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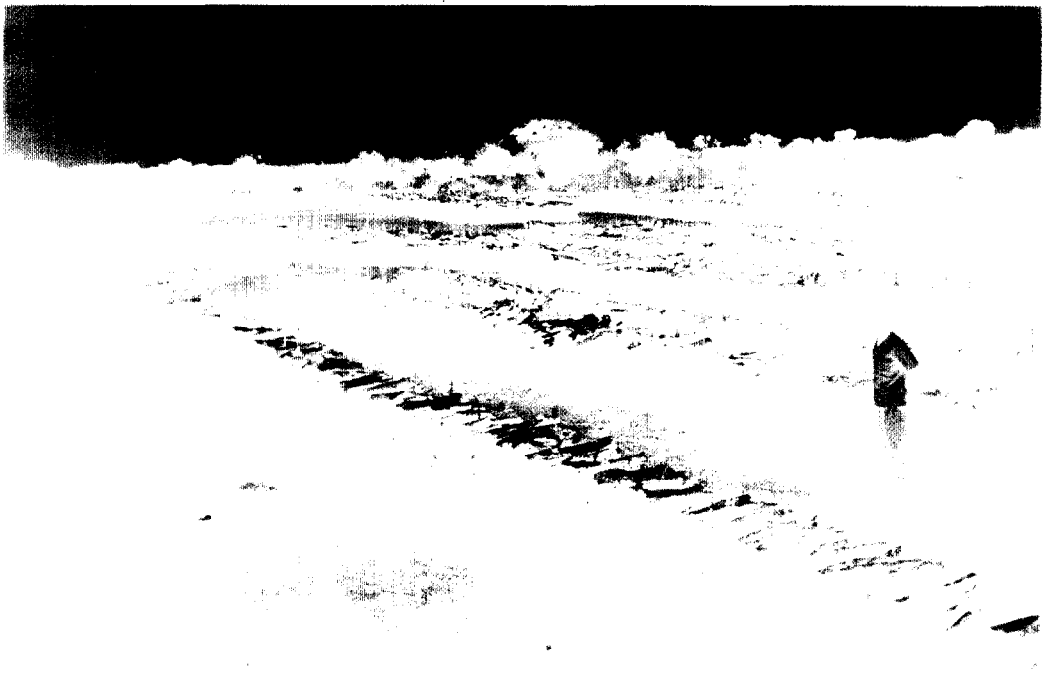
Energy Series

The Niger Household Energy Project

Promoting Rural Fuelwood Markets and Village Management of Natural Woodlands



Joint United Nations Development Programme / World Bank

ESMAP

Energy Sector Management Assistance Programme

Gerald Foley, Willem Floor, Gérard Madon, Elhadji Mahamane Lawali, Pierre Montagne, and Kiri Tounao

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Gerald Foley, Willem Floor, Gérard Madon, Elhadji Mahamane Lawali, Pierre Montagne, and Kiri Tounao

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Foreword

This contribution to the World Bank Technical Papers, Energy Series, reviews the Household Energy Project, which is implementing an innovative strategy for sustainable management of natural woodlands and production of fuelwood for Niger's major cities. The new strategy is of great importance for Niger and, potentially, for other Sahelian countries that face deforestation and desertification from natural events such as droughts and from unregulated mining of their vital biomass resources. The project arose from a study completed in 1987 that was sponsored by the government of Niger and the Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP). ESMAP was established in 1983 to provide technical assistance on sustainable energy to developing countries and is administered by the Industry and Energy Department. In 1988 an $11 million credit from the International Development Association (IDA) supported the Household Energy Project itself.

The project, which began in 1989, offers an integrated program of taxation and land tenure reform that devolves responsibility for managing natural woodlands to rural communities instead of allowing indiscriminate wood cutting from state lands by urban entrepreneurs. Its supply component includes the development of fuelwood markets run in the rural areas by local villagers, who collect sales taxes from urban fuelwood wholesalers to ensure that the full economic value of the wood is reflected in its price. The villagers, in turn, agree to exercise continuing stewardship over their local woodlands. The demand component of the project includes promotion of improved wood and petroleum-product stoves to reduce biomass consumption. Because it recognizes the interest of the villagers in controlling and protecting their own environment and the needs of city dwellers for secure supplies of cooking fuel, the project promotes sustainability in a way that comports well with both rural and urban interests.

The effort in Niger illustrates the World Bank's new initiatives on rural energy (elaborated in *Rural Energy and Development: Improving Energy Supplies for Two Billion People,* recently published in the Bank's Development in Practice series). The multifaceted initiatives involve technical, institutional, and policy reforms. They aim at mobilizing local entrepreneurs, private investors, and international agencies to promote sustainable production and use not only of modern energy supplies—such as petroleum products and electricity—but also of the traditional fuels upon which many millions of people in the developing world will remain dependent for decades to come.

Richard Stern
Director, Industry and Energy Department

Abstract

A radical new approach to dealing with the problems of energy and the environment in the Sahel is currently being implemented in Niger. The government is giving village communities control over their natural woodlands in return for a commitment to manage the woodlands and the production of fuelwood sustainably. By devolving responsibility for woodland management to the village community—the unit best-placed to carry out such management and the one that will benefit most from its success—the government aims to create a sustainable fuelwood supply for the capital, Niamey, and other major towns.

Under traditional arrangements in Niger, urban wood traders have dispatched teams of woodcutters into the countryside. These woodcutters simply take what they need from land owned by the state and truck it back to the cities, with little or no consideration for the sustainability of supply. Villagers in the areas where wood is being harvested have had no power to regulate the cutting and receive no benefits from it. As a way of breaking this pattern, the Household Energy Project developed the concept and practice of the rural fuelwood market. Under this system, communities are given formal rights to manage their local areas of natural woodland and exclusive rights to sell all the fuelwood produced through the rural markets. In return, the communities sign an agreement to manage the woodland sustainably. The project was designed as a result of a study by the government of Niger and the Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP) and funded by a World Bank/IDA credit.

The present paper details the rationale, history, and prospects for this innovative energy strategy. After a nontechnical summary of the project and its results to the end of 1995, the paper describes the local physical and socioeconomic conditions, with particular attention to the "tiger bush" that forms much of Niger's natural woodland. Chapter 2 treats the background of fuelwood interventions, which began in response to the Sahelian drought of 1974 and encompassed sponsorship of semi-industrial plantations of fast-growing exotic species and efforts to encourage cultivation and control harvesting. Soon abandoned as impractical, these approaches gave way to the more systematic examination of existing resources by the ESMAP team and their use by the Household Energy Project, as described in chapter 3. The supply component of a new woodfuels strategy centered around the idea of the rural fuelwood market and sustainable management of woodfuels. A demand component was aimed at encouraging dissemination of improved woodfuel and petroleum-product stoves and outlined revisions in tax and pricing policies.

The practical and legal aspects of the project's implementation after its official launch in 1989 are discussed in chapter 4. Chapter 5 presents some measures of the project's achievements and difficulties; at present, about 16 percent of Niger's urban fuelwood supply comes from sustainably managed areas. Chapter 6 considers how the project might be expanded during Phase II. If it can be expanded, the approach will have potential for replication over much of the Sahel and other countries in Sub-Saharan Africa.

Acknowledgments

This report describes Phase I of the Government of Niger–World Bank Household Energy Project. The project was designed as a result of a study completed in 1987 by the government of Niger and the Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP) and was funded by a 1988 World Bank/IDA credit. The present report presents results to the end of 1995 of the project's efforts to promote sustainable management of Niger's natural woodlands and provide adequate fuelwood supplies to Niger's major cities.

Because of its innovative character, the project needed much support to be considered for Bank funding. This support was given by Jean-François Bauer, at that time chief of the Sahel division; Ignatius Menezes, his right hand; and Jean Gorse, forester.

Willem Floor was the World Bank task manager for the project, and Gérard Madon was coordinator of technical assistance. Elhadji Mahamane Lawali was director of the supply component, Kiri Tounao was director of the demand component, and Pierre Montagne was resident external adviser to the supply component.

Grateful thanks are extended to Lawaly Ada, director of the Environment Directorate; Abdul Haji, resident representative of the World Bank in Niamey; Sophie Noestrup, Danish International Development Agency resident representative in Niamey; Madougou Idrissa, director of Tchip-Import; François Haaser; Tiemou Issoufou; Oumarou Sanda Lawan; Ibrahim Idi-Issa; Dieter Geesing; and all who provided information and otherwise helped in the preparation of the report.

The report was written by Gerald Foley. It was edited by Paul Wolman and Caroline McEuen. Carole-Sue Castronuovo provided word-processing assistance.

Abbreviations and Acronyms

English		*French*
	Association Nationale des Exploitants de Bois	**ANEB**
	Niamey Fuelwood Dealers Association	**ASEBN**
	Brigade Territoriale pour la Protection de la Nature	**BTPN**
	Caisse Centrale de Coopération Economique,	**CCCE**
	now Caisse Française de Développement	**CFD**
	Centre International de Recherche en Agronomie pour le Développement	**CIRAD**
	Comité Inter-Etats de Lutte contre la Sécheresse au Sahel	**CILSS**
ESMAP	Energy Sector Management Assistance Programme	**PAGE**
	Fonds d'aide et de cooperation	**FAC**
FAO	U.N. Food and Agricultural Organization	
FLUP	Forestry Land-Use and Planning Project	**PUSF**
	National Solar Energy Office	**ONERSOL**
GDP	gross domestic product	
GIS	Geographical Information System	
GPS	Global Positioning System	
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit	
IDA	International Development Association	
ha	hectare	
km	kilometer	
l	liter	
LPG	liquefied petroleum gas	
mm/year	millimeters per year	
NGO	nongovernmental organization	
		ORSTOM
	Projet Foyers Améliorés Phase II, executed by GTZ	**PFAII**
	National Gas Project (Projet National Gaz)	**PNG**
PIES	Permanent Information and Evaluation System	
PV	photovoltaic	
		SONIDEP
UNDP	United Nations Development Programme	**PNUD**
UNIFEM	U.N. Development Fund for Women	
UNSO	U.N. Sahelian Office	
USAID	United States Agency for International Development	

Currency Equivalents

The currency unit in Niger is the FCFA (franc de la communauté financiére africaine).

Before 12 January 1994

50 FCFA = 1 F
280 FCFA = US$1.00

After 12 January 1994

100 FCFA = 1 F
580 FCFA = US$1.00

Units of Measure

Fuelwood quantities in the field are usually measured in *steres.* A stere is a stacked cubic meter of cut wood. The weight per stere depends primarily on the density with which the wood is stacked, which in turn depends on its size and straightness. Small branches, for example, stack together more loosely than logs.

The figures used in the Household Energy Project are based on actual measurements and are as follows:

Small wood:	225 kg/stere
Medium-sized wood:	300 kg/stere
Large wood:	350 kg/stere
Average:	300 kg/stere.

Executive Summary

A radical new approach to dealing with the problems of energy and the environment in the Sahel is currently being implemented in Niger. The government is giving village communities control over their natural woodlands in return for a commitment to manage them sustainably.

By devolving responsibility for managing the natural woodlands to the village community—the unit best-placed to carry out such management and the one that will benefit most from its success—the project aims to create a sustainable fuelwood supply for the capital, Niamey, and other major towns. At present, about 16 percent of the urban fuelwood supply comes from managed areas. If the outcome of the first phase of the project can be expanded and made permanent, it promises to be a major breakthrough, with potential for replication over much of the Sahel and other countries in Sub-Saharan Africa.

Niger

Niger is a huge, landlocked country with a population of about 8 million. Some 85 percent of the people live as subsistence farmers and pastoralists. With a per capita gross domestic product (GDP) of about US$280, it is among the world's poorest countries. Niamey, the capital, now has a population of about 600,000, and it is doubling in size every 12 years.

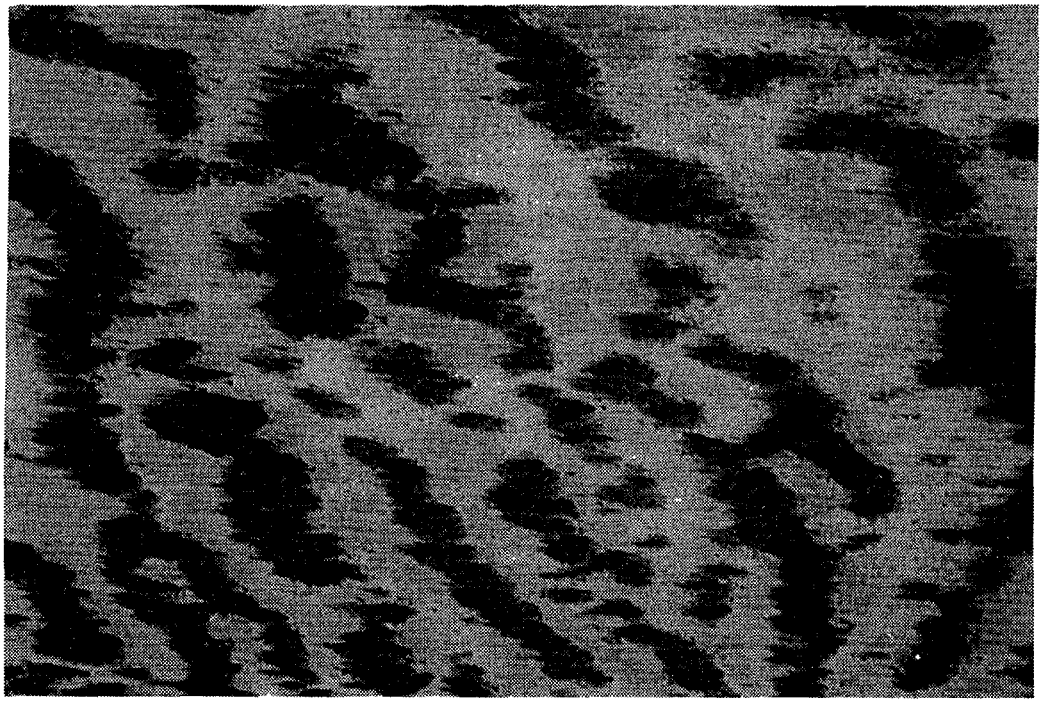
The northern three-quarters of the country is mainly desert, an extension of the Sahara. In the sparsely populated center band of the country, where the natural vegetation is a light savanna woodland, rainfed agriculture is just barely possible, but there is always a risk of drought. The people living here keep large herds of livestock that they move north and south with the seasons in search of grazing and water.

In the South, where the rainfall is in the range of 350 to 800 millimeters, agriculture is more reliable. Here, the natural vegetation is savanna woodland. About 90 percent of the population lives in this area, which covers about 12 percent of the country.

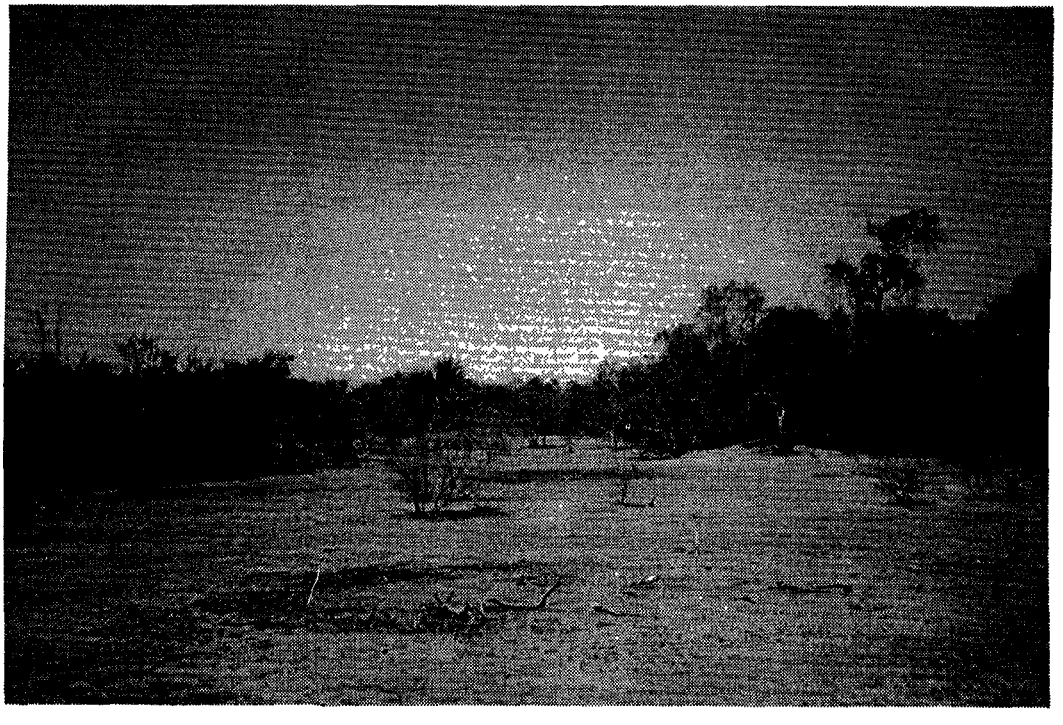
Natural Woodlands

Niger's comparatively sparse biomass reserves have long been cause for concern in light of the country's dependence on fuelwood. Even in the comparatively well-vegetated South, Niger does not have forests in the sense typical of the moist tropical and temperate regions. Rather, most of Niger's *natural woodlands*—a term used to emphasize their distinct differences from forests—occur as strips or patches of vegetation interspersed with areas of hard, impervious, denuded soil (Figure 1). The striped appearance of the terrain from the air has led to its nickname,"tiger bush."

Figure 1 Tiger Bush Formations



A. Tiger bush, aerial view.



B. Tiger bush, ground-level view.

Large areas of natural woodland have been cleared for agriculture. Trees are also cut to supply fuelwood to the urban areas. Around Niamey, the tree cover has been so reduced that, from the air, the city itself appears as by far the most heavily wooded area within a radius of 30 to 40 kilometers. During the 1970s, amid fears of a fuelwood supply crisis within the coming decades, there were proposals for large plantations, some of them irrigated, of fast-growing tree species such as eucalyptus and neem. Indigenous species, because of their slow growth, were not considered capable of producing the quantities of fuelwood required in time to avert the anticipated crisis.

By the early 1980s, however, it was becoming clear from experience in Niger and elsewhere in the Sahel that the plantation approach was a dead end. Survival rates of planted trees were poor, and yields were often less than those of the natural woodlands that had been clear-cut to make way for the new plantations. With costs of harvested wood running up to ten times the retail selling prices of wood from natural woodlands, the economics of the plantations were hopeless. At the same time, research into the natural Sahelian woodlands was finding that their stocks and yields, especially if managed and protected, were considerably greater than previously thought. Attention therefore turned to the possibility of introducing rational management of the natural woodlands as a means of meeting future fuelwood demands.

The Household Energy Project

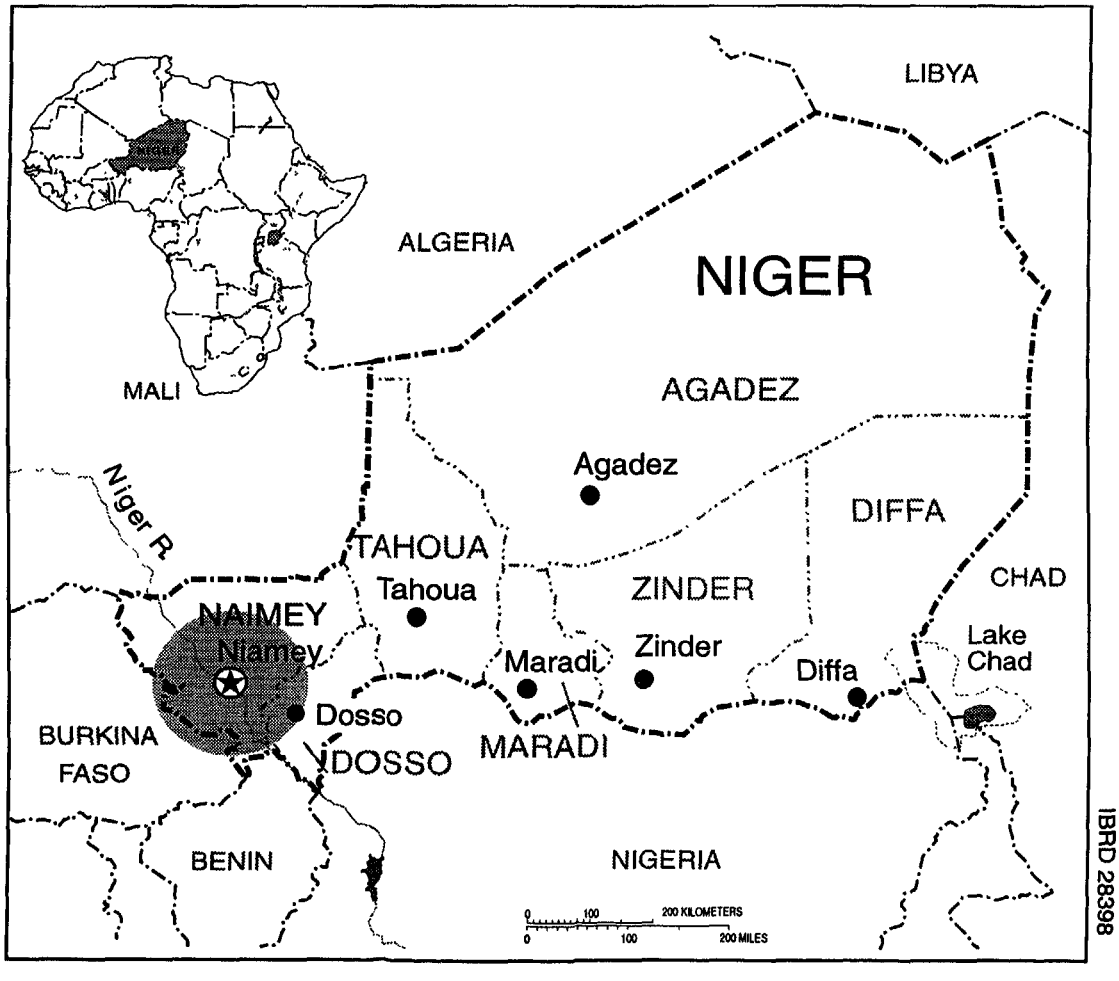
The World Bank Group first became involved in the work being done in Niger in 1978, when it launched a forestry project, usually referred to as the IDA/FAC/CCCE project (for the initials of the collaborating groups—the Bank Group's International Development Association and the French development assistance agencies, Fonds d'Aide et de Coopération and Caisse Centrale de Coopération Economique). The first detailed survey of the country's fuelwood supply system—carried out in 1984 within the framework of this project—showed that fuelwood provided virtually all the cooking fuel used by families in both the urban and the rural areas. A transport census showed that about 110,000 tonnes of fuelwood were being brought into Niamey each year. The project estimated that in the absence of alternative fuels, this consumption would grow at the same rate as the population of the city, about 6 percent yearly.

Around the same time, the first major natural woodland management project in Niger was getting under way in the badly degraded Guesselbodi National Forest to the southeast of Niamey. This project, which was carried out with funding from the U.S. Agency for International Development (USAID), was designed to draw village communities into the restoration and management of their natural woodland areas. Working under the direction of the forest service, local people were paid to carry out a range of woodland restoration measures. These included creation of "microcatchments" and small check dams to increase rainwater infiltration in the denuded areas of the tiger bush. The intention was that the local people would subsequently manage the woodland area under the direction of the forest service; in return they would be allowed to harvest and sell fuelwood and fodder.

Against this background, the Household Energy Project was designed by a joint government of Niger–World Bank team working in Niger in 1986. At the time, the initial results of the Guesselbodi project suggested that rational management of the natural woodlands in the supply catchment areas of Niger's main cities could enable the cities to meet a major proportion of their fuelwood needs in a sustainable manner. It was also evident, however, that unless the growth in fuelwood demand could be brought under control, it would rapidly outstrip and overwhelm any such sustainable supply.

The design of the Household Energy Project was therefore based on a two-pronged approach. The supply component focused on the management of the natural woodlands in the fuelwood catchment areas of Niamey and the other major towns (Figure 2). The demand component concentrated on the promotion of substitute fuels, principally kerosene and liquefied petroleum gas (LPG), as a means of limiting the growth in fuelwood demand.

Figure 2 Niger, Showing Niamey Fuelwood Catchment Area



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The Supply Component

The major problem facing the design team on the supply side was that rational management of the natural woodlands could not take place under the existing legal system. In Niger, as in other Sahelian countries, control over natural woodland is vested in the state. Villagers have rights to the collection of deadwood and fodder from the natural woodlands around them, but they are forbidden to cut living trees. The forest service enforces these laws, punishing rural people found transgressing them and thereby contributing to a legacy of hostility and mistrust between rural people and foresters.

In contrast to the local people, commercial fuelwood traders from the urban areas, once they obtain a cutting permit from the forest service, have free access to the natural woodlands. From the urban areas, the traders dispatch teams of woodcutters equipped with lorries into the countryside. Villagers have no power to control or restrict the activities of these teams—the woodcutters simply cut whatever fuelwood they need, load it onto lorries, and take it to the urban markets. The wood belongs to the state, and thus no payment need be made to the local community.

One of the most pernicious effects of this system is that it removes any incentive for rural people to manage their local woodlands. Villagers will see little point in encouraging the regeneration of areas after cutting if their efforts will only benefit the next team of urban woodcutters coming to the area.

A New Strategy: The Rural Fuelwood Market

As a way of breaking out of this impasse, the design team developed the concept of a rural fuelwood market as the centerpiece of its strategy. Under this plan, local communities would be given formal control over their own areas of natural woodland and exclusive rights to all the fuelwood produced. In return, the communities would sign an agreement to manage the woodland sustainably.

It was clear, however, that the woodfuel traders would not voluntarily accept an arrangement that precluded use of their own low-cost labor and restricted their access to the natural woodlands. The design team therefore proposed a differential tax system that taxed urban fuelwood supplies from controlled rural markets at a substantially lower rate than supplies from the open, natural woodlands, thus providing a financial incentive for traders to use the rural markets.

This, in turn, raised the question of enforcement. At the time, the law required that fuelwood lorries entering the urban areas be stopped and checked to ensure that the driver had the appropriate cutting permit. The system was barely functioning, however, and only a small proportion of the permit fees were actually collected. Enforcing the differential tax regulations would require a compete overhaul of the existing fuelwood traffic control system.

Additional questions had to be answered as well. At Guesselbodi, local people were employed to implement woodland restoration measures, and guards were paid to protect newly harvested areas against grazing animals so that the trees could regenerate.

Such measures could be implemented in areas under the direct control of the forest service as long as external funding was available, but there was little hope that local people would continue the program after the end of the project. If a sustainable system of natural forest management was to be introduced, it would have to be based on actions the villagers were prepared to undertake voluntarily. Developing such a system would be one of the main tasks of the project.

The opposition of the forest service also had to be overcome. Few foresters believed that local people were capable of managing their natural woodlands responsibly and sustainably. They were also fully aware that granting control of the country's natural woodlands to local communities would greatly diminish the role and power of the forest service in the rural areas.

The difficulties of achieving the project objectives were clearly foreseen when it was reviewed for approval. In today's more cautious and restricted funding climate, it is unlikely it would have been given the go-ahead. The timing was advantageous, however, and the program was launched in 1989 with the support of a $10.3 million grant, later increased to $12.3 million, from the Danish government.

Implementation

Once the project was under way, the implementing team set about collecting the needed working data. Detailed surveys of the fuelwood supply chain, from the urban consumer back to the source of supply in the rural areas, were begun. Inventories of the natural woodland resources around Niamey and the other major urban areas were carried out.

The fuelwood traders' professional association was brought into the discussions on how the supply system could be improved and made sustainable. The long process of drawing up and awaiting legislative passage of the necessary new land tenure and taxation regulations was begun. Large-scale trials of natural woodland management methods were initiated in collaboration with village communities at Tientiergou, to the south of Niamey.

