PN-ABM-425

AGRICULTURAL MARKETING IMPROVEMENT STRATEGIES PROJECT

Sponsored by the

U.S. Agency for International Development

Assisting AID Missions and Developing Country Governments to Improve Agricultural Marketing Systems

Prime Contractor: Abt Associates Inc.

Subcontractors: Postharvest Institute for Perishables, University of Idaho, Deloitte Haskins & Sells,

AID Contract No. DHR-5447-Z-00-7074 AID Project No. 936-5477

PN-ABM-425

AGRICULTURAL MARKETING IMPROVEMENT STRATEGIES PROJECT

Under contract to the Agency for International Development, Bureau for Science and Technology, Office of Rural Development
Project Office 4800 Montgomery Lane, Suite 600, Bethesda, MD 20814 • Telephone: (301) 913-0500 • Telex: 312636

NIGER

THE MARKETING AND PROCESSING OF GARDEN CROPS

AUGUST 1992

Prime Contractor: **Abt Associates Inc.**, 4800 Montgomery Lane, Suite 600, Bethesda, MD 20814 • (301) 913-0500

Subcontractor: **Postharvest Institute for Perishables**, University of Idaho. Moscow, Idaho 83843 • (208) 885-6791

Deloitte & Touche, 386 Woolwich Street, Guelph, Ontario N1H 3W7 Canada • (519) 822-2000

NIGER

THE MARKETING AND PROCESSING OF GARDEN CROPS

Submitted to:

U.S. Agency for International Development
Niamey, Niger

By:

The Agricultural Marketing Improvement Strategies Project (AMIS)

Dan Nicholson, Deloitte & Touche
Charlie Stathacos, Abt Associates

AUGUST 1992

TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

INDEX OF TABLES

APPENDICES

GLOSSARY

BOD	Biological oxygen demand
CFAF	Currency of the West African Financial Community
cm	centimetre
COD	Chemical Oxygen Demand
gm	gram
ha	hectare
INRAN	Nigerien National Institute for Agronomic Research
kg	kilogram
km	kilometre
ml	millilitre
MT	Metric tonnes
N	Naira
ONERSOL	Solar Energy Office, Ministry of Higher Education and Research
UNIDO	United Nations Industrial Development Organization
URC	Regional Union of Cooperatives

PREFACE

The Agricultural Marketing Improvement Strategies Project (AMIS), core-funded by the Agency for International Development's Bureau for Science and Technology, is a five-year project designed to assist USAID Missions and developing countries to:

- improve diagnosis of agricultural marketing system constraints, using rapid appraisal techniques;
- conduct in-depth analysis of specific marketing problems identified during rapid appraisal or by other studies;
- identify, design, and monitor appropriate marketing system innovations and improvements; and
- build local capacity in both the public and private sector to do marketing systems analysis.

AMIS is also assisting AID/W and USAID Missions in planning new marketing initiatives and projects.

The rationale for the AMIS Project, which began operations in October 1987, was the realization that benefits from increases in agricultural production, often the result of successful AID or other donor-sponsored projects, frequently do not reach farmers and others in the marketing chain because of constraints or bottlenecks in marketing systems. Likewise, inefficient distribution systems for fertilizer and other inputs may result in late deliveries and high cost to farmers. These constraints may be technical, institutional or infrastructural, but they are often the result of government policies with disincentive effects -- policies that discourage private sector participation in marketing. Through analysis and active interventions, AMIS is promoting a better understanding and appreciation of the importance of marketing in the agricultural development process.

The prime contractor for the AMIS Project is Abt Associates, a Cambridge, Massachusetts-based policy research and economic analysis firm, operating through its Washington, D.C. area office. Abt is assisted by two subcontractors: The Postharvest Institute for Perishables at the University of Idaho, a research and information center dedicated to improving postharvest handling and marketing of perishable crops, and Deloitte & Touche, an accounting, management and agricultural development consulting firm with special expertise in market liberalization.

EXECUTIVE SUMMARY

This report examines opportunities for expanding production, processing and marketing of the principal garden crops currently grown in Niger. It is based on fieldwork conducted in Niger, including field trips to Filingue, Tillaberi, Maradi, Zinder, and Diffa. One week was spent visiting markets in northern Nigeria, and several days were spent in Abidjan, looking at potential export markets. Crops were selected for this study based on their relative importance in terms of production, apparent demand in both local and regional markets, and potential for processing products acceptable to consumers. These crops included peppers, tomatoes, potatoes, and fruit. Although onions are one of the most important vegetable crops in Niger, its discussion in this report is limited to the potential for dehydration and sale to processors in the regional market, because that crop has been the subject of separate studies in 1991 and 1992. A list of persons contacted for this study appears as Appendix G.

Background on Off-season Production of Garden Crops in Niger

Agricultural production in Niger is dominated by rainy season production of millet and sorghum. Cowpeas, the third most important crop, are often intercropped with millet.

Niger's food supply is also supplemented by off-season garden production which takes place in bottom lands and along rivers, and which mostly depends upon irrigation. Although the total area planted to off season production (45,000 to 65,000 ha.) is only 5 - 6% of the area planted in the rainy season, garden crops have become a major source of revenue throughout Niger, especially since the 1984-85 drought when off-season production was encouraged to help offset food shortfalls.

Crops produced in the off-season include the following:

Roots and tubers (cassava, sweet potatoes, and potatoes),

Cereals (wheat, maize, sorghum and rice),

Legumes (cowpea and asparagus bean),

Vegetables (onion, tomato, peppers, pumpkin, cabbage, lettuce, garlic, okra and carrots), and

Fruits (melon, watermelon, mangoes, and guava)

Peppers are grown primarily in the Department of Diffa, along a 150 km. stretch of the Komodougou river bank. Approximately 2,000 ha. were under pepper cultivation in this area in 1991, up

about 68% from 1,190 ha in 1985. Area in production in all other regions totals between 300 and 600 ha.

Tomato production in the dry season is also an important economic activity. Although production is not as concentrated geographically as in the case of peppers, there are several important production zones. These include the departments of Maradi, Tahoua, and Agadez. Total production for Niger has ranged from 29,175 MT in 1987 to a high of 90,951 MT in 1990, while last year's production was reported to be 44,592 MT.

Potatoes, unlike peppers and tomatoes, are a new crop to Niger, introduced in the 1980's, using seed imported from France, to help improve the self-sufficiency for foodstuffs during the dry season. There are now four main areas of production: Filingue, Tahoua/Maradi, Zinder and Agadez.

Strong Demand for Red Peppers but Production Constraints Limit Potential for Expansion

The demand for red peppers is strong in Niger, with Niamey the most important market, followed by Maradi, Zinder and Birni-Nkonni markets. Although dried peppers store well, most traders report high turnover rates. The transport and distribution pattern of dried red peppers is typical of many agricultural commodities in Africa. Consignment lots range from 1 to 1,000 sacks, and pass from farmer intermediaries to consumers through various market intermediaries.

Storage of dried peppers is not a problem for producers or traders. Producers sun-dry peppers and register relatively low loss rates, in part because they use powerful insecticides, many of which are banned in many countries.

It is the conclusion of this study that further processing of peppers for traditional markets, in the form of powder for example, will not be a viable proposition in the foreseeable future. However, there is one specialty process which, under more competitive economic conditions, could be an interesting adjunct to the direct consumption market. The red pigment of the pepper can be extracted as an oleo-resin using a solvent such as hexane, ethyl alcohol or methylene chloride. This process is carried out with commercial success in Spain and Ethiopia, to yield the natural red color used extensively in Europe and North America in processed foods. Since the pigment would be marketed internationally, its success would depend not only on good quality control, but on external factors such as competitive exchange rates and labor costs as well as access to markets on the same terms as principal competitors.

Most of the constraints to expanding the pepper trade are related to production and include the following:

- Insufficient water for irrigation
- Difficulties in maintaining and repairing irrigation systems (knowledge, spare parts)
- Increasing cost of fuel to operate irrigation pumps
- Inadequate pesticides and herbicides or lack of knowledge of correct application techniques (particularly against aphid attacks and weeds)
- Labor shortages

Other longer-term constraints which may arise in the future are:

- Spread of a viral disease from locally retained seed,
- Soil salination as a result of continuous irrigation without adequate drainage.

Marketing constraints are not significant although some factors could slow development of the pepper sub-sector in the future:

- Increased production of peppers in Nigeria is expected as irrigated production of garden crops continues to expand. Nigerian demand, however, is expected to continue to be very strong.
- The presence of persistent pesticides, such as lindane, used during drying and storing on the farms, are banned in many countries. This ban would prevent any exportation of dried peppers to niche markets which may be identified in the future (for West Africans in Europe, for example).

Tomatoes are Produced Seasonally for Local Markets, But Low Quality Dried Surplus are not in Demand in Regional Markets

Since tomatoes are an important ingredient in prepared sauces in Niger, demand tends to be strong especially during harvest time when prices are relatively low. As supplies of fresh tomatoes decline in the period following harvest, and prices rise, consumers shift to dried tomatoes and canned imported tomato paste.

Tomatoes are produced and harvested at the same time period throughout Niger, resulting in market gluts and depressed prices. Fresh tomatoes are fragile and difficult to market without incurring high losses and high discounts due to reduced product

quality. Growers that dry most of their production incur losses because of poor drying techniques and heavy infestation. While the market for dried products is more stable and extends through September, demand is price elastic due to the availability of canned paste, which consumers can substitute for fresh or dried tomatoes.

Furthermore, unlike Diffa peppers, dried tomatoes are not consumed widely in Nigeria and therefore are not exported in any significant amounts. While dried tomatoes are sold along with dried peppers at the wholesale and retail level within Niger markets, the market is more limited in the region. In the southern regions of coastal countries such as Côte-d'Ivoire, for example, dried tomatoes are simply not consumed.

Tomato Paste Processing Is Not a Viable Option for Niger

The only processing carried out in Niger is sun drying. For the most part, the practice is to slice the fruit by hand and spread it on the ground, usually with no protection from sand or insects. Washing and the introduction of drying racks would improve final quality and reduce losses, as in the case of peppers. Evidence of a quality differential in retail prices support this type of process improvement. An intermediate form of solar drying, using tunnels and ducted warm air, would also appear to have the potential to improve quality and increase efficiency in drying operations, although this system would not be suited to cottage-scale operations. Designs currently in use in Southern China are constructed primarily of local materials and would be suited to volumes of one to five tons per charge.

Tomato drying is likely to be the only feasible development in tomato processing in the near future. Other processing, to make paste for example, would not be viable for several reasons:

i) Raw material is too expensive, even compared to the case of Nigeria;

ii) The cost of fuel for the evaporation and electricity for other plant operations is higher than that faced by competitors.

iii) The cost of labor is also higher than in neighboring Nigeria.

iv) Raw material is not uniform with respect to size, shape, variety, degree of ripeness or date of maturity, with the result that a suitable supply of raw material would be extremely difficult to develop.

v) Three MT/hour is the minimum volume required for such operations, and the optimal level in terms of unit processing costs is seven MT/hr. The plant should operate 14 to 24

hours/day, for a season of about three months. Unless there were a major increase in total production of tomatoes and other crops to be processed in the same plant, combined with a restructuring of production to facilitate the assemblage of large quantities as a steady price, such a factory could not operate in Niger.

Limited Market Exists for Potatoes in Niger, while Competition is Strong from Nigeria

The demand for potatoes in the growing regions is limited. In Filingue for example it was reported that only about 20% of production is consumed locally, the rest being sent to Niamey market. Even in Niamey, sales have been sluggish as they tend to be consumed by the expatriate community and the local elite, many of whom had not received their government salaries for three months at the time of the survey. Water shortages contribute to the smaller average size and higher cost of Nigerian potatoes. Nigeria supplies a significant portion of the potatoes purchased by Niger elites and expatriates, who are the primary consumers. The potato has not yet found a regular place in the diet of the average Nigerian household; furthermore, there are production and price constraints that will delay expansion of the potato market. In the near future, market development efforts could focus on boosting local demand by increasing consumer awareness and taste by promoting a variety of street vendor products.

Quality Seed is Lacking and Potato Storage is Problematic

On the production side, the lack of good quality seed potatoes is a constraint of great concern. The performance of superior planting material is generally much greater than the cost to the grower who chooses to retain his own seed potatoes. In addition, properly controlled seed material will be disease free, whereas the current practice of repeated use of infected potatoes increases the spread of soil-borne diseases that are extremely difficult to eradicate. It has been reported that Tablote area produces excellent seed potatoes. Subject to testing for its suitability in the major production areas, this material should be promoted for widespread use. Production conditions need to be monitored to ensure that certification is possible, and a certification program begun, together with demonstrations for growers. Normally, one would recommend restrictions on the movement and sale of uninspected planting material as part of a phytosanitary regime. However, the danger of such a measure becoming simply another means of increasing transaction costs is such that it is probably preferable at this time to focus development efforts on the superior performance of the certified material, and thus to create demand for the preferred seed potatoes. Technical assistance to the growers of certified seed would also be useful to ensure a

steady supply at remunerative prices. Recommendations for phytosanitary procedures have been made previously (Ref. PID III).

The major marketing constraint, which has been identified by growers for some time, is the lack of suitable storage facilities to enable produce to be kept for out of season sale (see Annex 2 of main report). This is not as much a technical issue as it is a financial and an organizational one. Economic signals to private entrepreneurs discourage them from making fixed investment commitments to the formal sector, or from disclosing their activities to the extent that would be implicit in cooperative agreements with other growers or intermediaries.

Recommended Actions

1. Sweet Peppers

Efforts should be made to combat aphid attacks, which can reduce pepper yields by up to 80 percent in very bad years. An early warning system and plan of action for growers in the Diffa area should be implemented.

An efficient herbicide treatment is urgently required to combat a pernicious grasslike weed which is becoming very troublesome in areas around Diffa, causing farmers to continually move plots to prevent significant losses in yield.

An alternative to the use of the harmful pesticides during drying and storage, which are banned in many countries, should be found as soon as possible. One step would be to use drying racks on short legs, to raise the peppers away from termites, instead of spreading pesticides on ground cleared for drying.

