cowpeas, sesame and livestock. There is real potential to increase resource productivity in Chadian agriculture through crop diversification and more and improved marketing activities. To encourage sustained investment and production in agriculture, a political and economic environment conducive to the free movement of goods, services, information and people must exist. To help successfully exploit this potential and encourage investment and production, donor technical and financial assistance must be carefully focused to:

- Demonstrate to the GOC the benefits of trade liberalization, market information dissemination and promotion of small enterprise development
- Help provide adequate and appropriate means by which the Government can commit to the assurance of this environment
- Facilitate the provision of information and services not currently available to government, traders, business and producers to assist in the development of a dynamic agricultural sector

This section discusses how AID might capitalize on opportunities in the agricultural sector within the scope of this focus.

Natural Resource Protection

Rural Resource Management/Land Use Planning

Many of the problems in rural Chad are rooted in the inability of the traditional production system to adapt to new conditions. Farmers recognize the effects of soil erosion and are aware of declining fertility, increased labor requirements and shorter fallows. They attribute these phenomena to the effects of the drought. Proposed solutions usually involve better access to fertilizers to enhance soil fertility and more equipment to enlarge productive surface. The former, at best, delays addressing the real problem, while the latter exacerbates it by putting more land in production, shortening fallow periods still further.

The importance of the preservation of the resource base in the most productive agricultural areas needs to be communicated and responded to in new and effective ways. The concepts of land use planning introduced at the most appropriate level, the village, can lay the foundation for increases in the productivity of the resource base. Soil, water, forestry, tenure, production and a number of other issues can be best dealt with in this context.

The village should be the focus of these efforts for two reasons. First, it is the principal organizational structure, tying together the diversity of farming activities where conflicts of resource use first appear and are resolved. Second, it is more efficient to address resource protection and production issues first on the village scale than to tackle a multiplicity of problems at a regional or watershed level. The concept should be one of encouraging continuity and building from the bottom up, exploiting recognized common interests among villagers and villages.

The village is the basic functional economic and political unit throughout Chad, yet few effective institutions have been developed which address rural needs at the village level. The exceptions to this tendency, such as the experiments in village organization (*Groupements de Producteurs*), suffer from lack of basic management skills and access to financial services. Organizations like these, increasingly spontaneously organized, have been the main channels for maintaining or adding to what little rural infrastructure there is in the Sahel region, including irrigated sites and financial services.

The objective of extension in a land use planning approach should be to promote maximum community involvement in village land use inventory preparation and the prioritization of local development issues. The role of technical assistance should be to provide management and financial training that villages need in order to fit traditional practice and affiliation into the more modern context needed to compete effectively with producers elsewhere. Most familiar with their available resources, villagers need technical assistance to produce appropriate development plans and acquire the knowledge and skills necessary to carry them out.

Emphasizing local participation, the village and its leadership will have to do by itself many of the tasks formerly done for them by extension personnel or denied them by allocating monopolies to parastatals and government agencies. This includes input ordering, loan applications, input delivery contracting, etc. A more highly qualified extension service will be necessary to help communities evaluate resources and their management needs and to formulate plans to capitalize on their strengths.

The technical message aimed at farmers also needs reorientation. Experience has shown that African farmers have extensive knowledge of their complex soil, water, agronomic and hydrologic environments. The risk-avoidance strategy practiced in subsistence agriculture itself evolved from this knowledge. Farmers know which varieties grow best in which soils as well as which soils retain the most water under different climatic conditions. In addition, utilization of advanced extension techniques such as locating problem areas on aerial photos and even the use of video technology to demonstrate locally appropriate solutions is not beyond their grasp. A farmer will often feel more at ease discussing his technical problems with a highly qualified technician whose knowledge of the subject matter more closely approximates his own, than with an extension agent whose knowledge is frequently limited to a set package of technical recommendations. "Now ... extension workers see themselves as selling outside solutions to peasants. They will have to come to see themselves as taking the peasants' problems to the

researchers. They will have to become agents of the farmers, rather than of the governments" (Timberlake, 1986, p. 218.).

At the same time, continued effort needs to be made to improve the content and quality of technical information disseminated to farmers. With a research agenda set by producer demand, research must be oriented to the adaptation of potential solutions to local conditions. This is particularly beneficial in the context of the variety and complexity of Chad's natural resources, both for resource protection and for crop production. Research tied to actual problems faced by rural communities gives researchers a stake in the solution and eliminates the barriers which often separate research and extension.

Regulatory Environment

Agricultural production and trade and exploitation of regional comparative advantages are constrained in Chad by a lack of security on the part of the government, traders and producers. The government, besieged by persistent political and military challenge as well as by threats to its shallow fiscal base, attempts to maintain control by devising and maintaining layers of regulation, licensing and taxation. Traders, burdened by the confusion and cost of licensing and regulation, seek to evade or circumvent them - or operate on a low level which avoids confrontation. Producers, deprived of opportunities to purchase inputs or to market surpluses because of prohibitive tariffs, lack of commercial opportunities and poor infrastructure, produce at subsistence level, mining the natural resource base to insure survival. The adversarial atmosphere set up by this relationship undermines national cohesion, promotes suspicion and distrust and wastes Chadian natural and human resources.

At this juncture, while a chance remains to stop and to slow natural resource degradation and the government shows some movement away from involvement in agricultural input and credit delivery, the opportunity exists to break this cycle of control and suspicion. The key is to find the point at which investment of time and money can make the most significant contribution to change. This appears to rest with the government. Deregulation and decentralization in favor of free trade flow as well as donor and government investment in services which trade and agriculture need and for which they can appreciate the value offers the optimum opportunity to change the atmosphere from repression and stagnation to one of productive economic activism. Vesting villages with land use and other communal decision making and placing the responsibility for building local infrastructure - with a degree of donor and government technical assistance - squarely with communities is the all important first step. Combined with moves to liberalize trade in agricultural inputs and production and to withdraw support from untenable parastatal activities can begin to energize the Chadian economy too long stagnated by control and expectation of subsidization, however meager, of ineffieciency.

This approach will require a shift of emphasis from regulation to empowerment, since it rests on investment in village level education, sensitization, prioritization and decision making. It will also require a government reorientation from imposition and control to one of providing

valued services to producers, traders and transporters at a reasonable price. It recognizes and respects the efficiency and rationale of each group concentrating on its own specialty to the benefit of all.

Farmers have shown an inclination to produce surplus crops for sale when markets have been available. They have expressed interest in the purchase of agricultural inputs and the demand for pesticides, seed and fertilizer constantly exceed supply. They have formed pre-cooperative groups for financial, input procurement and marketing services. Villages in the cotton zone which can afford to, invest their own hard earned capital in dispensaries, housing, schools, pharmacies and stores.

Traders, especially in regional markets, have shown great ingenuity in maintaining traditional tradeflows despite government prohibition. It is time that this energy be focused on contributing to the growth of the Chadian economy at rates and levels determined by their ability to perform their primary task - trading - rather than continuing to waste state resources on hit and miss enforcement and repression of the agriculture and commercial sectors.

This implies a realignment of the tariff structure as well as a phased privatization of parastatal interests. The World Bank is discussing restructure of UDEAC tariffs and regulatory structure. Privatization, deregulation and decentralization on the part of the Chadian government could go a long way in securing Bank support of Chadian positions within the customs union. Opening Chad for legitimate cross border trade can only be beneficial to Chad's regional trade partners.

Convincing the government of the wisdom of trade liberalization, tariff restructure, decentralization and the recommended allocation to it of coordination, education, consumer protection, and other, more light-handed functions presents a challenge to donor government economists and marketing experts. The degree of receptivity on the part of the current government, coupled with increasing awareness of the implications of resource base deterioration represents a window of opportunity through which the benefits of reform and restructure could now be introduced.

This could represent an opportunity to USAID/Chad, an approach being the proposal of a free trade zone/pilot project similar to that of China, to demonstrate private sector principals in action. Funding sources could include PL-480 Title III proceeds or a cooperative effort with other donors, including the World Bank, who share an interest in fostering private sector development. Emphasis should be on creating a private sector atmosphere, with government agreement to provide certain services in return for reasonable reimbursement through fees and/or taxes and trader, producer and transporter agreement to respect regulation and government need for record-keeping and reimbursement. Donor participation might include planning, technical and training support, monitoring, arbitration and transitional subsidisation of the system, with a close eye on system viability and eventual sustainability. The emphasis should be on village and trade association organization and development of social and physical infrastructure through

which individuals are able to trade, produce, market and transport within the context of a free system for which mutually agreed regulation attempts to maintain its fairness.

Transportation

The one aspect which conditions all production, marketing and resource development efforts is the improvement of physical access to the area. Infrastructure such as roads must be improved. Maintenance programs need to be continued and strengthened. With improvements made in infrastructure, economic operators must perceive a concomitant utility in using them, i.e. lower transportation costs. Thus, reforms in tariff structures which allow easier import of basic transport equipment should receive priority. On certain roads, truck weights appear to exceed design specifications. Improvements in design and construction standards can lower recurrent maintenance costs.

