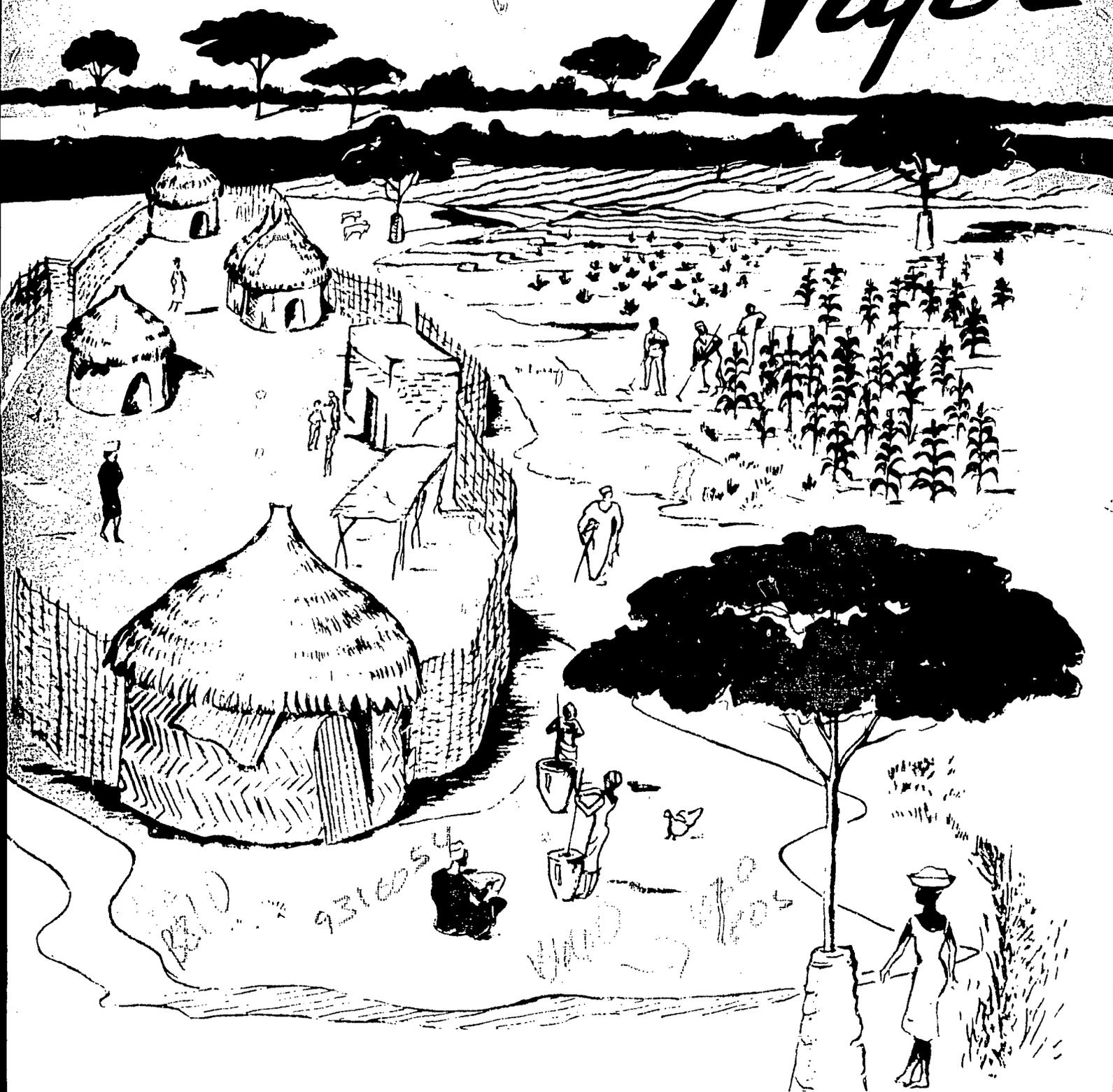


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A SOCIOECONOMIC STUDY OF FARM-LEVEL CONSTRAINTS TO FERTILIZER USE IN WESTERN

Niger



INTERNATIONAL FERTILIZER DEVELOPMENT CENTER

**A Socioeconomic Study
of Farm-Level Constraints
to Fertilizer Use
in Western Niger**

by

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Preface

The lingering effects of the drought during the early 1980s have exacerbated the human suffering in the Sahelian country of Niger. Declining food production per capita and limited use of fertilizer are critical problems that are becoming more evident in the 1980s. Farm-level socioeconomic research must be considered in evaluating the potential of the region to produce, market, and use fertilizer. Niger, at the geographical center of the Sahel, exemplifies the demographic, economic, and agricultural problems of the region. This exploratory study of farm-level constraints to fertilizer use in western Niger provides a basis for future socioeconomic research by IFDC in West Africa.

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List of Abbreviations and Acronyms

Economic and Monetary

GDP	Gross Domestic Product
CFA franc	Currency of the West African Monetary Union (295 CFA = U.S. \$1.00)

Measures

ha	hectare (2.47 acres)
kg	kilogram (0.454 kg = 1 pound)
km	kilometer (1.61 km = 1 mile)
tonne	metric ton (2.204 pounds = 1,000 kg)

Governmental and International Organizations

ALC	Associations Locales des Cooperatives
FAO	Food and Agriculture Organization of the United Nations
ICRISAT	International Crops Research Institute for the Semi-arid Tropics
IFDC	International Fertilizer Development Center
GMV	Groupement Mutualistic Villageois
GON	Government of Niger
USAID	United States Agency for International Development

Fertilizer

CAN	Calcium ammonium nitrate
SSP	Single superphosphate
TSP	Triple superphosphate

Introduction and Background

The Sahelian countries of West Africa may be described as a region of limited rainfall and frequent drought. Although diverse in many ways, the countries of Niger, Chad, Senegal, Mauritania, Burkina Faso, Sudan, and Mali have in common the problem of fragile agricultural sectors and demographic pressures. The Sahelian population counts its blessings by millimeters of rain and survives on a thin margin. Dust, wind, desertification, and a delicate ecological environment render life tenuous, harsh, and demanding.

The character of existence in the Sahel is well exemplified in Niger, a country sometimes described as "a land where the harvest is won with the soul's scythe." Niger is the largest country in West Africa and is the geographical center of the Sahelian region. Niger provides an excellent example of the demographic, economic, and agricultural problems confronting the region.

The Republic of Niger has a landlocked area of 1,186,408 km² or 458,075 mi² with a population that exceeds 7 million; it is the tenth largest country in Africa and sparsely populated. Although estimates vary, between 3% and 8% of the land is considered suitable for agricultural production.

The Demographic Character of Niger

Niger is in a period of explosive population growth caused by high birth rates, increasing life expectancies, declining infant mortality, and a generally declining death rate. The critical variables that describe that demographic transition are shown in Table 1. With an estimated midyear population of 7.1 million people in 1987 and one of the highest rates of natural increase in the world, Niger is confronting a rather dismal demographic horizon. One particular problem is



A typical Sahelian scene in the village of Simari in northwestern Niger.