USAID should fund a study of the potential for extracting oleo-resins from dried sweet peppers in Niger, using solvent extraction techniques similar to those already employed in Spain and Ethiopia for example. This produces a concentrated natural red color used in the food processing industries in Europe and the USA. This process could be viable in Niger, since the extracted residues can be burnt on a chain grate stoked boiler to provide all the heating energy required for processing.

2. Tomatoes

Better quality dried, sliced tomatoes would be obtained if drying racks were used, to raise them away from crawling pests and dirt.

Processing of tomatoes into concentrated paste is not an option for Niger in the near future, because of the high cost of fresh fruit and energy compared with neighboring Nigeria.

3. Potatoes

Potatoes cannot be safely stored for more than one to two weeks following harvest under the ambient conditions of most of the growing areas of Niger. The technical solution consists of improved harvesting and handling methods to reduce damage, and storage at cooler temperatures and higher humidity. The financial feasibility of the storage element of this solution, together with questions of ownership and logistics of storage, represent a complex set of issues that should be addressed in the first instance on a pilot scale. The advantage which could be gained in storing local potatoes is that they could be sold in July/August when prices in the market double and triple from those at the time of harvest.

Because of the shortage of good quality seed potatoes, a program should be developed to test seed material from Tablote in the principal growing areas. If the results are satisfactory, production and quality control of seed material from that source should be increased. A certification program and a promotion campaign based on the financial advantages of greater production and reduced losses should be initiated. In the meantime, the import of donor-funded certified seed from Europe, and its distribution at a price not less than good local seed potatoes, would be an important measure to reduce the spread of diseases and to broaden the awareness of certified seed potatoes.

Finally, husbandry and varietal selection efforts should be made to increase the size of potatoes presented to the market. Early maturing varieties may be better in this respect because they would face less heat and water stress during the final stages of tuber development as the dry season advances.

4. Onions

In the course of fieldwork in Côte-d'Ivoire the team established contact with Copral-Nestle to discuss the prospects for the sale of dried onions/onion powder. Copral-Nestle have indicated that they are in principle interested in buying this product from an African source to replace the 100 tons per year presently imported from the United States and Europe. However, subsequent investigation has led us to conclude that the product specifications required for this market could only be met by a modern plant that would require significantly more than 100 tons of finished product to justify the capital cost, and would probably require energy and other foreign exchange operating items that would bring its viability into serious question at the present time.

Given that dried onions are a high value product, it may be feasible in the longer term to use solar drying techniques in Niger, even though capital costs are high. Tunnel driers using

solar-heated forced air are being used with some success in Southern China. This innovation could be examined further.

5. Other Processing Opportunities

Most secondary processing of produce requires large quantities of heat energy, and consequently significant capital investment and economies of scale. These features mitigate against development at the present time. Niger's lack of capital, high energy costs, and fragmented supply pattern mitigate against the development of modern processing at the present time.

An alternative, in the medium term, is to recognize the comparative advantage of Nigeria in secondary processing and to develop production and marketing patterns in which Niger becomes a raw material supplier for factories to the south. In addition to canning operations, steam distillation in a center such as Kano could become a viable activity, whereby high value essential oils would be removed from onions, garlic, and spices. Ethnic ties across the border are the basis of some trade at the present time, and this form of market coordination could develop quickly if formal sector intervention were kept to a minimum. Then, as the economic distortions that contribute to Niger's high cost structure are reduced, one could see a gradual shift of post-harvest activities into Nigerian territory, although climate, water supply and fuel costs will always limit viable processing options.

1.0 INTRODUCTION

Agricultural production in Niger is dominated by rainy season production of millet and sorghum. Cowpeas, the third most important crop, are often intercropped with millet. Other rain-fed crops of some significance include groundnuts, tiger nut (vouandzou), and rice, while minor production figures are recorded for maize, roselle, fonio, and sesame. The area in production for these rainy season crops is about 10 million hectares, almost half of which is planted in millet.

Niger's food supply is also supplemented by off-season production which takes place in bottom lands and along rivers. While fast maturing crops may be sown where recessional agriculture is possible (where water recedes from normally flooded areas), most off-season production depends on at least supplemental irrigation from shallow wells or surface sources. The area of off-season production varies a great deal from year to year. While this is principally based on water levels, many growers have flexibility in their planting decisions based on their perceptions of market prospects. In 1990-91, production covered 48.5 thousand hectares, a significant decrease from the 63.8 thousand hectares planted in 1989-90, the highest level since 1984-85 when 62.8 thousand hectares were recorded. Crops produced in the off-season include:

Roots and tubers (cassava, sweet potatoes, and potatoes),

Cereals (wheat, maize, sorghum and rice),

Legumes (cowpea and asparagus bean),

Vegetables (onion, tomato, peppers, pumpkin, cabbage, lettuce, garlic, okra and carrots), and

Fruits (melon, watermelon, mangoes, and guava)

The importance of off-season, secondary crop production was underlined in 1984 when widespread shortages of cereals occurred as a result of drought conditions during the regular cropping season. The immediate food needs of the population were met by off-season production, pending the arrival of food aid. Since that time, the expansion of off-season production has been encouraged as both insurance against future food shortages and an additional source of income for producers.

Off-season production comes from three sources: home garden production, small plots located in and around market centers, and farms that are distant from major markets (where producers tend to dry most of their production). For some regions, off-season production now accounts for most of the revenue received for the sale of agricultural products. According to the Ministry of Agriculture, the ratio of income earned from off-season production

to rainy season production in Agadez is 27:1 (Statistiques Agricoles, 1991). In Diffa, the ratio was 2:1 and in Zinder off-season earnings now represent one-half of the total income from agricultural production. Onions are the major cash crop for producers in the Tahoua Department, which supplies not only Niger but also coastal West African markets in Abidjan, Accra, Cotonou and Lome. While there is reason to question the accuracy of agricultural income data, it is clear that off-season production is a critical economic activity for rural populations throughout Niger.

The technical potential exists to expand off-season production. However, the incentive to growers is often lacking. Market outlets are inadequate to cope with seasonal gluts, and growers are forced to accept low prices at harvest time for their produce on the local markets. Market improvements are needed, including expanded access to regional outlets and better storage and processing capacity to extend the marketing season.

The problems created by physical impediments to marketing are exacerbated by price distortions and public intervention in the formal sector, forcing most market intermediaries to operate in the informal market. Under these circumstances, they must depend on their personal relationships and negotiating skills to remain in business and to contain transaction costs; they certainly are not inclined to make fixed investments, for example in grading and storage facilities. One benefit that does accrue to intermediaries who succeed under these circumstances is limited competition for raw material supplies, particularly outside the three or four principal urban markets. From the growers' perspective, reduced access to markets depresses prices and reduces market development possibilities.

The criteria for selection of crops to study were based on their relative importance in terms of production, apparent demand in both local and regional markets, and potential for processing a product acceptable to consumers. This rapid appraisal study examines a number of crops with good potential, particularly in terms of production and demand: peppers, tomatoes, potatoes, and fruit crops. Onions were not selected since they had been studied previously although some attention was given to onion dehydration and its potential for the regional market. Other crops were to be analyzed if, in the course of the study, it became apparent that there was a potential market niche.

2.0 OVERVIEW OF OFF-SEASON CROPS: PEPPERS, TOMATOES, POTATOES AND SELECTED OTHER CROPS

2.1 Sweet Red Peppers

2.1.1 Background

Sweet pepper (capsicum) is one of the dry season crops introduced during the 1980's to improve farmers' income. It is grown in several departments along the Komadougou and Niger rivers, where sufficient water is available during the dry season to enable the weekly flood irrigation.[1] Peppers are now the major source of off-season revenue in the area around Diffa, supplemented to a small extent by okra (gumbo) and coriander.

The area of land under sweet pepper cultivation in Diffa is estimated at over 2,000 ha., most of which is along a 150 km. stretch of the Komodougou river bank. Area in production in all other departments totals between 300 and 600 ha.

Diffa is quite isolated from the majority of Niger's population. It is over 1,300 km. from Niamey and takes one and a half to two days to reach along good paved roads. Despite the long distance to markets, Diffa remains the leading supplier of sweet peppers within Niger.

2.1.2 Demand

The main markets for peppers from Diffa are Nigeria and Niamey. Significant quantities are also absorbed by Maradi, Zinder, and Birni-Nkonni. Much of the production sold to Birni-Nkonni also finds its way to Northern Nigeria.

The demand for red peppers remains strong, and all produce is readily sold by producers in Diffa and traders in marketing centers. Occasionally, there is a speculative shortage for a week or so as traders anticipate or respond to a price rise, but normally products move smoothly through the local and terminal markets.

Demand for Niger peppers is affected by Nigerian production. The Borno State Agricultural Department estimates its production over 47,000 MT dried red peppers every season, about 15 times that produced in Diffa. Price and off-take information in recent years

---

[1] There is a Danish aid project which constructs tube wells in the area at a completed and equipped cost of CFAF 30,000 each.

indicates that demand continues to grow, so this production does not threaten produce from Niger. However, the relative size of the markets means that the price of peppers will always be determined by developments in the market in Nigeria.

2.1.3 Production

In the Diffa Department as a whole, Diffa Arrondissement, supported by Diffa Commune and Maine-Saroa, has about 75 per cent of the area for peppers. Since 1985, the area under pepper cultivation in Diffa Department has gradually increased from 1,190 ha, to over 2,000 ha in 1991. Yields have been extremely variable, mainly because of aphid attack, especially in 1987 and 1990 (see Table 1 below).

In addition to insect attack, two factors influence pepper yields: the time of planting and the availability of water from the river and surrounding marshes for irrigation. When there is a bumper harvest of millet, the start of the pepper season is sometimes delayed, to allow the staple food to be harvested and stored. Such delays push the pepper crop further into the dry season, reducing the availability of irrigation water. Growers express the concern that any significant increase in the area under pump-irrigated peppers will also result in a shorter season around the marshy regions because of the volume of irrigation water required. There is not a sufficient data base on which to base a comprehensive judgement on this issue, but it is our opinion that the areas of concern are not large enough to pose a problem except in small isolated basins.

Table 1

Pepper Production in Diffa Department[2]

Year	1986	1987	1988	1989	1990	1991
Area (ha)	1190	1670	1280	1330	1520	2080
Yield (kg/ha)	1500	450	2270	2270	645	1430
Product (mt)	1785	750	2905	3020	980	2970

2 Yield and production figures are approximations since all dried pepper trade, including loan payoffs, are made by the sack, not by weight. Freshly harvested peppers usually contain 80-85 percent water, and 100 kg will yield about 17-22 kg, dried peppers at 10-12 percent moisture content; a ratio of 4 or 5:1. According to farmers, 2.5 sacks of fresh peppers produce 1 sack of dried peppers (weighing about 20-25 kg, according to the traders).

Source: Délégué Departement de l'Agriculture, Diffa, Niger

Diffa production, around 3,000 MT in a good year, is much smaller than that of Borno State, 47,000 MT produced on about 16,000 ha. However, these Borno production figures are understood to include both sweet peppers (several capsicum varieties) and hot peppers (frutescens), and have been calculated on an assumed yield of 3 MT/ha for each of the 24 government areas listed.

In Diffa, dried pepper seeds saved from the best fruit of the previous season are planted in seed beds as soon as labor is available after the rice and millet harvests, usually in June/July. If the millet crop appears to be failing, growers quickly switch attention to the preparation of the pepper seed beds in May. The seedlings are transplanted to the main growing areas in July-September, as soon as water is available from the river and marshes to enable the weekly flood irrigation to take place.

Factors affecting yields include aphid attacks which have become more prevalent in recent years. Okra, which is sown and tended by the women only along the small banks of the pepper irrigation channels, is usually the first crop to be attacked by aphids, from which aphid populations quickly spread to adjacent young pepper plants. This is not normally a difficult pest to control, but the supply and distribution of insecticide is not dependable. The local Ministry of Agriculture agent is the main source of pesticides and sprayers, but a case from the current season (Dec. 91 - Mar. 92) illustrates the problem. A 200 litre drum of concentrated insecticide was made available to farmers around Gueskeru, a village 38 km to the East of Diffa town, after the onset of an aphid attack. It was to be distributed in four-litre plastic containers, each to be shared among several farmers, who were then to dilute it for application from backpack sprayers.

However, little was achieved for the following reasons:

a) the insecticide arrived late,

b) farmers had no means of accurately diluting the concentrate,

c) each farmer who was allocated a four-liter container was so besieged by other farmers that too little was given to each individual to be effective and enable a 2nd and 3rd spraying to be achieved, and

d) there was a shortage of sprayers in good working order.

Because of these problems one farmer interviewed claimed that he lost more than one-third of his crop (a yield of only 14 sacks against the 22-25 expected from the crop which was very healthy before the attack). When one farmer in an area fails to control

the aphids on his plot they very soon multiply, and can spread to previously well-treated areas. Comprehensive timely treatment in the whole growing area is essential if this pest is to be controlled.

Ripe peppers are harvested every two weeks, usually starting in the first week in December. When money is required urgently to pay back loans taken out to pay for fuel for pumping and fertilizer, some smaller farmers sell a few sacks of fresh peppers. All farmers prefer to dry and hold some peppers for higher prices later when the growing season has finished.

When peppers have been harvested they are placed in piles, to await the removal of stalks by hand. This is a very labor intensive process usually involving all members of the family. When yields are high, labor bottlenecks arise, and losses can result from stalk-base rot that occurs in the period before drying has begun. While stalk removal prevents this form of decay, and has a secondary effect of reducing the time taken for the peppers to dry, removal needs to be done within a very short time after picking. Growers say that stalk removal is too time-consuming and would delay picking.

More frequent picking would result in a more uniform product, but the market does not presently pay a premium for uniformity of ripeness in the dried product. However, more frequent picking would reduce the daily volume of peppers to be de-stalked. This would reduce pressure on labor supply and drying surfaces, and would result in less lapsed time between harvest and drying.

The de-stalked peppers are laid out on flat prepared areas of sand, or preferably hard-pad (for quicker drying). The drying surface is treated with an insecticide powder, sometimes mixed with wood-ash as a diluent, to prevent attack, especially from termites. During drying on the ground the peppers are often contaminated by sand, carried on the strong prevailing winds. Under the present system, drying takes approximately 20 days.

