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NIAMEY DEPARTMENT DEVELOPMENT PROJECT:
MANAGING RURAL DEVELOPMENT WITH MINIMAL EVIDENCE

A Project Report

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ABSTRACT

Managers of agricultural projects in developing countries need farm-level information that is useful and timely. Large-scale efforts are frequently undertaken to obtain this information. These efforts are often costly and cumbersome to execute. They also may produce a large amount of information that is inconsequential to project operations. Moreover, much of the essential information generated by these efforts arrives too late to be of any use in making key project decisions. This paper uses the case of the Niamey Department Development Project in the Republic of Niger to illustrate how a minimal amount of easily obtainable data can often be adequate to implement a new project or effectively manage an on-going program. Drawing upon his own experience with this project, the author describes how this simple, common-sense approach was used to assist with the administration of this complex, regional development project. The author relates the many insights gained by the application of this approach and the problems involved with collecting farm-level data under uncertain agricultural conditions in a resource-poor country. The author recommends this approach for areas where little concrete information is available, especially those situations which call for an inexpensive means of quickly identifying principal farming practices and important constraints to improving major cropping systems.

BIOGRAPHICAL SKETCH

Mark Gregory Wentling was born on July 3, 1945 in Wichita, Kansas and grew up in the nearby rural communities of El Dorado and Udall. His interest in agriculture began while living and working on farms in the area. In May 1970 he received a Bachelor of Arts degree in Political Science from Wichita State University.

The author entered the Peace Corps in February 1967 and served for two years as a rural community development volunteer in Nueva Ocotepeque, Honduras. In September 1970 he returned to the Peace Corps and was assigned to undertake a program of primary school construction and gardening in the Agou district of Togo.

In September 1974 the author joined the Peace Corps staff in Togo as Associate Peace Corps Director responsible for agricultural and rural development programs. In February 1975 he was assigned to Gabon as Peace Corps Director, and in May 1976 he took up the same position in Niger.

In February 1977 the author accepted an appointment with the United States Agency for International Development. From this time until July 1981 he worked as a rural development project officer in Niger. For his work in Niger he received a superior honor award from USAID and a special commendation from the Government of Niger.

From August 1981 to July 1982 the author worked as a regional projects officer in USAID's Bureau for Africa in Washington, D.C. He left this position after being selected for a year of training at Cornell University.

The author is married to Gisele Nicole Alifotse of Agou-Nyogbo, Togo. They have three children: Elsa, Sudie, and Clyde.

DEDICATED

TO

MOUSSA SALEY

DIRECTEUR

DU

PROJECT PRODUCTIVITE NIAMEY

My friend and counterpart

who made all the difference

in my stay in Niger

ACKNOWLEDGEMENTS

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I accept, of course, full responsibility for this paper; therefore, any faults it may have are directly attributable to me.

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CHAPTER I

INTRODUCTION

> Often what is needed in managed development projects is more common sense rather than more rigorous analysis.
>
> D.A. Rondinelli (1, p. 34)

> The rapid appraisal of rural situations is widely practiced but not much written about.
>
> R.J.H. Chambers (2, p. 90)

The major purpose of this paper is to describe how easily obtainable information can be used to manage agricultural projects in developing countries. This approach will be termed the QUAD approach for the Quick Utilization of Available Data. The case of the Republic of Niger's Niamey Department Development Project (NDDP) will be used to illustrate how QUAD may be used to provide the basic information and insights development practitioners need to proceed effectively with project implementation. The case of NDDP is of particular pertinence for those working in marginal agricultural areas where little of the concrete information normally considered necessary for the design of development projects is available. It is therefore intended that the material presented in this paper will be of some practical use to those confronted with similar project design and implementation situations. It is also intended that much of the content of in this paper will serve to stimulate fruitful discussion among all of those interested in the development of low-income countries.

NDDP is a complex, regional development project located in southwest Niger. Its initial design was completed by the government of Niger (GON) in 1973, but project implementation did not begin until January 1978. Much

of the delay encountered during this five-year period was due to the belief on the part of project planners that a vast amount of additional information was needed about the project zone before an appropriate project could be designed. Consequently, NDDP was not allowed to begin until it was agreed that one of its major activities would be the comprehensive collection and analysis of data on the zone, especially on the zone's inhabitants and their farming practices.

Requiring much effort and expense, this data collection requirement was pursued. The results obtained from initial efforts were, however, very disheartening. These disappointing results and the difficulties incurred in obtaining them prompted NDDP managers to devise a simple, common-sense approach for analyzing the project's principal target, the traditional farm. In retrospect, this QUAD approach proved to be more useful than the project's comprehensive farm-level surveys. Furthermore, managers were convinced that this approach, along with on-going project monitoring, provided them with the essential information they needed to pursue intelligently NDDP's major objective of improving the productivity of farms in the project zone. The success of their approach demonstrated that comprehensive farm-level surveys are not always the most desirable nor the most effective means of providing development managers with the information they need to make key project decisions.

Preliminary background information is presented in chapters II and III on Niger, the project zone, NDDP activities and the events which prompted the development of this multiple-use approach. Chapter IV provides a description of this five-stepped approach and the many observations which evolved from its use. Chapter V examines some of the

criticisms of this approach and the later impact upon it of carefully collected data on farms participating in NDDP's farmer-couple training programs. Chapter VI presents some conclusions about the usefulness of QUAD and the situations where this approach is most likely to be applicable. This chapter also provides some brief remarks on the development prospects for rainfed agriculture in the Sahelian zone covered by the project.

Although at times the author relies upon relevant development literature, he has made a conscious attempt to provide an added element of realism to this paper by mainly using the documents and information which were available to him and his counterparts during the initial years (1977-1981) of project implementation. The bulk of the material presented in this paper is therefore based on the author's intimate association with the project as the United States Agency for International Development (USAID) officer assigned full time to the project from early 1977 until his departure from Niger in July 1981. During this time the author was involved full time with the design and implementation of the project's first phase (1978-1980) and the initiation of its second phase, which extends through 1985.

CHAPTER II

THE SETTING: THE COUNTRY AND THE PROJECT ZONE

A full understanding of NDDP and the conditions imposed by its environment requires some knowledge of Niger and, more specifically, of the area within Niger covered by the project. This chapter will, therefore, begin by briefly reviewing some of the more salient factors affecting Niger's current development prospects. This country-level overview will then be followed by a detailed description of the project zone. It is intended that the background information provided in this chapter will enable the reader to better appreciate the project and some of the problems encountered during its implementation.

The Republic of Niger: One of the World's Poorest Countries

By any measure the Republic of Niger is one of the poorest countries in the world. All of the basic indicators commonly used by the World Bank and other international assistance agencies place this West African nation near the bottom of the ranks of those countries categorized as low-income economies. If the physical quality of life index (PQLI) is applied to this arid country, it has the second lowest standard of living of any of the 49 low-income countries. 1/ For the period, 1970-1975 Niger had a PQLI of 13 (Guinea-Bissau, the lowest rated country had a PQLI of 12). This rating may be compared to the following cross section of countries:

1/ The PQLI is a composite index on a scale of 0-100 of the following component indicators: life expectancy at age 1; infant motality rate per thousand live births, and basic literacy for the population over age 15.

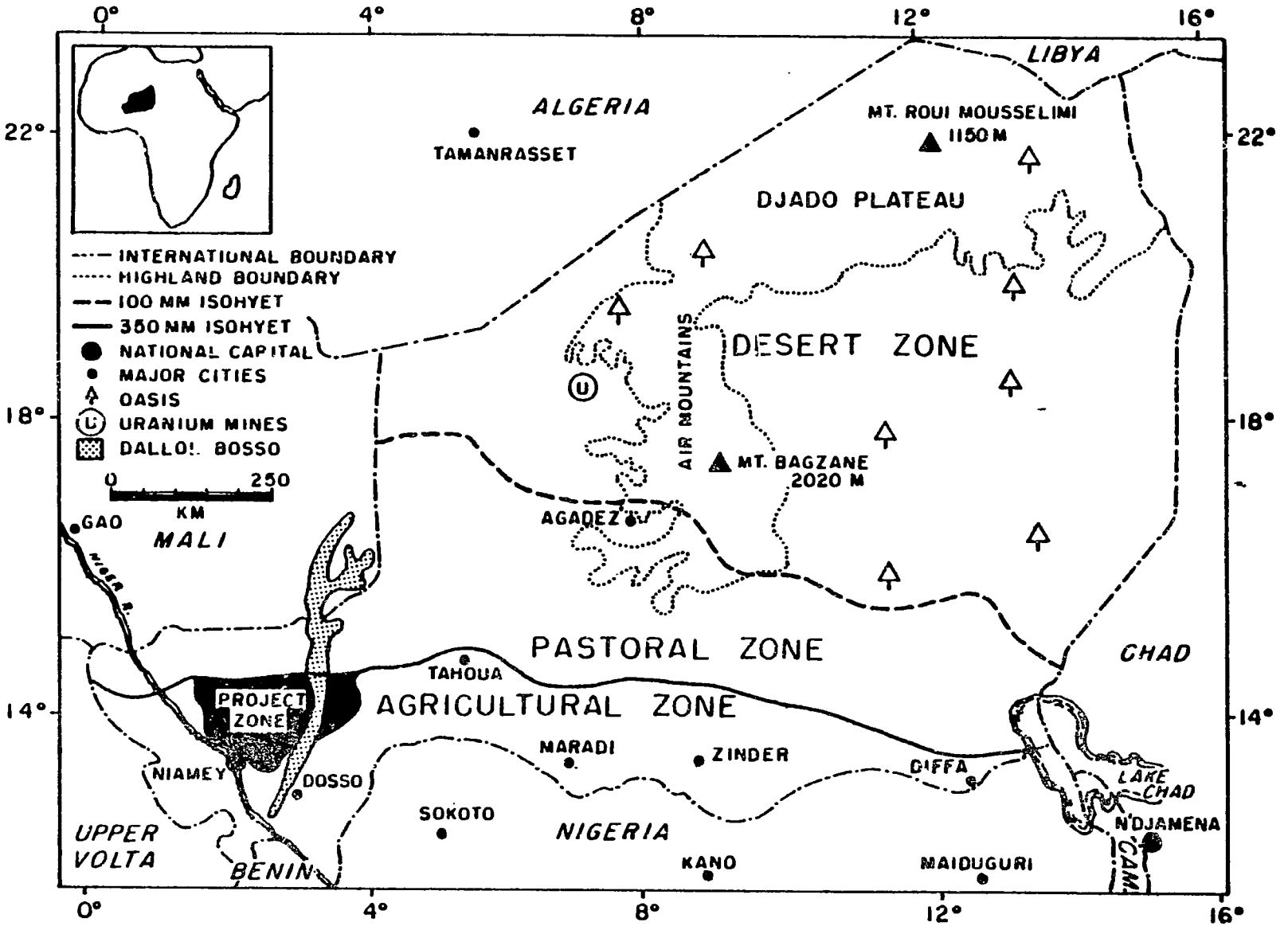
Haiti - 31; Bangladesh - 33; Phillipines - 73; U.S. - 96 and Sweden - 100 (3, p. 129). (See Appendix A for a presentation of basic development indicators on Niger.)

The Role of Uranium

The major factor which has kept this predominately agrarian country from slipping further into poverty has been the exploitation of uranium mines in Niger's northern desert zone. These mines are located some 1,200 kilometers northeast of the capital city of Niamey, which is situated on the banks of the Niger River. (See land-use map under Figure 1 on the following page). Although the great Sahel Drought of 1968-1973 exacerbated Niger's development woes, a favorable market for Niger's growing uranium production alleviated to a great extent the devastation caused by this drought. Moreover, the judicious use of this new uranium-wealth by the military regime which seized power in 1974 helped create an economic boom in Niger during the 1975-1980 period. This new and more efficient regime used Niger's fast growing uranium revenues to fund development projects and the expansion of social services. At the same time, it kept military expenditures to less than 0.7% of the annual gross national product (GNP); this is less than one-third of the average for Africa. This low national defense allocation reflects the high reputation for honesty and sincerity that this new regime has among international donor agencies. These favorable factors played a major role in attracting substantial foreign assistance (4, pp. 14-15).

During this 1975-1980 period world uranium prices increased six-fold and Niger became the world's fifth largest exportor of uranium by increasing its production five-fold, going from about 800 metric tons (mt) to

FIGURE 1. NIGER: LAND-USE DIVISIONS AND LOCATION OF PROJECT ZONE WITHIN THE COUNTRY*



*Adapted from Atlas du Niger (Editions Jeune Afrique, Paris, 1980).

4,000 mt per year. Such dramatic increases helped turn around the decade-long decline in the growth of Niger's gross domestic product (GDP), resulting in an average annual GDP growth rate of 12% during this period. This rapid growth in uranium revenues helped raise the per capita GNP from $120 in 1974 to $330 in 1980.1/ This upward growth trend peaked in 1980 when uranium revenues accounted for 80% of Niger's export earnings and 43% of its national budget. Uranium contributed nothing to the national budget in 1970, 20% in 1975 and 41% in 1978 (4, p. 6; 5, p. 37).

This favorable, uranium-driven growth phase abrubtly ended in 1980 when the world market price for uranium, which is fixed in U.S. dollars, dropped 30% following the nuclear reactor crisis at Three-Mile Island in the United States. This unforseen drop in world uranium prices was accompanied by several major factors which obliged the Nigerien government to enact economic austerity measure in 1982-1983. These included: an average national inflation rate of 15-20%, a more than 70% rise in value of the dollar relative to local currency, the CFA franc, and a 3-fold increase ($105 to $300 billion) in the national debt during the 1979-1981 period.2/ The austerity measures included a 75% reduction in the planned 1983 allocations to the national investment fund. This fund is the major repository of uranium revenues and the source of Niger's contributions to all its

---

1/ As most of the uranium revenues were invested in development projects, these per capita indicators reflect poorly income distribution. For instance, available statistics show that average annual rural per capita GDP increased from 32,500 CFA to 47,500 CFA in the 1977-1980 period while urban per capita GDP went from 59,100 CFA to 96,000 CFA during the same period (6).

2/Communaute Financier African (CFA) franc is the common currency of most of the ex-French colonies in West and Central Africa. It is tied to the French franc (FF) at the fixed rate of 50 CFA to 1 FF. The U.S. dollar value of the CFA franc climbed from 200 CFA in 1977 to a record high of 394 CFA in July 1983.

development projects, including NDDP. Consequently, Niger now finds itself hard pressed to maintain its recent development gains and to fulfill its commitment to cover the recurrent costs generated by the implementation of donor-financed projects like NDDP (5, pp. 16-20).

Niger's reaction to this situation has been to raise taxes on the commercial sector and, more important, to request an increase in donor assistance. However, given that the feasibility of many of the donor-assisted projects was predicated on Niger's ability to use its uranium revenues to defray a large portion of the recurrent costs of these projects, many donors have been reluctant to increase their assistance. The already high level of donor assistance to Niger ($240 million in 1981, about 13% of Niger's annual GDP or about $42.00 per capita) and the worsening economic conditions in many of the high-income countries have also contributed to the difficulties donors are having in responding favorably to Niger's request for additional assistance (8, p. 29).1/ In addition, many projects have not produced the results expected of them. This has made it even more difficult to justify the continued funding of these necessarily long-term efforts. It is, therefore, beginning to appear that part of the tragedy of the drought may have also been the rush by humanitarian organizations to undertake a great number of projects. Experience has now shown that many of these projects were poorly prepared, of doubtful viability and/or poorly implemented by Niger. In this

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1/About 40% of the assistance provided Niger is reimbursable, 26% is for technical assistance and most of this assistance comes from France (6). USAID ranks fifth among major donors, contributing $20-25 million annually (7, p. 46). Per capita assistance to Niger is three times the $13.70 average for Africa and well over four times the $9.60 average for the rest of the developing world (9, 174).

regard, NDDP was little different, and much of its initial "implementation struggle" involved overcoming the weaknesses of its conception.

There appears to be little hope for reversing this current downward swing in Niger's economic growth. The effects of the Three-Mile Island incident, which resulted in a cutback in the planned construction of nuclear-powered electrical plants in the U.S. and other industrialized countries, and the large stocks of uranium which have since been built-up in the U.S., Canada and Australia, leave little room for optimism regarding Niger's uranium fortunes. These external forces have caused Niger to hold down its annual production of uranium to about 700 mt versus a planned 1983 production level of 4,860 mt (8, p. 27).

This reduction in Niger's uranium revenues has, however, been attenuated somewhat by France which, in its role as Niger's ex-colonial power, continues to guarantee the purchase of most of Niger's uranium (about 60% in 1981) and the payment of higher prices (20,000 CFA/kg or about 20% over world market prices in 1981). The difference between France's annual payments for Niger's uranium and world prices is equal to about 15 billion CFA or nearly 30% of the total foreign assistance given to Niger in 1981. More important, the forced reduction in uranium production has resulted in a loss of revenue worth much more than all the external assistance provided Niger (10, pp. 34-37).

Niger has also been able to make some lucrative sales of uranium at above world market prices to such unlikely client countries as Libya (1,212 mt in 1981), Iraq and Pakistan (10, p. 35). However, in spite of such special arrangements, prospects for attaining previous levels of uranium earnings are bleak and, even if these previous levels are

attained, other factors will work to keep Niger in the "poorest-of-poor" nations category. These factors include a high annual population growth rate of 2.7%, which will result in a doubling of Niger's current 5.8 million population by the end of the century. Also contributing to this less than optimistic development forecast for Niger are: a weak human and natural resource base; climatic vagaries and its land, rail- and, for all pratical purposes, river-locked location in the south-central part of the Sahara.1/

The Nigerian Connection

Nigeria, Niger's powerful southern neighbor, shares with Niger a very porous, 1,200-kilometer border that was arbritrarily established by the colonial partition of Africa in 1898. This artificial border was maintained by Niger following its independence from France on August 3, 1960 and it was not disputed by Nigeria when it gained independence from Great Britian on October 1, 1960. Given this long border and that Nigeria is the most populous (near 100 million people) and the wealthiest nation in Black Africa, it is not surprising that it has an important influence on Niger's development. In addition, the strong ethnic affinity which exists among the Hausa people (a major ethnic group in both countries), whose traditional states were divided by the unnatural border, is another forceful Nigerian influence that has to be reckoned with.

Many of the estimated two-thirds of Niger's population, which lives within about 100 kilometers of the border, depends upon jobs and mar-

1/The capital city of Niamey is 1,110 road-kilometers north of the nearest seaport which is located on the Atlantic Ocean at Cotonou, the capital city of Niger's southern neighbor, Benin.

kets provided by Nigeria. Of high importance among the goods and services provided to Niger by Nigeria are chemical fertilizers. Niger's entire agricultural development effort depends mostly on fertilizer smuggled into Niger from Nigeria (the export of fertilizer is illegal in Nigeria but, according to Niger's laws, its importation into Niger is legal). The production of single superphosphate fertilizer in the Hausa city of Kaduna, Nigeria (280 kilometers south of the border), the high subsidization of this fertilizer by the Nigerian government (estimated at 80-90%) and a black market exchange rate which favors Niger's currency, make fertilizer smuggling a lucrative business.1/ For example, the author calculated in 1980 that the sale of one 50-kilogram bag of Nigerian fertilizer into Niger would provide the seller with sufficient returns to buy four more 50-kilogram bags of fertilizer in Nigeria. Oddly, the GON, which is the largest purchaser of Nigerian fertilizer, re-subsidizes this fertilizer by selling it at about 40% of its cost to Nigerien farmers (11, pp. 1-6). (One wonders if some of this fertilizer was not in turn resold to traders who would again sell it to the GON).

In summary, the uncontrollable, parallel market in Nigeria, which is capable of exhausting all of Niger's agricultural production, and the other factors mentioned above require that any development effort undertaken in Niger be done within an international context. This fact was highlighted in January 1983 when Nigeria, reacting to its own economic problems caused by a decline in its oil revenues, expelled ten's of thousand of foreign workers. This action further underscored the importance of the jobs pro-

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1/The adjective form of Niger is written Nigerien while it is Nigerian for Nigeria.

vided by Nigeria and other coastal countries to the hundreds of thousands of Nigeriens who migrate (usually temporarily) each year to these countries (12, pp. 22-24). The economic recession currently being experienced by these coastal countries serves, therefore, to aggravate the deteriorating economic situation in Niger.

Food Self-Sufficiency: Niger's First Priority

Fortunately, favorable climatic conditions and minimal crop pest outbreaks in 1979, 1980 and 1981 helped soften the negative repercussions of the decline in uranium revenues by permitting the production of millet and sorghum crop surpluses (44,000 mt in 1979, 120,000 mt in 1980 and 128,000 mt in 1981). These "statistical surpluses" give, however, a poor indication of Niger's food needs. For instance, despite the reported post-harvest surplus of 128,000 mt in 1981, Niger was later obliged to request 80,000 mt in food aid. This situation primarily results from much of Niger's "good-year" surpluses flowing into Nigeria, which suffers from large food deficits (13, pp. 1-2)1/.

Rainfall in 1982 was as low as any year during the great 1968-1974 drought, but a favorable rainfall distribution pattern helped minimize the expected shortfall in Niger's cereals (mostly millet and sorghum) harvest. Consequently, Niger continues to maintain its reputation as the only Sahelian country which has achieved, or at least—nearly so, food

1/A reversal in the flow of grain surpluses was observed in the 1982-1983 period when favorable exchange rates between the CFA and Niger's currency, the Naira, attracted "surplus" grains from Nigeria to deficit areas in Niger where local market prices for cereals were reaching all time highs.

self-sufficiency in recent years.1/ Niger's efforts to achieve food self-sufficiency are reflected in Figure 2. This figure relates apparent per capita millet-sorghum production for the 1964-1982 period with national calorie requirements and rainfall. Although the available data are confusing, this chart shows that following the 1968-1974 drought there was an upward trend in per capita millet-sorghum production until 1981-1982. Almost all of this increase is believed, however, to be due to an expansion of cultivated land rather than to increases in yield. In this regard, reported statistics show a doubling of millet-sorghum production from 753,000 mt to 1.6 million mt between 1973-1980 while the amount of land devoted to these crops, increasing at an average annual rate of 9%, went from 2.5 million hectares (ha) to 3.9 million ha during this same period (6, Annex 4-3; 7, p. 35). (Appendix B presents annual millet and sorghum production data for the 1964-1982 period.)

The total surface area of Niger is 1,270,000 square kilometers (about twice the size of Texas), but only 12% of the area is considered suitable for agriculture and under 3% of this total area is actually cultivated (4). It, therefore, appears that there is sufficient agricultural land available in Niger for further expansion of the land surface devoted to cultivation. The World Bank has predicted, however, that Niger will develop a structural food deficit in the 1990's as its 2.7% annual population growth rate will begin to outstrip the average 1.5% annual rate of

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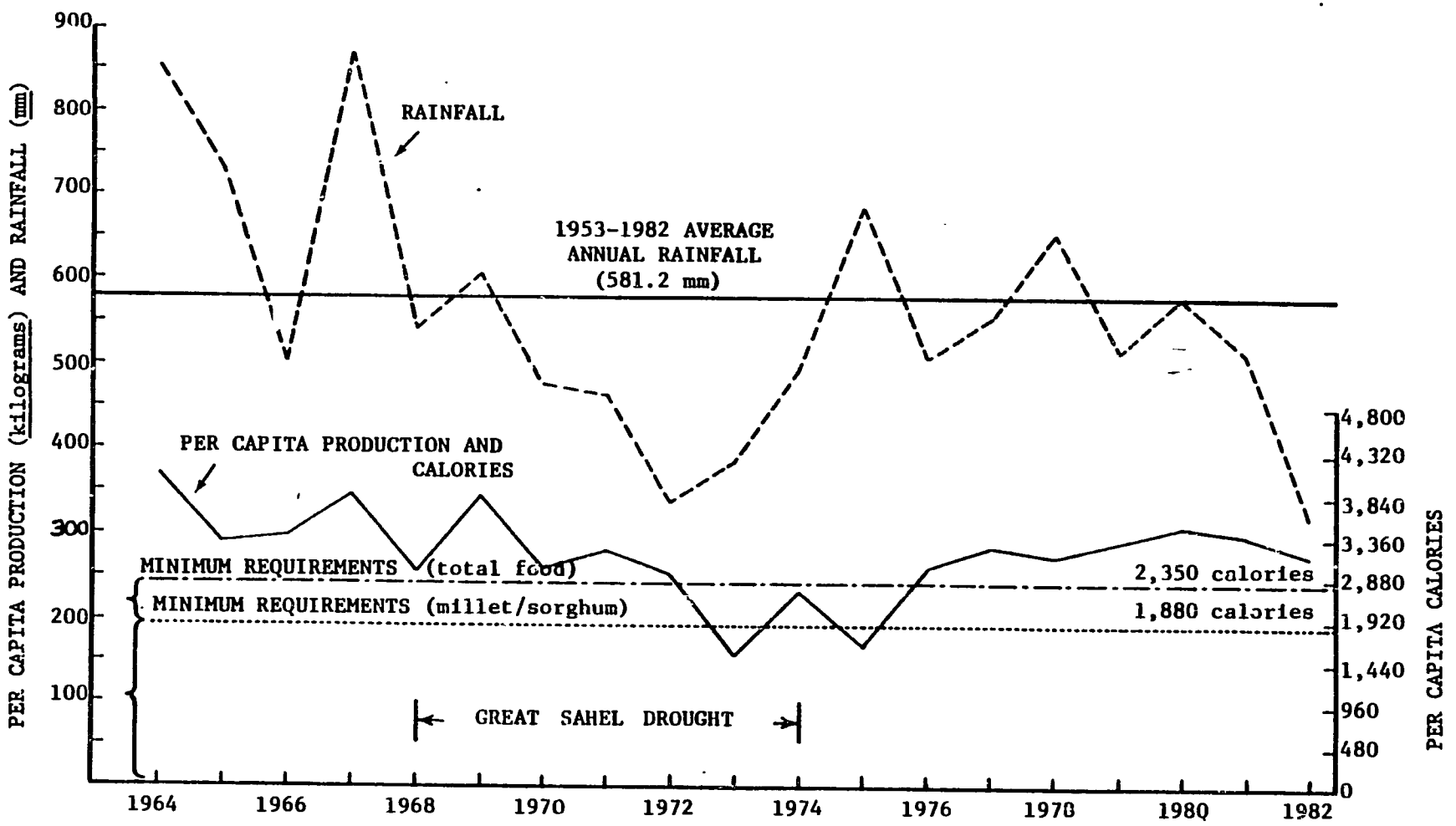
1/The word, Sahelian, is the adjective form of the word, Sahel, which is Arabic for the words, seashore or edge. This word is commonly used in reference to the area that straddles the southern limits of the Sahara Desert.

FIGURE 2. NIGER: PER CAPITA PRODUCTION OF MILLET AND SORGHUM (AND DAILY CALORIE EQUIVALENTS) AND ANNUAL RAINFALL, 1964-1982



*Production data, rainfall amounts and minimum millet and sorghum requirements are based on official Government of Niger records. Total food requirements are based on World Bank estimates (see text for explanation and appendix B for basic data).

increase in per capita food production.1/ Much of this predicted food deficit will result from population and economic pressures which cause farmers to deplete the soils of traditional farm lands by reducing fallow periods and to cultivate less accessible and, probably, less productive "new" lands. It is therefore expected that while only 10% of Niger's cultivable land supported 1.7 million people in 1920 and only 40% of this land was required to support 5.7 million people in 1980, that it will take 70% of this land to support the 8.5-9.0 million people Niger will have in the year 2000 (14, p. 2). The problems caused by this growing land-to-population ratio are further complicated by a decreasing rural-urban-population ratio. This is evidenced by the estimate that in 1990 it will take 1 person to feed 3 versus 1 to feed 2.5 in 1970 (7, p. 48).2/

A major element of Niger's strategy for bridging this gap between rainfed agricultural production and population growth has been the development of irrigated agriculture, mostly rice-culture along the Niger River. However, despite the heavy investment ($15,000-$20,000/ha) which resulted in a 28.7% increase in irrigated agriculture (16,400 to 21,114 hectares in the 1970-1980 period), rainfed agriculture continues to account for 99% of the land cultivated in Niger and 98% of all agricultural production. Millet and sorghum continue to be the dryland crops

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1/The World Bank projected that Niger will need 2.3 million mt of cereals in year 2000 to feed a population of nearly nine million. If this increase were to be met safely by using fertilizer to raise yields, about 145,000 mt of fertilizer would be required (assuming that one mt of plant nutrients will yield approximately 10 mt of additional grain). This amount of fertilizer is well over 12 times the amount used in Niger in 1982 (14, p. 2).