Arbitrary road check points impede free movement of goods and services. Although the government has a role in their elimination, village associations must also take responsibility for ensuring unobstructed movement among themselves.

Human Resources

All of the three main players, the government, traders and producers, will need technical assistance to rationalize Chad's agricultural economy. As the government moves to open trade and transfer responsibility to local institutions and moves emphasis from control to coordination activities it will need assistance in economic analysis, statistical analysis, tax code structure, public administration in a privatized economy, streamlining of record keeping, legal issues and education policy and administration, among other requirements.

Producers and villages will need assistance in preparing resource inventories and setting priorities from sources which can also direct them to possibilities of which they may not have been aware. They will need the services of extensionists and researchers, financial and management trainers, foresters, specialists in appropriate technology and natural resource management, among others. Traders will need similar services, especially in financial management and marketing skills, but also in making market contacts, discovering sources of supply and arranging payment and delivery.

Recalling that the Chadian education system has been devastated by more than a decade of economic and civil disorder, appropriate means to provide training to potential civil servants, agricultural extension personnel, financial and management specialists and many other specialties, must be found. This may be the most limiting and slowest process in the transition. This may also present the greatest opportunity to use the considerable experience and resources of U.S. institutions which specialize in continuing and vocational education, credit union training and agricultural extension. Experience in Senegal under the AID sponsored Sahel Regional

Financial Management Project is particularly applicable to training in commerce and trade and a number of West African training institutions offer relevant programs.

At the same time, the experience of agencies already assisting in the organization of village groups and financial institutions should be instructive to development efforts to address village aspirations. These include local service infrastructure, the productivity of the local resource base, opportunities for income generation and functional literacy and management training.

Agricultural Inputs and Credit

Agricultural Inputs

It has been observed that African farmers do not really suffer from problems relating to production itself. If the right combination of resources and markets are available, African farmers, like those everywhere, respond with greater production. Clearly this combination is not currently available to Chadian farmers. Previous sections have discussed farmers' lack of access to seed, fertilizer, plant protection materials, implements, technical advice, market information, credit and savings and transportation services. With trade liberalization and eventual dissolution of monopolies held by parastatals and government agencies, the issue will shift to commercial contacts, discovery of sources, quantity purchase to qualify for discounts and similar considerations. While this represents a great deal of work and research, it also offers opportunity to those willing to become involved.

Information and communication will be at a premium. This should not be ignored on the part of village associations and producers. The village is also the most appropriate level for the gathering and dissemination of agricultural production information. It is not necessary at this point to reiterate the skepticism surrounding the collection and presentation of agricultural production statistics in most of Africa. However, experience in other Sahelian countries (Park, op. cit.) has shown that when farmers understand the consequences of an activity, as well as its potential benefit to them, they readily share important and detailed information. Moreover, villagers should be enabled to do more of the basic data gathering involved in agricultural statistics and planning. The government of Chad and some PVOs have programs for monitoring agricultural market prices, but the use of this information for the benefit of the most interested parties (farmers, traders, and consumers) is not done at present. These prices should not only be published in newspapers for the benefit of urban consumers, but broadcast on radio in local languages and at times when farmers are most likely to be listening. A greater effort should be made to integrate into the information circuit the use of better and more rapid data gathering and dissemination techniques. The new SIM program will begin to address these problems.

Credit and Financial Services

The validity of the profit motive as an incentive should be recognized in the allocation of productive resources. A good first step would be the institutionalization of certain traditional forms of credit. Legitimization of the various forms of group, family and personal lending arrangements can put more money into circulation. A more market-oriented regulation of interest rates, allowing the forces of supply and demand to set the appropriate levels would also be an important step. "The removal of interest rate ceilings can constitute a step towards ensuring that interest rates for borrowers of all sizes more closely approximate the opportunity cost of capital," (Liedholm & Mead, 1987, pp. 122-123.). The experiences of the VITA/PEP program surely indicate that small and even micro-enterprises are not only willing to pay market interest rates, but they can be good credit risks as well.

Most of all, governments and development agencies of all kinds should actively promote, rather than impede, the integration of economic activities at the regional, sub-regional and local level. Taking advantage of opportunities for profit through utilizing economies of scale, integration of activities and a broader scope of financial relationships in effect creates a demand for the raw materials (ie. agricultural products) on which these activities are based while at the same time providing access to the inputs necessary for increasing the supply of those materials. Since many of these activities are pursued in a non-integrated, fragmented manner at present by so-called informal sector enterprises, this process should involve an active promotion of a transition from informal to formal business activity with the financial and fiscal incentives that transition implies.

Policy Reform

It must be emphasized that the Chadian economy does not function in isolation. It is part of a much larger regional market, where movements of goods and services across borders are affected by each government's policies. This will involve a serious effort on the part of the UDEAC states to negotiate reductions in local trade restrictions. Different trade, tariff and land tenure regimes among the three principal trading partners impose an artificial fragmentation in an area which should benefit from a natural economic interdependence. Exchanges of trade delegations to discuss problems specific to the Lake Chad Basin sub-region (such as the role of the informal sector) and the establishment of a regional traders association or chamber of commerce would be good starting points. Mutual access to market price information would be another.

Clearly, investments oriented toward a collective desire to increase general productivity should be well received and effective, while those which attempt to tap incentives for private gain will have positive short term results, but long term effects will have to be carefully evaluated. The presentation of scenarios based on available information which project expected outcomes could form the basis of discussion of proposed policy direction.

ANNEXES

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Annex A

Scope of Work

CHAD AGRICULTURE SECTOR REVIEW

Statement of Work

1. Background

The USAID agricultural development program for Chad has evolved through three phases since its inception in 1982. First, U.S. PVOs implemented a reconstruction program following several years of civil war. This phase was followed by a longer term development program aimed at increasing agricultural production to provide food security. This second phase, also implemented by PVOs, was essentially based on the earlier reconstruction program but focused on the development of irrigation and water lifting/pumping technologies along with agricultural extension and forestry activities. In 1988, the experiences of on-going activities and other studies indicated that one of the most critical constraints to increased agricultural production was the poor and unreliable marketing system. Thus, USAID/Chad started development of specific activities to address this urgent need. Since that time, the PVO activities have been modified to focus primarily on marketing in specific project sites and to continue a few other activities that have shown the greatest potential for increasing production. A new project was also designed to address marketing constraints at a national level with components in market information systems, agribusiness supports and policy analysis. USAID/Chad's agricultural development program is also supported by a large road maintenance project.

2. Purpose and Objectives

2.1 Purpose. The purpose of this statement of work is to carry out an agricultural sector review (ASR) to establish the direction and analytic framework of the current and future agricultural program as part of the Country Program Strategy Plan. Besides providing a justification for its current program, the ASR should identify new constraints and future opportunities. The ASR enable USAID/Chad to establish or reestablish priorities and will set the foundation for future work in the agricultural sector. These priorities will be determined by a number of factors such as:

A. AID strategic priorities as presented in the DFA legislation and the Mission's Program Log Frame;

B. USAID's comparative advantage and ability to make a development impact;

C. The activities of other stakeholders in the agricultural economy (including donors); and

D. The relation of these activities to the overall economy and potential to contribute to an improved quality of life and to increase agricultural income and production.

2.2 Objectives. The ASR will accomplish the following specific objectives.

A. Describe and analyze major agricultural activities in the country, focusing in particular on the policy and regulatory environment, human capacity, institutional capacity (both public and private), infrastructure, use of improved technologies, marketing systems, natural resource base and environmental management;

B. Determine and substantiate the stage of evolutionary development of Chad on the scaled defined in the "Strategic Framework for Promoting Agricultural Marketing and Agribusiness Development in Sub-Saharan Africa" developed by the Africa Bureau;

C. Identify major stakeholders in the agricultural sector (public and private sectors, international donors, etc.) and describe their relevant agricultural strategies and activities;

D. Analyze the major factors, including constraints, opportunities and external influences that affect agricultural development in Chad;

E. Provide recommendations and strategy options for USAID/Chad interventions in the agricultural sector and present how these options can be grouped to have a significant impact on agricultural income and production and other key indicators to be developed as part of this effort.

3. Scope of Work

3.1 General. The contractor shall produce a written report to meet the purpose and objectives described above and as explained in more detail below.

A. Overview. This report shall describe existing systems, strategies, policies and regulatory environment. This includes activities of both the Chadian public and private sectors, foreign companies, joint ventures, and donor and lender agencies. The contribution and linkage of the existing system to the overall economy should be shown. The quality of data available on which to base this overview would be commented on with an aim toward developing performance indicators to track progress in the future.

B. Analysis. The report shall critically analyze the components of Part A, above. The ability of existing systems and (unknown) to promote and support increased use of higher yielding production technologies, more efficient and lower cost marketing systems, and improved natural resource and environmental management will be included. This section will focus on the linkages among the substantive components, described in section A, and

whether they contribute to increases in agricultural incomes, productivity and volume marketed. The importance of different constraints to agricultural development will be assessed in terms of their economic and "people-level" effects.