As data became available, master plans for the supply of fuelwood to Niamey, and the next-largest towns, Zinder and Maradi, were developed. These plans divided the fuelwood catchment area into "decision grids," which displayed the standing stock of wood, the potential annual yield, the estimated amount of fuelwood consumed locally, and the amount that could be sustainably supplied to the city for each part of the individual catchment areas. Sociological studies added information on economic and social conditions in the different areas.

When they were drawn up, the master plans provided a basis for planning the fuelwood supply to each urban area. They highlighted the areas where the natural woodlands were already overexploited and the harvesting of fuelwood should be discouraged. They also identified areas of plentiful fuelwood resources where setting up rural markets should be a priority.

Effects of the Tientiergou Findings

The results of the research into natural woodland management carried out at Tientiergou provided a major boost to the project. They also have important implications for future natural woodland management projects in the drier areas of the Sahel.

The research results demonstrated that measures to increase infiltration of vegetation into the denuded areas of the tiger bush, in addition to being expensive and locally unpopular, tend to be counterproductive. If these efforts succeed in increasing infiltration in the areas without vegetation, they deprive the vegetated areas of the amounts of water they need and lead to increased tree mortality and a general degradation of their ecology. It appears that tiger bush represents a natural climax vegetation cover, and any other distribution of the available rainwater reduces the amount of woody biomass produced.

Equally surprising results emerged from the studies of protection against grazing—complete suppression of grazing was found to be undesirable. If no grazing takes place, grass grows excessively, at the expense of trees, leading to the development of a degraded grass-and-bush savanna. Simply protecting the stumps of newly cut trees for the first growing season with light branches, obtained from the cut tree itself, was found to be sufficient to allow regeneration to occur.

The study also highlighted the merits of the traditional method of harvesting the tiger bush. Because of the laws prohibiting tree cutting, woodcutters usually worked furtively, taking only a small number of trees in each area. Designed to conceal the activity from foresters, this harvesting method had the effect of leaving the basic structure and regenerative capacity of the woodland intact.

These findings provided the project with the simple model it required for natural forest management. Cutting of trees should be selective, leaving behind all those with a diameter of less than 6 centimeters (the thickness of a wrist) or 8 centimeters (the thickness of an ankle), depending on the species. Potentially valuable timber species should be left until they reach a harvestable size. The only protection from grazing required is that the regenerating shoots from newly cut trees be protected with a loose layer of cut branches during the first growing season. It is a workable system, familiar to the local population, and easily implemented by villagers once they have control over their own woodlands.

Progress to Date

Despite a few hiccups, and in the face of the doubts of the pessimists, the project has succeeded in overcoming its main obstacles. The national forestry legislation has been amended, and villages can now sign agreements that give them exclusive rights to harvest fuelwood from their own natural woodlands and sell the fuelwood through a local market.

The fuelwood permit and taxation system has been revised. The tax on fuelwood from rural markets is now about half that on fuelwood from the uncontrolled natural

woodlands. Rural markets are allowed to retain a proportion of the tax for their own funds; they pass the remainder on to the government. Getting the tax system into place, however, has not been without problems. The new taxes are still far below those initially proposed by the project, and the government remains reluctant to raise them further.

Serious problems with the transport control system have also become apparent. Before the project, evasion and embezzlement were common, and only 15 percent of the taxes owed actually found their way to the Treasury. Significant investments were made by the project in setting up new control posts and training personnel, and the collection rate increased. On the transfer of the management from the project to the Department of the Environment, the collection rate fell sharply. In 1994, it was only about 30 percent of the total due.

Although they now seem reluctantly reconciled to the new arrangements, fuelwood traders were vehemently opposed in the beginning. They attempted to break the system by boycotting the first markets, but the government stood firm and refused to issue any cutting permits until the wood from the markets had been taken up by the traders.

The first few markets were set up in 1992. At the end of 1993, there were 21 in operation. The number had nearly doubled—to 38—by the end of 1994 and had reached 50 by mid-1995. At the end of 1995, the total was 85, of which 60 were supplying Niamey, 14 were supplying Zinder, and 11 were supplying Maradi. The quantity of fuelwood sold through the markets was 25,000 tonnes, about 16 percent of the total urban supply.

A Genuine Contribution to Rural Development

The turnover of the markets in 1995 was FCFA 103 million (about $200,000). Of this, some FCFA 83 million went directly to the woodcutters in the villages. The amount going to village funds was FCFA 12 million. These are modest sums by the standards of the industrial world, but in the subsistence villages of Niger, where few opportunities arise for cash-generating activities of any kind, they can be extremely significant.

A survey of villages with rural markets found that they have invested these funds in a number of useful ways: repairing wells and pumps, buying emergency stocks of grain after the harvest when prices are low, paying for vaccination services, improving and repairing mosques, advancing credit to woodcutters for the purchase of donkey carts, and setting up mininurseries of valuable tree species. The changes have also led to an obvious improvement in autonomy and morale. Villages with rural markets are no longer passively subject to the depredations of fuelwood traders, and they have acquired a significant degree of independence from the forestry service. Their authority to collect fuelwood taxes on behalf of the government is an important symbol of their new role and status.

Social and hierarchical changes within villages have also resulted from the project. The ability to use village funds to repair a well means that the village does not

have to rely on funding by a wealthy individual in exchange for a degree of control over the water supply. Having to manage funds also develops responsibility and initiative. For example, the manager of one rural market has traveled to Niamey to sign up merchants for his fuelwood production.

The effects of the project thus spread well beyond the issue of fuelwood supply. It has developed into a genuine rural development initiative that, even in the short time it has been running, has produced clearly perceptible social changes. Its importance is recognized at the local level, and it is being enthusiastically supported by the participating villages. As knowledge of the program spreads, other villages have begun applying for authority to establish their own rural markets.

The Demand Component

Activity in the demand component has concentrated mainly on the development and promotion of kerosene stoves. Collaboration with programs sponsored by other agencies has helped to promote a more efficient fuelwood stove, the Mai Sauki, and to promote wider use of LPG.

When work began on the project, kerosene stoves suitable for the cooking needs of Niger were not commercially available in West Africa. An Indonesian wick stove was located, however, and adapted for use in Niger by providing a metal pot support. It was renamed the Tchip stove for the Niger market.

The project has resolutely refused to become directly involved in the manufacture or marketing of the stoves. Instead, it has helped establish and support a private sector company, Tchip-Import, which initially imported and modified the Indonesian stoves, but has now developed its own versions. About 10,000 of the imported stoves had been sold by mid-1995, but—given the decline in the economy, rising kerosene prices and other factors—the sales prospects for both the imported and the locally manufactured stoves currently appear uncertain.

The project has also promoted the establishment of energy shops; these are specialized wholesalers and retailers of improved fuelwood stoves, kerosene stoves, and LPG stoves. They are also authorized wholesalers of kerosene supplied at a concessional rate by the national petroleum company, SONIDEP.

The achievements of the demand component have been modest. The costs of stoves and fuel, allied with the unwillingness of the government to raise woodfuel taxes to the initially agreed levels, have rendered kerosene commercially uncompetitive, which is a major deterrent to potential users. The prospects for substitution were further damaged by the 50 percent devaluation of the FCFA at the beginning of 1994.

Although the ambitions of the demand component have been scaled down greatly since the beginning of the project, it is still seen as an important element in the evolution of the household energy sector. Cooking with kerosene is cleaner, healthier, and more convenient than using fuelwood. Having the stove available on the market provides

households with an opportunity to enjoy these benefits, and ensures an element of competition in the domestic fuel market.

Looking to the Future

The major achievement of the project is that by establishing the rural fuelwood market system, it has closed the loop of responsibility. Villages that have set up their own fuelwood market now know they will enjoy or suffer the consequences of how they manage their natural woodlands. Once significant amounts of cash begin to flow into a village through its rural market, an incentive is created to introduce more effective management of the surrounding natural woodlands. An increasing body of evidence from around the developing world indicates that rural people are quite able to manage their woodlands effectively and profitably when they are given the chance to do so.

Looking to the longer-term future, the sustainability of the fuelwood supply appears achievable, even without the high levels of fuel substitution envisaged as necessary at the beginning of the project. The stock and yield assumptions that formed the basis of the master plans now appear unduly conservative. Almost certainly a great deal more fuelwood is available for the supply of the major towns than was originally assumed. The supply position is thus not as critical as was initially feared, which opens the way to a more flexible and relaxed approach to the regulation of fuelwood supply flows. This, in turn, can simplify the taxation and transport control systems significantly, reducing operating costs and improving prospects for sustaining the project's innovations over the long term, independent of external funding and technical assistance.

The next few years are likely to be crucial to the woodland management project. Despite its initial success, the new system remains institutionally fragile, and it is vulnerable to renewed obstruction by fuelwood traders and the forestry service. Much can be gained if the program can consolidate its present achievements and acquire the critical mass required to become self-sustaining. It is a rare Sahelian example of a genuine transfer of cash resources from the urban to the rural areas, yet it also offers the prospect of a durable and flexible fuelwood supply system able to meet the needs of Niamey and the other towns for a long time to come.

1

Country Context

Niger is a completely landlocked Sahelian country covering an area of 1,267,000 square kilometers. With a per capita GDP of US$280 in 1993, it is among the world's poorest nations, and its people have been getting steadily poorer. During the period 1980–93, as a result of low or negative economic growth combined with a rapid rate of population increase, per capita GDP fell by an average of 4.1 percent annually (World Bank 1995). The currency, the CFA franc (FCFA), was devalued by 50 percent in the beginning of 1994, further sapping the already low purchasing power of the population.

The ability of the government to deal with the problems facing the country is heavily constrained. The tax base is small, and about 60 percent of tax receipts are devoted to paying government employees, whose salaries are often seriously in arrears. The balance of payments is chronically in deficit. The banking sector has been in a state of acute crisis since the late 1980s, and several major public banking institutions have failed.

The private sector in Niger is weak, and is characterized mainly by small, traditional enterprises. An informal metalworking sector produces cooking stoves and other products from scrap steel. The modern sector has been in decline since the early 1980s, with a negative net foreign investment created by the withdrawal of some international companies from the country. Further difficulties are produced by the long border with Nigeria to the south, which is extremely permeable to illicit trading.

The physical infrastructure of Niger is poorly developed. Of the country's estimated 40,000 kilometers of roads, only about 8 percent are paved. The education system is overwhelmed by demand. Primary school enrollment in 1991 was 25 percent, with classes of up to 120 children. The adult literacy rate is estimated to be only about 14 percent. Managerial, technical, and administrative capacities in the public and private sectors are generally low.

Although Niger has proven mineral resources, only uranium has been mined on a substantial scale. It was a major export in the 1970s and accounted for more than half of the country's total exports and one-third of government revenues in 1976. As a result of the global recession in uranium sales, it now represents only 5 percent of exports. There

are also coal deposits, but the coal is ashy and difficult to burn. Although it may eventually provide an alternative to fuelwood, it is currently neither economically competitive nor generally acceptable as a domestic fuel.

The climate is hot and dry, with a rainy season from June to October. The average annual temperature in the capital, Niamey, is 29.4°C (85°F). The country is subject to periodic droughts of great severity. Major drought-related famines occurred during the 1930s, and the period 1968–74 saw a decline in rainfall, culminating in a disastrous drought in 1973–74. Another major drought occurred in 1983–84.

Topography and Vegetation Zones

The topography of the country is generally composed of flat or gently sloping plateaus divided by valleys and flatlands. Temporary rivers flow through many of the valleys during the rainy season, and shallow lakes accumulate in the flatlands. Most of these lakes disappear in the dry season, but some remain as permanent water sources.

Niger can be divided into three climatic and natural resource zones. The North, which occupies about three-quarters of the country, is mainly Sahara Desert but fringes into an extremely arid and sparsely vegetated Sahelo-Saharan ecology. It is a highland area of plateaus and mountains with negligible rainfall. Apart from scattered oases, the region has little human habitation.

The central part of the country, which occupies about 13 percent of the total area, lies in the Sahelian zone. The rainfall varies from about 200 millimeters in the North to 350 millimeters in the South, but is highly variable and irregular. The natural vegetation is a light, bushy savanna. Soils are generally thin and light, especially on the plateaus. Rainfed agriculture is possible in the valleys and lowland plains, where the soils are deeper, but it is always subject to risk from the irregular rainfall.

About 90 percent of the population lives in the southern part of the country, which covers the remaining 12 percent of the land area. This region has an annual rainfall in the range of 350 to 800 millimeters. Over most of the area, the natural vegetation is savanna woodland, dominated by *combretum* species. Only in the extreme south, especially the southwest, where the rainfall is at its highest, are there areas of well-wooded Sudanian savanna forest.

The Niger River flows from north to south through the West of the country over a distance of 550 kilometers. Along its course, and especially in the Southwest, where it overflows during the peak flow period, recessional cultivation is practiced. There is also a limited amount of irrigated agriculture.

Much of the country's natural woodland occurs in the form of curved strips or patches of vegetation interspersed with hard, bare, impervious soil. The striped appearance of these woodlands from the air has led to the nickname of "tiger bush." There are also substantial acacia formations in the temporary riverbeds and lake areas, especially in the East of the country.

In all, the country has about 13 million hectares of woodland, about 10 percent of the total land area. Of the total wooded area, however, about 9 million hectares are marginal woodland, with a cover of less than 5 percent. It is only the remaining 4 million hectares, about 3 percent of the land area, that has a woodland cover of more than 5 percent. The total area of classified forest in the country is 600,000 hectares, but a substantial proportion—for example, the Aviation Forest near Niamey airport—has almost completely disappeared.

Population

The last census was in 1988, when the population was 7.2 million. Population growth is estimated at 3.2 percent yearly, one of the highest in the world. The present population is about 8.2 million people, about 85 percent of whom live in the rural areas.

The largest city is the capital, Niamey, which had a population of 400,000 in 1988 and an estimated annual growth rate of around 6 percent. The city's present population is estimated as about 600,000. Zinder and Maradi, with populations of approximately 140,000 to 120,000 each, are the next-largest urban areas. Tahoua has about 50,000 residents. These four urban areas account for about 80 percent of the urban population.

Out-migration from the central rural areas is substantial. Some of this represents travel to Niamey or abroad in search of jobs, but some reflects a strong movement of population toward the more fertile southern area of the country, where the risks of drought are lower. As a result, the natural woodlands of the South, the richest in the country, are being cleared for agriculture at an ever-increasing rate.

Ethnic Groupings and History

Present-day Niger is very much a creation of its long history of conquest and population movement. The people are strongly conscious of ethnicity and history, elements that continue to play a major role in determining social relations and patterns of landownership and use.

Niger has five major ethnic groups: Zarma-Sonray, Peul or Fulani, Haussa, Gourmantché, and Toureg. The Zarma-Sonray are the dominant group, accounting for some 75 percent of the population and occupying most of the fertile southern part of the country. They are mainly farmers, but are increasingly keeping their own livestock. The Peul are the second-largest group, with 18 percent of the population. They are agropastoralists, farming their lands as well as keeping livestock, and live mainly in the Center and Center-South of the country.

The Toureg make up about 5 percent of the population. They live mainly in the Sahelian zone and are predominantly pastoralists, but also carry out some settled farming. The Gourmantché are the oldest inhabitants of the region and now live mainly in a small area in the Center-West bordering Burkina Faso. They are farmers. The Haussa,

although numerically only a small proportion of the population, are found in most areas and are known for their trading abilities.

The area covered by the country came under French occupation in 1900, when it was designated a military territory. It became an autonomous territory in 1922, an overseas territory in 1946, an autonomous republic of the French community in 1958, and fully independent in 1960. The official language of the country is French.

Local Government and Landownership

The country is divided into seven departments, which are, in turn, subdivided into districts (arrondissments) and cantons. The canton is the lowest governmental administrative unit. Below the canton is the village, where authority rests with the traditional chief. A new decentralization law, which was ratified by the National Assembly in September 1994, devolves a considerable number of powers previously held by the central government to these local government structures.

The canton is a colonial creation, but its chief is usually chosen from a traditional ruling family by the village chiefs within the area and confirmed in office by the government. The canton chief receives administrative instructions from the government and is responsible for local tax collection; he also regulates relationships between villages in accordance with traditional law. The village chief is chosen from among the descendants of the family that first colonized the site and is confirmed in office by the canton chief.

Rural government systems are particularly complex at the village level. They are based mainly on traditional laws and lineages; in some cases these were reinforced during the colonial period, in other instances they were severely weakened. Adding further complexity to the picture are factors such as the migration of new people into an area or out-migration, especially of the young. There are also changing relationships with the land and its resources as a result of population growth, as well as the forces of modernization and the increasing need for cash incomes.

Landownership

Landownership is governed by traditional laws almost everywhere (outside the urban areas, where leases to plots of land are granted by the state and can be traded conventionally). Although the details vary among areas, the traditional laws fundamentally rest on occupation and use. Each village is surrounded by an area of land—with borders well-known to the villagers—over which the chief has certain rights. It is the chief, for example, who grants a family permission to clear an area for farming. In return they pay a fee, usually a portion of their harvest, to the chief. Once the land has been cleared, the family holds ownership rights that can be passed on to their descendants.

Traditional landholding arrangements, however, are changing. There is a growing feeling that the days of what were thought to be limitless bushlands are drawing to an

end, and there is an increasing tendency to "decollectivize" family lands in favor of individual ownership. In the flood plain of the Niger, renting land is becoming common, and litigation over family landownership has begun to occur. The government began the long and contentious process of developing a "Rural Code" in 1985, which is intended to move the country from an oral to a written land tenure system that will clearly define ownership and usufruct rights in the rural areas.

Problems are also arising in some areas because of traditional inheritance laws that divide the land among children. Traditional practice has produced holdings that are increasingly fragmented and reduced in size, which has led to the shortening or complete elimination of fallow periods. Another important new phenomenon is the emergence of absentee landownership in some areas; laborers are paid to clear and cultivate land on behalf of urban or rural entrepreneurs.

Woodland Ownership and Rights

Uncultivated woodlands have traditionally been open to all for grazing; fuelwood and pole collection; the gathering of fruit, herbs, and other products; and hunting. The colonization of the country, however, introduced the European notion of the "forest" as an entity—a reserve of wood and wildlife—separated from the agricultural and pastoral lands.

Under the colonial system, the state became the absolute owner of all wooded areas formally designated as classified forests. In a decree introduced in 1935, in addition to the classified forests, the state also attributed to itself all vacant, unowned woodland areas, which it designated as the "protected forest domain." The role of the forest service was to patrol and guard the classified forests and the protected forest domain against the local population.

This takeover of the natural woodlands by the state has been a potent source of discord between foresters and villagers. Although the state deemed a lack of agricultural activity in an area of woodland as sufficient to qualify the area as part of the protected domain, local people continued to regard it as belonging to them. The attitude of the forest service in carrying out its protection duties is captured well in the following quotation from an old forest warden (Montagne, Bertrand, and Babin 1994):

> At that time the forestry service was very harsh with the local populations. . . . I remember that often when I surprised a Peuhl [sic] shepherd with his flock in a classified forest, not only did I give him a fine and make him take his animals to the pound, but I forced him to eat leaves on the spot to discourage him from trespassing again. But there was nothing we could do, they were always coming back so we hounded and persecuted them.

Although some of the more deeply resented elements of the forestry code were dropped or watered down at the time of independence in 1960, the system was essentially adopted by the new government. Under present laws, local people are allowed to collect deadwood, graze livestock, and collect fruits and other products from natural woodland

areas, but they are not allowed to cut living trees without a permit. Another crucial implication of state ownership of woodlands is that local chiefs and communities have no authority to prevent fuelwood cutters with an official cutting permit from stripping an area of its fuelwood resources.

The Forest Service

The forest service in Niger dates from the 1930s. Through the decades it has been changed many times in accordance with the politics, preoccupations, and forestry policies in vogue.

Since 1992 forestry activities have been carried out by the Environment Directorate. This was set up in 1987 as part of the Ministry of Agriculture and the Environment but was shifted to the Ministry of Hydraulics and the Environment in 1989. At the central level, the Environment Directorate has five services: Silviculture and Land Restoration, Anti-pollution, Management of Classified and Protected Forests, the Territorial Brigade for the Protection of Nature (BTPN), and the Technical Support Unit. The department provides a range of decentralized services at the departmental and arrondissement levels, in some cases at the community level, and in the staffing of forest posts.

There are about 400 forestry employees, of whom 60 percent hold decentralized postings and 25 percent are working on projects. Although the forest service has the duty of policing the fuelwood laws, it lacks the resources required to do so effectively, and there is a considerable amount of evasion and illegal tree-cutting. Many of the forestry projects carried out in the country with donor assistance have been implemented by specially assembled project teams drawn from the forest service. This can bring major problems of sustainability if the project teams are disbanded after the end of the funding period or do not have the necessary resources.

Settlement Patterns, Farming, and Pastoralism

Settlement patterns have been determined by the availability of natural resource as well as by historic practices. Villages are primarily located in areas with accessible water resources and relatively deep soils. It is for these reasons that the most populous areas are the valleys of the Niger and its tributaries, the lowlands with permanent water sources, and areas where the water table is high enough to be easily reached. The plateaus, with their shallow lateritic soils and lack of water, have been left virtually unpopulated.

The detailed structures of villages vary among areas and ethnic groups. In general, however, people live in family compounds that are loosely grouped in villages. An average village has a population of 250 to 500 people. Surrounding the village is usually a permanently cultivated area, often dotted with trees such as the *acacia albida,* which are preserved or deliberately introduced.

Outside this permanently cultivated area are the fallow areas. Although these are cleared and brought into cultivation again after the fallow period, certain trees, useful for their fruits, timber, or other products, are usually left growing. Beyond this fallow area is the bush or natural woodland, which is used for grazing and the collection of fuelwood and other woodland products. This is also the village reserve of agricultural land, which can be brought into use as the population expands because of natural growth or the arrival of newcomers.

The main agricultural activity is rainfed subsistence production of cereals, principally millet. Other crops—grown on a much more limited scale—are peanuts, beans, and rice. Agriculture is carried out with human labor and traditional wooden implements. The continual risk of drought is a major deterrent to investment in mechanization or other methods of agricultural improvement, assuming that the capital could be made available. Mechanization, even animal traction, is rare. Chemical fertilizers are little used, and yields are generally low.

Pressures on the Agricultural System

The rapid population growth in the rural areas is imposing a range of pressures on the country's natural resources. In the absence of investment in methods of agricultural intensification, the only available option for increasing yields is to extend the area under cultivation. The agricultural frontier is therefore being continually pushed into the natural woodland areas. Fallow periods—formerly five to seven years—have been reduced to two to five years in some areas.

Moreover, as the available supply of good farmland diminishes, the areas coming into agricultural use are poorer quality land, formerly used only for grazing. The agricultural yields from these lands are lower and less reliable than those from the areas with better soil. At the same time, the land available for stock herds is reduced, further contributing to the impoverishment of the rural population. The result is heavy out-migration, particularly of the young, from the poorest rural areas. Paradoxically, this has led to farm labor shortages that are reported to have been responsible for decreases in millet yields of up to 30 percent in some areas.

The Role of Pastoralism in the Agricultural System

Raising cattle, sheep, and goats is the other major activity in the rural areas. It is carried out by settled farmers as well as pastoralists. Transhumance is still widely practiced. When the rainy season comes, there is a mass movement of livestock herds northward to take advantage of the new crop of grass produced by the rains. Pastoralists sometimes arrange to include the herds of settled farmers in the progress for a payment. The herds are moved southward during the dry season after the harvest has been collected.

In the absence of artificial fertilizers, these livestock herds play a vital role in maintaining the agricultural system. When they arrive in an agricultural area during the dry season, they are directed toward the cultivated areas. By allowing them grazing and

browsing in woodlands during the day, and spending the night in cultivated areas, the herds effect a transfer of soil nutrients from the woodlands to the cropped areas. In many cases, villages have contracts with the pastoralists, payable in millet, for this fertilization service.

But important changes are taking place. Many of the pastoralists who lost their herds during the 1984 droughts have not been able to replace them and have become farmers instead. Their herds are no longer available to provide a land fertilization service to the farming community at large. In response, increasing numbers of settled farmers have become livestock owners.

The availability of browse from the natural woodlands is an essential element in this process of mutual support between pastoralism and agriculture. In addition to being a source of soil nutrients for the cultivated areas, the woodland browse is essential for the survival of livestock herds during the dry season, when grass and other food sources are not available.

Recent years have seen a marked change in attitudes toward pastoralism in development thinking. Long viewed as environmentally destructive, inefficient, and wasteful of resources, pastoralism is gradually being recognized as a critically important element in the Sahelian ecology and the survival of its agricultural systems.

2

Project Background

The environmental impact of fuelwood cutting and the sustainability of energy supplies have been viewed with anxiety in Niger since the 1970s. A variety of projects have been launched in the search for practicable responses to these concerns.

The results of the majority of these initiatives have been disappointing, forcing a reassessment and modification of the approaches used. It is this evolving understanding, both of the fuelwood *problématique* ("field of enquiry") and potential methods of dealing with it, that formed the background for the development if the Household Energy Project.

Household Fuels in Niger

The preponderant use of household energy in Niger is for cooking. Fuelwood is the preferred fuel wherever it is available. In the rural areas, the fuelwood is collected by women or children from natural woodlands, fallow lands, or trees that have been planted or protected within the village area. This harvesting rarely involves the felling of live trees. In some areas men are responsible for bringing cartloads of wood from more distant woodland areas. Where the woodlands are a long way from the village, or in the more arid areas of the country, where wood is scarce, fuelwood is supplemented by twigs, millet stalks, cow dung, and other biomass.

A synthesis of the results of the fuelwood consumption surveys carried out in the country up to 1989 yields the following average fuelwood consumption figures:

- Large urban centers, 0.6 kg/head/day
- Smaller urban centers, 0.7 kg/head/day
- Rural areas, 0.8 kg/head/day.

In both urban and rural areas, cooking is normally done in the open air using a pair of three-stone fires. A metal stove, the Malgache stove, was introduced some decades ago and enjoys fairly wide use in the urban areas. The stove is made from scrap metal by local artisans and is in the form of a cylinder on top of which the pot rests. It costs about FCFA 200.

Small amounts of LPG are used for cooking by better-off families in the urban areas. The total consumption at the beginning of the Household Energy Project in 1989 was estimated to be about 300 tonnes yearly.

Kerosene is the normal lighting fuel in the towns, and to a minor extent in the rural areas. It is also used in small quantities in the urban areas to light fires, but it is not a traditional cooking fuel. Charcoal is used for making tea, heating snacks, and ironing, but not for general cooking. It is usually obtained by quenching embers from the cooking fire, although small amounts are also traded.

The proximity of Nigeria, with its large petroleum industry, heavily distorts the supply structure for kerosene and, to a lesser extent, LPG. Kerosene, which is heavily subsidized in Nigeria, is imported illegally by the informal sector into Niger. The oil companies in Niger, unable to compete with these low-priced imports, have been reluctant to invest in kerosene distribution networks outside Niamey or to promote the sale of kerosene for domestic cooking.

Emerging Environmental and Energy Concerns in the 1970s

The Sahelian drought of 1974 had a catastrophic effect on Niger. Agriculture and pastoralism were severely damaged, and food shortages were extensive. The woodland areas were seriously affected, tree mortality occurred on a large scale. The drought also created widespread international concern over desertification and the "advance of the Sahara," a concern that was amplified by the emergence of "the other energy crisis"—the fear that the developing world was rapidly running out of fuelwood (see, for example, Eckholm 1976).

By the latter part of the 1970s, a consensus had emerged that cutting fuelwood was a major cause of the deforestation so obviously occurring around the urban areas of the Sahel and elsewhere in the developing world. The rate of this woodland destruction, coupled with the high rate of growth in urban populations, created considerable apprehension about the sustainability of urban fuelwood supplies. Rapidly approaching urban fuelwood shortages were forecast by many commentators. Also evident were growing worries about the effects of deforestation on the sustainability of the agricultural system.

