



POSTHARVEST INSTITUTE FOR PERISHABLES

A SURVEY OF CROP PRODUCTION AND MARKETING PRACTICES
OF IRRIGATED PERIMETERS IN THE CERCLE OF KAYES, MALI

by

Malcolm A. Versel, Consultant

for the
U.S. Agency for International Development/Bamako
and the
Postharvest Institute for Perishables

GTS Report No.
PIP/Mali/February 84/No. 36



University of Idaho

in cooperation with
United States Agency for
International Development

PN 111A-768

A Survey of Crop Production and Marketing Practices
of Irrigated Perimeters
in the Cercle of Kayes, Mali

by
Malcolm A. Versel

for the
Postharvest Institute for Perishables
University of Idaho
Moscow, Idaho
U.S.A.

June, 1984

TABLE OF CONTENTS

PAGE

Executive Summary.....	1
Organization of the Report.....	1
The Geographical Setting.....	2
The Institutional Setting.....	3
Irrigated Perimeters.....	3
Organisation Vallée Sénégal Térékolé Magui (OVSTIM).....	5
Union Régionale des Coopératives Agricoles de Kayes (URCAK).....	5
Centre d'Animation et de Coopération (CAC).....	6
Office des Produits Agricoles Maliens (OPAM).....	6
Obtaining Credit and Other Agricultural Inputs.....	7
The Agricultural Setting.....	7
Grain Crops versus Vegetables.....	7
Production Constraints and Costs.....	9
Produce Marketing Practices of Irrigated Perimeters.....	13
The Kayes Market.....	13
Market Strategies and Perceptions.....	15
Marketing Constraints and Alternatives.....	17
Storage and Preservation.....	20
Appendices:	
Appendix 1: Maps of the Perimeters.....	23
Appendix 2: List of Sites and People Visited.....	27
Appendix 3: Janith Elder's Report.....	29
Appendix 4: Diesel Fuel Consumption and Cost for Perimeters.....	35
Appendix 5: OVSTIM Production Data for Dry-season 1982-83.....	36
Appendix 6: Retail Prices for Selected Vegetables.....	38
Appendix 7: Selected Data for Irrigated Perimeters.....	39

Executive Summary

The information presented in this study for the U.S. Agency for International Development/Bamako was collected during visits to 13 irrigated perimeters along the Senegal and Falémé Rivers in the Cercle of Kayes in western Mali (Appendix 1). The visits (Appendix 2) were made from February 15-26, 1984, a period which found farmers well into the dry-season production cycle and at the beginning of their vegetable marketing season.

The visits were conducted by Malcolm Versel, Agricultural Economist consulting in response to Cable Bamako 4639 (1983) for the Postharvest Institute for Perishables of the University of Idaho, and Janith Elder, Vegetable Crop Storage Specialist under contract to USAID/Mali. Ms. Elder's report (Appendix 3) provided a technical review of and basis for describing the agricultural situation and storage/preservation techniques observed at the irrigated perimeters.

The author acknowledges the help of the following people whose assistance greatly facilitated the accomplishment of the mission's objectives: Mr. Tommy Lee, WFP/Kayes, for his knowledgeable recommendations and logistical assistance; Mr. Oumar Dia, CAMSO/Sobokou, and Mr. Oumar Dia, USAID/Mali, who helped us in our travels; Mr. Modi Savane and Mr. Jaffar Maiga who proved to be intrepid masters of unforgiving roads; and Mr. Ernest Bowen, CAA/Samé, who kindly gave up his Sunday to enlighten us on the problems of the the zone. Special thanks are also offered to Ms. Janith Elder who was gracious in accepting the demands of a grueling schedule, and Dr. Diane Ponasik, USAID/Bamako, whose efforts helped bring all of the necessary elements into place. Finally, to the courageous farmers of the Senegal River Valley, I extend my full appreciation, both for the difficult pursuit in which they are engaged and for their accommodating patience in receiving yet another study mission. It is hoped that the time they took to explain their problems will not have been spent in vain.

Organization of the Report

This marketing survey provides an analysis of the structure, conduct and performance of the irrigated perimeters, with particular respect to the area's primary market, Kayes. The structure within which the perimeters operate are covered in sections describing the geographical and institutional settings of the perimeters.

Conduct and performance issues are discussed in sections describing current cropping and marketing practices of the perimeters. Each of these sections includes a discussion of production and marketing constraints which confront the perimeters' farmers.

Recommendations for improving marketing performance, especially with respect to increased farm revenues/decreased farm expenditures, are discussed in a final section. Recommendations for further research are also presented.

The objectives of this survey are:

to describe the agricultural situation in the area;

to describe the marketing situation currently existing in Kayes;

to analyze the constraints which exist in preservation, storage and marketing of fresh produce;

to formulate suggestions on ways to alleviate or overcome storage and marketing constraints;

to propose recommendations for improving marketing and/or storage conditions which could increase farmers' revenues in the irrigated perimeters.

The Geographical Setting

The First Region of Mali is located in the westernmost portion of the country, bordering Mauritania to the north, Senegal to the west, and Guinea to the south. Climatically, the region is largely situated in Sahelian zone, with annual rainfall of 300 to 800 mm, falling exclusively between the months of June and October.

The administrative capital of the region is Kayes. Kayes is a town of about 50,000 people, mostly functionaries and traders. Kayes is also the governmental seat of one of the six administrative cercles of the region.

Kayes is serviced by a rail line connecting Bamako, the national capital, and Dakar, Senegal, one of two ports available to land-locked Mali. The rail connection, however, is the only regular, reliable transportation linking Kayes with the rest of the country.

Bamako is about ten hours away by train. It can also be reached by road, by way of Nioro-du-Sahel. The 500-kilometer trip takes two days, primarily because of the difficult road conditions of the 250-kilometer segment connecting Kayes with Nioro. To the south of Kayes is the town of Kéniéba which provides Kayes with limited amounts of fresh fruit when in season. Again, the road conditions make travel very difficult.

The condition of the roads in the First Region is a major stumbling block to the development of the region. Roads in the region are typically sand tracks, often passing through rock and sand-filled washes. During the rainy season, many areas of the region are totally inaccessible, even to four-wheel drive vehicles. Other times of the year, road travel is arduous. The average speed of travel on roads connecting Kayes to the perimeters was only about 20 kilometers per hour during the period of this mission's visit.

The cercle of Kayes is divided by the Senegal River which flows through the center of the town of Kayes. Downstream from Kayes, about 110 kilometers to the west, at the border of Mali and Senegal, the Senegal and Falémé Rivers join. River travel is limited and, especially for the downstream portions of the river, usually possible only during the few months immediately following the rainy season.