Table 1. Selected Demographic Characteristics of Niger in 1987

Characteristic	Numerical Indicator
Estimated Midyear population, 1987	7.1 million
Annual natural increase	2.9%
Doubling time	24 years
Projected population year 2000	10.6 million
Infant mortality rate	141 per 1,000
Fertility rate	7
Population under 15 years	47%
Average life expectancy	44 years

Source: Population Reference Bureau, Washington, D.C., 1987

the rapid 6% estimated annual growth of urban populations whose demands for sustenance will become increasingly difficult to satisfy.

Ironically, programs and interventions in health care will decrease the time in which the population doubles and make it more difficult to achieve progress in economic development. The social custom of polygamy contributes to high aggregate fertility. The total fertility rate shows that on the average each woman will have seven children during the childbearing period.

The demographic structure and character of Niger are greatly increasing the population density per square kilometer of agricultural land. The data shown in Table 2 indicate that such density has more than doubled during the last quarter century. The Nigerien people are increasingly dependent on a fragile and deteriorating economy in the midst of tremendous population pressure.

Table 2. Population Density Per Square Kilometer of Agricultural Land for Selected Years, 1960-85

Year	Density
1960	23
1965	28
1970	31
1975	37
1976	38
1977	39
1978	41
1979	42
1980	43
1985 ^a	53

a. An estimate based on population growth.

Source: The World Bank, World Tables, Vol. II Social Data 1983, 3rd Edition.

The Economic Situation

One particularly useful indicator to describe the situation of the Nigerien economy is the per capita gross domestic product (GDP). Those data shown in Table 3 indicate a constant downward trend since 1980.

The accelerated economic growth during the decade 1970-80 was attributable to soaring world prices for uranium and several years of adequate rainfall that temporarily bolstered agricultural production.

The factors that explain the deterioration of the economy in the 1980s are the decline in the world demand for uranium, which is mined in Niger, and the lack of growth in the agricultural sector.

The annual growth rates in real GDP per capita shown in Table 4 dramatically illustrate the deterioration of the economic situation of Niger. The rapid population growth and decline in other sectors of the economy have had profound consequences for the Nigerien agricultural sector.

The Agricultural Sector

A reliable and valid database is a necessity in planning an agricultural development strategy. Although essential data on key factors of agricultural production in Niger are lacking or often contradictory, the World Development Reports of the World Bank provide useful insight into the general condition of the Nigerien agricultural sector (Table 5).

The people of Niger are experiencing a decline in domestic production and a growing dependence on cereal imports and food aid. Because of the rapidly growing population and deteriorating agricultural production and economic growth, a high priority of the Government of Niger (GON) is to increase grain production to meet domestic needs. Future expansion of agricultural production is to be realized from increased land productivity rather than expansion of the area of cultivated land. That

Table 3. Estimated Per Capita Gross Domestic Product for Niger, 1978-85 at Constant 1976 Prices

Year	GDP (Billions of US \$)	Per Capita GDP (US \$)
1978	1,123	214
1979	1,288	239
1980	1,369	246
1981	1,356	237
1982	1,345	230
1983	1,310	216
1984	1,100	176
1985	1,172	175

Source: Based on Rural Finance in Niger: A Critical Appraisal and Recommendations for Change. The Ohio State University, 1987 and FAO population estimates.

Table 4. Annual Growth Rates in Real and Per Capita Gross Domestic Product, 1978-85^a

Year	Growth Rate Per Capita (%)	Real Gross Domestic Product (%)
1978	5	7
1979	11	15
1980	4	6
1981	-4	-9
1982	-4	-8
1983	-5	-3
1984	-19	-16
1985	4	7

a. The figures are rounded.

Source: Rural Finance in Niger: A Critical Appraisal and Recommendations for Change. The Ohio State University, 1987.

Table 5. Key Indicators for the Nigerien Agricultural Sector, 1981-85

Indicator	1981	1982	1983	1984	1985
Agricultural Share of GDP (%)	30	31	33	33	47
Cereal imports ('000 tonne)	89	120	45	45	247
Food aid in cereals ('000 tonne)	11	71	12	13	218
Average index of per capita food production		122	113	95	
1974-76 = 100		(1981-83)	(1982-84)	(1983-85)	

Source: World Bank, World Development Reports, 1980-87.

strategy of intensive agriculture is predicated on developing and expanding the efficient use of appropriate fertilizer technology and other modern inputs.

Fertilizer Use in Niger

Central to the food and fiber production problems of Niger is the low level of fertilizer use, which was estimated by FAO in 1982 to average less than 10 kg/ha. Table 6 presents data on fertilizer deliveries for Niger by type for the period 1980-84.

The GON suspended credit for fertilizer in 1981. That decision had a depressing effect on sales and use of fertilizer and on agricultural production. The trend toward lower levels of fertilizer use has continued to the present. The lack of credit for fertilizer may have contributed to the expansion of the area under production and the use of smaller amounts of fertilizer.

Given the low levels of fertilizer use in Niger and the well-established contribution of fertilizers in increasing crop yields in other countries and regions of the world, it is apparent that in Niger there is a great potential to expand food production and promote economic development through increased use of fertilizers. Because 90% of the population of Niger is engaged in agricultural work, which is predominantly rural, economic development can only be realized through the rapid growth of the agricultural sector.

Table 6. Total Fertilizer Deliveries for Niger by Types, 1980-84

Type of Fertilizer	1980	1981	1982	1983	1984
	(tonne)				
Urea	1,455.8	2,824.6	2,551.3	2,726.0	3,835.0
Ammonium sulfate	56.9	17.0	3.2	56.0	61.0
CAN	3.8	11.4	3.3	58.0	50.0
SSP	2,865.2	7,089.9	5,206.4	3,823.0	1,584.0
TSP	370.8	219.3	660.6	47.0	530.0
Ground phosphate rock	314.6	73.4	432.3	730.0	487.0
15-15-15	717.2	1,339.1	701.1	2,136.0	2,503.0
14-7-7	40.0	77.4	0.0	0.0	0.0
Other	127.4	29.5	9.8	5.0	40.0
Total	5,951.7	11,681.6	9,368.0	9,581.0	9,090.0

Source: Étude Retrospective de l'Offre et de la Demande d'Engrais au Niger. Ministère de l'Agriculture Direction des Études, de la Programmation et des Statistiques Agricoles, Septembre 1986.

In order to design appropriate policies and enhance agricultural research and development, the Government of Niger needs a more elaborate and detailed understanding of farm-level constraints to fertilizer use. A study to provide this information, which at present is generally lacking, would clearly be useful and appropriate.