The need for urgent action was generally accepted, and some reports were quite alarmist. One study, which recommended planting 150,000 to 300,000 hectares of forest annually in the Sahel, stated: "Action must be prompt. Time is of the essence. It should not be wasted on 'analyzing the situation,' as there is a risk that the situation will have so deteriorated that it can no longer be remedied" (CILSS/Club du Sahel 1978, p. 48).

The most commonly advocated response was the creation of large plantations of fast-growing species such as eucalyptus and neem (*Azadirachta indica*). These would provide fuelwood for the urban areas, "taking the pressure off the natural woodlands." The new forest areas were often referred to as *industrial plantations* because they relied

heavily on mechanization to clear and prepare the ground for tree planting. Indigenous tree species, because of their slow rates of growth, were not considered capable of producing the quantities of fuelwood required in time to avert the impending fuelwood crisis.

An analysis by the World Bank (1978) referred to the damage caused by the extraction of fuelwood:

> Natural forest and bush supplies which in many areas, particularly around Niamey, have been completely cut out. The resulting wind erosion of top soil and disturbance of the fragile ecological equilibrium have led to the development of desert conditions, declining soil, fertility and degradation of some 0.7 million ha of potential agricultural land. . . . Desert conditions will spread to over an 80 km radius (around Niamey) unless steps are taken to reforest selected areas with compensatory plantations. (p. 7)

The analysis predicted increasing fuelwood scarcity, with an annual rise in fuelwood prices of 5 percent, in real terms, over the period 1978–90.

The World Bank's International Development Association (IDA) launched a forestry project in 1978 with support from the French Fonds d'Aide et de Coopération (FAC) and the Caisse Centrale de Coopération Economique (CCCE). This multicomponent project (generally known as the IDA/FAC/CCCE project) covered a variety of tree planting initiatives, including the establishment of 400 hectares of irrigated eucalyptus plantations along the lower terraces of the Niger River near Niamey. There were also rainfed plantations in the classified Aviation Forest near Niamey airport and in the classified forests at Guesselbodi and Takieta near Zinder. Additional project components were designed to support the promotion of village woodlots and the planting of shelter belts by the forest department.

New Approaches in the 1980s

By the early 1980s it was becoming clear that industrial or semi-industrial plantations of exotic species were a failure in the arid and semi-arid areas of the Sahel. Survival rates in rainfed plantations tended to be poor, and yields were often less than 1 m^3/ha/year. In many cases the plantation yields were lower than those from the natural forests that had been clear-cut to make way for them.

With establishment costs of up to $1,000/hectare and substantial management expenses, the production costs of the plantation fuelwood were up to 10 times higher than the retail price of wood harvested from the natural woodlands by urban fuelwood traders. The estimated cost of fuelwood from irrigated plantations, for example, was FCFA 170/kilogram; from rainfed plantations, the cost was FCFA 85–130/kilogram. Even wood from rural village or private plantations had a cost in the range of FCFA 30–60/kilogram. The levels of subsidy required to make wood from such sources

competitive on the fuelwood market, and divert consumption from the natural woodlands, were far beyond the means of governments or donor agencies.

In response to the failure of the plantation system, attention was turned to the potential of the natural woodlands. Research demonstrated that their standing stocks and annual yields had been seriously underestimated in many cases. This was largely because the natural woodlands had tended to be viewed in conventional forestry terms, with the main focus on their capacity to produce commercial-size timber. When the production of small-diameter shoots and branches suitable for fuelwood was considered, the estimates of standing stocks and annual yields were considerably increased.

There was also a growing appreciation of the environmental, social, and economic importance of these woodlands, which had previously been overlooked because of the focus on energy concerns. It began to be more widely recognized that natural woodlands provide village communities with much more than fuelwood. They are the source of the poles and timber required for building, fencing, tool and furniture making, and many other uses. Trees provide the browse that enables livestock to survive the dry season. Woodlands produce fibers, food, medicines, and other valuable products. They act as habitats for wildlife that can be hunted for food or for sale.

Taking these previously neglected benefits into account, the case for maintaining and managing the natural woodlands, instead of replacing them with plantations, began to appear much more attractive. If natural forest management could be made to work, fuelwood yields could be maintained, and the capacity of the woodlands to provide the grass, browse, and the other products crucial to the local people would be maintained as well.

The drought of 1983–84, with its particularly damaging effects on plantation forests, emphasized the need for new approaches in Niger. A national conference on forestry held at Maradi in 1984 was an important turning point. The conference resulted in a series of declarations and political undertakings intended to stimulate a general national mobilization against desertification. Emphasis was placed on the increasing degradation of natural woodlands and the need to counter this by bringing them under rational management. It was agreed that this could only take place with the active collaboration of local people. After the Maradi conference, the use of a local cooperative became a mandatory element in all natural woodland management projects in Niger.

The FLUP Fuelwood Resource and Annual Yield Estimate

One of the crucial programs in developing and implementing the management of natural woodlands in Niger was the USAID–funded Forestry Land Use and Planning Project (FLUP), which began in 1981. This project carried out inventories of the woodland resources around Niamey, Zinder, Maradi, and Tahoua based on Landsat images from 1978 and aerial photography from 1975. These inventories covered a 100-kilometer radius around each of the urban areas. The data were supplemented by ground-truthing at about 170 sites.

In the case of Niamey, it was found that soils with high forest potential occupied about 44 percent of the area within the 100-kilometer radius, a total of 1.38 million hectares. The total standing stock of exploitable wood in this high-potential area—defined as the species currently used for fuelwood in sizes above 4 centimeters in diameter—was estimated to be about 3.6 tonnes/hectare, which yielded a total available standing stock of about 5 million tonnes.

It was estimated that the average potential productivity of these woodlands would be about 315 kilograms/hectare/year if they were properly managed, about double their actual productivity. The management regime envisaged was based on a twelve-year rotation and complete protection against grazing for three years after fuelwood harvesting. The conclusion reached by the FLUP project was that if such a system could be implemented on a sufficiently large scale, it opened the prospect of a sustainable supply of fuelwood to Niamey and the other urban areas.

Analyzing the Fuelwood Supply System

In 1984 an economic review of the wood energy sector in Niger was carried out through the IDA/FAC/CCCE project. This was the first comprehensive study of the entire fuelwood supply chain in the country, from cutting in the rural areas through the use of the fuel for cooking in urban households. Before this study, knowledge of the fuelwood supply system had been fragmentary, based on small samples and anecdotal evidence.

The Fuelwood Supply Chain

The study found that the total urban fuelwood consumption in the country was about 200,000 tonnes, of which 100,000 tonnes were used in Niamey. A breakdown of the modes of transport used shows that about 40 percent of the supply was carried by lorry, 25 percent by pickup truck, and the remainder was divided among transport by camel (17 percent), donkey (7 percent), and private vehicles (11 percent). The wood carried by the lorry traders was mainly in the form of logs; that carried by pickups and animal transport was in the form of small branches or already split and bundled wood offered for sale by the roadside.

The study revealed that supplying fuelwood to the urban areas was one of the most important commercial activities in the country. The financial turnover was estimated to be about FCFA 1.5 billion, and the total number of people employed, from cutting through retail selling, was about 2,500. The supply system was also found to be extremely effective—the fuelwood was delivered reliably and conveniently to consumers, in many cases to their doors.

The findings on lorry transport, which accounted for 40 percent of urban fuelwood consumption, were particularly important. Instead of buying wood from rural woodcutters, as other transporters tended to do, lorry owners hired their own woodcutters at low rates of pay from among the urban unemployed. These workers were taken to the

chosen supply point in the rural areas, where they cut the fuelwood and loaded the lorry. They were provided with food by the lorry owner and had little or no contact with the local population. The cash generated by this segment of the fuelwood trade thus flowed in a closed loop between traders and consumers, with none going to the villagers whose resources were being depleted.

Phases in Fuelwood Exploitation

The study identified three distinct phases of fuelwood cutting. The first, when woodcutters move in, is the least destructive. Only deadwood, whether a result of drought or the natural mortality of trees, is taken. The damage to the structure and functioning of the woodland is minor.

In the second phase, the deadwood is scarcer, and assembling a load requires greater time and effort on the part of the woodcutters. Some cutting of living trees is carried out, but the woodland essentially retains its structure and continues to function as a source of browse and other forest products for the local population.

The third phase commences when all the deadwood has disappeared. Living trees are cut and left to dry before being transported to the city. This third phase typically occurs in woodland areas close to the cities and is much more destructive than the earlier phases. Carried to its natural conclusion, it strips the area of all salable trees and destroys the woodland as a functioning entity—it can no longer provide a sustainable supply of fuelwood, browse, or other products.

This is a highly significant finding. The common assumption that all the fuelwood consumed in urban areas comes from clear-felling of natural woodlands greatly exaggerates the damage done by fuelwood harvesting (with the magnitude of urban fuelwood consumption sometimes expressed by computing the area of natural forest that would need to be felled annually to meet these needs). Moreover, distortion of the apparent nature of the problem tends to evoke distorted responses. Replacement plantations would appear to be the preferred response if fuelwood supplies come from clear-felling of the natural woodlands. If the response is planned to deal with the way fuelwood is actually harvested, natural forest management appears a more appropriate response, especially in the early stages of exploitation of an area.

Urban Fuelwood Markets and Prices

The study found that once the fuelwood reached the city, it was quickly passed along the wholesale and retail distribution system. Stock levels of wholesalers and retailers were generally low; they rarely carried an inventory that would last more than two weeks. Supply shortages were virtually unknown, indicating the effectiveness of the system.

Splitting of the logs brought in by the lorry traders was usually carried out by wholesalers, who then passed on the split wood to the retailers. Most of the fuelwood brought in by pickup trucks had already been split by the woodcutters who sold it, and it

went directly to retailers. Those using animal transport frequently sold their wood door-to-door, directly to consumers.

Most of the retail trade was found to be carried out by women. A relatively small proportion, about 17 percent, were engaged in sales full time. This group generally bought wood in full lorry loads from a regular supplier and maintained sizable stocks. The great majority of sellers, however, worked part time, obtaining stocks on a more irregular basis. It was estimated that there were approximately 1,200 retail outlets in Niamey. The price of fuelwood was found to vary substantially depending on location, the quantity bought, and the time of year. The average in Niamey was found to be about FCFA 16/kilogram.

Far from being a lucrative cartel, the fuelwood trade was found to be highly competitive. For the owners of vehicles, the scant transport of goods to the rural areas meant that the outward journey generally offered no pay to help cover their fuel and maintenance costs. The low margins left little money available for investment in vehicle maintenance, and the transport fleet was found to be in extremely poor mechanical condition.

Absence of Effective Control and Tax Collection

At the time of the survey, there was little effective control over fuelwood cutting. Any interested person could obtain an official cutting permit on payment of the necessary fee to a forest service office. Possession of such a permit conferred the right to cut fuelwood anywhere in the rural areas.

The cost of a cutting permit, valid for one year, was FCFA 4,000. In addition, transporters were supposed to pay a fee of FCFA 35/stere (about FCFA 0.1/kilogram) on the amounts carried. There were no permanent control posts on the roads; only mobile patrols were available to check transporters. It was found that only about 15 percent of the taxes due were being collected.

Proposals to Address the Fuelwood Issue

Follow-up studies were carried out by the Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP), in collaboration with the U.N. Sahelian Office (UNSO), during 1984–85 under a program funded by the Norwegian government. A comprehensive report, summarizing the state of knowledge at the time and setting out a series of proposals for addressing the fuelwood issue, was produced (Madon 1986). This document provided the basis for the subsequent design of the Household Energy Project.

The Guesselbodi Project

The first major natural woodland management project in Niger was in the Guesselbodi classified forest. It was planned and implemented as part of the FLUP project. Following the declaration of the Maradi conference, it relied on the cooperative approach. It became extremely well known both nationally and internationally and

played a major role in raising awareness of the potential benefits of natural forest management. It was quickly followed by a number of similar cooperative projects.

The Guesselbodi National Forest is located some 25 kilometers southeast of Niamey. It is an area of natural woodland that covers about 5,000 hectares and was in a severely degraded state at the beginning of the project. The aim was to bring the area under management to restore its productive potential and establish the forest as a sustainable source of commercial fuelwood for Niamey.

In 1984, when the project was being planned, a vigorous debate was taking place among foresters about the future of the Sahelian natural woodlands. It was by no means universally agreed that natural woodland management was even technically feasible. Some foresters believed that many areas were completely dead, or beyond the possibility of regeneration, as a result of drought and overuse. Others were of the view that with restorative measures and protection against grazing, much of the natural woodland cover could be restored. The Guesselbodi project set out to establish how, at both the technical and social levels, natural woodland management could be carried out; how much it would cost; and what yields of fuelwood and other forest products could be expected.

The forest service was the national implementing agency for the project and retained its statutory control over the woodland area. Initial planning and preparatory work began in 1984. The first step was to prepare a map of the area showing its soils, vegetation, land forms, and areas especially susceptible to erosion. Surveys were also carried out in the surrounding villages to identify their use of the woodland area. A cooperative incorporating the nine surrounding villages was set up in 1986.

A management plan for the entire woodland area was developed and discussed with the villagers. Under this plan, the woodland was divided into ten 500-hectare parcels. Work programs were developed for each parcel according to its soil and ecological characteristics as revealed in the initial survey. The intention was that each parcel would be subjected to a range of rehabilitation measures in sequence. The treatment of the first parcel would be carried out over a year, after which the next parcel would be treated; a 10-year period would thus be required to cover the whole area.

The rehabilitation measures included blocking gullies with stone check-dams and creating small berms to trap runoff and increase rainwater infiltration. The purpose was to encourage the regeneration of the native grasses, bushes, and trees. Special half-moon-shaped microcatchments were also created as planting sites for individual trees. These measures were far beyond the physical capacity of the forest service, and the arrangement was that they would be implemented by the local population in return for payments in cash or in kind—a relatively conventional arrangement in development projects of the time. The innovative feature of Guesselbodi was that the local population would subsequently participate in the management and controlled exploitation of the area under the direction of the forest service; in return they would be allowed to harvest and sell fuelwood and fodder.

The rehabilitation work was carried out by about a hundred paid laborers from the villages under the supervision of forest service foremen (this description of the project is drawn from Heermans 1986). Some 100,000 seedlings of mainly local species were planted each year, with a particular emphasis on legumes and the trees most valued by the villagers. There was also extensive seeding with *Andropogon gayanus,* a perennial grass that is highly regarded in the area as animal fodder. Protection of tree and grass seedlings in newly planted parcels was provided for a minimum of three years by guards paid through the project. Owners of animals caught in these areas were fined in accordance with the number and kind of animals found trespassing. Light branches cut from trees during harvesting were spread over barren areas to provide a protective cover, allowing regeneration of grasses and the growth of tree seedlings.

The management plan envisaged each of the ten parcels being cut for fuelwood in sequence, yielding a 10-year rotation for each plot. The harvesting of fuelwood and grass would be carried out by the cooperative members, with the forest service designating the parcel to be harvested each year. The forest service would also arrange the purchase of fuelwood from local people and its sale to fuelwood dealers. The price paid to the woodcutters and the selling price would be set by the forest service, with the difference intended to cover the running costs of the project.

The early results were extremely encouraging. After the harvest of fuelwood in the first parcels, there was a rapid regeneration of shoots from the cut trees and a copious growth of grass. This was a major breakthrough. It resolved the forestry arguments and clearly demonstrated that natural forest management could be made to work at a technical level.

Nevertheless, a variety of social and managerial problems gradually began to emerge. For example, pastoralists developed considerable resistance to the project. They deeply resented being excluded from grazing areas they believed were theirs by tradition, areas that provided crucial fodder in the dry season. They also feared that any extension of the scheme would mean that they would be banned from an ever-increasing proportion of their traditional grazing areas.

The size of the project caused considerable access problems for the participating villages. Some villages were up to 20 kilometers from the areas they were entitled to exploit for fuelwood and fodder, much too far for people without regular access to vehicular transport. Villagers consequently lost interest in participating in the project.

Tensions and misunderstandings also arose between the cooperative and the forest service. Guards, for example, interpreted their instructions to mean that the entire woodland area was to be closed to everyone except those authorized to collect fuelwood and hay. The collection of other products—on which local people, especially women, had traditionally depended—was excluded.

Funding for the project ended in 1990. As a review rather depressingly observed (Christopherson and others 1993):

> At Guesselbodi, USAID support has ended, and the activities carried out with project support are now largely discontinued—the systems and institutions created are not functioning as intended. There is poor management of funds, little accountability, and perhaps most importantly, grazing is not effectively controlled following the initial cut. The cooperative no longer has the means to pay guards, nor to pay for soil and water conservation activities, largely because disciplined management of funds was not applied and (as the team was told on several occasions) the cooperative members did not have sufficient managerial or technical skills. This was indeed a surprising observation in view of the reputation of the excellent training given at Guesselbodi during project implementation. (p. 5)

The Guesselbodi project nevertheless deserved its pioneering reputation. It showed that, at a technical level, natural woodland management for a sustained fuelwood yield is possible. It also highlighted the importance of natural woodlands as far more than a source of fuelwood—they act as a multifaceted resource for the rural communities that live in and near them. Equally important, it made clear that these communities would have to be involved, on a voluntary and continued basis, rather than as paid laborers, if a sustainable method of natural forest management were to be developed.

Other Natural Woodland Management Cooperatives

The early successes at Guesselbodi inspired a number of similar projects in Niger, including Boyanga in 1989–90; Faïra in 1988–89; Dorobobo in 1989–90; Hamadidé in 1989–90; Baban-Rafi in 1989–90; and Gorou-Bassounga in 1990–91. These all follow the general Guesselbodi model, establishing a cooperative of villages surrounding the forest. They have also involved substantial paid forest rehabilitation work by villagers and the use of paid guards.

The experience of these cooperatives has generally been similar to that at Guesselbodi. After an initial period of enthusiasm and activity, fuelwood production and cash turnover have tended to fall off. In Guesselbodi, for example, the amount of wood sold in 1989 was 2,140 steres, the highest annual figure, but this fell to 1,066 in 1992. In Faïra the highest volume of sales was in 1990, when 4,233 steres were sold, but this was down to 2,330 steres in 1992.

In general, the deteriorating performance of the cooperatives was a result of management weaknesses. Given the generally low levels of education and training in the rural areas, this is not surprising. The almost inevitable result of low skill levels is that the financial control exercised by cooperative management tends to be poor, with considerable amounts of fraud and indiscipline. Regulations, although formally established, are frequently ignored.

A review by the National Union of Cooperatives published in 1991 noted that the cooperatives had a poor understanding of their precise role in relation to the various other organizations involved in the set-up and overall management of the schemes. Intervillage

disagreements have also been a factor. As in Guesselbodi, the sheer size of the forest areas brought under management has created major problems. Moreover, management plans, usually developed in relative isolation by forest technicians, are generally difficult for local people to understand or accept.

Grazing bans, which were imposed without the agreement of pastoralists, have also led to deep resentment, which has escalated in some cases to vigorous resistance. In Gorou-Bassounga, a number of pastoralists were imprisoned for their continued recalcitrance in refusing to accept the new restrictions.

High Costs of Fuelwood

Costs also turned out to be a major problem. Because of the heavy investment in rehabilitation work and the need to pay the guards as well as the management of the cooperatives, the wood produced in Guesselbodi and the other cooperatives has been considerably more expensive than conventionally collected stocks from natural woodlands. Break-even selling prices have generally been in the range of FCFA 1,500–1,750/stere. This compares with the cost of FCFA 500–700/stere incurred by fuelwood traders using their own paid labor. As a result, traders were unwilling to purchase wood from the cooperatives, and unsold stocks of wood accumulated. To deal with the problem, the government periodically stopped issuing cutting permits until the stocks had been cleared. Although not popular, this practice was feasible given the relatively small amounts of fuelwood involved, but it would be a much more difficult policy to carry through on a larger scale.

Improved Fuelwood Stove Programs

A number of improved stove projects have been undertaken in Niger since the beginning of the 1980s. The organizations involved included Association Bois de Feu and the Association Française des Volontaires du Progrès, Church World Services, and the U.S. Peace Corps. One of the best-known stoves promoted through these programs is the Mai Sauki, a metal stove designed for use in urban areas. The body of the stove projects up around the pot, offering a better transfer of heat to the pot than the conventional Malgache stove, and it is made by local artisans from scrap steel.

The Mai Sauki stove has been heavily promoted since about 1983 within the framework of a Sécheresse au Sahel (CILSS) regional program for the dissemination of improved cooking stoves. In Niamey, Maradi, and Tahoua the main activity has been under a World Bank/Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) project, funded by the United Nations Development Programme (UNDP), GTZ, and the Dutch government.

Tests by the National Solar Energy Office (ONERSOL) have shown that the Mai Sauki stove is about 40 percent more efficient than the open fire. Doubts remain, however, over the significance of such laboratory tests. There is such flexibility in the use of the three-stone fire that adopting any single figure for its efficiency is bound to be

misleading. Moreover, the difference between test conditions and normal use can be extremely large.

It is therefore unlikely that families switching from the open fire to the Mai Sauki stove will find their fuelwood consumption falling by anything like the 40 percent predicted by the tests. Nevertheless, surveys of different kinds of stoves in household use have shown that the draught protection and improved heat transfer provided by stoves such as the Mai Sauki provide savings of 10 to 12 percent in household consumption of fuelwood compared with the use of the open fire.

3

The Household Energy Project

The initial design of the Household Energy Project was carried out by a team drawn from ESMAP and the government of Niger, working in Niger between April and August of 1986. The final detailed project proposal was published in January 1988.

The Project Concept

The design team carried out a fuelwood supply-demand analysis based on the available FLUP data. The results of the analysis pointed to rapidly widening fuelwood deficits in the catchment areas of Niamey and Zinder by the year 2000. The findings are summarized in Table 3.1. The table lists the areas of woodland within 100 kilometers of the main urban areas and the potential annual sustainable fuelwood production estimated on the basis of the FLUP woodland inventory studies. Also shown are the actual fuelwood consumption of these areas based on the 1984 surveys, together with projections of consumption for each area through the year 2030 based on population growth rates. The figures, which do not include consumption by rural people, show that the sustainable supply for Niamey and Zinder would be exceeded by the year 2000. In Maradi the potential sustainable supply is sufficient until shortly after the year 2010, and in Tahoua until after the year 2020.

In developing the project concept, the design team addressed both supply and demand. On the supply side, the need was to develop a system of fuelwood harvesting that would enable the resources of the catchment areas to be harvested on a sustainable basis rather than destroyed by overcutting. Even if this could be done, however, the analysis showed that any stable level of production would eventually be overwhelmed by the ever-rising demand. A stable future required that demand be restricted to a level that did not exceed the sustainable yield of the fuelwood catchment area.

The project was conceived as a two-pronged response to these challenges. The supply component (*volet d'offre*) was designed to replace the existing, unsustainable fuelwood supply system with a managed and sustainable arrangement. The aim of the demand component (*volet demande*) was to restrict urban fuelwood consumption to a level that could be met by managed natural woodland resources for an indefinite period.

Table 3.1 Areas of Natural Forest, Estimated Sustainable Yields, and Projected Fuelwood Consumption, 1986–2030

Area	*Natural woodland[a] (1,000 ha)*	*Natural productivity (kg/ha/year)*	*Potential sustainable production (1,000 t/year)*	*Actual and projected fuelwood consumption (1,000 tonnes/year)*					
				1986	*1990*	*2000*	*2010*	*2020*	*2030*
Niamey	1,380	140	193	97	126	232	420	760	1,374
Zinder	360	125	45	23	30	55	100	180	326
Maradi	695	125	88	19	25	46	82	149	269
Tahoua	1,330	105	140	14	18	34	61	110	198

a. Within a 100-kilometer radius.

Source: World Bank 1988a.

A third component, promoting photovoltaic (PV) lighting systems for households, was also included in the final project proposal. As the project got under way, however, it was found that this element had little realistic potential in the short term because of the low purchasing power of households. This component was abandoned after a mid-term project review in 1992.

The Supply Component

The central issue in supply was that rational management of the natural woodlands was not taking place; more important, it *could not* take place within the existing system. Fuelwood harvesting was driven entirely by the short-term economic perceptions of fuelwood traders operating in a fiercely competitive market. Similarly, village communities, no matter how concerned they were with the destruction of their natural resource base, had no legal rights to control or direct the operations of fuelwood cutters in their territory. As long as these conditions remained, there was no hope of establishing a management regime that could assure a sustainable fuelwood supply to the urban areas.

At the same time, it was clear from the experience at Guesselbodi that fuelwood cutting in the natural woodlands around the major urban areas was not necessarily the inherently destructive and negative phenomenon so often portrayed. Properly managed, it could make economic, environmental, and social sense. The report of the UNSO study (Madon 1986) stated that "rational management of the natural woodland formations in the area around Niamey would permit a major portion of its fuelwood needs to be met for a considerable period of time into the future." The aim of the supply component was to put in place a practical strategy to achieve this goal.

The Rural Fuelwood Market. Guesselbodi provided a model, of sorts, for a fuelwood supply system based on natural woodland management by local people. Nevertheless, the results becoming available from the project were showing that the approach adopted, radical though it had been, had not gone far enough. The costs were far too high, and the fuelwood produced could not compete on the market without a substantial subsidy. The management system was proving bureaucratically cumbersome and beyond the capacity of the villages involved. More important, although local communities were willing to carry out the forest rehabilitation and protection tasks set for them by the forest service when they were paid to do so, it appeared highly unlikely that they would voluntarily continue these duties after the project ended.

The Guesselbodi approach was thus not sustainable without continued substantial support from outside donors. If a self-sustaining system were to be devised, it would have to be much cheaper. It would also have to be simple enough for rural people to manage on their own. Finally, it would have to offer benefits that were sufficient to prompt the villagers to implement the program voluntarily and without external subsidies.

The project therefore proposed the establishment of rural fuelwood markets run by "local entities" such as villages, cooperatives of villages, or cantons. Each market would draw its fuelwood from an area of natural woodland formally delimited and accepted by the market entity and local authorities. This area would be managed in accordance with a simple joint plan drawn up by the project and the village. The harvesting would be carried out by the members of the management entity, or subcontracted to others, while the fuelwood transporters, instead of using their own wood-cutting teams, would purchase the fuelwood from the market and transport it to the urban areas.

These markets, in contrast with the Guesselbodi arrangements, were intended to be commercially independent and self-sustaining. The local entity would set the selling price for the fuelwood, and no price subsidy would be available from project funds. Responsibility for management would not, however, be completely devolved to the local level. An essential element in the agreed-upon management plan would be an annual fuelwood quota designed to restrict market sales to the amount that could be sustainably produced from the managed area of woodland.

It was clear, however, that simply setting up such rural markets would achieve little in itself. Fuelwood dealers, for example, would not willingly buy their supplies from markets run by well-organized local communities if they could obtain the fuelwood they wanted more cheaply from areas where control over cutting and the amounts harvested was weak or nonexistent. They would require financial incentives to use the markets rather than the open woodlands, and controls and penalties would be needed to ensure that the new system was not abused. In short, successful implementation of the rural market system required a comprehensive planning, monitoring, taxation, and control system that covered the entire fuelwood catchment zone of each major urban area.

New Fuelwood Taxation System. The project proposed scrapping the existing, widely abused arrangement of annual cutting permits and extremely low taxes on the quantities of wood transported. In its place would be a completely new fuelwood taxation system based on differentially priced permits, or coupons, specifying the quantity of wood that could be carried on each individual journey and its origin.