The Institutional Setting

Irrigated Perimeters

In 1973, then-Governor Danfaga established the first irrigated operation in the cercle of Kayes at Kamenkolé-Danfagabougou, with the express purpose of providing the town of Kayes with a supply of fresh produce. Since then, a number of irrigated perimeters have been placed into production along the banks of the Senegal River. The period between 1974 and 1978 was especially active, with nine perimeters being established in the zone.

Virtually all of the perimeters were begun with outside financing from one or more sources, primarily from several French PVO's and from USAID. The number of irrigated perimeters in the cercle of Kayes now stands at 13, counting the four units of Kamenkolé as one perimeter and including the two perimeters on the Falémé, Sangalou and Gouthioubé. Additional perimeters are currently being planned.

The irrigated perimeters which began to appear along the Malian river banks were similar to ones which were beginning in Senegal and Mauritania, all part of the OMVS (1) river basin development program. The purposes of the perimeters were seemingly fourfold:

- 1) to increase the food production capacities of the populations living along the river;
- 2) to diversify the kinds of crops being produced to improve the nutritional levels of the local diet;
- 3) to provide young men of the region with an alternative to their established pattern of migrating to other African countries or to France to find work and support their families;
- 4) to acquaint farmers with irrigation techniques in the expectation that, with the completion of the Manantali dam, opportunities for irrigated farming in the zone would be substantial.

In the early years the perimeters met with various levels of success and sparked considerable enthusiasm, both from Malians and foreign donors. A number of Malians working in France opted to take the helping hand offered by several French FVO's and return to their homeland to begin farming in the irrigated perimeters. The perimeters were provided with diesel powered pumps (2), funding to purchase tools, inputs, and finance constructions, and irrigation infrastructures which included land improvement and earthen canals.

The farmers, called "attributeurs", began to grow a varied range of crops which included grain crops such as corn, rice and sorghum, as well as vegetable crops like potatoes, tomatoes, lettuce, and cabbage. There was cautious optimism among those involved with the perimeter projects that the four goals of the program could be met.

(1) Organisation de la Mise en Valeur du Fleuve Sénégal.

(2) Kamenkolé is the exception. Electric pumps are used by two of the four units at this perimeter.

Organisation Vallée Sénégal Térékolé Magui (OVSTM)

In response to the growing number of perimeters in the Kayes area, the Malian government established OVSTM, the agency responsible for overseeing the activities of the irrigated perimeters. It is based in Kayes and has a staff composed largely of agriculturalists, including agricultural engineers and agronomists. Several members of OVSTM's staff are reasonably well-trained and knowledgeable of the conditions and problems of operating the perimeters. However, the apparent lack of internal organization within OVSTM, coupled with a very low operating budget, results in a seriously ineffective administrative capability of the agency. The lack of internal organization is clearly visible to those outside of OVSTM.

Nevertheless, OVSTM is the sole agency charged with agricultural extension activities in the irrigated perimeters. In several of the perimeters which were visited, the OVSTM agent(s) assigned to the perimeters actively participated in the interviews with the farmers. It is noteworthy that some of the agents farm their own perimeter plots for commercial purposes. The agents in the perimeters make regular reports to the Kayes office. The reports contain statistical information on the types of crops planted and the surface for each crop. The quality of this data is not uniform and, in some cases, seems to be of questionable credibility.

Union-Régionale-des-Coopératives Agricoles-de-Kayes (URCAK)

URCAK is an organization composed of the cooperatives of the 13 perimeters visited and the vegetable producers' cooperative in Kayes (3). URCAK was formed initially by cooperatives made up mostly of former migrant workers returned from France. Its purpose was to provide a stronger voice for all the perimeters and to form a viable organization capable of actively seeking solutions to problems common among the perimeters. In part, URCAK was founded out of frustration with the ineffectual performance of OVSTM (4).

(3) Kayes has a number of traditional river bank gardens irrigated by hand-sprinkling. These gardens are predominantly farmed by women.

(4) The perimeter at Somankidi-Coura, where the URCAK president resides, asked OVSTM to withdraw all of their agents from Somankidi.

Centre-d'Animation-et-de-Coopération (CAC)

CAC, part of the Direction Régionale de la Coopération, has an increasing role in the activities of the irrigated perimeters, primarily, but not exclusively, in the management activities of the respective cooperatives. According to the Regional Director of the CAC/Kayes, Mr. Baba Coulibaly, URCAK and CAC would like to centralize all of the contributions from outside donors into a global project benefitting all of the perimeters. CAC views itself as a sort of management consultant to URCAK. In particular, CAC's agents are teaching the cooperatives how to organize and maintain a set of records. These records include costs of production and sales records. If these records are diligently maintained, economic analysis of the viability of perimeter production will be greatly facilitated.

A cause for concern for OVSTIM, and therefore one which should be considered by funding agencies, is the close collaboration between URCAK and CAC exclusive of OVSTIM. OVSTIM personnel expressed dissatisfaction that issues which they consider to be within their venue are not being discussed with them.

Office-des-Produits-Agricoles-Maliens (OPAM)

Following the government decree authorizing liberalization of the market in 1981-82, OPAM no longer retained the exclusive right to purchase grains in the Republic of Mali. Rather, its role was reduced to that of setting a government-guaranteed floor price for each grain, and monitoring grain production/deficit for each region of the country. Additionally, OPAM is primarily responsible for assuring that grain is available throughout the country.

As of March 1, 1984, OPAM estimated that the First Region (Kayes) will require 20,000 metric tons of grain prior to the next harvest (about November, 1984) (5). OPAM sells grain to individuals and merchants, selling at slightly higher prices to merchants. However, even though official prices are established, supply shortages do cause prices to go higher. Retail prices observed for millet during the mission's visit to the Kayes market were equal to the price of imported rice (350 FM per kilogram), well above the official price for millet.

(5) Personal communication. Emile Dackouo, OPAM Commercial Director, and Yacouba Sanogo, OPAM Regional Delegate/Kayes.

Obtaining Credit and Other Agricultural Inputs

Prior to the liberalization decree, two government agencies were able to extend credit to farmers for the purchase of agricultural inputs. These were OVSTIM and ODIPAC (6). Since 1981, however, ODIPAC has ceased all commercial activities in the First Region, including the offering of production credit to farmers. OVSTIM is also unable to provide credit to farmers because no such credit funds are made available to OVSTIM. Farmers are therefore required to obtain credit from private sources. However, many farmers reported selling animals or seed stock to satisfy their demands for cash.

Although the ODIPAC representative in Kayes stated that agricultural inputs (including equipment and fertilizers) were available to farmers on a cash-and-carry basis, this could not be independently verified. Farmers repeatedly cited their difficulties in locating available stocks of fertilizer, especially complexe coton and super-simple, the fertilizers which they have been accustomed to using. OVSTIM has no provisions for supplying inputs to farmers, either.