C. Recommendations. The report shall recommend options for sector assistance during the next five years as well as immediate action on the current program, particularly in the area of policy and regulatory reform such as with a non-project activity focused on policy reform. This will include an estimate of the likely effects on the Mission's strategic objectives and indicators to measure the expected effect. A justification of the recommended options will be included.

D. Supporting Materials. Supporting data and tables shall be included as appropriate.

3.2. Specific Requirements of the Report

The following specific information and analysis shall be included in the report, although it is not limited to such.

A. Technology

1. Institutional Base. How does Chad identify or develop technology for increasing agricultural production? How are these technologies promoted? What institutions are responsible for development and transfer of technology? How effective are these institutions? What is their human capacity for achieving higher levels of performance on a continuous basis? How relevant are the programs of institutions that deal with agricultural education and training?

2. Technology Transfer and Adoption. What technologies have been promoted and by whom? What major factors constrain the transfer and adoption of technologies? What has been done to ensure the continued promotion and support of these technologies?

3. Impact. Can the economic benefit of the adopted technologies be accurately measured? Is the benefit evident in terms of increased income or improved livelihood? Has there been a measurable change in the reliability of agricultural productivity? Annual carryover stocks? Impact on GDP? Among other things, this section of the report will analyze the effectiveness of a variety of production, management and marketing technologies implemented during the 1980s to restore economic viability to the cotton and livestock sub-sectors after their significant decline in 1984-85. The report

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will show the relation of these two sub-sectors to the rest of the agricultural sector and to the overall economy. The report will also discuss the merit of using approaches tried in livestock and cotton sub-sectors in other areas.

B. Policies and Regulatory Environment

1. Incentives/Disincentives. The team shall investigate the macroeconomic and agricultural sector policies that define the environment for agricultural activities and what effect these policies have on marketing (such as pricing policies, monetary policy, trade policy, quotas, licenses, export authorizations, transport policy, etc.). Incentives/Disincentives shall be discussed in detail.

2. Agribusiness. The team shall investigate policies, regulations and other factors constraining agribusiness, such as transportation and road maintenance, storage, pricing, promotion and distribution.

3. Private sector. The team shall investigate policies and regulations that discriminate against the private sector in agriculture and discourage competition., The team will also identify policies and regulations that prevent private entrepreneurs from investing in market infrastructure.

4. Impact of UDEAC. The team will investigate the impact of the Customs Union for Central African States (UDEAC) on agricultural activities, particularly regional marketing.

C. Efficient and Lower Cost Marketing Systems

1. Validity of Agricultural Marketing Policy Study. Given the recent changes in the GOC, are the findings and conclusions of USAID/Chad's 1990 Ag. Marketing Policy Study still valid? Specify what policy or legislative changes are likely to impact on agricultural marketing and agribusiness.

2. Infrastructure to Support Marketing Activities. Assess the effects of physical infrastructure (roads, market centers, assembly sites/bulking site, storage facilities, access to coastal port, shipping/cargo facilities, airport facilities, river and port facilities, electric power facilities and water supply facilities on agricultural marketing.

3. Financial Services. Assess the capability of the financial sector to meet the needs of agricultural producers, agribusiness and agricultural marketers (formal and informal).

D. Natural Resource and Physical Environmental Management

1. Institutional Base. How does Chad identify and develop programs and strategies to protect, improve and manage natural resources? What institutions are responsible? What effect have these institutions made on the physical and biological environment? What human capital is available to achieve a higher level performance on a continuous basis? How relevant are activities to the general problems of soil fertility, soil erosion, preservation and regeneration of flora and fauna and biodiversity?

2. Implementation and Adoption. What programs or activities have been promoted and by whom? How are these programs implemented or promoted? What major factors constrain their adoption and implementation? What has been done to sustain those programs and activities that have been adopted?

3. Impact. Can any benefit (economic, financial, other) of the adopted programs or activities be measure with any degree of accuracy? Is there any evidence that such programs and activities have an impact on rural or urban incomes or the (unknown) revenues? Has there been an evident positive change in the environment or natural resources?

E. Recommendations for interventions in the Sector

This section shall provide specific recommendations for project and non project (policy or program) interventions in the sector. This shall include objectives for the interventions and indicators to measure progress towards those objectives. These recommendations should:

1. Be consistent with changing economic conditions and problems;

2. Be based on strategic themes that can be readily translated into specific field actions with measurable outputs;

3. Be ranked in order of priority for Chad and in terms of expected impact on key indicators;

4. Concentrate on (unknown) that development resources are being used efficiently and effectively to further U.S. interests while serving the needs of disadvantaged groups;

5. Not necessarily address all agricultural development problems in Chad, but facilitate selective programming based on the likely impact of assistance on income and employment, AID's comparative advantage, long-term U.S. policies and economic interests, and the chances of success.

F. Supporting Documentation

All tables and other supporting data selected for this section of the document will help illustrate key arguments raised in the other sections of the report.

4. Methodology

A team of consultants will be assembled by a U.S. consulting firm to carry out the review. The team will review relevant documents, interview government officials, technical specialists, educators, private sector technicians and managers, USAID/Chad staff, PVOs, other donor organizations and farmers in a few project sites to be (unknown) jointly by the team and the USAID/Chad ADO. Data and information for completing the background sections of the report will be found in existing reports, evaluations and studies by USAID/Chad, PVOs, other donors and the Chadian government. The Mission will assist the Review Team in collecting background information by assembling and identifying available documents, and making appointments and introductions to relevant person. Prior to the consultants' departure from the U.S. each one will spend two working days at the AFR/TR/ANR office in A.I.D. Washington for briefings on Chad.

In addition, the core team will be augmented by two local technicians to assist with the collection of information, arranging meetings, interviewing farmers and help analyze constraints to identify options for future sector assistance. The two technicians will be identified by the Team Leader.

5. Deliverables

No later than one week after arrival of the Team Leader in Chad, the Review Team will present to USAID/Chad a detailed outline of the report. The outline shall be based on discussions between the Team Leader and the USAID/Chad ADO and on the scope of work outlined above plus any needed adjustments. Along with the outline, the contractor shall present to USAID/Chad a work plan and scopes of work for each team member identifying the responsible persons for completing each section of the report. The format of the final report shall be developed jointly by the Assessment Team Leader and the mission Agricultural Development Officer. No more than five working days prior to departure of the Review Team from Chad, the Team shall present to USAID/Chad for its review and comments, a typed draft of the report in the agreed-upon format. The Team shall hold and oral briefing for USAID/Chad prior to its departure, at which time USAID/Chad will provide it with comments for incorporation in to the final report.

The final typed report will be mailed not more than three weeks following the Team's departure from Chad. The final report will be typed in single space and submitted in ten copies in English.

6. Responsibility to USAID/Chad

The Review Team shall work under the direct supervision of the Contractor Team Leader. The Team Leader will be directly responsible to the USAID/Chad ADO.

Annex B

Bioclimatic Regions

CHARACTERISTICS OF BIOCLIMATIC REGIONS IN CHAD

Characteristic	Sahel		Sudan	Guinea	
	Northern	Southern		Northern	Southern
Boundary: Northern	0	350	500/600	880	1200/1300
Southern	350	500/600	800	1200/1300	1500/1600
Range in annual precipitation (mm/a)	0-350	350-500/600	500/600-880	880-1200/1300	1200/1300-1500/1600
Length of rainy period (days)	0-68	68-95/102	95/102-140	140-187/200	187/200-229/244
Evaporation during the rainy period (mm/d)	7.3-6.6	6.6-6.2/6.1	6.2/6.1-5.6	5.6-4.9/4.7	4.9/4.7-4.3/4.1
Main soil types	Sands-arid brown	Arid brown	Non-leached Ferruginous	Leached Ferruginous	Concretionary Ferruginous, Ferrisols, Ferralitic
Main food crops		Millet	Millet, sorghum	Sorghum	Yams, maize, sorghum
Main export crops			Peanuts	Cotton	Soya bean, sesame
Physiogonomy	Open thorn savanna	Open thorn savanna	Shrub woodland	Open savanna woodland	Light forest, open woodland

Source: Kowal, J. and A. Kassam. 1978. Agricultural Ecology of Savanna. Clarendon Press. Oxford. 403pp.

CHARACTERISTICS OF BIOCLIMATIC REGIONS IN CHAD

	Sahel		Sudan	Guinea	
Characteristic	Northern	Southern		Northern	Southern
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Southern	350	500/600	800	1200/1300	1500/1600
Range in annual precipitation (mm/a)	0-350	350-500/600	500/600-880	880-1200/1300	1200/1300-1500/1600
Length of rainy period (days)	0-68	68-95/102	95/102-140	140-187/200	187/200-229/244
Evaporation during the rainy period (mm/d)	7.3-6.6	6.6-6.2/6.1	6.2/6.1-5.6	5.6-4.9/4.7	4.9/4.7-4.3/4.1
Main soil types	Sands-arid brown	Arid brown	Non-leached Ferruginous	Leached Ferruginous	Concretionary Ferruginous, Ferrisols, Ferralitic
Main food crops		Millet	Millet, sorghum	Sorghum	Yams, maize, sorghum
Main export crops			Peanuts	Cotton	Soya bean, sesame
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Source: Kowal, J. and A. Kassam. 1978. Agricultural Ecology of Savanna. Clarendon Press. Oxford. 403pp.