In general, farm-level constraints to fertilizer use may be classified in two general categories. First, there are those constraints that restrict the demand for fertilizer and are associated with agricultural production technology, the resource endowment of farmers, and socioeconomic factors affecting the attitudes and behavior of farmers. Second are those constraints that restrict the supply of fertilizer and are associated with the imports, production and marketing of fertilizers. The focus of this research project is on the identification of farm-level constraints to fertilizer use that are associated with agricultural production.

The Village Chief (center) of Gotheye with other farmers who are users of fertilizer technology.

The Research Approach

Agricultural production theory is the basic framework used in this study of farm-level constraints to fertilizer use and demand. Agricultural production depends on decisions to use resources of land, labor, and capital for that purpose. Agricultural production is therefore a function of farmers' decisions about the use of the following:

1. A set of fixed factors of production such as factors that in the short run cannot be changed by farmers' decisions; these factors

usually include land, family labor, and capital assets.

2. A set of variable inputs such as inputs whose use in the short run is determined by farmers' decisions; these inputs include fertilizer, pesticides, labor, and irrigation.

Farmers' decisions about the use of fertilizer are therefore affected by several factors, including the following:

1. The availability of fixed factors of production and a set of socioeconomic variables influencing the use of these resources for agricultural production. Thus, information is needed about land, land tenure, family labor, and capital assets as well as about socioeconomic variables such as use of agricultural output, crop prices and access to market, availability of financial resources, and access to credit.
2. Access to timely and adequate supplies of fertilizers and other variable inputs and their prices. In this respect, information is needed about farmers' access to and prices paid for variable inputs such as fertilizers, pesticides, seeds of improved varieties, organic manures, and labor.



3. Knowledge of and access to information about the use of fertilizers and agricultural production technology in general. In this respect, information is needed on the farmers' education, experience, contact with extension service, and access to different means and types of information.

4. Perception of and response to risk associated with uncertainty on crop yields and prices.

A preliminary questionnaire to collect data on some of the factors described above was designed and field tested in Niger during the first 2 weeks of March 1987. Following that test, the questionnaire was redesigned to make it more suitable to the situation of farmers in the survey areas.

Overview of Farm-Level Research in Niger

Socioeconomic research on farm-level constraints to fertilizer adoption and use in Niger is conducted rather infrequently. The few studies that have

been conducted have concentrated on the departments of Maradi and Zinder in southeastern Niger, which are inhabited by the Hausa ethnic group. This geographical limitation has resulted in a bias in the research on Nigerian agriculture that has been widely disseminated among international research scientists and organizations.

The departments of Maradi and Zinder represent a distinct agroclimatic region; more extensive use of modern agricultural inputs and animal traction and higher levels of agricultural productivity are found in Maradi and Zinder than in other departments in Niger. In the departments of Niamey and Dosso, the use of animal traction is virtually nil, and the agroclimatic and soil conditions are quite different from those in Maradi and Zinder. Because of these factors, research distinctions between western and eastern Niger must be a continuing consideration and feature of future farm-level research.

This study offers an initial contribution to the literature by focusing on farm-level constraints to fertilizer adoption and use among the Djernia ethnic group of western Niger.

Farm Survey

The farm survey was conducted during the period June 10-August 6, 1987, and 48 interviews were completed. The interviews were primarily conducted in western Niger in the departments of Niamey, Dosso, and Tahoua. The specific villages visited were Bambey, Galmi, and Dan Gona in Tahoua; Sokorbey, Falmey, and Goberi in Dosso; and Trodi, Karma, Gotheye, and Simari in Niamey. Department names are used in the text and tables to refer to these villages. Figure 1 shows the locations of these villages. The remoteness of many of these villages mitigates the biases that are often associated with socioeconomic studies conducted in villages located near major highways.

Data Analysis

The questionnaire was designed to collect and analyze data on 11 main factors related to farm-level adoption and use of fertilizer. These factors included the demographic characteristics of farmers and household composition, patterns of dry-season migration, distances from households to commercial locations and fields, and land tenure and use.

The factors related to agricultural production and fertilizer use included cropping systems on household plots, fertilizer use on household plots, farm production and byproduct use, farm-level labor, benefits of agricultural cooperatives, and the characteristics of users and nonusers of fertilizer.

A scene in the village of Goberi shows the importance of crop byproducts for building fences and roofs.



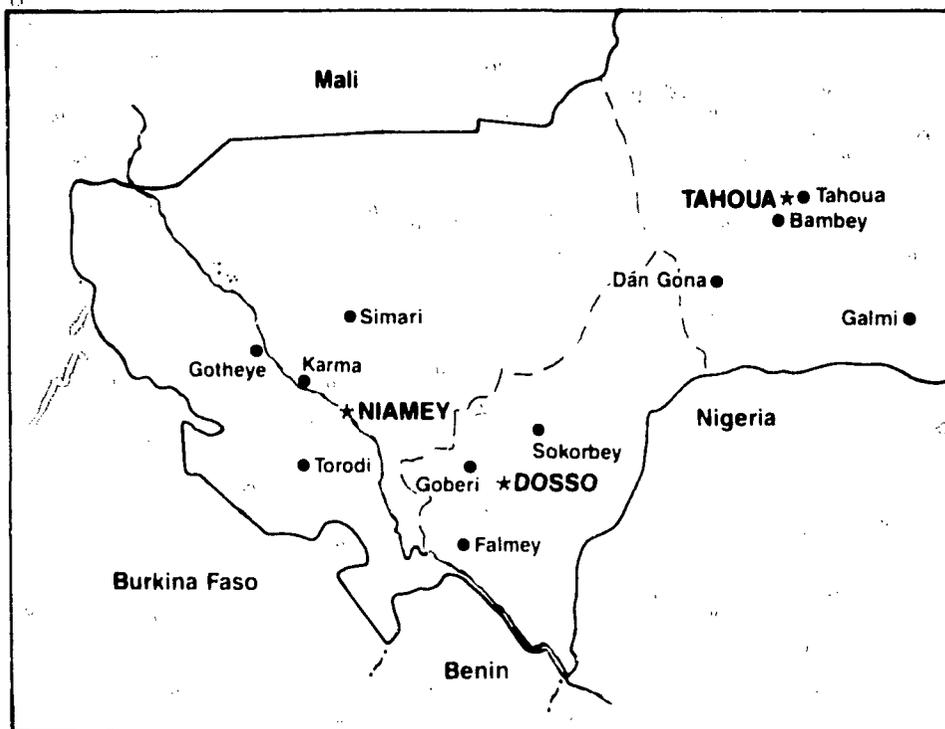


Figure 1. Sites of Field Interviews in Western Niger.