Drying conditions could be improved in terms of drying rate and sanitation by using screened or slatted racks on short legs. This would increase air circulation around the fruit, and insect and insecticide contamination could be avoided by placing the legs standing in small tins of insecticide or kerosene. This suggestion was not favored by the local farmers, even though they understood the potential advantages, as it would require extra work and expense which was unlikely to be met by a corresponding increase in the financial returns.

The team recommends that simple design innovations, such as the use of drying racks, be developed and tried in response to quality premiums paid by consumers for better food products. Urban consumers in Niamey, Maradi, and Zinder, for example, are already

willing to pay higher prices for better quality product and are likely to be responsive to further improvements.

A communal solar drier would not be appreciated, since farmers would lose control of their own produce. Small solar driers for individual farmers might be acceptable, but growers do not believe at present that they will receive higher prices to offset the added cost and effort of using such improvements. In a pilot mode, small solar driers could be given to interested growers, along with extensive training, provided that in exchange, they agreed to use the process for a greater share of the crop and a set period of time. This would give developers an opportunity to note quality improvements under actual smallholder conditions and would place better peppers on the market to test consumer and intermediary response.

Dried peppers are packed into burlap sacks, or occasionally woven polypropylene sacks, and a cap of sacking cut from old bags is sewn over the end. The sack is not weighed. Previous reports have suggested sack weights of 17 kg, but traders interviewed said when sacks were weighed a few seasons ago they were around 25 kg with 20 kg being the minimum encountered. As peppers were sold by the sack they were not concerned with weight. They were interested in the quality which they could tell by the feel and sound of a sack when it was tapped. Some small 'house' sacks, containing half the volume of the larger sacks, are used by small farmers, but are not a significant portion of the market.

Table 2 shows production costs for Diffa peppers using two young farmers as case studies, one son of a villager and the other the son of a village chief. The significance of the trade with Nigeria is evident from the fact that figures were quoted in Naira.

Table 2

Production Costs for Sweet Peppers: Two Cases From Diffa

	Grower #1 Son of Villager	Grower #2 Son of Village Chief
1. Area cultivated	0.4 ha	1.2 ha
2. Persons working	2	4 family members
3. Irrigation fuel	N 1,500	N 4,500
4. Pump hire cost	Loaned from uncle	Cost not calculated
5. Insecticide	N 20	N 40
6. Fertilizer	5 sacks @ N 100 Total N 500	6 sacks @ N 100 4 sacks @ N 60 Total N 840
7. Total Prod. Cost	N 2,020	N 5,380
8. Peppers Produced	14 sacks	60 sacks
9. Cost per sack	N 144	N 90
10. Cost incl. sack (avg. N 25 ea)	N 169	N 115
11. Sales to pay expenses	3 sacks @ N 360 Total N 1,080	20 sacks @ N 280 Total N 5,600
12. Sharecropper Payment	5 sacks	-
13. Sold to trader	-	10 sacks @ N 360 Total N 3,600
14. Token gift	2 sacks	-
15. Stock on hand	5 sacks	30 sacks

Other Cost Information:

Pump hire:	One day, N 50, and uses 8 liters of fuel. All season, eight to ten sacks of dried peppers
Insecticide:	For five dryings, N 20 to N 40
Sacks:	N 15 to N 25 and increasing

Labor: While wage labor for peppers is not common, payment in kind or informal share cropping arrangement are common (as with Grower #1).

Grower #1 appears to have just broken even on his operation. (14 sacks, less 5.5 sacks payment in kind to a sharecropper, less 2 sacks as "token gift" equals 6.5 sacks @ N 360; total sales value N 2,340 compared to total costs of N 2,020). There is almost no return to his efforts or to cover the cost of land or depreciation on the pump. (The "token gift" may have been in lieu of land rent or user payments on the irrigation pump).

Grower #2 apparently financed all production costs, and paid a significant implicit rate of interest to his creditor. However, while it is not possible to tell whether it was land, husbandry, seed or water that made the difference, this grower earned a return of N 900 per month for each of the four family members engaged in the enterprise, excluding land and equipment charges.

Despite complaints of rising fuel costs, and increased costs of sacks, no farmer interviewed had plans to cease growing peppers in favor of another crop. Pepper production was so profitable for one former farmer that he accumulated enough savings to become a speculator/trader and livestock holder. He buys dried peppers from local farmers needing money at the beginning of the season, and holds on to stocks in order to sell peppers later in the year when prices are high. His younger brother now tends his land.

With regards to training, the younger pepper farmers said they had been taught by their fathers. Production methods spread by word of mouth gradually from Diffa and Nigeria. The local agricultural service has provided limited support, especially in recent years, except for some assistance in supplying aphid insecticide concentrate.

In Gueskeru, a Peace Corps volunteer had assisted local farmers for several years and experimented with the following techniques: insecticide powder mixtures with wood-ash, which was successful only in part; growing seedlings in the sun, so they did not wilt so readily as when transplanted from a shady bed; and teaching farmers to water seedlings as they were transplanted (out of the heat of the day), instead of waiting until the whole plot had been filled. He also organized the purchase of a number of water pumps, and introduced two tube wells on the outskirts of the village, so some water was available for plants out of the normal season.

Farmers wish to be independent to such an extent that it is extremely difficult for them to be organized, as was demonstrated over the pesticide distribution this year. Another example of their desire for independence is demonstrated by their underutilization of a large warehouse. This warehouse, built

jointly by the local URC and Canadian aid for pepper storage, currently lies empty. Farmers said they had not asked for such a store; they prefer to use their own facilities in their compounds, where they will have total control over stocks without the danger of pilferage or mixing. They are reluctant to accept major changes to their way of operating, even if small capital expenditure or extra labor is required. Only a few have adopted the improvements demonstrated by the Peace Corps volunteer.

2.1.4 Storage

Dried red peppers store well for one season, as long as they are dried properly and are protected by insecticide powder. They are stored in burlap or woven polypropylene sacks, stacked usually in circular buildings of dried mud bricks with an outside overlay of mud/straw mixture and with a thatched roof. Some buildings are rectangular with flat roofs. Both are satisfactory provided they are well maintained and remain waterproof during the May-July rainy season. Producers protect the produce in storage from insects (particularly termites), by sprinkling a layer of insecticide powder on the floor and walls. The use of such powerful insecticides is banned in many countries, and more acceptable alternatives must be found if peppers are to be processed into products for export. Under present conditions the sacks can be stored without difficulty until September/October, after which time they would start to deteriorate and shrink. During and immediately after the rainy season (May-September), they become flaccid and wilt, but remain acceptable to traders who are short of supplies and know the peppers are from the latest crop. When peppers are kept into the next season (December), traders are forced to reduce their prices, often by more than one half, because of the shrinkage and quality reduction which takes place.

2.1.5 Processing

Other than sun drying, further conventional processing of peppers is not envisaged. In Chad, a significant trade in ground dried peppers has been reported. However this is not to be recommended for Niger for two reasons. First, grinding and crushing is a way of disguising produce which has become infested with insects and/or contaminated with sand, and Niger has no established system or standards for analysis of foodstuff to detect such adulteration. Second, according to local markets in Niamey, consumers buy either dried ingredients (tomatoes, onions, peppers) and grind and blend themselves, or buy such preparations from a few reliable market traders who are known to make their own.

One possible option to consider is the extraction of red color as an oleo-resin using a solvent such as ethyl alcohol or methylene chloride. This process is carried out with commercial success in

Spain and Ethiopia, to yield the natural red color used extensively in Europe and North America in processed foods. This is discussed further in Appendix A.

2.1.6 Transport and Distribution

The transport and distribution of dried red peppers begins on the farm with peppers sold by farmers to various trading intermediaries who take peppers to terminal market destinations in Niger and Nigeria. The means of transport used ranges from small bullock carts (at the farm level) to pick-up trucks and large high-sided lorries with trailers for 5-600 sack capacities for long-distance hauling. Much of the trade from Diffa is directly to Nigeria; shipped to nearby villages where it is consolidated into large consignments for onward transport to Maiduguri. This route usually by-passes the official markets and local buying and sales taxes, making it difficult to obtain accurate estimates of the amounts being traded at any one time.

At each point in the distribution chain, some sacks are held for price rises which inevitably take place towards the end of the season before the arrival of the new crop. There is insufficient organization and concentration in the marketing chain for intermediaries to contrive scarcity, and product flow is fairly orderly. Farmers normally need to trade 50-75 percent of their dried produce early in the season to pay off debts and buy domestic items, mostly from Nigeria. The amount any farmer or trader held at any time was seldom disclosed, as this was seen as being their main trading card. The largest storage capacity admitted by each of the larger traders in Diffa, Maiduguri and Kano was only 1,000 sacks, whilst the largest trader in Niamey said he had about 3,000. Those who manage to conserve some sacks for later trading do make substantial profits.

Trading and distribution aspects vary according to the need of farmers for immediate cash, the amount of pepper each has for sale, the season, the area where the peppers have been grown, and the prices being realized in Niamey and Maiduguri, the two main trading areas for peppers from Diffa. From information gathered at the various markets it appears that the market is split about 50/50 between Niger and Nigeria depending on the season and price differentials.

Apart from the occasional bullock cart, none of the farmers, or traders/middlemen have their own transport; all transport requirements were readily met by hire arrangements. Vehicles used range from small Land Rover loads of 20-30 sacks to high sided lorries of 250-300 sack capacity, sometimes supplemented with a 250-300 capacity trailer. Often, when trading direct, smaller producers combine their consignments to share a vehicle. They then

take a taxi to the main market to sell the goods. Typical scenarios and costs are given in Table 3.

Table 3

Transport and Distribution to Various Destinations

A. Transportation from Gueskeru to Nigeria, by farmers	Cost/Sack
1. Wet season.	
By bullock cart to the river	N 3
To cross river and load on to trucks	N 3
Transport to Maiduguri	N 10
Total	N 16
2. Dry season, when there is no river	
By Land Rover, direct to Maiduguri	N 20
By bullock cart eg. to Gashagar village	N 5
Then large truck to Maiduguri	N 10
Total	N 15

B. Diffa to middlemen/wholesalers in Maiduguri, (approx. 250 km)	Cost/Sack
Diffa to Nigerian collection point	N 5
Large truck to Maiduguri	N 10
Total	N 15
Added costs for transport to Maiduguri:	
Middlemen handling, holding, selling commission	N 10
Cost return taxi to accompany consignment	2 x N 50
Border customs police pay-offs	N 10

C. Diffa to Niamey wholesalers (approx. 1,300 km)	Cost/Sack
Transport cost	CFAF 1,000
To load	25
Local selling tax, Diffa	250
Police pay-offs	50
Total cost	1,325
Orders for Niamey are usually made by large wholesalers who prepay the traders in Diffa for deliveries of 250-600 sacks at a time. Some collections are also made by traders from Agadez, Maradi and Zinder.	

D. Shipping Costs in Nigeria	Cost/Sack
Transport cost form Maiduguri to Kano (615 km)	N 10
Cost to load and unload	N 1
Police pay-offs and 3 State border taxes	N 2
Total cost, per sack	N 13

Note: Trucking costs in Niger are about three times the cost in Nigeria (even before addition of higher taxes): Maiduguri-Kano, 615 km for N 10 (approx. CFAF 150), or 41 km/CFAF Diffa-Niamey, 1,300 km for CFAF 1,000, or 13 km/CFAF.

Gueskeru Market. Although the village of Gueskeru is only 35 km to the east of Diffa town, none of the villagers take their sacks of peppers to wholesalers there, as they save on transport costs by going to Nigeria direct; they also avoid the Diffa market selling tax of CFAF 100 per sack. In the village, farmers trade in a number of ways. They sell to passing traders, larger farmers, or a trader in the village, or go to Nigeria directly to nearby collection villages or Maiduguri itself, according to the circumstances. Officials have tried to impose a local purchasing tax of N 5 (Note: Naira, not CFAF,) per sack on the buyers, to emulate Diffa, but the system failed as all traders by-passed the market.

All transactions are in naira, and often farmers and traders use the proceeds of the sales in Nigeria to bring back millet for the family and for sale in times of shortage, fertilizer and domestic items such as soap and utensils. None of those interviewed ever enter into barter arrangements.

Diffa Market. Wholesaling of peppers was investigated in the Diffa market. When farmers or traders bring produce to the central pepper market they must pay a local selling tax of CFAF 100 per sack. The buyers then have to pay a further tax of CFAF 250 per sack. It was not clear if these taxes are by official government policy, or enforced by local edict. These local taxes are a significant extra burden for the pepper trade to bear, especially when costs of production and transport already compare unfavorably with those in Nigeria. These taxes could have an adverse effect on any export opportunities which are identified.

The pattern and direction of trade from Diffa seemed to depend largely on contacts that traders had developed over the years. One trader, with 10 years of experience, only trades with Maiduguri as he knew the middleman personally and had no contacts in Niamey. A second trader only deals with Niamey for similar reasons. Both traded up to 300 sacks per month during the peak period January-March. A third large trader, with 23 years experience, deals in both places according to the prices being realized and also sells to traders from other areas of Niger such as Agadez, Maradi and Zinder. Most of his trade to Niamey is to fulfill large orders of up to 1,000 sacks at a time received from large traders there. He also sends smaller loads on contract. At peak trading he sends as many as 8-10 sack loads of 500-600 each to Niamey per month. His trade to Maiduguri is always on contract to his chosen middleman and reached 5-6 similar sized loads per month at the peak time this year. One trader also dealt in fresh red peppers in the growing season, December to March, when he could buy them from the farmers. He sent them directly to Maiduguri, (where they realized up to 160 naira per sack), sharing trucks with consignments of dried peppers. He thought they were processed fresh in the town there. Traders in Gueshkeru and Diffa said they had traded in small amounts of dried

okra and coriander earlier in the year to Nigeria, and it had been profitable. (See section 2.4. for coverage of other crops).