Dealers obtaining fuelwood from a rural market would pay for the coupon at the time of purchase. Those who received their load from an uncontrolled area of natural woodland would have to obtain their coupon, at a considerably higher price, in advance. The coupons, which would bear the name of the market where the fuelwood had been purchased, would be checked at transport control posts set up on the main entry routes to the urban areas.

As a further refinement, it was decided that the system could also be used to discourage dealers from obtaining their supplies from the more heavily degraded woodlands close to the urban areas and promote acquisition from the more remote and better-endowed areas. This would be done by applying a differential tax on fuelwood, depending on the distance of its area of origin from the urban area. The difference in tax would compensate for the extra transport costs of acquiring supplies from the more remote areas. The differential tax system would only apply to fuelwood from rural markets.

The tax on fuelwood from uncontrolled woodland areas would be set at FCFA 2,700/stere, equivalent to FCFA 9/kilogram, bringing the retail price up to about FCFA 25/kilogram. The rationale for this tax figure was that it approximated the cost of natural forest management as estimated from the Guesselbodi project—at the time, the lowest known method of sustainable fuelwood production. When taxed at this level, the selling price of fuelwood from the uncontrolled areas would roughly reflect its replacement value. It would also provide a sufficient incentive to prompt traders to use the rural markets rather than the open woodlands, provided that the system was properly enforced.

The details of the transition to this new tax system remained to be defined, but the project design envisaged that it would take place over a period of 5 to 10 years. A first step was made in 1988. At the instigation of the forest service, the government increased the existing fuelwood tax of 35 FCFA/stere by a factor of 10 to FCFA 350/stere—the first increase since 1957. The intention was that further tax increases would gradually follow as the rural markets were established and the control system was put in place.

Control over Fuelwood Traffic Flows. Effective control over fuelwood transport was the key to the proposed new system. If there were substantial loopholes, enabling dealers to evade the taxes on wood from uncontrolled areas, the competitive position of the new markets would be undermined. The answer was to upgrade the existing, largely ineffectual, control system. New control posts would be set up on all the main vehicular routes into the urban areas and would be manned 24 hours a day. Staff would be properly trained. Supervision would be improved and there would be a clamp-down on fraud and evasion.

The need to involve the fuelwood traders in the development of the new system was recognized. This process was eased when, at the instigation of the forest service, the fuelwood traders in Niamey formed the Niamey Fuelwood Dealers Association (ASEBN, Association Syndicale des Exploitants de Bois résident à Niamey). The membership of 280 represented about 90 percent of the lorry and pick-up traders and about 40 percent of the camel and donkey traders. The existence of the ASEBN meant that it was possible to draw the Niamey transporters into the discussions on setting up the new system. As an incentive to the ASEBN to support the system, it was proposed that allocation of transport coupons be confined to the membership. The association was later expanded to cover the other major urban areas and was renamed the Association Nationale des Exploitants de Bois (ANEB).

Fuelwood Supply Master Plans. The inventory of the natural woodlands around Niamey and the other major towns carried out under the FLUP project revealed great variation in conditions. In some areas, the woodlands were so heavily degraded that little, if any, commercial fuelwood could be harvested sustainably. Elsewhere, resources were more abundant and could provide substantial quantities of fuelwood on a sustainable basis—provided they were properly managed.

This pointed to the need for an overall strategy for the location of rural markets. It was therefore decided that supply master plans for Niamey and the other major towns should be drawn up. Areas where woodland resources were sufficient to provide a sustainable supply would be given priority in the establishment of rural markets. Fuelwood harvesting would gradually be restricted, and eventually prohibited, in areas where the natural woodlands could not sustainably support such activity.

The Overall Supply Component Strategy. The design of the supply component was thus a highly complex process. It envisaged an interlocking series of actions involving the following practical steps:

- *Modify existing law to create a new set of rights for villages.* These new rights would enable villages to exercise control over the natural woodland resources in their area.
- *Gradually bring under control the exploitation of all natural woodland areas used for fuelwood supplies to the main urban areas.*
- *Reorganize the national fuelwood trade through new control systems and regulations.* It was initially envisaged that all transport by camels and donkeys would be forbidden. The owners of these animals were to be encouraged to offer their services to rural markets, transporting fuelwood from the cutting site to the point of sale. This would also help fuelwood dealers by eliminating the need for off-road journeys, with the associated risks and damage to vehicles.
- *Use the taxation system to favor fuelwood production from managed areas and those with the highest resources.* This would take pressure off areas where resources were heavily depleted.

- *Provide material incentives for villages to enter into forest management contracts with the relevant local government authorities.*
- *Establish an effective system to control the entry of fuelwood into the urban areas.*
- *Provide the government with sufficient revenues from fuelwood taxation to cover the costs of implementing the program.*

The project set a target of control over the whole transport system within 5 years. It was envisaged that 30 percent of the urban supply would come from rural markets in 5 years, and that this would reach 70 percent within 10 years. The 10-year target would mean that there would be a total of 250,000 hectares of managed woodland around Niamey, divided into about 80 rural markets, with a similar total area under management around the other urban areas.

Implementing the rural market system would thus involve the totality of relations among fuelwood suppliers, local villages, pastoralists, the forest service, and local administrative authorities. It would bring profound changes in the fuelwood supply system and how it was managed and regulated. The legal status of villages, as well as the powers and role of the forest service and local authorities, would be changed. It was an ambitious program. In the light of experience, however, it was the only choice: the available alternatives did not work; it was the rural market system or nothing.

The Demand Component

The challenge in demand management was to prevent the predicted rapid growth in consumption from overwhelming the supply system. The project design set itself the target of holding fuelwood consumption at the existing level. This, in effect, would mean that fuelwood consumption would be only half its projected level in 10 years. It was decided to tackle this task in two ways: by encouraging the use of kerosene and LPG as substitute cooking fuels and by increasing the efficiency of urban fuelwood use through the promotion of energy-efficient wood stoves.

Consumer Surveys and Market Assessment. The project design team carried out consumer surveys and market assessments to gauge the likely acceptability of both kerosene and LPG as cooking fuels. These showed that women, in general, did not like cooking with fuelwood. The idea of switching to the cleaner and more convenient kerosene or LPG was attractive to a large proportion of families.

The detailed findings of these surveys were that 21 percent of urban families, principally business people and salaried workers who would be seen as market leaders, were potential users of kerosene for cooking, even if it cost more than fuelwood. A further 19 percent would probably follow any large-scale adoption of kerosene cooking by the market leaders. Although a further 27 percent would be willing to change to kerosene because of its greater convenience and cleanliness, the disposable income of this group was so low that they would only be willing to make the shift to kerosene if its cost were no higher than that of using fuelwood.

In the case of LPG, the findings were that only about 6 percent of households in Niamey could realistically be viewed as potential users. This would bring consumption up from its existing level of 300 tonnes/year to about 1,200 tonnes/year. Extending the use of LPG beyond this 6 percent would require heavy subsidies on the LPG fuel itself and was too impractical to consider.

Comparative Costs of Cooking Methods. The team analyzed the relative costs of cooking using the available methods. The baseline figure was taken as the average monthly cost of fuelwood for a family using the traditional three-stone fire. This was compared with the costs of using the Malgache and Mai Sauki fuelwood stoves and with the costs of cooking with LPG and kerosene. The ONERSOL test figures, which showed the Malgache stove to be 20 percent more efficient than the three-stone fire, and the Mai Sauki a further 20 percent more efficient, were used in calculating the costs of cooking with these stoves.

The results of these calculations on relative cooking costs are shown in Table 3.2. It can be seen that adoption of the Mai Sauki stove brings a saving of almost 40 percent to a family in comparison with the three-stone fire. Cooking with kerosene, however, turned out to be twice as expensive as using the three-stone fire, and LPG was more than four times as expensive.

The team then calculated the effects of imposing a tax of FCFA 9/kilogram on fuelwood and removing all taxes from LPG and kerosene. The results given in Table 3.2 show that cooking with kerosene is now cheaper than with the three-stone fire and the Malgache stove, and close to the cost of using the Mai Sauki. LPG, however, remains about 50 percent costlier than the three-stone fire and 250 percent more expensive than using the Mai Sauki. On the basis of these figures, kerosene was the most promising option as a substitute for fuelwood, provided the necessary changes in the taxes levied on the two fuels were implemented.

Table 3.2 Comparative Costs of Cooking with Different Stoves and Fuels

(FCFA)

Stove type	*Stove price*	*Monthly fuel consumption*	*Fuel price*	*Monthly cost*	*Revised price*[a]	*Revised monthly cost*
Three-stone fire	—	160 kg	16	2,480	25	4,000
Malgache stove	150–220[b]	128 kg	16	1,980	25	3,200
Mai Sauki stove	550–1,450[b]	102 kg	16	1,584	25	2,550
LPG stove	12,000–16,000	20 kg	540	10,800	325	6,500
Kerosene stove	5,500	33 liters	150	5,000	90	3,000

a. With FCFA 9/kg tax on fuelwood and no taxes on LPG and kerosene.
b. Depending on size.

Table 3.3 takes the comparative cooking cost analysis a stage further and examines the relative costs of using fuelwood and kerosene under different market prices. The table shows that, on the assumption that the full FCFA 9/kilogram tax is imposed on fuelwood, bringing the price to about FCFA 25/kilogram, the price of kerosene required to make it competitive is about FCFA 100/kilogram.

Table 3.3 Relative Prices Required for Fuelwood and Kerosene to be Competitive

Price of fuelwood (FCFA/kg)	*Price of kerosene (FCFA/l)*
20	80–90
22	88–99
24	96–108
26	104–117
28	112–126
30	120–135

Note: Calculations based on fuelwood consumption of 4 to 4.5 kilograms per day or 1 liter per day of kerosene.

Table 3.3 takes the comparative cooking cost analysis a stage further and examines the relative costs of using fuelwood and kerosene under different market prices. The table shows that, on the assumption that the full FCFA 9/kilogram tax is imposed on fuelwood, bringing the price to about FCFA 25/kilogram, the price of kerosene required to make it competitive is about FCFA 100/kilogram.

Tax and Pricing Strategy for Substitute Fuels. The proposed abolition of taxes on LPG and kerosene would obviously involve a loss of revenue to the government. The project analysis showed, however, that the loss would be more than compensated by the proposed fuelwood taxes. In addition to providing the funds required to run the transport control system, the revenue from the new fuelwood tax would provide a substantial surplus for the national treasury.

In the light of these findings, the government agreed to the proposed tax and pricing strategy. Some of the necessary moves were made quickly. In November 1986, the tax on LPG was reduced by 50 percent, which led to a 60 percent increase in sales. The taxes on LPG and kerosene stoves were also reduced. It was also agreed that the price of kerosene sold through the national petroleum company, SONIDEP, would be reduced from its prevailing level of FCFA 145/liter to FCFA 105/liter through the use of cross-funding from the taxation of gasoline.

Kerosene Stove Promotion. Cooking with kerosene was virtually unknown in Niger at the time the project was being designed. The project design team therefore

carried out research to identify a suitable kerosene stove for promotion in the country. This research revealed that none of the commercially available kerosene stoves in West Africa was suited to the traditional cooking methods in Niger.

Following a worldwide search, an Indonesian stove, with 36 wicks and two burners, the Thomas Cup 36 stove, was identified. Laboratory tests showed that it had the maximum power output and flexibility required to meet family cooking needs in Niger but required some modification in the form of additional pot supports. These modifications could be carried out in Niger.

The stove was renamed the Tchip stove for the Niger market. Its retail price, with the modifications, was estimated to be just over FCFA 8,000, including a tax of FCFA 2,600. At this price it was five to six times more expensive than the Mai Sauki. To make the price more competitive, the project proposed that the Tchip be exempted from all taxes and sold at a promotional price for the first few years of the project. The necessary subsidy would be provided from project funds but would gradually be reduced as sales of the stove increased.

The intention was that the private sector would be the driving force in the promotion of the stove. The role of the project would be purely supportive and limited to the provision of technical assistance in manufacture, marketing, promotion, and publicity and providing initial risk capital at favorable interest rates. It would not become directly involved in the manufacture or sale of the stoves.

The project set a target penetration rate for the Tchip stoves of 40 percent in Niamey and 50 percent in the other urban areas by the year 1997. This would bring the number of kerosene-consuming families from near zero to 91,000 in 1997. It would raise kerosene consumption from its 1988 level of 2,500 m^3/year, which was almost entirely for lighting, up to 34,000 m^3/year.

Promotion of Improved Fuelwood and LPG Stoves. The project determined that rather than developing its own improved fuelwood stove initiative, it would support the promotion of the Mai Sauki stove that was already being carried out by GTZ and other donor agencies in collaboration with the Department of Energy. The project estimated that about half a million Mai Sauki stoves would be sold in the period up to 1997, resulting in a 25 percent penetration rate in Niamey, Zinder, and Maradi, and 50 percent in Tahoua and other smaller urban areas. At a production rate of about 5,000 stoves each month, this was within the capacity of the artisans already trained under existing and previous promotion campaigns.

In the case of LPG, the project decided to support the existing Regional Program for the Promotion of Butane Gas implemented by CILSS and funded by the European Development Fund. The Niger component was known as the National Gas Project (Projet National Gaz, PNG). This effort was based on the promotion of subsidized 6-kilogram and 3-kilogram stoves as opposed to the 12.5-kilogram stoves used by the existing, mainly wealthy, users.

The target penetration rate for LPG was 11 percent in Niamey and 3–4 percent in the other urban areas. This would bring the number of families using LPG up from around 3,000 to 23,000, and consumption up to 3,800 tonnes/year. It would involve the import of 70,000 of the 6-kilogram and 3-kilogram LPG bottles and the import and modification of 20,000 LPG stoves.

Project Approval and Cost

Given the complexity of the project, and the radical nature of many of its proposals, it is little wonder that it was viewed with some concern at the project appraisal stage. There was particular resistance among foresters, who had grave misgivings over the proposal to give local communities control over the management of their local natural woodlands. The World Bank's (1988b) own final appraisal report commented, somewhat grudgingly as follows:

> The household energy strategy is new and may encounter serious social or political obstacles. Also, difficulties and abuses could be expected at all levels of the firewood regulation and management network. However, given that the alternatives are few and unpromising and the cost of deforestation high, the risks associated with the relatively small investments are well worth taking. (p. vi)

The project was, nevertheless, given the go-ahead and was formally launched in 1989. Its estimated total foreign exchange cost was US$10.3 million, which was provided as a grant by the Danish government. As a result of exchange rate fluctuations between the Danish kronor and the U.S. dollar, this figure was later increased to US$12.3 million. The local costs, borne by the government of Niger, were estimated at US$4.2 million.

4

Implementing the Project

The Household Energy Project was officially launched in 1989. Once it was under way, a number of major data collection and planning exercises were set in motion. Woodland management trials and monitoring exercises, designed to establish the most effective method of natural woodland management, were begun near Tientiergou, to the south of Niamey. The long process of obtaining the necessary changes in legislation required for the establishment of rural markets was set in motion. Work began on the development of fuelwood supply master plans for the major urban areas.

The initial project design was developed and refined as experience increased and additional data became available; in particular, major simplifications were made in the intended method of natural woodland management. A number of other areas of activity, particularly in the demand component, progressed more slowly than anticipated.

Project Management and Administration

The Household Energy Project is a component of the overall World Bank–Government of Niger Energy II Project. The national implementing agency in Niger is the Department of Energy, which is part of the Ministry of Mines and Energy.

The Household Energy Project is under the dual control of the Department of Energy and the Department of the Environment. (The latter is part of the Ministry of Hydraulics and the Environment.) The director of the supply component is nominated by the Department of the Environment and the director of the demand component by the Department of Energy. The majority of the project staff are seconded from these two departments.

Overall administration and monitoring of the project is carried out by the World Bank. The technical support services were put out to tender, and the winning bid was submitted by a French joint-venture team composed of SEED and CIRAD-Forêt (the former is a consulting company based in Paris, the latter the French national center for international cooperation in forestry and agricultural research and was formerly known as the CTFT). A resident expatriate technical adviser was attached to the supply component for a total of six years, and another expatriate technical adviser worked with the demand

component for four and a half years. Other technical assistance has been provided as requested by the project management with the agreement of the technical assistance coordinator in France. All trips to Niger by the external consultants are treated as discrete consultancies, with specific terms of reference drawn up for each visit and an obligation to produce an aide-memoire before leaving Niger, followed by a formal report. This system provides an effective means of quality control over the external inputs and facilitates the financial supervision of the overall project.

In Niger, the project administration is divided between the supply and demand components, with a common core of personnel and accounts services. The supply component is divided into four services, each headed by a chief. These services include "control," in charge of the fuelwood transport control system; "fuelwood supply chain," which carries out studies of the fuelwood supply chains to the urban areas; "forest management," which provides technical support in setting up rural fuelwood markets and developing their management plans; and "promotion and sociology," which is responsible for the establishment and initial working of rural markets. The supply component of the project is supported at the regional level by the staff of the local Department of Environment offices.

The demand component also has four services, including "marketing"; "commercial networks," which is responsible for setting up sales points and after-sales services; "improved fuelwood stoves," which was set up in 1992; and "programming and evaluation," which produces monthly statistics on stove sales. The demand component has project offices in Zinder, Maradi, and Tahoua.

Every six months a program of proposed activities, together with a provisional budget for the next six months, is produced by the directors of the two components. This is accompanied by a report of the activities carried out during the previous six months. This six-month budget and plan of action is sent to the World Bank for approval before it is implemented.

The Five-Year Plan of Action

One of the first activities of the project was the preparation of a Five-Year Plan of Action. This was produced in March 1990 and is a substantial document, just over a hundred pages in length. It reviews and restates the overall objectives of the project and sets out the practical measures required to meet them. It then describes the detailed organizational structure of the project, the staffing levels, the responsibilities of personnel, and how project monitoring is to be carried out. It reviews the data needs of the two components and sets out the actions required to meet them. It lists the other projects and activities taking place in the country and their relevance to the Household Energy Project.

In the case of the supply component, seven basic tasks were identified, each of which was further broken down into detailed actions. In all, about 150 of these actions are listed, with the timing and responsibility for each clearly defined. A detailed schedule

of the planned actions, and their budgets, was prepared for each of the five years of the project.

In the case of the demand component, the activities were broken down into 10 basic tasks, and again each task was subdivided into the actions to be taken and who would be responsible for each one. A total of about 60 activities were defined and a five-year plan for their completion, together with a projected budget for each over the five years of the project, was also prepared.

At the time the plan was being drawn up, the intention was that project activities would be carried out in and around the four major urban centers: Niamey, Zinder, Maradi, and Tahoua. Because of security problems, it was decided to defer the preparation of the supply master plan for Tahoua.

Establishing the Legal Framework for the Rural Fuelwood Market System

Draft proposals for the establishment of rural fuelwood markets were published by the project at the end of 1989. These were then discussed over a period of two years in a series of seminars and meetings involving representatives of all the relevant parties. The final proposals were then presented to the government. This led to the drafting of legislation and the publication of Government Order No. 92-037 in August 1992, which came into effect in March 1993.

This order stated that a *rural market* is a place of fuelwood sale where an organized local management organization exists. This management organization is approved by the Department of the Environment for the purpose of commercial fuelwood supply to the main urban areas. The rural market is supplied from a zone of woodland negotiated between the local management organization and the Department of the Environment. The task of the local management organization is to exploit, guard, and manage the area and to ensure its regeneration.

The rural market is authorized to collect tax on the wood sold. This is a highly significant step. Granting the rural market entity the authority to collect taxes gives it an official recognition and status that is both practically and symbolically important in its dealings with fuelwood traders and the forest service.

The order states that, from the date of its coming into force, only approved rural markets and the owners of private forests are entitled to supply commercial fuelwood. For a transition period, which will be ended by decree of the minister, the exploitation of commercial fuelwood from uncontrolled areas remains permissible. It also states that a quota, defining the quantity of fuelwood that may be harvested each year, will be set for each delimited area of natural woodland associated with a rural market. The order makes a distinction between directed and controlled markets. In the directed market, the area of natural forest is delimited and agreed upon and an annual harvesting quota is set, but no formal management plan is established. A controlled market is one where a management plan—specifying the division of the area into parcels, the order of their harvesting, and the management measures—has been established.

The 1992 Fuelwood Taxation Reforms. In addition to defining and legalizing the establishment of rural fuelwood markets, Order No. 92-037 introduced some key changes in the fuelwood taxation system. As the project had proposed, the cutting of wood itself is no longer taxed, and the old cutting permit was abolished. Now, it is the transport of cut fuelwood to the towns that is taxed. Commercial transport of fuelwood for sale is restricted to professionals licensed by the Department of the Environment. (At a July 1991 congress, the department encouraged the establishment of the Association Nationale des Exploitants de Bois, ANEB, which replaced the ASEBN, to ensure that the woodfuel traders had a voice in these discussions.) Individuals may transport a maximum of one stere of fuelwood each month for their own use but must still pay the tax. Village consumption remains outside the scope of the order.

The cutting permit is replaced by a series of transport coupons. These specify the amount of fuelwood carried and whether it comes from a rural market or an area of uncontrolled, open woodland. The rural market coupons distinguish between directed and controlled markets as the origin of the wood. In addition, they specify the distance of the zone, relative to the urban area, from which the fuelwood has been obtained. These coupons are only issued to authorized professional transporters, and each is valid for one trip, which is to take place within 48 hours of its issue. Each transporter, on entry into a town, must present a coupon at the control post or at any other time it is requested. This coupon acts as a receipt for the payment of the appropriate tax on the amount of fuelwood being carried. In the case of a rural market, the tax is collected by the market manager at the time the fuelwood is purchased. When the fuelwood is obtained from an uncontrolled zone, the tax is paid in advance at a Department of the Environment permit-issuing office. Order No. 92-037 specifies the division of fuelwood tax receipts among the national treasury, the local authority, and the rural market, and how this division varies depending on the fuelwood source. The relevant figures are shown in Table 4.1.

Table 4.1 Division of Taxes Levied on Fuelwood (percent)

Recipient	*Uncontrolled area*	*Directed area*	*Controlled area*
Rural market	0	30	50
Local authority	10	20	40
National treasury	90	50	10

The breakdown of how these tax revenues may be spent by the parties is also specified in Order No. 92-037 and is shown in Table 4.2. Depending on whether the market is directed or controlled, between 40 and 60 percent of the revenues must be spent on woodland management measures such as seedling nurseries, firebreaks, and erosion protection. The remainder is at the discretion of the village or local authority. The actual level of the various taxes at a given time is determined by government regulation. Order No. 92-037 states that these tax rates should be revised at least once a year and at any other time deemed necessary. The revisions are to take into account the inflation rate, evolution of other fuel prices, and other relevant economic, social, or environmental factors.

Table 4.2 Authorized Expenditure of Tax Revenues (percent)

	Type of rural market			
	Directed		*Controlled*	
Spending entity	*Woodland management*	*Discretionary*	*Woodland management*	*Discretionary*
Rural market	60	40	40	60
Local authority	60	40	40	60

An interministerial working group, with representatives of the supply component, was set up to prepare detailed recommendations on the exact levels of taxes to be levied under the order. The final recommendation of the working group was that the maximum rate of tax, which would be levied on fuelwood from uncontrolled areas, should be FCFA 600/stere (about FCFA 2/kilogram), as opposed to the FCFA 2,700/stere proposed by the project. The FCFA 600/stere figure was accepted by the government. The substantially lower rates proposed for the taxes on fuelwood from different categories of rural markets were also accepted by the government.

Table 4.3 lists the full range of taxes that came into effect in March 1993. The FCFA 600/stere rate applies to all fuelwood from uncontrolled areas, no matter where they are located. The rate for fuelwood from rural markets varies from FCFA 280/stere to FCFA 375/stere, depending on the distance from the urban area and whether it is from a controlled or directed market.

Table 4.3 Structure of Fuelwood Taxes Established in 1992 (FCFA/stere)

	Rural markets		
Distance from urban area	*Controlled*	*Directed*	*Uncontrolled zones*
Less than 40 kilometers	350	375	600
40 to 80 kilometers	315	340	600
Beyond 80 kilometers	280	300	600

Another important change in the fuelwood taxation system was also introduced at the beginning of 1993 and came into effect simultaneously with the new tax regulations in March of that year. Data from the project's survey of the fuelwood chain had shown that the nominal capacity of vehicles assumed for tax purposes was generally far lower than what they actually carried. Under a government order of February 1993, the capacities of all vehicles used in fuelwood transport were revised upward by from 40 percent to 200 percent. Animal loads were left unchanged.

At the central government level, a special account for tax receipts, known as Account No. 3001, was also set up. Funds from this account were to be used to cover the costs of operation of the taxation and control system. The intention was that the buildup of revenue in this account would eventually enable the system to become self-financing.

Fuelwood Supply Surveys

The only available fuelwood consumption figures at the beginning of the project were those from the 1984 survey carried out under the IDA/FAC/CCCE project. New surveys of the fuelwood supply systems of Niamey, Zinder, and Maradi were therefore carried out during 1990 and 1991. These used a variety of techniques, including a traffic census designed to identify the quantities of fuelwood being carried into the urban areas, their points or origin, and the breakdown of the modes of transport used; surveys of roadside and urban sales points; sample surveys; and in-depth interviews with people involved at each stage of the supply chain.

The Niamey Survey. The Niamey survey was carried out in 1990 over a period of seven days, 24 hours daily, and covered each of the 23 entry points on roads into the city. It showed that, extrapolated to a yearly figure, the total fuelwood consumption of Niamey was 133,000 tonnes. Of this, 64 percent was carried by lorry and 13 percent by pickup truck. A further 12 percent was carried by camels and donkeys, and the remaining 11 percent by private, nominally noncommercial, transport.

Table 4.4 summarizes the results of the survey and compares them with the figures for 1984. The annual growth rate in total consumption over the period was 3.2 percent yearly. There was also a marked shift in the breakdown by transport mode over the period 1984–85, with the share taken by lorries increasing by 24 percent at the expense of pickup and animal transport. This may be a result of the depletion of stocks close to the city. Nevertheless, the 1990 survey found that virtually all the supplies still came from within 60 kilometers of the city, and about two-thirds came from within 40 kilometers. Camel and donkey loads were found to come from within 30 kilometers.

For wood carried by lorry, the survey found that 82 percent was cut by the transporters' woodcutters and loaded directly into the lorries in the form of logs. This is the preferred mode for lorry transporters, because the larger wood stacks more easily, allowing greater quantities to be carried and transport costs to be reduced. Pickup-truck owners were found to obtain a higher proportion of their supplies, usually in the form of bundles of split wood or small branches, from roadside sellers. Most of the fuelwood carried by animal transport was found to be collected by the traders themselves and consisted mainly of small branches. It was learned that 76 percent of the total fuelwood supply was cut and loaded directly by woodcutters or traders from Niamey. The local population thus received no benefit from three-quarters of the fuelwood sold in the city.

Table 4.4 Niamey Fuelwood Supplies and Transport Mode, 1984 and 1990 (percent)

		Transport mode			
Year	*Total supply (tonnes)*	*Lorry*	*Pickup*	*Camel and donkey*	*Other*
1984	110,000	40	25	24	11
1990	133,000	64	13	12	11

The 1990 survey found the same pattern of exploitation as in 1984. Areas close to the city and along the main tarmac roads tended to be heavily exploited, and the size and quality of the remaining wood was relatively low. Farther from Niamey, or well away from the tarmac road, wood resources were greater and exploitation lower. In some of these less-accessible areas, good-quality deadwood was was simply being left to rot.

Fuelwood Costs and Prices along the Niamey Supply Chain. The survey also produced a considerable amount of data on the costs incurred at different points in the supply chain. In the case of lorry transport, where no payment is made to the local population for the wood, the "production" cost is represented by the wages of the woodcutters hired by the transporters in Niamey. These wages were found to be generally in the range of FCFA 500–700/day, yielding a fuelwood harvesting cost of FCFA 600–700/stere. For other transporters, the "production" cost is represented by the amounts paid to villagers or roadside vendors. Owners of donkeys and camels usually cut and load their own wood, although in some areas they may buy it from villagers.