Annex C

Seasonal Cumulative Rainfall

SEASONAL CUMULATIVE RAINFALL (mm), CHAD

Year	Ati		Coef. Var. Ati	N'Djamena Aero	Coef. Var. N'Djamena	Bousso		Coef. Var. Bousso	Moundou Meteo	Coef. Var. Moundou	4-station average
1940	330.0		-0.6538	624.0	0.1396						
41	236.7		-1.3857	530.7	-0.4776				1063.1	-0.0916	
42	236.7		-1.3857						1086.3	0.0227	
43	393.1		-0.1479	647.4	0.2944				1238.9	0.7743	
44	548.5		1.0979	504.9	-0.6483				840.4	-1.1886	
45	489.6		0.6257	562.7	-0.1336				1321.9	1.1832	
46	492.4		0.6482	677.5	0.4835	991.1		0.6936			
47						740.3		-0.7037	1228.5	0.7231	
48	326.9	<es	-0.6783	343.0	-1.7193	781.2		-0.4758	601.2	-1.3817	
49	256.0		-1.2470	435.2	-1.1093	380.9		-2.7060	761.6	-1.4763	
50	530.4		0.9528	948.4	2.2655	975.9		0.6069	1062.4	-0.0951	
51	384.6		-0.2161	549.9	-0.3506	619.3		-0.2635	1797.8	3.5274	
52	395.6		-0.1263	757.4	1.0220	913.7	<es	0.2624	971.8	-0.5414	
53	593.5		1.4587	642.6	0.2626	845.9		-0.1153	840.5	-1.1881	
54	515.1		0.8305	769.5	1.1021	1024.5	<es	0.8796	1097.1	0.0759	
55	516.7		0.8434	735.1	0.8745	1086.6		1.2257	974.2	-0.5295	
56	466.9		0.4441	606.0	0.0205	932.8		0.3688	875.9	-1.0137	
57	444.5		0.2646	740.0	0.9069	979.5		0.6290	953.0	-0.6340	
58	588.3		1.2570	536.4	-0.4399	1279.5		2.3004	1189.0	0.5265	
59	355.9		-0.4457	980.5	2.4985	953.3		0.4830	1098.4	0.0823	
60	226.6		-1.4823	525.8	-0.5100	915.4		0.2719	1210.3	0.6335	
61	598.1		1.4959	766.9	1.0649	1153.9		1.6006	1051.7	-0.1478	
62	511.0		0.7977	488.6	-0.7548	751.7		-0.6401	1275.0	0.9522	
63	373.4		-0.3054	472.4	-0.8633	830.2		-0.2028	1191.9	0.5428	
64	683.4		2.1797	457.1	-0.9645	711.4		-0.8647	1269.4	1.0724	
65	381.2		-0.2429	584.7	-0.1204	698.6		-0.9349	1073.9	-0.0384	685
66	460.3		0.3912	568.0	-0.2309	1077.7		1.1761	832.4	-1.2280	735
67	476.4		0.5363	577.2	-0.1700	904.6		0.2128	1055.7	-0.1281	754
68	266.9		-1.1592	561.2	-0.2758	888.7		0.1231	729.5	-1.7349	612
69	359.6		-0.4145	425.6	-1.1729	632.0		-1.3070	1416.2	1.6477	708
70	411.7		0.0016	648.4	0.2878	968.0		0.5538	1234.4	0.7522	615
71	279.7		-1.0566	422.9	-1.1907	836.9		-0.1655	950.0	-0.6487	622
72	192.4		-1.7565	598.5	-0.0291	619.1		-1.3789	1028.1	-0.2640	610
73	163.2		-1.9905	312.8	-1.9190	741.2		-0.6966	1056.3	-0.1251	568
74	371.2		-0.3231	416.6	-1.2192	748.0		-0.6719	991.6	-0.4438	632
75	354.1		-0.4602	745.4	0.9426	1027.3		0.6953	1096.6	0.0734	606
76	279.1		-1.0614	632.6	0.1976	742.0		-0.6942	1160.1	0.3862	704
77	469.7		0.4686	539.3	-0.4207	651.3		-1.1995	1012.0	-0.3433	668
78	456.6	<es	0.3779	641.4	0.2547	913.1		0.2591	1142.9	0.3015	769
79											
80											
81											
82											
83											
84				329.9	-1.8059	532.2		-1.8631	870.2	-1.0416	
85	234.0		-1.4230	562.2	-0.2692						
86				491.4	-0.7376	665.7		-1.1193	1072.0	-0.0476	
87	268.0		-0.9901	445.1	-1.0439	670.6		-1.0909	919.9	-0.7970	561
88	482.1		0.5660			1146.9		1.5618	1168.5	0.4276	
89	476.2		0.5167	604.4	0.0099	803.6		-0.3499	759.7	-1.5861	661
90	244.5		-1.3368	471.7	-0.8679				793.2	-1.4211	
30 yr mean: 1949-78	411.6			602.9		866.6			1081.7		
Std. dev:	124.74			151.17		179.50			203.01		

Lat: 13 13' 30-year mean, 1949-78: 411.60
Long: 18 19' Standard deviation: 124.74

Lat: 12 08' 30-year mean, 1949-78: 602.90
Long: 15 02' Standard deviation: 151.17

Data source: Direction des Ressources en Eau et de la Meteorologie Nationale

Lat: 10 29' 30-year mean, 1949-78: 866.60
Long: 16 43' Standard deviation: 179.50

Lat: 8 37' 30-year mean, 1949-78: 1081.70
Long: 16 04' Standard deviation: 203.01

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Annex D

Natural Vegetation Index Values

NATURAL VEGETATION INDEX VALUES
NATURAL VEGETATION INDEX VALUES

Date	Decade	Ati	N'Djamena	Bousso	Moundou
Jan 82	1	12	18	15	17
	2	13	18	15	16
	3	11	15	13	14
Feb	1	14	14	14	13
	2	12	15	14	16
	3	8	11	9	14
Mar	1	10	14	12	15
	2	9	11	10	12
	3	13	16	16	22
Apr	1	14	15	17	24
	2	12	10	11	16
	3	6	9	8	16
May	1	8	12	14	15
	2	8	12	15	22
	3	4	3	11	15
Jun	1	7	9	20	31
	2	5	9	15	29
	3	5	8	15	33
Jul	1	5	12	20	38
	2	8	15	26	39
	3	11	16	27	41
Aug	1	9	22	34	34
	2	26	29	35	45
	3	32	35	39	42
Sep	1	28	32	40	43
	2	23	25	39	39
	3	23	25	39	39
Oct	1	16	20	36	45
	2	16	23	41	42
	3	14	23	34	33
Nov	1	14	22	27	31
	2	14	21	25	30
	3	13	20	20	24
Dec	1	14	19	20	24
	2	12	19	17	22
	3	13	16	15	19
Jan	1	13	17	14	18
	2	13	16	14	17
	3	8	13	12	11
Feb	1	11	12	12	14
	2	12	14	14	14
	3	11	11	11	7
Mar	1	10	10	9	10
	2	13	12	11	14
	3	13	13	13	16
Apr	1	9	7	7	11
	2	12	12	13	18
	3	13	13	12	19
May	1	13	12	12	19
	2	9	8	10	18
	3	10	8	13	19
Jun	1	7	7	14	21
	2	9	9	18	23
	3	11	11	22	29
Jul	1	11	14	30	38
	2	14	17	38	40
	3	14	18	37	45
Aug	1	21	23	37	47
	2	22	28	40	45
	3	26	32	40	44
Sep	1	31	30	46	48
	2	20	31	44	50
	3	20	31	44	50
Oct	1	17	24	36	34
	2	13	19	28	23
	3	14	22	31	37
Nov	1	13	22	24	27
	2	15	26	26	29
	3	11	20	18	21
Dec	1	11	19	18	24
	2	14	22	20	24
	3	14	22	19	20