Maiduguri Market. The team, comprising the investigator, a former Peace Corp volunteer, who had acted as interpreter, and a Diffa trader who knew the route and Nigerian traders, went directly to Maiduguri, taking a typical route along sand and hard-pad tracks to Damasak. This is a major collection point, especially for local Nigerian produce, and is at the head of a paved road to Maiduguri, the main pepper trading town.

The team was well received in Maiduguri as a result of being accompanied by two well-known traders who run the main pepper market there. Traders take a 10 percent commission on the selling price. For this fee they organize the unloading, obtain the best price, hold stocks for up to a week on the odd occasion when trade is slow, and protect the produce with tarpaulins during the rainy season. No trader interviewed claimed to hold stocks, although they said some of the traders hold small stocks of up to 1,000 sacks for contingencies. When produce is moving fast, in January through March, over 4,000 sacks can be cleared in a day by a single trader with no holding time. None of the traders own transport, this being hired by the subsequent trader. Selling prices are determined by market forces and there are significant quality differentials. At the time of the visit in mid-April, selling prices ranged from 570 naira for good quality to 450 naira per sack for poorer quality harvested at the end of the season when irrigation water had become scarce. With such large quantities being handled, systematic quality control sampling and checking is not possible. However, the traders maintain that they can judge quality accurately by the weight and general feel of a sack, and by the sound it makes when tapped by hand. Suspect sacks are examined more closely. Examples of 570 and 450 naira products were shown, and the testing technique demonstrated.

Produce in Maiduguri arrives from the north, east and southeast of Borno State (renamed Yobe last year). The best quality peppers come from the Komadougou river area, including those grown in Diffa.

The main markets for peppers traded from Maiduguri, in order of importance, are Kano to the west, and Lagos, Ibadan and Onitsha to the southwest. There is very little export/re-export of peppers to Cameroon or Chad, according to the traders contacted. Of the group involved in the discussions, only one trader had sent a mere 30 sacks so far this season. Any exportation to Cameroon is more likely to take place directly from growing areas around Ngala to the east, and Bamba in the southeast of Maiduguri, some 140 and 100 km., respectively, nearer the border.

There is some trade in fresh red peppers during the growing season. This was traced to the local fruit and vegetable market,

where small traders with petrol-driven grinder/mincers prepare sauce mixes of peppers and/or tomatoes or onions to order for sale to local hotels and restaurants. The overall consumption or share of the pepper market was not established during the visit, but it would be relatively small.

Kano Market. The last port of call in Nigeria for the team was Kano, to visit a new tomato paste factory (Appendix B) on the outskirts of town and the main pepper market in the center. Here a similar trading situation exists, with traders concentrating on rapid turn-over, rather than hoarding for higher prices later in the season. As elsewhere some speculative storage was admitted, but the largest capacity declared was only 1,000 sacks, small compared with the overall volume traded. During the wet season some sacks are stored temporarily in small warehouses nearby, but most are left in the open, covered by tarpaulins.

Peppers in the Kano market originate mainly from the Maiduguri market, supplemented by direct trade from Damasak and Guidan, in Northeast Nigeria near the border with Niger. The main destination for peppers from Kano market varies with the seasons. At the time of the visit the urban market around Kano itself was the main area requiring supplies. At other times the south, especially around Lagos, Kaduna and Jos are more significant. Peppers are also traded to the west in Sokoto and Yelwa. Occasionally 270 sack loads have been traded in Maradi. No exportation to Benin in the west was reported.

Traders have no knowledge of peppers or other produce coming directly to Kano from Niger, except of course peppers via Maiduguri. They confirmed the best quality comes from the Komadougou area.

Prices were similar to those in Maiduguri, ranging from 580-450 naira per sack in the main, with poorer quality only realizing 350 naira. One trader, who claimed to be the largest of the 30-40 estimated to be in Kano, has a turnover in excess of 4,000 sacks per day at peak times, which can fall to zero out of season. The turnover of fresh red peppers during the December to March season is even larger in volume than that in dried peppers, peaking at over 5,000 sacks per day for the same trader. The turnover and total storage area for the Kano market as a whole could not be estimated.

Niamey Market. In Niamey, the trade in dried peppers in the main wholesale market is significant. One trader interviewed, who claimed to be the largest in Niger, estimated his total pepper volume through the market in one year at 1,000 MT, or about one-third to one-quarter of the total production of 3,000-4,000 MT for the whole country (as estimated by Ministry of Agriculture for the 1991 season).

There are probably 100 to 200 small-scale wholesale and retail traders in the Niamey market, dealing in Diffa peppers primarily, with other supplies coming from Maine-Saroa, Maradi, Tillaberi, Tessaoua, and around Niamey itself. Most selling is to Niamey proper and surrounding villages, with some peppers going to Tahoua and Agadez. No re-exportation to Nigeria, or countries to the west was reported.

Selling prices at the time of the visit were CFAF 11,000/sack, having started the season at CFAF 8,000. Prices are expected to reach CFAF 20-23,000 by the end of the season. Selling prices during the current year, obtained or expected in the various markets visited, are given in Table 4. Figures in parentheses for Diffa are for the previous season (when the exchange rate was the parallel market price of N 37 to N 45 per CFAF 1000, compared with the current rate of N 67/CFAF 1,000):

Table 4

Retail Pepper Prices for Selected Markets, 1992

		Jan/Feb	Mid-April	Est. Season End
Gueskeru	N	240 - 360	400 - 480	600 - 800
Diffa	N	350	400 - 480	800 - 1,450
	CFAF	5,500	6,000 - 7,200	12,000 - 22,000
	CFAF	(3,500-5,500)	(5,000-5,500)	(20,000)
Maiduguri	N	350 - 400	450 - 570	800 - 900
Kano	N	250 - 450	360 - 580	900 - 1000
Niamey	CFAF	8,000	9,000 - 11,000	20,000 - 22,000

2.1.7 Constraints

Most of the constraints identified were related to production. Farmers in Gueshkeru mentioned several major constraints, including: lack of sufficient water often curtailing the season by up to a month, pumps and especially spares, pesticides, and herbicides.

The increasing cost of fuel to run the irrigation pumps is also causing concern, as the increase in the price of sacks, and

difficulty in obtaining sufficient compound fertilizer. As no fencing materials are available and the felling of trees is banned, crops remain unprotected. A permanent watch has to be maintained during the day to ward off grazing ruminants; this is not seen as a major constraint, but more a way of life.

Farmers are very concerned that any significant increase in the already extensive use of pumps for weekly flood irrigation will lead to local water shortages. This year for example, even though the rains were good, harvesting was curtailed by 2-3 weeks in some areas around the swamps as the surface water had run out. In some marshy areas temporary earth dams are built to retain water when the river starts to subside, to make water available for a longer period.

Few farmers can afford to buy pumps for themselves, so pumps are normally shared among five to seven growers. (A special aid program in 1991 obtained Yamaha pumps in Maiduguri at a discounted price of CFAF 110,000 each). Those who have pumps which are a few years old complain about the cost of repairs, lack of spares, and technicians to effect repairs. Pump operators know that pumping rates are reduced when air is drawn into the system, for a vortex forms around the inlet pipe. Pump Operators attempt to prevent this by maintaining a mat of reeds around the inlet. They were unaware, however, that the main cause of wear on the stators and rotors in their centrifugal pumps is by cavitation -- the drawing in of air bubbles into the system. They were also unaware that centrifugal pumps operate more efficiently when the unit is placed as near as possible to the level of the water supply, leaving the lift to the field on the discharge side of the pump. This procedure also reduces the risk of drawing air into the feed pipe from above water level.

The unpredictability and severity of aphid attacks is a cause for great concern to farmers, who can lose up to 80 percent of their expected crop in very bad years (eg. 1987 and 1990). It seems that the aphids usually start in the east, and follow the prevailing wind towards Diffa and Maradi. At the moment there is no early warning system or emergency plan of action to deal with an outbreak. It seems that when the problem asserts itself the local Ministry of Agriculture agent distributes a drum of insecticide concentrate to the relevant area for farmers to dilute and use. This system is far from satisfactory, as has been described in section 2.1.3. above. In any affected area, all crops must be efficiently sprayed at least twice, with the correct time interval in between, and preferably three times to prevent cross and re-infestation. It is likely that this can only be achieved by having a good early warning system and well trained and coordinated teams of local farmers, properly equipped to react quickly at the onset of an aphid attack.

In many areas around Diffa, a pernicious grass-like weed has established itself in the pepper plots. Usually it is rather sparse and is apparently kept under control by goats and other ruminants during the rainy season, and termites when the weather is hot and dry. The grassy shoots come from a small bulblet or corm about 10-15 cm. below the surface. This makes removal by digging practically impossible; weeding by hoeing seems to worsen the situation by causing the weed to spread more quickly. When well established it adversely affects the pepper yield, and some farmers have resorted to moving up to 50 percent of the area under peppers every 2-4 years to new plots in an attempt to overcome the problem. Since the most suitable areas near the water have already been used for pepper cultivation, this attempted solution can only be used for a limited period.

To date no systemic treatment has been tried. It is suggested that controlled experiments with systemic weed killer treatments be carried out, when the growth is at its peak, to kill the bulblet. The land may need to be left fallow for a year to enable several applications to be made, without affecting pepper crops. The grass does provide one small benefit in stabilizing the small banks of the irrigation channels against erosion. Experiments should include alternative measures to stabilize these banks.

Although growing and harvesting peppers is labor intensive, it is not reliable or profitable enough to enable hired labor to be used, as happens with onions. Instead the work is either carried on within the family, or is shared with an outside partner who shares the crop, costs and inherent risks.

In the good years, when peppers are being harvested (every two weeks), there can be a bottleneck with stalk removal from the piles accumulated after picking, prior to being laid out to dry. If the stalks are not removed promptly after picking, basal stalk rot can ensue, causing losses. More frequent picking would reduce the volume to be handled on any given day; de-stalking could be done immediately, and drying could be initiated much sooner after harvest. By removing the need for double handling, this change could also reduce the risk of contamination. The removal of the stalk also increases the drying rate. The buyers expect peppers to be de-stalked, and would severely discount shipments that do not conform to this practice.

Other constraints which may arise in the future are:

a) The spread of a virus disease from locally saved seed, which was reported during discussions with Professor Preshar at the Soil Laboratory, INRAN, Niamey, as having severely curtailed the production of peppers in the Maradi-Zinder area in recent years;

b) Soil salination, which is said to be present in some areas east of Diffa (but was not confirmed by farmers in Gueskeru);

c) Planned World Bank financing of a $68 million loan to promote the use of 40,000 small-scale irrigation pumps in the Northern valley bottom (fadama) areas of Nigeria would inevitably involve the production of peppers, and thereby pose a potential threat to pepper sales from Niger;

d) Export constraints to the countries to the west of Niger may arise because of the high transport costs compared with Nigeria (currently CFAF 4.1/km and CFAF 1.3/km respectively). The imposition of market taxes amounting to CFAF 350 per sack may also be detrimental in the future; and

e) The presence of persistent pesticides, used during drying and storing on the farms, which are banned in many countries. This ban would prevent any exportation of dried peppers to niche markets which may be identified in the future (e.g. ethnic West Africans living in Europe).

2.2 Tomatoes

2.2.1 Background

Tomato production in the dry season has become an important economic activity since the 1984-85 drought when off-season production was encouraged. The most important production zones include the departments of Maradi, Tahoua, and Agadez. Production has ranged from 29,175 MT in 1987 to a high of 80,951 MT in 1990, while last year's production was reported to be 44,592 MT. Variation in production can be attributed to two factors. First, data tend to have large margins of error due to difficulties in accurately measuring production. Second, farmers overproduced for several years and experienced market gluts which have caused them to scale back their plantings.

The lack of market outlets for tomatoes, which grow well in the off-season in Niger, has prompted this study which examines the potential for expanding markets through improved methods of post-harvest handling, processing, and distribution.

2.2.2 Demand

Since tomatoes are a basic staple of the Nigerian diet, demand tends to be strong especially during harvest time when prices are relatively low. As supplies of fresh tomatoes decline in the period following harvest, and prices rise, consumers shift to dried tomatoes and canned imported tomato paste. In Niamey, urban

consumers tend to prefer imported paste to locally-produced dried tomatoes (USAID, 1991). In rural areas, farmers dry tomatoes for sale in the local market, but they also tend to keep a significant quantity for home consumption.

Accurate market prices are difficult to obtain because tomatoes do not have a long shelf life. Traders must turn over their product rapidly and will discount heavily tomatoes they have held for even just a few days. Price data are further complicated by the fact that tomatoes tend to be sold in different sized baskets or metal containers. In January and February 1992, fresh tomato prices ranged from CFAF 25 per kg to CFAF 100 per kg in retail markets in the Zinder and Maradi departments, according to data obtained from local agricultural offices.

Over the last two years, fresh wholesale tomato prices during harvest periods have ranged from less than CFAF 40/kg in regional markets near zones of production to about CFAF 125/kg in Niamey. Scarcities of fresh tomatoes begin to occur on the market with the onset of the rainy season in June and July and consumers switch to dried tomatoes as fresh become unaffordable if not unavailable.

2.2.3 Production

Tomato planting begins at the end of the rainy season in September with the first harvested crop appearing on the market in November. Volume increases each month to a peak during the period between February and April. Two basic kinds of tomatoes are grown, the round tomato sometimes known as the "Caribbean" and the plum tomato known as the Italian "Roma".

While tomatoes are produced in all departments of Niger, the most important producing area is Tahoua, followed by Agadez, Maradi and Zinder. Diffa's tomato production is negligible. Table 5 below shows the breakdown by department of area in production, yield and total production for 1990 and 1991.

Table 5

Total Off-Season Tomato Production

	Area (ha)		Yield (MT/ha)		Production ('000 MT)		
	1990	1991	1990	1991	1990	1991	Change
Agadez	455	446	23.7	24.2	10.8	11.6	+0.8
Dosso	142	35	9.6	19.7	1.4	0.7	-0.7
Maradi	768	393	18.0	14.0	13.8	5.5	-8.3
Tahoua	1868	1209	21.3	12.9	39.7	15.6	-24.1
Tilla-bery	230	119	24.9	10.5	5.7	1.6	-4.1
Zinder	248	297	38.1	33.5	9.5	9.9	+0.4
Total	3711	2499	21.8	17.8	80.9	44.6	-36.3

Source: Rapport Annuel de Campagne de Cultures de Contre Saison, 1990-1991; Résultats Définitifs de la Campagne Agricole, 1990. Ministère de l'Agriculture et de l'Elevage, Service des Statistiques Agricoles.