The result is that farmers are constrained to procure their own inputs after identifying their own supply sources. Because they lack adequate information channels, the task of acquiring inputs is a difficult one and not presently being accomplished effectively. As an example of the proportions of this problem, farmers in one village reportedly travelled to Bafoulabé, a day's trip, to purchase urea. The urea was purchased from a private source for 21,000 FM per 50-kilogram sack, 150 percent of the official price.

The Agricultural Setting

Grain Crops versus Vegetables

The first perimeter in the Kayes area, Kamenkolé, was set up to provide the town of Kayes with a supply of fresh vegetables (7). This apparently set the tone for vegetable production on the perimeters. As the new perimeters went into production, few farmers concentrated their efforts on cereal production, ignoring one of the principal purposes for establishing the perimeters. Rather they turned to vegetable production which, initially, was highly profitable.

(6) Office du Développement Intégré de la Production Arachidière et Céréalière.

(7) Kamenkolé, situated only 3 kilometers from Kayes, also had a second purpose. Governor Danfaga, who founded the perimeter, intended that the perimeter would provide employment opportunities for the numerous retired railroad workers living in the area.

This was a natural response to market conditions. In particular, at the time most of the perimeters began operating, the producer price of grain was controlled by the government and was kept relatively low in the eyes of the farmers. There was, thus, a low cash incentive to produce grain crops above and beyond the traditional rainy season crops, especially when there existed a relatively profitable alternative enterprise, namely, vegetable production.

The perimeters which were established by "les Parisiens", the local name for the migrant workers who have returned from France, also turned to vegetable production, in part to capture their portion of the profitable market, in part to produce foods which they had become accustomed to eating in France. However, as total production increased, the profit on sales of vegetables began to erode. The market became saturated, then glutted, and large amounts of vegetables went unsold and spoiled in the market.

Nevertheless, in the majority of the perimeters visited by this mission, vegetables were the principal cropping enterprise. Cereals were being produced in limited quantities and on only a few perimeters. Dry-season grain production under irrigation was limited to a few ares of corn. This was very surprising given that rain-fed cereal production for 1983 resulted in almost total crop failure throughout the First Region due to insufficient rainfall (8).

Dry-season vegetable production varies from perimeter to perimeter but the most common crops are cabbage, tomatoes, onions, okra (gumbo), sweet potatoes and hot peppers. The crop mix depends on a number of factors including access to market (distance), availability of inputs (especially, seeds), and individual farmers' personal experience with particular crops. Other crops grown during the dry-season include local-variety eggplant, cowpeas, manioc, groundnuts, garlic, and some fruit, including bananas, mangoes, and papaya.

Only one perimeter, the relatively recently-established Sangalou, attempted to produce cereals using supplemental irrigation during the rainy season of 1983. Sangalou's farmers were unable to provide estimated production figures but, in normative terms, they stated that the corn they cropped produced relatively well. The ears were consumed as soon as they

(8) Throughout the zone, farmers repeatedly stated how thoroughly their crops had failed during the rainy season. In most instances the plants never reached maturity, burning and dying from lack of water. Where some grain was harvested, yields of only 20 to 30 kilograms per hectare were obtained.

reached maturity. Sangalou's dry season cropping pattern included 17 hectares (out of a total 20 hectares) of corn being grown under irrigation. The remaining hectarage was cropped in mixed vegetables, all for on-farm consumption. Because of Sangalou's relative isolation from markets in either Mali or Senegal (9), the perimeter provides a large portion of their food supply. Their perimeter is their sole source of grain this year, other than market-level grain purchases.

Production Constraints and Costs

Sangalou, though, was facing a major production constraint. The Falémé River from which its irrigation water is drawn was almost completely dry at the time of the mission's visit in late February. Only a few scattered and shallow pools of water remained. The farmers dug channels, some 500 meters long, to connect the pools and direct water to the pump's water intake pipe. It seemed highly unlikely that they would be able to continue irrigating much longer, and perhaps would be unable to bring their dry-season crops to maturity. The same problem pertained to Gouthioubé but farmers there were only working about one-half hectare of mixed vegetables. Sangalou had much more to lose. Downstream from Kayes the Senegal River also appeared to be quite low, but it seemed to have sufficient water for irrigation purposes.

Beyond water shortages, the most frequently cited constraints hindering cereal production on the perimeters were (a) uneven land which prevents consistent irrigation throughout the field, and (b) the difficulty the farmers experience in financing the pump operating costs. Again, the farmers observed that by producing vegetables, they were providing themselves with a revenue-producing commodity. Grain crops were not perceived by many of the farmers interviewed to fall within that same category.

However, many farmers were discussing the possibility of growing grain crops on the perimeters during the 1984 rainy season, and supplementing the rainfall with irrigated water if necessary. This was due to the catastrophic failure of the prior year's grain crop. The farmers will still have to confront the two constraints cited above, but at current grain prices the opportunity cost of not producing grain is high.

(9) Sangalou is on the Mali-Senegal border, 111 kilometers from Kayes.

The irrigation schedule used by each perimeter was independent of the crop mix. Most perimeters irrigated by pumping water into the canals for four hours in the afternoon, either once every two days or once every three days, uniformly watering all of the perimeter crops at the same time. Fuel consumption was estimated at about 24 litres per irrigation, a figure which appeared to be consistent for several of the perimeters. At the market price for diesel fuel, 560 FM per liter exclusive of transport from Kayes (10), an "average" irrigation costs about 13,500 FM. At two or three irrigations per week, the cost of fuel inputs for the three-month production cycle can amount to as much as 672,000 FM, the equivalent of six 200-litre barrels. Most perimeters reported using between four and eight barrels during the dry-season production period (see Appendix 4).

In addition to diesel fuel, the pumps also use oil (in some cases, a lot of oil), filters, and require mechanical attention. The farmers must pay all these costs as well as purchase any necessary replacement parts. Because the pumps are old and poorly maintained, it can be expected that such replacement costs will present major obstacles to irrigated production on many of the perimeters in the near future. Djimékon was unable to operate its perimeter during the 1982 dry season because of pump problems. Fanguiné almost did not plant a crop this year because essential and expensive pump repairs were required, and completed, before the dry season irrigation could begin.

Difficult transportation and road conditions throughout the perimeter zone limit the distance over which fragile or easily perishable vegetables may be transported. The perimeters which were closest to Kayes selected crops which allowed them to take advantage of their relative proximity to the Kayes market.

The perimeters at Kamenkolé produce a variety of vegetables, many of them perishable, but transporting the vegetables to market only involves a distance of three kilometers. Moussala, 35 kilometers downstream from Kayes, principally grows tomatoes for sale in the Kayes market. Maloum and Fanguiné specialize in producing onions which tolerate transport better than tomatoes.

(10) Additionally, transportation of one 200-litre barrel of diesel fuel to the perimeters cost 4,000 to 10,000 FM depending on distance to Kayes, a cost increase of 20-50 FM per litre.