MONTHLY VEGETATION INDEX VALUES
MONTHLY VEGETATION INDEX VALUES

X axis	Monthly avg. Ati	Monthly avg. N'Djamen	Monthly ave. Bousso	Monthly avg. Moundou
Jan 82	0.120	0.170	0.143	0.157
	0.113	0.133	0.123	0.143
	0.107	0.137	0.127	0.163
	0.107	0.113	0.120	0.187
	0.067	0.090	0.133	0.173
	0.057	0.087	0.167	0.310
	0.080	0.143	0.243	0.393
	0.223	0.287	0.360	0.403
	0.247	0.273	0.393	0.403
	0.153	0.220	0.370	0.400
	0.137	0.210	0.240	0.283
	0.130	0.187	0.173	0.217
83	0.113	0.153	0.133	0.153
	0.113	0.123	0.123	0.117
	0.120	0.117	0.110	0.133
	0.113	0.107	0.107	0.160
	0.107	0.093	0.117	0.187
	0.090	0.090	0.180	0.243
	0.130	0.163	0.350	0.410
	0.230	0.283	0.390	0.453
	0.203	0.307	0.447	0.493
	0.147	0.217	0.317	0.313
	0.130	0.227	0.227	0.257
	0.130	0.210	0.190	0.227
84	0.113	0.157	0.140	0.137
	0.110	0.113	0.120	0.130
	0.087	0.110	0.107	0.147
	0.077	0.077	0.093	0.167
	0.073	0.093	0.147	0.303
	0.070	0.097	0.193	0.370
	0.073	0.103	0.303	0.427
	0.150	0.183	0.387	0.453
	0.120	0.193	0.333	0.460
	0.107	0.163	0.253	0.357
	0.093	0.137	0.157	0.173
	0.087	0.103	0.137	0.123
85	0.073	0.113	0.110	0.110
	0.110	0.110	0.120	0.093
	0.093	0.083	0.093	0.113
	0.087	0.100	0.103	0.127
	0.053	0.080	0.103	0.173
	0.050	0.067	0.150	0.320
	0.100	0.120	0.267	0.427
	0.260	0.233	0.367	0.427
	0.213	0.230	0.323	0.460
	0.147	0.213	0.320	0.427
	0.133	0.207	0.233	0.303
	0.123	0.160	0.187	0.190
86	0.123	0.153	0.160	0.160
	0.117	0.137	0.140	0.153
	0.113	0.113	0.107	0.140
	0.100	0.110	0.110	0.173
	0.083	0.100	0.103	0.190
	0.097	0.100	0.157	0.303
	0.130	0.167	0.307	0.373
	0.260	0.330	0.367	0.443
	0.283	0.357	0.430	0.500
	0.200	0.280	0.417	0.473
	0.150	0.230	0.260	0.320
	0.137	0.200	0.213	0.240
87	0.127	0.177	0.163	0.193
	0.107	0.143	0.137	0.133
	0.100	0.100	0.097	0.103
	0.110	0.133	0.123	0.153
	0.100	0.103	0.100	0.143
	0.107	0.157	0.257	0.317
	0.090	0.133	0.343	0.447
	0.210	0.243	0.433	0.493
	0.293	0.327	0.460	0.570
	0.170	0.227	0.403	0.453
	0.157	0.207	0.233	0.307
	0.157	0.193	0.197	0.237

NATURAL VEGETATION INDEX VALUES

Jan	1	13	17	16	14
	2	8	14	11	11
	3	13	16	15	16
Feb	1	11	10	12	12
	2	11	13	13	13
	3	11	11	11	14
Mar	1	13	16	14	16
	2	9	11	11	13
	3	4	6	7	13
Apr	1	9	9	11	12
	2	9	7	9	20
	3	5	7	8	18
May	1	8	9	14	23
	2	7	9	13	30
	3	7	10	17	38
Jun	1	7	9	16	38
	2	7	9	21	34
	3	7	11	21	39
Jul	1	7	9	28	42
	2	6	8	29	43
	3	9	14	34	43
Aug	1	13	16	36	47
	2	16	21	37	48
	3	14	18	37	41
Sep	1	8	16	28	38
	2	14	21	38	50
	3	14	21	36	50
Oct	1	10	18	32	44
	2	11	17	23	38
	3	11	14	21	25
Nov	1	6	12	13	18
	2	12	16	18	16
	3	10	13	16	18
Dec	1	9	12	15	14
	2	10	11	15	11
	3	7	8	11	12
Jan	1	7	12	12	11
	2	7	12	12	11
	3	8	10	9	11
Feb	1	9	11	11	8
	2	12	12	13	13
	3	12	10	12	7
Mar	1	11	11	12	13
	2	9	9	10	11
	3	8	5	8	10
Apr	1	7	7	6	8
	2	9	13	13	17
	3	10	10	12	15
May	1	5	6	9	14
	2	6	9	10	18
	3	5	7	12	22
Jun	1	7	8	14	27
	2	4	5	14	32
	3	4	7	17	37
Jul	1	5	6	24	42
	2	9	13	27	43
	3	16	15	29	43
Aug	1	25	20	35	39
	2	27	24	34	47
	3	26	26	41	42
Sep	1	22	23	29	46
	2	21	23	34	48
	3	21	23	34	46
Oct	1	18	20	36	46
	2	14	23	33	45
	3	14	21	27	37
Nov	1	13	21	25	34
	2	13	21	23	30
	3	14	20	22	27
Dec	1	14	18	20	24
	2	10	16	14	17
	3	13	14	16	16

MONTHLY VEGETATION INDEX VALUES

88	0.137	0.147	0.140	0.140
	0.140	0.150	0.143	0.163
	0.123	0.147	0.147	0.177
	0.113	0.110	0.100	0.173
	0.107	0.090	0.123	0.253
	0.097	0.110	0.223	0.320
	0.210	0.160	0.347	0.417
	0.367	0.350	0.423	0.483
	0.347	0.320	0.380	0.430
	0.237	0.277	0.370	0.407
	0.207	0.290	0.320	0.340
	0.147	0.217	0.213	0.220
89	0.160	0.210	0.213	0.217
	0.143	0.160	0.173	0.173
	0.123	0.160	0.140	0.177
	0.123	0.157	0.147	0.207
	0.090	0.130	0.143	0.213
	0.087	0.130	0.250	0.373
	0.147	0.240	0.380	0.433
	0.277	0.370	0.460	0.463
	0.273	0.267	0.427	0.487
	0.160	0.253	0.377	0.450
	0.147	0.237	0.270	0.323
	0.137	0.210	0.207	0.243
90	0.137	0.160	0.157	0.150
	0.120	0.147	0.140	0.1[illegible]0
	0.117	0.137	0.137	0.170
	0.107	0.130	0.123	0.173
	0.097	0.107	0.143	0.230
	0.083	0.097	0.177	0.373
	0.153	0.160	0.347	0.463
	0.330	0.400	0.460	0.487
	0.210	0.267	0.473	0.523
	0.140	0.227	0.390	0.450
	0.133	0.220	0.240	0.290
	0.127	0.210	0.200	0.210
91	0.120	0.167	0.170	0.163
	0.117	0.153	0.157	0.170

NATURAL VEGETATION INDEX VALUES

Jan	1	13	15	17	19
	2	13	17	17	19
	3	11	14	14	18
Feb	1	13	15	18	15
	2	11	13	13	15
	3	11	13	13	18
Mar	1	14	14	13	18
	2	9	10	8	11
	3	11	10	11	15
Apr	1	11	13	14	17
	2	12	11	12	18
	3	7	9	7	17
May	1	7	11	8	15
	2	9	10	11	19
	3	9	9	12	23
Jun	1	11	13	15	26
	2	9	8	14	29
	3	9	9	18	36
Jul	1	9	13	25	38
	2	14	20	34	42
	3	18	23	33	32
Aug	1	25	30	41	44
	2	28	33	28	44
	3	25	36	41	45
Sep	1	29	35	41	50
	2	28	36	44	50
	3	28	36	44	50
Oct	1	21	29	42	49
	2	22	29	46	46
	3	17	28	37	45
Nov	1	18	25	34	39
	2	18	23	27	31
	3	13	21	23	26
Dec	1	15	21	23	27
	2	13	21	21	24
	3	13	18	20	21
Jan	1	12	17	18	20
	2	13	18	19	19
	3	13	16	18	19
Feb	1	12	16	15	14
	2	11	14	14	13
	3	9	13	12	13
Mar	1	12	13	11	13
	2	10	12	11	13
	3	6	5	7	5
Apr	1	13	16	15	18
	2	10	14	11	15
	3	10	10	11	13
May	1	11	13	11	10
	2	11	10	9	16
	3	6	8	10	17
Jun	1	8	12	12	17
	2	12	16	32	36
	3	12	17	33	42
Jul	1	10	14	31	44
	2	7	14	37	49
	3	10	12	35	41
Aug	1	15	15	38	51
	2	19	23	46	46
	3	29	35	46	51
Sep	1	32	36	50	57
	2	28	30	47	57
	3	28	30	47	57
Oct	1	17	22	44	43
	2	18	25	43	50
	3	18	21	34	43
Nov	1	18	21	25	31
	2	18	22	25	34
	3	15	19	20	27
Dec	1	15	20	20	25
	2	18	20	21	28
	3	18	18	18	20