According to the national agricultural statistics, 1991 off-season production of tomatoes declined by over 36,000 MT, or almost 50 percent of the previous year's production. About 90 percent of this decline occurred in Maradi and Tahoua where lack of adequate water for crops was a major problem. In Maradi, the groundwater levels were low and the annual flooding of the Goulbi river was at low level. In Tahoua, lack of water combined with labor shortages resulted in lower production. As noted in Table 5 area in production in Tahoua fell off by a third, from approximately 1,800 ha in 1990 to 1,200 ha in 1991, and average yields declined by almost 50 percent. In Maradi, the area in production dropped almost 50 percent, while yields, which were already low at 20 MT per hectare, eroded to 14 MT per hectare, barely above the approximate 13 MT per hectare realized in Tahoua. These figures for area in production, yield, and total production should be used with extreme caution since tomato production tends to occur in very small plots and yield variations are substantial.

Tomato Production in Filingue. In Filingue, one farmer visited was growing tomatoes in double rows, with stakes for support. He had received rudimentary training from the local extension agent, who was present during the visit. Varieties were being grown in the same fashion in mixed rows. (Bush varieties

should be planted with wider spacing to enable better spread). The farmer said he grew both indeterminate (cordon) round and determinate (bush) varieties, often from seed he had saved himself, so that when he went to market he had the smaller plum tomatoes, from the bush variety, to sell at CFAF 5-10 each, and the larger round fruit at CFAF 15-30. Some of the farmer's tomatoes were growing in the dappled shade of a type of thorn tree and were healthier than those growing in the full sun, which were showing evidence of scorch and were also tending to wilt when the visit was made around mid-afternoon. The farmer had received few instructions on finer points of tomato growing from the local extension agents, who said more detailed training was required for all farmers. He said there was also a need for more varieties of disease resistant seeds to be made available, since virus infections were becoming common. Many of the "round" tomatoes were badly misshapen, a problem which occurs with increasing frequency as seeds are kept over from year to year without replacement with new varietal material.

2.2.4 Storage

Fresh tomatoes are highly perishable, and no attempt is made to store them. Traders purchase fresh tomatoes either in the fields and take them to market the same day or they buy from producers who haul them to markets in lidded, wicker baskets or metal containers. Since tomatoes are harvested ripe, wholesalers have to resell to retailers right away, and the latter have only two to three days to sell to consumers, as they have no refrigerated storage facilities.

Producers dry the tomatoes they cannot sell fresh in their fields. Dried tomatoes are kept for household consumption or for sale later in the year when prices go up. In the more remote production areas, producers may dry the majority of their crop. Dried tomatoes are stored in burlap sacks for sale out of season.

Drying methods are very rudimentary. Typically, farmers cut tomatoes in half and spread them out over the ground without washing them or providing any protection from dirt or other surface or wind-borne adulterants. Both worms and insects feed on the tomatoes as they dry, resulting in very high losses as well as off-flavors in the dried product. Growers who produce mostly for the fresh market dry the lowest quality portion of their crop, so even the initial quality of the dried fruit is poor. As a result, much of the dried tomatoes found on the market are of poor quality. Good quality dried tomatoes were receiving a premium of CFAF 1000 per bag in the wholesale market, and CFAF 100 per tiya retail. Traders identified Agadez as the source of good quality dried tomatoes.

2.2.5 Processing

For any processed products, packaging materials and machinery would be required, all of which would need to be imported.

Tomato production for processing requires a product that is characterized by high soluble solids (Brix), high viscosity and red color. Tomatoes for processing are usually the determinate type, which are the kind most widely grown in Niger. However, apart from drying, there is little processing of tomatoes except for a few small-scale cottage industry projects. One project is producing an italian tomato sauce for sale in Niamey supermarkets. The cost is relatively high, CFAF 550 for a 370 ml jar. This is out of reach of the majority of the population, and the product quality is variable.

Factory processing of tomato paste is discussed in Appendix C and it is our conclusion that the complexity and costs of such operations make it a very low potential option, especially in view of cheap imports of Italian tomato paste, the comparatively low raw material costs in Nigeria, and the large amounts of energy required that, in Niger's case, would have to be imported.

2.2.6 Transportation and Distribution

The transportation of fresh tomatoes to market is handled mostly by small-scale rural assemblers, both men and women, who buy from several bags to several tons for resale in regional markets. Most fresh tomatoes sold in the regional markets are from producing areas either on the outskirts of market towns, or within 50-100 kms. In Maradi, for example, there is extensive garden cultivation in the Goulbi river bed that runs alongside the town. During harvest, farmers take tomatoes directly to the market. The marketing of fresh tomatoes is very informal, involving many small traders.

Long-distance trade of fresh tomatoes is not strong, although localized shortages may provide opportunities for substantial profits for traders who can move products long distances quickly, especially as the season winds down and prices double or triple. However, consumers shift to dried tomatoes when fresh ones are either too expensive or unavailable, beginning in May and June.

Dried tomatoes are traded through a different market channel than fresh tomatoes, and in fact are usually sold with dried Diffa peppers at the wholesale stands in the market. In Maradi, one of the larger wholesalers traded dried tomatoes and peppers in addition to his traditional business in dry cereals such as millet and sorghum. He explained that he could easily store dried tomatoes and peppers in his existing warehouse along with other dried goods.

Dried tomatoes this year are selling for CFAF 3,500-4,500 wholesale per sack in the month of April. Traders report prices for fresh produce remain stable during harvest and for some time afterwards (February-April) until it becomes scarce, usually beginning in May and peaking in August and September. Last year, prices during harvest were about the same as this year and rose to CFAF 18,000 per sack during the August-September period.

2.2.7 Constraints

Production constraints. The major production constraint is the availability and cost of water for irrigation. Water lifting is very labor-intensive, requiring 6,000 person-hours per hectare. Not only is watering costly, but labor shortages develop during peak periods of demand for services.

Diseases and insects are also a problem which result in reduced yields and lower profits. The regular availability of pesticides and application equipment would have a major impact on production, as would the introduction of new varietal material.

Marketing constraints. Tomatoes tend to be produced and harvested at the same time, resulting in market gluts and depressed prices. Fresh tomatoes are fragile and difficult to market without incurring high losses and high discounts due to reduced product quality. Growers who dry most of their production incur losses because drying techniques are poor and infestation heavy. While the market for dried products is more stable and extends through September, demand is price elastic due to the availability of canned paste which consumers can substitute for fresh or dried tomatoes. An extension on either side of the main marketing season may be possible, through the use of early and late maturing, hybrid disease-resistent varieties.

Unlike Diffa peppers, dried tomatoes are not consumed widely in Nigeria and therefore are not exported in any significant amounts. While dried tomatoes are sold along with dried peppers at the wholesale and retail level within Niger markets, the market is more limited in the region. In the southern regions of coastal countries such as Côte-d'Ivoire, for example, dried tomatoes are simply not consumed.

Processing Constraints. The only processing carried out in Niger is sun drying by slicing by hand and spreading tomatoes on the ground, usually with no protection from sand or insects. This technique could be improved by using drying racks, as described for the peppers.

Other processing, to make paste for example, cannot be recommended. One major reason is the high price of fresh fruit compared with Nigeria -- CFAF 50-100/kg compared with CFAF 9-11/kg

in Nigeria (Appendix B). About 10 kg. fresh tomatoes, of the correct high solids varieties, are required to make just 1 kg of 28% tomato paste. The raw material cost for tomato paste in Niger would therefore be CFAF 500-1,000/kg, before any other processing and capital depreciation costs were added. Other factors mitigating against paste production in Niger are the quantity of tomatoes required (a minimum of three, or preferably seven MT/hr for 14-24 hrs/day, for 3 months during the season), the high cost of fuel for the evaporation and electricity to operate the plant. In all these aspects, Niger is unable to compete with neighboring Nigeria, where labor is also much cheaper.

2.3 Potatoes

2.3.1 Background

To improve the self-sufficiency for foodstuffs during the dry season, potatoes were one of the crops introduced in the 1980's, using seed imported from France. Since the introduction of potatoes as an out of season crop, potatoes have become a major source of revenue for the farmers in the relevant areas. There are now four main areas of production, according to Ministry of Agriculture: Filingue, Tahoua/Maradi, Zinder and Agadez.

Official travel restrictions prevented the team from visiting the Agadez area. A visit was made to the next most important area, Filingue.

2.3.2 Demand

The demand for potatoes in the growing regions is limited. In Filingue for example it was reported that only about 20% of production is consumed locally, the rest being sent to Niamey market. Even in Niamey, sales have been sluggish as potatoes tend to be consumed by the expatriate community and the local elite, many of whom had not received their government salaries for three months at the time of the survey. Local potato growers also have to compete with imports from Nigeria which are typically of a larger size. A high priority should be to increase the average size of Niger produced potatoes presented to the market.

2.3.3 Production

It is estimated that total production for this year, 1991/2, will be reach approximately 7,000 MT overall. Figures on annual production in previous years are given in Table 6 below, by region:

Table 6

Potato Production in Niger, 1987-91, by Region (in metric tonnes)

Region	1987/88	1988/89	1989/90	1990/91
Filingue/ Dosso	5,400	3,300	1,800	1,800
Tahoua/ Maradi	2,100	1,800	1,200	1,200
Zinder	2,800	1,400	500	n.a.
Agadez	1,200	8,400	5,400	6,500
Total	11,500	14,900	8,900	9,500

The table shows that three of the areas have had a steady decline in production, while production in the Agadez area has increased since the 1987/88 season so that in recent years it has consistently produced over 50 percent of the total reported harvest. The reasons for the decline in elsewhere were not documented, although other attractive off-season crops with better markets may account for the change. In Agadez, it appears that the supply of good seed from Tablote, 140 km. to the north of Agadez, and the existence of a good producers' cooperative in the area (Ref. PID Technical Annexes III), led to the growth in production.

In the Agadez area, two cropping seasons have been reported, with harvest in January-March and September-October. In other areas potatoes are only grown in the period which culminates with harvest from January to March.

In Filingue, potatoes are usually sown in October/November for harvesting from January-March. According to the local agriculture service, 26 ha were planted with potatoes in the Bonkoukou area, out of a total of 34 ha in Filigue as a whole, which in turn represents almost 10 percent of the cultivated area. Yields obtained are 33-40 MT/ha depending on seasonal conditions, relative freedom from diseases, quality of the seed, and availability of compound fertilizer.

The approximate area of the small-holder farm visited was 0.3 ha, of which about 0.1 had been used for potatoes. Of the rest, about 0.1 was being used for tomatoes with cassava, interplanted with a few carrots, sweet peppers and eggplants on the remainder. Irrigation was by means of a bucket filled from a well about 7

meters deep. Out-of-pocket costs incurred and returns for the potato production based on the recent season are shown in Table 7:

Table 7

Potato Production Costs and Returns (1992)

	CFAF
Seed potato, (probably from Nigeria) 40 kg @ 250	10,000
Sacks, (recycled jute bags), 3 @ 350 each	1,050
Transport to Niamey, 3 sacks @ 750 each	2,250
Return taxi fare, to accompany the sacks	1,000
Total expenditure (no fertilizer used this year)	14,300
Amount sold in Niamey, 3x100 kg sack @ 9,000 each	27,000
Gross profit	12,700
(Qty retained for family, approx. 50 kg (14% of production).	

The farmer visited said he had more land available, but considered he was cultivating as much as he could manage with the bucket irrigation system, without employing other helpers. Three other farmers present agreed. They appreciated that for pump irrigation to be affordable five or six farmers would need to share the facility to disburse capital costs. Even if a pump was obtained, concern was expressed over the cost of fuel. The farmer felt he could increase the production from his existing plot using the present system if disease-free seeds and adequate pesticide and fertilizer (manure and chemicals) could be made available.

2.3.4 Storage

Storage of potatoes in Niger is problematic since producers rely on very rudimentary methods, either burying potatoes in the ground, or keeping them in open-air covered shelters, both of which result in high losses.

Most local farmers are not prepared to store potatoes for long periods of time because of the risks involved. Most keep potatoes for no more than 1-3 weeks until sufficient quantities are assembled to justify a shipment by truck to the Niamey market. In view of the high temperatures reached at harvest time (40+ midday, 30+ at night), potatoes are susceptible to high losses from diseases such as 'brown heart', a common problem encountered in the tropics. The only way to prevent 'brown heart' is to have a properly designed and controlled storage system made available

(Appendix C). Sprouting is not a problem before September/October, by which time seed potatoes are being planted.

In Filingue, the agricultural service reported that potato prices realized in Niamey during the harvesting season were CFAF 100-125/kg (compared with CFAF 90 received by the farmers). For potatoes stored successfully for 2-3 months from the end of the season until July/August, higher prices could be anticipated. The maximum retail price of potatoes was about CFAF 350/kg according to stall-holders in the Niamey *petit marche*.

Increased storage of potatoes might help to increase local consumption of current production, and increase revenues from marketed production (when prices are higher). In Felingue, current production is about 1,000 MT, and investment to improve storage facilities would allow for a higher proportion of this production to be sold at higher prices. If 500 MT of stored potatoes were sold later in the marketing season in Niamey for CFAF 100/kg more than during harvest time, this would represent CFAF 50 million in additional revenue, less the costs of storage.

For a storage program to become operational, it would be necessary to train both farmers and those operating the storage facilities (see Appendix C). A small experimental 50 MT unit is suggested for initial controlled storage trials. If it was deemed feasible, a parallel experiment could be run, storing potatoes in an excavated clamp. The organizational issues of potato ownership and facility operations would require careful attention and active grower participation.

The results of such experimental trials could benefit producers in Agadez as well, where the need for good storage facilities has already been identified (Ref PID III).