Fuelwood cutting is taxing, difficult work and many village people see it as demeaning. The survey found that when the fuelwood is cut by local labor, the cutters are often migrants who come to an area after the crop harvest in their own villages. In other cases, the cutters are poor area farmers who are seeking to earn some cash. Transport costs are difficult to estimate precisely when the fleet of vehicles is far past its normal working life. Because depreciation cannot be calculated in a meaningful way, the principal expenses are fuel, repairs, and drivers' wages. Lorry transport, because of its economies of scale, is much less expensive than the use of pickup trucks, an effect that increases with transport distance. Lorry transporters use their own low-paid labor rather than buying the fuelwood from local people and so have lower production costs. Table 4.5 shows the costs for three different supply chains. In each case, the final selling price was normalized at FCFA 23.5/kilogram to facilitate comparisons.

Table 4.5 Costs and Prices for Fuelwood Transport to Niamey (FCFA/kg)

	Mode of transport		
Item	*Lorry*[a]	*Pickup truck*[b]	*Camel or donkey*[c]
Production cost/price	2.1	7.5	7.2
Transport cost	2.7	4.2	0.0
Gross wholesale margin	5.6	4.3	0.0
Gross retail margin	13.1	7.5	16.3
TOTAL	23.5	23.5	23.5

Note: The normalized figure of FCFA 23.5/kilogram for selling price is on the high side; a more typical retail selling price, at the time, was about FCFA 20/kilogram (see Table 4.6).

a. Cutting by paid labor; loading as logs at point of cutting; wholesale to retailers in Niamey; splitting by retailers.

b. Cutting by villagers; roadside loading 50/50 logs and split bundles; wholesale to retailers; splitting by retailers.

c. Cutting by donkey owner; loading, as small branches, at place of cutting; average journey of 30 kilometers; 50 percent sale to retailers, 50 percent direct doorstep sales.

The Zinder, Maradi, and Tahoua Fuelwood Surveys. Similar fuelwood surveys were carried out for Zinder, Maradi, and Tahoua, and the results are summarized in Table 4.6. The survey found that the total consumption in Zinder was about 25,000 tonnes. With a population of 135,000, this works out to about 180 kg/person/year, about one-third less than consumption in Niamey. At least in part, the reason for this is the difference in eating habits—in Zinder, it is usual to eat only one cooked meal each day. Per capita consumption in Maradi, in contrast, appears to be similar to the Niamey figure.

The Zinder survey found that just under 60 percent of the fuelwood was carried by lorries, 9 percent by pickup trucks, 17 percent by donkey, and 5 percent by camel. Of the total, about 60 percent was in bundles of split wood and 26 percent in logs, with the remainder in mixed loads or in small branches. In all, about 40 percent of the fuelwood was cut by the transporters, without payment to anyone in the rural areas. The corresponding figure for Maradi was about 50 percent.

Table 4.6 lists the prices of fuelwood found by the three surveys and compares them with those in Niamey. The price of fuelwood—apart from Maradi, where it is about 20 percent lower—is remarkably similar throughout the country.

Table 4.6 Fuelwood Consumption and Prices in Four Urban Centers in Niger, 1990 or 1991

Urban center	*Fuelwood consumption (tonnes/year)*	*Price of fuelwood (FCFA/kg)*	*Date of survey*
Niamey	133,000	20	1990
Zinder	25,000	21	1990
Maradi	40,000	16	1990
Tahoua	19,000	20	1991

Preparing the Niamey Supply Master Plan

The first supply master plan prepared by the project was that for Niamey. A multidisciplinary team including foresters, sociologists, economists, geographers, agriculturalists, agronomists, and cartographers was involved in its preparation.

Wood Stocks and Sustainable Yields in the Niamey Fuelwood Catchment Area. A radius of 150 kilometers around Niamey, rather than the 100 kilometers used in the FLUP assessment, was chosen as the potential fuelwood catchment area for Niamey. To the north, this includes virtually all the existing natural woodland. To the south of the city, it is cut by the border with Burkina Faso and the National Park W. The catchment spans a rainfall range from an arid 250 millimeters/year in the North to about 800 millimeters/year in the extreme South.

The resource assessment was based on Landsat images recorded in December 1988. Ground-truthing was carried out in 25 locations to calibrate the interpretations of the satellite imagery. The work was also cross-checked with the results of the FLUP study and other previous inventories. In evaluating the stocks of wood suitable for commercial fuelwood harvesting, only clearly defined natural woodland areas were considered. As in the FLUP study, standing stock estimates were based on shoot diameters above 4 centimeters. It was not practicable to make an assessment of the wood resources on fallow lands, farmlands, or other nonforest areas, although it was seen that these were an important supply source of cooking fuel for local people.

The natural woodland area within the 150-kilometer radius was divided into three categories, depending on the standing stock (Table 4.7).

Table 4.7 Standing Forest Stocks and Sustainable Yields, Niamey Catchment

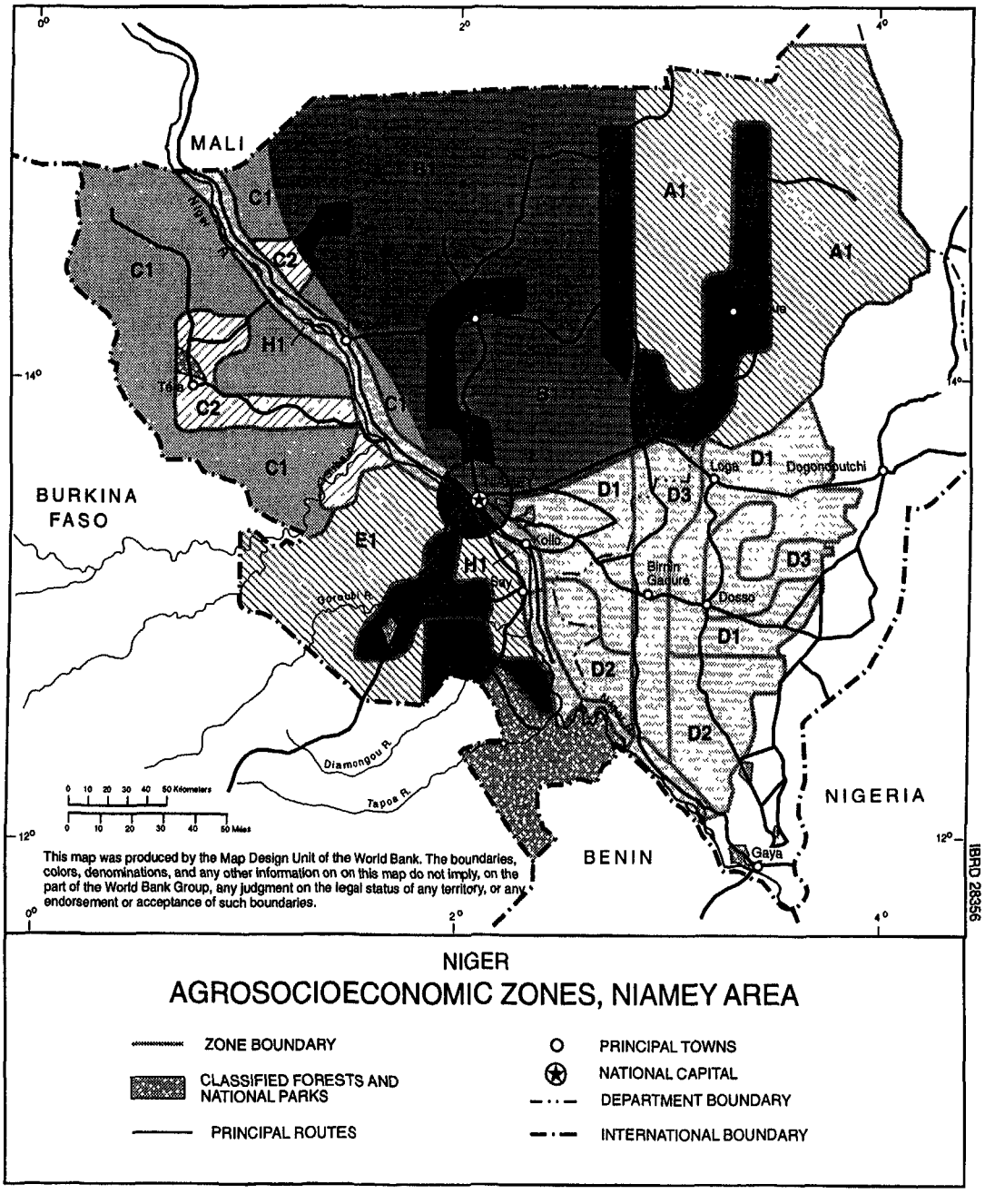
Category	*Standing stock (steres/ha)*	*Area covered (ha)*	*Total volume (steres)*	*Annual yield (steres/ha)*	*Total annual yield (steres)*
1	11	251,100	2,762,100	1.0	251,100
2	7	849,487	5,946,412	0.6	509,692
3	3	1,337,513	4,012,536	0.2	267,503
TOTAL		2,438,100	12,721,048		1,028,295

Estimates were made of the sustainable yield for each category based on the available research results from Niger and elsewhere and are also shown in the table. The analysis showed that the area covered by natural woodland totaled 2.4 million hectares, about 34 percent of the catchment area. The estimated total volume of standing wood was 12.7 million steres, around 3.6 million tonnes. The annual sustainable yield was about 1.0 million steres (300,000 tonnes).

Agrosocioeconomic Analysis. Ecological, agricultural, social, and economic conditions vary greatly in the catchment area and must be taken into account in assessing sustainable natural woodland yields and the potential for establishing rural fuelwood markets. An agrosocioeconomic analysis of the catchment area was therefore carried out, with group interviews in 40 villages. Previous studies were also reviewed. The analysis identified seven distinct zones within the overall catchment area. Within several of these areas, further subzones could be distinguished.

The main zones are shown in Figure 4.1, and their major characteristics are summarized in Box 4.1.

Figure 4.1 Agrosocioeconomic Zones around Niamey



Box 4.1 Zones of the Niamey Catchment Area

Northeast: Zones A and B

Sandy, low-fertility soils susceptible to wind erosion; rainfall in the range of 300 to 450 mm/year and high risk of drought; generally low population densities of about 10 persons/sq. km.; high emigration and considerable poverty; productivity of agropastoral systems in decline; production of staple foodstuffs below local needs; long history of settlement and well-developed social organization; forest resources severely depleted but fuelwood cutting an important source of income among the poor.

Northwest: Zone C

Sandy, low-fertility soils susceptible to wind erosion; rainfall in the range of 300 to 450 mm/year and high risk of drought; population densities generally in the of range of 30 to 50 persons/sq. km. although much lower in some areas; self-sufficient in food; long history of settlement and well-developed social organizations; forest resources heavily depleted, but little commercial fuelwood cutting.

South: Zone D

Fertile soils; rainfall in the range of 500 to 600 mm/year and low risk of drought; population density of 30 to 45 persons/sq. km.; long history of settlement and well-developed social organization; agricultural holdings highly fragmented; serious landownership conflicts between farmers, and between farmers and pastoralists; substantial forest resources and a long tradition of commercial fuelwood supply to Niamey; forest resources now generally remote from villages.

South: Zones E and F

Potentially fertile soils; rainfall in the range of 500 to 600 mm/year and low risk of drought; population densities in the range 15 to 30 persons/sq. km., but lower in many areas; formerly little settlement because of risks of human and livestock diseases, but these areas are now zones of high immigration and rapid population growth; as a result of the rapid population growth, little social organization or cohesion; large forest resources that are relatively little exploited for commercial fuelwood.

Niamey Peri-Urban Zone

Sandy, low-fertility soils; rainfall about 500 mm/year and low risk of drought; population density 30 persons/sq. km. and growing rapidly; traditional agropastoral farming, often with cattle owned by urban dwellers, and intensive market-gardening and fruit growing; highly depleted and degraded woodland resources.

River Niger Valley

High population density in the range of 30 to 50 persons/sq. km.; intensive irrigated or recessional agriculture; heavily depleted woodland resources.

Estimating the Available Fuelwood Supply for Niamey. A cartographic representation was chosen for synthesizing the data needed for an estimate of the sustainable fuelwood supply for Niamey. The catchment area was divided into a grid; each square represented about 32,000 hectares. For each square the following data were shown: the annual production of wood; the amounts collected by the local population for their own use; and the amounts taken to supply Niamey.

In general, the assumptions about yield were deliberately on the low side, whereas those about wood extraction were on the high end. This approach led to a relatively conservative overall evaluation. Since the purpose of this part of the exercise was solely to identify extraction areas where unsustainable harvesting was already taking place, or likely to do so soon, it seemed preferable to adopt a conservative view.

Using data from the 1977 and 1988 censuses, the overall population growth rate in the catchment area was found to be 4.84 percent yearly, compared with the national growth rate of 3.57 percent—the higher rate was largely the result of migration into the area from the North. There were also substantial local variations. The highest growth rates were found in the south, in Zones E and F, where woodland resources are greatest. These are also the areas of highest immigration, where the agricultural frontier is most conspicuously being pushed into the natural woodlands.

Population projections were prepared for the periods 1990–95 and 1990–2001. Those for 1990–95 were made on the basis of the canton. The estimates for 1990–2001 were made on a more aggregated basis, that of the arrondissement—there are 10 in the area considered. These population projections were combined with an estimated rural fuelwood use of 0.8 kg/head/day to obtain the total figure for rural consumption in 1995.

Two alternative projections were made. The first assumed that requirements for rural consumption are entirely met by the natural woodlands; the second projection took the more realistic estimate that 50 percent of the needed wood was supplied by the natural woodlands and 50 percent from fallows and farmland trees. The first projection assumed that consumption in Niamey would continue to grow at the 1984–90 rate of 3.2 percent yearly, while the second assumed that implementation of demand-reduction measures would stabilize consumption at its 1990 level.

Table 4.8 presents the results of the projections. Under the first assumptions of 100 percent rural consumption from the natural woodlands and a continuation of the 1984–90 growth trend in Niamey, there was already a large fuelwood deficit in 1990, which reached 310,000 tonnes/year, almost 10 percent of the standing stock, by 1995. (This deficit is the difference between consumption and the assumed annual yield. The implication is that the deficit is met by cutting the stock of wood, thereby reducing the annual yield. The depletion process accelerates exponentially once this process begins.)

The second projection, with 50 percent of rural consumption supplied by the natural woodlands and consumption in Niamey stabilized, shows a small deficit in 1990, and a much slower rate of increase. The table also shows that the most critical assumption relates to rural consumption—consumption in Niamey has a relatively minor effect.

Table 4.8 Annual Forest Yields and Fuelwood Use, Niamey Area (tonnes)

Fuelwood	*1990*	*1995A*	*1995B*
Annual forest yield	300,000	300,000	300,000
Exported to Niamey	130,000	160,000	130,000
Local consumption	370,000	450,000	450,000
Annual deficit[a]	200,000	310,000	280,000
Annual deficit[b]	15,000	85,000	55,000

Note: Column 1995A = business-as-usual projection of trends; 1995B = stabilization of consumption in Niamey.

a. Local rural consumption, 100 percent from natural woodlands. b. 50 percent from natural woodlands.

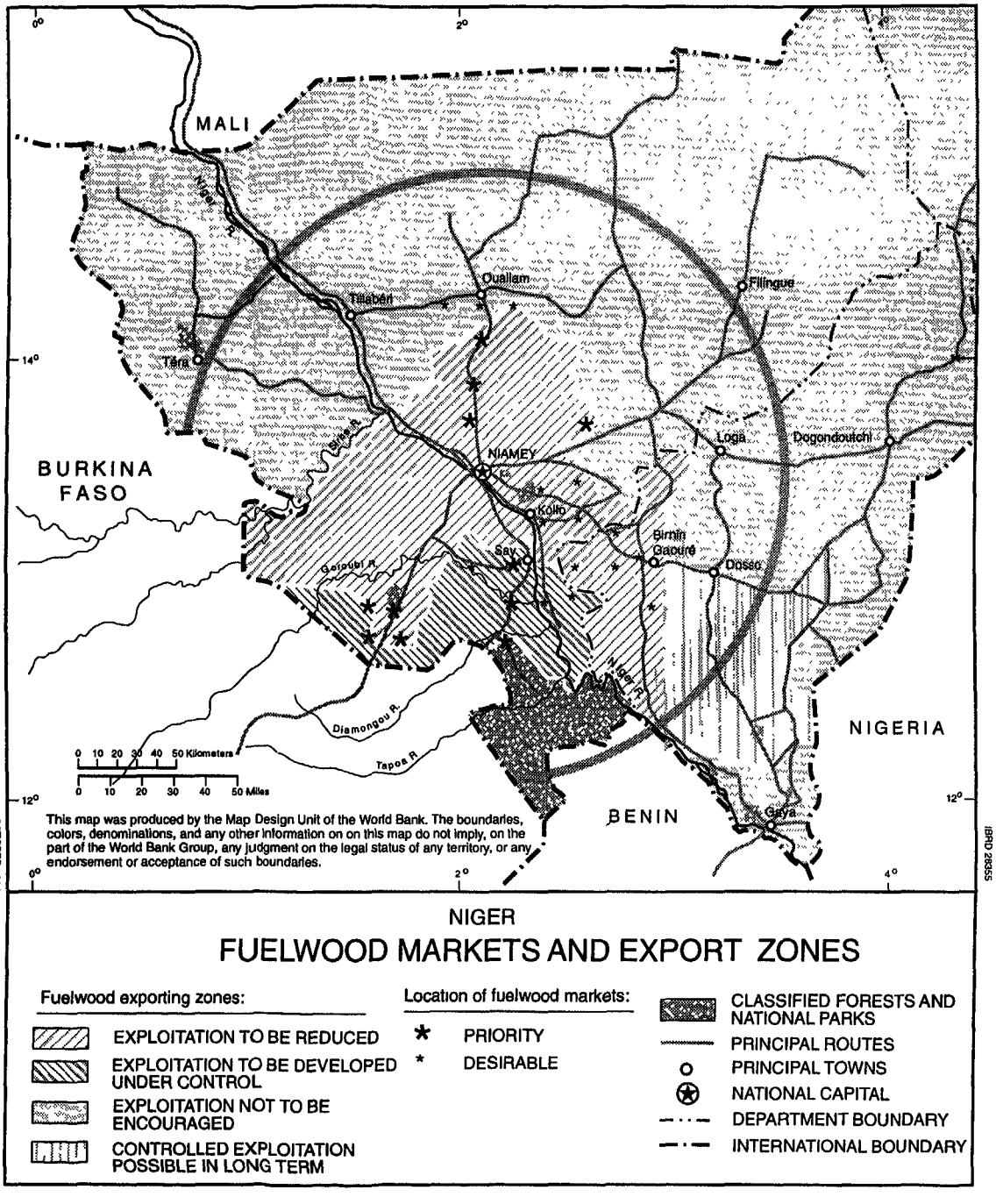
Drawing up the Supply Master Plan. The woodland resource assessment and the agrosocioeconomic analysis showed a wide range of conditions within the Niamey fuelwood catchment area. Some areas had considerable fuelwood surpluses available for export to Niamey; others were already overexploited. Similarly, social and other factors may influence the viability of rural markets, and a detailed supply master plan must take them into account. This could only be done by adopting a disaggregated approach.

The canton level was chosen as the basis for disaggregation. The available information on each canton supplying fuelwood to Niamey was synthesized and presented in the form of a "decision grid" showing the total annual production of the natural woodlands, the balance available for export to Niamey (assuming that either 50 percent or 100 percent of the needs of rural people were met from their local woodland resources), and the actual amounts of fuelwood exported to Niamey. Other data, drawn from the agrosocioeconomic analysis and added to the decision grid, included population density, dominant land-use type, and degree of social cohesion.

The decision grid made it possible to identify areas where rural markets were likely to succeed. It would not make sense, for example, to set up a market in an area with insufficient fuelwood resources to provide a sustainable supply for a market or in one lacking the social cohesion necessary to function effectively. Areas of abundant resources where the social and other conditions were fulfilled, however, would be natural choices for markets. The decision grid also highlighted the areas where the supply-demand deficit was highest, and measures were required to discourage fuelwood harvesting and to increase the productivity of the remaining woodlands.

A final synthesis map (see Figure 4.2) was then prepared to show the interventions required in the different parts of the catchment area. In broad terms, in the North, which is generally poor in natural woodland resources, the master plan indicates a need to reduce the flow of wood to Niamey. In the South, the natural woodland endowment is considerably greater, and there are still significant areas of unexploited natural woodland. The master plan, however, shows that some of the areas with substantial stocks are being overexploited. This needs to be brought under control by the introduction of natural forest management and diversion of excess harvesting to areas where it can be met on a sustainable basis.

Figure 4.2 Niamey Supply Master Plan Exploitation Zones



The creation of the master plan thus provided a basis for identifying areas for priority action in setting up rural markets and local management plans. It also clearly highlighted the gaps in reliable information on a variety of crucial parameters. Primary among these was the pattern of rural consumption—the amounts used and their origin. Other important areas where information was lacking included the transhumant and year-round livestock populations and the productivity of nonforest areas such as fallows, farmlands, and areas of scrub and bush.

This lack of information emphasized the need to view the master plan as the basis for dialogue and negotiation with local people rather than a rigid prescription for each area. Such a dialogue, supplemented by detailed local studies, was recognized as the only path toward locally relevant and workable solutions.

Zinder and Maradi Supply Master Plans

Supply master plans were also prepared for Zinder and Maradi. As in the case of Niamey, a detailed analysis of the fuelwood supply chain was carried out using a seven-day fuelwood traffic census; surveys of roadside and urban sales points; and sample surveys and in-depth interviews with people involved at each stage of the supply chain. Estimates of the standing stock of natural woodland and the sustainable yield within a fuelwood catchment area with a radius of 150 kilometers were made for both towns. Agrosocioeconomic analyses of the catchment areas were also carried out. Table 4.9 summarizes the main results of the supply-demand analyses for the two catchments.

In the case of Zinder, the total standing stock in the catchment area was estimated to be about 1.3 million tonnes. In addition, there were an estimated 200,000 tonnes of deadwood. The potential sustainable supply was estimated to be 32,800 tonnes yearly, excluding the deadwood, which was estimated to be sufficient to provide an additional 20,000 tonnes annually for approximately ten years.

Even at the 1990 consumption levels, the analysis shows a huge supply deficit for both catchments. This is almost entirely the result of rural fuelwood consumption, which is 11 times higher than the urban consumption in the case of Zinder and about 3.5 times higher in the case of Maradi. Assuming that 50 percent of the requirement is supplied by fallow lands and other nonwoodland sources, the deficits remain high, and rural consumption remains dominant. Projecting the rising demographic and consumption trends forward, as was done with Niamey, shows rapidly increasing deficits.

Looking at Zinder in more detail, the standing stock is 1.3 million tonnes, with an additional 200,000 tonnes of deadwood. The annual rural consumption figure of 282,000 tonnes is growing at an annual rate of 2.9 percent, whereas the annual urban consumption of 24,800 tonnes is increasing at a yearly rate of 6.7 percent. Projecting these trends forward shows a complete exhaustion of natural woodlands and deadwood stocks in 1999. Again, the picture is dominated by the rural figures. Restricting the annual urban demand to 25,000 tonnes makes little real difference—it only postpones the depletion date by two years.

Table 4.9 Fuelwood Supply and Demand, Zinder and Maradi

(tonnes/year)

Urban area	*Potential sustainable supply*	*Urban demand*	*Rural demand*[a]	*Deficit*[b]	*Deficit*[c]
Zinder	60,000[d]	24,800	282,000	254,000[e]	113,000[e]
Maradi	78,100	39,300	275,000	236,200	136,200

a. Based on an assumed 0.6 kilogram/person/day.

b. Assuming all rural consumption from natural woodlands.

c. Excluding supply from estimated 200,000 tonnes of deadwood.

d. Assuming 50 percent rural consumption from natural woodlands.

e. Assuming 20,000 tonnes yearly from deadwood stocks for ten years.

By the year 2000, therefore, the household energy needs of the population will need to be met increasingly from agricultural land, with people relying on agricultural residues and cow dung for domestic fuel. The outlook, the master plan notes, is one of major risk to the agricultural system, with diminution of soil fertility and increased erosion.

The objectives of the Zinder supply master plan, in this context, are limited. By setting up rural markets, it aims to ensure that rural people, rather than professional fuelwood dealers, obtain whatever benefits can be derived from the remaining meager natural woodland resources for as long as they last. It also attempts to preserve the increasingly rare remnants of lowland forests as sustainable fuelwood supply sources, as well as to maintain the fuelwood productivity of nonwoodland areas and, if possible, increase them. The outlook and prescriptions for Maradi are similar.

Under these circumstances, the fuelwood supply master plans amount to little more than holding operations. In the meantime, it is essential to promote vigorously the more efficient use of fuelwood, and the substitution of kerosene and LPG is strongly encouraged in the urban area. The analysis notes that such measures may have to be introduced in the rural areas as well.

Developing the Rural Fuelwood Market

In the initial design of the project, the designation of the "local entity" that would operate the rural fuelwood market was deliberately left open. It could be a single village, a cooperative, or another local body.

Once the project was under way, however, it became evident that, with rare exceptions, the logical and best choice was a single village. In Niger, as in most of the rest of the Sahel, the village is the primary social and land management unit. It is a locally familiar unit that regulates important aspects of rural life. It thus provides a

ready-made focus for the management of the local fuelwood market and the area of woodland that provides the supply.

Using the village as the organizational center also eliminates many of the management problems encountered with the large intervillage cooperatives assembled in Guesselbodi and elsewhere. With a single village, decisionmaking is simplified and intervillage disputes—such as those about protection of cut areas or the quantities of fuelwood that can be harvested in particular areas—are eliminated. With just one village involved, the amounts of money being handled are reduced, which simplifies the accounting. Keeping track of the stocks of wood, sales income, tax receipts, and the share-out among woodcutters is also simpler, and more easily made transparent, when the number of woodcutters is small and they all belong to the same village.

The physical tasks of supplying the market and managing the designated area of natural woodland are also more easily handled when only one village is involved. A typical village, with a population of about 250 people, tends to be surrounded by a circle of cultivated and fallow land with a radius of perhaps 3 kilometers. If a further 5-kilometer radius of natural woodland is taken as being within the management area of the village, the area of woodland will be around 1,800 hectares. If a rotation period of 6 years is used, rather than the 12 or more years previously deemed necessary, six management parcels of 300 hectares can be planned. With such an arrangement, the whole scheme becomes simpler and more easily controlled. Villagers are able to visit any part of the area under management, carry out their work, and return to their home village within the same day.

Delimiting the Area of Village Woodland

The area of land "belonging" to a village is a result of historical population movements, interethnic conflicts, colonial interventions, and a variety of other factors. As a result, some villages—often the longest established or those of traditionally dominant ethnic groups—may control large areas of natural woodland, whereas other villages in the same area may have few effective rights over their local woodlands.

The project accepted that it was not practicable to use the introduction of rural markets as an occasion to attempt to impose a more equitable distribution of land rights among villages. Such a task was far beyond its abilities and resources. Neither could the project take upon itself the task of defining the "ownership" of the different areas of land subject to the assertion and exercise of customary rights. It was therefore decided to restrict the establishment of rural markets to villages that could show they had undisputed fuelwood harvesting rights to the woodlands around them or were able to secure agreements on such rights with neighboring villages without any pressure or intervention by the project or the government.

Where local customary systems for the allocation and sharing of land and natural resources already existed, the project attempted to incorporate them into the process of delimiting the area of natural woodland to be controlled by a village. By invoking the

help of these existing social control systems, the intention was to provide additional support and legitimation for the newly established rural markets. The project also determined that it would be best to try to establish markets in groups of four or five adjoining villages at the same time. In addition to providing some economies of scale in publicity and training, this practice is also helpful in territorial delimitation.