2/All population statistics are derived from the U.N.-sponsored national census of November 1977.

of preference, occupying over 80% of the land cultivated and providing an equal percentage of calories consumed. It is estimated that nearly all of Niger's rural population (90% of the total population) and a large percentage of the urban inhabitants are involved with the cultivation of these two crops. In comparison, rice-culture concerns less than 2% of the Nigerien population, less than 0.5% of total cultivated land and, with an annual production total around 22,000 mt, less than 2.5% of Niger's total production of cereals (6).

The Importance of Rainfed Agriculture

The largesse provided by uranium mining has permitted the GON to accelerate somewhat the execution of its development agenda and to take other popular actions. These have included raising the official prices paid for farm produce (e.g., official millet price increased from 30 to 80 CFA in the 1979-82 period), eliminating the national head tax (people and livestock), the higher subsidization of agricultural inputs (57% subsidized in 1979) and imported foodstuffs, and the increasing of commerical cereal (rice and wheat) imports from 12,900 mt in 1976 to 42,900 mt in 1980 (4, p. 22) (6).1/ Current economic difficulties are causing the GON to question the wisdom of some of these actions, especially with regards to its agricultural development policies. In effect, these difficulties have served to remind the GON of Niger's high vulnerability to external

1/Statistics are not available, but it is certain that the over 90% rise in the CFA value of the U.S. dollar have made this almost 350% increase in cereal imports very expensive. This large and rapid increase in the value of the U.S. dollar, coupled with the spin-off effects of the Three-Mile Island incident, have, therefore, led some critics to suggest that U.S. policies are responsible for the current economic disorder in Niger.

market forces. This, in turn, has caused it to re-emphasize the importance of rainfed agriculture to the national economy and the well-being of the vast majority of Niger's population, including agriculturalists as well as the 10-15% nomadic segment of the population.

The nomadic people (primarily Fulani and Tuareg) are of particular importance because they control over 90% of the livestock, which account for 10-16% of Niger's export earnings. These livestock earnings have remained high despite a high loss of animals during the drought because of the almost six-fold increase in animal prices since the drought. The growing demand of coastal countries for meat has played a major role in keeping these prices high (14, p.22).

Although uranium continues to be Niger's major foreign-exchange earner, agricultural output still accounts for a significant portion of Niger's GDP. The rise in uranium revenues has meant, however, that the agricultural portion of the GDP has declined. In 1970 the agricultural sector accounted for 70% of Niger's GDP and 80% of its exports (mainly groundnuts), compared to 33% and 20%, respectively, in 1980. (The 1980 GDP was reported at $1.9 billion.) (4, p. 46).

This decline in the agricultural portion of the GDP is due not only to increases in uranium revenues, but also to a decline in groundnut and cotton production. In 1968 groundnuts accounted for 63.3% of total exports while in 1981 no exports of groundnuts were reported. The production of cotton, which is produced mainly for use by Niger's textile mill in Niamey, declined from an all time high of 11,100 mt in 1975 to 2,200 mt in 1981 (6, 15, p. 46).

The drastic decline in groundnut production has resulted, in part, from plant disease problems (especially rosette virus), low world prices, and stiff competition with other groundnut-exporting countries.1/ Another factor contributing to this decline in groundnuts was the reaction on the part of Nigerien farmers and the new miliatry regime to the food scarcities caused by the 1968-1974 drought. This reaction resulted in a concentration on the production of the major food staples, millet and sorghum, and on less risky crops like bambara groundnuts and cowpeas. Cowpeas have become Niger's major export crop in recent years; its annual production going from 132,700 mt in 1974 to near 300,000 mt in 1981 (6, annex 4-4).

This concentration since the drought on increasing the production of food crops has not, however, resulted in the level of success expected. Development planners and managers have found that the obstacles to increasing food production and improving associated rural standards of living are as many as they are complex and difficult to surmount. NDDP was one of many efforts devised by the GON and contributing donor agencies following the drought to address these obstacles. The following description of NDDP's zone of operation provides further background on the nature of these obstacles and the environment in which they occurred.

Description of the Project Zone

The map presented in Figure 1 shows the location of the project zone within Niger. The zone covers about 30,000 square kilometers (2.3% of

1/As with Niger's other farm commodities, uncontrollable, clandestine trade with Nigeria is also a factor in the reported decline in groundnut production. For instance, in 1980 a kilogram of groundnuts sold for 105-175 CFA in Nigeria versus Niger's official price of 50 CFA per kilogram (6).

Niger's total land mass or 20% of its agricultural area) which all lie within the confines of three of the six administrative districts (Filingue, Ouallam, and Kolo) of one of Niger's seven provinces, the Department of Niamey. It is estimated that nearly 70% of this zone is arable while less than 20% has ever been cultivated (16, p. 3).1/ Of the cultivated area there are perhaps a total of 200-300 hectares which are hand-irrigated from shallow wells or ponds for the purposes of growing vegetable gardens. This compares to the estimated 300,000 hectares devoted to the extensive dryland farming of mostly millet (over two-thirds of the crop area), sorghum and cowpeas. NDDP's emphasis is, therefore, on rainfed agriculture. The pastoral area in the extreme north (all area more or less north of 14°30'N) up to the border with Mali and the irrigation perimeters along the Niger River were excluded from project coverage (17, annex 4-9; 18, pp. 29-33). A definition of the project zone is included in Appendix C.

Climate

The climate of the project zone is a typical Sahelian one. The average annual rainfall varies from rarely more than 350 millimeters (mm) in the north, usually concentrated in a 70-100 day period, to near 600 mm in 120-130 days in the southern part of the zone. Rainfall amounts and distribution (duration and pattern) are unpredictable from one year to the

1/The amount of arable land in the zone is debatable, depending on the definition used. Some would include, as was done above, all land that was cultivable, while others would include only that cultivable land which is easily accessible and/or where ground water for human consumption is readily available. Also, surplus land within an area traditionally controlled by one ethnic group cannot usually be farmed by members of neighboring ethnic groups.

next. The zone is afflicted by recurrent droughts (e.g., 11 major droughts have occurred in the past century), which result in frequent crop failures (19, p. 28).

It is also important to note that rainfall records show that since 1967 the 350 mm isohyet, normally considered the northern limit for the cultivation of annual crops, has descended southwards by 50 to 100 kilometers.1/ For instance, average annual rainfall in Filinque, near the northern limit of the zone was 519.4 mm during the 1943-1967 period but only 311.9 mm for the 1968-1981 period. During this latter 14-year period the 350 mm rainfall amount was exceeded only twice; 352 mm and 380 mm of rainfall fell, respectively, in 1968 and 1971. This long cycle of low rainfall continued in 1982 with less than 300 mm of rain falling over most of the northern half of the zone, and with the Niamey airport on the southern border of the zone receiving, perhaps, an all time low of 328.3 mm.2/ (See Appendix B for annual rainfall amounts.)

This decline in rainfall has, obviously, severely compromised agricultural activities in a large part of the project zone. The crop losses caused by increased aridity and a large and evolving number of crop pests

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1/An official northern limit for cultivation was established by passage of legislation in 1954 and 1961. It was intended that this legal definition of the boundary between the strictly pastoral area in the north and the agricultural area in the south according to the 350 mm rainfall line would help prevent land-use conflicts between herders and farms. This limit was, however, based on rainfall records for the 1930-1960 period; subsequent changes in rainfall patterns have, therefore, cast doubts on the validity of this boundary. In any event, hardly any attention has ever been paid to this division by either herders or farmers, and the government has rarely attempted to enforce this division (15, p. 14).

2/All rainfall statistics are based on reports issued by Niger's National Meteorological Service.

(even in a good year 25-50% of the millet is lost to plant diseases and pests) have cost the zone its traditional reputation as the granary for the capital city of Niamey, which currently requires 40-50,000 mt of grain annually (20, p.2). A list of major crop pests and diseases is presented in Appendix D.

The temperature range in the rainy season (May-September) is roughly 22-35°C, with an average mean range of 27-30°C, and during the dry season the mean range is 19-40°C, with an average mean range of 27-29°C. Daily radiation averages from 460 cal cm^{-1}/day in the rainy season to around 550 cal cm^{-1}/day in the dry season. This hot environment results in a high potential evapo-transpiration rate, averaging 7 mm/day in May and falling to 4 mm/day in August in the northern part of the zone. Overall, the total average annual evaporation rate is well over 2 meters (or 3 to 4 times precipitation). The relative humidity is low, rarely exceeding a monthly average of 40% even during the rainy season. Winds are usually gentle to moderate breezes, ranging from 8-20 km/hr (21, p. 108; 22, p. 309).

Much stronger winds do occur when the tropical monsoon arrives from the south, commencing the unimodal rainy season, and when the cooler, desicative Harmattan winds descend from the North during the December to March period. The area where these two air masses meet is called the Inter-Tropical Convergence Zone. The movement, sometimes capricious of this zone, determines the nature and duration of the rainy and dry season. The intensity of the wind and rain is sufficient to make erosion caused by these two elements a major problem (23, pp. 6-7).

Topography and Soils

The physical relief of the zone consists mainly of a monotonous plateau, 200-290 meters above sea level. This plateau is broken by flat-topped escarpments rising up to 50 meters in parts of the north and by the Dallol Bosso depression in the east, which stretches in a north-south direction across Niger for over 400 kilometers (see Figures 1 and 3).1/ The southern boundary of the zone is formed by the right bank of the approximately five-kilometer wide Niger River valley which cuts through the western end of Niger from northwest to the southeast. (Further information on land use in the zone is provided in Appendix C along with other basic statistics on the project zone).

The soils of the zone typically contain over 90% sand and usually much less than one percent organic matter, except the more "clayey" soils in depressions left by fossil riverbeds like the Dallol Bosso and in other low-lying areas where seasonal runoff collects. These latter soils have, however, been depleted of much of their original nutrient content by over-cultivation. The low water-holding capacity of these generally sandy soils and, perhaps more important, their lack of plant nutrients (especially nitrogen and phosphorus) are major factors contributing to low crop yields in the zone (24, pp. 8-12; 25, pp. 16-17).2/ (See Appendix E for a complete profile of a "typical" soil found in the zone).

1/Dallol is local language term for depressions left in earth by the passage of ancient water courses. Similar low-lying areas are also known as Kori, Wadi, Oued, Dillia or Goulbi in other arid areas of Niger and Africa.

2/Recent studies have concluded that the lack of plant nutrients is the most limiting factor. In effect, it appears that plants cannot make efficient use of water which might be available in the soils until the nutrient level in the soil is raised to a certain point (26, pp. 492-497).

Water and Vegetation

Excluding the Niger River, which falls just outside the zone, there are no permanent water courses in the project zone. In most of the zone, ground water is generally found at a depth of 50 meters or more. The requirement to dig through lateritic sandstone strata to reach this deep water table discourages settlement and, hence, cultivation in many areas of the zone. By contrast, groundwater in the Dallol Bosso area can usually be reached at only a few meters and, therefore, is readily accessible by hand-dug wells for both domestic, livestock watering and small-scale irrigation purposes. Scattered throughout the entire zone are numerous seasonal and some permanent ponds, especially in the more densely populated Dallol Bosso area where the shallow aquifier frequently comes to the surface, creating countless small ponds.

The vegetation varies from typical African, open-thorn savannah with very sparse tree cover in the north, gradually changing to shrub woodland in the south. The major tree and shrub species are Acacia, Commiphora, Combretum and Terminalia. The main grass species are Cenchrus, Aristida and Andropogon gayanus. Throughout the zone there are important tree populations of Acacia albida, which are used for dry-season forage and are prized by farmers for their beneficial effects on the soil, Parkia biglobosa, which provides edible fruits, and the Arbre de Cochon, Balanites aegyptica, which is valued for its many uses, including the making of cooking oil (27, pp. 19-36; 28, pp. 155-184).

Animal and Human Population Levels

It is estimated that there are 200-300,000 head of domestic livestock (Zebu -type cattle, hairless sheep, goats, camels, horses and donkeys) in

the zone. These animals represent the zone's principal financial resource and are the major asset of many of the farm families living in the zone. It is estimated that some 175,000 Tropical Livestock Units (T.L.U.) of ruminant animals are permanently kept in the zone. This yields a carrying capacity ratio of about 17 hectares to 1 T.L.U. and a ratio of 0.625 T.L.U. per person (17, annex 4-5).1/

The total human population of the zone is about 280,000 rural people. The population density in the zone is very low, averaging near 9.3 people per square kilometer (km). This density ranges from about 4.1/km^2 in the north to around 40/km^2 in the Dallol Bosso area, which covers about 4,000 km^2 or about 13% of the project zone. The capital city of Niamey, on the south-central limit of the project zone, reported a permanent population of 225,314 in 1977 (this is about six times larger than any other urban center in Niger) and a density of about 665/km^2 (18, p. 31). The distribution of population in the zone is shown in Figure 3.

In the project zone, there are only four population centers which exceed 3,000 inhabitants. The average size of the 523 villages in the project zone is 535 inhabitants, although approximately 75% of the villages are smaller than this. A large majority of these villages were settled in the last 20-30 years (30, pp. 145-146). Growing urbanization of the zone is reflected by an annual population growth rate in the few larger towns of 4 to 6%. This compares to an overall rural population increase of 2.2% per year (6).

Village and family size and population densities are usually less during the dry season when much of the male population (10-20% of the

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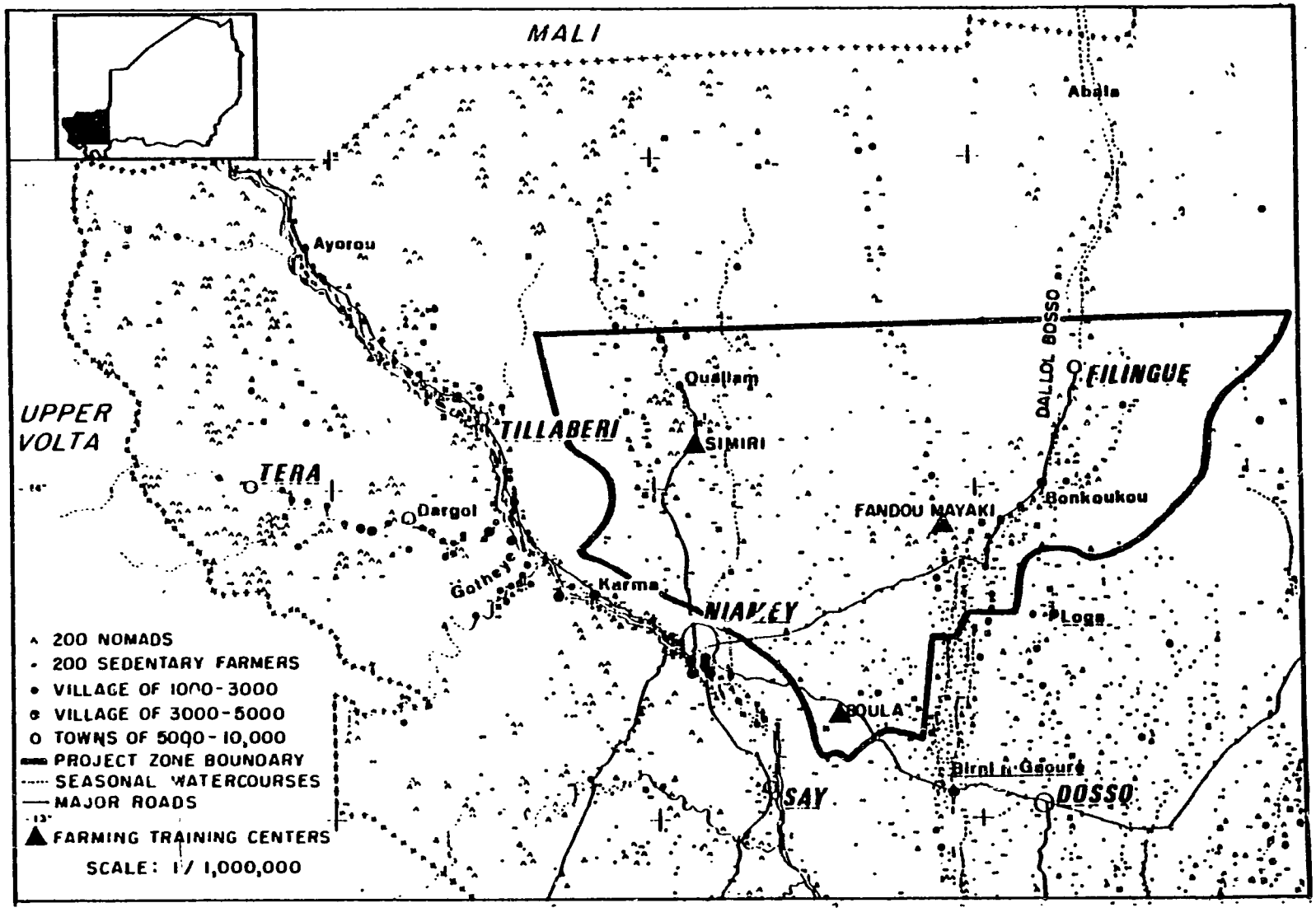
1/ A T.L.U. is defined as 250 kilograms of animal live weight (e.g., 1 mature cow or about 8 goats or sheep) (29, p. 1339).

FIGURE 3. POPULATION DISTRIBUTION WITHIN THE PROJECT ZONE



Source: Y. Poncet, Cartes Ethno-Demographiques du Niger (Etudes Nigeriennes No. 32, IRSH, Niamey, 1973).

total population) departs for the capital city or neighboring countries in search of salaried employment. This is also the annual period when transhumant herders move south in search of pasture and water for their animals and those the sedentary farmers often entrust to them. This human tide is such that the population of Niamey increases by 80,000 or more during the dry season (31, p. 22).

Ethnic Groups

The major ethnic groups in the project zone are the Djerma, Hausa, Fulani and the Tuareg, respectively representing about 60%, 30%, 6%, and 4% of the population (18, p. 31). The Djerma, who are related to the Songhay in neighboring Mali, are the original inhabitants and they live primarily in the western and southern portions of the zone. The Hausa, who emigrated into the area at a much later date from the East, are concentrated in the central and northeast parts of the zone. In general, the Hausa are considered to be better farmers than the Djerma who, prior to the enforcement of French rule in the early 1900's, assigned all agricultural tasks to their serfs (32, pp. 5-9). Settlements of the semi-sedentarized or transhumant Fulani are scattered throughout the area. The normally nomadic Tuareg make their home base in the east-central part of the zone where they have maintained permanent villages for decades. The Fulani are normally associated with cattle raising and the Tuareg with a variety of ruminant animals, especially camels and goats.

These various ethnic groups, and the many sub-groups contained within them, have long lived in close association with one another. There has, therefore, been a substantial mixing of the distinct languages, social

customs, and racial types that distinguish them. This mixing has been facilitated by the Islamic religious beliefs, which all these different groups share (32, pp. 10-11). These common ties do not mean, however, that a peaceful co-existence always prevails among these various groups. On the contrary, growing population pressures (human and animal), progressive ecological degradation and increased monetarization of the economy are increasingly causing conflicts between the sedentary and pastoral groups. Also, such groups as the Iklan or Bella (the descendents of former black serfs) are often treated as social outcasts in spite of official sanctions against such discrimination. It is important to note that such sub-groups dominate skill areas like blacksmithing, which are usually associated with their inferior social status (33, p. 81).

Roads, Communications, Power and Water Supplies

Outside some of the city streets of Niamey and excluding 100 kilometers of national highway No. 1, which closely corresponds to the southern boundary of the zone, there are no paved roads in or near the project zone. Altogether there are, however, about 430 kilometers of all-season, laterite roads in the zone (about 0.7 kilometers of good roads per 100 km^2 of surface area). These roads primarily serve to link major administrative and market centers with Niamey. As most of the villages are not along these major arteries, much of the project's work was carried out over roadless, rough terrain. This required the use of four-wheeled-drive vehicles, good driving, mechanical skills and astute logistical planning.

Telephone and telegraph communications between Niamey and the major administrative centers are possible, but often difficult. Also buses

(bush taxis) and commercial trucks make frequent trips from Niamey to each of these centers. At the village level the major means of transportation are horses, camels, donkeys and travel by foot. All of the district centers have post offices with regular overland postal service. The Filingue and Quallam administrative centers have seldom-used lateritic air strips.

Filingue is the only administrative center within the zone which has a permanent diesel generator for electric power. (Niamey receives its electrical power from the Kainji Dam in Nigeria, 566 kilometers to the southeast.) All the centers have small running water systems which mainly serve the homes of civil servants. Hand-dug wells, permanent and seasonal ponds remain the primary water source for most people. The hauling of water for domestic use and the collection of firewood for cooking purposes require major allocations of labor on the part of women and children. The loss of 30-40% of the trees during the last drought (1968-1974), the growing aridity of the zone and rapid population growth (especially in urban areas) have increased the difficulty of finding sufficient firewood (27, pp. 19-22). Although large-diameter, open wells are often very unsanitary sources of water, they are among the declared priority needs of 63% of the villages in the zone which do not have permanent wells (17, p. 62). In effect, some water, even if bad, is better than none.

Health, Education and Markets

All three of the administrative centers and the larger villages have health dispensaries of varying capacity. It is estimated, however, that over 40% of the zone's population live more than 40 kilometers from any

modern health service and that there are about 9,000 people per medical agent (includes only 1-2 physicians). The project's nutritional survey reported that 17% and 8.6% of the children under five years of age surveyed were suffering, respectively, from chronic and acute undernutrition (34, p. 3). This low nutritional status, the intestinal diseases caused by unsafe water supplies, and malaria are major contributors to a high infant mortality rate (over 30% of infants die before the age of 4 year) and the low average longevity age of 43 (35, p. 110). Yet, the rapid population growth and the fact that nearly 47% of the population is under 15 years of age indicate that some improvements in providing health care have been made in recent years (7, p. 10).

It is estimated that less than 5% of the population in the zone is functionally literate. In 1978 about 16% of the primary school age children were attending school (over 50% drop out by sixth grade) while less than 900 students were enrolled in the zone's three secondary schools (7th through 10th grade) (18, p. 32). The project's rural market and grain storage studies concluded that for the most part efficient, indigenous grain marketing and on-farm storage systems existed in the zone. The market study identified 17 traditional weekly markets in the zone and 9 other important market centers just outside the boundaries of the zone (36, pp. 5-7; 37, p. 1).

Summary of Salient Factors

Several important factors make the comparison of the NDDP zone with the other regional, "productivity" project zones strung mostly across Niger's southern tier with Nigeria difficult. First, and perhaps most

important, unlike other zones the NDDP zone had never been the object of a major development project. Other factors which distinguished NDDP's zone from others include: ethnic composition and diversity; proximity to the capital city; greater distance from Nigeria's markets and coastal ports; the lack of infrastructure and government services and the almost total absence of the use of modern agricultural inputs.

As is evident from the above description, the zone is also distinguished by the severe natural constraints (e.g., poor soils, unreliable low rainfall) imposed upon it. These constraints single this agricultural zone out as a high-risk area with low and uncertain growth potential. It was this low potential which had discouraged other donors from funding a major rural development project in the zone, and it is noteworthy that these donors (World Bank, France, European Economic Community) continue to exclude from coverage those portions of their respective project zones with natural characteristics akin to those of the NDDP zone (6).

CHAPTER III

PROJECT AIMS, ORIGINS AND INITIAL SURVEYS

NDDP was the first phase of a long-range program of rural development in the Niamey area of the Republic of Niger. The general objectives of the project were to increase food production, raise farm incomes and thereby improve rural standards of living in the project zone. Much of the emphasis of this three-year (1978-80) phase was on testing and initiating new development activities and on building the institutional capability of local government services and village-level organizations. A major component of this effort to create the organizational structure and motivation needed to initiate a self-sustaining process of rural development was the establishment of a rural-delivery system.

A major occupation of NDDP was therefore the training of the Nigerien government's rural development cadre and villagers, especially cooperative officers and farmer couples. The centers created to train the latter became the focal points of most project activities. These multi-purposed, residential centers, together with the village cooperative network established by NDDP, were designed to play a prominent role in the training of villagers. These centers were also designed to play an essential role in providing farmers with the services and agricultural inputs needed to increase significantly the production of Niger's major food staple, millet. In addition to millet, the project also focused on increasing cowpea production as a means of improving local nutritional levels, maintaining soil fertility and raising rural incomes.

NDDP was the fourth in a series of major regional development projects initiated by the GON throughout its agricultural belt as part of its global strategy to achieve food self-sufficiency following the devastating Sahel drought of 1968-1974. It was therefore necessary for NDDP to follow closely the example already set by these other regional "productivity" projects, each of which was funded and designed by a different donor agency. NDDP was and continues to be funded by USAID. In terms of the number of activities to be achieved during its initial three-year (1978-80) phase, NDDP was regarded by many as the most complex and ambitious project USAID was funding at the time in West Africa.

Certainly, the project design, which called for the implementation of over 30 major activities in more than 200 villages spread over a desolate area larger than Maryland and Delaware combined, presented a formidable challenge. During this brief period NDDP was also supposed to assist the estimated 50,000 small-scale, family farms in the zone. Project managers quickly found that the tasks demanded of them were overwhelming and that, by trying to do so much, their efforts became too widely dispersed. In essence, NDDP managers discovered that, by trying to do everything, they usually ended up achieving very little. Nonetheless, the quality of project management was such that NDDP was considered at the time one of the best managed rural development projects in West Africa (38, p. 3).

Activities and Achievement

Figure 4 presents and compares NDDP's planned targets with actual achievement levels recorded at the end of the three-year project period. Figure 4 also shows how much money and time were spent on each of NDDP's

Figure 4. CHART I: NIAMEY DEPARTMENT DEVELOPMENT PROJECT - PERFORMANCE DURING PHASE I (1978-1980)

MAJOR SECTORS 1/	TARGETS 2/	% ACHIEVED 3/ (0 50 100)	ACHIEVEMENTS 4/
I. AGRICULTURAL SERVICES AND TRAINING ($1.02m; 1978 1979 1980)	1. 3 office complexes built		1. 1 house, 3 offices & 1 warehouses completed
	2. 3 training centers built		2. 3 centers created and functioning well
	3. 43 field agents trained		3. 40 trained and working
	4. 90 farm couples trained		4. a) 84 young farmers trained b) 100 farm couples trained c) 1,710 other farmers given some training
	5. 1,125 demonstrations carried out		5. 1,440 ha. of demonstration fields in 201 villages
	6. School gardens established		6. 46 gardens established & materials prepared
	7. Collection of farm statistics		7. Baseline data collected in 148 project villages.
II. CREDIT COOPERATIVES & INPUT DELIVERY ($2.24m)	8. 3 office complexes built		8. 3 offices, 3 houses & 3 warehouses
	9. 43 coop. meeting centers constructed		9. 23 completed (insufficient funds for rest)
	10. Coop. level monitors trained		10. None (not needed)
	11. 10 grinding mills tested and evaluated		11. 10 installed and evaluated
	12. 4 tapioca/cassava flour mills tested		12. None installed (not feasible)
	13. 252 coop. leaders trained		13. 165 trained
	14. 2,100 village leaders trained		14. 2,099 trained, plus 313 marketing agents
	15. Coop. marketing & credit system developed		15. a) 43 coop associations created b) 208 villages coops created c) credit fund established
	16. Blacksmith training		16. 28 trained
III. FARMER LITERACY AND RADIO CLUBS ($.26m)	17. 3 offices built		17. 3 constructed
	18. 84 literacy instructors trained		18. 86 trained
	19. 3,100 villagers received literacy training		19. 3,711 attended classes (only 173 passed)
	20. 42 radio club monitors trained and functioning		20. a) 16 radio clubs established b) 9 radio clubs programs performed c) 15 monitors trained d) 5,384 listened to program
IV. LIVESTOCK SERVICES ($.13m)	21. Cottage poultry demonstrated		21. a) 61 farm chicken houses installed in 7 villages b) creation of 52 pilot chicken houses in 33 villages c) 700 pure bred roosters sold
	22. Maradi Red goats introduced		22. Distributed 294 goats in 1979
	23. On-farm cattle feeding demonstrated		23. 295 steers fattened
	24. Animal health program initiated		24. a) 54,500 vaccinations and 12,590 deparitizing medicines provided b) 3 vaccination chutes provided
V. VILLAGE WOODLOTS & CONSERVATION PLANS ($.77m)	25. 42 field agents trained		25. 20 trained
	26. Land-use and soil conservation plans developed in 425 villages		26. Agents given special training but unable to develop plans
	27. Tree planting activities begun in 50 villages		27. 102,000 trees planted in 11 village woodlots and windbreaks
	28. Three nurseries established		28. 3 nurseries established & 2 well completed
	29. Experimental fish ponds stocked		29. 2 natural ponds stocked, others studied
	30. Not listed		30. 3 offices and 3 houses constructed
VI. STUDIES AND SURVEYS ($.77m)	31. Baseline data collected		31. Ag. Statistics collected in 148 villages
	32. Studies of nutrition, socioeconomic conditions, grain storage, aerial photography, etc. . . . completed		32. 9 major studies and 45 major documents completed
	33. 6 minor irrigation schemes tested		33. Several proposals considered, but no activity
	34. Area development plan completed		34. 3 volume, Phase II (1981-85) project paper completed
VII. PROJECT MANAGEMENT UNIT 5/ ($1.21m)	35. No target level set.		35. Unit consisting of 15 people well established and functioning efficiently

1/ Darkened portion of circles represent percentage of total Phase I funds ($6.4 million) spent on each component. Dollar amounts show actual value of this percentage. Bar lines show period of execution for each component during three-year life of Phase I.