2.3.5 Processing

Although potatoes can be processed commercially into starch, instant powder, flakes, extruded snacks, crisps, frozen and/or oven-ready french fries and canned products, such processing for the near future cannot be recommended for Niger. A commercially viable processing plant requires a minimum input capacity of four to five tons of fresh potatoes/hr, of the correct varieties, grown and stored under the best conditions to have the correct properties. The most critical requirements for processing potatoes into french fries and chips is reducing the sugar content in the tuber and having a proper ratio of these sugars to the amino acid content. These properties are necessary for a consistent brown color to be obtained during processing or subsequent frying.

In addition to the correct chemical properties, it is essential to have large, disease free, uniform potatoes with a thin

skin, no eyes and minimum mechanical damage, to keep preparation and processing losses to a minimum. A regular supply for 250 days a year, to enable 14-24 hrs/day running is also a desired aim, to keep capital costs within reasonable bounds.

There are several stages in potato processing, starting with sorting, cleaning, peeling and sulphiting to prevent enzymic browning. This initial preparation is followed by a number of operations depending upon the final product(s) to be made. These can include, in various orders, dicing, slicing, blanching to kill of enzymes, sulphiting, pre-cooking, flaking, dehydration, and canning. Effluent disposal of the waste is also a costly problem, due to its very high biological and chemical oxygen demand (BOD & COD). Production costs and size of operations would not be consistent with the purchasing power and the size of the market at the present time. Some regional exports might be envisaged, but this strategy would confront the cost disadvantages of production in Niger discussed in earlier sections.

Besides processing, there is also the need to package the products for protection, distribution and sale, and Niger has no packaging industry to support this need. All packaging materials would therefore have to be imported, along with the required packaging (and processing) equipment.

The only processing which can be envisaged is on the domestic, hotel, and restaurant scale, to make french fries and potato crisps, for which large potatoes 5-8 cm in length are needed to minimize peeling and slicing losses, and frying oil usage.

Typical processing losses when preparing good quality large and medium sized potatoes for restaurant use are, 20-30 percent when abrasive peeling for boiling, 10-20 percent for french fries, and 8-15 percent for chips. The small potatoes seen in the market will increase these losses by up to 50 percent.

For chips and french fries, the reducing sugar content should not be below 0.25 percent; otherwise they will tend to be too pale in color, whilst a content above 1.2 percent will give too dark a color.

The specific gravity of the tubers also has an effect on performance, especially with regard to oil uptake during frying. For example a typical oil uptake when making chips from tubers with a specific gravity of 1.07 is around 40 percent, whereas if specific gravity is 1.09, oil uptake is reduced to about 32 percent.

2.3.6 Transport and Distribution

The production area of Filingue is only 175 km from Niamey. Farmers interviewed transport their production directly to the Niamey market. Two of the other production zones, Zinder and Tahoua, are located on or near good major paved roads within a days drive to the main domestic market in Niamey. The growing area of Tablote is 140 km north of Agadez, served only by an unpaved rough road. Agadez itself is 1200 km from Niamey. Despite these distances, and the resulting high transport costs, the local farmers, for the most part Tuaregs, manage to market their produce through seven well-organized co-operatives and numerous producers' associations (PID III).

Besides Niamey, the other principal terminal markets for fresh potatoes are Agadez, Zinder, Tahoua, and Maradi. In Niamey and Maradi, producers compete with potato imports from Nigeria, which at certain times account for over 60 percent of the market.

2.3.7 Constraints

Despite the fact that potatoes have not become a regular part of the diet of most Nigerians, the seasonality of supply prevents growers from serving the demand that does exist. The major constraint to expanding the potato sector is the lack of storage facilities to enable produce to be kept for out-of-season sale. (See Appendix C). This would enable growers to realize higher overall prices and to tap latent demand in the off-season.

The lack of good quality seed potatoes is another constraint causing concern. It has been reported that the Tablote area produces excellent seed potatoes. This area should be encouraged to produce good quality seed potato for sale to growers elsewhere, recognizing that this product normally commands a significant premium over commercial potatoes. Technical assistance in seed potato production techniques would be an important part of this program, along with measures to promote adoption of this planting material by growers elsewhere in Niger.

The risk of soil-borne diseases in potatoes is such that one would normally expect to have a ban on the sale of uninspected or uncertified seed material. However, we are reluctant to recommend such a measure at this stage for Niger because of the tendency for these measures to become an opportunity for informal taxation and market control. In the first instance, a program of grower education and the promotion of good seed material should be undertaken, together with the development of a certification program. Recommendations for phytosanitary procedures have been made previously (Ref. PID III). Then, as price premiums are established for good seed potatoes, and a reasonable supply is established, some form of regulation may be imposed. This approach

poses more of an agronomic risk than outright control of seed production, but it represents a compromise that avoids the risk of prohibitive intervention.

Currently all potatoes are sold unsorted, with a high percentage being very small (less than 2 cm diameter). It is likely that the present sluggish demand could, in part, be overcome if potatoes were sorted, since small potatoes yield significantly more waste unless simply boiled or roasted. Small potatoes are more time consuming to prepare, and are not suitable for slicing into french fries -- the major potential for use in hotels and restaurants.

2.4 Other Crops

2.4.1 Onions

Onions have already been studied in detail (Ref. PID and Niger 88/89) in which consumer demand, production, marketing systems, government intervention, and future research were discussed.

In the course of fieldwork in Côte-d'Ivoire, the team established contact with Copral-Nestle to discuss the prospects for the sale of dried onions/onion powder (see Appendix F). Copral-Nestle has indicated that they are, in principle, interested in buying this product from an African source as a substitute to the 100 tons per year presently imported from the United States and Europe. However, the product specifications required for this market could only be met by a modern plant that would require significantly more than 100 tons of finished product to justify the capital cost, and would probably require energy and other foreign exchange operating items that would bring its viability for Niger into serious question at the present time.

Given that dried onions are a high value product, it may be feasible to use solar drying techniques in Niger, even though capital costs are high (see Appendix D for information on onion drying plants). Tunnel driers using solar-heated forced air are being used with some success in Southern China. This innovation could be examined further.

Europe itself is also a potential market for dried onions, a significant amount of which is imported from the USA. To reach each of these potential markets, the dried onion produced will need to meet strict bacteriological, colour, and purity standards.

Processing of dried onions is covered in Appendix A. Closer investigation may indicate that the capital cost of solar drying is too high for present volumes and prices of onions. In that case an alternative location, just over the border in Nigeria but within easy reach of the main onion growing area around Galmi, should be

considered, to take advantage of the low cost of fuel which would be used on a less expensive design of a conventional dryer.

2.4.2 Garlic

The main area for garlic is in Agadez Department, around Tablote, over 1,400 km from Niamey. This area produces over 90 percent of the garlic grown in Niger (Ref. PID III). As this area was closed to the team, a detailed assessment was not possible. However, as was confirmed by the visit to Abidjan, and previously reported (PIP Niger 88/89, Annex A), garlic from Niger is not competitive in terms of price or quality with imports from Europe, China, Egypt, and South America.

Garlic should be considered as a potential crop for steam distillation for the recovery of essential oils, as discussed in Appendix A.

2.4.3 Tropical Fruits

Compared with the neighboring countries of Nigeria, Côte-d'Ivoire, Mali, Burkina-Faso, and Benin, Niger produces small quantities of a limited range of tropical fruits, although data on the area under cultivation and amount produced are not available in any official reports.

A fruit processing factory does not look promising for Niger in the near future, until the country can ensure a regular supply of good quality uniform fruit, which would be required for 250 days per year.

The processing of tropical fruit has been successful in Côte-d'Ivoire and Burkina Faso, for example, where continuous processing seasons are possible using pineapple, papaya, mango and guava. The juice extraction and subsequent fruit drying mentioned in Appendix A are appropriate for these countries.

2.4.4 Okra

Okra is an off-season crop grown in Diffa, where it is planted, harvested, prepared and dried, and sold in the local market mostly by the women who grow it. In Gueshkeru, it is inter-planted with peppers, along the small banks of the irrigation channels, and is harvested shortly before the pepper crop. The harvested crop is cut into short segments and sun dried on the ground. Women keep much of the okra for household consumption, but small surpluses are sold to supplement family income.

Traders in Diffa and Maiduguri trade okra profitably albeit in relatively small quantities. Okra is therefore seen as a crop which has potential for expansion, and is worthy of a more detailed appraisal. It must be realized, though, that extensive cultivation may clash with sweet pepper production. Account must also be taken to its susceptibility to aphid attacks.

3.0 RECOMMENDATIONS

3.1 Sweet Peppers

A plan of action to combat aphid attacks, which can reduce yields by up to 80 percent in some years, should be implemented, and include plans for setting up an early warning system.

In order to combat the grasslike weed that is becoming prevalent in areas around Diffa, an efficient herbicide treatment is urgently needed. Farmers are now required to continually move plots to mitigate against yield losses.

An alternative to the use of persistent pesticides such as lindane, which are banned in many countries, should be found as soon as possible.

One step to reduce insect damage and other forms of contamination would be to use drying racks on short legs, to raise the peppers away from termites, instead of spreading pesticide on the ground cleared for drying.

A study should be made of the potential for extracting oleo-resins from dried sweet peppers in Niger, using solvent extraction techniques similar to those already employed in Spain and Ethiopia for example. This produces a concentrated natural red color used in the food processing industries in Europe and the USA. This process can be done on a modest scale if the product is to be refined subsequently elsewhere, and plant fiber and other extraction residues can be used as fuel on a chain grate stoked boiler to provide all the heating energy required for processing.

3.2 Tomatoes

Better quality dried, sliced tomatoes would be obtained if drying racks were used, to raise them away from crawling pests and dirt. Attention to hygiene in fruit preparation would reduce drying loses and off-flavors.

Processing of tomatoes into concentrated paste is not seen as an option for Niger in the near future, because of the high cost of fresh fruit, and electricity, compared with neighboring Nigeria.

3.3 Potatoes

It is not possible to store potatoes for more than one to two weeks in the ambient conditions in most potato growing areas. A pilot test should be undertaken using refrigerated storage units,

for example reefer containers partially recessed into the ground or otherwise protected from direct sunlight and warm wind.

The lack of sufficient, good quality, certified seed is a cause for concern. A study should be conducted of the feasibility and approach to develop the Tablote area as a source of seed material, with a long-term view of introducing a system of certification and distribution control. In the meantime sufficient certified seed should be imported from Europe, and distributed in growing areas at a competitive cost, to discourage growers from using uninspected local seed potatoes. This urgent action is required to prevent any long term contamination of existing potato growing areas.

Efforts should be made to increase the size of potatoes presented to the market, through husbandry practices, improved inputs, extended growing season where heat is not a factor, and selection and grading of harvested product.

3.4 Onions

A feasibility study is recommended for solar drying onions to meet market opportunities in Côte-d'Ivoire and eventually Europe. Stringent quality standards should be insisted upon from the outset. As a comparison, the study should include the alternative of oil-powered conventional drying in Nigeria, where fuel costs are much lower, but where raw material supplies could still originate in Niger.

3.5 Other Processes

Steam distillation can be used to obtain high value-added essential oils from onions, garlic, and spices. Crops produced in Niger could be shipped to Nigeria for conversion to essential oils, and thereby take advantage of the very much lower energy costs there. An investigation of potential products should examine those crops like onions for which Niger already has a competitive advantage.

APPENDIX A

PROCESSING OPPORTUNITIES IN NIGER

No commercial food processing takes place in Niger, apart from two brewery/soft drinks bottlers, in Niamey and Maradi, and a dairy in Niamey. A cottage scale producer of jams and sauces in Maradi has reportedly closed down. One missionary-supported cooperative is producing a similar range of products, on a similar small-scale for sale in Niamey supermarkets.

The only significant conservation taking place is the drying of sweet red peppers, tomatoes, and some ginger, onion and okra. This drying is rudimentary fashion, with produce placed in the sun on the ground by producers.

Niger has no centrifugal sugar, vinegar, or salt manufacturing industries to produce those basic ingredients needed for jams, preserves, sauces, or pickles. Neither has it any packaging industry to make the necessary tins, jars, bottles, bags, and boxes required to support the industry. All of these items would therefore have to be imported. There is also an acute shortage of trained, experienced technologists, scientists and commercial managers to run such businesses. Perhaps of even greater significance is the fact that there is neither the stable supply of consistent raw material, nor the large consumer market to support this type of activity. A conventional agro-based processing and packaging industry is therefore unlikely to be developed in Niger in the near future.

However, there could be opportunities to develop the following niche markets of intermediate processed products:-

Potential Market for High Quality Dried Onion Pieces and Powder

Niger already has a good reputation for the production of good quality onions from Galmi, and a suitable climate for solar drying techniques to be used. There is a good market in Europe for high quality dried onion pieces and powder, a significant amount of which is currently imported from the USA. A small market for good quality powder has also been identified in Côte-d'Ivoire, where imports from Europe of 100 MT/annum have been reported, (equivalent to at least 1,000 MT fresh onions), to supply a bouillon cube factory (Appendix F).

An analysis of Galmi and other varieties of onion should be carried out, possibly in conjunction with the Société Ivoirienne de Technologie Tropicale (I2T) in Côte-d'Ivoire, which already has impressive and modern experimental facilities. Analyses could

establish the suitability of Niger onions for drying, taking into consideration seasonality and the effects of storage on quality.

This research program should be supported by a detailed feasibility study on the potential for controlled solar drying. This could be done with the assistance of ONERSOL (Appendix E), where there are local personnel with experience of utilizing solar energy. We also recommend that the experience of processors in Guangdong Province in Southern China be drawn into the study, particularly with respect to drier designs that could reduce the capital intensity of the process.

Other crops such as tomatoes could also be considered for solar drying, but the volume required for export is likely to be very small.

Current locally dried tomatoes, and especially onions, are usually prepared from poor quality raw materials which have not found a place in the fresh market. These products therefore do not carry a quality image, and sales of high quality (more expensive products from a new production unit) may not have a local outlet.