Table 7. Average and Standard Deviation of Selected Sociodemographic Characteristics of the Households Studied (N=48)

Characteristic	Average	Standard Deviation
Number of children per household	5	3.1
Household size	8	3.5
Number of wives	2	0.55
Age of household heads (years)	48	12.2
Years of schooling of household head	3	0.0
Persons in household speaking French	1	1.5

Household Composition

The sociodemographic characteristics of the households during the cropping season, shown in Table 7, have several important implications. The average number of persons per household is eight and indicates a high level of dependency of children. The average number of wives per household is two, and polygamy is a critical factor contributing to population growth. The typical pattern is for younger men to have one wife, and additional wives may join the household as men age and accumulate resources and assets. Typical of national characteristics, the sample indicates minimal formal education; on the average, one person per household speaks French, usually a dependent enrolled in school. The importance of documenting the number of persons speaking French is that it is, to some extent, a measure of social integration with modern national and commercial culture. Illiteracy is a serious hindrance to economic and social development in general and the expansion of modern agricultural inputs in particular. The inability to read and understand fertilizer packages and instructions for use restricts the effectiveness of using written information as a means of disseminating knowledge about fertilizers. Pictorial depictions of proper fertilizer use should be considered.



Djerma farmers from the village of Bambey are the beneficiaries of fertilizer technology.

Patterns of Dry-Season Migration

For those men who migrate during the dry season, Côte d'Ivoire and Ghana appear to be the favored destinations among the Djerma of western Niger. Although some may work as stevedores in Abidjan, the most prevalent work among seasonal migrants is small-scale trade. In that type of work, the migrant receives cloth, shoes, watches, and like items on consignment from a wholesaler; these goods are sold by the migrant, and profits are shared. Temporary migrations of 6-9 months are not uncommon. As shown in Table 8, earnings of US \$650 are possible. In some cases young men will permanently move to Ghana or Côte d'Ivoire, periodically return to present money to the household, and then depart only to repeat that process.

Table 8. Selected Variables Describing Dry-Season Migration of Household Heads Interviewed (N=18)

Variable	Percentage
Percent of total sample that migrated in the 1986-87 dry season	38.0
Percent migrating to	
Within Niger	17.0
Côte d'Ivoire	67.0
Benin	5.0
Nigeria and Côte d'Ivoire	5.3
Within Niger and Côte d'Ivoire	5.7
Type of Work	
Sales and trade	98.0
Labor and construction	2.0
Estimated average dry season earnings (US \$/6-9 months)	650.00

Migration is a complex topic of sociological research, but it is very useful in understanding labor and finances that are available for capital investment in land, general agriculture, and fertilizer.

The theoretical relationship between dry-season migration and farm-level fertilizer use is one where earnings may be used to purchase fertilizers and other modern agricultural

inputs to improve household production. That observation should be further validated through empirical research.

Overview of the National Transportation System

The transportation system of Niger is constrained in that it serves the largest landlocked country in West Africa. Poor internal and external transportation linkages have always hindered economic development.

Although substantial improvements in Nigerien domestic transportation have been realized during the past two decades, the rapid population growth and urban expansion will require future road development. Adequate paved highways link major cities, but the secondary and tertiary roads are poor. Often there are no roads linking remote villages with centers of production and consumption. Motorized forms of transportation are frequently overloaded with goods and people, and vehicles with broken axles, shock absorbers, and suspension systems are often seen on roads and highways.

The external transportation system of Niger also requires consideration. The main external linkages are (1) a road connection to Abidjan, which links to rail in Côte d'Ivoire, (2) a road connection to Cotonou, which links to rail in Benin, and (3) a road linkage to Lagos and Port Harcourt which links to rail in Nigeria. Although those linkages are adequate, future economic development is contingent upon elaborations of those linkages with the outside world. Both the internal and external transportation systems of Niger deserve serious research and policy attention because the delivery of agricultural inputs to farming areas and food to urban areas are dependent on that infrastructure.

Distances From Households to Commercial Locations and Fields

The distances from households to fields and markets and the very infrequent ownership of animal-drawn carts are serious constraints to agricultural development, in general, and the transportation of fertilizer



Millet is sold in the marketplace serving the village of Goberi.

and crops output in particular. The mean distances from households to markets and fields are shown in Table 9. Farm-level transportation of people and goods in western Niger is typically accomplished on foot, by donkey or camel, or by cart. When fertilizers are purchased, farmers often make smaller packages from the 50-kg bags and complete several trips from the cooperative to the fields.

Table 9. Mean Distances From Households to Fields and Markets in Kilometers (N=48)

Households to:	Total Sample	Niamey	Dosso
Markets	7.0	12.0	5.0
Fields	3.0	2.3	2.3

A donkey can transport two 50-kg bags, and that weight limitation also requires multiple trips to transport fertilizer. The better form of transportation is a cart drawn by oxen or a donkey-drawn cart. However, only 1% of the farmers interviewed in this study owned carts.

Cooperative credit is available to farmers to purchase carts, but the cost of a donkey cart, estimated to be CFA 78,000 or US \$265, is still prohibitive. Farmers who make that substantial investment sometimes experience delays in delivery of 2-3 months and often longer. Cart ownership requires new expense to maintain the beast of burden but may also provide a source of income when transportation services are hired by other farmers. A fee of about CFA 300/day (US \$1) appears to be the customary and usual price for cart transportation services. When payment for farm-level transportation services is made in kind, a measure of cowpea straw is not uncommon.

Because the average distance from households to fields is about 3.0 km and fields are scattered, an estimated 15%-20% of each working day is spent commuting on foot. That arduous task reduces productivity and requires a substantial expenditure of spirit and energy. The problem of in-

adequate farm-level transportation is particularly evident during the harvest season when numerous trips from households to fields are necessary. When fertilizer, manure, and production are transported on foot, the task is more laborious and proceeds at an even slower pace.

Land Tenure and Use

Because land is a sine qua non of human existence, it is the single most essential object of possession among Nigerien farmers. In the absence of a well-developed economy, most sustenance is drawn from the soil.

Land tenure systems in Niger reflect both African and Islamic traditions. Although the intricacies of Nigerien land tenure exceed the scope and intent of this study, some basic characteristics are discussed. The basis of the system of land tenure is the recognition that, although village residents have the right to use as much community land as needed for their support, the land is the ultimate property of the village and is controlled by village chiefs. Village chiefs may allocate land to new village residents and to residents requiring additional land. In the event of migration, allocated but uncultivated land or land of heirless farmers reverts to the control of the village chief. Although land is owned by "use rights," it may also be inherited; an agreement about inheritance is made at the time of allocation.

The general pattern of land tenure in western Niger indicates that land may be borrowed or owned by individuals or households. The frequency of these types of arrangements for plots of farmers in the sample is shown in Table 10. When land is borrowed from another village resident, payment of 10% of production appears customary and is a means for the owner to realize benefit without investment.

It should be noted that the farmers interviewed for this study are members of the Djerma ethnic group. Therefore, the observations about land tenure shared in this study may not be characteristic of those among the Hausa or other ethnic groups. More detailed studies would perhaps show useful contrasts and comparisons, but that task is beyond the intent of this study.