NATURAL VEGETATION INDEX VALUES

Jan	1	13	13	11	10
	2	14	16	17	17
	3	14	15	14	15
Feb	1	15	16	14	16
	2	14	15	14	13
	3	13	14	15	18
Mar	1	11	14	13	12
	2	12	14	14	20
	3	14	18	17	21
Apr	1	12	14	12	18
	2	10	9	8	16
	3	12	10	10	16
May	1	12	9	10	18
	2	9	10	14	28
	3	11	8	13	30
Jun	1	8	9	16	27
	2	12	11	22	31
	3	9	13	29	38
Jul	1	12	14	35	46
	2	23	13	33	33
	3	28	27	36	46
Aug	1	34	30	41	49
	2	37	34	40	49
	3	39	41	46	47
Sep	1	36	36	36	51
	2	34	30	38	39
	3	34	30	36	39
Oct	1	27	29	39	46
	2	24	31	41	39
	3	20	23	31	35
Nov	1	26	32	37	38
	2	16	27	30	32
	3	16	26	29	32
Dec	1	18	24	25	26
	2	15	25	23	25
	3	13	16	16	15
Jan	1	16	21	22	23
	2	16	20	21	21
	3	16	22	21	21
Feb	1	15	19	16	17
	2	13	17	16	17
	3	15	16	16	16
Mar	1	13	17	15	17
	2	12	17	14	19
	3	12	14	13	17
Apr	1	14	16	16	21
	2	12	15	13	20
	3	11	14	13	21
May	1	5	9	7	16
	2	11	16	16	21
	3	11	14	20	27
Jun	1	10	14	23	34
	2	9	13	27	37
	3	7	12	25	41
Jul	1	11	19	33	41
	2	15	23	39	46
	3	16	30	42	43
Aug	1	23	32	47	41
	2	27	38	44	48
	3	33	41	47	50
Sep	1	31	30	44	48
	2	26	27	39	50
	3	25	29	45	50
Oct	1	20	26	43	47
	2	16	24	34	44
	3	16	26	38	44
Nov	1	15	24	29	35
	2	15	23	27	31
	3	14	24	25	31
Dec	1	13	21	21	25
	2	15	23	22	25
	3	13	19	19	23

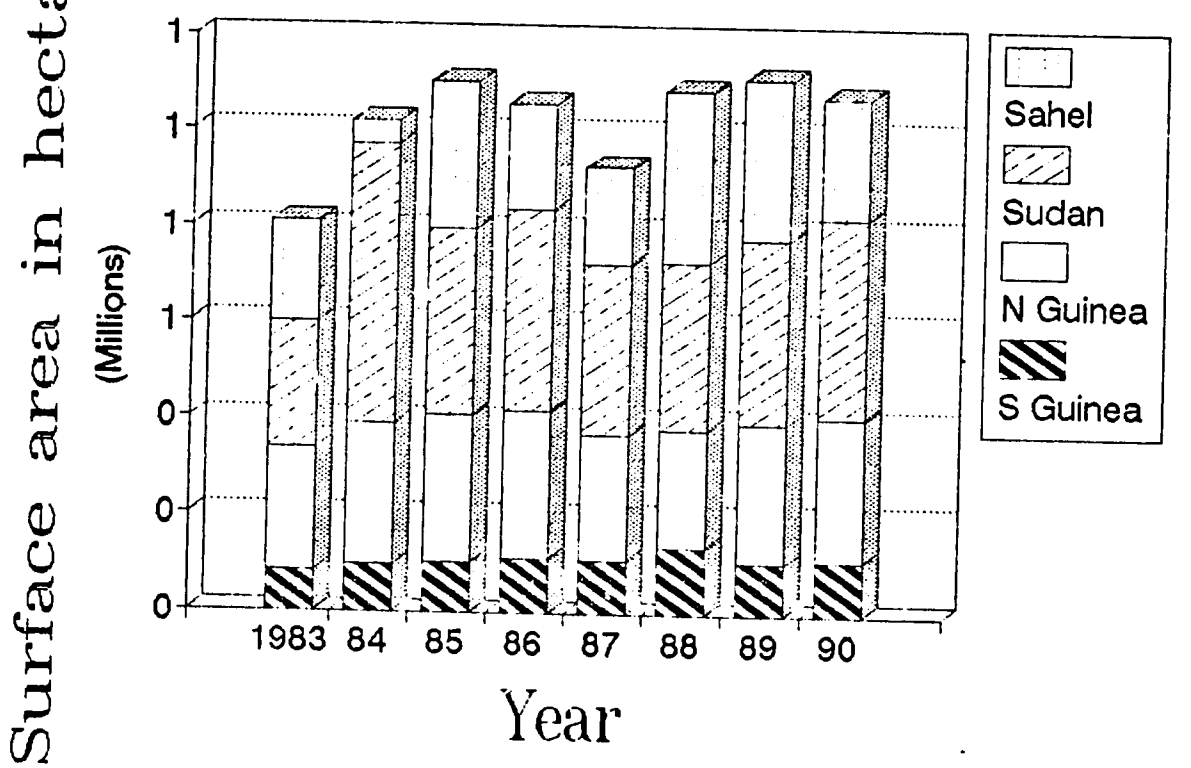
NATURAL VEGETATION INDEX VALUES

Jan	1	14	17	17	15
	2	14	18	17	18
	3	13	13	13	12
Feb	1	13	15	14	14
	2	11	14	14	16
	3	12	15	14	12
Mar	1	13	15	15	18
	2	12	14	14	19
	3	10	12	12	14
Apr	1	11	14	13	19
	2	12	14	13	16
	3	9	11	11	17
May	1	9	10	11	17
	2	8	11	15	25
	3	12	11	17	27
Jun	1	10	12	16	36
	2	8	9	17	36
	3	7	8	20	40
Jul	1	9	11	29	46
	2	14	16	32	48
	3	23	27	43	45
Aug	1	33	41	43	46
	2	34	42	49	51
	3	32	37	46	43
Sep	1	26	34	48	52
	2	20	27	46	53
	3	17	25	48	52
Oct	1	14	23	43	50
	2	14	22	42	45
	3	14	23	32	40
Nov	1	13	23	25	33
	2	12	20	23	28
	3	15	23	24	26
Dec	1	11	22	20	23
	2	13	21	21	20
	3	14	20	19	20
Jan	1	11	17	17	16
	2	12	15	16	14
	3	13	18	18	19
Feb	1	10	16	14	16
	2	14	16	18	20
	3	11	14	15	15

Annex E

Evolution of Surface in Crops

EVOLUTION OF SURFACE IN CROPS
(Hectares)



Annex F

Map, Bioclimatic Regions

-MAP TO BE INSERTED IN CHAD-

Annex G

Per Capita Cereals Production

CHAD AGRICULTURAL STATISTICS

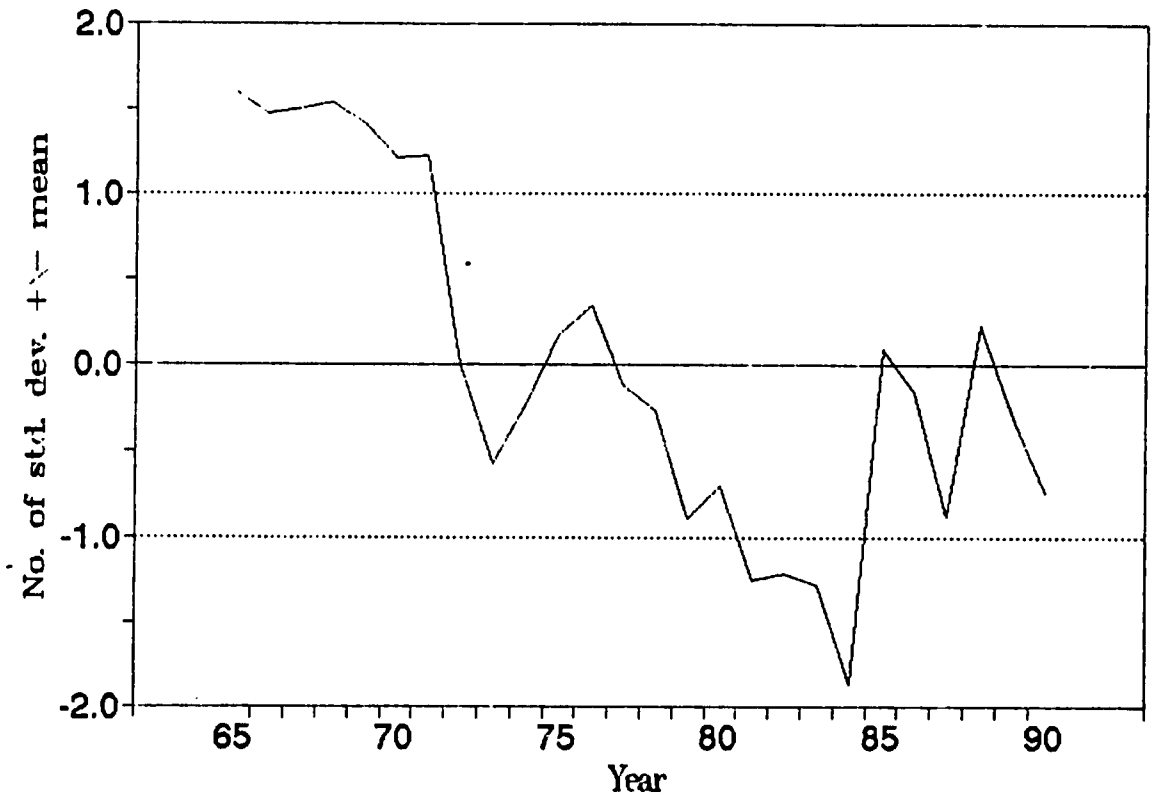
Year	Total population (1000)	Cereal production (1000 MT)	Percap production (MT)	Coef. variation
65	3334	664	0.199	1.59633
66	3380	658	0.195	1.47530
67	3450	675	0.196	1.50168
68	3510	692	0.197	1.54212
69	3570	687	0.192	1.41492
70	3652	676	0.185	1.21705
71	3720	690	0.185	1.22730
72	3800	532	0.140	0.00000
73	3870	460	0.119	-0.57034
74	3950	520	0.132	-0.22543
75	4030	591	0.147	0.17944
76	4050	619	0.153	0.34645
77	4193	569	0.136	-0.11596
78	4277	557	0.130	-0.26359
79	4362	466	0.107	-0.89499
80	4477	510	0.114	-0.70384
81	4388	409	0.093	-1.26258
82	4489	425	0.095	-1.22299
83	4592	424	0.092	-1.28617
84	4698	332	0.071	-1.87079
85	4806	689	0.143	0.09073
86	4916	658	0.134	-0.16598
87	5029	541	0.108	-0.87490
88	5145	763	0.148	0.22394
89	5263	677	0.129	-0.30670
90	5384	605	0.112	-0.74555