Although a controlled solar drying installation costs significantly more than a conventionally designed unit using fossil fuels or electricity, this method may be the most cost-effective alternative due to high energy in costs in Niger. Once installed, the operating costs of a solar dryer are probably lower, although technical skills required for supervising on-going operations might be costly. Alternative methods need to be analyzed and compared in terms of technical and financial feasibility.

A solar drying unit should be designed so that the air used for drying is closely controlled (correct temperatures, humidity and flow rates) to enable the optimum drying program to be maintained. A heat sink facility should also be an integral part of the design so that the excess heat generated, usually around early afternoon, could be saved for later use. This conserved heat is usually used in conjunction with conditioning bins which are utilized to complete the drying of produce from the dryer proper.

When drying fruit, vegetables, or meat, care must be taken to chose the right conditions. Too fast a drying rate can lead to case-hardening, whereby the pieces are dried too quickly to form a hard outer skin which greatly slows down the rate of removal of moisture from the center. Drying too slowly because the temperature is too low and/or the humidity of the air is too high, can lead to fermentation, particularly in fruits, and even mould growth.

If the temperature of the product is allowed to go too high, especially towards the end of the process, browning and even par-cooking can occur, with a subsequent loss in quality.

The sizes of pieces to be processed at any one time must be carefully controlled, to ensure uniform drying. The capacity of a dryer can be reduced by 90 percent when processing pieces with a thickness of 1/2", compared with pieces of a similar size only 1/8" thick.

Any drying unit should be constructed as near to the main source of the raw material supply as possible, to minimize transport costs. The output of a fruit or vegetable drying factory will always be 10 percent or less of the weight of the input, depending upon the initial moisture content, and preparation trimming and losses.

Potential Market for Production of Oleo-Resins (Natural Colors)

The demand for natural colors to replace synthetic chemicals used in food manufacture is increasing in Europe and the USA. This demand is met by oleo-resins produced by solvent extraction using ethyl alcohol or methylene chloride[3]. This extraction process yields high value-added, low volume products for export in metal or plastic drums.

Dried red peppers are already processed with commercial success in this way in Spain and Ethiopia, for example. The good quality peppers grown around Diffa would be suitable for this process, provided they were free of any insecticide residue.

Other agricultural products which lend themselves to this process include: dried turmeric root, for the yellow color; ginger, coriander, and possibly lemon-grass, for their flavors; all of which are or can be grown in Niger to supplement red pepper extraction.

The vegetable waste from this process is dry enough to be burnt on a chain-grate stoked boiler, in most cases producing more than enough steam to run the process.

A feasibility study is therefore recommended to evaluate this processing possibility.

Potential Market for Essential Oils

Essential oils can also be recovered from plant material by steam distillation. Crops which can be processed commercially include onions, garlic, ginger and other spices, and lemon grass.

---

[3] Hexane is seldom specified in new construction today because of its attendant fire hazard.

For this process, Niger is at a disadvantage because of the high cost of energy needed for steam distillation. Nevertheless, there is interest on the part of at least one Nigerian businessman to establish the promotion facility just over the border in Nigeria, in Katina or Jibiya, to take advantage of the cheaper fuel and labor costs there. The general question of steam distillation and the issue of a supplier/processor relationship between businessmen in Niger and Nigeria deserve further investigation.

Potential Market for Dried Fruit

There is also an export market for high quality pieces of dried fruit to Europe, for inclusion in such products as mueslix, yoghurt, and confectionery. This business is controlled by a few prominent houses, and high quality is essential, but the supply of exotic ingredients can be lucrative.

In the U.K., a process has been developed which removes up to 50 percent of the juice from prepared fruit, (slices, dices and rings), such as pineapple, mango, papaya, guava, apple, quince, cherry, and lychee, before drying under carefully controlled conditions. In this way the high quality produce required is obtained, with a guaranteed export market. The extracted juice can be used locally to make fruit wines, cordials, or included in soft drinks and confections, to generate local operating capital.

The process is operating commercially in the U.K., and will shortly be starting in central Africa, where a specially designed solar drying system will also be used to produce up to 90 percent of the energy requirements during the day (Ref. AFP, 1992).

APPENDIX B

TOMATO PASTE MANUFACTURE IN NIGERIA

A new tomato paste factory, which had been in operation for a year, was visited on the outskirts of Kano including a tour of the processing unit and discussed the running of the plant.

The processing equipment from Italy comprises two pre-washing and inspection stages, followed by hot-breaking to inhibit pectin esterase enzymes and soften the fruit, and triple-stage pulping and finishing to produce skin and seed-free pulp of 4.5 (min) to 5.5 degrees brix concentration. This pulp is then concentrated on a double-effect, 4-sequential batch evaporator to 35-40 degrees brix to be stored, covered by a requisite layer of salt to prevent oxidation, and placed in large drums ready for reprocessing in the evaporator out of season to the required 28 degrees brix paste, by the addition of tomato juice and/or water. Immediately after reprocessing, the hot paste is filled into 70 gm sachets of polypropylene/aluminum foil/polythene laminate on an automatic form/fill/seal machine. The filled sachets are then passed through a pasteurizing tunnel, before being cooled, dried and packed into fiberboard boxes, 100 to a box, ready for sale. The wholesale, ex-factory price is 300-350 naira per box.

The factory has an input capacity of 7 MT/hr of fresh tomatoes, to yield 8-9 MT paste in a 12-14 hour processing day. The fresh tomatoes, mainly a special hybrid plum variety 'Ronita' from Denmark, with a good juice brix of 5-5.5 degrees, are purchased from the main tomato market to the south of Kano from farmers who transport them to the factory in stackable plastic baskets, owned by the factory. Each basket contains approximately 15 kg, for which the factory pays 9-11 naira, delivered (equivalent to around CFAF 10/kg, compared with prices of CFAF 50-120 realized in Niger for the same period).

Despite this apparent low price, factory owners are planning to cultivate a significant nucleus estate area when they find the land, so they can be more independent of the local market supplies, especially at the beginning and end of the main season. They have already purchased a caterpillar tractor and associated equipment for mechanized cultivation.

The factory usually manufactures the paste for 3-4 months between the end of December and the beginning of April, depending upon the price and the quality of the tomatoes. The manufacturer depends on off-season fresh tomatoes produced on irrigated land. At the time of the team's visit in mid-April, early rains had led to a deterioration in quality of tomatoes and one basket in eight was being rejected either because the color was too pale, even

yellow, or the degrees brix had fallen to just below the required minimum of 4.5 percent.

Tomato paste sales are stagnant during the two harvest seasons December-April and September-October; paste sales are strong from April to September and November to December when fresh tomatoes are scarce. In Nigeria there is a second fresh tomato season in September/October period, but these fruits are not used for paste manufacture as the brix is always too low. The color is also poor.

Conventionally, most tomato paste is sold in 70 gm tins, which have a shelf life of several years, providing they have a good interior coating of the correct lacquer. Even in Nigeria these have to be imported, ready made from Italy. Some producers have attempted to use 130 gm containers, with screw-on lids, which appeared to be of high density polythene. They have not been successful, since the plastic used did not have the right oxygen barrier properties, and the contents became oxidized to a dark brown, unsavory, product. If plastic containers are used they must be of co-extruded plastic laminates of at least two components, to obtain the correct barrier properties to enable a reasonable shelf life to be obtained. The closure system must also be airtight.

In 1991, the imported 70 gm tins cost 1.3 naira each, against a cost of 0.4 naira for the laminated sachets used at the factory. The shelf life claimed for the sachets is two years, but this is thought to be optimistic, especially in the temperatures prevailing in Nigeria for much of the year. However, besides the price advantage over cans, the sachets are also easier to store in large rolls and take up far less storage space.

The plant, which cost $4-5 million in 1991, runs for only 12-14 hours per day during the paste producing period because of a shortage of tomatoes and trained staff to operate the factory. About 1,000 MT paste is made in a season, which could be increased to 1,500-1,700 MT under ideal conditions.

There are other factories in the Kano, Jos, Bauchi area, one of which is said to handle over 600 MT tomatoes per day. The new Kano factory is able to take advantage of the large volume of tomatoes produced to meet all these demands. When only one factory is producing in an area a problem of supply always occurs, since tomatoes have a fairly short season with a pronounced peak. This means either the factory has to leave large quantities in the hands of the farmers, or more usually operate well below capacity either side of the peak.

One solution tried in the past, and still used in Sudan, is to supplement the supplies with imported drums of 40 degree brix paste from the Mediterranean region. Except as a temporary measure, and as a small share of seasonal requirements, this is self defeating in terms of import substitution, since the cost of the paste, and

in particular the cost of the imported cans in which to pack the paste, is always more than the cost of importing better quality produce ready packed from Europe.

APPENDIX C

POTATO DISEASES AND STORAGE

Potato tubers for storage must be disease free. Some typical diseases that can be encountered in the tropics are the following:

Brown Rot, caused by Pseudomonas solanacearum, which is largely a xylem invader, and prevalent in most tropical areas. No immunity to this disease in known, although some varieties have some resistance.

Blackheart, sometimes known as 'internal heat necrosis', or 'hollow heart'. This occurs in tubers which are left in the warm ground or starved of oxygen during storage.

Common Scab, caused by streptomyces scabious, which is carried in the soil from late or early blight. Scab develops particularly in dry soils and high temperatures, and is more severe in alkaline soils. There are resistant varieties, and the only way to protect against it is to use phytosanitary certified seed of such varieties.

Verticillum Wilt. Crop rotation is the most important action to take to combat the severity of this disease, combined with the use of certified, resistant varieties.

Most diseases enter the tuber via damaged areas on the surface. Care must therefore be taken during harvesting and subsequent handling to keep this damage to a minimum. All potatoes destined for extended storage should be sorted carefully to exclude all diseased and damaged tubers.

For proper storage, a balance of temperature and humidity, sufficient to favor suberin formation, followed eventually by periderm formation, (to heal small wounds and abrasions), but sufficiently low to inhibit excessive multiplication of bacteria, is required. Light, specifically ultra-violet light, must be excluded to prevent the formation of solanine, a green, slightly toxic alkaloid with a bitter after-taste. Small potatoes should not be stored since they tend to lose more weight on account of their higher ration of surface area to weight, and air circulation through them is not as good. A well designed potato store must have good insulation, a strong slatted floor, good ventilation and air circulation, properly designed ducting, and efficient temperature control.

Table C-1

Good Conditions for Potatoes

Typically good conditions for potatoes are:	
Temperature:	10-20 degrees C, ideally 15+/-2
Air duct velocity:	1,000 cu. ft./min.
Air volume:	12-15 cu. ft./ton capacity
Humidity:	75-85 percent
Lateral distn. ducts:	10 ft. apart or less, to give correct amount of air at the right velocity.
Holes in laterals:	1-1.25 ins. diameter, every 12 inches, in a depth of 10 ft. of potatoes.

Under ideal conditions, tubers are best stored in large pallet boxes, with vent spaces all around. However, in Niger, where farmers have a strong preference for identifying their own produce, storage in identifiable, labelled sacks would seem to be a better choice. In this way, sorting at the store and administrative problems would be minimized. Farmers could then bring their sorted produce in sacks to the store and have them placed in an allocated space ready to be removed for sale when they chose. If the potatoes had been badly sorted beforehand and deteriorated during storage, then the farmer would be solely responsible. A charge could be levied according to the number of sack-days the farmer had used, to cover the running cost of the store.

Weight loss during storage will vary according to maturity, freedom from injury, temperature, humidity and ventilation during storage and length of storage. Under ideal conditions, losses are around 4.7 percent after 1 month, and 6.4 percent after 3 months. Losses from sack stored, mature potatoes in Niger of 8-10 percent can be expected when stored for 3 months.

Out of the potato storage season, other crops such as onions may be stored in this unit, providing the correct conditions could be maintained. Budget figures, capital costs, refrigerated/air conditioned equipment and insulation costs, excluding stand-by generator: For 25 tons static capacity, UKL 400 per ton; for 800 tons static capacity, UKL 200 per ton.

APPENDIX D

ONION DRYING PLANT

Primary drying of the sliced onion would be done during sunlight hours in one of 3 batch driers, followed by final drying in conditioning bins overnight. It is anticipated that the unit would run for 250 days per year, assuming onions with the correct properties (high solids) are available for that period of time, with no drying planned for the rainy season, when air humidity may be too high.

Output would be around one ton dried onion/day, at moisture content of 5-6 percent. This would result in annual production of 250 tons, valued at $2.50/kg. FOB for Europe.

Table D-1

Indicative Equipment Costs for Solar Onion Drying

Equipment		UK £
1.	Trimming/inspection belt	4,000
2.	Dicer/slicer (capacity 2t per hr.)	20,000
3.	Solar heat collection/storage	25,000
4.	Ducting, fan and controls for 3	10,000
5.	3 batch driers and conditioning bins	175,000
6.	Metal detector	5,000
7.	Basic Q.C. laboratory equipment	3,000
		242,000
	x 1.78	
	=	$431,000
Optional Extras		
8.	Hammer mill grinder	5,000
9.	Screen bank	7,500
10.	Bact. laboratory	3,000
		15,500
	=	$27,600

Note: Excluding buildings, land, electrical wiring, installation, commissioning. IE, for Capital Equipment Investment of $460,000 and raw material cost of 2,500,000 kg at CFAF 50 per kg. equivalent to $446,000, gross return would be 250,000 kg x $2.50 = $625.000 p.a.

If the plant is built, preferably in or near an onion growing area to keep transplant cost of raw materials to a minimum, there should be a minimum commissioning/training period of three months, followed by at least two visits by consulting technologists after 3-6 months to ensure methods have been understood and unforeseen problems can be handled.

Suggested Qualified Staff Requirements.

1. Experienced food processing technologist/engineer to run the factory for an initial 2 year period.

2. Three technicians at grade staff supervision.

3. Quality control chemist, with knowledge of bacteriological testing procedures, plus 3 technicians.

4. Electrical/instrumental engineer, plus 3 technicians.

APPENDIX E

ONERSOL

ONERSOL was inaugurated in 1965, and the first Director appointed the following year, under the auspices of the Government Solar Energy Office, to carry out applied research into the utilization of solar energy. In 1975, ONERSOL was reorganized into a Research Section and a manufacturing and Marketing Section. ONERSOL staff include 6 engineers, 5 technicians, 4 administrative staff, 2 secretaries plus general workers, overseen by the Director. For the commercial market it has a range of 4 solar water heaters, 2 solar stills, 2 solar dryers and some solar collectors.