The relative proportions of owned and borrowed land are difficult to accurately determine for whole departments and villages. It is, however, clearly in the political interests of village chiefs to maintain control over land that is available for borrowing and to avoid permitting use rights to land to dominate the village pattern. Individuals who are in a position to loan land also have political and economic interests at stake. Although the commercialization of land may be increasing in Niger, no instances of such transactions were observed in this study.

Land that is obtained by inheritance, gift, or purchase is more secure for long-term investment. Those farmers in western Niger who are

Table 10. Number and Percentage of Household Plots Owned and Borrowed Per Household in Niamey and Dosso (N=116)

	Plots Owned by Household		Plots Borrowed by Household	
	Number ^a	Percentage	Number ^a	Percentage
Niamey	1.8	60	1.2	40
Dosso	2.2	85	0.4	15
All sample	2.1	75	0.7	25

a. Average number of plots per household.

dependent on borrowed land, and therefore on the good graces of village chiefs and landowners, almost never make capital investments for land improvement. Even the manuring of borrowed fields is rare or nonexistent. Thus, to the extent that borrowed land dominates the land use pattern, investment and therefore fertilizer use and agricultural production are stifled and severely constrained.

Cropping Systems on Household Plots

The principal food crops of western Niger are millet, cowpea, and sorghum. Less common are rice and sorrel. The questionnaire was structured to obtain data on a 4-year history of cropping strategies. The longitudinal data for 116 plots shown in Table 11 indicate that patterns of intercropping vary between the villages sampled in the departments of Niamey and Dosso.

It appears that Djerma farmers in western Niger establish a crop pattern that minimizes risks and promotes productivity, and they do not alter that pattern over time. The data show that the millet-cowpea intercrop is more prevalent in Dosso and the millet-cowpea-sorrel intercrop is more frequent in the Niamey department.

Although millet is a staple in both departments, risk is reduced in Dosso

with sorghum and in Niamey with sorrel. That difference is probably attributable to the expectations of the greater rainfall and heavier soils in Dosso that are required for sorghum. These strategies of risk reduction through intercropping are methods that have been established through years of experience and trial and error. The intercrops should be taken into account in establishing recommendations for fertilizer use. Table 12 shows that the production of millet, the principal food staple, is greatly improved by fertilizer use.

Table 12. Mean Household Production of Millet, Cowpea, and Sorghum in 1986 Among Users and Nonusers of Fertilizer (N=48)

Crop	Production	
	Users (N=19)	Nonusers (N=29)
	(kg/farm)	
Millet	2,341	1,351
Cowpea	134	125
Sorghum	120	180

Farm-Level Production

Agricultural production statistics for Niger, especially average per hectare yields, vary by source and should be viewed with skepticism. Impressions are that subsistence farmers in Niger generally cultivate 4 or 5 ha, but such

subjective estimates make no contribution to rigorous statistical analysis. The measurement of land areas will undoubtedly remain a constant problem in future farm-level research in Niger.

Byproduct Use

Following the advice of agricultural authorities, farmers frequently use millet and sorghum stalks as groundcover to reduce wind erosion. Additionally, those stalks are used for construction of fences, wind barriers, housing, and, to a lesser extent, animal feed.

Straw from cowpea, sorghum, and millet is frequently used as animal feed and is a source of income. Although it is difficult to be precise, a commonly encountered price for a "bundle" of cowpea straw is CFA 225 or about US \$0.80. Straw is also traded for goods and services and may also be given as a gift. In short, straw byproducts are a medium of exchange among the Djerma of western Niger. Production research should be cognizant of the value and uses of straw and should generate appropriate calculations on per hectare yields of

Table 11. Percentage Distribution of Crops on Household Plots Over 4 Years in Niamey and Dosso (N=116 Plots)^a

Crops	1984		1985		1986		1987	
	Niamey	Dosso	Niamey	Dosso	Niamey	Dosso	Niamey	Dosso
Millet	17	10	13	10	17	10	17	10
Millet-cowpea-sorghum	2	18	2	18	2	18	2	18
Millet-cowpea	21	56	25	56	21	56	21	56
Millet-sorghum	-	6	-	6	-	6	-	6
Millet-cowpea-sorrel	33	3	33	3	33	3	33	3
Millet-cowpea-sorghum-sorrel	17	-	17	-	17	-	17	-
Other	10	7	10	7	10	7	10	7
Total	100	100	100	100	100	100	100	100

a. Rounded.

Table 13. Uses of Millet, Cowpea, and Sorghum Byproducts (N=48)

Crop/Use	Percentage
Millet	
Groundcover	92
Animal feed	4
Other	4
Total	100
Sorghum	
Groundcover	77
Animal feed	18
Other	5
Total	100
Cowpea	
Groundcover	29
Animal feed	35
Gift	3
Market sale	27
Trade	6
Total	100

valuable byproducts. The specific use of byproducts is shown in Table 13.

Farm-Level Labor

It is customary for heads of households in western Niger to labor exclusively on household plots, but other smaller plots may be cultivated by individuals within the households for personal use. Young men, perhaps older than 12 years of age, work with household heads in the tasks of planting, weeding, and harvesting. It appears that weeding is the task for which labor is most frequently hired, and wages are a major expense. Table 14 shows data that describe labor, wages, and tasks.



A group of Djerma farmers with an extension agent (left) in the village of Falmey.

Table 14. Characteristics of Farm-Level Wage Labor (N=48)

Variable	Percent or Mean
Percent of farmers hiring labor	100
Mean number of laborers hired per farm	7
Mean number of household laborers per farm	2
Mean number of days of hired labor per farm	13
Mean daily wage in US \$	2.20
Percent of farmers hiring labor for:	
Weeding only	64
Planting and weeding	18
Planting, harvesting, and weeding	9
Land preparation and weeding	4.5
Harvesting only	4.5
Total	100

No shortages of labor were reported by the farmers who were interviewed for this study. Labor "bottlenecks" reported by various sources are most likely to occur in eastern Niger in the departments of Zinder and Maradi where intensive cash crops prevail.

The average daily wage paid for hired labor among the Djerma of western Niger is CFA 640 or US \$2.20. It should, however, be noted that the sick and elderly are provided with village labor as a charitable and humane gesture.

Agricultural Cooperatives in Niger

French colonial law governed the activities of agricultural cooperatives until 1960. Following independence, the GON initiated policies to accelerate social and economic development, distribute modern agricultural inputs, and bolster agricultural production through cooperatives.

As organized, the cooperative system is based on the support and activities of villages rather than individuals. The structure of the cooperative system in Niger is as follows:



In the village of Goberi a father and his sons pause while weeding their millet field.

1. *Groupement Mutualistic Villageois (GMVs)* are organized at the village level and are the basis of the structure of cooperatives.
2. The *cooperatives* are organized to include groups of perhaps five to ten villages that are mutually supportive in the production and marketing of agricultural goods.
3. *Associations Locales des Cooperatives (ALC)* are found in those regions where markets are substantial enough to support unions of cooperatives. Five to ten cooperatives usually form a union.