2/ As per USAID Project Paper 683-0205 of May 28, 1977 for Phase I (1978-80) of the project.

3/ Shows percentage of individual activities achieved up to 100 percent.

4/ As per Annex F of USAID Project Paper 683-0245 of April 28, 1981 for Phase II (1980-85) of the project.

5/ Over 10 percent included in other component for refurbishment and purchase of vehicles used to execute all components.

seven major sectors: agricultural services and training; credit cooperatives and input delivery; farmer literacy and radio clubs; livestock services; village woodlots and conservation activities; studies and surveys and project management (39, Annex C).

A review of the achievement column in Figure 4 indicates that NDDP enjoyed a high level of success in achieving quantifiable targets. This "quantitative success" should not be construed, however, to mean that all went well. On the contrary, the numbers reported under the achievement column reflect poorly the "qualitative success" of each activity. For instance, the number of cooperative agents and farmers trained says nothing about the quality of the performance of these individuals or the constraints which often prevented them from performing as desired. Also, the achievement of these tangible target levels neither gives an indication of unplanned results (e.g., the impact on the over 200 salaried employees of the project and the educational impact on the Ministry of Rural Development) nor of unarticulated objectives (e.g., promotion of more intensive, mixed-farming systems; the reduction of migration from rural areas; and the political satisfaction of working in a neglected area).

Pre-Project Events

As indicated in Chapter II, NDDP evolved out of the harsh lessons learned from the occurrence of the 1968-74 Sahel drought. The critical food shortages and human suffering caused by this severe drought prompted national governments and foreign assistance agencies to begin placing high priority on programs designed to achieve increased food security. In the case of Niger, the inability of the civilian government to execute an

effective drought relief program helped bring about a coup d'etat in March of 1974 which brought to power a military government strongly committed to achieving food self-sufficiency. This new government moved quickly to take advantage of the special bilateral assistance programs and the regional organizations which had been formed to facilitate and coordinate the funding of drought and post-drought relief projects.

NDDP was thus one of the first post-drought relief projects prepared by Niger to be forwarded to the Inter-State Committee for the Struggle Against Drought in the Sahel (French initials CILSS). This committee was created in 1973 by seven of the Sahelian nations (Chad, Mali, Mauritania, Niger, Senegal, The Gambia and Upper Volta) in response to support offered by the Club de Sahel, a Sahel-relief organization composed of western donors (37, p. 539). NDDP was one of many projects presented by CILSS to western donors at its March 1975 conference in Dakar, Senegal. It was at this meeting that USAID, under the auspices of the U.S. special Sahel Development Program, tentatively agreed to fund NDDP. As previously mentioned, one factor which helped Niger attract the assistance of USAID and other donor agencies was the impressive revenues it was beginning to garner from its uranium production. In effect, increased uranium earnings convinced the Nigerien government and donor agencies that Niger could handle the recurrent cost burdens generated by development projects and, hence, continue their implementation after donor support was terminated.

Figure 5 lists major pre-project events which occurred from late 1973 until project implementation began on January 2, 1978 (39, Annex A). It is remarkable that, although all parties involved were working under considerable pressure to begin this important post-drought project, it

FIGURE 5. NIAMEY DEPARTMENT DEVELOPMENT PROJECT
CHRONOLOGICAL LIST OF MAJOR PRE-PROJECT EVENTS*

Period Covered by Each Event (1973 · 1974 · 1975 · 1976 · 1977 · 1978)	Events	Time Period
	1. Preliminary project document prepared by government of Niger (GON).	Late 1973 - Early 1974
	2. Final GON document prepared and AID agrees to consider project funding.	February 1974 - March 1975
	3. GON processed official request for assistance and transmits to AID.	April 1975 - January 17, 1976
	4. AID consultants recruited and first project paper (PP) drafted for submittal to AID/ Washington (AID/W).	February 1976 - September 1976
	5. AID/W reviews first PP and requests USAID/Niger to re-write it.	October - November 1976
	6. Revised PP re-submitted and AID/W agrees to approve it if certain modifications are made.	December 1976 - February 1977
	7. PP modified and subsequently approved by AID/W.	March - May 28, 1977
	8. Project funding authorized and grant agreement negotiated with GON.	June 4 - August 28, 1977
	9. Grant agreement signed and its conditions present are satisfied by GON.	August 29 - November 26, 1977
	10. Assignment process of designated GON project director is completed and project implementation begins.	November 27, 1977 - January 2, 1978

* Derived from M. G. Wentling, "End of Tour Report" (USAID/Niger, July 13, 1981, Draft Manuscript).

took almost five years from the time the GON prepared its first project proposal until actual implementation was started. Much of this five-year delay was caused by the insistence on the part of NDDP planners that much more data had to be collected and analyzed before a project document acceptable to donor agencies could be completed. This insistence became particularly noticeable following USAID's agreement to fund the project in March 1975.

Many of USAID's personnel had just recently been obliged to leave Southeast Asian countries after programs there were curtailed following the U.S. departure from Viet Nam and Laos. These administrators were concerned that an adequate data base for USAID's major new undertakings in Niger and elsewhere in the Sahel did not exist. It was suspected that, as many of these people were looking intensely at Africa for the first time, they felt uncomfortable with the apparent weak data base and Niger's low institutional capacity for collecting data.

The lack of confidence in the local data base and planning capacity prompted USAID to hire a team of consultants from a reputable firm which had performed well elsewhere in Africa. These project designers spent much time and money (26.4 person-weeks and $177,992) assembling a large amount of data in the spring of 1976 (41, p. 129). These data were considered essential to the completion of the required USAID project paper. In May 1976, these designers used their data and analyses to prepare a two-volume (242 pages) version of this paper and, after a detailed review by USAID's Niamey-based office, this paper was completed and sent to USAID's headquarters (AID/W) in Washington, D.C., for approval and subsequent authorization of funding.

Following a series of in-depth reviews of this comprehensive paper by AID/W, it was rejected in October 1976 on the grounds that sufficient information was not included to support the funding of this ambitious, multi-faceted rural development project. A revised paper was subsequently prepared by the USAID office in Niamey and, following another series of reviews and further revisions, it was eventually approved by AID/W on May 28, 1977. This approval was contingent, however, on the agreement to include as one of NDDP's major emphases the collection of the data considered necessary for future project planning. Accordingly, several major socioeconomic and agricultural statistic collection efforts and related studies were undertaken during the three-year life of the project. The results of some of these efforts are briefly reviewed in the following section.

Initial Efforts to Overcome Data Deficiencies

In view of the issues raised in AID/W concerning the lack of sufficient planning data and the problems involved with gaining AID/W's approval of the project paper, the USAID office in Niamey decided to take special measures. These measures included the unusual step in early 1977, several months before AID/W's approval of NDDP, of using funds (approximately $10,000) from another, already ongoing AID-funded project in Niger. These funds were used to entice Niger's National Office of Agricultural Statistics (NOAS) to modify one of its ongoing comprehensive socioeconomic surveys to include the random selection of population groups in 148

villages in the project zone.1/ In the event that AID/W did not approve the project it was hoped that the data collected under this survey could be used to re-design NDDP to AID/W's satisfaction. Also, it was thought that, even if AID/W did approve the project, the information generated by this large-scale survey would help accelerate NDDP's much delayed implementation.

Unfortunately, the preliminary results of this ambitious survey so greatly disappointed the NOAS director that he delayed for almost a year before turning them over to NDDP managers in the Spring of 1978. It was not until then, therefore, that the managers learned that only 65% of the project's questionnaire forms had been completed and that many of these were so incomplete or of doubtful validity that they were of little usefulness. Furthermore, after doing their own ground level check of some of the most complete forms, managers found that some of these contained faked or incorrect information. For instance, some farms were never visited by the designated enumerator but the questionnaires were nonetheless completed. In other cases, farmers were visited, but only part of the farmer's fields were measured. These are just a few illustrations of why the overall quality of this survey was considered to be so low that its results could not be taken seriously. It is interesting to note, however, that the partial results of this survey did confirm earlier national statistical reports which estimated the average farm size in the project zone at around six hectares (19, pp. 6-7).

The first major data collection effort undertaken with NDDP funds, following its actual commencement in January 1978, was during the summer

1/This $10,000 payment to NOAS was a relatively small payment for the services demanded, but it was sufficient to cover some 16,000 hours of enumerator labor.

and early fall of 1978. Given the discouraging results of the previous large-scale effort, it was decided that this survey should concentrate on six representative villages. This decision was based on the belief that it would be better to have in-depth, quality information on a few villages that was easily verifiable than partial information on a great number of villages. Furthermore, to better ensure the quality of this socioeconomic survey of these six villages, it was also decided to engage two U.S.-trained, expatriate specialists to conduct the survey.

The hiring of these two specialists proved to be very difficult. Indeed, NDDP managers found that French-speaking specialists who were available could only participate in the survey for a few weeks, and only then if the survey could coincide with the vacation periods of their academic institutions. Given this situation and the urgent need to begin this survey, NDDP managers were obliged to hire two specialists, a rural socialogist and an agricultural economist, whose qualifications were less than those desired.1/

These two specialists worked together with several Nigerien officials from the Ministry of Plan to develop and field-test a questionnaire. The survey was then to be completed by direct interviews with 272 inhabitants randomly selected from census records of the six villages. Like previous and subsequent surveys, a major task confronting these specialists was the recruitment and training of enumerators. The academic commitments of the

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1/It was also lamented that a tropical agronomist and/or ecologist could not be found to participate in this study. Since NDDP managers considered the problems they faced in the zone were determined more by agro-climatic factors than socioeconomic ones, it was believed that such people were needed. Unfortunately, people qualified in these fields are among the hardest to recruit.

expatriate specialists limited the time they could devote to this survey to about two months. Consequently, the hiring of a relatively large number of 30 enumerators was required to complete this survey within this time limit.

The minimal educational requirement for enumerators was low (primary school plus 1 or 2 years of secondary school) and this survey was carried out when many high school and university students were on their summer vacation. However, the scarcity of unemployed, educated people in Niger made the hiring of this number of enumerators a formidable task.2/ Altogether over 40 enumerators were recruited and trained for two weeks, but only about half of these proved to be capable of successfully completing training. The remaining enumerators required for the survey were acquired from among the employees of the Animation Rurale Department of the Ministry of Plan which agreed, after much persuasion, to assign temporarily some of its employees to NDDP. These Ministry of Plan employees were all experienced data collectors, having worked in 1977 with the U.N.-supported national census.

More formidable than finding suitable enumerators and training them were the difficult logistics involved in providing the three survey teams (one per two villages), their supervisors and the two specialists with the cars, drivers, money, camping equipment, fuel, water and food they needed to survive and function in the austere environment of the project zone. The providing of this support was particularly onerous given that many

2/There were about 300 high school graduates in Niger in 1978 and almost all of these graduates were obliged to work for their government. This was, however, a large improvement over 1977 when few, if any, students were allowed to graduate following the closing of all secondary schools by the GON in response to student protests.

of the vehicles and other supplies ordered from the U.S. at the start of NDDP had not yet arrived. NDDP managers were to learn later that the elapsed time between the order and receipt of U.S. goods sent overland was very variable, ranging anywhere from 8 to 18 months.

Logistics were further complicated by the movement of many of the selected respondents to isolated "farm camps" for the cultivation of their annual crops. The planting of these crops often blocked the passage of vehicles. This meant that enumerators and their supervisors often had to walk 10-20 kilometers from a main track to the respondents seasonal residence. Many times respondents were working in their fields and this meant that further walking and much perserverence were required to locate them. NDDP managers soon learned that the undertaking of such a survey required a level of skill and discipline seldomed encountered in Niger. They also learned that this type of survey monopolized project resources to such an extent that little else could be accomplished. This survey and others, therefore, interfered appreciably with NDDP's progress toward the achievement of more important objectives.

When the field work phase (July 28-August 5, 1978) of the survey was reviewed it was discovered that the questionnaires for one village had been poorly or improperly completed; consequently, a special team composed of those enumerators considered to have done the best work and the expatriate specialists was quickly assembled to repeat the survey in this village. This reduced the time the specialists had to analyze the information collected. In any event, following the usual delays of tabulating data and producing reports in both French (the official language of Niger) and English, the results of this relatively small-scale, low cost

($68,607), and rapidly-executed survey became available in late September 1978.

Although this survey mainly confirmed what was already known by NDDP managers, it did provide a few important notions on the social structure of the inhabitants of the project zone. More important, however, is the fact that this survey did not provide as much new knowledge as expected on NDDP's principal target, the traditional farm. This latter fact helped place this survey along side many other socioeconomic studies and reports which were already collecting dust in the offices of local government and donor-agency officials. In brief, this survey did not provide NDDP managers the kind of information they needed to manage effectively the project (42, pp. 1-4).

Under continued pressure from host government and USAID officials to undertake a meaningful comprehensive farm-level survey, NDDP managers decided in late 1978 to give NOAS and their European advisers another opportunity to carry out a survey similar to the one they attempted to do in 1977. NDDP thus provided NOAS with additional funding and logistical support valued at over $38,782 (43, pp. 75-78). Benefiting from the hard lessons of prior surveys, NOAS made careful plans and preparations for this survey. Regrettably, the results of this survey were more disappointing than the previous survey carried out by this office in 1977.

The poor results of this survey were largely due to a constant turnover of NOAS' personnel during the field survey period. Ironically, this turnover resulted in part from the strengthening of enumerator supervision. (Poor supervision had been singled out as a major weakness in previous surveys.) In effect, closer supervision resulted in the dis-

missal of many enumerators who, it was discovered, were either not doing their job or were faking their entries on the questionnaire forms. Another major contributor to this turnover were the illnesses that supervisors and enumerators claimed were brought upon them by the physical rigors and deprivations of working in such an inhospitable zone during the dry season. These personnel problems resulted in a large extent to the completion of only about 50% of the planned survey. A major effort was said to have been made by NOAS to compile and analyze the half of the survey which was completed, but the results of this effort were still unavailable when the second phase of the project began in July 1981.

The experience with NOAS' second survey again demonstrated the overwhelming difficulties of carrying out large-scale surveys in an area where human survival is a challenge, few people are literate, the farming population is highly mobile, travel is extremely difficult, and trained supervisors and competent enumerators are rare (19, pp. 8-9). It was these difficulties and the discouraging results of this survey which prompted NDDP managers to begin developing its common-sense QUAD approach to the collection and analysis of basic data essential to project implementation.

In view of the poor results of NOAS' 1978 survey and the growing need to concentrate on NDDP components, managers decided that it would be best to refrain from supporting further large-scale data-collection efforts and, instead, to depend more on the on-going flow of information generated by the project's implementation experience. However, shortly after this decision was made, NDDP managers found themselves obliged to satisfy a request from the local representative of the U.N.'s Food and Agriculture Organization (FAO). This required providing vehicles, personnel and about

$40,000 as partial support of a large-scale survey of the three administrative districts which encompassed the project zone. The FAO needed this support to complete the world-wide census of agriculture that it carries out every ten years (43, pp. 72-74).

For this survey the FAO assisted NOAS with making many improvements over previous efforts. Survey forms were simplified and, for the most part, they were carefully completed by a select group of enumerators and studiously reviewed by skilled field supervisors. Expectations were therefore high that the results of this 1979 survey would be useful to project management. However, when the preliminary results of this survey were reviewed by NDDP managers in September 1980, it was found that some of the more important conclusions were very suspect. For instance, the average farm size of the zone was shown to be 3.22 ha, or about half the size reported by previous studies. Also, this farm size was much less than the size of many of the farms with which NDDP managers were acquainted. If this smaller farm size was correct and average millet yields were near the 300 kg/ha mark also reported by this previous survey , the zone was producing 30-40% less than needed to feed the population that census records clearly showed inhabited the zone. Since it was evident that such food deficits did not exist in the zone, this lower farm size was unacceptable to GON authorities.

Although it was widely acknowledged that farm size was not a very useful indicator in a zone where land access was not generally a constraint, it is believed that it was primarily this inconsistency which kept the GON from releasing the final report on this survey. In any event, as of early 1983, NDDP had not yet received the final results of this 1979 survey. Managers never learned how the FAO handled this

anomaly in the publication of its 1980 World Agricultural Census (44, p. 3).

The foregoing very briefly describes only the initial four major data-collection efforts undertaken by NDDP. No mention has been made of the many other studies (over 30 major reports, documents, etc.) that were produced by NDDP in less than three years to fill what were then thought to be crucial gaps in the data base needed to plan and implement the project (see Appendix F for list of major project documents) (45, p. 93). The above should suffice, however, to support the contention of NDDP managers that large-scale data-collection efforts, especially under such conditions as briefly described above, can often be of very low utility.

NDDP's experience demonstrated that the results of large-scale surveys frequently contain misleading anomalies, often provide information already sufficiently known and almost always become available too late to be of much use. Even if the results of such surveys were very useful, timely and the conditions they reflected continued to exist, these kinds of surveys are frequently so costly, time-consuming and cumbersome to execute that they are difficult to justify. The manner in which they often interfere with project implementation also makes them an unattractive alternative. In the case of NDDP, it was the low value of its initial surveys and the way they monopolized project resources that made managers argue that further large-scale collection efforts should not be undertaken unless deemed absolutely necessary.

Recognizing that the NDDP zone was one of the most socially and economically underexplored areas of West Africa, NDDP managers did, however, concede one major exception to their argument against doing more

large-scale surveys. This exception involved supporting the long-term residence of a qualified scholar, perhaps a graduate student, in the zone. It was believed that this scholar could, by living and working with the local people on a daily basis, obtain information and insights that would be difficult to obtain through single-point surveys. Regrettably, a search made by NDDP managers for such a scholar indicated that few, if any, professional scholars were interested in residing in the inhospitable project zone and learning the required local languages. Evidently, it was much easier and more popular for scholars to do their work in the Hausaland areas of eastern Niger and Northern Nigeria, which were fast becoming the most studied areas in West Africa.

A fear was also expressed by one NDDP manager that academic scholars may not provide the kind of practical information the project could use in its operations. This issue was raised because experience elsewhere had shown that some scholars were often more concerned with adhering to the analytical rigor and internal logic required by the current "state-of-the-art" methodologies of their profession. The view was also expressed that scholars would be more interested in gaining the recognition of their peers for articles published in journals of limited readership than providing projects with useful information. In the case of master's and Ph.D. students, it was feared they would have difficulty satisfying both the project's needs and the demands of their university examiners. Despite these possible drawbacks, NDDP continued to extend a welcome to any scholar who is prepared to attempt a major work on the project zone and its inhabitants.

As part of their argument against additional large-scale surveys, and in view of their urgent need for a decision-making framework, NDDP managers

elaborated the comparatively simple and low-cost QUAD approach. They believed this approach provided them with sufficient information for making major project implementation and policy decisions. Hindsight now shows that had this approach been adopted early in the project planning process, much delay, cost, and frustration could have been avoided. Moreover, it is believed that NDDP could have been launched on an equally firm footing if project planners had been more willing to apply approaches like QUAD to make better use of what was generally known, yet, perhaps, not precisely quantified. A description of the QUAD approach developed by NDDP managers and the many observations which resulted from its application to the project is presented in the following core chapter of this paper.

CHAPTER IV

MANAGING WITHOUT SUFFICIENT DATA: THE QUAD APPROACH APPLIED

The disappointing results of the surveys briefly described in the previous chapter forced project managers to conclude that it was highly unlikely that any of the planned surveys would provide them with the information they urgently needed to manage effectively the project. Of particular importance was information which would help managers gain a firmer grasp of what NDDP's principal target--the traditional farm--was like and how the new farming practices being promoted by NDDP would impact upon this farm and society at large. Managers thus realized over a year after the start of this three-year project that a different approach was required if they were to obtain the information needed to govern ongoing implementation and to properly orient the design of the second phase which was scheduled to begin in the following year (1980).

This need to cope rationally with on-going implementation and to construct a framework for orienting future project directions compelled managers to attempt to develop and employ a simple, common-sense approach. This QUAD approach relied heavily on the rapid identification and interpretation of relevant available data, the exercise of experienced professional judgment, and the consensus of host country and expatriate personnel knowledgeable of key project activities, the project zone and the local farm situation. Although the application of QUAD resulted in conclusions which were not perfect, they were sufficiently accurate to permit managers to justify and pursue intelligently the implementation of

activities designed to achieve NDDP's major goal--the marked increase of millet and cowpea production. A description of the five basic steps of this approach and the insights gained by its application to the NDDP follows.

Step One: Make Initial Assumptions

The lack of reliable official statistics is often cited as a major reason for undertaking many data-collection efforts; however, sufficient information can usually be obtained from official statistics by exercising professional judgment to determine what statistics appear to be reasonable. This determination can often be aided by comparing official statistics with information provided in secondary sources. For instance, the background material on Niger and the description of the project zone presented in Chapter II were based entirely on a synthesis of various interpretations of official references. Most of the analysis presented in this chapter could have indeed been derived from the information presented in Chapter II.

It is therefore recommended that, time permitting, one should not commence a new data-collection effort until a careful inventory of relevant data has been completed. Such an inventory can help avoid wasteful duplication. Project managers were, for example, able to forego the undertaking of transport and hydrological studies by showing that sufficient information already existed to analyze and describe the situation in the project zone with regard to these two areas. Managers suspected that, even in a country like Niger, which has in comparison with other countries been little studied, there was probably a wealth of relevant

reports, studies, etc, but time did not permit tracking down such fugitive documents.1/ It was also known that relevant data were being generated by the other "productivity" projects in Niger and by similar efforts in Northern Nigeria and other Sahelian countries, but NDDP did not have access to these data. In this regard, it was considered unfortunate that a central respositiory did not exist for the systematic collection and dissemination of relevant project information, and that regular channels of communications had not been established between NDDP and similar projects in Niger and elsewhere in the region.

In view of the absence of possibly better sources and the urgent need for information upon which to base implementation and policy decisions, managers were obliged to base their QUAD approach primarily on official GON statistics and the 50 years of experience working with development projects in West Africa possessed collectively by the two Nigeriens and two Americans managing the project. The character and paucity of this kind of intitial data base required the making of some fundamental assumptions at the outset. A brief description of these assumptions follows.

It was accepted that Niger, like most of the newly developing countries, lacked reliable agricultural statistics. The GON and all major donors (e.g., FAO, U.N., World Bank) appeared, however, to acknowledge, with only slight modifications, the general accuracy of these statistics by using them as the basis for their analysis of Niger's agricultural situation. NDDP management, therefore, decided that its reasonable use of

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1/B. Harriss' 1978 inventory of agricultural-related studies in the Sahel showed that 676 studies had been done on Niger (46, pp. 20-22) and in 1979 G. Abalu reported on 17 major farm-level studies for Niger (47, p. 2). NDDP managers knew of only a handful of these studies and had access only to a couple of them.

these statistics would be within the limits of accepted practice. Consequently, it was agreed that those available statistics deemed reasonable would be used and that, to the maximum extent possible, any important data deficiencies encountered would be handled through the exercise of experienced judgment by NDDP managers and other professionals in the GON ministries and USAID. In the event that the use of professional consensus failed, it was agreed that small sample surveys which could be completed within a few weeks time would be employed to obtain essential information. It was thought that such small, "spot" surveys along with the information derived from the on-going implementation of project activities would adequately compensate for any sizeable gaps in the available data base.

The decision to assume that official statistics were sufficiently accurate to be used as the basis of analyzing the traditional farm in the project zone was made easier by the prevailing, semi-arid agro-climatic conditions which resulted in a lack of agricultural diversity. This high degree of homogeneity in the agricultural systems practiced in the project zone greatly simplified the analysis of these systems. Such predominating factors as relatively small farm size; total reliance on hand implements and the same drought-resistant crops; a short growing season, and low capricious rainfall all served to limit the farmer's alternatives. These factors and others helped simplify an analysis of the potential accuracy of common hypotheses. This meant that more error could be tolerated when developing a illustrative profile of an average farm in the project zone.

It was generally agreed that these factors safely permitted error margins of 10-15% when estimating farm sizes, yields, labor inputs, number

of farms growing different crops, and of up to 20-30% for on-farm crop consumption. For instance, whether or not a farm family grows one hectare or 0.85 hectare of cowpeas and consumes 200 or 250 kgs of millet were not believed to be differences which would have an important impact upon the making of major project decisions. With regard to this latter assertion, NDDP managers believed that their primary concern was with how to produce more rather than with what a farm family currently consumes.

Although project managers were aware that the characterization of an average farm on the basis of available statistics and common hypotheses could mask a considerable diversity in the actual behavior of individual farm units, it was not believed that the accommodation of this diversity would change significantly the way NDDP could be implemented. Managers agreed that other factors such as ethnic background, soil quality, pest outbreaks, localized droughts, distance between residence and fields, off-farm labor and access to water, roads and health services did often result in differences among individual farm units which must be taken into account when dealing with such farms. However, it was believed that the predominating factors mentioned in the previous paragraph were of overriding importance when it came to orienting project activities and allocating scarce project resoures. In addition, the unpredictability and variability from one year to the next of many of these other factors made them unsuitable for use in the elaboration of a generally applicable decision-making model. It was also believed that the possible inequalities produced by these factors were not of great importance to project planning in a zone where the differentiation in the standards of living was marginal.

On the basis of the initial assumptions mentioned above, managers decided they could with sufficient accuracy quickly synthesize available data in such a way as to develop an "average farm profile." It was intended that this profile would provide a useful illustration of the kind of farming system currently practiced by the majority of farm families in the project zone, and that it would serve as the basis fcr making operational decisions. The following sections of this chapter briefly describe the methodological and decision-making process as it was actually developed and employed by project managers in their attempt to produce a meaningful picture of the traditional farm in the zone.

Step Two: Construct a Profile of the Average Farm

This step involved assembling and analyzing in a simple, straightforward manner the basic information needed to examine production and income aspects of the present farm system as practiced on a statistically average farm. The achievement of this step required that available information and knowledge of farming practices in the zone be used at the outset to make decisions as to what the most important factors were in terms of farm production and income, and that only these factors be considered when developing an output model of the present farm system. This meant that only major crops and livestock categories were included in this analysis. Any crop which concerned less than 10% of the total cultivated area was considered to be of minor importance and, therefore, was excluded from the analysis. Likewise, any crop or animal type which concerned less than 20-30% of the farm population was excluded from consideration. GON statistics for the three administrative districts and,

in some cases, for the 12 cantons concerned by the project were used to determine major and minor farming categories.

The importance of each crop and animal type was shown by noting the estimated amount of area devoted to each crop and the number of animals expected on an average farm. This information, coupled with estimates of individual crop yields, was then used to calculate total production. Next, the amount of total production consumed on the farm was determined according to basic nutritional needs. At this point the current floor prices offered by the GON-controlled marketing office were used to estimate gross returns to the farm. Net income was then derived, following a rough determination of production costs. Also, once market prices had been established for each crop and animal, valuable insights were gained by computing the gross value of the farm's produce. The results of this process were easily presented in a simple tabular format which permitted quick review. This format also facilitated the accommodation of other possible illustrative examples of the present farm system. Figure 6 shows how this was done.

The average farm as profiled in Figure 6 shows that the only crops of real significance in the project zone were varieties of bulrush (pearl) millet (Pennisetum typhoides) and cowpeas (Vigna unguiculata).1/ NDDP's almost exclusive focus on these two crops was therefore deemed appropriate. Other crops such as groundnuts (Arachis hypogea), roselle (Hisbiscus sabdariffa), bambara groundnuts (Voandzeia subterranea),

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1/Farmers often used several indigenous varieties of millet. NDDP promoted the use of improved varieties which had been developed in Niger. These varieties were names as follows: P_3 Kolo, CIVT, HPK and Ankoutes.