Those villages are located about the same distance from Kayes as Moussala, but they are upstream and accessible by a rockier, bumpier road than the road which connects Kayes to Moussala. Sapou-Kakalou and Djimekon, which are on the same road as Maloum and Fanguiné, grow cabbages as a principal enterprise because cabbage travels relatively well.

Another determinant of crop mixture is the availability of inputs, particularly fertilizers and seeds. In a prior section of this report, some of the problems farmers encountered trying to procure fertilizers which they were accustomed to using were discussed in part.

The Government of Mali has apparently adopted a policy designed to substitute domestic Telemsi rock-phosphate for imported chemical fertilizer. The Telemsi phosphate is inexpensive relative to the imported fertilizers which were previously sold -- about one-third the cost. But the results of Telemsi phosphate do not begin to show until the third year of application. It seems certain, therefore, that the perimeter farmers will experience a minimum of two years of poor yields.

If farmers did not begin Telemsi phosphate applications this year, and many of them did not, that period of comparatively low yields will be longer. To compound the problem, the extension network has failed to inform the farmers about the characteristic time-delay properties of Telemsi. Many farmers expressed reluctance about using it because they were convinced that it had no effect on their crops.

With respect to seed procurement, the following example for potato seeds is representative of the problems the farmers experienced. In prior years, potatoes grew very well in the perimeters. None of the perimeters visited, however, were cultivating potatoes this year. The problem which was cited in every instance was the unavailability of seed at the time of planting.

Several of the perimeters stated a distinct preference for growing potatoes and had made attempts to get seed. Those few who managed to locate potato seed were unable to purchase it because it would have arrived too late for planting. In particular, in the hot climate of Kayes, and most other parts of Mali, it is critical to plant potatoes as early as possible in the cool dry-season so as to maximize carbohydrate storage over the entire three-month development period of the plants. The major delay in timely delivery of potato seeds to the perimeter farmers seemed to be attributable to

the fact that the seeds, which come from France via Dakar, were transported to Bamako first -- through Kayes -- and then shipped back to Kayes.

Other seeds which farmers experienced difficulty obtaining included cabbage, pepper, and improved variety (Bambey) okra. Many farmers complained of the poor quality, often outdated, seeds available in Kayes. Presently, seeds are purchased from local merchants (packaged seed) or from other gardeners in the area, particularly from the women who cultivate the traditional river bank gardens. URCAK is attempting to identify reliable seed sources, either in Bamako or Dakar, as a possible solution to the problem.

Other inputs, such as phytosanitary treatments, are not used in most of the perimeters. When the perimeters were still receiving outside funding, a selection of relatively expensive fungicides and insecticides were widely used. It seems reasonable to conclude from our visits that the current use of such products is the exception rather than the rule. On the other hand, insect problems were reportedly minimal. Some cabbage heads showed mild insect perforation, and nematodes were causing limited damage in a few of the perimeters, but no major problems were reported or discernable.

Actual production records were not available for prior years from any of the perimeters. With the assistance of CAC, farmers in several of the perimeters are maintaining detailed records for the current marketing campaign. However, not enough data was yet available to develop significant production estimates. It is encouraging that this data is being recorded and, perhaps as early as May, a comprehensive production analysis may be possible to perform.

OVSTM furnished a set of data for the 1982-83 dry-season campaign (11). It provides an approximate indication of the relative area under cultivation at each perimeter and the associated yields. However, careful examination of the figures suggests that some data fabrication may be present. Therefore, anyone using this OVSTM data for analytical purposes should consider the possibly specious origin of at least part of the data.

(11) See Appendix 5.

Produce Marketing Practices of Irrigated Perimeters

The Kayes Market

The town of Kayes' central market is a two-square-block complex of open-sided structures with either concrete or earthen floors. The market operates daily from about 8:00 a.m. until 5:00 p.m., but it is especially busy in the early morning hours.

The town requires that a daily market fee of 100 FM be paid by each vendor. This fee represents the least of the expenses vendors must pay to bring their goods to the buying public. If they need to move their goods from one area of town to another, for example, from the bush taxi station to the market, they need to hire a cart which costs about 100 FM per sack. Additionally, meal expenses cost about 600 FM per day if kept to a minimum. These charges are in addition to the cost of transportation to Kayes for both seller and merchandise.

The market is to some degree organized into sections according to commodity. In particular, there is one section where only meat and fresh fish are sold, another part where cloth is sold, and a third area where spices are offered for sale. It also has an entire building allocated to fruit and vegetable sellers. This building is apparently insufficient, however, as one finds vegetable sellers throughout the market area, lining the perimeter of the streets leading to the market, as well as peddling their produce from trays while strolling through the marketplace.

Arriving at the market the seller finds scores of other people, male and female alike, who have brought their produce to sell. If they have come with vegetables, they readily perceive that many others have brought similar produce with them. Each seller seeks a spot from which to try his/her luck. A Saturday morning visit found 43 women in a row, all attempting to sell the small local "Logo" onion. They were in competition with the 20 or so onion sellers observed in other parts of the market. The prices quoted by the vendors were all about the same; the quantities remaining in each seller's possession were plentiful. (Appendix 6 lists representative prices.)

The competition could be greater but several of the more distant cooperatives, especially Maloum and Sapou, send their produce to market with one seller. He serves as the market representative for each producer in the cooperative. Profits are later proportionally divided among contributing producers. Maloum and Somankidi are the best organized for direct market sale because they have established market stands in Kayes.

A recent report by a team of French socio-economists states that, "the Kayes market...can absorb 400 to 500 tons of vegetables. Supplied in part by traditional gardens along the river banks, 20 to 30 hectares of irrigated crops would be sufficient to satisfy the market. The 240 hectares prepared in 1980 greatly surpassed the possibilities of marketing (the produce)" (12).

Still, the hopeful sellers come to Kayes. They come from the traditional gardens bordering the river banks of the town and nearby villages, and they come from the irrigated perimeters. The volume coming from the perimeters is greater, but the costs of production are also higher on the perimeters.

Both production processes, perimeters and traditional gardening, use labor. The difference in the labor costs of production per unit of land are probably not great, but the perimeter operators are able to draw water for their plants with less manual labor effort. The major difference in perimeter production costs is the cost of mechanical irrigation.

Kayes is the only market outlet that the vegetable producers can readily access. The means of transportation, most typically 404 bachées, and the entire road network all lead to Kayes. Other markets at Yelimané and Niore are very small, reportedly have low demand for vegetables and other fresh produce, and the physical and monetary costs of transporting goods there are expensive. The markets in Senegal are amply if not over-supplied by perimeters operating in Senegal. Furthermore, many of the growers transport their produce to Kayes without needing to make a cash payment. They receive credit from the local bachée driver. These growers often do not have the cash to pay for transporting their goods to other markets.