Because of limited financial resources and the devastating drought, cooperative development slowed during the period 1969-74; however, the cooperative formation was greatly accelerated during the period 1974-78 (Table 15). Although there have been some changes from 1978 to the present, the structure has remained basically the same. Perhaps the most significant and important change in the cooperative structure was the collapse of credit for fertilizers for cereal production in the early 1980s.

The ambitious goals of the 1960s and 1970s have not been realized, but the GMVs cover about 50% of the agricultural producers in Niger. The lack of credit deters the expansion and development of cooperatives and constrains the expansion of fertilizer use.

Table 15. The Expansion of Agricultural Cooperative Organizations in Niger, 1965-78

Department	1965	1974	1975	1976	1977	1978
Niamey	8	15	23	27	48	78
Dosso	4	14	29	29	64	68
Tahoua	5	35	49	50	55	64
Maradi	8	72	125	153	158	159
Zinder	7	97	164	165	194	195
Diffa	-	-	3	8	29	31
Agadez	-	2	3	15	21	27
Total	32	235	396	447	569	622

Source: Niger Agricultural Sector Assessment. Vol. II. Agency for International Development, Niger, 1979.

Benefits of Agricultural Cooperatives

When questioned about the benefits of cooperatives, Nigerien farmers expressed approval of the credit plans for the purchase of plows and carts but virtually universal disappointment about the lack of credit for the purchase of fertilizer. The responses of farmers about the benefits of cooperatives are shown in Table 16.

Table 16. Perceived Benefits of Participation in Agricultural Cooperative Organizations (N=48)

Benefit	Percentage
No perceived benefits	67
Tools available on credit	19
Fertilizer transported to village	6
Seeds and fertilizer available	4
Fertilizer available	2
Increased knowledge about fertilizers	2
Total	100

Emphasis has been placed on expanding cooperatives in Maradi and Zinder, but in western Niger cooperatives are not viewed as beneficial.

Fertilizer is an agricultural input that necessarily passes through cooperatives and extension services to reach the farm level. The success of such efforts depends on the literacy of the participating farmers. The ability of the farmers to read and write, understand and use simple arithmetic

and bookkeeping, and understand management and agricultural practices is a basic and critical prerequisite to agricultural development.

Few Nigerien farmers have any formal education, and few speak French. An effort to enhance agricultural skills was realized in 1978/79 when 20 permanent agricultural training centers were created in the department of Dosso. Although such efforts are commendable and important, progress remains slow.

Nigerien farmers may obtain information about fertilizer use from several sources other than cooperatives. The farmers interviewed in this study were asked to identify the principal source of information about the use of fertilizers, and those data are shown in Table 17.

Table 17. Sources of Knowledge and Information About Fertilizer as Reported by Farmers (N=48)

Sources	Percentage
Informal sources ^a	40
Cooperatives	19
Field trials	14
Extension workers	19
Farmers' meetings	4
No knowledge source	4
Total	100

a. Other farmers, relatives, friends.

Not surprisingly, Djerma farmers appear to be aware of fertilizer and to learn about fertilizer use by observation and by exchanging advice and experience with others on an informal basis. The educational role of cooperatives and extension is substantial; however, informal learning undoubtedly occurs in those contexts and the categories therefore are not mutually exclusive.

Although farmers do receive formal advice and guidance from authorities, that advice is undoubtedly modified and altered by perceptions of risks and unique conditions. For example, authorities advise farmers to incorporate fertilizer before and at planting time. Although that is excellent

technical advice, farmers are very reluctant to risk fertilizer use until rain and small plants are clearly visible. That practice hinders root development but makes infinite sense to farmers who find it difficult to till very dry topsoil and are reluctant to risk fertilizer loss through heavy windstorms before planting.

Characteristics of Users and Nonusers of Fertilizer

Additional insights into farming systems and fertilizer use are obtained by comparisons between the departments of Niamey and Dosso in terms of the frequency of fertilizer use and the types of fertilizers that are attractive to farmers.

As shown in Table 18, the use of fertilizers appears more prevalent in Dosso than Niamey. Therefore, the expected overall level of fertilizer use is greater in Dosso than in Niamey, and the difference is partially explained by a higher probability of adequate rainfall in the Dosso department. The proximity of Dosso to the Nigerian border and access to additional fertilizer supplies may also contribute to the increased use of fertilizers.

The sample data that show the relative use of various types of fertilizers are presented in Table 19. The use of SSP was prevalent in both departments, whereas urea was used only in some sampled plots of Dosso. The use of SSP fertilizer appears to be increasing in the Dosso department, but 15-15-15 fertilizer is not widely used.

The farmers interviewed in this study were asked to identify what each understood as constraints to fertilizer use, and those data are shown in Table 20. The constraints of cost and credit are closely related and are understood as significant constraints that reflect the lack of financial resources by farmers to purchase fertilizers. Lack of knowledge and familiarity is also a frequently cited constraint.

Table 18. Percentage of Sampled Household Plots Receiving Fertilizer in Niamey and Dosso, 1984-87 (N=116)

Department	Percent of Plots Receiving Fertilizers			
	1984	1985	1986	1987
Niamey	8	6	8	6
Dosso	18	38	38	37

Table 19. Percentage of Sampled Fertilized Household Plots Receiving Various Types of Fertilizer in Niamey and Dosso, 1984-87 (N=116)

Fertilizer	1984		1985		1986		1987	
	Niamey	Dosso	Niamey	Dosso	Niamey	Dosso	Niamey	Dosso
SSP	75	67	100	58	75	61	100	88
15-15-15	25	-	-	-	25	12	-	12
Urea	-	33	-	42	-	27	-	-
Total	100	100	100	100	100	100	100	100

Table 20. Types of Constraints to Fertilizer Use as Cited by Farmers (N=48)

Constraint	Percentage
Cost	21
Cost in conjunction with lack of credit	48
Lack of knowledge and familiarity	25
No constraint identified	4
Other	2
Total	100

Table 21. A Comparison of Selected Socioeconomic Characteristics of Users and Nonusers of Fertilizer (N=48)

Characteristic	Mean or %	
	Users (N=19)	Nonusers (N=29)
Mean distance to markets (km)	5.4	7.6
Mean distance to fields (km)	2.5	3.0
Mean number of nonhousehold relatives providing labor per farm	11.0	3.0
Mean number of hired laborers per farm	6.0	2.7
Percent citing fertilizers as most important agricultural input	84.0	36.0
Mean number of days a hired herd is used for organic manure	0.0	25.0

Those data support the observation that an increase in the frequency of demonstrations, trials, and other forms of information dissemination will enhance the adoption and use of fertilizer. Restoration of farm-level credit in Niger is a complex problem, but improvements in knowledge and familiarity with the benefits of fertilizer use appear possible.