Figure 6: PRESENT FARM SYSTEM - OUTPUT MODEL FOR PROJECT ZONE (1979)*

(1) Principal Crops Raised	(2) % Farms	(3) Avg. Ha. or Head Per Farm	(4) Avg. Yield per ha. (kg)	(5) Total Produced Per Farm (kg)	(6) Consumed at Home (Kg or Head)	(7) Net Marketed (Kg or Head)	(8) Price[a] Kg/Head (CFA)	(9) Gross Cash Earned (CFA)	(10) Cash Costs (CFA)	(11) Net Cash Income (CFA)	(12) Value of Product (CFA)
1. Millet	100	4.8	283	1,358	1,223	135	40	5,400	2,200	3,200	54,320
2. Cowpeas	90	1.1	105	116	60	56	45	2,520	500	2,020	5,220
3. Sorghum	75	.02	255	5	5	0	30	0	—	—	150
4. Miscellaneous crops	70	.007	—	—	—	—	—	300	—	300	300
5. Sheep/Goats	70	6	—	—	1	3	4,000	12,000	500	11,500	24,000
6. Poultry	50	10	—	—	1	5	400	2,000	100	1,900	4,000
7. Donkeys/Horses/ or Camels	40	1	—	—	—	0	25,000	0	—	—	25,000
8. Cattle	40	2	—	—	—	1	25,000	25,000	1,000	24,000	50,000
9. Total	—	5.927 ha. (19 head)	—	1,479	1,288 kg (2 head)	191 kg (9 head)	—	47,220	4,300	42,920	162,990

*Derived from Republic of Niger, Ministry of Rural Development, Direction De L'Agriculture, Rapport Annuel - Statistiques, 1976 and M.G. Wentling, "Average Farm In the Project Zone", (Draft Paper submitted to USAID/Niger, December 19, 1978, Mimeographed).

a/ $1.00 U.S. = 210 CFA Francs.

cassava (Manihot esculentus), tiger nuts (Cyperus esculentus), okra (Hisbiscus esculentus) and sesame (Sesamum indicum), which are grown on less than 1% of the cultivated land in the zone, were considered to be of minor importance as far as NDDP was concerned.

It was, however, readily recognized that these minor crops were often an important source of income for women, and that they probably enhanced the nutritional value of the farm family's diet. It was also recognized that many wild plants were consumed. Of special interest were such wild greens as Cadaba farinosa, Salvadora persica, Maerua grassifolis and Ceratotheca sesamoides, which are often used to make a "sauce" which accompanies dishes made from millet flour (30, p. 159).

The 283 kgs/ha average yield listed in Figure 6 for millet compared favorably to the yield of 312 kgs/ha that the World Bank had cited at the time as an average millet yield for Niger (49, p. 30). It was thought that, given the lower productivity of the project zone, the difference between these two figures might be larger. This cross-checking with World Bank statistics is just one example of the many checks which were and should be applied to this kind of approach.

It had been observed that most farmers in the zone cultivate millet and cowpeas in association, therefore, for purposes of this exercise, NDDP managers arbitrarily separated the mixed cultivation of these two crops into pure-crop equivalents on an 80% millet to 20% cowpea basis. This separation was based on a rough estimation of traditional plant-spacing practices. It was noted, however, that the importance of cowpea yields is conditioned by whether or not farmers grow this crop mainly for its beans (black-eyed peas) or for fodder. The latter is fed to their own

livestock or readily sold at attractive prices at local markets or to passing travelers or merchants along the main roads.

A quick review of the eating habits of the 10-13 Nigeriens working for the NDDP management unit, along with information provided by the Ministry of Health, led to the conclusion that at least 80% of an average farm's surface would have to be devoted to millet if basic nutritional needs were to be satisfied. This review also led to the conclusion that the average farm family consumed 90% of its millet crop, the basic dietary staple, and only 10-15% of its cowpea crop (50, p. 5). This lower consumption level of cowpeas was considered plausible, given that it is primarily grown as a cash crop and that it is extremely difficult to store for a long period of time because of insect damage.1/ Also Nigeriens consider cowpeas to be an inferior food. This latter factor might be related to the reluctance to use scarce firewood in the long boiling process required to cook cowpeas. Also important was the ready, profitable market for cowpeas that existed as a result of the high demand for this staple in neighboring Nigeria, where it is a popular food among coastal peoples.2/

The consumption of millet was also correlated with nutritional needs as a means of providing another check on the reasonableness of the 90% millet-consumption level. Using this level of consumption and available

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1/Infestation by the destructive bruchid beetle, Callobruchus maculatus, makes the storage of cowpeas practically impossible under indigenous conditions.

2/The Nigerian cowpea deficit was estimated at 500,000 mt in 1980 whereas Niger's entire national production of cowpeas was around 300,000 mt (14, p. 5).

data, which indicated that average family size was near six people, it was calculated that 204 kgs per capita was consumed annually on the farm. At approximately 3,500 calories per kilogram of millet, this resulted in 1,956 available calories per person-day (51, p. 19). Given the results of a Ministry of Health study, which reported that millet/sorghum represent 80% of the average Nigerien diet, this amount of calories would appear to be minimally adequate even after making deductions for possible losses and grain used for seed (52, p.2). As an additional check, these annual per capita consumption figures were compared to FAO, World Bank, and Niger's estimates which were respectively, 190, 220, and 250 kgs for Niger's sedentary population (the GON uses a base of 200 kgs for its nomadic population) (49, p. 3). The higher requirement figures were probably related to the 2,640 calories per day that is believed to be needed by an active man doing light work (53, p. 57). Certainly, the World Bank's report that 220 kilos of millet provides 1,687 calories gives credence to this view (49, p. 30). The World Bank also reported that the average minimum daily calorie requirement per person in Niger was 2,350 calories (54, p. 168). Although these various millet consumption and calorie requirement figures were some cause for confusion, they did allow project managers to conclude that the use of its annual 204 kg per capita consumption rate for millet was reasonable, and, perhaps, more justifiable than any of the other figures in use at the time.1/

1/The use of millet and sorghum to make alcoholic beverages was never widely practiced in Niger because of the interdictions of the Islamic religion, and during the drought such use of cereals was made illegal. This is in stark contrast with neighboring Upper Volta, where it is estimated that one-half of the sorghum crop is made into local beer. It has, therefore, been concluded that animist families probably produce more than Moslem families because the making of alcoholic beverages requires that they consume more (55, p. 2). Contrarily, it has also been reported that animist families produce and consume more than Moslem families because they tend to be larger (32, p. 8).

It was assumed that the farm was marketing most of its produce shortly after harvest time; therefore, it was not necessary to account for storage losses. As studies have shown that storage losses in Niger's dry climate are very low (around 2-4%), it was not thought that this assumption made much difference (37, p. 2). It had also been frequently observed that many farms do sell the millet they have set aside for such a purpose immediately after the harvest period to satisfy their hard cash needs. Unfortunately, the early sale of millet at this time results in lower income and obliges many families to buy additional millet to meet consumption needs later in the year (when millet prices are usually several times higher) on the open market (56, p. 5; 57, p. 25). By multiplying the 135 kilos of millet marketed as shown in column 7 of Figure 6 times the approximately 50,000 farms in the zone, NDDP managers were able to estimate that about 7,500 tons of millet were being sold or exchanged in the zone each year. This is another example of the way in which this kind of analysis might be used.

The prices at which the farm sells its crops that are noted in column 8 of Figure 6 are based on official government prices, which usually averaged 15-25% less than the local harvest-time market prices (36 , pp. 25-27). It was believed that the use of these lower, conservative prices would help to avoid the disappointments which often occur in this type of analysis if prices are overestimated. If the cultivation of a particular crop could be profitable at these minimum prices, then there was a much better chance that the introduction of improvements in the cultivation of this crop would be adopted by farmers.

The cash costs involved in this type of mostly subsistence farming system are so minimal that for planning purposes they could have been neglected. NDDP managers decided, however, that some expense (2,700 CFA) was incurred by the farm in the purchase and maintenance of the two traditional hand implements (a long-handled, scraper-hoe called an "iler" and a longcutting-knife), which were used by all the farmers in the zone. Nothing was included under the cash-costs column tc cover the value of the farm family's own labor or the cost of hiring outside labor. NDDP managers believed that these costs remained more or less constant. Preliminary observations and discussion with others familiar with this subject indicated that the amount of non-family farm labor hired or received through communal labor-sharing arrangements was usually balanced by a nearly like amount of "hiring-out" or voluntary contributions of the farm's labor resources. In view of the seasonality of the labor requirements, NDDP managers also believed it was unlikely that farm-family members would forego the cultivation of their staple food during the growing season for unknown, short-term alternatives elsewhere. The labor model used in this analysis was therefore built around the full availability of farm-family labor for the duration of the short (4-5 month) growing season.

As it was believed that it would be difficult to raise successfully animals without having some recourse to Niger's well-established veterinary service, some costs were included for animal medicines. On the other hand, no costs were included for any crop inputs because, except for fungicides, their use was practically inexistant. With regards to fungicides, observations had indicated that they were popular but used

only by a minority of the farmers in the zone. The minimal cost of fungicides (30-60 CFA/ha) was, therefore, not included. Given their relatively low level of importance, the value of animal products such as eggs, milk, cheese, etc., were also not included.

It was also acknowledged that many farm-family members gained additional income from local artisanal and commercial activities, and from menial jobs they might find during their dry-season migration to other areas in Niger and to neighboring countries. However, income derived from such sources was excluded from consideration because sufficient information on off-farm incomes was not available. NDDP's 1978 socioeconomic survey of six villages did report that 28% of the 272 respondents did migrate during the dry-season, but surveyors were unable to determine the level of earnings of these migrants (42, p. 47).

Some indication of the importance of seasonal migration to the rural economy can be obtained by recording the amounts of money orders received at local post offices. For example, A. Sidikou reported that money orders totaling 23,736,467 CFA were received at Ouallam's post office in 1975 (30, p. 161). On a per capita distribution basis this sum represented 210 CFA per inhabitant living in the Ouallam district. For the six-member family farm postulated in Figure 6 this amounts to about 3.0% of net, on-farm cash income. NDDP managers were tempted to build this percentage of off-farm income into the farm model presented in Figure 6, but they did not believe this partial information on off-farm income for one year was sufficient basis for doing so. NDDP managers do recommend that, if possible, an estimate of off-farm incomes be included as, perhaps, a tenth

line addition to Figure 6.1/

Although this exclusion of off-farm incomes may be interpreted as a major deficiency of this approach, NDDP managers believed that it would not significantly change the results of this approach. This belief was based on the knowledge that dry-season activities did not conflict with on-farm work. In addition, it was believed that income derived from off-farm activities was only rarely invested in farming. This exlcusion of unpredictable off-farm incomes was, therefore, considered acceptable for the purposes of this preliminary QUAD analysis.

One thing that must constantly be kept in mind is that, for the purposes of this type of QUAD analysis, consideration of what a minority of farms do is excluded. This does not mean that the importance of the role played by outstanding, "innovative" farmers in promoting improved agricultural practices was ignored. On the contrary, NDDP managers believed that such farmers should be identified and that efforts should be made to involve them with the project's research and extension activities. Furthermore, it was believed that their involvement can be helpful in gauging the potential results of the adoption of the project's innovations by typical farms in the middle quintile group, which were the main focus of this analysis.

Another important observation produced by the analysis of Figure 6 was that the approximate $34.00 in net income per farm family member compared unfavorably with the $270 annual per capita income average quoted

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1/D. Norman reported in his 1966-67 study of three villages in the Zaria province of Northern Nigeria that 22% of the farm family's income was derived from off-farm employment (58, p. 335).

for Niger at the time (54, p. 134). This pointed out the all too well-known fact that national income statistics poorly reflect the standard of living of the rural population. A better picture of the farmer's well-being is more accurately reflected in the gross value of all farm products as shown in the last column of Figure 6. The total gross value of the average farm's product works out to a more favorable figure of about $125 per person.

The situation of the farm family looks even better when one considers that the urban dweller would have to pay much more than this amount to acquire the same products. In many respects, project managers believed that the farm family had a higher standard of living than many urban workers, who must use their minimum wage ($85 per month) to pay for food and many additional costs (e.g., rent, fireword) which living in the city entails. In fact, a comparison of millet prices and the GON's minimum wage for the years 1969 and 1979 showed that the minimum hourly wage purchased about the same amount of millet, 2.4 kgs, in both of these years. During this period the official millet price increased from 10 CFA to 40 CFA per kilogram while the official minimum wage went from 4,250 CFA to 17,180 CFA per month. If the more likely and higher, open-market cereal prices are used (official prices concerned less than 20% of the grain marketed in the zone), there is a further decline in the economic status of the minimal wage earner relative to the farmer (6; 59, p. 17).

Perhaps the most important insight to be gained from Figure 6 is the important role livestock played as the farm's major financial resource. It had often been observed by NDDP managers and others working in the zone

that in times of crop failure it was through the sale of livestock that the farm family usually acquired the funds to purchase the additional cereals it needed to survive. It was clear that without livestock many farm families would really be in a precarious position. This observation prompted managers to begin defining a farm's wealth according to the number and kinds of livestock it possessed. It, therefore, became evident that the poorest farmers in the project zone were usually those who did not possess any livestock. Furthermore, managers believed the viability of a farming enterprise in NDDP's marginal zone was greatly diminished by the absence of livestock. Managers were also convinced that this absence usually implied that the farm family's survival strategy involved a high dependence on non-agricultural, income-generating activities.

Given the importance of livestock as a key component of the average farm system, it would have normally been singled out for special treatment in this analysis. This was not the case, however, for several reasons. First, NDDP managers saw no reason to do an in-depth analysis of the livestock component because the project was not involved in introducing on a large scale any new livestock innovations. Secondly, given Niger's very low stage of agricultural development, it was not believed that significant improvements in livestock production could have been successfully introduced. Thirdly, managers were not aware of any proven techniques which could be readily and widely adopted by farmers to overcome the biggest obstacle to improving livestock production in the zone. This obstacle concerned the acute animal nutritional deficiencies which always occur in the dry season when the natural vegetation can no longer satisfy the maintenance needs of animals. Therefore, livestock elements which

are shown in Figure 6 were included only to give a more complete picture of what an average farm might be like.

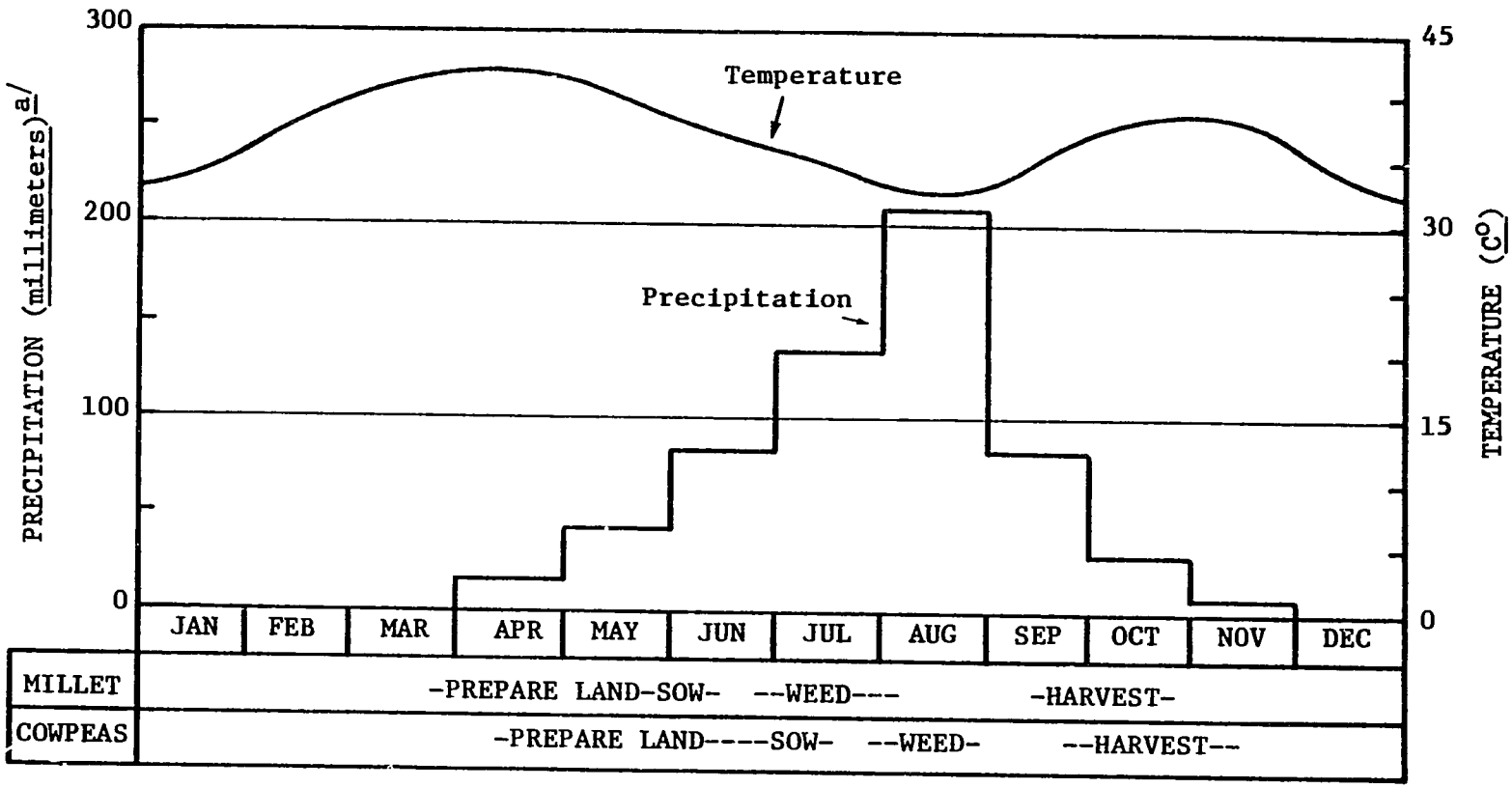
Step Three: Analyze Labor Requirements

Since available information and NDDP managers' own experience indicated that labor was probably the most critical input in the type of subsistence farming practiced in the zone, the farm family labor requirements were singled out for special analysis. It was decided that the first step of such a labor analysis would be to determine the key tasks which must be performed in the cultivation of major crops, and when they must be done in the agricultural season. This information, along with monthly rainfall and temperature data, is presented in Figure 7. 1/ This visual presentation and monthly breakdown of the agricultural calendar is a very useful start in the analysis of any cropping system.

It was then decided that the next step in this labor analysis would be to determine the size of the available work force. This was accomplished by breaking down the average farm-family size of six people into weighted, adult-male worker equivalents (AME's). This was done following a standard scale developed by M. Collinson and H. Ruthenberg and adapted by E. Kulp for use in East Africa, and by D. Norman and P. Matlon for use in Northern Nigeria. These four authors evaluated the approximate contributions of family members to agricultural work by their age and sex relative to healthy, adult males as follows:

1/Ideally, especially for an arid zone like NDDP, this generalized outline of the agricultural year would also show monthly evaporation and soil moisture storage data. Unfortunately, the author was unable to obtain such data for the NDDP zone.

FIGURE 7. NIAMEY, NIGER: 13°30'N, 2°4'E - 223 m
GENERALIZED OUTLINE OF THE AGRO-CLIMATIC YEAR



a/ Rainfall and Temperature Data are for the 1954-1973 period.

Source: Climatic data from L. Berry, "The Sahel: Climate and Soils," in The Sahel: Ecological Approaches to Land Use (The UNESCO Press, Paris, 1977). Cropping cycles from personal notes.

Author	5-9 years F/M	10-15 years F/M	16-60 years F/M	60 years plus
Rothenberg	0	.25/.25	.67/1.0	.5/.67
Kulp	0	.4/.5	.8/1.0	.5/.6
Norman	0	.5/.5	.75/1.0	.5/.5
Matlon	.25/.25	.5/.8	.6/1.0	—

As Matlon's data were based on his work with similar cropping systems, his AME work equivalents were used by NDDP managers; however, similar results could have been achieved by the judicious use of any of the other three author's values (58, p. 323; 60, p. xv; 61, p. 61; 62, p. 93).1/

Keeping in mind the average size of the land surface (6 hectares) cultivated by the farm family and that this size was often determined by the food needs of the farm family, NDDP managers determined that the average farm labor force most likely consisted of 2.65-3.35 AME's. This determination was reinforced by the project managers' personal knowledge of the structure of a number of farm families in the project zone.

A major variable in this AME-range is the amount of work performed by women. For those households which adhere strongly to the Moslem practice of requiring women to stay as much as possible within the walls of the household compound, it was believed that this amount would be very low. In view of this variable, it would have been useful to break down the labor contributions of family members by age and sex groups according to each agricultural task (e.g., how much labor do adult women contribute to

1/Matlon's Ph.D. work was only one of many relevant studies carried out under the auspices of Ahmadou Bello University's (Zaria, Nigeria) Institute of Agricultural Research (IAR) at Samaru, Nigeria. Of particular importance, is the pioneering work of Norman who spend over ten years studying farms in Northern Nigeria. (For a good review of the results of Norman's work see 58, pp. 320-347.) Unfortunately, NDDP managers did not have copies of IAR's many publications.

planting, weeding, etc.). In any event, project managers decided that for the purposes of this analysis the use of three AME's was acceptable. The acceptability of this work force level was further enhanced by Kulp's observation that throughout the world most subsistence or semi-subsistence farms will have from two to three AME's, and by the observation of NDDP managers that many farms in the zone had a AME for about every two hectares of cultivated land (44, p. 4; 58, pp. 60-61).

In their labor analysis NDDP managers focussed on essential crops and the critical labor operations involved in their cultivation. In view of the short growing season, this meant that they only needed to focus on critical labor operations which could not be postponed for more than a week or two without causing serious crop losses, and those which occupied the available work force of three AME's for a full work day of 5 or 6 hours of activity. Following Kulp's guidelines, it was also assumed that it would not be realistic to expect more than twenty full work days per month per AME on a consistent basis.1/ Also, for purposes of this preliminary labor analysis, the simplifying, but necessary, assumption was made that the hypothetical average farm received sufficient, evenly distributed rainfall amounts.

Once the above ground rules were established, NDDP managers proceeded to separate work tasks by crop according to the agricultural calendar and

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1/By international standards this 100-120 AME hours per month and NDDP's resulting annual labor input of 842 hours per AME is a very low. In Egypt and many Asian countries 2,500-3,000 hours per year have been reported. A review by R. Cleave of 50 farm-level surveys conducted in sub-Saharan revealed that male adults worked an average of 1,000 hours per year. Norman's work in Northern Nigeria showed adults males spending as little as 500-600 hours per year on farming activities. The causes and remedies of this low labor input, and the low productivity of African labor in general, are priority areas of research (63, pp. 99-108; 64, p. IX-32).

to assign each task an AME labor value. This exercise provided information that was easily assembled into a tabular format. Figure 8 shows the type of tabular format used by managers to illustrate a possible labor input model of the average farm in the project zone. Labor values used for each work task in this model were based on the practical experience of NDDP managers and by using for each task labor time requirements reported in standard references (29, pp. 347-8; 65, pp. 173-8). Confidence in the accuracy of resulting labor times was later bolstered by a comparison with the findings of detailed studies done elsewhere in Niger and in Northern Nigeria (15, pp. 22-32; 58, p. 323; 66, p. 1).

Presenting the data as shown in Figure 8 vividly communicated that throughout the peak agricultural work season the estimated maximum number of 60 AME's available per month is equalled or exceeded, while during the off season, December through March, practically no work is done. There was no doubt therefore that the average farm was making maximum use during the peak season of its labor force of about three AME's. The results of this analysis therefore only served to confirm what was already well known by farmers and those with experience in the project zone and neighboring areas: that a tremendous labor bottleneck exists during the peak work months of the growing season. It was also apparent that the severity of this bottleneck was inversely proportional to the length of the growing season. The large number of unweeded fields during the month of July provided ample evidence of the importance of this bottleneck.1/

1/The existance of a seasonal labor bottleneck throughout the semi-arid savanna regions of West Africa has been amply documented over the past 20 years by the execution of many empirical studies. Norman's work in Northern Nigeria represents the most comprehensive coverage of this bottleneck. For review of work on this important subject see Norman (58), Derek Byerlee (67) and Carl Eicher and Doyle Baker (63).

Figure 8. PRESENT FARM SYSTEM – LABOR INPUT MODEL (1978)*

(LABOR REQUIREMENTS FOR MAJOR FARM OPERATIONS ON MONTHLY, PER CROP BASIS) a/

Labor Inputs (AMD) b/ / Crops/Ha	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	AMD's Total	AMD's Per Ha.	AMD's % of Total
Millet 4.8	0	0	0	P-50	P-59	P-25 S-30	T-5 W_1-55	W_2-45	H-55	H-55	F-50	0	429	89.4	84.95
Cowpeas 1.1	0	0		P-10	P-10	P-10	P-10	T-2 W_1-15	W_2-5	H-55	H-5	F-6	73	66.4	14.46
Sorghum 0.2	0	0		—	—	—	—	—	—	—	—	0	3	—	0.59
Totals 5.92 Ha.	0	0		60	69	65	65	62	60	60	55	6	505	—	100%

*Labor times are rough estimates derived from field observations and T.A. Phillips, An Agricultural Notebook (Ikeja, Nigeria, 1966) and France, Ministere De La Cooperation, Memento de L'Agronome (Paris, 1974).

a/ Code for Labor operations:
P = land preparations; S = sowing; T = thinning; W_1 = 1st weeding; W_2 = second weeding; H = harvesting; F = finishing (thresh, sort, dry, store)

b/ AMD = Adulst-Male Day Equivalents

It was obvious to NDDP managers that the labor bottleneck posed severe constraints to increasing farm output. These constraints prevented the farm family from cultivating in an optimum manner the average farm size of six hectares and from increasing the surface cultivated. This meant, particularly under good growing conditions, that farmers were usually obliged to skimp on such key labor operations as preparing fields for planting and weeding. This results in lower yields which, along with the many risks associated with the uncertainty of farming in the area, further encouraged farmers to try to compensate for its losses by sowing even larger areas.1/ This strategy for minimizing risks makes it difficult to convince farmers that they could obtain greater yields by cultivating more intensely smaller areas. The promotion of more intensified farming was considered a necessary step in resolving this "low productivity trap". Intensification would also allow more land to recuperate by laying fallow for longer periods. The shortening of the amount of time land was left fallow was a major contributor to the reported decline in yields that NDDP aimed to remedy.

Another important repercussion of this labor bottleneck was that farm laborers became so scarce during the peak farming months that the cost of hiring extra laborers was prohibitive. During the 1978 growing season an adult-male farm laborer cost nearly 600-750 CFA per day (about $3.75) and, in addition to this cash cost, the employer usually had to provide food and lodging (68, p. 2). These costs were equal or higher than the legal minimum wage. These high labor costs have permitted only the richest

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1/It might be concluded from this that it is the over-sowing of crops which results in the labor bottleneck. In other words, the labor bottleneck is relative to the amount of land a farm family could farm well but cannot do so because of a lack of labor.

Nigeriens to hire farm laborers. NDDP managers frequently heard salaried employees and other members of the non-farm population complain that it was the high cost and/or the scarcity of laborers that kept them from cultivating their farm lands.

Although these high labor costs should be kept in mind when placing a value on the time the farm family spends working on its fields, NDDP managers did not think they could be used as opportunity costs. This belief was based on the observation that few farmers would give up completely the cultivation of their own millet fields for the cash wage which might be received from cultivating someone else's fields. The often high cost and seasonal scarcity of millet, and the difficulties of transporting it from market to home made producing millet preferable to relying on purchased millet. The above did demonstrate, however, that one good measure of possible labor constraint problems was the cost and availability of farm labor during the peak agricultural work months.

NDDP managers willingly conceded that the labor data presented in Figure 8 were not based on solid evidence but, at the same time, they concluded that for project planning purposes more precise data were not needed. Even with a large error in the labor input calculations and the omission of such labor factors as tending livestock and walking to and from fields (considered minimal in the project zone), NDDP managers believed that the project's needs as far as labor data were concerned were sufficiently fulfilled by knowing that the average farm was making maximum use of its labor force. Furthermore, previous experience elsewhere had shown NDDP managers that detailed labor studies are so fraught with measuring difficulties that their results are loaded with caveats regarding an almost infinite number of possible variations.