Even with the assistance of these practices, however, gaining agreement about the areas to be controlled by the first villages selected for the establishment of rural markets proved to be a long and complex process. Villages began by trying to claim the maximum possible area for themselves. Not surprisingly, these claims were contested by neighboring villages, who asserted their competing historical or usage rights over the same areas. Resolving these disputes required a major commitment of time and resources by the project. It involved the use of aerial photographs, numerous trips to landmarks, and long discussions with village chiefs. The process was so drawn out and complicated that it became clear that the approach would not be practicable on a national or regional scale.

Instead, it was decided that these discussions should be undertaken by representatives of the villages in conjunction with the local canton chief. The villagers would then produce an agreement that defined the area by local landmarks such as roads, riverbeds, and other prominent features. An official from the Department of the Environment would then be invited to visit and officially record the defined area in the company of the village representatives concerned.

Under this procedure, key landmarks that define the agreed boundaries are marked on a map with their local names and identification. In addition, precise coordinates are established using the Global Positioning Satellite system and recorded on the map. The labor involved in making this formal record is still substantial—delimiting a 1,000-hectare forest can involve a 20-kilometer trek in the bush—but it can be accomplished in a single day. The cartographic details are then sent to Niamey, where they are recorded in the computerized central Geographical Information System (GIS) established by the project.

Once the details have been entered into the GIS, the map is printed out and a final discussion takes place with the villagers. The map is confirmed or amended by a final trip around the perimeter. If a managed rural market is being set up, the division of the woodland area into six exploitation parcels is determined with the villagers, and the starting parcel for exploitation is established. The parcels are identified with references to the already defined landmarks. Once agreement has been reached, the final information is sent to Niamey to be recorded by the GIS.

Setting the Quota for a Rural Market. A major step in the creation of each rural market is the establishment of its annual permissible level of fuelwood sales—its quota. The aim in setting the quota is to restrict fuelwood extraction to a level that can be sustained indefinitely. Otherwise, villages with complete control over their woodland resources could overharvest for short-term gain, bringing about the very problem the

project is designed to prevent. At the same time, the system will not work if it depends on coercion; villagers must understand and accept the quota.

The quota is calculated using the estimated sustainable yield per hectare for the area shown in the master plan. This is translated into an allowable annual fuelwood offtake for the market. The final figure is determined in consultation with the village, taking local circumstances, such as the availability of the necessary woodcutting capacity, into account.

Stages in Establishing a Rural Market

A six-stage process for establishing a rural market has been developed by the project, and it has worked well (see Box 4.2). Nevertheless, the demands in trained manpower are heavy. In the future, when it is intended that many more rural markets will be established at a much faster rate—the Phase II project proposal envisages creation of more than 300 markets over a five-year period—it will be necessary to spread the workload to avoid long delays and frustration. It is therefore intended that local consulting firms or NGOs will be selected and trained to provide the necessary services.

Box 4.2 The Six Stages in Setting up a Market

Stage 1: Initial Information Campaign

This campaign is carried out at the national or regional level and creates the framework for the subsequent activities. The aim is to produce a widespread awareness of the new rural market legislation, to make people aware that fundamental changes have taken place, and to inform the people that new opportunities are now available to village communities. At the national level, the information is presented through radio, TV, and other media. As a follow-up, trained agents travel to villages in priority areas for market establishment to provide more detailed information and engage in discussions with local people.

Stage 2: Selection of Candidate Villages

The district administration of the Department of the Environment collects the names of villages that have expressed interest in establishing a rural market. This can be either the result of an initiative by a project agent or a spontaneous inquiry by a village. As the existence of rural markets becomes better known, the latter is likely to become the more common.

The selected villages are visited by agents who make a rough assessment of their suitability for a rural fuelwood market. This assessment primarily considers the availability of sufficient woodland resources to justify a market, but it also incorporates additional sociological factors, such as the seriousness of the request and the likely level of village commitment. Based on this assessment, candidate villages are placed on a short list for further investigation.

(. . . continues)

(Box 4.2 continued)

Stage 3: Detailed Assessment

During this stage a much more comprehensive study of the village is carried out. Any fuelwood harvesting already being carried out in the area is investigated. The number of existing and potential village woodcutters and their positions within the village are assessed. A preliminary assessment of the extent of the lands under village control, and whether there are territorial disputes with neighboring villages, is carried out using GPS technology to record the results. If the results of these investigations are satisfactory, the village is selected as a potential location for the establishment of a rural market.

Stage 4: Drawing up the Rural Market Application

The aim of this stage is to help the village community to establish the rural market and draw up the formal application for recognition to be submitted to the local Department of the Environment office. The basic framework for the market organization is already laid down in Order No. 92-037, but it requires adaptation to the needs of each village. This stage thus involves a considerable amount of discussion within the village, aided and supported by the project agent.

The general management committee of the market is elected. The committee officers—especially the manager, who keeps the sales and tax records; the treasurer, who is responsible for checking the manager's accounts and distributing the collected sums of money among the beneficiaries; and the president, usually the village chief—are provided with the necessary training to enable them to carry out their functions.

The annual fuelwood harvesting quota for the area is established with the Department of the Environment. Finally, all the necessary information is entered on the form required for the official approval application.

Stage 5: Official Approval

The approval application is sent to the Department of the Environment, where it is scrutinized and, if acceptable, approved. A detailed dossier setting out the particular circumstances of the village is prepared and appended to the general legal agreement establishing the market. An example of the kind of information assembled in the preparation of the dossier is provided by the village of Kankani situated on the border with Burkina Faso in the arrondissement of Say to the south of Niamey. The dossier provides a location map of the village that shows the extent of its lands. These cover a total of 5,049 hectares, of which 4,564 hectares are natural woodland. It includes a brief socioeconomic description of the village that covers its history, population, social cohesion, interethnic relationships, crops produced, work force, and how pastoralism interacts with the sedentary activities of the village. It also sets out the type and extent of the woodland resources on the village lands, their estimated annual yield, and their present method of exploitation.

(. . . continues)

(Box 4.2 continued)

The Kankani dossier locates the village within the context of the supply master plan for Niamey. It is in agrosocial Zone E (see Box 4.1), and it is listed as one of the priority areas for intervention. It also falls in the tax band applicable to distances beyond 80 kilometers from Niamey (see Table 4.1). The dossier sets an annual market sales quota of 1,522 steres for the village. It also names the officers of the management committee, who have been chosen during the process of setting up the rural market. These include the village chief as president, as well as representatives of the woodcutters, farmers, and pastoralists.

Once official approval has been obtained, the commercial fuelwood traders are informed that the market has been formally constituted. The coupons corresponding to its annual quota are printed and given to the market management. The market is then operational.

Stage 6: Support and Supervision

In the beginning, as it gets under way, the market is provided with administrative support and guidance. This, is strictly limited, however, because the goal is to ensure that the market will function independently as soon as possible. Once the market is running independently, the state has no right to influence how the fuelwood is sold, at what price, and who will benefit; these are internal matters determined by the management committee and the village at large. Nevertheless, management is audited regularly to ensure that taxes are paid and that tax revenues accruing to village funds are used appropriately for woodland management measures or contributions to approved social objectives in the village.

The Tientiergou Natural Forest Management Study

A series of trials of different methods of natural woodland management were begun by the project in February 1991. These trials took place near the village of Tientiergou, which lies about 50 kilometers southwest of Niamey. Tientiergou is surrounded by about 30,000 hectares of natural woodland, which is the site of about 20 smaller villages or hamlets.

The area has substantial fuelwood resources. Although exploitation is still relatively limited, it is an important potential source of fuelwood for Niamey. At the time the study was launched, villages showed considerable interest in developing the fuelwood trade, and four villages agreed to participate in the trials. The total area under management by these villages was about 5,000 hectares.

Ecological Dynamics of the Tiger Bush

The Tientiergou area is typical of the tiger bush formations of Niger. It is characterized by gently sloping areas that alternate between impervious vegetation-free soil and patches or strips of vegetation. Within the vegetated strips are trees, bushes, and grasses. One of the notable features of these areas is the high mortality of trees in the vegetated strips.

Work carried out by ecologists from the French research organization ORSTOM has revealed that the rainfall flowing down the slope across the impervious area interacts with the patches of vegetation in a complex, and previously unsuspected, way. At the upstream edge of the vegetation strip, the water flow causes an accumulation of grass seeds and vegetable matter that promotes intense termite activity. This makes the ground considerably more permeable than it would otherwise be and promotes the infiltration of some of the rainwater runoff. The remainder of the water flows into the vegetation patch, where it infiltrates and is taken up by the vegetation roots. Under normal conditions, little of the inflow of water to the vegetation patches escapes at the downslope edge.

At the upstream edge of the vegetation patch, as a result of the infiltration and accumulation of seeds and organic matter, a fringe of pioneer grass species a few tens of centimeters wide colonizes a strip of the impermeable area each rainy season. The overall patch of vegetation thus creeps gradually up along the slope year by year, provided the new grassy fringe is not completely destroyed by overgrazing.

At the center of the vegetation patch, where the availability of water is greatest, the potential for tree growth is at a maximum. The species found include *Combretum nigricans*, *Combretum glutinosum,* and *Gardenis sokotensis*. After several decades of growth, the trees reach maturity, but because of the gradual movement of the overall patch up along the slope, they are now downstream from the zone of maximum water infiltration. Their water needs no longer fully met, they slowly die.

The tiger bush thus effectively represents the climax vegetation for the area. The total quantity of biomass is at a maximum, determined by the availability of rainfall, and any attempt to increase the infiltration of water in one area will lead to a reduction in its availability elsewhere. As the vegetation patch moves up the slope, it leaves the dead trees and scattered patches of *Boscia senegalensis*, a highly drought-resistant bush, behind. In periods of drought, which lead to a shortfall of water even in the center of the vegetation patch, the less drought-tolerant species may also die.

Grazing plays a vital part in the ecology of the system. In their natural state, these areas of tiger bush support a variety of wild herbivores. Over the centuries, these have been gradually replaced by domesticated livestock. The grazing animals, wild or domesticated, hold the key to the full functioning of the ecological dynamics of the tiger brush.

When the grass fringe is grazed, its ability to impede the flow of rainwater runoff is reduced, and sufficient water penetrates the vegetation patch to enable the tree species to develop and mature. If grazing were to be completely suppressed, the grass fringe would become much larger and absorb a greater proportion of the rainwater runoff, which would leave trees in the vegetated patch without sufficient water for survival. Experiments at Tientiergou have shown that trial areas that were completely closed to grazing have become completely covered with grass species. Although it remains to be confirmed by long-term trials, this finding suggests that complete suppression of grazing would lead to the development of an entirely grass or grass and bush savanna.

These findings also strongly suggest that the practice of building check dams, half-moon minicatchments, and other anti-runoff measures is likely to be counterproductive. One of the ORSTOM trials showed that building an anti-runoff bund upstream from a vegetation patch caused it to die off. Given the cost of such anti-runoff measures and the resistance of the local population to carrying them out except when paid to do so, it is a consoling finding.

There is also a longer-term dynamic in the ecology of the tiger bush that is a result of periodic climatic fluctuations. In the severe drought years of 1984–85, for example, many trees died for lack of water. The grazing pressure on the remaining vegetated areas simultaneously increased, so that they were reduced in size and their overall water-absorption capacity was lessened. With the return of higher rainfall in recent years, the vegetation is no longer able to absorb all the rainfall, and the runoff from the area has increased. As a result, water levels are much higher in the lowland areas, with the flooding and in some cases drowning of their tree formations.

Harvesting the Natural Woodlands

The Tientiergou study encouraged the local woodcutters to harvest the woodlands in their own traditional manner. The researchers reasoned that if this method of harvesting could be adapted or modified to conform to the requirements of sustainability, it had a much greater chance of acceptance than if attempts were made to introduce completely new techniques. The results were highly encouraging.

The study found that, as a result of the forest laws prohibiting tree cutting, local woodcutters usually operated furtively, cutting only a small number of trees in a given area to avoid detection by forest officers. This is precisely what is required. In comparison with clear-cutting, such sporadic harvesting leaves the structure and regenerative capacity of the woodland intact. Work was therefore carried out to develop and test a few simple and locally acceptable rules based on the furtive cutting approach. These could then provide the basis for a recommended management technique.

The harvesting method developed is essentially based on setting a minimum diameter of 6 centimeters for the shoots harvested. Restricting cutting in this fashion means that many healthy, growing stems of reasonable size are left behind. Moreover, although while the average diameter of the shoots left in position is obviously reduced, the structure of the woodland is not destroyed, and it naturally regenerates in a balanced manner.

Because a substantial proportion of the shoots left behind are not far short of harvestable size, the time to the next harvest can be substantially reduced. Rather than the rotations of 10, 12, or even 25 years commonly recommended, the study found that after about 6 years, reharvesting would be worthwhile. This greatly simplifies the management technique. Dividing an area into six parcels, each with a rotation period of 6 years, rather than twelve parcels, each with a rotation of 12 years, makes for a much more easily visualized and remembered management system at the local level. (The data still

need to be confirmed by long-term follow-up and further studies, which will also provide data on longer-term survival rates, the actual quantities of harvestable wood obtained at the end of the 6-year rotation period, and the sensitivity of the regeneration to rainfall fluctuations and the intensity of grazing.)

An additional major benefit of this approach is that the value of the forest's nuts, herbs, fruits, medicinal materials, and other products, mainly collected by women, remains intact. It also continues as a reserve for the small wildlife that forms a important part of the local diet. Increased numbers of guinea fowl and francolins (partridges), both of which can be readily sold, have already been observed in the managed woodland areas in Tientiergou. This has generated considerable local enthusiasm, especially among women.

The study also found that local woodcutters had already decided, without any prompting from the project, to protect rings of trees around lowland areas where temporary or permanent accumulations of water were found. The reason given by the woodcutters was that they wished to protect the water sources from sand invasion, a consideration that would not be important to commercial woodcutters from the city. The incident clearly reveals that given control over their own wood resources, local people are quite capable of exercising restraint in their cutting, provided they see good reason for doing so.

The study also produced important information about tree cutting and revealed serious conflicts between the practices that are easiest for woodcutters and those that are best for regeneration. When the maximum degree of regeneration is the objective, the optimum time for cutting is just before the beginning of the rainy season. If this is done, sufficient water will be available to nourish the new shoots when they appear. Moreover, their rapid growth during the rainy season will mean that they have begun to lignify and become sufficiently large to be less attractive to grazing animals searching for browse in the following dry season. The height at which the tree is cut is also important; to encourage regeneration, it should be cut as close to the ground as possible.

This kind of harvesting is difficult for woodcutters. The traditional ax is of poor quality, and it is difficult to use if the cut is too low for a comfortable swing. The ideal cutting height from the woodcutter's point of view is around 50 centimeters above the ground. The time of cutting also affects the difficulty of the work—woodcutters prefer to work on trees when they are full of sap, which makes them easier to cut. Waist-height cutting in the middle of the growing season is thus easiest for the woodcutters, but that is far from the optimum for regeneration. Work was therefore carried out to find a compromise method of cutting that would favor regeneration while not burdening the woodcutters unduly.

Findings on Protection against Grazing after Harvesting

The need to provide at least three years of complete protection against grazing in areas of natural woodland that have been harvested for fuelwood is almost an axiom of

natural woodland management. The reason is easy to understand. The soft shoots that spring from newly cut stumps or newly germinating seeds are quickly eaten if livestock gain access to them. If woodland regeneration is to occur, it would appear essential to protect an area completely until these shoots have established themselves.

Enforcing such grazing bans can be prohibitively expensive if paid guards are used. It is also full of practical difficulties, including the problem of ensuring that pastoralists are properly informed about the exact areas where grazing is forbidden. Even if they are informed, some pastoralists may choose not to respect the ban. Establishing the responsibility of a particular pastoralist for trespass is especially difficult. Unless the individual's animals are actually found on the land, any trespass is always by animals from "another village."

Keeping their animals out of designated areas is also difficult for herders, assuming they were willing to do so. Herds are normally allowed to wander freely through the natural woodlands during the dry season, because herders know that the animals will return each evening to the well that provides their water. Where only one water source is available, keeping track of the livestock is no problem.

Controlling the movements of the whole flock to keep animals out of designated areas at all times would therefore impose a large additional burden on herders. They may be willing to do this in exceptional circumstances—for example, when cattle are in danger of being stolen—but mounting a full-time guard to prevent the flock from obtaining their fodder from traditional sources is not an attractive or readily acceptable option.

Grazing bans can also introduce a significant degree of social discord between herders and woodcutters. The Tientiergou experience was that woodcutters, because of the support provided by the project, were attempting to ban pastoralists from using their traditional grazing areas. This was doubly unacceptable to the pastoralists, who felt entitled to the grazing by reason of their traditional rights and deeply resented any attempted interference by woodcutters, a traditionally subservient group. Under such conditions, grazing bans may turn out to be impractical at a local level without the presence of project personnel.

The Tientiergou trials therefore investigated whether grazing bans were really necessary. A total of thirty-five plots, each with an area of 0.1 hectares, were chosen for monitoring after fuelwood harvesting in 1990. Some were fully protected against grazing, but others were left open.

The results of these trials overturned the conventional wisdom on the need for elaborate and prolonged grazing protection after fuelwood harvesting. The most surprising finding was that there was virtually no difference between the protected and unprotected plots that had been harvested in the traditional "furtive" manner. In the plots subject to grazing, only 2 percent of the new shoots were eaten, and protection against grazing would not appear to be necessary. Indeed, as the studies on the dynamics of the tiger bush showed, the likelihood is that grazing bans, so notoriously difficult to enforce

and the cause of so many project problems, are actually counterproductive: by encouraging an excessive growth of grasses, they lead to the degradation of the woodland ecology rather than its preservation.

Guidelines for Natural Woodland Management and Protection against Grazing

The findings on the ecological dynamics of the tiger bush enabled the project to draw up guidelines—some quite contrary to the widely accepted views—for its management.

The recommendation on fuelwood harvesting is that it should follow the local traditional practice of "furtive" cutting. This can be formalized into a number of simple rules that can be easily understood and accepted by the local people. The pioneer species *Guiera senegalensis* and *Combretum micranthum* should not be cut until they reach a base diameter of 6 centimeters—the thickness of a wrist. The species *Combretum nigricans* and *Combretum glutinosum* should not be cut until they reach a base diameter of 8 centimeters—the thickness of an ankle. Potential timber species such as *Pterocarpus lucens* should be left until they reach a base diameter of 35 centimeters, subject to local agreement.

Rules can also be agreed with the local community about refraining from cutting species that produce fruit, such as *Tamarindus indica,* until they have died naturally. Similarly, species that provide browse, which is particularly vital to livestock survival in times of drought, should generally not be cut. Such rules may even prove superfluous, since villagers tend to follow these practices on their own if they have control over their areas of natural woodland and are entitled to exclude external woodcutters.

The cutting compromise recommended by the project is that the cut should be 20 to 40 centimeters above ground and that the felling should be between April and June. The wood should then be left to dry where it is cut, supported on a mulch formed from its own small branches, until the following year. During this time, its bark is eaten by termites, thus returning the greater part of the nutrients to the soil. When it comes to market, the dry, bark-free wood is in optimal condition for sale and highly attractive to buyers.

The project also recommends that areas where fuelwood harvesting has been carried out should be given some protection during the rainy season immediately following the cutting. This can be done by spreading the smaller branches cut from the felled trees to protect cut stumps and the fringe areas of the vegetated patches. This protection would ideally be supplemented by some additional seeding of the fringe areas with desirable tree species, including those previously found in the area but eliminated by drought or overcutting.

Keeping livestock out of the harvested areas during the following rainy season is practically achievable. Many of the livestock herds are already on their way to their northern grazing areas at this time, and the remaining herds must be controlled to prevent crop destruction. Avoiding the areas spread with branches is an additional, but

potentially acceptable, limitation if the herders have been consulted and feel they will subsequently benefit through increased availability of fodder and browse. Even some livestock accidentally gain access to these areas, the protection provided by the branches will prevent the complete destruction of the newly emerging shoots. In subsequent years the need for protection will be greatly reduced, and livestock can be allowed access.

The Demand Component

The main emphasis of the demand component was the development and promotion of kerosene stoves. The project also monitored and analyzed the overall household fuel market and provided general support and publicity to the improved fuelwood stove and LPG stove programs being carried out by other agencies.

Publicity Campaign and Identification of Stove Market Niches

Using radio, TV, billboards, and demonstrations, a domestic energy publicity campaign was launched in 1990. This campaign was discussed with the already running LPG and Mai Sauki stove programs, and agreement was reached on the strategy. Improved fuelwood stoves were promoted on the grounds that they were less expensive, kerosene stoves because they were quicker to use, and LPG stoves because they were cleaner. The campaign slogan was that the new cooking methods made life easier. From 1991 onward, the publicity focused on the promotion of the Tchip kerosene stove.

To supplement and update the preliminary market studies done at the project design stage, new assessments of the market for each stove were carried out in Niamey, Maradi, Tahoua, and Zinder at the beginning of the project. These studies attempted to quantify, as precisely as possible, the niche for each stove, taking purchasing power and consumer preference into account.

The market analysis divided the urban population into four broad income groups. The proportions in each group varied among the urban areas. The spread across the total urban population was as follows: upper income, 4 to 10 percent; middle income, 20 to 49 percent; low income, 36 to 43 percent; and those living an almost-peasant life in the urban areas, 6 to 27 percent.

Table 4.10 shows the actual cooking methods used by households, based on 1993 data. It can be seen that the three-stone fire is the dominant method of cooking outside Niamey. The Malgache stove is almost universally used in Niamey, but it has a much lower penetration in the other areas. The Mai Sauki is used by 20 percent of families in Niamey, but to a much lesser extent in the other urban areas. The figures provide a vivid illustration of the dominance of fuelwood in the domestic energy sector and the degree of social and economic change that will be required to shift the balance toward other fuels. As additional socioeconomic indicators, the table also lists the proportions of households that are connected to the electricity supply and own radios and TVs.

Table 4.10 Cooking and Other Energy Equipment Used by Households in Four Urban Areas

(percent)

	Area			
Equipment used	*Niamey*	*Maradi*	*Tahoua*	*Zinder*
Cooking				
Three-stone fire	18	74	68	70
Malgache stove	84	41	60	38
Mai Sauki stove	20	8	13	—
Tchip stove	5	7	10	12
Other kerosene stove	5	8	5	11
LPG stove	7	4	2	7
Other				
Electricity connection	40	30	33	56
Radio	80	75	70	75
TV	26	22	33	49

In July 1991, a panel of 675 household energy consumers was set up in Niamey. The members of the panel were chosen, using data from the National Statistical Service, to be representative of the consumer categories in the city. The panel was questioned at six-month intervals about its views on different aspects of the Household Energy Project's activities through a questionnaire drawn up by the project. Sample surveys of consumers were also carried out in Maradi, Zinder, and Tahoua in 1993.

Table 4.11 presents a summary of the results of these market studies. LPG was recognized by all groups as a clean, convenient, and modern fuel, although many believed it was dangerous. About 50 percent of the upper-income group were prepared to consider its use. The cost of the stove and the fuel were a major deterrent to the middle-income group—only about 10 percent of this group thought it a realistic option for them. Kerosene, however, was seen as attractive by 50 percent of both middle-income and upper-income families. Middle-income families were also prepared to buy the Mai Sauki, and a considerable number had already done so.

Among lower-income families, the studies found that cost was the primary criterion in the choice of cooking fuel. Whatever their longer-term aspirations, these families were primarily interested in cooking by the cheapest means available. Only a small proportion were prepared to make the relatively minor investment required to purchase a Mai Sauki stove; none were interested in the kerosene and LPG stoves. Cooking with the three-stone fire was the only acceptable option in the rural areas.

Table 4.11 Breakdown of Potential Stove Markets by Socioeconomic Class
(percent)

	Socioeconomic class			
Stove	*Upper*	*Middle*	*Lower*	*Rural*
Improved fuelwood stoves	—	30	20	—
Kerosene stoves	50	50	—	—
LPG stoves	50	10	—	—

Developing and Marketing the Tchip Stove

The modified Tchip stove, with locally made supports, was introduced to the Niamey market in July 1991. Initial sales were between 170 and 460 each month, but supplies were interrupted frequently by difficulties in arranging regular deliveries of the stoves from Indonesia.

Follow-up studies of households using the stove showed that it was well-adapted to the cooking requirements of Niger. The regulation and replacement of the 36 wicks, however, was found to be somewhat cumbersome, and the project continued to look for alternatives. One model tested was a 24-wick version with one burner that was found to meet the cooking needs of families. Another model, a 12-wick version, did not have sufficient power for cooking main meals but was found to be suitable for making tea or snacks.

The project maintained its determination not to become involved in the actual manufacture and distribution of kerosene stoves. To do so would be to abandon the possibility of a self-sustaining manufacturing and distribution system. A major effort was devoted to the selection of a local company capable of handling these tasks.

The project eventually identified a private sector entrepreneur with the skills and qualities required to carry forward the local manufacture of the Tchip stove. One of the conditions of the contract between the government and the entrepreneur was that he have FCFA 10 million of his own capital available for investment in the company. The government, in return, agreed to free the stove and its accessories from all taxes, and the project undertook to provide support in the form of publicity and promotion of the stove, to provide a banker's guarantee, and to make available the necessary accountancy and technical support to the company.

The entrepreneur established the Tchip-Import company in December 1991 with an investment of FCFA 20 million. The company initially relied on imported stoves but carried out the construction of support frames and accessories and distributed the assembled stoves to appointed retailers. The retail selling price of the imported stoves had, at this stage, risen substantially above the original project estimates and stood at FCFA 14,000 to 17,000, including wholesale and retail selling margins. The project

agreed to provide a temporary subsidy of FCFA 5,000 to enable the stove to be sold at a retail price of FCFA 9,500, which was felt to be commercially acceptable.

The project set up an after-sales network called Tchip Service in collaboration with Tchip-Import. The network consists of 64 appointed agents; 35 are in Niamey, with the remainder divided among the other three urban areas. A one-year guarantee is provided with each stove at the time of purchase. The guarantee is accompanied by coupons for repairs, maintenance, and replacement wicks that the purchaser can use at the authorized service agent. The repair agents are reimbursed on the basis of the coupons returned. The after-sales service was operated by the project until the end of 1994, when it was taken over by Tchip-Import.

Energy Shops

As experience in the effort to disseminate the Tchip stove accumulated, it became evident that the existing distribution system was not sufficiently dynamic in its marketing. The typical urban shop in Niger is far more oriented toward the sale of daily necessities, which require no marketing efforts, than to the promotion of a major cooking innovation such as a new kerosene stove. To address this difficulty, the project developed the concept of the energy shop. This is an independent private enterprise that specializes in household energy, using proven techniques of marketing and selling the Mai Sauki, Tchip, and LPG stoves. The energy shops also provide after-sales services.

The project provided support in the form of interest-free loans to set up the energy shops. In Zinder, Maradi, and Tahoua the managers are former senior regional project staff, chosen for their enterprise and ability. This means that they are, in effect, inheritors of the project, preserving the experience and expertise it developed. The manager in Niamey is a private entrepreneur.

The aim of the energy shops is to become profitable, self-sustaining business enterprises. This is hardly realistic in the immediate future, however, if the sole source of revenue is the sale of Mai Sauki, LPG, and Tchip stoves. The energy shops have therefore been appointed as official distributors of kerosene in the main urban areas.

The total market for kerosene in Niger is about 9,000 cubic meters; about 35 percent of demand is in Niamey. Of the total supply, only about 10 percent comes from the government oil company SONIDEP and the multinationals; the remainder is provided by the informal sector, which obtains supplies from Nigeria, where kerosene is subsidized. Most of the supply pumps at service stations in Niamey and the other towns have been closed because the companies cannot compete with the informal imports.