Sources: FAO, IFAD, BAS, MASI and ONDR

Mean:	0.140	MT/person/a
Std. dev:	0.03706	

PER CAPITA CEREAL PRODUCTION, CHAD

DEPARTURE FROM THE MEAN



Annex H

National Herd, 1945 - 1990

NATIONAL HERD, CHAD (1000 HEAD)

Year	Cattle	Sheep and goats	Camels	Donkeys	Horses	Total
1945	1104	987	92	330	150	2663
46						
47						
48						
49						
50	1399	1473	110	330	150	3462
51						
52						
53						
54						
55	1374	1371	134	330	150	3359
56						
57						
58						
59						
60	2019	1375	210	330	150	4084
61						
62						
63						
64						
65	3482	3004	291	330	150	7257
66						
67						
68						
69						
70	4500	4300	370	343	153	9666
71	4690	5200	560	343	153	10946
72	4690	5200	550	300	150	10890
73	2970	4900	545	300	150	8865
74	3250	4650	518	300	140	8858
75	3600	4800	305	300	145	9150
76	3650	4848	310	300	145	9253
77	3954	4460	400	271	154	9239
78	4012	4508	405	271	154	9350
79	4070	4556	410	271	154	9461
80	4233	4624	426	300	160	9743
81	4402	4694	443	300	166	10005
82	4578	4764	461	300	170	10273
83	4672	4826	476	293	172	10439
84	3750	3952	459	221	175	8557
85	3900	4300	470	250	175	9095
86	3886	4193	488	230	182	8979
87	4002	4358	502	221	186	9269
88	4098	4482	520	232	188	9520
89	4197	4624	533	231	193	9778
90	4297	4764	549	263	178	10051

Sources: 1984-85: Ministry of Livestock and Rural Water Supply
1945-83: USAID
1988, 90: IFAD
1986, 87, 89: Ministry of Planning and Cooperation

POPULATION RESPONSE FOLLOWING DROUGHT

	CATTLE				SHEEP AND GOATS			
Year	1972-79	Increase from '73	1983-90	Increase from '84	1972-79	Increase from '73	1983-90	Increase from '84
0	4690		4672		5200		4826	
1	2970	0	3750	0	4900	0	3952	0
2	3250	280	3900	150	4650	-250	4300	348
3	3600	630	3886	136	4800	-100	4193	241
4	3650	680	4002	252	4848	-52	4358	406
5	3954	984	4098	348	4460	-440	4482	530
6	4012	1042	4197	447	4508	-392	4624	672
7	4070	1100	4297	547	4556	-344	4764	812

Annex I

Rinderpest Vaccinations, 1945 - 1985

RINDERPEST VACCINATIONS

Year	Number
1945	350000
46	300000
47	300000
48	400000
49	500000
50	900000
51	1045598
52	1049659
53	1058580
54	1269429
55	1092397
56	835109
57	963882
58	1056529
59	886821
60	1144605
61	1065073
62	1988828
63	3223379
64	2240857
65	1564275
66	1500703
67	2662465
68	1576968
69	1426237
70	1284027
71	1926734
72	1633915
73	1744869
74	1539464
75	1713995
76	1674940
77	1183912
78	0
79	0
80	29736
81	0
82	0
83	6152346
84	2241083
85	1733635

Source: L. Berger and BCEOM. 1988. Étude des perspectives de la commercialisation du betail et des produits de l'élevage. Vol 2. Ministère du Plan et de la Coopération.

RINDERPEST VACCINATIONS

Year	Number
1945	350000
46	300000
47	300000
48	400000
49	500000
50	900000
51	1045598
52	1049659
53	1058580
54	1269429
55	1092397
56	835109
57	963882
58	1056529
59	886821
60	1144605
61	1065073
62	1988828
63	3223379
64	2240857
65	1564275
66	1500703
67	2662465
68	1576968
69	1426237
70	1284027
71	1926734
72	1633915
73	1744869
74	1539464
75	1713995
76	1674940
77	1183912
78	0
79	0
80	29736
81	0
82	0
83	6152346
84	2241083
85	1733635

Source: L. Berger and BCEOM. 1988. Étude des perspectives de la commercialisation du betail et des produits de l'élevage. Vol 2. Ministère du Plan et de la Coopération.

Annex J

Forestry Statistics

ESTIMATED WOOD BALANCE BY REGION

Province	Surface area (M ha)	Population	Estimated fuelwood requirement (m3/a)	Forest lands, (million ha): Closed broad-leaved forest	Productive forest grassland assoc.	Unproductive forest grassland assoc.	Fallow	Shrub-lands	Total forest lands
	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
BET	6003.5	104966	62980						
Batha	888.0	265764	159458					0.93	0.93
iBiltine/Ouaddai	1240.9	574498	344699		0.07	2.04		2.62	4.73
Kanem	1145.2	316736	190042					0.13	0.13
Lac	223.2	243240	145944					0.03	0.03
Subtotal	2609.3	1134474	680684		0.07	2.04		3.71	5.82
Chari/Baguirmi	829.1	1146235	687741		0.18	2.36		1.22	3.76
Guera	589.5	241975	145185		0.66	1.32		0.46	2.44
Salamat	630.0	132632	79579	0.03	0.45	1.44	0.30	1.94	4.13
Mayo-Kebi	301.0	650179	390107	0.03	0.22	0.44		0.92	1.58
Subtotal	2349.6	2171021	1302613	0.06	1.51	5.56	0.30	4.54	11.91
Tandjile	180.4	315417	189250	0.02	0.23	0.23		0.31	0.77
Logone occident	77.0	338151	202891	0.01	0.22	0.07		0.12	0.40
Moyen-Chari	451.8	619949	371969	0.08	1.00	0.50	0.11	1.03	2.64
Subtotal	709.2	1273517	764110	0.11	1.45	0.79	0.11	1.45	3.81
lLogone oriental	280.4	313347	188008	0.05	0.59	0.30		0.40	1.29
Total	5948.5	4892359	2935415	0.22	3.62	8.70	0.41	10.10	22.84

Data sources: (2) and (3) Bureau de Statistiques, Plannification et Étude. 1989. Annuaire de statistiques sanitaires du Tchad

(5) to (10) L. Berger, Inc. and BCEOM. 1988. Conservation des ressources naturelles et développement rural.

Computations: (4) = 0.6 * (3)

WOODLANDS, RESERVES AND PARKS

Incremental annual growth, (million m3/a)						Reserves and parks, (million ha)				
Closed broad-leaved forest	Productive forest grassland assoc.	Unproductive forest grassland assoc.	Fallow	Shrub-lands	Total forest lands	Total forest lands	Parcs nation-aux (M ha)	Reserves de faunes (M ha)	Total reserves and parks (M ha)	Total forests less reserves (M ha)
(11)	(12)	(13)	(14)	(15)	(16)					
								0.21	0.21	0.00
	0.07	1.43		0.47 1.31 0.07 0.01	0.47 2.81 0.07 0.01	0.93 5.55 0.13 0.03		8.00	8.00	0.93 0.00 0.13 0.03
	0.07	1.43		1.85	3.35	6.64		8.00	8.00	1.09
0.15 0.15	0.18 0.66 0.45 0.22	1.65 0.92 1.01 0.31	0.15	0.61 0.23 0.97 0.46	2.44 1.82 2.73 1.14	4.71 2.97 4.85 1.91	0.30	0.14 0.54 2.06 0.14	0.14 0.54 2.36 0.20	3.62 1.90 1.77 1.38
0.30	1.51	3.89	0.15	2.27	8.12	14.44	0.30	2.87	3.24	8.67
0.10 0.05 0.40	0.23 0.22 1.00	0.16 0.05 0.35	0.06	0.16 0.06 0.51	0.64 0.37 2.32	0.96 0.48 3.24	0.11		0.58 0.52	0.77 0.00 2.12
0.55	1.45	0.55	0.06	0.73	3.34	4.68	0.11		1.10	2.89
0.25	0.59	0.21		0.20	1.25	1.67			0.43	0.86
1.10	3.62	6.09	0.21	5.05	16.07	27.42	0.41	10.87	12.77	13.52