Some of these variations relate to the following: differences in individual farmer experience, motivation and managerial ability; the urgency or pleasantness of a given task; the changing of the pace of work according to such conditions as air temperature and humidity; alternative leisure and holiday activities, and the exchanging of work roles among the sexes, adults and children (e.g., an adult male may do tasks such as scaring birds that a child could do equally well). In addition to these complex variations, the energy (calories) an individual may expend for a specific task on any given day is unknown. The large variations in individual physiological capacities for controlling appetite and energy losses make it almost impossible to relate energy expenditures and a fixed amount of food intake to a given work task (69, pp. 23-27). With regards to food intake, the observations of farmers working during times of food shortages indicated to NDDP managers that low levels of food intake do not necessarily result in low levels of work output.

In view of the above, NDDP managers concluded that as long as the project was not introducing "yield-raisers" which did not require additional labor inputs more precise labor data were not really needed. This conclusion was further supported by the belief that in actual practice the effective contribution of the three AME work force was likely much less than the assumed maximum. Illnesses, hungry-season stress, the uneven participation of women and the failure of migrant family members to return from their seasonal exodus contributed strongly to this belief. These factors further underscored NDDP's need to orient its interventions around a labor model where no slack time existed during the peak work months. These findings also made it clear that, even if some new pro-

duction alternatives were discovered, the labor bottleneck would not allow much room, if any, for trade-offs.

Step Four: Evaluate the Impact of Improved Practices

The previous steps concerned methods of analyzing existing farm practices and some of the problems involved with the successful execution of these practices. The main object of these previous steps was to give managers a firmer grasp of what the current farm situation was like so they could better gauge the impact of the improved practices NDDP had been designed to introduce. A summary description of these improved practices and the traditional farming practices they were to replace or complement is presented in Figure 9. The improved millet practices were based on the results of many years of research by Niger's national agricultural research institute (INRAN-Institut National des Recherches Agronomique du Niger) and its predecessor, French-run institute IRAT (Institute des Recherches Agronomiques Tropicales). The improved practices for cowpea cultivation were based on local tests by INRAN of improved seed varieties (e.g., TN-4-69 and TN-88-63) provided by the International Institute of Tropical Agriculture (IITA) located in Ibadan, Nigeria.

The fourth step concerns an attempt to evaluate the potential impact on the average farm of adopting the improved practices briefly summarized in Figure 9. This evaluation primarily involved adding the costs and substituting the expected yields for the basic set of improved practices for the costs and yields presented for the unimproved farm model in Figure 6. The additional costs for the improved practices were 3,672 CFA/ha for millet and 4,703 CFA/ha for cowpeas. These costs were based on the information presented in Figure 10.

Figure 9. Summary of Traditional and Improved Practices for Millet and Cowpeas

Basic Practices	Millet		Cowpeas	
	Traditional	Improved	Traditional	Improved
1. Seed Variety Selection	Farmer produces and/or obtains native seed considered best suited to local conditions.	New varieties, CIVT or HPK for Northern parts of zone.	Locally grown, low-yielding seeds.	New variety, TN88-63.
2. Seed Treatment	Variable, depends on local availability of fungicides	New varieties are treated with fungicides before distribution.	Usually none, depends on local availability of fungicide.	New varieties treated with fungicide before distribution.
3. Soil Preparation	Minimal clearing of overgrowth but dry hoeing before rains not usually done.	Dry hoeing immediately prior to rainy season.	Minimal clearing of land, no dry hoeing.	Dry hoeing immediately prior to rainy season and hoeing at planting time.
4. Seeding Rates (varies according to number of seeds per pocket, density and seed purity)	10-12 Kgs/Ha	8-10 Kgs/Ha	20-30 Kgs/Ha	15-25 Kg/Ha
5. Planting Dates	Variable, often according to moon cycles; usually done after first rain.	After first rain of least 10 mm or plant dry after June 15.	Variable, after first successful planting of millet or after failure of millet due to drought.	After sucund rain of at least 10 mm.
6. Spacing/Plant Density	Variable spacing, around 2x1 meters with cowpeas or other crop frequently interplanted. Usually 2-5,000 stands/Ha.	Sole crop. Use of row marking device to achieve optimum 1m x 1m spacing and a density of 10,000 stands/hectare.	Variable spacing, around 2x1 meters if sole cropped but wider if intercropped. Usually 2-5,000 stands/Ha.	Sole crop. Use of row-marking device to achieve optimum 30cm x 60cm spacing and a density of 57,000 stands/hectare.
7. Cultivation (weeding)	Variable but often only 2 cultivations done, one about 15 days after planting and the second 2 weeks later. Depends greatly on rainfall amounts and labor availability.	3 cultivations: 1st 8-10 days after planting; 2nd 10-15 days after 1st cultivation; 3rd 10-15 days after 2nd cultivation.	Minimal, varies according to cropping pattern, rainfall, if grown for forage or beans, and if conflicts with other work.	2 cultivations: 1st 15 days after seeding; 2nd 3 weeks after first cultivation.
8. Thinning	Seldom done, often 3-6 plants per pocket.	Thin to 3 plants per pocket approximately 21 days after first rains.	Seldom done, often many plants per pocket.	Thin to 3 plants per pocket between 1st and 2nd weeding.
9. Fertilization	Usually none. Some farmers spread manure or arrange with pastoralists to keep livestock on fields during part of dry season.	Manure or compost (when available): 6mt/Ha spread prior to dry hoeing; or broadcast 34 kilos of triple superphosphate prior to hoeing and 2 applications of 25 kilos each of urea, banded around seed pockets, at the time of 2nd and 3rd weedings.	Rarely done.	Broadcast 34 Kg/Ha of triple superphosphate at the time of dry hoeing or immediately prior to planting.
10. Insecticide applications	Rarely done. Indigenous materials (e.g. fires, ashes) sometimes used.	As needed and feasible.	Rarely done; especially if grown for forage.	2 sprayings required. (1 at flowering and 1 at post-flowering stage) to achieve acceptable bean harvest.
11. Rotation	Seldom done, but intercropping and swidden agriculture widely practices.	Depending on land availability and farmer needs, 1:1 or 1:2 millet-cowpeas rotation.	Seldom done, but inter-cropping and swidden agriculture widely practiced.	To maximum extent possible, farmer encouraged to rotate with millet/sorghum crop.
12. Animal Traction	None.	Optional.—Basic implements for donkey traction for farms over 3 ha. and oxen traction for farms over 6 ha. in higher rainfall zones.	None.	Optional. Same recommendation as for millet.
13. Harvest/Storage	Heads cut from stalks, tied into 25-30 kgs. bundles and placed in mud silo covered with straw thatch.	None recommended.	Little which is stored is consumed rapidly due to high risk of damage by insects.	Storage in 100 kilo tightly sealed jute sacks with plastic liner and one tablet of phostoxin per sack.

Source: USAID, Niamey Department Development Project Paper - Phase II (Niamey, Niger, Vol. II, Annex Q, April 28, 1981) and N. G. Wentling (field notes, Niamey, Niger, July 6, 1981).

Figure 10. Costs for Basic Set of Improved Practices

	Inputs	Required Quantity/Ha	Unit Cost a/ Subsidized	Cost/Ha
MILLET	TSP (46% P_2O_5)	34 kgs	30	1,020
	Urea (45% N)	50 kgs	35	1,750
	Seeds	10 kgs	60	600
	Fungicide	1 (25 gm packet)	30	30
	Interest (8%)	—	—	272
	TOTAL			3,672
COWPEAS	TSP (46% P_2O_5)	50 kgs	30	1,500
	Seeds	25 kgs	65	1,625
	Fungicide	1 (25 gm packet)	30	30
	Insecticide	2 liters	600	1,200
	Interest (8%)			348
	TOTAL			4,703

a/All cost in CFA francs, ($1.00 US - 210 CFA).

Source: J.H. Mullenax, "Are the Technical Packages Profitable" (USAID/Niamey, June 19, 1979, mimeographed).

The results of this simple substitution procedure are presented in Figure 11. The improved model presented in Figure 11 was selected by project managers from among other possible versions as the most realistic one. It was expected that this model would be the object of ongoing modification according to the receipt of new information and actual project experience. The major thrust of models of this sort should always be to illustrate how an individual farm can, with minimal risk and a high level of certainty, maximize its productivity and, accordingly, its income.

A comparison of the yield columns (No. 3) in the improved model presented in Figure 11 with the present farm model shown in Figure 6 provides the basis for analyzing the potential impact of NDDP's improved production model. Such a comparison shows that managers estimated that average millet yields would increase from 283 to 600 kgs, and that average cowpea yields would increase from 105 to 500 kgs. Given that these new yield figures were one-half or less than those that had been regularly achieved under good rainfall conditions by farmers on demonstration fields supervised by extension personnel, NDDP managers believed them to be low estimates of possible yield increases. Such conservative estimates were used because managers thought it best, for planning purposes, to underestimate yield potential than to overestimate it.1/ It was also believed that such increases must be achieved if the farmer was to be convinced of the advantages of the improved practices.

NDDP managers were impressed by the possible impact that this doubling of millet yields and a five-times increase in cowpea yields could

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1/It is interesting to note the M. Jones and A. Wild's work in Northern Nigeria indicates that the optimal yield for millet was probably five times current traditional yields (70, p.158).

Figure 11: IMPACT OF IMPROVED PRODUCTION MODEL ON PRESENT FARM SYSTEM - 1979*

(1) Principal Crops Raised	(2) % Farms	(3) Avg. Ha. or Head Per Farm	(4) Avg. Yield per ha. (kg)	(5) Total Produced Per Farm (kg)	(6) Consumed at Home (Kg or Head)	(7) Net Marketed (Kg or Head)	(8) Price[a] Kg/Head (CFA)	(9) Gross Cash Earned (CFA)	(10) Cash Costs (CFA)	(11) Net Cash Income (CFA)	(12) Value of Product (CFA)
1. Millet	100	4.8	600	2,880	1,223	1,657	40	66,280	19,826	46,454	115,200
2. Cowpeas	90	1.1	500	550	60	490	45	22,050	5,673	16,377	22,500
3. Sorghum	75	.02	255	5	5	0	30	—	0	0	150
4. Miscellaneous crops	70	.007	—	—	—	—	—	300	—	300	3,000
5. Sheep/Goats	70	6	—	—	1	3	4,000	12,000	500	11,500	24,000
6. Poultry	50	10	—	—	1	5	400	2,000	100	1,900	4,000
7. Donkeys/Horses/ or Camels	40	1	—	—	—	0	25,000	0	—	—	25,000
8. Cattle	40	2	—	—	—	1	25,000	25,000	1,000	24,000	50,000
9. Total	—	5.927 ha. (19 head)	—	3,443	1,288 kg (2 head)	2,147 kg (9 head)	—	125,630	27,099	100,531	244,170

*Derived from Republic of Niger, Ministry of Rural Development, Direction De L'Agriculture, Rapport Annuel - Statistiques, 1976 and M.G. Wentling, "Average Farm In the Project Zone" (Draft paper submitted to USAID/Niger, December 19, 1978, mimeographed).

a/ $1.00 U.S. = 210 CFA Francs.

have. Indeed, it was calculated that, if this higher level of millet yield could be achieved by 50% of the farms in the project zone, the additional production in the zone would be near 40,000 mt. Such a large increase in production would be more than enough to cover all of Niger's 1978 cereals deficit and, at official prices, this increase would be worth about $7,600,000 or about 50 percent more than USAID's total life-of-project contribution of $4,698,000 (71, p. 16). These impressive amounts prompted managers to wonder if their low estimates of yield increases were not really as low as they thought them to be. It was believed that reducing these already very low esimtates would make the use of improved practices uneconomical for the individual farm.

The impact of such production increases on individual farm income was no less spectacular. Farm income would increase by 134% per farm member, net income would more than double, and the gross value of the farm's crops and animals would increase by almost 50%. Of course, increases in income would probably be less than this because market prices would decrease and farm families would eat and store more of their extra production.1/ If such factors are significant, additional versions of Figure 11 should be constructed to account for them.

It is important to note that farm families would usually not feel secure until they had sufficient cereals stored to cover their needs for two to three years. This meant in most instances that sales of cereals would be limited and very non-reactive to price changes until the farm's efficient, mud-walled, thatch-topped granaries were full. As the male head of household was usually the only one

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1/In view of the practically inexhaustible market in Nigeria for Nigerien farm produce, it is not believed that market prices would drop.

permitted to see inside the farm's granaries, making an estimate of the amount of grain stored had to depend on indirect means. For example, the noting of the number, size and state of repair of a farm's granaries. Also, as farmers in the zone often equated their "happiness" with full granaries, an indication of the content of granaries was frequently, but indirectly, revealed in conversations with farmers (37, p. 6).

At this point NDDP managers began asking fundamental questions about what the farm family might do with the additional income they would derive from the adoption of the improved practices. Experience indicated that almost all this additional income would be controlled by the male head of household and that he would likely spend it for such conspicuous consumption items as dowry payments for an additional wife, baptisms, a horse (a high prestige item), fine clothes, a transistor radio, jewelry for wives, travel to Mecca, etc. (42, p. 40).1/ This predicted consumption pattern, coupled with the frequent refrain heard among farmers that one of their biggest needs was for retail stores at the village level, led managers to believe that the creation of such consumer goods stores would provide an additional incentive to farmers to increase their production.

In the belief that it was the goods money could buy and not money itself that was the major incentive, NDDP managers went as far as to recommend that the sale of consumer goods be included as one of the functions of the farm credit and marketing cooperatives that the project was trying to establish throughout the zone. Some members of the GON and USAID had difficulty agreeing with this recommendation because they were unwilling to accept that the development process could be condensed to

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1/Securing an additional wife could be interpreted, at least in part, as an investment in agriculture.

countertop transactions involving the sale of such popular items as cheap Chinese clocks and Japanese transistor radios. Whatever the case may prove to be, managers were sufficiently persuaded by their observations to conclude that the increased acquisition of material possessions was indeed a major element of the development process as far as the farmer was concerned.1/

It was hoped, however, that once the farmer had satisfied his initial material wants that he would then begin to invest his additional income in the improvement of family farm land and livestock, and/or the education of his children. However, it was not thought that investments in farmland improvements would occur to any significant degree until the practice of communal land distribution was replaced by one that gave clear title and permanent rights over a parcel of land to the farmer who cultivates it. It was also thought, in view of the absence of off-farm job opportunities and the need for child labor on the farm, that farmers would be very reluctant to invest further in their children's education. Certainly, there was no doubt that if the children were not available to do such tasks as scaring away birds at harvest time, collecting firewood and water, tending livestock, caring for infants, etc. that the productivity of the farm would be reduced. Also, children who attend school almost never return to the farm.2/

1/It is expected that if incomes did rise as dramatically as depicted in Figure 11 traders and goods would be attracted to the area in greater numbers.

2/School-leavers, and even students who have successfully completed their studies, usually become members of the unemployed in urban areas. This is especially so in Niger, where only 60,158 salaried employees were reported in 1978. This represented less than 5% of the population over 15 years of age (72, p. 4).

Step Five: Identify and Appraise Major Constraints

NDDP managers were all too painfully aware that if the heartening "improved" production model presented in Figure 11 was to become representative of a significant number of farms in the project zone, many constraints would have to be overcome. Primary among these constraints were the labor bottleneck (already identified under Step Three) and the unreliable availability, costliness and appropriateness of the agricultural inputs required for the execution of the improved practices. The purpose of this step is therefore to describe these constraints as they related to the project and to see how they might be overcome. In essence, the job of NDDP, or any other agricultural development project, was and continues to be the alleviation of such constraints on increased productivity.

Labor Bottleneck: Implications and Possible Solutions

In view of the results of the labor analysis (step 3), which strongly indicated that farm-family labor was fully absorbed during critical periods of the agricultural season, a major question facing managers was: Do the innovations being introduced by the NDDP require significant amounts of additional labor? The response to this was that if the aim is to have farmers cultivate more intensely smaller areas, it was then unlikely the innovations would require additional labor; however, if the intention is for the farm family to cultivate the same six hectares or more, then it was believed that following project recommendations would require additional labor. This increase in labor requirements would come about because the proper execution of the improved practices would require

that the farm family spend more time and care on land preparation, spacing and weeding operations.

Indeed, INRAN had reported that the application of improved millet practices would require 12-21 percent more labor time per hectare than the use of traditional practices (73, p. 12-13; 15, p. 30). The upshot of all this was that the use of improved practices meant that the farm family would be obliged to cultivate a smaller surface; therefore, if the farm family was to be persuaded to adopt these practices, it must be confident of achieving yields higher than those shown in the improved production model (Figure 11). The profound ramifications of this conclusion naturally had project managers searching for answers to the next big question: How can this labor bottleneck be broken?

The textbook answers to the question offered no relief. Irrigation would help distribute labor requirements more evenly through the year; unfortunately, there is almost no potential for the widespread practice of irrigated agriculture in the zone. Even for the limited irrigated-gardening possibilities which do exist, the traditional disdain by many people for this kind of work and the custom of doing agricultural work only a few months of the year, make it hard to gain acceptance of the year-around demands of irrigated agriculture. Also, it was suspected that for many farmers the income and adventure offered by off-farm work during the dry season made irrigated agriculture less attractive.

New crop varieties with shorter growing periods, more drought resistance, etc., would make the scheduling of labor requirements more flexible; however, there are no major breakthroughs in the offing here. Some imported, short-statured varieties of millet have performed well, but the

farmers' need for the stalks produced by the long-stemmed, traditional varieties made these short varieties unacceptable. Some local African varieties like "Ankoutes" have also produced well in the zone, but its very short heads are not liked by farmers because they cannot be tied into easy to carry and to store bundles. The latter also upsets the traditional manner of calculating yields on a "per-bundle" basis.

Mechanization comes readily to mind as one way of breaking the labor bottleneck. Small tractors have been used with some success in other countries but, given, inter alia, that Niger has almost no capacity to maintain such vehicles, their introduction would be practically useless. Also, agricultural productivity in Niger is such that sufficient surpluses are not available to pay for the use of tractors. (Others have argued, however, that you cannot create surpluses without first resorting to mechanization.)1/

One of the major problems with the use of tractors in such arid zones is that the short growing season limits the number of farms which can use a tractor cooperatively, even if farmer groups could decide to make their fields more amenable to mechanization by consolidating their usually fragmented fields into large blocks of land. Such a permanent consolidation of land would require a profound reform in the current land tenure system and a transformation of the communal social organization it reflects.

The obvious pitfalls of introducing mechanization in an area like the project zone gave NDDP managers further incentive to look more closely at

1/Some authorities also claim that the use of tractors in such an arid zone would be detrimental to the fragile soils of the zone.

the use of animal power as a means of reducing labor constraints. One of the major thrusts of the project was indeed to promote the use of donkey and oxen traction; therefore, managers were sorely disappointed when preliminary results indicated that the use of appropriate animal-drawn implements seldom reduced the labor time requirements and, at times, even increased overall labor requirements.

In general, labor economies were not achieved by the use of animal traction because it was difficult to use animals in such high labor-consuming operations as weeding. If they were used, two or three farmers had to accompany the animals and the implements they pulled in order to prevent damage to crop plants.1/ Added to the time-consuming care with which animal traction operations must be carried out was the limit to the amount of land and times an animal can work. A healthy, mature bullock cannot usually work more than 6 hours per day while donkeys are limited to working three to four hours per day (29, p. 364). This means, according to M. Benoit-Catlin's work in the Sahel, that the maximum surfaces which can be worked by draft animals are as follows: donkey - 2.5 ha.; a pair of bullocks - 3-6 ha (depending on age); a pair of oxen - 4 ha; and a pair of strong bullocks - 8 ha (75, p. 219).

As with tractors, optimum benefits can be derived from animal traction under such dryland farming conditions only if it is performed on relatively large tracts of land and it is used for most labor operations,

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1/Experience elsewhere in West Africa has shown that weeding can be performed three to four times faster with animal traction than by hand (76, p. 64-68). Despite this added efficiency, M. Sargent, et al. estimated that less than one-fourth of animal traction users in West Africa use weeding implements (77, p. 17). (Sargent et al. provide an excellent survey of the past and present problems facing the introduction of animal traction into West Africa.)

especially weeding. Of course, this implies an extensification of agriculture, versus the desired intensification of cropping practices. This creates new labor bottlenecks by shifting labor demands to other tasks that are not usually addressed by animal traction (e.g., weeding, harvesting).1/ It was therefore concluded that as long as Nigerien farmers continue to cultivate low-yielding crops on farm small, widely dispersed fields, successful animal traction operations should not be expected even if Niger is eventually able to develop an economical and efficient system of producing and maintaining well-designed animal traction implements.

Other factors which weighed heavily against the use of animal traction included its high cost relative to average farm income and the long learning process involved with the adoption of animal traction by farmers. The cost of oxen and basic implements was about four times greater than estimated annual farm income, and the implements were often of no more use by the time the farmer had the three to four seasons of practice needed to fully pay for and use this revolutionary means of cultivating. These

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1/It was, however, not considered realistic to expect farmers to change from the often more economic extensive practices to more intensive ones. History has shown in Africa and elsewhere in the world that farmers generally will not adopt intensive practices until required to do so. This obligation to convert to intensive practices usually occurs when population densities reach near 100 persons/km^2. At current population growth rates it will take over 300 years to reach this density in the project zone. It is, however, expected that at the current rate of ecological degradation in the zone that it would never be able to support such a population level. In this regard, instructive lessons might be learned by observing how farmers have coped in higher population density areas such as the Matameye district which has Niger's highest rural population density of 54 persons/km^2, and in the neighboring Hausaland area of Kano State in Northern Nigeria which had an estimated population density of 115 persons/km^2 in 1981 (33, p. 75; 74, p. 20).

problems were exacerbated by the long dry season which entailed extra expense and labor to maintain the oxen, which often required re-training after such a long period of not working. This also often meant that oxen were underweight and weak at the start of the rainy season when work demands on them were the highest. This further increased the probability that many fields could not be worked by oxen until the first rains had softened them up. This in turn meant a delay in planting, and consequently, resulted in, among other things, a loss to initial plant growth of the accelerated release of nitrogen (Birch effect) which occurs when very dry soils are first wetted.1/ Also, in view of the short season, late planting can often be a major contributor to low yields.

The risks and costs involved with the use of animal traction indicate that its use best be limited at this stage to those farmers in higher rainfall zones (> 600 mm) with access to larger, easily cultivable land surfaces (>6 hectares) and other income sources. These farmers would normally also be those who want to concentrate on the production of cash crops like groundnuts, cotton or cowpeas. (It makes little sense to invest so heavily in the animal-powered cultivation of subsistence, non-income generating crops). Of course, one inherent problem in following such a guideline is that such higher rainfall areas are infested by the vectors which transmit such diseases as trypanosomiasis (sleeping sickness) and onchocerciasis (river blindness). And, if these kind of disease problems are absent, these areas are often densely populated, resulting in

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1/Weakened oxen, or access to smaller animals (e.g., donkeys) also means that the benefits of the "deep-plowing" recommended for such sandy, arid soils by such eminent authorities as C. Charreau cannot be executed (78, pp. 316-323). These benefits include: higher soil-moisture retention; increased micro-biological activity in the soil; easier and fewer weedings.

a lower land per person ratio. Such high rainfall areas are also covered with a more dense natural vegetative growth which makes the use of animal traction extremely onerous during the initial years of clearing and working new fields.

In brief, animal traction is probably for the richer farmers who can easily afford the many risks associated with its adoption. It is therefore believed that those who continue to promote the use of animal traction among farmers cultivating primarily subsistence crops should be prepared to provide them with an insurance policy to cover the risks involved. This could take the form of a contract which guarantees the farmer who faithfully attempts to employ animal traction and associated recommended practices a specified level of income and/or amount of grain.

The use of herbicides can greatly reduce or eliminate altogether the time required for crucial weeding operations, and their use in the United State has been one of the major factors behind the production of super-abundant harvests of grain in that country. Unfortunately, herbicides are unavailable in Niger and their importation and use would probably entail a prohibitive expense. In addition, their use would raise difficult to resolve environmental concerns. NDDP managers were therefore obliged to discount this as a practical means of reducing labor constrants. They did, however, strongly recommend that the use of herbicides be further explored. Indeed, it was thought that, in view of the weeding bottleneck, the development and use of a safe, economical herbicide might by itself increase productivity more than the use of any of the other chemical products (e.g., fertilizer, pesticides). Even now, herbicide use is cheaper and more efficient than the use of oxen for weeding. Herbicides kill

weeds between and within rows while oxen can only weed between rows. Another advantage of herbicides is that they are more scale-neutral than the use of oxen.

Like other possible innovations, a major stumbling block to the use of herbicides is the farmer's practice of intercropping two or more crops. Of course, among the farmer's reasons for practicing such a system is to minimize labor demands. For instance, the planting of cowpeas between millet plants can reduce the labor time required for weeding. This millet-cowpea combination usually does, however, reduce overall yields, but, even so, it may also result in greater returns per AME (58, p. 338).

This reflection on the problems of using herbicides on polycropped fields persuaded NDDP managers that they needed to know better how widespread intercropping was, why the farmers praticed it and what were the advantages and disadvantages (economical, agronomic, nutritional, etc.) of changing to the sole-cropping practices recommended by the project. The knowledge that labor, not land, was a major constraint also led to the conclusion that farmers were more interested in increasing returns per unit of labor, especially in peak labor weeks, than in increasing production per unit of land. This conclusion further underscored the need for project innovations to "fit" within the farm's available labor supply.

Another possible, but unlikely prospect, for reducing the labor bottleneck would be the introduction of new crops whose cultivation requirements could be satisfied during the idle farming months (December-March). Given the almost total absence of precipitation during this

period and the absence of stored soil moisture, it is an almost impossible task to find a crop which could survive during this period. NDDP managers did suggest, however, that over the long term the jojoba plant, which can thrive under such arid conditions, might be an ideal addition to the current farm system (79, p. 1-4; 80, pp. 361-370). The addition of jojoba (Simmondsia chinensis), or some other fiber or oil-producing commercial crop which could be worked on in the dry season, would nicely balance the calories provided by millet and the protein provided by cowpeas.

In this regard, it was thought that the project should do more to encourage the expanded use of revenue-producing trees such as the Gum Arabic (Acacia senegal). This tree has long been a key component of many of the traditional agro-sylvo-pastoral systems in Niger and elsewhere in the Sahel (23, p. 1). It was thought that more work on indigenous crops like bambara groundnuts and tiger nuts might be worthwhile. (The former yields as well or better than groundnuts, and the latter is often one of the few foods available during times of drought.) In any event, the introduction of new crops into the zone cannot be expected in the foreseeable future. Little or no research is being done on indigenous crops, other than the major staples (millet, sorghum, cowpeas); therefore there is little hope for the improvement of minor crops.

Another possible avenue for alleviating the labor bottleneck would be to reduce the efforts demanded by such competing, non-cultivation tasks as hauling water and firewood, food preparation and processing, etc. Such tasks are, however, usually among the heavy domestic burdens of women, who, except for assisting with planting and harvesting, often do not

participate in the cultivation of major food staples. It would be a major breakthrough if some way could be found to increase the participation of women in critical labor bottleneck tasks such as the weeding of major staple crops. Of course, if women did begin contributing to such weeding tasks, this would detract from the important household functions they perform. In addition to those already mentioned, these include: child-rearing duties; making and selling crafts; tending small livestock and garden plots; petty trade and marketing.

NDDP did experiment with the introduction of diesel-powered, grain-grinding mills as a means of relieving some of the burdens placed on women so they could devote more time to more productive activities. The problems of keeping these mills running and doing sufficient business to make them economical resulted in mixed success. Initial findings also indicated that those women which could afford to grind cereals at the mills used the time saved to take a well deserved rest.

Another repercussion of these grinding mills was that they decreased the amount of work available to poorer women, usually transhumant pastoralists, who were often engaged to pound millet and/or sorghum into flour in exchange for food or income. It was thought, however, that it would be difficult to replace the latter practice with grinding mills, because it allowed women to respect the Moslem custom which confines women to the household compound. This is only one aspect of Islam which effects agricultural practices. Others worth noting are the mass slaughter of male sheep during the celebration of Tabaski (Aidel Kebir or Id-al-Fitr) and the debiliating effects of the month-long fast of Ramadan, when this annual religious rite falls within the agricultural season.

Given the plentiful and constant supply of sunlight falling in Niger, the GON has invested heavily in the development of such solar-powered devices as pumps, water heaters and cookers. It was hoped that the use of the latter would not only save labor, but would also help conserve Niger's dwindling reserves of trees and shrubs. Unfortunately, many years of research in this area have yet to result in an economical solar cooker which is adapted to the needs of Niger's rural population.