(12) Ballique, Hubert, Michel Didier-Laurent et Pierre Marie, "Place des Travailleurs Migrants dans le Processus de Développement de la Région de Kayes", Ministère de la Santé Publique et des Affaires Sociales, Division du Développement Communautaire, Mai 1983, p. 91.

The result is that the seller may have to remain in Kayes for several days to sell all his/her produce. In some cases, farmers reported spending up to two weeks in Kayes to sell about 150 kilograms of onions. Each day the market fee and meal expenses must be paid. Each day the profit margin is reduced. Also, the longer it takes to sell, the greater the spoilage.

At times of the year when the market is glutted, many sellers are unable to sell all of their produce and it spoils. Loss records have not been kept for prior years, but farmers affirm that spoilage losses were of major proportions. With CAC's assistance such records are being kept for the current campaign and can help define the exact dimensions of the losses incurred by each perimeter.

Market Strategies and Perceptions

Farmers in the perimeters have sought to identify alternatives and solutions to the annual market glut for several years. Their efforts have included attempts by several cooperatives to transport their produce to markets other than Kayes.

A 1979 attempt to sell potatoes in Nioro resulted in a large loss because half the potatoes spoiled in the truck during transport. Of the remaining half, as many spoiled as were sold.

The cooperative of Moussala transported tomatoes to Tambacounda, Senegal. They discovered that the demand for tomatoes there was already satisfied and they incurred a substantial loss.

Gouthioubé and Sangalou, the two perimeters on the Senegal-Mali border, confirmed that the market to which they are closest, Bakel, Senegal, is also saturated. Between Sangalou and Bakel, a distance of 33 kilometers, there are seven irrigated perimeters on the Senegalese side of the Falémé.

A couple of the perimeters furthest from Kayes, in particular Sobokou and Lani-Modi, have created local demand for their garden produce among neighboring village populations. Sobokou has a small clientele in villages as distant as 30 kilometers. Transport is done by donkey cart and the farther the distance from Sobokou, the less the quantity sold for a given price. The farmers of Sobokou built demand for their products by initially distributing

selected produce free to neighboring villages. They then adjusted their crop mix to accommodate the tastes and preferences of their clientele. At present Sobokou depends very little on sales of produce at the Kayes market.

Sobokou, however, must be considered to be an exceptional perimeter relative to the others. It is very well managed and provides for much of the food needs of its farmers as well as limited cash surplus. Also in this category are the perimeters at Somankidi-Coura and Sapou-Kakoulou. The perimeter at Lani-Modi is potentially of the same caliber but has not been in production as long as the other three.

All four of these cooperatives have diversified crop selections which include fruit trees. There is considerable optimism on the part of these enterprising farmers that this diversification will enable them to increase their profits in future years.

The common thread of all of these perimeters is that the "attributeurs" left productive employment in non-farming jobs. Sapou's cooperative includes some former teachers, while the other three cooperatives are composed of returned migrant workers.

The perimeter at Somankidi produces a variety of hot peppers which does very well both in the garden and in the marketplace. They have tried to limit production to allow the price to remain relatively high. This strategy has apparently been successful. They receive as much as 1500 FM per kilogram for the peppers which they have nicknamed "l'or rouge" (red gold).

Beyond changing the crop mixture to achieve crop diversification, other marketing strategies are being pursued by the perimeters. Some of the perimeters made special efforts to get their seeds planted as early as possible in the dry season (October) in order to deliver their produce to market before the competition's produce was ready. Others, like Moussala, planned a staggered planting schedule designed to avoid the need to deliver their entire tomato crop at once. Still others tried to limit their hectareage for each vegetable crop.

Despite these measures, there still appeared to be large quantities of tomatoes, onions, and cabbage in the fields, all at about the same stage of growth, and most likely all headed for market at about the same time. Apparently these market strategies alone are not sufficient.

Marketing Constraints and Alternatives

A capsulization of the primary marketing problems confronting the growers in the Kayes area includes the following:

- limited population with relatively low levels of discretionary income;
- low absorptive capacity for fresh produce and little possibility of significantly increasing demand;
- production capacity which is far greater than demand levels which leads to a high degree of competition and low profit margins;
- high transportation costs coupled with poor roads and limited availability of transportation;
- poor protective measures for produce while in transit which causes substantial (up to 50 percent) losses during shipment;
- insufficient and ineffective methods for long-term storage;
- absence of transformation of fresh produce to storable forms. Another factor which limits effective marketing of perimeter produce is the apparent lack of organized entrepreneurial effort by entrepreneurs with sufficient sources of capital. Although the opportunity exists to transport or transform relatively large quantities of produce for sale in other markets, for reasons which were not readily identifiable, no such efforts were observed.

At the present time, there is speculation that the Kayes area will experience some population growth after the Manantali dam is put into operation. However, that will not occur for at least five more years. Therefore, there is little reason to believe that the demographic composition of the market will change very much in the near future. Consequently, it is not expected that current demand levels for fresh produce will experience any substantial changes.

If the above proposition is accepted, then a more logical place to begin looking for solutions to the marketing problem is on the supply side of the market. Vegetable production needs to be curtailed to approach equilibrium levels of demand. More specifically, this implies that the quantity of vegetables offered on the market at any one time should be limited to reasonable levels with respect to market demand. This can be accomplished in several different ways.

The leadership of URCAK is developing a plan to assign exclusive rights of production of specific crops to each member perimeter. The concept behind this plan is to attempt to control the production levels of each commodity and thereby assume the role of price setter rather than price taker. A similar plan was tried under the aegis of OVSTM's predecessor in 1979 but it failed when farmers producing "low-price" vegetables became envious of those producing higher-priced ones. URCAK's plan will hopefully avoid that pitfall.

Timing of delivery to market would also improve farmers' chances of earning a reasonable profit from sales of their produce. Presently, there is no formal information network operating to apprise farmers of current prices being offered in various markets. This may be considered somewhat too sophisticated of a technique, but many farmers have radios, and most market towns have telephone or telegraph facilities. One possible limitation of this idea is that it is often difficult to receive Radio Mali broadcasts in Kayes.

Substitution of other crops for those which are currently oversupplied is another possibility. Alternative crop selections might include vegetable crops which are not currently being produced except in very limited quantities, such as improved varieties of eggplant, squash, carrots, or melons. Any "new" crop selection should be carefully chosen with attention to its potential ability to withstand transport, susceptibility to heat, consumer preference, etc.

Increased grain production should also be considered. Not only was grain production one of the original goals behind the establishment of the perimeters, but in recent years rain-fed grain production has dropped off to seriously deficient levels. This has resulted in very high grain prices with correspondingly high opportunity costs of growing crops other than grain. At the time of this mission's visit, imported rice and domestically grown millet and sorghum were being sold at the same retail prices, 300 to 350 FM per kilogram.