1) = 5.0 * (5)
2) = 1.0 * (6)
3) = 0.7 * (7)
4) = 0.5 * (8)
5) = 0.5 * (9)

Source: L. Berger, Inc. and BCEOM. 1988. Conservation des ressources naturelles et développement rura

Annex K

Cereals Balance

ANNEX K
Cereals Balance 1965 - 1990

Year	Production (000T)	Population (x1000)	Consumption (150kg/prs)	Balance (000T)
1965	460	3,320	495	-35
1966	660	3,380	505	+155
1967	675	3,450	515	+160
1968	690	3,510	525	+165
1969	685	3,570	535	+150
1970	650	3,640	550	+100
1971	690	3,720	560	+130
1972	530	3,800	570	-40
1973	460	3,870	580	-120
1974	520	3,950	590	-70
1975	665	4,030	605	+60
1976	620	4,050	608	+12
1977	565	4,080	612	-47
1978	555	4,120	618	-63
1979	465	4,130	620	-155
1980	510	4,160	624	-114
1981	410	4,190	628	-218
1982	425	4,220	633	-208
1983	445	4,240	636	-191
1984	345	4,340	650	-305
1985	715	4,450	670	+45
1986	645	4,560	685	-20
1987	565	4,670	700	-135
1988	765	4,780	715	+50
1989	690	4,890	730	-40
1990	600	5,010	750	-150

Source: USAID ('65-'78), ONDR.

Chad: Cereals Balance

Crop Year	Zone	Rainfall (mm)	Population (x1000) Total	Population (x1000) Rural	Cereals Production (000T)	Rural Subsistence Needs	Urban Requirements (000T)	Total Consumption (000T)	Balance (000T)	Food Aid (000T)
	Sahara	-	92	NA	-	4	NA	4	-4	
1984	Sahel	263	2540	2040	140	336	82	418	-267	
	Sudan	693	1913	1820	235	300	15	315	-80	
	Total		4545	4082	375	640	175	737	-362	62
	Sahara	-	94	NA	-	4	NA	4	-4	
1985	Sahel	372	2600	2065	35	340	88	428	-393	
	Sudan	856	1960	1860	260	306	17	323	-63	
	Total		4654	3925	295	650	105	755	-460	117
	Sahara	-	96	NA	-	5	NA	5	-5	
1986	Sahel	356	2670	2100	220	340	95	435	-215	
	Sudan	899	2005	1900	470	315	15	330	140	
	Total		4815	4000	690	660	110	770	-80	67
	Sahara	-	98	NA	-	5	NA	5	-5	
1987	Sahel	310	2735	2120	225	345	102	447	-222	
	Sudan	1051	2097	1985	375	325	18	343	32	
	Total		4930	4105	600	675	120	795	-195	32
	Sahara		100	NA	-	6	NA	6	-6	
1988	Sahel		2800	2145	170	354	110	464	-294	
	Sudan		2150	2030	315	335	20	355	-40	
	Total		5050	4175	485	695	130	825	-340	26
	Sahara		102	NA	-	7	NA	7	-7	
1989	Sahel		2885	2185	295	360	115	475	-220	
	Sudan		2188	2060	360	340	20	360	-	
	Total		5175	4245	655	707	135	842	-227	12
	Sahara		105	NA	-	7	NA	7	-7	
1990	Sahel		2955	2200	220	360	125	485	-265	
	Sudan		2240	2100	370	343	20	363	7	
	Total		5300	4300	590	710	145	855	-265	18

Annex L

Areas, Yields, and Production of Major Food Crops

Areas (000 ha), yields (kg/ha) and production (000tons) major food crops in Chad

	1983			1984			1985			1986			1987			1988			1989		
	A	Y	P	A	Y	P	A	Y	P	A	Y	P	A	Y	P	A	Y	P	A	Y	P
Sudan Zone	512.2		289.9	571.1		303.8	609.9		534.7	605.8		414.8	541.1		356.6	487		413.1	507.7		348.3
Millet	129.7	567	73.5	164.3	534	87.8	190.8	1.23	234.5	200.7	649	130.3	189.3	583	110.4	186.8	689	128.6	152.2	434	66.1
Sorghum	307.3	581	178.7	332.8	584	194.2	352.1	741	260.8	336.9	681	229.3	288.7	687	197.1	240.9	750	180.7	298.8	531	158.7
Berbere	16.1	416	6.7	22.1	308	6.8	25.4	610	15.5	21.6	619	17.7	20.3	635	12.9	17.5	1217	21.3	19.2	635	12.2
Rice	38.3	472	18.1	31.4	51	1.6	14.6	520	7.6	18.2	808	14.7	21.1	919	19.4	31.4	2347	73.7	28.6	3674	105.1
Maize	19.8	651	12.9	20.5	653	13.4	27.2	599	16.3	28.2	801	22.6	23.7	709	16.8	10.4	827	8.6	9.1	681	6.2
Sahel Zone	332		110.9	139.4		41.2	529.5		269.7	481.2		219.6	447.3		191.6	613.3		395.1	605.6		267.1
Millet	190.1	211	40.2	109.3	209	22.9	300.4	390	117.3	307.4	399	122.7	274.7	388	106.6	382.2	578	226.9	372.5	304	113.2
Sorghum	63.4	298	18.9	na	na	na	106.3	448	48.3	133.3	519	69.2	120.1	490	58.9	106.3	726	77.2	134.4	582	78.3
Berbere	67.6	599	40.6	26.5	457	12.1	101.1	787	79.6	35.2	699	24.6	48.5	476	23.2	91.3	691	63.1	68.5	708	62.7
Rice	na	na	na	0.6	1333	0.6	0.2	1000	0.2	0.2	1000	0.2	0.2	500	0.1	0.1	2000	0.2	na	na	na
Wheat	1.1	727	0.6	2.1	571	1.2	4.4	1205	5.3	0.9	667	0.6	1.1	1000	1.1	2.3	1043	2.4	na	na	na
Maize	9.6	1083	10.4	0.9	4666	4.2	15.1	1245	18.6	4.2	548	2.3	2.7	704	1.9	21.1	1199	25.3	10.4	1240	12.9
Other cereal*						20.1			31.1			18.6			13.6			60.1			18.9
CEREALS	844.2		400.6	710.5		365.1	1139.4		835.5	1066.6		653	988.4		562	1100.3		868.3	1113.5		832.3
Sudan Zone	142.5		84.6	159.2		85.4	170.7		116.3	166.6		106	151.6		86.5	115.3		67.4	138.1		190.7
Sesame	28.4	275	7.6	34.1	258	6.6	36.3	314	11.4	37.1	275	10.2	27.2	272	7.4	7.6	776	5.9	2.3	913	2.1
Peanut	114.1	673	76.6	125.1	612	76.6	134.4	761	104.9	129.7	739	95.6	124.4	636	79.1	107.7	757	61.5	135.6	1389	188.6
Sahel Zone	16.9		5.6	4.9		2.5	12.5		6.7	19.1		9.3	32.8		16.1	28.3		20			
Sesame	na	na	na	0.4	250	0.1	0.4	250	0.1	2.9	310	0.9	6.7	287	2.5	8.4	359	2.3	na		na
Peanut	16.9	331	5.6	4.5	533	2.4	12.1	545	6.6	16.2	519	6.4	24.1	564	13.6	21.9	806	17.7	na		na
OIL CROPS	159.4		90.2	164.1		87.9	183.2		123	185.9		115.3	184.4		102.6	143.6		107.4	na		na

Source: Bureau Statistiques Agricole
* SODELAC

Annex M

Tariff and FIR Surtax Rates

ANNEX M

Tariff and FIR Surtax Rates

Product	Import			Export		
	Tariff & Tax	FIR Surtax	Total %	Tariff & Tax	Surtax Rate %	Total %
Cotton	0.0	0.0	0.0	12.0	0.0	12.0
Live Animals	38.0	0.0	38.0	11.24	2.0	13.2
Dried Milk	20.75	0.0	21.0	3.0	0.0	3.0
Meat	61.0	2.0	63.0	3.0	0.0	3.0
Milk Products	66.75	4.0	71.0	3.0	0.0	3.0
Live Plants	55.25	0.0	55.0	3.0	2.0	5.0
Vegetables	61.0	2.0	63.0	3.0	1.0	4.0
Fruits	61.0	2.0	63.0	3.0	1.0	4.0
Tea	61.0	1.0	62.0	3.0	0.0	3.0
Spices	70.0	2.0	72.0	3.0	0.0	3.0
Rice	0.0	0.0	0.0	0.0	0.0	0.0
Flour	0.0	0.0	0.0	0.0	0.0	0.0
Cola Nuts	72.5	3.0	3.0	3.0	3.0	6.0
Gum & Resin	55.25	2.0	3.0	3.0	2.0	5.0
Skins & Hides	55.25	1.0	3.0	3.0	2.0	5.0

Source: *Decret No. 315/PR/MADR/86.*

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