The foregoing review of possible solutions to the labor bottleneck led NDDP managers to believe that there were not any readily available solutions to the problems caused by this bottleneck. They continued to believe, however, that the rough analysis of labor inputs reflected in Figure 8 was sufficient for project planning needs and, therefore, the gathering of more precise data was probably not worthwhile. Also managers were very skeptical about the accuracy of the results of any detailed study of labor times. This skepticism was based on the knowledge that labor data can vary widely from one season to the next according to such significant, but highly variable, factors as rainfall amounts, location and spacing; pest, disease and weed infestations; number of people the farm family must feed; off-farm income and the widespread, annual migration of many farmers (30, pp. 159-162). These unpredictable and hard to quantify factors often render meaningless even the most expertly conceived and executed farm labor studies.

The influence of rainfall alone can impact in a number of ways on the kind and degree of farm labor inputs. For instance, a favorable succession of early rains will encourage the farm family to plant more land to millet than it can possibly weed if rains continue to be good. Also, such

favorable rains prompt farmers to alleviate some labor problems by following the planting of short-season varieties with longer-season ones.1/ If early rains are uneven, several plantings (usually the rule) will be required while insufficient early rains, or the late arrival of the first rains, will result in the abandonment of all agricultural work or lead to a total concentration on late-season crops like cowpeas. This recourse to longer-season or late-season plants does, however, increase the possibility for conflict when transhumant herders return south to the agricultural areas to find them still covered with unharvested crops. It is noteworthy that the improved seeds distributed by NDDP are all short-season (80-90 days) varieties. They, therefore, do not allow the farmer this flexibility.

Of course, insufficient rain early in the growing season (June 1 - July 15) means no harvest at all. The occurrence of such drought has been more the rule than the exception for a great many farmers in the northern half of the NDDP zone and its frequency in the southern part of the zone has increased in the last 25 years from about one in ten years to, perhaps, one in three years. This increased frequency of crop failures due to drought in the zone has discouraged farmers from investing in agriculture and it results in the further migration of males out of the zone. This exodus of the male population decreases disproportionately the number of AME's available to the farm family and, thus, further decreases crop production. This emigration of males usually includes the most able-

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1/Unfortunately, good rainy seasons are also favorable to the propagation of many plant diseases and pests. Too much rain at the wrong time also causes problems like keeping the soil too cool for seed germination and making it difficult to harvest and dry a ripe crop.

bodied, younger men and this results in a farm-family labor force mainly composed of aging males, women and children. This aging of the male component of the labor force is cause for great concern.

Some families have stated, however, that this absence of male members is helpful as it reduces the number of persons that must be fed from farm produce. Also, if the absent family members are fortunate enough to find gainful employment, the income they send home permits the family the added luxury of purchasing foodstuffs. The level and certainty of receiving such income also influences the amount of effort the family will put into farming. The amount of effort employed will usually center around concepts concerned with productivity per labor in terms of the nutritional needs of the family rather than in the somewhat alien concepts of production per unit of land and profit margins. In view of this conceptual framework and the other factors briefly mentioned above, it was easy to further conclude that the heretofore highly regarded and much used farm-size measure had little revelance. A more useful tool would be one which considers family or farm work-unit size and, if possible, other key factors such as the following: off-farm income; rainfall; the number and kind of livestock possessed; on-farm storage capacity and the amount of effort and money the farm family is already investing in their farm operations.

Availability, Cost and Appropriateness of Inputs

Farmers often reminded NDDP managers that they were eager to adopt the new practices but they could not usually obtain the required inputs

and, even if they could, they could not afford them (see appendix G for list of input costs). The unhappy fact was that there was not enough fertilizer, the key input, in Niger at any one time to satisfy more than 5% of all the farms in Niger. Also, even if a farm could obtain and use correctly the required fertilizers, it was doubtful if the gains in production would justify the expense and trouble. This situation became so critical that the GON committee charged with overseeing NDDP decided in their July 1979 meeting that it was useless to talk of agricultural development in Niger until the problems of fertilizer supply and delivery were solved (81, p. 1). This caused NDDP managers to raise many questions concerning the wisdom of introducing practices which could only be adopted by that small minority of farms which had access to the very limited supply of imported inputs. This concern eventually led to a less optimistic estimate of the rate of adoption which, necessarily, was conditioned by the current and projected capacity of essential inputs like fertilizer and associated supporting services. It also led to a more cautious approach which tried not to create among farmers a need for imported inputs that could not be reasonably satisfied.

One major limiting factor in this regard was Niger's subsidy program for agricultural inputs. NDDP managers believed such subsidies were required during an initial period to encourage farmers to adopt the new practices and that it was probably in Niger's national interest to use some of its uranium revenue in this way. The program as operated by Nigerien officials served, however, to constrain the project's progress. Briefly stated, Niger's ill-planned and poorly managed subsidy program severely affected NDDP because available subsidy funds were small compared

to the need. They were also usually made available too late to procure inputs for the agricultural season for which they were intended. For example, in May 1979 the GON agency responsible for the purchase and distribution of inputs informed its Ministry that it would need 1.6 billion CFA in subsidy funds to satisfy the requests already received from farmers for inputs for the following year. Of this requested amount, only 0.52 billion CFA or 32.5% was approved and this approval decision was not known until late in 1979 (4, p. 60).

The lateness of this decision did not leave enough time to import and distribute the inputs needed for the agricultural season beginning the following May. Thus farmers never knew in advance whether or nor they would receive the inputs they had previously requested and, if they did receive inputs, they often arrived too late and had to be kept until the following season. Similarly, farmers never knew in advance of the agricultural season the exact cost of these inputs or the prices the GON would pay for their produce. This lack of subsidy funds and their late appropriation meant that the number of farmers which NDDP could reach was greatly reduced and that necessary long-term planning was almost impossible. It also raised the issue of "equity" with regard to which farmers would be selected to partake of the limited supply of available inputs.

Another major constraint on the improved production model was the inefficiency of the credit program which provided in-kind loans of agricultural inputs to farmers. Certainly, this credit program was hampered by the input supply and delivery problems mentioned above, but even when inputs were available the management of the credit arrangement side of the operation was chaotic. The capacity of the GON agencies responsible

for the management of the credit program was exceedingly low and the villagers were even less prepared to understand and follow the intricate procedures of the twentieth-century paperwork required to make and repay the loan of inputs. In brief, despite the quantitative success of NDDP in establishing credit cooperatives at the village level and a revolving credit fund at the level of the National Agricultural Bank for use by the cooperatives, its credit-input system did not work. Furthermore, the prospects of it ever working anywhere near the way it should without the constant surveillance of outside consultants were very dim.

The problems of providing agricultural inputs on a credit basis were so overwhelming that NDDP managers began to believe that at this stage in Niger's agricultural develoment that providing inputs on a credit basis was perhaps not essential. This was believed to be especially true if the farmer was already able to buy these inputs under Niger's subsidy program at 40% or less of their actual cost. Moreover, it was not expected that government-run credit programs could work in the zone as long as subsistence-type agriculture predominated and the farmers were neither able to manage such a program nor able to back the value of the loans granted to them with some kind of collateral (e.g., grain, animals, land).

In general, even if farmers were eventually able to satisfy these criteria, the marginal nature of the zone would continue to make any lending activity a risky venture. For example, in good years prices paid to farmers for their produce are low and in the all too frequent bad years the farmer has nothing to sell. Yet, in good or bad years, the farmer must repay his loan and he usually must do so at harvest time when his cash needs are the highest. In either case the farmer has difficulty

repaying his loan and these difficulties only encourage the GON to foregive these loans. The latter action has occurred sufficiently to encourage the belief that government loans do not have to be repaid. This belief is further supported by the fact that even in the best of times no sanctions are taken against those individuals who fail to repay their loans, except that of refusing the further loan of unreliably-delivered inputs whose worth has not yet been sufficiently demonstrated to the farmers.

Such are some of the perils of introducing an in-kind credit program for the first time into a zone populated by illiterate farmers practicing, for the most part, subsistence agriculture. More success might be expected of a consumer-credit program which addressed the farm family's material wants and such priority agricultural needs as providing funds to hire field workers. NDDP managers believed such a credit program would serve as a stimulus to the farm family to increase its efforts to produce more. In any event, it was believed that it would be better for the farmer to obtain cash loans from the village cooperative at reasonable interest rates than from the local money-lender whose interest rates were likely exorbitant. It may be, however, that the best approach would be to utilize the ability and status of local money-lenders in the operation of credit programs.

Besides the problem involved with providing inputs to farmers on a reliable basis at a price they could afford, there were also encountered more fundamental technical and economical constraints. For instance, it was discovered that the yields of the improved varieties of millet were really no better than some of the traditional varieties already being used

by farmers.1/ This was no cause for great concern (although a "miracle" millet would be welcomed) as farmers had already demonstrated that the use of traditional varieties, along with the other recommended practices, did not measurably reduce yield levels (82. p. 3).

Given that good quality, improved millet seeds were proving to be difficult and expensive to produce and distribute, this discovery offered some relief.2/ In any event, and despite the admirable efforts of the AID-supported national cereals research and seed multiplication project to produce certified seed, the quantities of improved seed available for timely distribution were very low. For example, 114.5 mt of "improved" millet seed were distributed nation-wide in 1979. At a recommended seeding rate of ten kilograms of seed per hectare this was sufficient for only 11,450 hectares or about 0.4% of the total millet crop area reported for Niger in the same year (4, p. 66).

Another problem encountered was the lack of quality control over chemical fertilizer which, for the most part, found its way to Niger through clandestine and sometimes unscrupulous channels originating in Nigeria. Also, the desired triple superphosphate (TSP) could not be obtained from Nigeria, resulting in the need to more than double the application of single superphosphate (SSP) to achieve the same benefits

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1/The maximum percentage increase in yields resulting from the use of Niger's improved seeds was reported at 10-15% (4, p. 39).

2/In 1982 improved millet seeds cost about 485 CFA/kg to produce and were sold to farmers at 105 CFA per kilogram. The high cost of seed production in Niger, the problems inherent with making government-operated seed multiplication centers work, and the risks caused by frequent drought prompted some observers to suggest that Niger's seeds be multiplied elsewhere in the world (6).

derived from the recommended application of TSP.1/ This action more than doubles the transport requirements and increases the labor required for fertilizer application. As the GON sells SSP for 20 CFA/kg, the use of SSP also increased costs to farmers. This meant that an equivalent amount of SSP cost 70% more. These rather irrational transfer prices for these two fertilizers have been in effect since 1973 despite the almost constant climb in the open-market prices of these fertilizers (11, p. 3). This unadjusted subsidized price structure for fertilizer has, consequently, increased the amount of subsidy funds needed to cover Niger's fertilizer consumption requirement, which has grown from 964 mt in 1973 to a projected 17,750 mt in 1983 (4, p. 68; 6).

The problems caused by the use of Nigerian fertilizers did not greatly affect the NDDP because, as a U.S.-funded project, it was required to procure all its fertilizer from the U.S. Of course, this meant that the project had to create an artificial supply system that brought fertilizer to Niger at great effort, cost, and time.2/ This fertilizer issue was the object of much study by NDDP managers. In essence, they concluded that the GON and USAID needed to make a serious review of this

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1/In the groundnut areas of Niger SSP (18% P_2O_5) did, however, continue to be preferred over TSP (46% P_2O_5) because the former contains small amounts of sulfur which are beneficial to this crop (74, p. 32). Sulfur is generally deficient in the soils of the area because of their low organic matter content and the low sulfur content of tropical rainfall.

2/The CIF Niamey cost of one 50-kilogram of urea imported from the U.S. was 5,500 CFA ($26.19) in 1980. This compared to 3,000 CFA ($14.30) for a bag of Nigerian fertilizer. The latter could be ordered through local traders and be received within a few days, while it took nearly one year to receive fertilizer from the U.S. Much of the delay in the receipt of U.S. fertilizer centered around finding a supplier which was interested in exporting the small quantities of fertilizer (310 mt in 1979) needed by NDDP and locating that rare U.S. freighter going to a West African port serving Niger that was willing to transport such a relatively small load (83, p. 1).

priority issue with the aim of developing a strategy for reducing Niger's dependence on unreliable and unrealistic sources of fertilizer. One recommendation made was that Niger arrive at some kind of official understanding with Nigeria for importing some of its fertilizer. It was thought that such an arrangement would be in the interest of both countries.1/ Given that next to good rainfall, better and increased use of chemical fertilizer is Niger's best short-term hope for achieving food self-sufficiency, it is remarkable that this issue has received so little attention over the past years.2/

Viability of Complementary Yield-Raising Practices

Although NDDP managers believed that Niger could never achieve food self-sufficiency without increasing its use of chemical fertilizers, this should not be construed as meaning that this was the only soil improvement practice promoted by NDDP. On the contrary, as evidenced by the optional fertilization practices included in the presentation of NDDP's "technological package" in Figure 9, managers were very much concerned about creating a dependence on imported fertilizer. NDDP therefore encouraged such complementary practices as the use of manure, compost, local

1/In 1979 Niger used 5,000 mt of fertilizer while Nigeria used 394,300 mt. Of the amount used by Nigeria 35,000 mt of SSP was manufactured at its Kaduna fertilizer plant. This amount represents only 30% of the capacity of this plant. Niger's current needs for SSP could be satisfied by a less than 10% rise in the amount of SSP manufactured at this plant (74, p. 55).

2/Given that the two productivity projects (Dosso and Maradi) in Niger and three similar projects Gombe, Gusau, and Funtua in Northern Nigeria are funded by the World Bank and they used, respectively, 60% of the fertilizer in Niger and 35% (82,803 mt) of the fertilizer in Northern Nigeria, it was thought that the World Bank should play a special role in encouraging the development of a joint Niger-Nigeria fertilizer strategy (14, p. 16; 74, p. viii).

rock phosphates and the rotation of nitrogen-fixing cowpeas with millet. Also encouraged through the reproduction and planting of thousands of seedlings was the restoration of the traditional, ecologically-balanced Acacia-albida system of permanent cultivation on a fixed area.

The beneficial effects of this leguminous, A. albida tree on the soil not only result in a two- fold increase in millet yields within its leaf-fall area, but it is also a unique source of green fodder during the long dry season. Most of the advantages of this tree are due to its reverse decidous cycle which causes it to drop its leaves at the onset of the rainy season and sprout new leaves and nutritious pods during the dry season. Unfortunately, the regeneration and survival of the A. albida tree, and other beneficial trees which share the same eco-system, require the caring intervention of man, especially with regards to providing protection from free-ranging goats. NDDP's efforts to increase the already high goat population in the zone was, therefore, considered to be at odds with its efforts to protect and expand the zone's increasingly meager arboreal cover (23, pp. 7-13).

Other issues at stake here included NDDP's promotion of more intensified cultivation and the mixed-farming practices required to make such cultivation possible. Additional underlying issues concerned traditional land tenure policies and governmental legislation which prevented individual ownership of land and trees like A. albida. This complex situation is further complicated by the increasing competition between sedentary farmers and transhumant herders. The latter are not interested in the agronomic aspects of trees like A. albida and have interests which are not served by the promotion of intensified, mixed farming systems.

Despite all these complexities it was clear to NDDP managers that the long-term survival of the inhabitants would require that the natural course of events lead to situation where people in the zone exercised much more care for and control over their land and animals.

NDDP's initial experience with the use of animal manure was discouraging. The collection and distribution of the large quantities (six-ten mt/ha) required to achieve yields equal to those postulated in the improved model of Figure 11 involved tasks that most farmers were unable or unwilling to do. Major obstacles included the lack of manure in many areas and, if not lacking, the difficulty of transporting it to cropping areas. Also, it was noted that many of the soil-improving qualities of manure were quickly lost if it was left exposed to the hot, dry climate. This meant that if manure was to be useful it had to be collected shortly after it was deposited and then kept protected in a shady, moist area until it was spread on or, more ideally, buried under the top soil of the farmers' fields. The labor and water required for the preservation of manure in this way made this an impossible task for most farmers. The collection and preservation of manure can be facilitated by the stabling or tethering of domestic animals. This requires, however, intensive care and feeding which cannot always be provided and, even if it could, the amount of manure which can be collected from only a few "household" animals is small compared to the need.1/

1/The maximum amount of manure which can be provided annually in Africa by well-fed, mature animals which are kept permanently stabled is estimated as follows: cattle - 10 mt; goats - 0.6 mt, sheep - 0.6 mt; horses - 0.3 mt, and donkeys - 0.1 mt. These quantities are reduced to less than one-third if the animals are stabled only during the night. Cattle not only produce greater quantities of manure but their manure contains a higher level of fertilizing nutrients (29, p. 123; 84, p. 79).

The traditional system for overcoming many of these problems involved arrangements between farmers and herders which permitted the animals of the latter to graze on crop stubble left in the fields during their dry-season sojourn in the cultivated zone. It is believed, however, that the benefits of this system to the soil have been overrated. In effect, the soil nutrients contained in the manure and urine deposited on the fields by the herder's animals are largely volatilized by the hot, dry-season sun. Also the herder's animals have already departed for northern, rainy-season pasture lands when fresh manure could be of some use to cultivated fields. It is also expected that with the growing scarcity of firewood in the zone that people will begin to use animal dung as cooking fuel. The farmer thus receives little benefits from the manure left by animals and loses the potential soil-enriching benefits of the plant residues consumed by the animals.

The problem of returning plant residues to the soil is a crucial one. Farmers usually have other uses for plant parts, therefore all plant material is removed from the fields following harvest. For instance, millet stalks are valuable for their use as a construction material and fuel, and cowpea vines and leaves are a major source of feed for domestic animals. The denuding of the fields in this way limits the build-up of organic matter (OM) in the soil. The OM content of most soils in the zone is already extremely low (less than 0.2%) and, if nothing can be done to remedy this situation, it will not be possible to achieve sustainable increases in crop yields.

This low OM content of the soil also decreases the efficiency of chemical fertilizer because it reduces substantially the soil's cation

exchange capacity. It was thought that the increased yields and plant densities associated with the use of chemical fertilizers would lead to a build-up of OM in the soil by producing more plant residues which could be returned to the soil. This will never happen, however, if farmers do not change their current pracitices and begin working these residues back into the soil. Much of the future of agriculture in the zone and the rest of Niger revolves around this fundamental issue.

Research results have given support to the idea that the best approach for Niger in addressing the common phosphorous and nitrogen deficiencies of its soils was to utilize its sizeable rock-phosphate (RP) deposits and to rotate its cereal crops with nitrogen-fixing legumes like cowpeas. Although this continues to appear to be the best strategy Niger can have for reducing its dependence on imported fertilizer and their drain on its scarce foreign exchange, there are many practical difficulties which restrain the implementation of this strategy. For example, Niger's current production of crushed RP in very low and several years have past without it being able to expand its single production unit or to develop other more promising RP sites.1/

Another problem associated with the use of RP is that larger amounts of it are needed (75 kgs/ha and above) to achieve acceptable yield increases. This entails increased transport requirements and places higher demands on the farm's scarce labor. Also, as RP takes longer to react

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1/During the first year of operation (June 1978-June 1979) Niger's Tahoua RP plant which has a capacity of 8,000 mt produced about 6,000 mt of crushed RP. At the minimal application rate of 75 kgs/Ha this amount was sufficient for 80,000 hectares or about two percent of Niger's cultivated land surface (85, p. 1). One of the major constraints to expanding RP production is the lack of electricity needed to run the crushing mill.

in the soil than chemically-produced phosphate materials, the farmer may have to wait a year or more to benefit from the results of the application of RP. Some farmers also complained that much of the finely-ground RP applied by the usual broadcasting method was carried away by the wind. Much of this latter problem could have been avoided if the RP could be granulated; however, this would further increase the time it would take for RP to dissolve into the soil.

Experiments with crop rotation, following one cowpea crop with millet, have resulted in millet yields 200 kgs larger than average traditional yields, and following two or three cowpea crops with millet have resulted in yields two-four times higher (82, p. 3). Unfortunately, initial experience with farmers demonstrated that it was hard for them to adopt rotational practices because it did not satisfy their needs. For instance, if the farmer's food needs require that 80-90% of his cropping area be planted in millet, it is very hard for him to adopt optimal rotational patterns. Of course, some rotation is better than none. On the other hand, it may be that the farmer is already deriving the benefits of limited rotation through the practice of intercropping. Unfortunately, research had not yet provided NDDP with innovations for improving the farmer's intercropping practices.1/

NDDP was thus obliged to extend innovations which required major changes in traditional farming practices and sought more to adapt the

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1/Recent advances in biological nitrogen fixation (BNF) techniques have been pointed to as possible crop production breakthroughs for countries like Niger. The background provided in this paper should, however, erase any optimism about Niger being able to satisfy the novel requirements of this new technology (e.g., manufacture and storage of rhizobia and the introduction of new crops like soybeans).

farmer to new technology rather than the more preferred approach of adapting technology to the system already practiced by the farmer. It is hoped that the establishment in 1981 of a research base in the Niamey Department by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) will help further the development of more farmer-oriented and ecologically-balanced approaches to increasing agricultural production in the project zone. It is also hoped that the establishment of this base will permit Niger to benefit from the lessons learned by ICRISAT in its many years of work with the advanced peasant-agricultural systems of the semi-arid regions of India. In this regard, P. Hill's recent work, which compares the dry farming systems of southern India with those of Northern Nigeria, is instructive (86).

Another technical problem which relates to fertilizer use is the difficulty of maintaining the optimum plant density required to obtain the full benefit of fertilizer. NDDP managers discovered that the higher and more uniform densities required by the improved practices could not be satisfactorily achieved by farmers without the use of some row-marking device. Following disappointing experiences with such marking devices as measured strings, sticks and wooden markers, NDDP managers devised a usable, metal row-marking device which was durable enough to last many seasons. This devise was designed in collaboration with local blacksmiths with the intention that they would be responsible for their fabrication and repair. Unfortunately, this device proved to be too costly, too difficult to pull and too consuming of the farmer's time. For instance, it was calculated that a farmer had to walk ten kilometers to cover one hectare with this implement.

The use of local blacksmiths also caused problems because their caste status usually meant that they were concentrated in a few areas. This made distribution of the row-markers difficult in areas where no blacksmiths resided. (This problem also applied to the assembly and repair of animal traction equipment.) Also, blacksmiths equipped and trained by NDDP to make these markers were often tempted to move to the capital city where they could better profit from their skills and new equipment.

Plant spacing, therefore, continues to rely mostly on the farmer's not too accurate skill at estimating and stepping-off distances with which they have little familiarity. To date, NDDP managers have rarely observed, even among farmers who have completed an agricultural season of training at the farmer-couple training centers, any farmer who had managed to achieve more than 80% of the recommended density of 10,000 millet stands per hectare. The recommended cowpea density of 55,000 stands per hectare poses even more difficult challenges. Apparently, farmers are not able or willing to devote the extra time that precise row-making requires. It is also possible that they dislike denser planting because it slows down subsequent field operations (e.g., weeding).

Pesticide Use Dilemma

Another important technical difficulty involved the use of pesticides. According to the recommended improved practices, insecticides were supposed to be used on millet as required and at least twice on the new variety of cowpeas which was subject to severe insect attacks (primarily aphids). It does not take much imagination to visualize the many difficulties encountered in the procurement, delivery, control, and application

of these newly introduced insecticides in a practically roadless area larger than Maryland and Delaware combined. Special storage measures had to be taken, farmers and government agents had to be trained and provided with sprayers and mandatory protective equipment. The latter required importing from the U.S. rubber boots, aprons, gloves and face masks which were all very uncomfortable to wear in Niger's extremely hot weather.

All these problems were compounded by the obligation that NDDP procure from U.S. sources only those pesticides approved for their intended use by the U.S. Environmental Protection Agency (EPA). Since it was not certain what EPA-recommended, U.S.-source pesticides would work on the crops and pests of Niger, special test programs had to be set up. One drawback of these complicated test programs was that they prevented NDDP agronomists from carrying out as planned NDDP's very important applied research component. Additional frustrating drawbacks were caused by the long delays, often up to eighteen months, caused by the elaborate ordering and shipping procedures involved in obtaining pecticides from the U.S. This delay meant that it was highly probable that pesticides initially recommended at the time an order for them was placed would no longer be on the EPA's approved list when they arrived in Niger. Also, pesticides obtained from the U.S. were more costly, especially if they were packaged in the small quantities needed by Nigerien farmers.

The need to respect EPA regulations required the setting up of parallel arrangements whereby NDDP insectidies were kept separate from the non-EPA-approved ones financed by other donors for use by the GON's national plant protection service. As these legally mandated regulations clearly stated that the U.S. could not participate, directly or indirectly, with the application of pesticides not approved by the EPA,

Nigerien officials became concerned that it could not count on the assistance of NDDP in the event of a large-scale insect invasions. This well founded concern led to negotiations between the GON and USAID which resulted in the inclusion of special language in the project grant agreement that was signed by the two governments. This language attempted to define the kind of emergencies that would permit the use of NDDP personnel and materials in the application of non-approved pesticides. Such emergencies had to be certified by the Niamey-based USAID mission director and approved by the Washington-based USAID administrator. The justifiable fear on the part of Nigerien officials was that by the time the USAID administrator's approval was obtained the insects would have already done their damage.1/

Other problems involving insecticide application included their cost and the difficulty of obtaining and transporting sufficient water in isolated areas to mix with them. In general, if farmers were able to purchase and apply insectides themselves, they probably would not do so because of the cost of the insecticides (especially for insecticides imported from the U.S.) and the application equipment. Inexpensive fungicides have, however, been widely adopted by many farmers and the demand is such that such non-approved fungicides as Thioral (thiram plus heptachlor) can easily be found for sale by private traders in local market places. This, however, further complicates the U.S. statutory requirement that NDDP disassociate itself from the use of pesticides not approved by the EPA. The current practice is that all pesticides are applied under the supervision of agents paid and equipped by the GON.

1/African and other donor officials also expressed the fear that U.S. pesticide policies were forcing useable pesticides of the market and making the remaining pesticides unnecessarily expensive.

This includes application by expensive (approximately $5,000) motorized, knapsack sprayers and, in case of major outbreaks, spraying by one or more of the several airplanes owned and operated by the GON's plant protection service (20, p. 6).

The knapsack sprayers require a constant supply of clean water (220-330 liters/ha) which is a scarce commodity in most parts of the zone. This water-related problem could be eliminated by the use of inexpensive ($30-$50), ultra-low-volume (ULV) sprayers which use only two to five liters/ha. Unfortunately, this new, and perhaps unperfected technology, had not yet been introduced in Niger and tested in the zone. As many of the ULV's require a continuous supply of small batteries, this was identified as one possible constraint to their use. Concerns were also raised concerning the increased risk of toxic contamination resulting from the concentrated insecticides used in ULV sprayers. It was also questioned whether or not ULV sprayers can reach to the tops of mature millet plants which are two-three meters tall (87, p. 1; 88, p. 282).

One complicating factor resulting from the parastatal control and use of insecticides is that the farmer is normally not charged for these services. One, therefore, is never sure to include or not the cost of insecticides in an economic analysis of the improved practices and, if included, at what cost per hectare. Funding resources and the physical limitations of the national plant protection service also means that only a minority of the farmers can be served. Aerial spraying, although costly to the GON, reaches more farmers and, as a result of the GON's belief that large-scale spraying played a major role in the achievement of good harvests in 1978, this type of spraying is receiving more emphasis.1/

1/Niger's National Plant Protection Service has a maximum coverage capacity equal to about one-fourth of Niger's cultivated area (6).

In brief, pecticide use raises many complicated issues and it, unfortunately, is an area where knowledge, ability, experience, and capacity are sadly lacking. The situation was such that NDDP managers were forced to conclude that any improved practices which rely on the timely and effective use of pesticides will not likely succeed in Niger in the foreseeable future.

Agronomic and Economic Returns

Although a comparison of the present farm model (Figure 6) and the improved model (Figure 11) shows that the farm's net income is substantially increased, NDDP managers continued to have doubts about the profitability of the improved practices. Managers were particularly concerned that the returns from the improved practices still might not be sufficient to encourage their adoption. It was, therefore, decided to apply three rule-of-thumb tests to the agronomic and economic viability of the key fertilizer component of the basic set of improved practices (excludes animal traction). The results, sometimes confusing, of these tests and a brief discussion of their meaning follows.

It was evident that the 37.8 kilograms of plant nutrients supplied by the recommended application of 84 kilograms of fertilizer per hectare (34 kgs of TSP and 50 kgs of urea) were mainly responsible for the achievement of the increase of 317 kgs/ha of millet as postulated in the improved model (Figure 11). This rate of fertilizer application thus resulted in an incremental grain-per-kilo-of-nutrient ratio of about 8.4:1. 1/ This

1/One kg of urea contains 0.45 kg of nitrogen and one kg of TSP contains a like amount of phosphorus in the form of P_2O_5 (89).

is short of the 10:1 rule-of-thumb measure which, from an agronomic standpoint, normally reflects good returns for improved varieties. A yield of at least 661 kgs/ha was needed to achieve this 10:1 ratio (90, p. 2).