Some of the perimeter farmers have already acted to respond to this economic condition, but promotion of the idea might encourage faster adoption. To successfully implement this action, land improvements, especially grading and levelling, will need to be done at most of the perimeters. There also may be problems controlling predator birds and insects which attack grain.

Unless and until extensive reconstruction of the roads in the Kayes area is performed, transportation conditions will remain a major barrier to the development of the zone. With respect to the perimeter operations, marketing capabilities will continue to be restricted, and shipping losses can be expected to continue at the present, relatively high, level.

To respond to this condition, improved methods of transporting produce to market can be adopted. Such methods would replace the current ones, for example, piling ripe tomatoes into a large basket, then piling the baskets into a truck. An idea for an improved method for safely transporting the vegetables is to construct protective crates from locally available materials, such as bamboo. The vegetables could be placed in these crates, either alone or with a local cushioning material like peanut shells.

It is expected that such protection would serve to reduce shipping losses, especially for fragile crops like tomatoes. In addition, picking tomatoes before they are fully ripe would permit slightly longer leeway periods for transporting and storing tomatoes before they spoil. Extension efforts need to be expanded and focussed on harvest and postharvest techniques.

Air freighting produce to other parts of Africa or to Europe is not presently practiced, nor does it seem feasible under present circumstances. Specifically, the infrastructure does not lend itself to the efficient undertaking of such an enterprise. No cold storage facility is available, the air strip is relatively small and could not accomodate large freight carriers, and local transportation is too unreliable to permit adherence to rigorous delivery schedules. For these reasons, it seems unlikely that Kayes' perimeter production will enjoy the same export market as the perimeters in the Bamako region or in parts of Upper Volta.

The railroad, which goes through the middle of the cercle of Kayes, is little used by the farmers, especially for transporting their produce to market. The principle reason for this is that the trains are very full when they stop off in the villages along the way and they therefore have limited baggage/freight capacity.

The railroad offers relatively economical domestic rates for transporting fresh fruits and vegetables, and the fare for passengers is also inexpensive compared to the fare asked by bachée drivers. Railroad transportation from Kayes to Bamako of fresh fruit and vegetables is about 25 FM per kilogram for loads less than two tons. This compares very favorably with the 30-50 FM which perimeters pay just to get produce to Kayes. It seemed that few farmers considered using the railroad for transporting their produce. Perhaps URCAK could enter into discussions with the railroad freight office in Kayes to develop a transportation schedule for perimeter produce.

Storage and Preservation

Onions are the only vegetable crop which is currently stored without undergoing some form of transformation, either by drying or processing. The perimeters of Maloum and Fanguiné specialize in onion production because it is a durable crop. Onion can withstand transport and endure prolonged storage conditions.

The present method most farmers use for storing onions is, after removal of the leaves, spreading them out on the earthen floor of a traditional grass-roofed granary. These buildings remain relatively cool and dry inside. The onions are able to be stored for several months, but some spoilage does occur. The granaries are not well-adapted to onion storage. A proper adaptation would provide greater ventilation and air flow for the onions to prevent the build-up of "hot spots" which promote rotting.

After the onion leaves are cut from the bulb, the leaves are slightly pounded, shaped into a ball, and left to dry in the sun. These onion balls are popular condiments throughout the First Region and are added to most sauces. It is interesting to note that before onion production became a prevalent local industry, the First Region imported the dried onion balls from the Dogon region of Mali, via Bamako.

Okra is also stored after being sliced and dried in the sun. The dried okra slices are placed in sacks and kept in dry rooms. Dried okra is also frequently sold in the market and is reportedly a very sought after commodity in Senegal. If this latter situation is true, a feasibility study might be able to identify new market outlets for perimeter production. Few farmers reported drying okra, however, preferring to consume it in its fresh form.

Some limited sun-drying of peppers was reported. Dried peppers are a commodity that is both marketable and storable. The variety of peppers which is grown on the perimeters is not preferred for drying. The variety which is well-adapted to sun-drying is reportedly more labor intensive than the one that the perimeter farmers plant.

Traditional methods of sun-drying vegetables are neither very salubrious nor conducive to an appealing product. The introduction of dust and foreign matter into the drying produce is inevitable. Farmers report that sun-drying is ineffective for drying tomatoes, bananas, or other high moisture-content fruit. The sun does not dry them quickly enough and they rot.

It is suggested that another form of drying be investigated, preferably using low-level appropriate technology. Efficient solar dryers which direct the intense heat of the sun into a closed space, like a cabinet, can dry food products cleanly and quickly. Postharvest Institute for Perishables has developed one such dryer in East Asia which might be readily adapted for use in Mali. This and other similar apparatuses warrant consideration.

At present, refrigeration is infeasible throughout most of the perimeter zone. The Dutch built a small (2000 tons capacity) cold storage facility in Kayes, not far from the market, about three years ago but it has never been operated. There are reports that the Dutch will be sending a technician to put the machinery into proper working order in the near future. The problem which will have to be resolved is, who will be responsible for operating the facility? There will be both electricity bills and maintenance and operating costs for running the supplementary diesel generator. Those costs are exclusive of paying the personnel.