A comparison of users and non-

users is helpful in understanding farm-level constraints to fertilizer use. As shown in Table 21, the households of fertilizer users are closer to both commercial markets and household fields than are those of nonusers. Those differences are probably related to the nature of farm-level transportation constraints. Specifically, users of fertilizer are somewhat less constrained by distances to transport

fertilizer to fields and crops' production to household and market.

Users of fertilizer have labor provided by nonhousehold relatives at a frequency four times that of nonusers. In contrast to nonusers who offer monetary compensation to hired labor, users compensate the labor provided by relatives with some share of production. Because of the pattern of labor use by fertilizer users, increased production is a social asset as well as an economic one. The data also show that users of fertilizer hire an average of six workers, whereas nonusers hire an average of less than three workers (2.7). Fertilizer users demand more labor at the point in the season when weeding is necessary, but nonusers hire labor for the varied tasks of planting, weeding, and harvesting.

As expected, users of fertilizer frequently cite it as the single most important input, whereas nonusers have yet to realize the benefits of commercial fertilizer and instead hire herds of animals to deposit manure on fields for an average of 25 days per year.

Users and nonusers of fertilizer are also contrasted by the sources of their information about fertilizer. As shown in Table 22, fertilizer users cite agricultural cooperatives as the principal source of information about fertilizers five times more frequently than do nonusers. The data also show that nonusers cite extension services as the principal source of information about fertilizer five times more frequently than do users.

The greater frequency of farmer meetings among fertilizer users is probably a result of more frequent participation and activity by users within agricultural cooperatives. Nonusers reported no participation in meetings of farmers. Such meetings should be given attention in the future development of fertilizer use in western Niger. Finally, the data show that nonusers are more likely to have learned about fertilizer from informal sources than are users and that nonusers remain mostly outside the realm of formal information. These

observations suggest that information dissemination and accelerated contact with nonusers are needed and required for the expanded use of fertilizer.

As shown in Table 23, users and nonusers of fertilizer exhibit differences in the use of crop byproducts (basically straw). Millet straw is virtually always used as ground cover; however, sorghum and cowpea byproducts are more likely to be used as ground cover by nonusers of fertilizer than by users. An inventory of animals is not included in this study, but the data suggest that the extent of animal ownership is greater among users than nonusers because byproducts of both sorghum and cowpea are more frequently used as ground cover among those who do

not use fertilizer. The speculation on that point would be that fertilizer use supports the development and maintenance of farm animals; nonusers own fewer animals and therefore are generally poorer than those who use fertilizer.

The value of cowpea straw among fertilizer users is apparent in its use for animal feed, market sale, and trade. Perhaps proximity to markets explains the ability of fertilizer users to sell and trade cowpea straw, whereas, because of transportation constraints, nonusers have limited choices and are compelled to use cowpea straw as ground cover. Fertilizer users have a source of income from cowpea straw that bolsters their ability to continue to purchase fertilizer and enhance their cash flow.

Table 22. Principal Sources of Information About Fertilizer Cited by Users and Nonusers of Fertilizer (N=48)

Source	Percentage	
	Users (N=19)	Nonusers (N=29)
Agricultural cooperatives	36	7
Agricultural extension services	5	27
Farmers' meetings	11	-
Farm-level trials	16	14
Informal sources	32	45
No sources cited	-	7
Total	100	100

Table 23. Uses of Byproducts Among Users and Nonusers of Fertilizer (N=48)

	Users (N=19)	Nonusers (N=29)
	(%)	(%)
Millet byproducts	1	
Ground cover	90	93
Animal feed	5	3
Other	5	4
Sorghum byproducts		
Ground cover	63	89
Animal feed	25	11
Gift	12	-
Cowpea byproducts		
Ground cover	7	45
Animal feed	43	30
Gift	-	5
Market sale	43	15
Trade	7	5

Significant Differences Among Users and Nonusers of Fertilizer

Additional insights concerning the differences between users and nonusers of fertilizer were explored through statistical analyses. In the search for contrasts, the variables of owned and borrowed land, age, household size, number of wives, number of children, number of family members speaking French, dry-season migration, and cart ownership showed no meaningful differences between users and nonusers of fertilizer.

Some meaningful contrasts and distinctions are shown in Table 24. Those data suggest that the availability of household labor and the distance from household to market are significant variables explaining the use or nonuse of fertilizer. Those variables should be evaluated in future research. The observation of no significant differences in the use of organic manure among users and nonusers of fertilizer is instructive. Previous research has sometimes suggested that the use of fertilizer is associated with a decline in or lack of the use of organic manure and that the organic richness of the soil is thereby lost. The data suggest that this is not the case, and Djerma farmers complement the use of fertilizer with the traditional use of organic manure. This observation should also be evaluated in future research.

Summary

Niger is a country that exemplifies the demographic, economic, and agricultural problems of the Sahelian region of West Africa.

High rates of population growth are occurring amidst declining agricultural and economic sectors. Substantial increases in food production are needed to meet the requirement of the Nigerien population,

Table 24. Variables Showing Significant Differences Between Users and Nonusers of Fertilizer (N=48)

Variable	Mean		Difference ^a
	Users	Nonusers	
Distance to market (km)	5.4	7.6	-2.2*
Distance to field (km)	2.5	3.0	-0.5*
Number of household laborers	6.4	2.1	+4.3*
Number of hired laborers	6.0	2.7	+3.3*
Percent of farmers using organic manure	50	58	-8

a. Users with respect to nonusers.

*Significant at the 1% level of significance.

which is expected to be in excess of 10 million in the year 2000.

The use of appropriate fertilizers and other modern agricultural inputs is necessary to build a sustainable and prosperous agricultural sector. At present, the use of fertilizer in Niger is among the lowest in the world. Nigerien agricultural authorities are keenly aware of the contribution that fertilizer can make in increasing food production and are developing policies to enhance and strengthen the diffusion of modern agricultural inputs.

Farm-level socioeconomic research, data, and information are critical factors in properly assessing the agricultural sector and developing appropriate and beneficial policies. This study is an initial and exploratory effort to gather data and provide a report on farm-level constraints to fertilizer use in western Niger.

On the basis of agricultural production theory, a questionnaire was prepared and field tested in the departments of Niamey and Dosso during the period March 1-15, 1987. Following that pretest, the questionnaire was refined, and field interviews were conducted among 48 Djerma farmers in western Niger during the period June 15 to August 6, 1987. The villages of Bambey, Galmi, Dan Gona, Sokorbey, Falmey, Trodi, Karma, Gotheye, Goberi, and Simari were visited in the departments of Niamey, Dosso, and Tahoua.

The data indicate that Djerma farmers in western Niger are expect-

ed to support an average of eight persons, often including more than one wife. Dry-season migration earnings in other West African countries average about US \$650 for as much as 9 months of work. Those earnings are important sources of household finances.