It was thought that this insufficient 8.4:1 ratio indicated that either the improved practices were deficient or the amount of fertilizer recommended was excessive. Assuming good growing conditions, this low ratio also led NDDP managers to begin thinking that the technology embodied by the improved millet practices might not be adequate to overcome the "productivity barriers" imposed by the unfavorable agriculture environment.

This 8.4:1 grain-fertilizer ratio was therefore considered an initial signal that the returns offered by the improved practices may not be sufficient to encourage their adoption by farmers.1/ This thought was further supported by the fact that not all the increase in yield could be attributed to fertilizer and the observation that under good rainfall conditions farmers often used more fertilizer than recommended. (Contrarily, in poor rainfall years farmers would use less or no fertilizer.) This overuse of fertilizer was believed to be due in part to the convenience of using a whole 50-kilogram bag of TSP per hectare instead of about 70% of the bag (34 kgs) as recommended, and to the farmers' poor grasp of what a hectare was and how this alien measure could be applied to their often

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1/Even accounting for carry over effects, the use of the highly recommended 150 kg/ha of TSP as a soil-building application for especially poor soils would only further lower this ratio. This ratio could be raised by banding fertilizer around or along the seed-holes instead of broadcasting it. This more efficient fertilizer application process would, however, entail additional labor and skill.

oddly shaped and widely dispersed fields.1/ The smallness of many of the farmers' fields, the difficulties of transporting large bags of fertilizer and the reluctance or inability of farmers to invest in large amounts of fertilizer were all factors that argued for bags containing smaller quantities of fertilizer. Unfortunately, the costs of such special packaging were prohibitive. The only solution to this problem appeared to be an arrangement between Niger and neighboring countries for the importation of large volumes of fertilizer material for mixing and packaging according to the farmer's needs at a regional bulk-blending and sacking facility. Similar arrangements are also needed for pecticides.

The value-cost ratio of using fertilizer as recommended under the basic set of improved practices did indicate that the financial returns to the farm family were favorable at the subsidized rate and marginally profitable at the theoretical unsubsidized rate. For example, the 84 kgs of fertilizer recommended, which cost 2,770 CFA in 1979 at the subsidized rate and 5,448 CFA at the unsubsidized rate, helped result in an increase in millet yield valued at 12,680 CFA at official market prices. This yields a value-cost ratio of 1:4.6 for subsidized fertilizer and 1:2.3 for unsubsidized fertilizer. These ratios compared favorably to the FAO's rule-of-thumb that a value-cost ratio of 2 or above usually meant that fertilizer use was profitable (74, p. 36).

Another, simpler ratio, which might be used to quickly judge the viability of the key fertilizer component of the improved-practices

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1/The practice of cultivating widely dispersed fields reflected another effort on the part of the farmer to minimize the risk of "pockets" of inter-season drought which may effect one field but not another a few kilometers away.

package is to compare the cost of a kilogram of plant nutrients with the prices paid for a kilogram of grain. With TSP and urea costing, respectively, 30 CFA/kg and 35 CFA/kg at subsidized prices, and the official price of millet set at 40 CFA/kg, there was in 1979 a very favorable grain-to-plant-nutrient cost ratio range of 1.7 - 1.9. Even at unsubsidized fertilizer prices this ratio would still be in an acceptable range of 3.3 - 6.7. A ratio of 5 or 6 is considered good. At ratio levels of 8 and above fertilizer use would probably not be finanically attractive to farmers (90, pp. 6-7).1/

Although it is difficult to reconcile the results of these simple agronmic and economic tests, they did help NDDP managers to conclude that the GON was over-subsidizing fertilizer and/or underpricing millet. Over-subsidization appeared to be especially true in view of the fact that most farm families sold their produce at the higher, open-market prices. It was also concluded that, even if fertilizer was sold at unsubsidized prices through private channels, GON involvement would be required to ensure that the zone received its share of quality fertilizer at fair market prices. Finally, this brief analysis of fertilizer costs and returns indicated, despite possible technical shortcomings, that under current conditions the basic set of practices were profitable at both subsidized and unsubsidized prices. It was believed, however, that at the latter prices the margin of profit was not sufficient to encourage farmers to adopt the use of fertilizer and the associated set of improved practices.

1/At subsidized prices one kilogram of phosphorus (P_2O_5) provided by TSP costs 66.7 CFA and one kilogram of nitrogen (N) provided by urea cost 77.8 CFA. At unsubsidized prices these plant nutrient costs were, respectively, 266.7 CFA and 133.3 CFA.

The profitability of the improved practices was altered if the optional donkey traction component was included in the cost benefit analysis. A rough analysis of the improved practices, including donkey traction, generally indicated that they could be profitable at subsidized input costs at both official and open-market prices. At unsubsidized costs the farmer would incur a slight loss at official prices, but at the higher open-market prices he would make a 10-20% profit. For instance, using official prices and the information provided in Figure 12, it was calculated that about 204 kgs/ha of additional millet would be required annually by the average farm postulated in Figure 6 over a five year period to cover the subsidized cost of using the donkey traction option of the improved practices. At unsubsidized cost levels 335 kgs/ha would be required to cover the expense of this mode of cultivation. Comparing this with the projected millet yield increase of 317 kilos, clearly indicated that subsidies and/or higher market prices were required if the use of the donkey-traction package was to be profitable. The same conclusion would apply, but to a much greater degree, to the more expensive and strictly optional oxen traction component of the package.1/

Given that subsidy funds were already limited and the prices paid by the GON for grain were already higher than those paid in neighboring CFA countries, it was not thought that there was much scope for adjusting upwards these payments. Also contributing to this conclusion was the fact that the price (CIF Niamey) of grain sorghum imported from the U.S. already compared favorably with local, open-market prices. For instance,

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1/These returns can, of course, be more favorable if the farmer already owns suitable donkeys and/or oxen and their use can result in higher yields than the hand-implement scenario portrayed in Figure 11. (A donkey cost near 25,000 CFA and a bullock 50-60,000 CFA.)

Figure 12. Annual Cost of Donkey Traction Component of the Improved Practices*

Inputs	Cost of Inputs a/ Subsidized	Unsubsidized
A. Basic Set of Practices b/		
4.8 ha of millet	17,626	41,160
1.1 ha of cowpeas	5,173	11,506
Sub-total (A)	22,799	52,666
B. Donkey Traction Unit/year c/		
Donkey hoe	7,600	3,116
Donkey harness	600	1,000
Donkey	5,000	5,000
Interest (8%)	576	729
Feed and Health Care	18,000	18,000
Equipment Maintenance	600	600
Sub-total (B)	26,376	28,445
Total Cost for 5.9 Ha (A + B)	49,175	81,111

a/All costs are in CFA francs ($1.00 U.S = 210 CFA).

b/See Figure 10.

c/Costs are spread over a five-year period.

*Adapted from J. H. Mullenax, "Are the Technical Packages Profitable" (USAID/Niamey, June 19, 1979, mimeographed)

in 1979 a metric tone of U.S. sorghum cost about 63,000 CFA ($300) compared to the 60-65,000 CFA/mt commonly paid for local millet or sorghum by private Nigerien traders (14, p. 3).1/ Fortunately, local grains were preferred over the often moldy, weedy U.S. sorghum which had never been intended for human consumption.

It was acknowledged, however, that the additional acquisition of a cart for the transportation of the farm family and such agricultural related items as manure, fertilizer, and harvested grain offered advantages which could make the use of the optional animal traction component of the improved practices more attractive. Indeed, the subsidized carts were very popular among farmers and the demand far exceeded the supply. It was believed that this popularity primarily stemmed from the rental use of carts during the off-season to transport such things as water and firewood. Many of the farmers who were among the first to receive carts were able in this manner to augment markedly their incomes; however, as more carts were distributed in the zone, the increased competition decreased the additional income gained by any individual farmer.

Despite the costs and the many maintenance difficulties involved, carts and animal traction equipment remained popular due to the high prestige value attached to them.2/ In fact, the high cost, oxen-traction

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1/It is interesting to note, however, that official GON storage costs of around $140 per ton per year made the long-term storage of cereals an expensive operation (14, p. 3).

2/Up to four times the pulling animal's weight can be transported in carts, but this requires relatively smooth road ways which do not exist in many parts of the zone. This increased the number of cart breakdowns and flat tires caused by the thorns that were deposited throughout this open-thorn bush savanna. Of course, the poor construction of many of the carts exacerbated this situation. This situation and the lack of an efficient parts and service system meant that a great number of carts were never in operation for more than a few months at a time.

unit was even more popular than donkey traction. This was due to the higher prestige value attached to oxen and the potential income that could be gained from their sale.1/ An oxen-traction unit costs (excluding animal feed and health care) at the subsidized rate about $850 versus nearly $400 for the donkey-traction unit. Compared to the average farm family's net annual cash income of nearly $205 that was postulated in the 1979 present farm model (Figure 6) this is a very high cost and, of course, without the average 55% subsidy this cost would have been much higher. In view of the subsidy, easy credit at low interest rates (8-9.5%), free delivery and assembly and the frequent help provided by government agents, it might be that farmers perceived this as a chance to acquire a scarce item that they otherwise could never own. In effect, the end-use of the item might have been viewed as secondary when compared to their desire to own these prestigious items. Also, the novelty aspects surrounding the use of animal traction for the first time in the zone must be considered when attempting to describe the reasons for the high demand for this revolutionary innovation.

Other Constraints and Consequences of Success

The foregoing description of some of the more obvious constraints to the adoption of NDDP's improved practices made it abundantly clear that it will be a long time before a large number of farmers in the zone will be able to match the improved-model scenario presented in Figure 11. The

1/Also a factor in the selection of oxen over donkeys was that, if need be, farmers could entrust the care of their oxen to herder groups (primarily Fulani people), but could not do the same with donkeys since these groups will not care for donkeys.

job of NDDP was to eliminate or, at least, reduce the negative effects of these constraints. It is important to note that its success in doing so was severely handicapped by the limits placed upon it by a weak administrative environment.

These limits included, most importantly, an administrative structure which gave NDDP management the responsibility for implementing the project, but not the authority over the GON personnel who had the job of executing individual project activities in the field. This powerlessness of NDDP management to control the "executors" of project activities was further complicated by the rapid turnover of this executing personnel. For instance, during the three-year life of the project the chief administrative official of the department was changed four times; eight different people occupied the head civil administrative positions in the three administrative districts covered by the project; fourteen different people held the departmental chief positions of the four key GON service agencies (Agriculture, Cooperatives, Livestock and Forestry) and 25 different people held the nine district-level positions of these four services. This rapid turnover of key GON personnel probably reflected better than anything else the unwieldly mixture of administrative, political and developmental interests that were constantly at play in the selection and assignment of this personnel. It was evident to NDDP managers that such a mixture of interests greatly diluted the effectiveness of this personnel.

This chaotic administrative environment served to increase the magnitude of the problems facing NDDP in its attempt to create the conditions for higher agricultural producitivity in the zone. It also served to remind NDDP managers that many of the major problems facing NDDP could not

be handled within the framework of the project. In other words, NDDP management had no control over, or influence on many of the major factors affecting its implementation (e.g., personnel assignments, pricing policies, tied-assistance).

In spite of the formidable constraints mentioned above, and others which have not been mentioned, NDDP managers remained convinced that the pursuit of its goal of increasing agricultural production was still a viable and worthwhile endeavor. If nothing else, it was believed that NDDP had initiated a learning process which was laying the groundwork that would be needed to get agricultural development moving and to keep it moving according to Niger's developmental capacities. At the current stage of development in Niger, it was believed that satisfactory progress would be achieved if only a small percentage of farm families were able to adopt improved agricultural practices, thereby producing reliable surpluses in good rainfall years that would help them and their communities through the inevitable drought years.

Given the almost inviolable principle that the solving of one development problem only creates new ones, no review of constraints on the adoption of the improved practices by farmers would be complete without reflecting on the possible consequences of the removal of these constraints. What indeed would happen if the majority of the farmers in the zone did successfully adopt the improved practices? If such a formidable feat could be accomplished, it is obvious that the increased production would saturate the local market and depress prices. Although Nigeria should be able to absorb the increased production, Niger's capacity to transport, preserve, process, sack, store, market, and export this surplus

and the inputs which produced it would be overwhelmed. Despite this inherent paradox in the successfull accomplishment of the project development, all parties agreed that the problems caused by abundance were to be preferred over those caused by food insufficiences.

It was also agreed that speculating on the problems caused by success was not an idle exercise. In the case of Niger, where the prospects of producing large food surpluses continue to appear remote, it must be remembered that Niger regularly had large surpluses (near or over 200,000 mt) of cereals during the favorable rainfall years of the early 1960's. Even in the average rainfall years since this favorable period, considerable amounts (5-20%) of Niger's total cereal production have been marketed and much of this (20-50%) was exported to neighboring countries, especially Nigeria which has a growing cereals deficit larger than all of the other West African states combined (46, p. 266).1/ It is therefore not out of the realm of possiblity that large surpluses, especially if all the agricultural projects started in Niger during the last decade begin achieving their goals, could again be produced if the good rainfall of the early 1960s could be duplicated. If only all the farmers could produce 10% more (165,000 mt of millet and sorghum) than they produced in a poor rainfall year like 1982, Niger would begin to find itself in such a surplus situation.

Reputable authorities (H. Faure and J. Gac) predicted in 1981 that a favorable rainy cycle will begin to return to the Sahel in 1985 (91, pp.

1/Recent projections show that Nigeria can expect an annual cereals deficit of 10.6 to 19.3 million mt in 1985 while Niger's total annual cereals production for the same year is projected at 1.7 - 2.0 million mt. It is also projected that the amount Nigeria will spend on importing cereals will be almost twice Niger's annual GDP of $1.8 - 2.0 billion (74, p. 22).

475-478). If this prediction becomes true, Niger may be much closer to achieving, with or without projects like NDDP, reliable food surpluses than anyone realizes.1/ It must, however, be kept in mind that such surpluses do not mean the elimination of undernutrition. In this regard, thousands of Nigeriens, especially such vulnerable groups as infants and lactating and pregnant mothers, will continue to suffer the debiliating effects of undernutrition unless special measures are taken to address their food access, preparation and consumption problems. This is particularly true for those living in those geographical pockets of food deficits that exist even in the best rainfall years. The obstacles involved with resolving nutritional problems probably demonstrate better than any other example that the equitable distribution of rural development benefits is a prize not easily won.

1/Its worth noting that this prediction was made before the world-wide climatic disturbances caused by changes in the flow of the "El Nino" current in the Pacific Ocean began to occur.

CHAPTER V

ASSESSING THE CREDIBILITY OF THE QUAD APPROACH

While the five-step QUAD approach described in Chapter IV was not explicity rejected by the superiors of NDDP managers, neither did they support its adoption. The QUAD approach was criticized as being an oversimplified method for understanding very complex farm-level situations. Therefore, it was felt that it could not serve as a substitute for the systematic, in-depth collection and analysis of data. NDDP managers were especially criticized for assuming that the farm community was an undifferentiated, uniform mass and for the inequitable exclusion of the less than average farms. The upshot of all this was that NDDP was expected to follow its original, comprehensive plan for collecting data at the farm level in spite of the deficiencies of the initial data collection efforts described in Chapter III.

Criticisms and Possible Failings of QUAD

Perhaps there was some truth in these criticisms, but NDDP managers believed they had adequately addressed them. More important, NDDP managers remained unshaken in their belief that the QUAD approach provided them with the information they needed to successfully manage the project. If anything, managers were overloaded with more data than they could effectively use. In any event, as clearly indicated in the preceding description of major constraints and their many ramifications, there were more important issues confronting NDDP than having a large mass of accurate data.

Underlying much of the criticisms directed at NDDP's common-sense approach was the opinion that it lacked credibility because its authors did not have credentials which identified them as having appropriate academic backgrounds, or as being affiliated with institutions known for their expertise in African development. Also undermining the credibility of the authors was the commonly held belief that an impartial analysis of NDDP could only be achieved by those not involved in the daily implementation of the project. This credibility factor, and the weight it carried in terms of the amount of respect shown a document, was the major reason given for not allowing project managers to design NDDP's second phase.

In view of this credibility issue, NDDP managers decided to try to raise the status of their QUAD approach by submitting a preliminary version of it and the findings resulting from its use to recognized West African development authorities for their review and comment. Although this step seemed appropriate and it is still recommended as an additional step of the QUAD approach, the reaction of the authorities in this instance, while not negative, was neither entirely supportive. These authorities, drawing from their own experiences in Sahelian Africa, did provide interesting comments, but none of them changed the content or conclusions of the QUAD approach as employed by NDDP managers. More important, no hint of approval of QUAD was given. One authority did, however, acknowledge that the methodology used by project managers would not be generally accepted, but that NDDP managers should not let this discourage them. The underlying message was that a good measure of practical development common-sense was often worth more than academically excellent development studies that are seldom used in practice.

In retrospect, it appears that it might have not been sufficiently fair to ask these authorities to take time out of their busy schedules to review free-of-charge something distant acquaintances were trying to do in Niger. It was also unrealistic to expect these authorities to be highly supportive of the QUAD approach while they were so heavily involved in the execution of comprehensive farm-level surveys in other Sahelian countries. There was also some misunderstanding with regard to the belief that NDDP managers were offering the QUAD approach as a substitute for large-scale, longer-term approaches. The truth was that managers never intended that QUAD replace any other approach. Their intention was simply that it be seriously considered as a viable, additional tool for situations like NDDP's or as a complement to the application of more standard practices.

Hindsight also seems to suggest that this approach and the results obtained by its use were never taken seriously by GON and USAID officials because of the bureaucratic and political difficulties of changing original project plans. In effect, it seemed that one of the biggest challenges to introducing a new approach like QUAD was changing the routine thinking of key GON and donor agency officials who, unfortunately, had little time to consider even simplified project analyses like this one. Given that one of the underlying reasons for the QUAD approach was to stimulate a discussion of key development issues by providing essential information in a format that busy executives can quickly read and understand, the failure of these officials to seriously consider the issues raised by the project's initial QUAD approach was very discouraging.

Perhaps the brevity of the format used to report on the application of NDDP's first attempt to apply the QUAD approach led officials to think that not much confidence could be placed on such an abbreviated treatment of such a terribly complicated subject. This initial format consisted of less than 20 double-spaced pages. It focused on the present farm model (Figure 6), the impact of the adoption of improved practices on this model (Figure 11) and the major constraints to the adoption of these practices. Also included was an introductory summary of the methodology employed and a concluding section on the events which must occur if the improved model was to become a reality. This brief format is a handy way of showing officials what the current situation is, what can be done to improve it, and what the results of improving it may be.

Testing QUAD Against More Reliable Data

The failure of NDDP's initial large-scale surveys prompted project managers to establish their own procedures for collecting needed information. This effort centered on the careful collection of information on those farmers selected by their respective villages for participation in the farmer-couple training programs. These programs involved the creation of multi-purpose, "Rural Promotion Centers" (Centres de Promotion Rurale) at strategic locations within the project zone's various administrative cantons and agro-pluvial areas. The location of the three centers established under Phase I of the project are shown in Figure 3. (Seven additional centers were planned under Phase II.)

This primarily entailed the setting aside of 40 hectares of depleted land and the construction of a meeting-house, a water well and sufficient

thatched huts for the two to three member training staff and 20 farmer-couples,including up to two children per couple. The rationale behind this low-level of infrastructure was not only related to cost factors but, more important, to an attempt to imitate typical village surroundings. These relatively cost-effective centers were considered an ideal way of institualizing two-way linkages among farmers, extension (including credit and inputs delivery) and research agencies. Such centers were considered especially appropriate for a resource-poor country like Niger which, since 1975, has established throughout its agricultural belt nearly 80 of these centers.

The farmer-couple trainees would stay at these village-governed centers during an entire agriculture season. They would bring with them only the basic necessities, leaving the care of their fields and animals to other family members. Transport, food, fuel, bedding, utensils and a pocket allowance was provided to each couple by the center. Each couple was guaranteed a sufficient amount of grain upon their completion of training. This grain would be taken from the center's harvest and/or purchased on the local market.

During their stay at the center the trainees would cultivate the center's fields according to various combinations of recommended or different practices as decided upon by them and the agricultural technicians assigned to the centers. In addition, they would receive training in literacy, livestock care, food preparation and hygiene. The keystone element of NDDP's strategy was the multiplier effect these more mature, married farmers would have after they returned to their nearby

villages.1/ It was therefore incumbent upon NDDP managers to collect data on these farmer-couples and their farms before and after their stay at the centers. It is noteworthy that this onerous task was never mentioned in the project paper.2/

Given the problems noted previously with obtaining statistically respectable data from paid enumerators, NDDP managers decided to collect, at least for the initial classes, the data needed on each farmer-couple themselves. This data collection experience not only produced relevant and useful data, but also gave managers a deep appreciation of the tremendous difficulties involved with collecting precise data on isolated farms that are cultivated on what might be termed a haphazard basis. Among other things, managers were reminded by their efforts of the difficulties of calculating the exact area of oddly-shaped fields whose boundaries had been obliterated by blowing sand. During the cultivation season there was also difficulty finding particular farmers and their

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1/One of the impetuses behind the creations of "couple" centers was the failure in Niger of previous "single-men" farmer training centers. In general, the young age and lower status of single men is such that, even if they wanted to, they could not practice new techniques on the family farm without the consent of the head of household. Also young men who find themselves in a subordinate position on the family farm are more likely to emigrate, enter petty trade, etc. The rationale for the creating "couple" centers was, therefore, that married farmers were more likely to stay on the farm and practice what they learned in training.

2/Perhaps one reason this task was not mentioned was the belated and hurried fashion these farmer-couple training centers were added to the project. Oddly, these center-piece elements of NDDP were quickly added to the revised design of the project following a visit late in 1977 to similar centers created under the French-supported productivity project in the Zinder Department of Eastern Niger.

fields in the "sea" of millet which covered most of the agricultural areas of the zone.1/

More difficult than measuring field size was the problem of calculating precise yields. For millet, this entailed primarily the following: arriving at the farmer's field before he had harvested his crop; getting permission from the farmer to cut and remove a representative sample of millet heads; making cash or in-kind payments for the millet removed; drying the millet grains to a moisture level of 10-12%; protecting the millet from damage; removing the millet grains from the head and then weighing the grain. The entire procedure was even more complicated for cowpeas, whose uneven ripening (several weeks) required that several harvests be completed to ensure removal of the entire production of beans. Further complicating the measuring of cowpea yields was the difficulty of determining the yield and value of this crop's vines. The obstacles to the latter task were so cumbersome and prone to error that it was never attempted by NDDP managers.2/

In view of the time required and the many difficulties encountered by NDDP managers during this data-collection exercise, they were convinced that their efforts had seldom been matched by the vast majority of the

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1/Blowing sand was a constant, multi-faceted problem in the project zone. For example, wind-blown sand could block roads, reactivate and create new "moving" sand dunes and cover up or sand-blast young plants. All these problems were accentuated by the dry weather cycle that had been affecting the zone since 1967.

2/Despite the difficulties of accurately measuring the yield of cowpea vines, their high value has prompted on-farm researchers to make greater efforts toward doing so. For instance, ICRISAT in its first year (1982) of on-farm research in Niger reported an approximate yield of vines from improved cowpea (TN88-63) varieties intercropped with millet of about 45 kgs/ha and a local market price for these vines of 67.7 CFA/kg (92, p. 35).

Figure 13. MODIFIED FARM SYSTEM MODEL FOR THREE DISTRICTS OF PROJECT ZONE (1980-81) USING IMPROVED PRODUCTION PRACTICES*

(1) Principal Crops Raised	(2) % Farms	(3) Avg. Ha. or Head Per Farm	(4) Avg. Yield per ha. (kg)	(5) Total Produced Per Farm (kg)	(6) Consumed at Home (Kg or Head)	(7) Net Marketed (Kg or Head)	(8) Price[a] Kg/Head (CFA)	(9) Gross Cash Earned (CFA)	(10) Cash Costs (CFA)	(11) Net Cash Income (CFA)	(12) Value of Product (CFA)
1. Millet	100	5.9	575	3,393	1,514	1,879	50	93,950	23,865	70,085	169,650
2. Cowpeas	90	1.4	375	525	55	470	55	25,850	7,084	18,766	28,875
3. Sorghum	75	.03	255	8	8	0	50	0	0	0	400
4. Miscellaneous crops	70	.008	—	—	—	—	—	330	—	330	3,300
5. Sheep/Goats	40	4	—	—	1	1	6,000	6,000	550	5,450	24,000
6. Poultry	70	5	—	—	1	2	500	1,000	110	890	2,500
7. Donkeys/Horses/ or Camels	20	1	—	—	—	—	—	—	—	—	27,000
8. Cattle	30	1	—	—	—	—	30,000	—	2,000	(2,000)	30,000
9. Total	—	7.338 ha. (11 head)	—	3,926	1,577 kg (2 head)	2,349 kg (3 head)	—	127,130	33,609	93,521	285,000

*Farm sizes and yields derived from D. Wagner, "Profil des Stagiares - Promotions 1980 and 1981" (Niamey Department Project, Niger Mimeographed); M.G. Wentling, Field Notes, Niamey, Niger, July 6, 1981; and T. Mukherjee, (Draft Manuscript) was consulted for official prices of cereals and cowpeas.

a/ $1.00 U.S. = 300 CFA Francs.

GON's data collectors. It was therefore expected that the use of this more recent and reliable data in the formulation of a new version of the improved production model would result in major differences with the preliminary model, which had been compiled from secondary sources by NDDP managers in 1979. Consequently, NDDP managers took the next logical step and used the information collected on the 114 farmers who participated in the 1980 and 1981 farmer-couple training programs to construct a new version of the improved production model. This modified version is presented in Figure 13.

An initial comparison of the data in this new model with that contained in the previous model presented in Figure 11 does point up some major differences. For instance, the average farm size of the farmer-trainees surveyed was 7.34 hectares versus the 6 hectares used previously by NDDP managers. (It is interesting to note that this farm size is more than twice the 3.22 hectares reported in the NDDP-supported 1979 farm survey mentioned in Chapter III.) Another important difference was that these farmer-trainees did not achieve the project's yield goals. Millet yields per hectare were 575 kgs versus the goal of 600 kgs and cowpea yields were 375 kg/ha instead of the projected 500 kgs.1/ These farmer-trainee follow-up surveys also reported fewer animals per farm than expected and, not surprisingly, that few farmers used the entire set of recommended practices. It was also noted without surprise that more

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1/It must be noted that average yields were lowered because of drought in the Filingue district which resulted in average millet yields of 290 kgs/ha. If Filingue had been excluded, average millet yields would have been near 717 kgs/ha. Its also noteworthy that in the same year the farmer-couple training centers at Boula and Simiri produced, respectively, 1,458 and 968 kgs/ha of millet.

farmers were working off the farm and migrating to other areas during the dry season than previously had been reported, and that a significant portion of the farm's cultivable surface was not being cultivated.

At first glance these new findings seemed to make NDDP management's initial improved farm production and income model as presented in Figure 11 unacceptable, but further analysis revealed that the differences between the two models were nearly within the range of error established at the outset. Also, given that the farmer-trainees selected in these initial project years were probably more motivated and represented larger than average farms (families), any error in the use of six hectares as the average farm size versus the average 7.34 ha for these trainees is probably less than it appears. In any event, it had already been noted that farm size was more a reflection of family size than any other factor and, therefore, its sole use as a key indicator of farm wealth was misleading. In this regard, the average family size of the 114 farms surveyed was 7.42. This is 24% higher than the six member family size used in previous hypothetical models. Further observations and review of the data collected on the 114 farmer-trainees did lead managers to conclude that for almost all farms the average number of AME's/ha stayed near or slightly above two and the family-member-per-hectare ratio near one.1/

The differences between the two models were further minimized when, as was done in the modified version presented in Figure 13, new official price and exchange rate levels are used. For instance, since the formulation of the first improved model in 1979, official millet prices increased from 40

1/For a good discussion of labor and time allocation in African agriculture and the drawbacks of applying conventional micro-economic theory to these factors see the recent book of J. Levi and M Haviden (93, pp. 59-71).

to 50 CFA/kg and cowpea prices from 45 to 55 CFA/kg. Meanwhile, the CFA value of the U.S. dollar went from 210 CFA to 300 CFA in the same 1979-1981 period. During this same period input costs remained unchanged.