The informal supply from Nigeria, however, has been in a state of some turmoil since the petroleum workers' strike and social unrest in Nigeria in 1993. Further disruptions were caused by the devaluation of the FCFA at the beginning of 1994. The supply problems for the informal sector have been compounded by a clamp-down on the smuggling of kerosene across the border by the authorities in both Nigeria and Niger. In reinforcement of the border controls by both governments, the authorities in Nigeria have

forbidden all sales of petroleum products within 25 kilometers of the border. The Nigerian government has also expressed its intention to abolish the subsidy on kerosene.

Thus, although the informal sector has managed to meet the kerosene lighting needs of people in Niger, the supply has been erratic, the quality of the kerosene supplied varies greatly, and consumers are at the mercy of the rapid fluctuation that can take place in the price of kerosene. In 1993 the price was FCFA 118/liter in Niamey, FCFA 97/liter in Zinder and Maradi, and FCFA 133/liter in Tahoua. During 1994 prices rose substantially as supplies became increasingly erratic. Later in the year prices seemed to stabilize at about FCFA 200/liter in Tahoua and FCFA 150/liter in the other urban areas.

With such unreliability in supply and price, the prospect of people adopting kerosene as a regular cooking fuel is greatly reduced. The aim of the energy shops is to overcome this obstacle through the provision of reliable and reasonably priced kerosene supplies. To this end, each energy shop has been equipped with a kerosene storage tank and a guaranteed supply from SONIDEP. This kerosene is made available to the energy shops at a concessional price, and they undertake to sell it at a price set by the Ministry of Commerce. The distribution of this kerosene to a selected network of retail outlets provides the energy shops with a source of revenue as well as market opportunities for the sale of stoves.

The Permanent Information and Evaluation System

An adequate information system is essential for the household energy strategy and its separate components to function. The project therefore decided to put in place a Permanent Information and Evaluation System (PIES).

PIES was established as a collaborative effort of the Ministry of Energy, the Ministry of the Environment, and the supply and demand components of the project. It was designed to have 12 separate but complementary modules, each with its own precisely defined information-collection mission. These modules and their activities are as follows:

- Module 1 monitors the overall evolution of fuelwood exploitation zones through satellite images.
- Module 2 monitors the impact of fuelwood exploitation on sample areas of managed, directed, and uncontrolled natural forest through field surveys.
- Module 3 monitors commercial fuelwood flows into the main urban areas.
- Module 4 monitors urban fuelwood prices.
- Module 5 monitors fuelwood selling prices in the rural areas.
- Module 6 monitors improved fuelwood stove sales.
- Module 7 monitors kerosene stove sales.
- Module 8 monitors kerosene prices.

- Module 9 monitors kerosene sales.
- Module 10 monitors sales of LPG stoves and LPG.
- Module 11 monitors the responses of the Niamey panel of 675 households to the evolution of the project with survey questionnaires at six-month intervals.
- Module 12 monitors the role of the energy subsector and the evolution of energy prices in relation to the consumer price index and other indicators.

Half-Yearly Newsletter

A half-yearly newsletter, "L'Indicateur," has been produced by the project. It provides statistical data and discussions of project progress. In addition to offering a running record of achievements, it is a significant element in fostering communication among the project staff, as well as among members of the project, the government, and others.

5

Project Achievements

The Household Energy Project has introduced fundamental change into rural Niger by giving rural people control over their local woodland resources as well as responsibility for their management. Substantial cash benefits already are flowing into rural areas, where opportunities for income-generating activities are rare. The institutional structures it has established remain vulnerable, however, and further consolidation of the achievements of the project is essential.

Phase I of the project was scheduled to finish at the end of 1994, but it has proved possible to continue with the external support for the project through the end of 1996. This chapter sets out the achievements of the project through mid-1995 and looks at some of the problems that have arisen.

The Changing Role of the Forest Service

In handing control of natural woodland management over to village communities, the project has introduced major institutional changes into the country. One of the institutions most affected is the forest service. As the number of rural markets has increased, the police role of forest service agents in detecting, punishing, and preventing violations of the forest code has diminished.

With the establishment of a rural market, the law now gives village people exclusive control over their own woodlands. The forest service no longer has the legal right to exclude them from these areas or to dictate their behavior, provided they remain within the framework of the management agreement they have signed. Rather than being in confrontation with villages, forest wardens are now expected to ensure that others, whether fuelwood traders or woodcutters from other villages, respect the rights of the local population. In addition, forest officers are expected to advise, not command, villagers on matters of tree growing and woodland management.

All these requirements place a heavy burden on forest officers—one that their training and expertise have not prepared them to carry. Villagers are likely to know far more about light harvesting of natural woodlands for fuelwood—a traditional activity—

than forest officers trained in plantation forestry and commercial timber production. Moreover, many forest officers are reluctant to give up their power and influence.

A mission in March 1995 expressed some of these concerns. It noted that if the rural market system is to survive, it needs the help and support, and certainly not the opposition, of local Department of the Environment staff. It is therefore important to win the support of the forestry staff for the new system through training, information, and the incentives necessary to ensure that they help rather than hinder its proper functioning. The project held a colloquium on the rural market system for Department of the Environment staff in May 1995 to promote understanding of the system.

Rural Market Establishment, Production, and Revenues

Detailed statistics on rural markets are available up to the end of 1995. At that time, 85 markets were in operation. Of these, 60 were in the Niamey catchment, 14 in the Zinder catchment, and 11 in the Maradi catchment. All except two of the Zinder and Maradi markets were set up during 1995 and so were at an early stage in the buildup of their sales and financial turnover.

At the beginning of the project, when the initial promotion of the rural markets was getting under way, the villagers largely did not trust the process. Many were unable to believe that a real transfer of control over their village woodlands was being offered to them or that they would truly be given discretion over the spending of funds. Much of this distrust has now been overcome, and the formation of rural markets appears to be gaining momentum. In some areas, without any intervention by the project, villages are spontaneously applying to have a market.

It has also been found that a number of villages that are adjacent to functioning markets and awaiting the establishment of their own markets have begun to refuse access to fuelwood dealers, again without any intervention by the project. In one area, a number of markets have banded together to set prices, preventing any attempt by fuelwood dealers to play them off against each other.

Table 5.1 shows the quantities of wood sold through the markets, the total turnover, and how this was shared among the woodcutters, the village funds, and the market managements for each of the years from 1992 to 1995. The 1995 figures cover only Niamey, but, as this accounts for over 90 percent of the market transactions, the distortion is minor. The rapid growth in revenues and in the amounts of fuelwood sold can be seen clearly in the table. In 1995, fuelwood sales in Niamey were more than 75,000 steres, about 25,000 tonnes, some 16 percent of total fuelwood sales in the city during the year. The total turnover of the markets in the Niamey catchment was FCFA 103 million. By far the greatest proportion of this, FCFA 83 million, went directly to rural families in the form of woodcutters' earnings. Village funds obtained FCFA 12 million and the market managements FCFA 7.5 million.

Table 5.1 Quantities of Fuelwood Sold, Turnover, and Division of Rural Market Receipts, 1992–94

				Shares of turnover (FCFA)		
Year	*Markets*	*Wood sold (steres)*	*Turnover less tax (FCFA)*	*Woodcutters*	*Village funds*	*Market management*
1992	9	5,613	2,808,600	2,112,300	415,050	415,050
1993	21	16,478	11,640,650	10,015,300	883,875	749,825
1994	38	51,730	58,908,500	49,721,500	4,862,200	4,087,550
1995[a]	60	75,413	103,170,000	83,588,050	12,034,850	7,547,300

a. Figures are for the Niamey catchment only and account for approximately 90 percent of overall totals.

Allocation of Tax Receipts from Rural Markets

The tax paid by fuelwood transporters when they purchase fuelwood from a rural market varies according to whether the market is controlled or directed; it also fluctuates according to the distance of the market from the urban area it supplies (see Tables 5.1 and 5.3). Villages are allowed to retain a proportion of this tax for their own use. The amount retained is determined by whether the market is directed, in which case it is 30 percent, or controlled, which sets the rate at 50 percent (see Table 5.2). Of this retained portion, the village is permitted to spend the tax money on projects of its own choosing at a percentage dictated by the kind of market in operation—40 percent in the case of a directed market and 60 percent for a controlled market. The remainder of the retained portion must be spent on woodland management measures.

Table 5.2 shows the rapid growth in the amounts of tax collected by the rural fuelwood markets in the Niamey supply area for the years 1993 to 1995. The table also shows how these revenues were shared among the rural markets, the local offices of the Department of the Environment, and the national treasury. It also displays the allocation of these shares between discretionary expenditures and funds that must be used for natural woodland management measures.

Table 5.2 Tax Receipts from Fuelwood Markets and their Allocation, 1992 to mid-1995

					Division of expenditure			
		Share of taxes (FCFA)			*Village*		*DoE*	
Year	*Total tax (FCFA)*	*Local market*	*Local DoE*	*National treasury*	*Woodland management*	*Discre-tionary*	*Woodland management*	*Discre-tionary*
1993	2,640,995	911,907	647,838	1,081,210	487,327	401,672	317,925	306,979
1994	14,615,698	4,564,112	3,099,820	6,951,766	2,654,266	1,897,088	1,788,099	1,308,335
1995[a]	22,737,245	7,207,223	4,935,492	10,574,525	4,128,308	3,076,914	2,804,479	2,130,019

Note: DoE = Department of Environment.

a. Figures for Niamey catchment only.

Utilization and Impact of Market Funds in a Village

The major financial impact of the markets is found in the increased flow of cash to the woodcutters. As Table 5.1 shows, this sum amounted to FCFA 83.6 million in 1995.

The spending of these funds is entirely at the discretion of the individuals and families concerned, and, given the extended-family culture of most villages, the benefits are likely to be widely distributed throughout the community. Most of the money tends to be spent on domestic goods, raising the low standard of living in the villages. When longer-term investments are made, they are generally in livestock.

The increased availability of money also has a number of social implications at the village level. Not the least of these is that woodcutting, formerly a despised activity, is now seen as increasingly attractive—it is one of the few ways to secure a cash income in the rural areas. In some areas, it has become a recognized profession. This has already created tension, and will continue to do so because the formerly underprivileged woodcutters now have greater purchasing power than their superiors in the village social system.

Compared with the earnings of woodcutters, the amounts of cash flowing into village funds from taxation receipts are relatively minor. The total village share of the taxes in 1995 was FCFA 7.2 million. This is about FCFA 120,000 (about US$200) for each village. Of this amount, between 40 and 60 percent must be spent on woodland management measures, with the remainder available for discretionary use. The amounts of money are small, extremely so by industrial country standards, but they are sufficient to support a wide range of expenditures that were previously impossible for villages to consider.

Table 5.3 offers a breakdown of investments by village communities in the Niamey catchment area in 1994. The overall total invested was FCFA 3.86 million. Of

this sum, FCFA 2.5 million was spent on village improvements. The biggest investment, 60 percent of the total spent, was in cereal banks, purchases of grain after the harvest when the price is relatively low, as security against future shortages. Other investments included the construction and repair of wells, repairs to mosques, school repair and construction, payment for vaccinations and health care, provision of advances to woodcutters for the purchase of carts, and loans to village people in difficulty.

Table 5.3 Investment of Village Market Tax Receipts in Niamey Catchment Area, 1994

(FCFA)

	Amounts invested (FCFA)				
Investment activity	*Total*	*Village discretionary funds*	*Village woodland management funds*	*Local Department of Environment funds*	*Others*
Forest management					
Nurseries and plantations	1,069,574	127,550	642,112	90,000	209,906
Woodland inventories	135,000	121,610	13,390		
Fire breaks	70,000		70,000		
Others	55,600	5,000	50,600		
Subtotal	1,330,174	254,160	776,102	90,000	209,906
Village improvements					
Cereal banks	1,606,037	1,606,037			
Pharmacies	80,400	80,400			
Wells	304,500	304,500			
Mosque repairs	421,250	421,250			
Vaccinations	10,000	10,000			
Others	107,500	107,500			
Subtotal	2,529,687	2,529,687			
TOTAL	3,859,861	2,783,847	776,102	90,000	209,906

It can also be seen in Table 5.3 that a total of FCFA 1.3 million was spent on woodland management measures in the Niamey catchment during 1994. Of this, 60 percent came from the woodland management component of the tax receipts retained by villages, and 20 percent came from funds nominally available for spending at the discretion of the village. The bulk of the investment was in village tree nurseries and plantations with villagers paying for the training provided by the forest service and for the seedlings, pots, and other material inputs. These investments were made mainly on the

advice of the forest service agents and clearly illustrate their continuing influence over village decisions. The forest service is supposed to provide support and advice to villages, but not give orders. The choice of some of the investments made with discretionary funds indicates that this has not yet been fully understood, or accepted, by the forest service agents.

Concern has also been voiced over the share of funds allocated to woodland management, amounts that are derisory in relation to the sums required for any serious investment in woodland rehabilitation work. The total investment of FCFA 1.3 million, just over US$2,200, in 1994 is insufficient for any meaningful level of activity by qualified professionals or the use of external material inputs. This, in turn, raises the question of whether any such investments are required. If woodland areas are harvested in accordance with the project recommendations and satisfactory regeneration occurs, there would seem to be little need for any regeneration measures on the part of the forest service. Instead, the villagers themselves, with a small amount of technical support or simply relying on their own knowledge and expertise, would appear to be capable of providing whatever management is required.

Costs of Establishing Markets

The establishment of the initial rural markets was a learning exercise for all concerned. The time and funds required were greater and more variable than expected. The cost of setting up Torodi 1, for example, was more than FCFA 12 million; that of Say 1 was FCFA 1.8 million. These costs did not include the salaries of the Ministry of Environment officials and technicians involved.

Nevertheless, considerable reductions in the costs of setting up the markets can now be envisaged because the procedures have been established and tested in practice. Ensuring that villages agree with their neighbors on the boundaries of the area of woodland under their control, for example, greatly reduces the amount of support staff time required to set up the market.

Table 5.4 lists the projected setup costs per hectare for three areas of controlled and directed markets. In each case, it is assumed that the necessary external support will be provided by a local nongovernmental organization (NGO) or consultancy company. As can be seen, the costs vary from FCFA 1,270/hectare for a large directed market to 8,440/hectare for a small controlled market. These figures, in the range $2.0–14.5/hectare, compare very favorably with the $50–100/hectare required for projects to promote village forestry and the $500–1,000/hectare for plantation projects.

Table 5.4 Estimated Future Costs of Establishing Rural Markets

(FCFA/ha)

	Area of woodland		
Type of market	*1,000 hectares*	*2,000 hectares*	*3,000 hectares*
Directed	4,430	2,210	1,270
Controlled	8,440	5,220	3,840

The Fuelwood Taxation Issue

Order No. 92-037 of August 1992 marked a major change in Niger. It legitimated and made permanent the main recommendations of the supply component of the project and provided a basis for the complete transformation of the fuelwood supply system of the country. The fuelwood tax levels it put in place, however, fell considerably short of those called for by the project.

The original project analysis calculated that a tax of FCFA 9/kilogram, about FCFA 2,700/stere, was required to bring the selling price of wood from the uncontrolled natural woodlands up to that of wood from a fully managed area. This would enable sustainable fuelwood production from managed woodlands to compete with that from the uncontrolled areas. The calculation was based on the experience at Guesselbodi, with its relatively heavy restoration work and paid forest guards.

Imposing this level of tax would also have a number of other beneficial effects within the general framework of the Household Energy Project. It would enable the project to become entirely self-financing—indeed, it would provide a useful surplus to the national treasury. It would encourage households to economize in the use of fuelwood and enable kerosene to compete in the cooking fuel market.

The actual tax increases introduced (see Table 5.1) were far less than recommended, and the government remains reluctant to increase them further. This is perhaps understandable, because there is little political credit to be gained from a major increase in the price of such a basic commodity as fuelwood, which is used by all strata of society. At the same time, it puts the overall project strategy in jeopardy.

The problem, in the context of project priorities, is that taxes at their present levels do not provide any financial incentive to fuelwood transporters to use the rural markets. On the contrary, calculations by the project show that, with the present tax differential between fuelwood markets and the uncontrolled natural woodlands, purchase from a rural market reduces a trader's margin by about FCFA 300/stere. The tax on fuelwood from uncontrolled areas would have to double, to FCFA 1,200/stere, to provide a significant financial incentive for traders to use the rural markets.

For the consumer, the present tax on fuelwood from a rural market adds about FCFA 1/kilogram to the retail price, about FCFA 2/kilogram if it comes from an

uncontrolled area. These amounts are well within the seasonal fluctuations in fuelwood prices, or even the differences among retailers in different parts of the same urban area. The taxes do not provide any serious incentive to consumers to economize on fuelwood consumption or to switch to kerosene or LPG.

Fuelwood Tax Collection Shortfall

At the beginning of the project, in 1989, only about 15 percent of the taxes due on the amounts of fuelwood entering the urban areas were being collected. This shortfall had two causes. The licensing and control system was barely functioning, and the nominal capacities of the vehicles, on which they were assessed for taxation, were only about 50 percent of the amounts of fuelwood actually carried.

One of the initial activities of the project was to put in place measures to improve this performance. Beginning with Niamey, control posts were set up on the main roads leading into the four major urban areas, while the secondary routes were covered by mobile patrols. To man the control posts, the project hired a team of guards and provided preliminary and on-the-job training. Three guards were assigned to each post on 8-hour shifts to provide 24-hour coverage.

As can be seen in Table 5.5, by the end of 1989 the amount of tax collected had risen to 68 percent of the total due in Niamey and to 57 percent of the total due for the other four major urban areas. This collection rate was based on the existing taxation system, which taxed fuelwood at FCFA 350/stere and assessed the nominal rather than the real capacities of the vehicles. The amounts and the proportion collected rose further in 1990, reaching 78 percent of the total due in Niamey.

In mid-1991 responsibility for the control posts was transferred from the project to the BTPN; total tax receipts dropped by one-third in 1991. As can be seen in Table 5.5, there was some recovery in the total amount collected in 1992. A further increase was recorded in 1993, but since the new taxation system was introduced in that year, the figure actually represented a major deterioration in overall collection performance, which fell to only 30 percent of the total due. Because the control system and the available resources remained unchanged, the fall-off in performance can only be attributed to poor management on the part of the BTPN. The position in 1994 showed little improvement.

This poor performance is doubly disappointing in view of the crucial role of effective tax collection in the project and the major emphasis it has received from the beginning. Because of the importance of this function, FCFA 400 million was provided by the project between 1989 and 1993 to help make the control system more effective. The amounts actually collected, however, have remained well below the support provided. At the end of 1993, the World Bank decided against providing any further external support for the operation of the control system. The Bank maintained that the revenues allocated to Account No. 3001 to cover the costs of the control system are adequate for its operation if tax collection is carried out effectively.

Table 5.5 Forestry Tax Receipts and Rates of Collection
(million FCFA)

Tax	*1989*	*1990*	*1991*	*1992*	*1993*
Theoretical tax revenue	124.4	128.4	132.5	136.7	324.0[a]
Taxes collected	71.5	79.5	52.3	62.4	97.0
Rate (percent) of collection					
Niamey	68	78	48	49	39
Zinder	35	48	36	55	21
Maradi	51	30	20	37	15
Tahoua	24	22	22	27	7
Overall	57	62	39	46	30

a. New taxation system in operation from March 1993.

The project brought in an external consultant at the beginning of 1995 to review the operation of the control system and propose improvements. The preliminary report of the consultant made a series of about thirty detailed recommendations covering the system and its operation. By mid-1995, a follow-up mission by the same consultant revealed that about half of these proposals were in various stages of implementation, and no action had been taken on the remainder.

Management Weaknesses in Rural Markets

Inspections and audits of rural markets carried out to date have revealed a variety of management problems and weaknesses. Given the novelty of the system and the shortage of basic education in the rural areas—let alone bookkeeping and management skills—this is hardly surprising.

In some markets little communication takes place between the rural market managers and the rest of the village. The market is seen as exclusively a matter for the woodcutters and the management committee. Most other villagers have little knowledge or involvement in the decisions on spending the money flowing into the village fund. In the long run, this lack of involvement could well lead to problems and disputes over the management of the natural woodlands if conflicts of interest arise between woodcutters and other users of the woodland. It is also clear that villages do not know how to spend their woodland management funds and depend on instructions from forest service agents.

Keeping accounts and records has also proven to be beyond the capacity of the managers in some markets. Records are often incomplete, confused, or inaccurate. This applies to fuelwood stocks, records of taxes and levies collected, and the amounts paid into village funds or returned to the government authorities. Some of these shortfalls are clearly a result of a lack of the necessary bookkeeping skills. Some fraud is also evident,

and some market managers appear to be prepared to make arrangements with transporters to avoid paying tax, although this does not appear to be a major problem.

Such observations should, however, be taken in context. The inability to keep accurate records is not confined to rural fuelwood market managers in Niger. The performance of the BTPN in collecting fuelwood taxes, to take a pertinent example, undermines the financial basis of the control system and sets a poor example for others connected with the fuelwood trade.

Nor does the inability of market managers to keep correct formal accounts mean that rural people are incapable of handling financial business. Pastoralists and other rural people, for example, are quite able to keep track of their livestock inventories and the related financial dealings. The most important lesson from the experience to date is that the administrative system should be tailored to the available resources. This means that the load placed on rural market managers should be kept to a minimum, and obligatory recordkeeping tasks should be kept as simple as possible.

Evolution of Fuelwood Prices

Fuelwood prices vary greatly, depending on the time of year, the urban area, the retail outlet, and other factors. Average prices can therefore give a misleading or at least oversimplified picture, and it is difficult to identify trends with any certainty.

As the number of rural markets grows, their selling prices to dealers appear to be increasing. In 1992, when the markets were first established, their bargaining position in relation to the fuelwood dealers was weak, and the average selling price in the markets was about FCFA 700 per stere. In 1994 selling prices of FCFA 1,250 per stere were observed. It remains to be seen whether this represents a permanent shift of bargaining power to the markets.

Fuelwood prices at the retail level, in real terms, do not appear to have changed greatly over the past decade. Extensive sampling of prices in Niamey in 1986 found that they varied between FCFA 12/kilogram and FCFA 22/kilogram, with an average of about FCFA 16/kilogram. Sample surveys by the project in 1990–91 showed that the price oscillated around FCFA 20/kilogram, and the figures for 1994 showed little change. Preliminary indications for Niamey in 1995, however, indicate an increase to about FCFA 25/kilogram—this could, at least in part, be a result of the growing bargaining power of the rural markets, but this remains to be confirmed.

It has also been noted that the quantities of fuelwood consumed by families appear to be declining. It may be that families have been forced to use their fuelwood more efficiently because of the fall in their purchasing power resulting from the economic problems in the country. It could also, perhaps, represent the kind of changes in eating and cooking habits that tend to take place in urban areas as formerly rural people gradually adopt a more urban way of living.

Results of Monitoring Harvested Woodland Areas

Regeneration of harvested areas remains a matter of concern to many foresters, despite the results of the Tientiergou study. The project has therefore continued to monitor harvested areas in a number of locations. In addition to follow-up in Tientiergou, monitoring has also covered *combretum* formations in the Niamey catchment area at Kollo, Say, and Torodi and at Baban Rafi in the Maradi catchment. Monitoring of harvested acacia formations has also been carried out around Zinder and Tahoua. The results are generally encouraging.

Mortality among new shoots in areas harvested in accordance with the project recommendations has proved to be no more than 3 percent, an extremely low figure. Destruction by grazing animals has also turned out to be minimal, at 2 percent of the shoots. Regrowth is vigorous, with 90 percent of shoots reaching a height greater than 50 centimeters after three years.

The degree of grazing in the monitored areas does not appear to have a significant effect on regeneration. By far the most significant factor appears to be the extent to which harvesting is restricted to the sizes and numbers of trees recommended in the management plan. Extracting about 10 percent of the trees, as opposed to the cutting of all salable fuelwood carried out by commercial fuelwood cutters, appears to be the crucial factor in maintaining the regenerative and productive capacities of the woodland.

It has also been found that pruning of trees, the method favored by pastoralists to obtain browse, causes no permanent damage. On the contrary, it results in a high degree of regeneration. Seeding of areas with local species has also been found to yield spectacular results in some areas, especially where the seedlings are protected by cut branches.

The monitoring period has been too short, however, for firm quantitative conclusions to be drawn on the likely yields or the optimum rotation period. Moreover, many of the markets currently operating have been selling mainly deadwood and have not yet begun to cut living trees on a significant scale. As experience is gained, some fine-tuning of the management recommendations may be needed. Nevertheless, the results to date strongly suggest that the management regimes proposed by the project, if properly carried out, are likely to achieve their objectives.

Support for Fuelwood Transporters

The project provided the fuelwood transporters association, ANEB, with support in a variety ways. These included financial contributions to the setting up of its head office in Niamey and its constituent offices in the other major towns, help in producing membership cards, and a contribution to the cost of buying the white and green paint for fuelwood lorries. The project also sponsored workshops that brought together transporters, project officers, and government officials concerned with the fuelwood supply system.

Recognizing the extremely poor state of the vehicle fleet, the project also introduced a credit system that allowed transporters to obtain loans for the repair of vehicles. A commercial bank was provided with a guarantee of FCFA 35 million in the case of default by borrowers. The intention was that the repaid loans would be recycled to new borrowers. The guarantee funds were nonrenewable and were intended only to protect the bank against default.

The results here have been disappointing. The average repayment rate for loans has been 48 percent, ranging from 14 percent in Zinder to 83 percent in Tahoua. Because the project guarantee was a one-time-only provision, it is unlikely that the scheme will prove viable in the long term, when project funds are no longer available to the bank.

The Demand Component

The demand component has concentrated primarily on the promotion of kerosene as a substitute cooking fuel. The achievements have fallen far short of those anticipated at the beginning of the project, as have the results of efforts to promote the Mai Sauki fuelwood stove and the 6-kilogram and 3-kilogram LPG stoves under other programs.

Promotion of Kerosene as a Substitute Cooking Fuel

The initial promotion of kerosene stoves was based on imported stoves from Indonesia that had been modified for use in Niger by the Tchip-Import Company. The high cost of these stoves has been a major obstacle to their wider use. The devaluation of 1994 greatly increased this problem—imported stoves are far out of the reach of a large proportion of the project's initial target market. This increases the need for the substantial economies that local manufacture of stoves should be able to produce.

The project has attempted to build up the managerial and technical capacity of the Tchip-Import Company so that it can move from making only the pot supports to manufacturing the entire stove in Niger. The company has been working on the development of its own locally manufactured kerosene stoves since the beginning of 1993. In 1994 it installed two metal presses, one of 70 tonnes and the other of 120 tonnes. It now has a monthly manufacturing capacity of about 2,000 stoves.

The company has also developed a 12-wick, single-burner stove, intended for making tea, snacks, and general light cooking, which came on sale in mid-1995. A 24-wick, single-burner stove has also been developed. Tests show that this can meet the maximum power and flexibility needs of cooking in Niger. In addition to being considerably cheaper than the imported 36-wick model, it is simpler and easier to use and adjust.

Nevertheless, problems remain to be resolved before full confidence in the ability of Tchip-Import to carry out bulk manufacturing effectively and profitably is proven. The quality of stove manufacture is not always satisfactory. A March 1995 project mission noted its disquiet about the delays in the program. It also noted a variety of faults in the 12-wick stove and warned against the danger of the stove earning a poor

reputation for itself, as well as for cooking with kerosene in general. The same mission recommended that tests on an imported pressure stove be accelerated to ensure competition in the kerosene stove market.

The total number of kerosene stoves sold under the project up to mid-1995 was about 10,000. The great majority of these sales have been in Niamey.