The lack of transportation is a serious constraint to fertilizer use and agricultural development, and distances to fields and markets present a frequent problem. A cart is a prized but expensive purchase, and most farmers are dependent on foot transport. Although the system of land tenure is complex, land may be owned or borrowed by households and individuals. Djerma farmers are reluctant to make capital investments in borrowed land and generally forego using fertilizer and manure. Therefore, the frequency of borrowed land is a constraint to fertilizer use.

Crop histories of household plots show little variation in cropping patterns over time. Intercroppings of millet and cowpea or millet and sorghum are common risk-reduction strategies. Virtually no household production is sold. Straw byproducts are used in a variety of ways; cowpea straw is a medium of exchange and is traded for goods and services.

Farm labor for weeding is frequently hired, and wages are a significant expense. Few women and children labor on household plots, but labor from nonhousehold relatives is compensated with harvested grain or straw. The weeding of fields is the

most frequent task for hired labor, and the average daily wage is about US \$2.20. On the average, seven laborers are hired for about 13 days per cropping season.

A major constraint to fertilizer use in western Niger is the lack of government-supported credit. Farmers interviewed in this study expressed virtually universal disappointment about the lack of credit to purchase fertilizer. Farmers in western Niger view agricultural cooperative organizations as offering few and limited benefits.

Illiteracy is a constraint that prevents full realization of the contributions of agricultural training.

The users of fertilizer differ from nonusers in that their households are closer to markets as are their household plots. The users of fertilizer benefit from the labor of nonhousehold relatives, and that labor is compensated with a share of the increased production that is attributable to fertilizer use. The users of fertilizer also hire more labor than do nonusers, and the contribution of fertilizer in creating farm-level employment is evident. The data clearly show that the traditional practice of organic manuring is not abandoned when commercial fertilizer is used.

In summary, the principal constraints to fertilizer use among Djerma farmers in western Niger include illiteracy, lack of financial resources aggravated by severely limited agricultural credit, poor transportation and access to fertilizer supplies, insufficient household labor, and lack of knowledge and training about the use of fertilizer. As government programs alleviate those problems, fertilizer use will become more attractive and widespread.

Suggestions for Future Socioeconomic Research in Niger

Farm-level research in Niger should be conducted among the Djerma in the western region of the country.

Although the Hausa in eastern and southern Niger should not be ignored, the fact is that western Niger has received only scant and inadequate research attention. Western and southeastern Niger represent distinct agroclimatic and cultural areas, and that distinction should be permanently recognized in the literature on farm-level constraints to fertilizer use. The distinction between the departments of Niamey and Dosso provides an excellent dichotomy that should be maintained and elaborated through empirical research.

Continued research on patterns of dry-season migration is important in understanding the nature and dynamics of farm-level financial resources and income and should be pursued. A more elaborate understanding of the origins and destinations of migrants, types of work pursued, duration of residence, and wages would be particularly useful and informative.

This study has outlined and described the salient aspects of land tenure and use in western Niger; however, more sophisticated techniques of sampling will allow useful comparisons between those who "borrow" land and those who own land through "use rights." Differing levels of fertilizer use, production, and capital investment in land are some potentially interesting points of comparison.

Land use and agricultural productivity among Djerma women were not extensively explored in this study, but it does appear that "women's crops" on individual plots are an important source of household income and should not be neglected in future research. The role of women in Nigerien agriculture should be considered as an important topic in future research.

Ascertaining the sizes of household plots in Niger is difficult, and therefore per hectare yields are notoriously inaccurate and misleading. One alternative is to explore the adequacy of production to meet household needs. This study did not seek data on household grain storage or explore

the frequency and costs of grain purchases, but those variables should be explored in future research.

The use, value, and sale of crop byproducts, especially cowpea and straw, should be investigated with more empirical rigor and detail. Farm-level fertilizer trials should provide information about the volume or weight of straw byproducts per hectare.

This study was conducted during the period of planting and weeding and therefore offered no insight into the socioeconomic variables related to harvesting. The use of household and hired labor during harvesting should be explored in future research.

The role of children in farm labor rests on the social distinction between adult and child. The age at which young boys are expected to provide labor on household plots was not well established in this study but should be carefully documented in future research.

Although animals owned by a household represent capital, farmers in western Niger are reluctant to discuss their livestock holdings, which is unfortunate. However, continued attempts should be made to inventory farm animals as sources of money to purchase fertilizers and, of course, as sources of organic manures.

Cooperatives and extension services are established to offer Nigerien farmers information and training about modern agricultural practices in general and fertilizer use in particular. These services, however, are not uniformly beneficial and useful to farmers. Some comparisons of "successful" and "less successful" cooperatives and extension services should be made in future research where the attitudes of farmers are assessed concerning the usefulness of structured training and assistance.

The factors discussed thus far may, of course, be included in a single study and would represent a refined replication of the work discussed here, but there are also new directions for socioeconomic research in western Niger.

Important areas for future research include the following:

1. This type of study should be replicated in northwest Niger, where no socioeconomic research has been conducted. The area north of Tillaberry to the Malian border is an area where this study may be usefully replicated. Such research was suggested by the USAID mission in Niamey.
2. Farm-level fertilizer trials in western Niger should be evaluated from a socioeconomic perspective. Attention should be given to the location and organization of the trials to increase the probability that farmers will understand the technical, social, and economic benefits of fertilizer use.
3. The development of phosphate resources in the Parc W region of western Niger will require literate labor. A socioeconomic assessment of labor availability should be conducted if those resources are to be beneficially exploited.
4. The agricultural practices of the Fulani ethnic group in western Niger have been virtually ig-

nored. Provided that some work is accomplished with that group, a comparison of agricultural practices and fertilizer use among the Djerma, Hausa, and Fulani groups could be pursued. Such comparative research would be a valuable basis for understanding regional and ethnic distinctions and Nigerien agriculture as a whole.

5. Future research on farm-level constraints to fertilizer use in Niger should be pursued within small geographical units such as cantons and villages as opposed to departmental and national studies. The research discussed here may be replicated within such smaller geographical areas.
6. The observations of this study suggest that many farmers are uninformed about fertilizer and have not participated in a formal introduction. The socioeconomic means to expand initial and general information may represent an independent project in its own right.
7. Agricultural training centers are rather numerous and diverse in

Niger. Research on the curriculum should evaluate how modern fertilizers are presented to farmers, and technical and socioeconomic factors should be given particular attention.

8. The role of the media in presenting fertilizer messages at the farm level should be explored. Variables such as clarity, appropriateness, and receptivity by farmers should be evaluated.
9. The role of women in Nigerien agriculture should be considered as an important topic in future research.
10. Finally, research attention should be given to integrating the youth organizations and movement in Niger with the introduction of fertilizer technology.

Quite naturally, other ideas and research projects will emerge as these ideas are discussed, elaborated, and considered. Through such exchanges a course of socioeconomic research can be charted by IFDC that will provide direction for alleviating the farm-level constraints to fertilizer use in Niger.

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