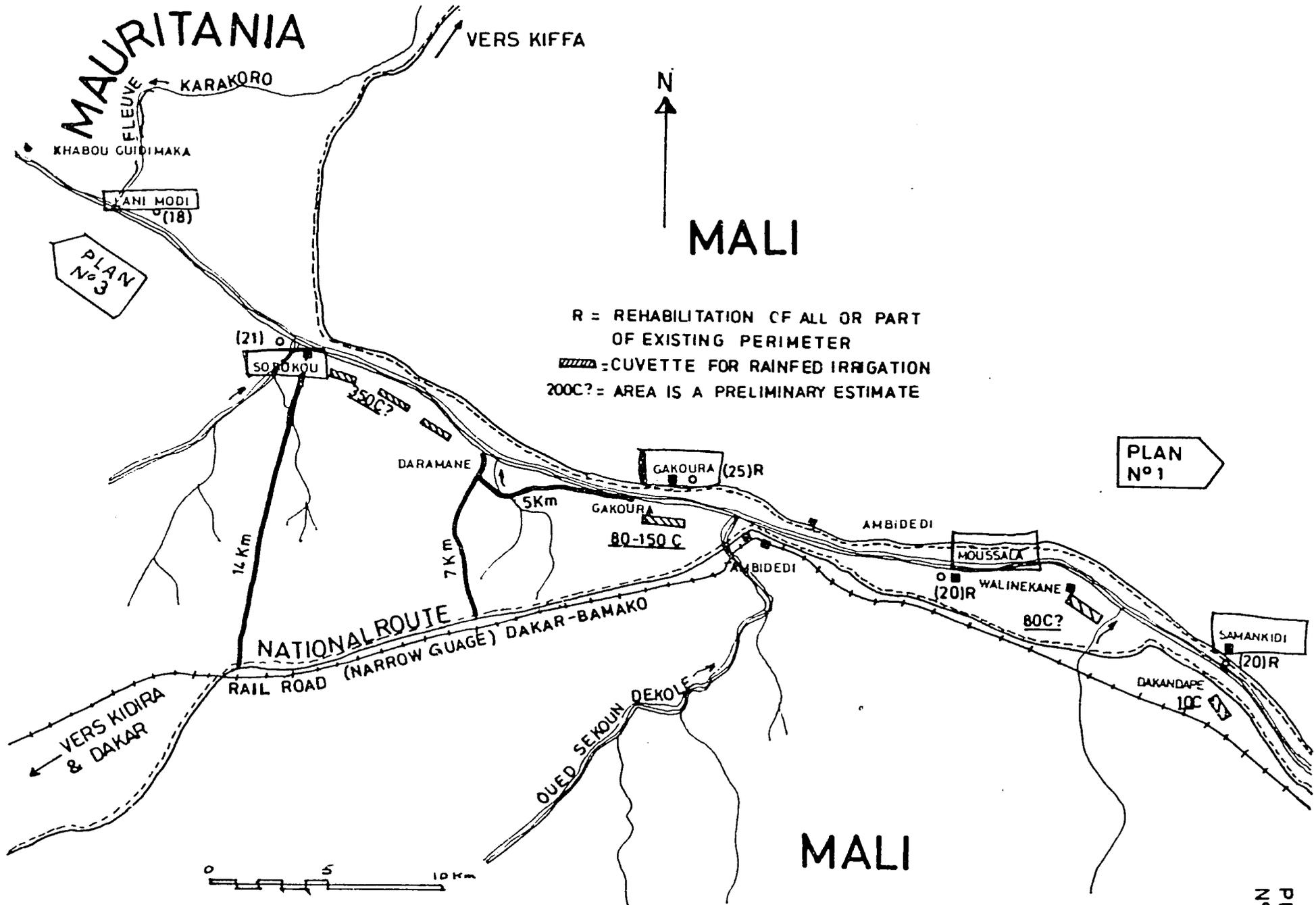
URCAK strongly believes that cold storage rooms will solve all of the marketing problems that the perimeters are now experiencing. One proposal URCAK made was to build a couple of more cold storage rooms in other locations along the river valley. Couthioubé was one location which was mentioned. This hardly seems practical, and certainly not at this stage in the development of the zone.

The idea of reducing the field heat of the freshly-picked produce is a good one. There may be less expensive ways to do so, although only for

relatively small quantities at a time. Evaporative food coolers use the cooling effect of evaporating water to reduce the temperature of foods placed in the cooling box. They are inexpensive to fabricate and can be operated by anyone at extremely low cost. This method might allow a slightly extended storage period for heat-susceptible vegetables, though not nearly as long an extension as a cold storage room. The cost of the former, though, is a fraction of the latter's cost.

One additional improvement in the storage of perimeter produce would be to ensure that the storage rooms being used are properly ventilated. This applies particularly to the small shacks at the Kayes market which some of the cooperatives maintain as store rooms for their unsold produce. These shacks are typically made of corrugated metal and have little or no ventilation. The properties of this kind of construction are such that heat is very easily trapped inside and retained. Small air holes near the roof of the building or use of straw mats as insulation over or under the metal roofs might reduce the heat inside the shack and reduce the rate of vegetable spoilage.

Integration of appropriate storage and preservation methods with more efficient and safer transportation can help bring about decreases in the amount of produce which currently spoils. This effort will require more detailed study and applied research to identify those techniques which are best adapted to the Kayes area. If expanded and improved extension efforts and controlled production are also integrated with these research efforts, the problems that the farmers are currently experiencing will be well on the way to being resolved.



MAURITANIA

MALI

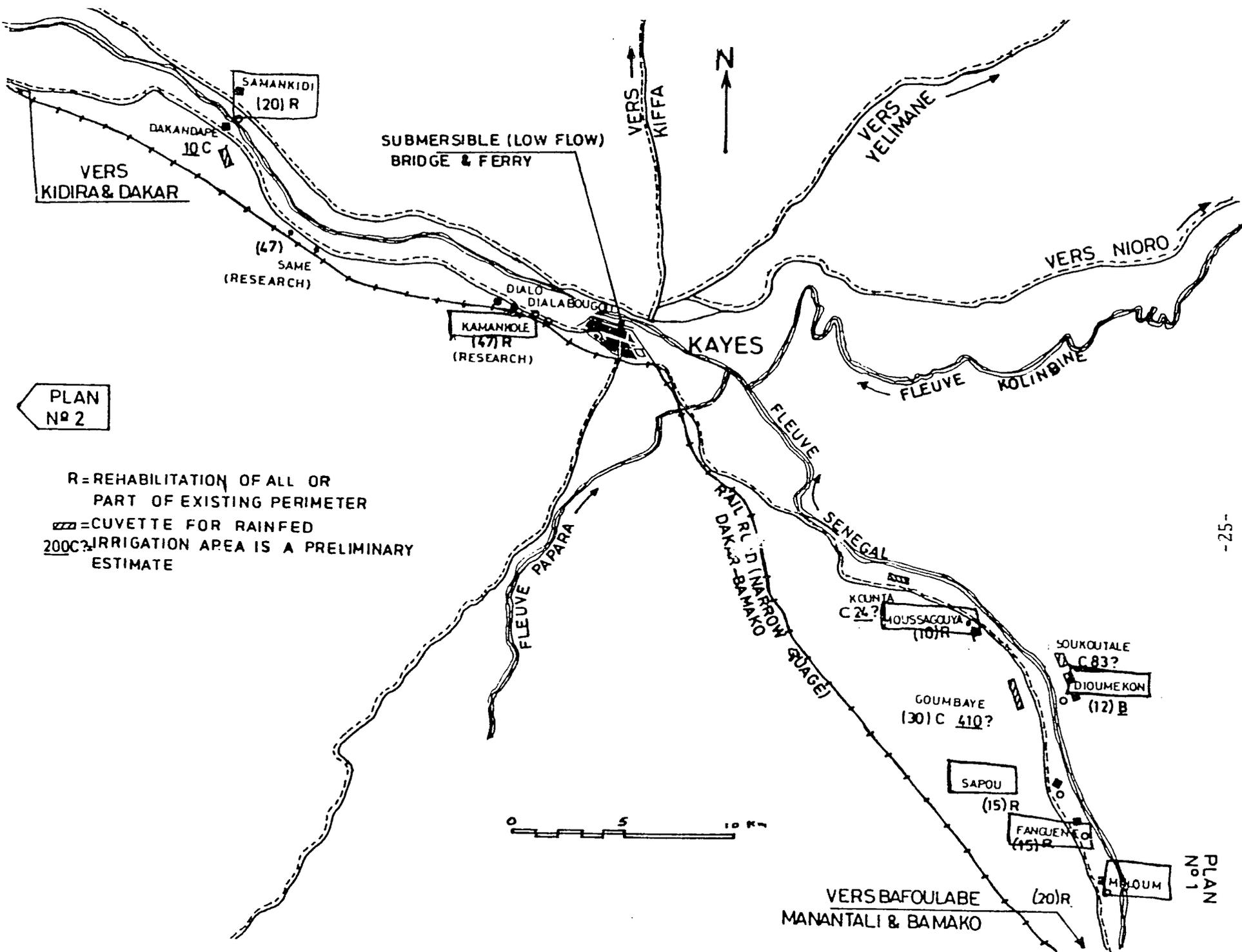
MALI

R = REHABILITATION OF ALL OR PART OF EXISTING PERIMETER
 [Hatched Box] = CUVETTE FOR RAINFED IRRIGATION
 200C? = AREA IS A PRELIMINARY ESTIMATE