Promotion of Improved Fuelwood Stoves

The bulk of the promotion of improved stoves has been carried out under the Projet Foyers Améliorés Phase II (PFAII), executed by GTZ. The project was a follow-up to the earlier improved stove programs in the country. It concentrated on the dissemination of two stoves: the metal Mai Sauki and a home-constructed mud, or banco, type in the rural areas. The project began in 1989 and finished in June 1993.

Sales of the Mai Sauki stove by urban area to the end of 1993 are given in Table 5.6. Just over 45,000 stoves were sold.

Table 5.6 Sales of Mai Sauki Stoves by Urban Region, 1989–93

Region	*1989*	*1990*	*1991*	*1992*	*1993*
Niamey	2,605	8,806	6,894	7,733	8,740
Zinder	341	641	970	794	356
Maradi	363	1,085	1,071	1,328	1,678
Tahoua	152	548	973	378	805
Total	3,461	10,543	9,553	10,240	11,579

LPG Stove Promotion. Promotion of the use of LPG for cooking was carried out under the CILSS-sponsored Projet National Gaz (PNG), which began in early 1990. At that time, cooking with LPG was confined to a small, upper-income, largely expatriate group living in Niamey; a sample survey showed that 90 percent of the households in this group had an air-conditioner. The total annual LPG consumption was about 300 tonnes, for the most part supplied in 12.5-kilogram bottles. No stoves on the West African market were suitable for traditional cooking methods in Niger.

To address this lack, PNG examined two of the commercially available stoves—one using a 6-kilogram bottle and the other a 3-kilogram bottle—and considered how they could be modified to make them suitable for use in Niger. It was found that with the addition of a conical pot support to accommodate a variety of pot sizes, they would be suitable for use. These pot supports could be manufactured locally.

These modified versions of the 6-kilogram and the 3-kilogram stoves were promoted by PNG under the title of the "Popular" stove. The price of the 6-kilogram version was about FCFA 16,000, which included taxes of FCFA 3,000. That of the 3-kilogram model was about FCFA 12,000, including taxes of FCFA 2,600. The 6-

kilogram model was thus about 20 times more expensive than the Mai Sauki stove. The project provided a subsidy of FCFA 5,000 for each version of the Popular stove.

The stoves were marketed through private companies and arrangements with public institutions that made them available to employees on a deferred-payment basis (the monthly installments were deducted from their salaries). This system, however, began to break down in 1992, because the government found it increasingly difficult to pay the salaries of the staff.

A stabilization fund to iron out fluctuations in the price of LPG was also established. The intention was to hold down the price of LPG when sold in the 6-kilogram and 3-kilogram bottle sizes. In July 1991 the price of LPG was reduced from FCFA 300/kilogram to FCFA 240/kilogram to stimulate sales. This was intended as an interim measure that would remain in force until sales built up, yielding economies of scale in transport and bottling (the price of FCFA 240/kilogram was the estimated cost when sales rose to the annual target of the project of 2,000 tonnes).

The program finished at the end of 1993. At that time, 2,555 of the 3-kilogram stoves and 10,233 of the 6-kilogram stoves had been sold. Total LPG sales in the 6-kilogram and 3-kilogram bottles reached 658 tonnes in 1993. The activities of the program took place almost entirely in Niamey. Apart from some joint publicity and marketing at an early stage, the demand component of the Household Energy Project did not involve itself to any significant extent in the program.

With the cessation of support from the PNG at the end of 1993, the price of LPG would have reverted to its commercial level. The government decided that cross-subsidies from other petroleum products would be provided to keep the price at FCFA 240/kilogram. This was intended to prevent the families that had switched to LPG from reverting to the use of fuelwood. With the devaluation of the FCFA, however, this became unrealistic—it would have required an LPG subsidy of more than FCFA 200/kilogram.

Overall Effect on Fuelwood Consumption. The overall impact of the project, and the associated campaigns to promote improved stoves and LPG cooking, has been small thus far. User surveys have found that the new stoves, especially the kerosene and LPG types, are for the most part used as supplementary equipment, in parallel with the traditional three-stone fire or Malgache stove. The estimated total savings of fuelwood in 1993 totaled 3,900 tonnes, about 2 percent of the total urban consumption.

The failure to raise fuelwood taxes to the level anticipated at the beginning of the project is undoubtedly one of the reasons that the rate of penetration of these stoves has failed to match expectations. Other important contributing factors have been the reduced purchasing power of consumers, the higher prices and general uncertainty and anxiety caused by the country's economic difficulties, and the devaluation of 1994.

Nevertheless, the demand component has widened the horizons of families with respect to cooking methods. It has also put in place the capacity to manufacture and

distribute kerosene stoves on a significant scale if people can be persuaded to buy them or if a generally acknowledged need for their use arises.

Need for Consolidation

The project has a number of important achievements to its credit. It has made a major breakthrough in demonstrating that natural woodland management is possible and affordable and that it can be carried out by local people. It has shown that changes in the laws of land tenure are possible, and that governments can be persuaded to devolve authority to local people. It has succeeded in diverting substantial flows of cash from the urban to the rural areas.

These achievements, however, are fragile. Although they benefit rural people, they have encountered considerable, although generally latent, opposition from those who feel they have lost because of the changes. The transporters are waiting for the rural market system to fail so that they can restore control over the supply chain and reduce their costs. Forest wardens find themselves in a changed and less advantageous position. They have lost their privileged relationship with the traders and the opportunities it brought for illegal gains. Operation of the control system in a durably effective and noncorrupt manner remains to be achieved.

Much of what has been accomplished could therefore be reversed. It is easy to envisage undermining of the existing rural fuelwood markets and reversion of control over their woodlands to the fuelwood traders. The gains made thus far need to be consolidated, the structural and institutional reforms must be secured, and conditions must be created to ensure a self-sustaining and self-generating spread of the rural market system. This is the objective of Phase II of the project.

6

Review

The need to continue the Household Energy Project is beyond question. Its primary justification was, and is, that one of Niger's major natural resources is being grossly mismanaged by the traditional system of providing fuelwood supplies to the urban areas. The project provides an approach that squarely addresses, and redresses, the failures of this system.

The exploitation of the country's natural woodlands, as traditionally carried out by fuelwood traders, is both counterproductive and economically suboptimal. Furthermore, this mismanagement is socially inequitable—the benefits of the destruction of the country's woodland resources are going to fuelwood dealers and urban consumers; the costs are being borne by people in the rural areas. Even if no problems were in view for the long-term supply of household energy, the fuelwood exploitation system in operation at the beginning of the project needed to be changed on economic, ecological, and social grounds.

It is therefore essential to accelerate the establishment of rural markets. This requires that the procedures established in Phase I of the project be carefully reviewed and streamlined wherever feasible. Increased attention should also be given to the question of sustainability, ensuring that the financial and administrative costs of implementing and running the rural market system are reduced as far as possible. It is particularly important that this is done on a realistic basis, recognizing the political, administrative, and resource constraints in the country.

Tax Levels and Collection Rates

Substantial problems with the taxation and control system were evident during Phase I. The original project goal was that a tax of FCFA 2,700/stere would be levied on fuelwood from uncontrolled areas, but the level was set at FCFA 600/stere. Moreover, only about 30 percent of the tax is presently being collected, so that the average amount paid is just FCFA 200/stere.

Rural markets do not pay tax on the fuelwood they sell. Instead, they collect a levy of FCFA 300/stere on their sales. Directed markets are allowed to retain 30 percent

of the levy; in the case of a directed market, 50 percent retention is permitted. From the viewpoint of the purchaser, however, the FCFA 300/stere levy does not differ from a tax—it increases the purchase price of the fuelwood.

Because of these differences in rates of tax collection, fuelwood traders who receive supplies from uncontrolled areas are paying a slightly lower average rate of tax than if they purchase their fuelwood from a market. Taking into account the higher production and administrative costs of rural markets, which must be included in the selling price, the current system is biased against the commercial survival of the rural markets—the reverse of the intention of the project. Increasing the tax on fuelwood from the uncontrolled areas to the proposed FCFA 975/stere would go some way toward redressing the balance, but current tax collection rates would still leave rural markets at a competitive disadvantage because of their higher administrative costs.

If they are to compete in the fuelwood market, rural markets must squeeze their margins to an extent that puts their longer-term survival in question. To enable the system to function as intended, both taxation levels and collection rates must be increased to a level that will ensure that markets are able to charge a realistic price and that dealers still have a significant incentive to deal with them. In broad terms, this would require a collection rate of at least 60 percent and a tax of about FCFA 1,200/stere.

If such a system could be put in place, it would provide a fiscal framework that would allow the normal operation of market forces to promote and reinforce the rural market system. The experience of the project in its attempts to have taxes increased and to improve the rate of collection, however, suggests that such an achievement will be slow and difficult. The alternative is to speed up the establishment of rural markets so that they cover the bulk of the fuelwood supply area. Once this has happened, rural markets will be able to increase prices by the relatively small amounts required to ensure their own survival—and the sustainability of the fuelwood supply.

The current poor tax collection rate, coupled with a major financial crisis at the central government level, have reduced the resources needed to accelerate the establishment of rural markets. This highlights the need for continued external funding to extend the coverage of the market system as rapidly as possible. Once this has occurred and fuelwood prices have been adjusted upward, the system will become self-sustaining, and the need for external funding will disappear.

Simplifying the Levy on Rural Market Sales

The calculation and division of revenues from the levy on rural market sales is a complex process. There are three different levy bands; placement within these bands is dictated by the distance of the market from the urban area. Superimposed on this levy structure is the difference between controlled and directed markets. The levies collected by markets must also be allocated between discretionary and mandatory investments in proportions determined by whether the market is designated as directed or controlled.

Apart from the administrative burden the activities represent for the rural markets, operating and checking this system at the central government level is also complex and costly. As the number of markets increases, the present difficulties in administering and controlling the system will grow greater, and the risk that the system will break down or become discredited will increase (the BTPN, for example, has recently found itself without the necessary funds to issue sales coupons to rural market managers). It is also doubtful that the small differentials between the bands that were finally negotiated with the government—as opposed to those originally supported by the project—have any practical impact in directing fuelwood harvesting from heavily exploited to underexploited areas.

These considerations create a strong case for a major simplification of the existing system. A first step would be the adoption of a flat rate levy of FCFA 300/stere on all fuelwood sold from rural markets, irrespective of distance from the urban area and designation as controlled or directed. This simpler system would also yield roughly the same total revenue as the present multiband system.

The division of the proceeds of the levy between discretionary and woodland management expenditures also deserves reconsideration. The amounts involved at the level of the individual village are small, and administrative and checking costs are likely to absorb a substantial proportion of the sums available. Eliminating the distinction and allowing the entire amount to remain with the village for discretionary spending would simplify the system considerably, without noticeably reducing the project impact.

Any such review and restructuring of the taxation system must, however, be carried out in a manner that does not undermine the overall credibility of the rural market system. Such effort has been expended to explain it and convince rural people, forest service personnel, administrators, and others of its value. Change needs to be presented as an evolutionary improvement rather than as a repudiation of the current effort.

Management Plans for Rural Markets

The original project intention was that each rural market should be a controlled market with its own detailed management plan. The plan would divide the market's area of natural woodland into parcels, specifying the order of exploitation and the annual quota of fuelwood to be harvested from each parcel. The amount of work involved in drawing up these plans, as well as assuring that they are understood and accepted locally, has been formidable. It was for this reason that the simpler concept of the directed market, where the area of woodland is defined and a harvesting quota set, was adopted to speed up market establishment.

Phase II of the project envisages the number of rural markets rising to a total of about 380. If these are to be of the controlled type, even assuming the workload to establish them is shared with nongovernmental organizations (NGOs) and local consultancy firms trained for the purpose, the effort will be a major exercise, and the problem of quality control is going to be significant. Moreover, monitoring compliance

with the management plans would be a colossal task. To be done properly, it would require yearly inspection and updating of 380 plans, as well as maintenance of accurate and accessible records on more than 2,000 management parcels.

Given the current limited availability of financial and technical resources in Niger, the widespread establishment of controlled markets is unlikely to be a practical option for the immediate future. The project should therefore focus on creating directed rather than controlled markets. This will allow quicker and broader dissemination of the rural market concept.

At the same time, a limited number of the existing controlled markets should be selected for further trials and monitoring in collaboration with the local village management committees. The aim should be to develop and refine the natural woodland harvesting and management techniques to increase the sustainable yields of fuelwood and other locally valuable products. As the efficacy of improved management techniques is established, they will be available as models that can be transferred to existing directed markets willing to adopt them.

The Fuelwood Harvesting Quota

The fuelwood harvesting quota set for rural markets is a contentious issue. In principle, it provides a check on the natural tendency of village communities, especially during difficult times, to overharvest the natural woodlands in order to maximize their short-term gains at the expense of long-term sustainability. Significant practical problems must be faced in establishing and maintaining the system, however.

The quota system must be operated properly if it is not to be counterproductive. Unless the quotas are realistic, accepted locally, and monitored effectively, they will be ignored, and the exercise could well discredit the project rather than further its objectives. The tasks of setting and reviewing the quotas for the planned 380 rural markets, monitoring compliance, dealing fairly with disputes, and imposing effective sanctions on defaulters is a major task that it is likely to be beyond the capacity of the supervisory authorities.

The most radical solution would be to abandon the quota concept completely. This would carry the ideal of the project, which is to devolve responsibility to the village level, to its ultimate conclusion. In this context, the following comments made a decade ago remain equally relevant today (Floor and Gorse 1986):

> It seems prudent, as a general policy, to transfer authority permanently and then let local people experience the consequences of their own management decisions. Such transfers should be preceded by careful discussion with local people on the terms and conditions of the transfer. If they maintain or develop the natural forest, they will derive the benefits; if they reduce or destroy it, they will support the costs. Clearly, some communities will eliminate their natural forest capital for short term gain, or because they cannot organize themselves to regulate its use. This is a

> serious risk, but one which must be taken if the policy is to succeed eventually. And it is certainly no more risky for natural forest maintenance than continuation of the official control measures which are presently inadequate in most areas. (p. 17)

Adopting this approach would provide village communities with the maximum discretion. They would be in a position to decide how to optimize the use of their natural woodland areas in accordance with their own priorities and to make broad-based natural resource management decisions on whether areas of natural woodland are best used for fuelwood or for the production of crops for subsistence or sale. Such decisions lie at the heart of the rural development process and impinge directly on people's livelihoods. Mistakes and wrong decisions would certainly be made, but it can be argued that this is inevitable if people are ever to be given the opportunity to learn responsible and rational land-use management.

A more cautious approach would be to retain the existing quota system but to tailor it to the resources available for its implementation. These resources could then be focused on areas where the risks of overexploitation of the natural woodlands are greatest. In these areas, exploitation quotas could be set, with the agreement of the local community, and subsequently monitored.

For other, less resource-critical areas, the quota could be regarded as primarily advisory, although the right to impose a mandatory quota, should circumstances warrant, would be retained. When a market is being set up, villagers would be advised on sustainable management and the need to keep the amounts harvested within the sustainable limit indicated by the quota. The quota could be seen as a tool to be used by the village to monitor its own performance. Exceeding the quota would be a warning that the woodcutters were beginning to deplete the woodland stocks that are the foundation of a sustainable flow of revenue, not only for themselves but for the village as well.

Redefining the Role of the Forest Service

Clear-sighted review and redefinition of the role of the forest service in relation to the project are urgently needed. The greater part of the technical training provided to forest officers and technicians is in connection with conventional forestry activities, and it is irrelevant to the role they are being asked to fill within the rural market system. Few foresters, for example, have received formal training in the optimal production of the small, often malformed, shoots and branches typical of the fuelwood harvested from a sustainably managed area of natural woodland.

This is not the fault of the forestry service. In the past 15 years, the forestry activities proposed by international donor agencies in Niger have moved from irrigated plantations of exotic species; through the now discredited woodland rehabilitation measures of Guesselbodi; to the present, almost hands-off, attitude toward natural woodland management by village communities.

The project has also displaced forest agents from their traditional policing roles—the source of much of their status and in many cases a large portion of their income. Their tasks in the promotion of sustainable woodland management have been poorly defined and often appear trivial in relation to their training. Instead of having authority in the rural areas, they have felt themselves consistently denigrated in the eyes of rural people. At the same time, and despite the condemnation of their former role as forest police, they are still called upon to perform police functions in the enforcement of the new regulations.

Despite the confusion over roles, the forest service is, nevertheless, a significant resource of trained personnel that the country can ill-afford to waste. It is important to carry out a careful review of its role when Phase II of the project is being planned. There is no point in deploying forest officers to perform work they are neither trained nor suited to carry out. The crucial task is to identify the tasks that foresters, or forestry technicians, are uniquely capable of carrying out and to ensure that they are deployed accordingly and properly supported.

Reviewing the Fuelwood *Problématique*

At the time the project was being designed in the mid-1980s, the virtually universal conclusion drawn from the Sahelian data was that the region was in the grip of a severe energy and environmental crisis. Rapidly growing fuelwood consumption either exceeded the sustainable capacity of the natural woodlands or was on the point of doing so. This conclusion was supported by a range of authoritative publications from the U.N. Food and Agriculture Organization (FAO), CILSS, and a variety of other organizations (see, for example, CILSS/Club du Sahel 1978 and de Montalembert and Clément 1983).

The predicted consequences of this widening fuelwood deficit, or "fuelwood gap," were grave. It was warned that consumption, well in excess of the sustainable supply, would bring about mining, rather than the sustainable exploitation, of woodland resources, leading to their early depletion and severe energy shortages in the urban areas. In the rural areas, the outlook was equally discouraging. Deprived of the natural woodlands for fuel supplies, the population would turn to the use of agricultural residues and cow dung, which would deprive the soil of nutrients and present a major threat to the agricultural system.

In the past decade, however, it has become evident that the views prevalent in the late 1970s and early 1980s seriously exaggerated the magnitude and urgency of the fuelwood problem. The project contributed significantly to the development of a less crisis-driven view of the fuelwood problem. Studies carried out by the project in 1992 and 1993 showed that the woody biomass resources of the cultivated and fallow lands in the Niamey catchment produce around 200,000 tonnes annually. This confirms the observations of other commentators on the Sahel, one of whom has noted: "It has been a grave error to think that fuelwood has come from the exploitation of the natural savanna when, in the great majority of cases, it comes from deadwood in areas cleared for

agriculture" (Catinot and Bonkungo 1985). Moreover, it appears that the fuelwood consumption in Niamey has grown at a slower rate than predicted.

The project has also reconsidered its initial assumptions about the levels of standing stock in the natural woodlands. Following the methodology of previous woodland resource assessments, the project only considered shoots over 4 centimeters in diameter in its initial assessment of the available fuelwood supply. Although this is likely to be valid for commercially salable fuelwood, it seriously underestimates the amounts of woody biomass available to rural people for their own consumption. When this is added to the fuelwood obtainable from farm and fallow lands, as well as the cooking fuel available in the form of agricultural residues, rural consumption is transformed from the dominant element in the analysis to a matter that can effectively be ignored in the projection of available supplies for the urban areas.

Nor does the shift to on-farm fuel sources pose any serious threat to the agricultural system through the removal of soil nutrients. The impact of a shift to these alternative sources of cooking fuel can be roughly quantified. Consider a village of 400 people living within an area of cultivated farmland and fallows with a radius of 4 kilometers. With a per capita daily fuel consumption of 0.8 kilogram, the total annual fuel consumption for the village is 117 tonnes. This can be met by harvesting just 23 kilograms of burnable biomass per hectare annually.

The biomass harvested can be in the form of lopped branches from trees, twigs, bushes, millet stalks, cow dung, and any other burnable material available. Much of this material will be of low fertilizer value, but the quantities abstracted are not so great that the agricultural system is put at risk. Moreover, the ashes from the fire, together with other household wastes, will normally be returned to fertilize the home garden and nearby cultivated fields.

Although these conclusions require further scrutiny and confirmation, an accumulation of evidence suggests that the household energy problems facing Niger are neither as great nor as urgent as they appeared a decade ago. It could even be argued, somewhat provocatively, that rather than dealing with a rapidly disappearing and seriously underpriced resource, the major issue in fuelwood management is how to improve the management of a relatively abundant resource with a low economic value.

The resolution of such questions has major relevance to policymaking in the domestic energy sector not only in Niger but in the remainder of the Sahel and other areas of the developing world as well. The project, with its background studies and evolving understanding of the fuelwood problem, is uniquely positioned to carry out the investigation of these issues. Continuation of background studies and analytical work with a view to developing a new and up-to-date conceptual model of the evolution of the fuelwood *problématique* and its relation to the natural woodland resource base should be a major focus of research during the next phase of the project.

The Question of Stumpage Value

The question of stumpage value—that is, the intrinsic, or replacement, value of fuelwood—has long been a concern in the Sahel and other parts of the developing world. Many attempts have been made to establish credible and widely acceptable methods of arriving at such values. If this could be achieved, it would provide guidance on the level of taxation required to bridge the difference that is usually found between the actual selling price of fuelwood and the price required to achieve a sustainable supply.

Fuelwood dealers, for example, will normally use the most efficient harvesting methods available to them when they move into an area of natural woodland. The result is that the resource base is destroyed rather than harvested sustainably. It also means that the dealer's cost is less than if the harvesting were done sustainably. In setting the selling price, the dealer is therefore able to ignore the stumpage value of the fuelwood and sell it at less than its replacement value.

Such short-sighted behavior by fuelwood dealers leads to a succession of negative effects. Consumers, who obtain their fuelwood supplies at a lower price than if the wood were harvested sustainably, tend to use more fuelwood than they would if the true stumpage value were included in the price they pay. The lower price also inhibits the shift to substitute fuels, and the higher cost of producing fuelwood sustainably prevents such supplies from competing successfully on the open market.

One way to restore the balance and allow sustainably produced fuelwood to compete commercially is to impose a tax equal to the stumpage value on fuelwood that is harvested unsustainably. This was the strategy adopted by the project when it was initially designed. The proposed level of tax on fuelwood from uncontrolled areas was FCFA 9/kilograms, which was the estimated additional cost of producing fuelwood sustainably, based on the Guesselbodi experience.

Meanwhile, however, the project developed its own approach to natural woodland management that was much less costly than the Guesselbodi system. Under the project approach, there is no physical input to the managed area, and there is no paid labor guarding or protecting the newly harvested woodland. The management system simply demands that those harvesting the woodlands refrain from overcutting. To make the system work, the local community, which has a vested interest in ensuring that harvesting is carried out sustainably, must be involved through the local market system.

The additional costs of sustainable production are, therefore, those involved in setting up the market, which the project has calculated as ranging from FCFA 1,270/hectare for a large, directed market to FCFA 8,440/hectare for a small, controlled market. Assuming a future average cost of FCFA 2,500/hectare to establish a directed market, the annual cost amortized over 10 years at an interest rate of 10 percent is about FCFA 240/hectare—about FCFA 1/kilogram of harvested wood. A further FCFA 1.5/kilogram would be needed to cover the costs of the less efficient harvesting methods used by local woodcutters and the administrative costs of the rural markets. Taken together, these costs yield a total stumpage value of FCFA 2.5/kilogram, or FCFA

750/stere. This figure also needs to be increased by a further FCFA 0.5/kilogram to compensate for the portion of the levy on fuelwood sold from markets that is taken by the local Department of the Environment office and the Treasury, and can be assumed to be necessary to the overall operation of the rural market system.

Figuring in these additional costs, the total stumpage value rises to FCFA 3/kilogram, or FCFA 900/stere, which is the tax required on the selling price of fuelwood from uncontrolled areas if its selling price is to reflect the replacement cost. This assumes a 100 percent collection rate of the tax. If the collection rate is about the current 30 percent, the tax level will need to be increased to about FCFA 2,700/stere. If the rate is 60 percent, the tax level should be FCFA 1,350/stere.

This computation reinforces the conclusions reached earlier. Taxes on fuelwood from the uncontrolled areas—and the collection rates—must be considerably higher if they are to reflect the true replacement costs of the fuelwood harvested. In the absence of the appropriate level and rate of collection of taxes on wood from the uncontrolled areas, the long-term viability of the project depends on establishing a critical mass of rural markets, which will be able to dominate the fuelwood market and set prices at the levels needed to ensure their commercial sustainability.

Dealing with Demand

The original conception of the project postulated a need to hold urban fuelwood consumption at existing levels. The devaluation of the currency, the economic problems of the country, and the refusal of the government to impose the agreed levels of taxes, however, threw the demand component strategy seriously off course. The question is whether, in the light of the experience to date, a renewed attempt should be made to implement the original strategy.

Current evidence suggests that efforts to implement the demand strategy can be relaxed. If, as appears to be the case, rural fuelwood consumption can be largely discounted, or even eliminated from the demand estimates, the need to hold urban fuelwood consumption at its present levels disappears. In the Niamey catchment area, using the conservative assumptions of the project, the annual sustainable yield is 300,000 tonnes, more than double the present annual consumption of the city. Similarly, in Zinder and Maradi, the sustainable yields from the supply catchment areas are two to three times greater than present consumption. The immediate urgency is thus removed from the issue of urban fuelwood consumption.

Switching from fuelwood to other fuels no longer needs to be promoted. Instead, this process can be left to the gradual operation of normal economic processes in the urban areas. For example, reduction of fuelwood consumption and increases in fuel-switching are typical as urban areas evolve. The reasons for this transition include the shift to more urban dietary patterns; the development of employment opportunities for women, which increases the opportunity costs of their time and justifies the shift to more quickly prepared foods; and the emergence of small cafes and kiosks serving ready-

cooked food, which brings substantial economies of scale in cooking-fuel consumption. Some evidence also suggests that the effect of these forces can already be seen in Niamey and that the rate of growth in fuelwood consumption is slowing.

The precise identification and quantification of such changes and trends requires in-depth socioeconomic studies. Again, the project is extremely well positioned to carry out this work and to develop a model of the evolution of urban domestic fuel demand. As in the case of the rural demand studies, this would be of major value in providing a framework for future energy planning in Niger and other countries in the developing world.

Conclusions

The project already has a number of highly important achievements to its credit, and the need to continue it is not in doubt. It has made a major breakthrough in demonstrating that natural woodland management is possible and affordable and that it can be carried out by local people. It has shown that changes in the laws of land tenure are possible and that governments can be persuaded to devolve authority to local people. The rural market system has succeeded in creating the conditions that render the sustainable management of the country's natural forests a realistic possibility. The project has also succeeded in developing a mechanism for diverting substantial flows of cash from the urban to the rural areas.

The crucial element in the project is the transfer of control over natural woodlands to the rural people most concerned with them. Once a community has control over its own area of natural woodland, it cannot avoid responsibility for management decisions. The people involved know they will receive the benefits of maintaining the productive potential of these woodlands; they also know they will bear the costs of destroying them. Giving rural communities control over their own natural woodlands is the first step toward rational management and economic optimization of the productive potential of these woodlands.

The rural market also deals with the inequity of the present system by enabling local communities to receive a fair share of the benefits of harvesting their own natural woodlands. Moreover, by providing a flow of money into the rural areas, the fuelwood markets can act as starting points for further rural development. Investment in agricultural improvements becomes a more realistic possibility if there is some cash available to farmers. Planting trees for timber and other purposes may begin to make sense to communities when they have complete control over the process, from planting to harvesting and selling.

These achievements of the project, however, are fragile. Although they benefit rural people, they are subject to considerable, although generally latent, opposition from those who feel they are the losers in the new system. The transporters are waiting for the rural market system to fail so that they can restore control over the supply chain. Forest wardens find themselves in a changed and less advantageous position. They have lost the

privileged relationship with the traders and the accompanying opportunities for illegal gains.

Much of what has been achieved could be reversed. It is easy to envisage the existing rural fuelwood markets being undermined and control over the exploitation of the natural woodlands reverting to the fuelwood traders. The project thus needs to continue in order to consolidate the gains, secure the structural and institutional reforms, and extend the scope of the market system so that it becomes self-sustaining and independent of external support.

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