The Manufacturing Section has a capacity to make 400 solar water heating units per year, but total sales since 1976 of around 1,000 units represents a capacity utilization of only 16 percent. The Director said the Marketing Section was finding it difficult to generate sales, and needed some staff to be trained to improve the performance. They had no one with any commercial selling experience.

Besides solar heaters, dryers and collectors, the Research Section had developed a range of other equipment including solar powered pumps, parabolic reflector/cookers capable of producing temperatures in excess of 500 degrees, a steam generating boiler (in collaboration with German engineers), and had started work on solar-powered water cooling and refrigeration systems which in time may be applicable for controlled storage conditions for potatoes, for example.

The establishment has no laboratory facilities or staff qualified in food chemistry, technology, or quality control. Some collaboration has taken place with INRAN and the agricultural school in Niamey in the past, but appears to have been rather perfunctory.

During recent years ONERSOL has been critically short of funds from the Government and outside sponsors and donors. Current funding was said to be CFAF 60 million/annum. This year the financial situation has become so grave that all research work has been at a standstill since the electricity was cut off over 10 months ago, because of unpaid bills. The only electricity available at the time of the visit was being provided by a bank of photo-voltaic cells, capable of driving one office overhead cooling fan.

The present study did not investigate the circumstances that have led to this deterioration of ONERSOL, and decisions by donors to leave this institution out of their development assistance.

Politics, bureaucracy and personalities may well have brought about this unfortunate decline, and recovery may not be feasible. On the other hand, a revitalized ONERSOL, equipped with laboratories and staff qualified in food storage and processing technologies, could provide the corner-stone for the development of a fruit and vegetable storage and drying industry in Niger in the future.

APPENDIX F

PROSPECTS FOR NIGER PRODUCTS IN THE ABIDJAN MARKET

Introduction

Côte-d'Ivoire is an important producer of fruits and vegetables, some of which, like pineapples, are grown on are large scale, while others like tomatoes, carrots, and cabbage are grown as garden crops on small plots in dispersed areas throughout the country.

Tropical fruits grown in Côte-d'Ivoire include pineapple, papaya, mango, guava, and citrus. There are two mango groups of mango varieties, "Americaines" and "Antillaises". The "Antillaises" varieties are Amélie, Julie and Gouverneur and account for 60-70 percent of Ivory Coast production. The balance of production is of the "Americaines" varieties: Kent, Keitt, Valencice, Palmer, Smith, Zill, and Brooks. Exports to Europe are limited to less than 1,000 metric tons per year and, due to seasonal fluctuations in supply and demand, Côte-d'Ivoire actually relies on imports from Burkina Faso and Mali for certain periods of the year.

Fresh tomatoes, okra, and chili peppers are all produced locally (in the regions of Kotobi, Man and Korhogo) in sufficient quantities to satisfy local demand for most of the year. Because of the low producer prices for coffee and cocoa (due to weak world markets for these commodities), some producers have diversified into vegetables crop gardening for added income. However, during periods of slack production, some dried okra and chili peppers are imported from Burkina Faso and Mali. Demand is strongest in Abidjan because of its large and growing population, characterized by changing tastes for new foods and food products. Tomato prices peak from May to July when supplies are scarce. For the remainder of the year, locally-produced fresh tomatoes are plentiful.

Imported Vegetables in the Abidjan Market

For those crops which are not well suited for Côte-d'Ivoire (onions, potatoes, and garlic) or for which scarcities occur during certain periods of the year (fruits), the country relies on imports, either from neighboring countries or from non-African countries. Data collected by customs is mostly on goods that come through the port and trade from neighboring countries, while substantial quantities typically go unrecorded. Niger, for example, is a major supplier of onions to the Abidjan market, and hundreds of tons per week are imported during the peak of the marketing season. Onions from Niger are shipped in burlap bags to wholesale distributors in the Treichville and Adjame markets, who

resell to market wholesalers and retailers. Onions from Holland are shipped in smaller plastic mesh bags.

There are two kinds of onions in demand in Côte-d'Ivoire, large onions and shallots, and it is the large onions that are imported either from Holland or Niger. Large onions are not produced in Côte-d'Ivoire. The Galmi onions from Niger are highly regarded, although at least several wholesalers in the market complained about the need to repack onions from large burlap bags in plastic mesh (recycled from other imported onions). There are some imports of onions from Mali but these are small and considered of low quality. Shallots are produced in Côte-d'Ivoire from mid-March through July.

High quality garlic is plentiful on the market, imported from Argentina, Chile, Egypt, and China. One of the major market wholesalers reported that there was no potential for Nigerian garlic given the quality he could obtain for about CFAF 50 per bunch, which would then sell for CFAF 100 per bunch in retail markets.

Côte-d'Ivoire imports potatoes from France, Mali, Morocco and Holland. Malian potatoes are large and of good quality, and are found in the market in Abidjan between the months of February and April. Prices for Malian potatoes were CFAF 125/kg in April, up from CFAF 100/kg in March. Wholesalers sell to retailers for CFAF 150 per kilo, which are then resold for CFAF 200-220 in neighborhood vegetable markets throughout Abidjan.

Imported Fruits

Côte-d'Ivoire is self-sufficient in fruit during most periods of the year. However, imports of mangos become significant during periods when local production declines. Imports from Burkina Faso and Mali include Kent, Keitt, and Brooks varieties which begin to arrive in April and taper off in September. Mangos are shipped in rough cardboard cartons weighing 60-70 kgs. and sell for CFAF 6,000-8,000 per carton in the Adjamé market in August. Importers reported that approximately 100 Mt per week were arriving from Mali and Burkina Faso, although there was no idea of total volume.

Imports from Mali arrive in the months of September through November. Quality is very good. Local production in Côte-d'Ivoire is from Katiola, Korhogo, and Sassandra. Imports of limes tends to be significant only significant during periods when local production declines.

Processing Opportunities for Nigerian Onions

Novalim Nestle in Abidjan produces Maggi bullion cubes for sale in Côte-d'Ivoire and throughout West Africa. At present, approximately 100 MT of dried onion powder are imported from Europe or the USA as a basic ingredient for Maggi. The potential for using dried onions from Niger was discussed with Nestle and at their request the team sent a fax which inquired as to their specifications for the product that they purchase. We also inquired whether dried kibbled pieces would be acceptable for them to grind themselves in lieu of powder. The response received is summarized in Table F-1:

Table F-1

Novalim-Nestle Buying Specifications for Dehydrated Onions

Quality: Produced from ripe fresh, carefully washed and trimmed first quality onions with strong aroma and flavor peeled, sliced and dried. Without peels or roots. Size depending on use. Not treated with SO_2. Free from pests, sand, and other foreign matter as well as additives of any kind.

Appearance: White to light grey coloured flakes or powder.

Taste Sampling: 10 grams in 500 ml of cold water. Boil for 10 minutes.

Odor: Fresh, aromatic without being musty or foreign typically boiled onion.

Taste: Pure and pronounced.

Analysis:	Typical Analysis (%)	Requirements(%)
Moisture	5-6	max. 7
SO_2		not detectable
Sand		max. 0.1
Protein	8.3	
Fat	1.2	
Total Carbohydrate	80.5	
Crude Fiber	4.3	
Ash	3.8	

Suggested Packaging: Kraft paper bag lined with polyethylene.

In addition to the specifications above Novalim-Nestle furnished samples of the dried onion powder they import so that a

determination could be made of the feasibility of Niger producing the same product.

An 1990 UNIDO study on agribusiness in Côte-d'Ivoire had identified dehydrated onion production as a potential venture for investors. The market targeted was Novalim-Nestle in Abidjan and other buyers not specified for a total of 250 MT of dehydrated onion. A quote for machinery required to dry onions was obtained from a French supplier and came to over one million dollars. No preliminary estimates were made of actual operating costs, although the study envisioned purchasing 2,500 MT of fresh onions from Niger at 130 fcfa per kilogram. The fact that this project never progressed past the identification stage suggests that it was never seriously considered as a viable investment project. However, no mention was made of the financial and economic viability of processing in Niger, where raw product costs are much lower; onions could then be shipped in processed form to Abidjan. Nigeria could also represent a potential market for dehydrated onions. Nestle apparently operates there although no one at Novalim-Nestle knew of the demand for dehydrated onion by food processors such as Nestle operating in Nigeria.

APPENDIX G

LIST OF PERSONS CONTACTED

Persons Contacted in Niger

Niamey

Baker, Greg - USAID/Niamey
Callen, George - USAID/Niamey
Sullivan, Mike - USAID/Niamey
DeCock, Francis - INC ILNOVO Castoro
Ali Alidou - Businessman

Tillaberi

Windi, Yacouba - Director, ONAHA/Tillaberi
Saidi, Issa - Assistant, DDA/Tillaberi
Igue, Moussa - Director, Cooperative Agricole de Tillakaina

Maradi

Mahamadou Naroua, - Supervisor, Maradi Fruit Nusery
Abdou Mahaman Sani - Assistant Director, DDA/Maradi
Ray Norman - Icrisat
Two dried pepper/tomato wholesalers
Two dried pepper/tomato retailers
One potato wholesaler-retailer

Ague

Hadjia Maria Hamidou - cereals trader

Zinder

Mamadou L. Tchougoune, Director, DDA/Zinder
Ouba Garba, Assistant Director, SDSA/Zinder
Mahamane Harouna, Chief, SDSA/Zinder
Salissou Issa, Assisant Chief, SDSA/Zinder
Three dried pepper/tomato wholesaler-retailers
One dried pepper wholesaler

Mirriah

One onion/potato wholesaler-retailer
One dried tomato and dried pepper wholesaler-retailer

Birni-N'konni

Cheferou Mahatan, Director, "Privat" Project

Persons Contacted in Côte-d'Ivoire

CIRES (Center Ivoirien de Recherche Economiques et Sociales)

Mr. Yao, Director
Mr. Mody Bakar BARRY, Assistant Director

Grand Travaux

Mr. George PALACIOS, Agronomist
Mr. Mathias YESSOU, Agronomist
Mrs. Maferiam TOURE, Agricultural Economist

Ivoirienne de Technologies Tropicale

Mr. Dominique GAO, Section Chief, Food Chemist
Mr. Patrick DOUKA, Laboratory Biologist
Dr. Michael MANLAN, Quality Control

Novalim Nestle

Mr. Guy MOULOT, Raw Material Purchasing Agent
Mr. Gilbert ADOLFE, Purchasing Department Coordinator

Pioneer Seed (Pioneer Agrogenetique Côte-d'Ivoire)

Mr. Douffi YAO, Marketing Agronomist

Sialim

Mr. Kouadio Blaise TANOH, Director-General

Markets in Abidjan

Plateau: Two wholesalers

Adjamé: Two wholesalers
Three retailers

Treichville: Three retailers

Cocody: Three retailers

BIBLIOGRAPHY

Agribusiness Worldwide. July/August 1989. "Special Report, Irrigation".

Barrier, C. août 1988. Evaluation rétrospective du projet fruitier de Gaya au Niger. Caisse centrale de coopération économique, département d'appui aux opérations, division des politiques sectorielles et des évaluations rétrospectives.

Centre Nigérien du Commerce Exterieur, Chambre de Commerce, d'Agriculture, d'Industrie et d'Artisanat du Niger, Rencontres Interprofessionnelles ACP/CEE Accra 2-8, Analyse des obstacles liés au developpement d'exportations des produits maraîchers de contre-saison (Niamey, Niger: 1991).

Jaffee, Steven. 1991. Marketing Africa's Horticultural Exports: A Transaction Cost Perspective. Paper presented at the Workshop on the Globalization of the Fresh Fruit and Vegetable system at the University of California, Santa Cruz, December 6-9, 1991. Agriculture & Rural Development Department. Washington: World Bank, Published for Agriculture & Rural Development Department.

Kulibaba, Nicolas and Jim Brown. 1991. USAID/Niamey Agricultural Marketing and Export Promotion Project: Technical Annexes to the Project Implementation Document. Washington, DC.

République du Niger, Ministère de l'agriculture et de l'élevage, Département d'Agadez, Direction départementale de l'agriculture. août 1991. Programme annuel d'activités agricoles de contre-saison 1991-1992. Niamey, Niger.

République du Niger, Ministère de l'agriculture et de l'élevage, Communauté urbaine de Niamey, Direction de l'agriculture, Programme annuel d'activités agricoles de contre-saison (Niamey, Niger: 1990).

République du Niger, Département de Maradi, Direction de l'agriculture. Rapport mensuel d'activités de contre-saison (Niamey, Niger: 1992).

République du Niger, Ministère de l'agriculture et de l'environnement, Direction de la statistique de l'agriculture et de l'environnement, Rapport annuel des statistiques de l'agriculture et de l'environnement 1988 (Niamey, Niger: 1989).

République du Niger, Département de Zinder, Direction départementale de l'agriculture, Rapport annuel d'activités agricoles de contre-saison (Niamey, Niger: 1991).

République du Niger, Département de Zinder, Direction départementale de l'agriculture, Service des statistiques agricoles, Annexe du Rapport, Campagne 1989-1990 (Niamey, Niger: no date).

République du Niger, Ministère de l'agriculture et de l'élevage, Evaluation, campagne agricole 1991-1992 (Niamey, Niger: 1991).

Robert R. Nathan Associates, Inc., Regional Fruit and Vegetable Processing Industries in West Africa, (Washington, DC: USAID, 1983).

Vengroff, Richard, Djibo Maiga, and Robert Seromba. 1991. Maps Niger-Phase III: Enquête d'étude sur les secteurs informel et formel. Private Enterprise Development Support Project II. (Ernst & Young).

Versel, Malcolm A. Vegetable Marketing in Niger, An Assessment and Overview. Postharvest Institute for Perishables, University of Idaho in collaboration with the Niger Irrigated Agriculture Sub-Sector Assessment Team General Development Office, USAID/Niamey. (Moscow, Idaho: USAID, 1984).