Using these new price and cost factors in the construction of the modified improved production model shown in Figure 13 resulted in a net cash income of $311.74 and a gross value of the farm's product of $950.00. These results were 34.9% and 18.6% lower than the same figures reported, respectively, in the 1979 improved farm model profile (Figure 11). A comparison model using the CFA values, however, gave much different results. This CFA model showed that net income would be only 7.0% lower in 1981 for the improved, farmer-trainee model than that shown in the estimated model of 1979, and that the 1981 gross value of the farm's product would be 16.7% greater than that postulated in 1979.

This brief, comparative analysis of farmer wealth demonstrated the necessity of using local currency values when calculating returns to the farm. An additional analytical tool which might have also been used would have been to account for local inflation by comparing the increases in farm family income with the cost of items it usually has to purchase (e.g., cloth, kersoene and salt). It is suspected that had this been done it would have been determined that the farm's purchasing power would have declined. The United Nation's consumer price index for Niger did increase from 261.9 to 329.5 (1970=100) in the 1979-1981 period (94, p. 192).

A major conclusion drawn from comparing these two models was that periodic adjustments should be made in all the input factors (e.g., labor data, costs, prices, animal number and yields) as new and better data becomes available. These changes must, however, be very large if they are

to result in important modifications of NDDP's general strategy and major activities. In retrospect, the results of NDDP's initial analyses proved to be more accurate than could have been expected from an armchair analysis that NDDP managers completed in their spare time. It, therefore, could have continued to serve as a solid management guideline. The new model contructed from data collected on farmer-trainees was instructive, but its use led to only small refinements and no major modifications in the initial improved production model. It was thought, however, that the construction of a model for each agro-pluvial subdivision in the zone according to various family sizes would have been a helpful improvement to this approach. On the other hand, it was also suspected that even this more useful improvement would not have changed much the way NDDP was being implemented.

CHAPTER VI

ADVANTAGES AND LIMITATIONS OF USING MINIMAL EVIDENCE

The intention of this paper was to illustrate by using the case of NDDP that even a minimal amount of readily accessible data can often be adequate to cope rationally with on-going project planning and implementation. NDDP managers attempted to demonstrate this point by developing and testing a simple, common-sense approach (QUAD). They hoped that the application of this approach would obviate the need for further comprehensive farm-level surveys and studies, which had been included in the original project planning documents. This attempt resulted from NDDP management's frustrating disappointments with NDDP's initial farm surveys. In general, the poor results of these initial surveys led NDDP managers to believe that sophisticated, large-scale surveys were not only cumbersome and relatively expensive to carry out, but that they also were likely to produce a large amount of minutiae which would be inconsequential to project operations. Also, the experience with these initial surveys had shown that much of the essential information generated by them did not usually become available until long after key decisions concerning NDDP had already been made.1/

It was therefore concluded by NDDP managers that if the systematic analysis of existing data and relevant references could produce a sufficiently accurate picture of a typical farm, comprehensive farm-level

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1/Delays of up to five years in the receipt of the final report on farm surveys involving frequent interviews are often incurred. Also, Matlon doubted that the benefits of his frequent interview technique justified the time and other resources it required (95, p. 23-25).

surveys were probably unnecessary. It was believed that this conclusion was particularly true for marginal agricultural zones such as that covered by NDDP where viable options for improving crop production are extremely limited. Also contributing to the project managers' contention that the undertaking of large-scale surveys in NDDP's zone were probably undesirable was Niger's weak institutional capacity. In brief, it was thought that a meaningful data based could not be developed as long as Niger had neither the institutional capacity to fully participate in such surveys nor the wherewithal to maintain such efforts on the permanent basis.

Approaches like QUAD are, therefore, especially recommended for areas where the governmental institutional capacity is weak and where the vast majority of farms suffer almost equally the consequences of a resource-poor environment. In addition, family farms that do not hire labor and which consume most of their produce are believed to be particularly susceptible to this kind of approach. Such approaches also seem particularly suitable for dryland farming areas, where short rainy seasons do not allow much room for any trade-offs, landlessness is not a problem, there is no monopoly over resources by a land-owning elite, and where rainfall is the major determinant of farm income.

Although QUAD approaches may work best in such areas, the approach itself can be undertaken for any number of reasons. Whenever the objective is the quick identification of principal farming practices and the constraints to improving major cropping systems, QUAD can be a useful tool in gaining valuable insights about critical activities, functional relationships and fundamental problems. Also, besides the NDDP example of

how QUAD was used to rapidly synthesize data into information upon which project managers could base their decisions, it is believed that QUAD can be a useful initial approach to such activities as the following:

* Determining information priorities and the problems of collecting and analyzing data;
* Identifying projects and evaluating alternative farm-improvement strategies;
* Describing and analyzing the basic nature of agriculture in an area;
* Capturing from the complex network of social and economic transactions the essence of the family's farming system and lifestyle, and
* Confirming or modifying the assumptions upon which on-going projects are based.

Regardless of the many ways QUAD could be used and the varying circumstances which prompt its use, the final aim should always be the same: providing the timely guidance needed by agricultural policy-makers, planners and/or development managers to select the correct course of action. Any QUAD approach must therefore be geared to produce results in the briefest possible timeframe. This means not only identifying problems but offering possible solutions as well.

The experience of NDDP also demonstrated that the unpredictability of its particular situation further undermined the usefulness of any data collection and analysis exercise, small or large. Indeed, although there may be shortcut methods of gathering useful information, there are few, if

any, shortcuts to agricultural development. Certainly NDDP's experience clearly demonstrated that the very best analyses, plans, policies, and studies are of little value if the farmer is unable or unwilling to adopt more efficient and productive farming practices, and if the natural elements dictate that, regardless of what the farmer does, a poor harvest is just as likely as a good one. Also, it must be added, that the results of either short and simple or long and sophisticated information collection efforts are of little value if host country and donor agency officials are unable or unwilling to confront and appropriately dispose of the issues raised by such efforts.

In view of Niger's weak governmental infrastructure and the subsistence, part-time nature of farming in the NDDP zone, project managers concluded that the collection of accurate agricultural statistics was probably of less importance than they had previously thought. In brief, if any farmer in the zone is just as likely to cultivate as he is not, it is impossible to predict results. Consequently, the practice of such random agriculture adds to the high probability that much of the evidence, minimal or optimal, generated by any detailed farm survey that covers only a few cropping seasons will be misleading. The advantage of QUAD in this instance is that it can, at much less cost, produce results that are near enough reality that actions based on them have their intended consequences.

With regards to cost, a basic QUAD approach can usually be handled within the regular work hours of host country and/or donor agency officials. If an outside consultant is required, it should not take a competent individual more than one month to complete such an approach. At

current salary, per diem and travel costs the hiring of such an individual for a month would cost $10-$12,000. QUAD, therefore, costs only a fraction of the cost of comprehensive farm-surveys, which frequently require at least several months to complete, dozens of enumerators, several outside consultants and substantial logistical support.

It is evident that the marginal and seasonal nature of agriculture in the NDDP zone will continue to make even an approximate quantification of the key elements of the zone's farming systems an extremely difficult task. Moreover, even if NDDP is able to help some farmers reduce the effects of the fundamental constraints--low rainfall and poor soils--to agricultural productivity in the zone, it is doubtful that the cultivation of the kind of crops which can be grown in such an arid zone can become the primary source of these farmers' livelihood. It is, therefore, apparent that, even under the best of circumstances, farmers in the zone cannot build a rising standard of living entirely upon the three to five months of farming permitted by the immutable climatic conditions affecting the zone. Consequently, any on-farm data collection efforts which fail to account for the growing importance of off-farm activities will misrepresent the farmer's situation.

The dilemma of how to collect information on off-farm activities with on-farm surveys is a difficult one, and it is probably not one amenable to approaches like QUAD. On the other hand, the unpredictability and wide variability of the importance of off-farm activities for any given family from one season to the next make the meaningful collection of data on off-farm activities an exceedingly difficult task, even for long-term and

highly sophisticated approaches.1/ However, in practical terms, it may be that the knowledge of, or a fairly rough determination of, the importance of off-farm activities which could be provided by a QUAD approach would be sufficient for most development planning work under such changing circumstances.

It is obvious from the foregoing that the random nature of agriculture in the NDDP zone and the unpredictable influences of external forces will continue to offer special challenges to the collection and analysis of farm-level data. It is therefore expected that the use of minimal evidence to devise approaches such as described in this paper will continue to be an attractive alternative to NDDP managers and other development practitioners confronted with similar circumstances elsewhere in the world.

1/The detailed study of personal income among farmers in Northern Nigeria carried out by Matlon during the 1974-75 cropping seasons describes many of the difficulties in determining income derived from off-farm activities (62). The pitfalls of doing such a sophisticated study were highlighted by R. Palmer-Jones' thorough critique of Matlon's work. This critique showed conclusively that the analysis of the data upon which some of Matlon's key conclusions were based was "statistically naive... and that his conclusions could not follow from either his own or any possible re-interpretation of the data presented by him" (96, p. 270).

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APPENDIX A

NIGER: SELECTED DEVELOPMENT INDICATORS

INDICATOR	YEARS 1960	1975	1979	1980	UNIT OF MEASURE
GNP per capita	--	160	--	330	U.S. Dollars
GDP	250	595	--	1,890	Millions of U.S. Dollars
GDP per capita	77	123	--	342	U.S. Dollars
Terms of trade	98	100	138	80	Index: 1975 = 100
Exports	--	86[a]	--	290	Millions of U.S. Dollars
Imports	--	173[a]	--	630	Millions of U.S. Dollars
Debt service	0.6[b]	0.9[a]	--	2.2	Percent of GNP
Life expectancy at birth	37	39	--	43	Years
Infant mortality rate	191	162	146	--	Number per 1,000 for age 0-1
Child death rate	45	--	31	--	Number per 1,000 for ages 0-4
Population per physician	82,170	--	41,060	--	--
Population with access to safe water	--	27	--	--	Percent of total population
Adult literacy	1	8	--	--	Percent of total population
Primary school Enrollment	5	17	23	--	Percent of age group
Secondary school	--	2	4	--	Percent of age group

APPENDIX A, continued

INDICATOR	YEARS 1960	1975	1979	1980	UNIT OF MEASURE
Labor force in agriculture	95	--	91	--	Percent of adults over 15 years of age
Urbanization	6	10	--	13	Percent of total population
Energy consumption	5	35	46	--	Kgs of coal equivalent
Food imports (Commercial)	--	12.9[a]	--	42.9	Thousands of metric tons of grain
Food aid imports	--	74.8	23.2	--	Thousands of metric tons of grain
Disbursements of official development assistance (ODA)	36[b]	141	172	240	Millions of U.S. dollars
Per capita ODA	8.53	29.20	31.95	42.23	U.S. dollars
Fertilizer consumption[c]	602	2,070	5,008	5,550	Metric tons
Fertilizer use	0.20	0.65	1.3	1.7	Kgs per ha of cropland
Fertilizer per capita	0.14	0.43	0.93	1.0	Kgs per capita

	1960-1970	1970-1980	
Rate of inflation	2.1	12.2	Average annual percent
GDP growth rate	2.9	2.7	Average annual percent
Population growth rate	3.3	2.8	percent
Urban population growth rate	7	6.8	percent

APPENDIX A, continued

INDICATOR	YEARS 1960-1977		1960-1980	UNIT OF MEASURE
GNP growth rate	-1.4		-1.6	Average annual percent
	1960-1977	1968-1975	1976-1981	
Satisfaction of food production needs	115	88	103	Percent of needs
	1975-1977	1977-1979	1978-1980	
Food production per capita	79	89	93	Average index 1969-1971 = 100

Sources: World Bank, World Development Reports (1978, 1979 and 1982) and Accelerated Development for Subsaharan Africa: An Agenda for Action (1981); and OECD/CILSS, "Le Developpement des Cultures Pluviales au Niger" (Club de Sahel, September 1982, Paris).

a/ 1976

b/ 1970

c/ Reflects only fertilizer distributed by the government of Niger's parastatal firm which has a monopoly on fertilizer trade.

APPENDIX B

Niger: Millet and Sorghum Production Data and Annual Rainfall of Niamey Airport, 1964-1983

YEARS	POPULATION (000)	MILLET (M) SURFACE (Ha) (000)	MILLET (M) PRODUCTION (Mt) (000)	MILLET (M) YIELD (Kgs)	SORGHUM (S) SURFACE (000)	SORGHUM (S) PRODUCTION (Mt) (000)	SORGHUM (S) YIELD (Kgs)	TOTAL PRODUCTION (M + S) (000)	PER CAPITA (Kgs)	RAINFALL, NIAMEY AIRPORT (MM)
1964	3,590.0	1,777.0	1,013.4	570	453.0	315.4	696	1,328.8	370	854.4
1965	3,690.0	1,810.0	789.5	436	465.0	265.6	571	1,055.1	286	728.4
1966	3,790.0	1,743.0	846.8	486	545.7	277.1	508	1,123.9	297	506.0
1967	3,890.0	1,864.6	1,000.1	537	530.2	342.2	645	1,342.3	345	868.4
1968	4,000.0	1,895.2	732.6	387	556.8	301.0	541	1,033.6	259	543.6
1969	4,100.0	2,271.9	1,035.4	456	595.6	387.6	651	1,423.0	347	600.6
1970	4,220.0	2,309.8	870.9	377	593.1	230.2	380	1,101.1	261	476.9
1971	4,330.0	2,355.8	958.0	407	579.1	266.8	461	1,224.8	283	467.5
1972	4,450.0	2,194.8	918.8	419	580.8	208.4	359	1,127.2	253	342.6
1973	4,570.0	2,007.7	626.9	312	448.0	126.1	282	753.0	165	390.5
1974	4,700.0	2,230.0	882.6	495	541.7	218.9	404	1,101.5	235	500.0
1975	4,830.0	1,692.9	581.3	343	790.9	253.8	320	835.1	173	689.5
1976	4,960.0	2,526.9	1,019.1	403	615.5	286.6	466	1,305.7	263	508.4
1977	5,098.4	2,728.5	1,130.3	414	732.5	334.0	456	1,464.3	287	556.3
1978	5,239.6	2,746.7	1,091.0	397	795.9	361.4	454	1,452.4	277	663.1
1979	5,384.7	2,922.1	1,245.9	426	716.7	345.8	483	1,591.7	296	524.2
1980	5,533.9	3,072.4	1,368.5	445	762.1	379.6	494	1,748.1	316	585.6
1981	5,683.3	3,060.3	1,371.4	448	987.0	379.8	384	1,751.2	308	518.1
1982	5,836.8	3,061.0	1,294.2	423	1,154.0	355.7	308	1,649.9	283	328.3
1983[a/]	5,994.4	--	--	--	--	--	--	1,674.0	279	--
AVERAGES:		--	--	431	--	--	467	--	279	--

Sources: M.G. Wentling, "Per Capita Production Chart for Niger, Millet-Sorghum, 1964-1980" (USAID/Niamey, December 1980, draft manuscript); OECD and CILSS, "Le Developpement des Cultures Pluviales au Niger" Club de Sahel, Paris, September 1982, draft manuscript; Economie-Jeune Afrique (Paris) December 1982; Niger, Ministry of Rural Development, "Rapport sur la Reunion des Cadres Nationaux et Departementaux de l'Agriculture," (February 1983); and Niger, National Meteorological Service, "Bulletins Agrometeorologique" (1964-1982).

a/ Amounts shown for 1983 are the author's estimated projections.

APPENDIX C

BASIC STATISTICS ON THE PROJECT ZONE

Definition of Zonal Limits: The project zone (Phase I) covers the administrative districts (arrondissements) of Filingue, Quallam, and Niamey, which are situated north and northwest of the capital city of Niamey (est. pop. 225,314). The northern limit of the zone is the 14° 40' N parallel (approximately the 350 mm rainfall line). The Niger Riverine areas (approximately 5 kilometers from each bank) are excluded.

Surface area: 30,000 km^2 (3,000,000 ha.)

Population (1977): 279,518 rural inhabitants

Average population density: 9.3/km^2

Average village size: 535

Number of villages: 523

Average family size: 6 persons

Cultivable surface area: 22,000 km^2 (2,200,000 ha.)

Cultivated surface area: 3,000 km^2 (300,000 ha.)

Irrigated surface area: 2 km^2 (200 ha.)

Surface area not cultivable: 8,000 km^2 (800,000 ha.)

Average farm size: 6 hectares

Number of farms: 60,000

Average adult-male equivalent work force/farm: 3

Average crop yields: millet--283 kg/ha.

sorghum--255 kg/ha.

cowpeas--105 kg/ha.

Weekly rural markets: 17

Education: 16.3% primary school enrollment rate; less than 1,000 students in 3 secondary schools

Nutritional findings: 17% chronic and 8.6% acute child undernutrition

Health services: 1 dispensary/23,000 people; 9,400 people/medical agent

Rainfall: 350-600 mm concentrated in 100-day period (June-September)

Temperature: 40° C regularly attained in April-May; lowest temperatures of 15-16° C attained in December-January

Elevation: 260-290 meters above sea level

*Derived from estimates present in Niger, Ministry of Rural Development, Rapport Annuel du Projet Productivite Niamey--1979, and USAID/Niger, "Project Paper, Niamey Department Development Project--Phase II" (Niamey, Niger, April 28, 1981).

APPENDIX D

Major Millet and Cowpea Pests and Diseases in Niger

Crop	Name of Pest/Disease	Damage	Remarks
	Insects:		
Millet	Rhaguva albipunctella R. bordati R. graminivorella	Eat flowers, mine surface of seed head, cutting lower peduncles.	Not abundant until 1974. Losses estimated at 20-25%. Worse in damp weather.
	Geromyia penniseti	Eats flowers.	Attacks just as new heads appear. Difficult to reach with pesticides.
	Mylabria, Coryna	Eats flowers	Also eats cowpea flowers.
	Schizonicha africana Pachnoda africana Anomala plebeja	Eats flower parts and young milky grains.	Attack at night. Infestation in 1980 more widespread and serious than usual.
	Chilo pyrocaustalis C. partellas	Stem borer.	Widespread, annual attacks.
	Haimbrachia ignefusalis	Stem borer.	Widespread, annual attacks.
	Busseola fusca	Stem borer.	Widespread, annual attacks.
	Sesamia calamistis	Stem borer.	Widespread, annual attacks.
	Spodoptera littoralis Heliothis sp., Agrotis	Defoliators.	Also attack cowpeas.
	Nezara viridula Agonosceles leontyii Acrosternum acutum	Suck milky seeds.	Also attack cowpeas.

Crop	Name of Pest/Disease	Damage	Remarks
Cowpeas	Anoplochemis curvipes Mirperus jaculus Clavigralla Tomentosicollis	Pod-sucking insects, cause young pods to shrivel and drop, and shrivel seeds in mature pods.	Also attack cotton and peanuts.
	Megalurothrips sjostedti	Sucks plant juices from buds, flower peduncles, flowers.	Causes bud abortion. A severe attack prevents flowering.
	Marucca testulalis	Eats flowers, mines pods.	Does wide-spread, annual damage.
	Ootheca mutabilis	Chews holes in leaves of young plant.	A virus vector, sendom does much physical damage.
	Aphis craccivora	Sucks plant juices.	Virus sector, seldom a serious pest otherwise. (Carrier of the rosette virus which stunts groundnut plants.)
General for both crops	Grasshoppers:		
	(Orthoptera: families Acrididae, pyrgomorphidae)	General defoliators.	Eleven major different varieties. Responsible for 25% of losses. Invasions require major spraying activities.
	Locusts:		
	Locustidae Locusta migratoria Migratoroides Shistocerca gregaria	General defoliators.	Invasions are devestating and require massive aerial spraying (330,000 ha. sprayed for locusts and grasshoppers in 1978). Last major locust plague was in 1954.

Crop	Name of Pest/Disease	Damage	Remarks
	Birds:		
	Quelea quelea, black-faced dioch Ploceus cucullatus, village weaver Passer luteus, golden sparrow		
	Rodents:		
	Praomys natalensis Arvicanthis niloticus Gerbullus agog G. gerbillus Taterillus gracilis		A constant menace and in some years large outbreaks cause much damage.
	Diseases:		
Millet	Sclerospora graminicola Tolyposporium penicillariae		Mildew. Grain smut.
Cowpeas	viruses, bacterial diseases Cercospora sp.		
	Weeds:		
Millet	Striga hermonthica S. eutea		10-50% of crop is lost to this "symbiotic" weed.
Cowpeas	Striga gesneroides		
General for both crops	sedges, genus Cyperus		

Source: P. C. Matteson, "Crop Pests in Niger" (USAID/Niamey, Niger, September 1980, mimeographed).

APPENDIX E

SAMPLE PROFILE OF A "TYPICAL" SOIL FOUND IN THE PROJECT ZONE

Location: Hamdallaye, Niger (approx. 30 kms. Northeast of Niamey, Latitude 13°31'N, Longitude 2°07'E)

Soil Profile

Classification: Sandy, siliceous, hyperthermic family of Paleustults (No subgroups yet defined).

Ap&A1	0-21 cm	Yellowish red (5YR 4/6) fine sand; massive; soft; clear boundary.
B1	21-65 cm	Red (2.5YR 4/6) loamy fine sand; massive to weak subangular blocky structure; hard; gradual boundary.
B2t	61-166 cm	Red (2.5YR 4/6) loamy fine sand; weaker subangular blocky structure; hard; gradual boundary.
B3	166-265 cm	Red (2.5YR 4/8) loamy fine sand; weak subangular blocky structure; hard; gradual boundary.
C	265-300+ cm	Red (2.5YR 4/8) fine sand; massive; hard.

Parent material: Eolian sand

Topographic position: Rolling upland

Drainage: Well drained

Vegetation: Annual grasses and forbs; some perennial shrubs, perviously cultivated.

Textural Classification

Horizon/ Sample	Depth	Sand	Silt	Clay	Textural Class
	cm	----------	%	----------	
Ap	0-21	95.0	2.2	2.8	Sand
B1	21-65	89.4	2.2	8.4	Sand
B2t	65-166	85.3	3.4	11.3	Loamy sand
B3	166-255	86.2	3.4	10.4	Loamy sand
C	265-300	89.2	3.4	7.4	Sand

Soil Properties

Horizon/ Sample	Depth	pH	O.M.	CEC	Exchangeable Cations CA	Mg	K	Na	Base Saturation
	cm		%		----meq/100 g-------				%
Ap	0-21	5.3	0.16	3.0	0.4	0.1	0.2	<0.1	23.3
B1	21-65	4.6							
B2t	65-166	4.9		2.5	0.5	0.1	0.2	<0.1	32.0
B3	166-265	4.2							
C	265-300	6.0							

SOURCE: B. L. Allen, "Report on Soils of Tarna, Doukoudoukar, Guescheme and Hamdallaye" (USAID/Niamey and Texas Tech University, 1978).

APPENDIX F

LIST OF PRINCIPAL PROJECT DOCUMENTS[a]

	Title[b]	Author	Date
1.	A Brief Description of Animal Traction Activity	M. Sargent	1977
2.	A Brief Analysis of the Impact of Modernization upon the Traditional Land Tenure System of the Zarma	S. Goldmark	1977
3.	Cost-Benefit Analysis of the Practices Used on Demonstration Fields	M. Wentling	December 1977
4.	Report on the Socioeconomic Survey of Six Villages	K. Luc and F. Reid	September 1978
5.	Evaluation of Demonstration Fields - 1978	J. Mullenax	August 1978
6.	On-Farm Storage Practices and Problems	C. Lindblad	November 1978
7.	Planning and Evaluation of Information Activities and Rural Organization	R. Charlick	1978
8.	Basic Analysis of an Average Farm	M. Wentling	December 1978
9.	Annual Report - 1978	Management	February 1979
10.	Analysis of Project Villages	M. Wentling	March 1979
11.	Brief Description of the Problems Involved in Supplying Agricultural Inputs	M. Wentling	March 1979
12.	Project Orientations for 1980 and the Second Phase (1981-1985)	M. Wentling and J. Mullenax	May 1979
13.	Analysis of the Profitability of the Improved Practices	J. Mullenax	June 1979
14.	Results of a Study of the Training of Agricultural Extension Agents	S. Radja	July 1979
15.	Results of an Examination of the First Project Evaluation and the Orientations for 1980 and Phase II	Management	July 1979

APPENDIX F, continued

	Title[b/]	Author	Date
16.	Evaluation of Proposals for the Development of Small-Scale Irrigation at Sargane	J. Mullenax and M. Wentling	August 1979
17.	Synthesis of Trip Reports for 1979	J. Mullenax	September 1979
18.	Guidelines and Policies for the Operation of the Farmer-Couple Training Center	J. Mullenax	October 1979
19.	Monographies on 82 Project Villages	Rural Animation Service	1979
20.	Agricultural Plan for 1980	Management	January 1980
21.	The Project's Agricultural Strategy and a Description of its Component Activities	J. Mullenax and S. Moussa	February 1980
22.	Potential Areas of Collaboration Between the Project and INRAN	M. Wentling	February 1980
23.	Annual Report - 1979	Management	March 1980
24.	Study of Rural Market Centers	M. Godfrey	March 1980
25.	Economic Analysis of Project Activities	D. Wagner	April 1980
26.	Nutritional Survey of the Project Zone	F. Zerfas and F. Awantang	August 1980
27.	Evaluation of Millet Grinding Mills Installed by the Project	D. Wagner	August 1980
28.	Local Employment Practices and Problems	M. Wentling	August 1980
29.	Evaluation of Millet and Cowpea Yields for 1980	D. Wagner	November 1980
30.	Report on Aerial Photography Work and Land-Use Maps of the Zone	J. Mullenax and J. Deschaunettes	November 1980

APPENDIX F, continued

	Title[b/]	Author	Date
31.	Guidelines for the Organization of the Farmer-Couple Training Centers for Phase II	J. Mullenax and S. Moussa	December 1980
32.	The Role of Women	M. Wentling	December 1980
33.	Annual Report - 1980 and Evaluation of Phase I (1978-1980) Activities	Management	March 1981
34.	Evaluation of the Phase I Experience with Credit and Agricultural Inputs System	T. Shaw, J. Mullenax and M. Wentling	April 1981
35.	Report on the Applied Research Component of the Project	J. Mullenax	July 1981
36.	Operational Guidelines for the Management of the Agricultural Credit-Inputs System	S. Moussa and J. Mullenax	July 1981

Source: M.G. Wentling, "End of Tour Report" (USAID/Niger, July 1981, draft manuscript).

a/ This list is just a sampling of the documents produced by the project. It does not include routine documents such as quarterly reports, minutes of meetings, trip reports, property inventory, etc. It also does not include key USAID documents such as the project papers, grant agreements, evaluation reports, audit reports, etc. Also not included are the many financial reports prepared by the project and USAID's controller's office. There is, of course, a wealth of additional information in the project management unit's office files (GON's and USAID's), which contain letters, cables, memorandums, personnel records, invoices, purchase orders, policy statements, etc.

b/ All titles have been abbreviated and translated from French to English by the author.

APPENDIX G

NIGER: PRICES FOR SELECTED AGRICULTURAL INPUTS (1980-1981)

Item	Actual Cost[a/] (CIF Naimey)	Transfer Price to Farmer	Subsidy Rate (%)
Fertilizers:[b/]			
Urea (45%N)	60/kg	35/kg	41.6
Single Super (18%P_2O_5)	45/kg	20/kg	55.6
Super Triple (46%P_2O_5)	120/kg	30/kg	75.0
15-15-15	52/kg	30/kg	42.3
Draft Implements:			
Basic Plough	14,500-16,500	4,000	72.4-75.6
5-tooth Cultivator	16,360-19,980	4,000	75.6-80.0
Donkey Hoe	15,580	8,000	48.6
Lifter/Weeder	7,500-8,000	2,500	66.7-68.8
Mono-row Seeder	42,000-60,000	18,000	57.1-70.0
Transport Equipment:			
Donkey Cart	60,000	45,000	25
Cattle Cart	75,000-80,000	65,000	13.3-18.8
Pesticides:			
Proprothion or fenithrotion (insecticides)	1,200/liter(est.)	600/liter	50%
Thioral (fungicide)	60/packet (25 gr.)	30/packet	50%
Improved Seeds:			
Millet/Sorghum[c/]	485/kg	105/kg	78.4
Cowpeas	80/kg(est.)	65/kg	19.8

Sources: M. G. Wentling, "Description of Project's Credit Fund and Agricultural Inputs Operations" (USAID/Niamey, April 1980, mimeographed) and T. Shaw, "Prix des Materiels et Intrants Agricoles" (USAID/Niamey, November 20, 1981, mimeographed).

a/ All costs and prices in CFA francs (210 CFA francs = $1.00 U.S. in 1980 and 300 CFA = $1.00 US in 1981).

b/ Transfer prices of fertilizer have remained the same since 1973.

c/ Reflects 1982 costs and prices.