PLAN No 3

PLAN No 1

PLAN No 2



PLAN
No 2

R=REHABILITATION OF ALL OR
PART OF EXISTING PERIMETER
 =CUVETTE FOR RAINFED
 200C? IRRIGATION AREA IS A PRELIMINARY
ESTIMATE

PLAN
No 1

26

P L A N S

LEGEND

LEGENDE

EXISTING

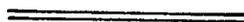
Actuel

RIVER



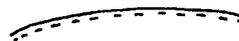
FLEUVE

PAVED ROAD



ROUTE BITUMEE

(UNPAVED) ROAD



ROUTE AMENAGEE

EXISTING PERIMETER(S)
AND AREA (Ha)



PERIMETRE(S) EXISTANT(S)
ET SUPERFICIE (Ha)

PROPOSED

PROPOSE

FEEDER ROAD



PISTE DE PRODUCTION

FEEDER ROAD IN
FLOOD ZONE



PISTE DE PRODUCTION
EN ZONE D'INONDATION

PROPOSED PERIMETER(S)
AND AREA (Ha)



PERIMETRE(S) PROPOSE(S)
ET SUPERFICIE (Ha)

APPENDIX 2

List of Sites and People Visited

February 14, 1984 USAID/Bamako:

Dr. Diane Ponasik, CROPS Officer
Mr. Rollo Ehrich, Agricultural Development Officer
Mr. S. K. Reddy, Senior Horticultural Officer
Mr. Roger Simmons, Program Director
Dr. Gerald Cashion, Program Officer
Mr. James Anderson, Deputy Director

February 15-26, 1984 Kayes:

Mr. Abdoulaye Traoré, Director, OVSTM
Mr. Modibo Traoré, Assistant Director, OVSTM
Mr. Kassim Sidibé, Agronomist, OVSTM
Mr. Mamadou Traoré, Assistant Director, Division of Social Affairs
Mr. Dassé Bouaré, ODIPAC Representative
Mr. Baba Coulibaly, Director, CAC
Mr. Oumarou Ongoiba, CAC
Mr. Donso Camara, Regie des Chemins de Fer du Mali
Mr. Cissouma, Regional Director, Direction Nationale de Cooperation
Mr. Modibo Samaké, Direction Nationale de Cooperation

February 18, 1984

Maloum:

Mr. Madi Makalou, President of Cooperative
Mr. Celestin Diallo, Animateur Rurale
Mr. Ibrahima Kola Cissé, Monitor, OVSTM
Mr. Albert Keita, Chief of Rural Production Center, OVSTM

Fanguiné:

Members of the Cooperative

Sapou-Kakoulou:

Mr. Joseph Cissoko, Vice-President of Cooperative
Mr. Maturin Sylla, Bookkeeper of Cooperative
Mr. Maçi Tigana, Production Manager of Cooperative

February 19, 1984

Same:

Mr. Ernest Bowen, USAID Agricultural Economist working with
Agricultural Apprenticeship Center (CAA)

Somankidi-Coura:

Mr. Ciré Soumaré, President of URCAK

February 20, 1984

Lani-Modi:

Mr. Modibo Konaté, President of Cooperative
Members of the Cooperative

Moussala:

Mr. Wali Bathily, President of Cooperative
Mr. Seydou Goita, Extension Agent, OVSTM
Mr. Issa Bathily, Pump Operator
Mr. Daouda Camara, Commercial Agent

February 21, 1984 Kamenkolé:

Mr. Oumar Oyahitt, Chief of Sector of Kamenkolé, OVSTM

February 22, 1984

Sangalou:

El Hadji Mamadou Namboumou, President of Cooperative
Members of the Cooperative

Gouthioubé:

Mr. Sekou Souaré, President of Cooperative
Members of the Cooperative

Sobokou:

El Hadji Tambo Saounara, President of Cooperative
Mr. Moussa Sellou, Secretary of Cooperative
Mr. Oumar Dia, Vice-President of URCAK and Mechanic of Cooperative
Members of the Cooperative

February 23, 1984 Moussa Waguiya:

Members of the Cooperative

February 24, 1984 Gakoura:

Mr. Dionkoundou Diabira, President of Cooperative
Mr. Issa Dembélé, Extension Agent, OVSTM
Members of the Cooperative

February 26, 1984 Djimékon:

Members of the Cooperative

March 1, 1984 OPAM, Bamako:

Mr. Morifing Koné, Director General
Mr. Yacouba Sanogo, Regional Director for Kayes
Mr. Emile Dackouo, Commercial Director
Mr. Bakari Karabenta, Head of Sales

I. INTRODUCTION

There are thirteen irrigated perimeters along the Senegal river from the Senegal border to Diamou. The farmers of these perimeters all have the same marketing and production constraints. These constraints are: lack of storage facilities for fresh market produce, poor state of the roads, inefficient transportation methods, and lack of appropriate means of preserving farm produce.

II. PERIMETER CROPPINGS

A representative sample of farmers from the thirteen perimeters were interviewed. These perimeters have diversified production among fruits, vegetables and grains.

A. Wet Season croppings

During the wet season, from July until October, farmers plant millet, sorghum, rice and maize. With the exception of Sangalou, none of the thirteen perimeters use supplemental irrigation when rainfall proves inadequate. Due to extremely poor rainfall last rainy season, yields were low. Cited by farmers were yields of 20-30 kilos of sorghum per hectare. The reasons most often given for not supplementing rainfall with irrigation are: the unlevelled state of the perimeter which prevents water from irrigating evenly, and the lack of available money or credit to pay for diesel at that time of year. Sanaglou grows two crops of maize per year, all under irrigation. Maize production is preferred since Sangalou is 111 kilometers from Kayes. Sanaglou feels it would be very difficult to compete with other perimeters for the vegetable market.

B. Dry Season croppings

During the cool season, November through March, the perimeters grow a wide selection of fruits and vegetables. Each perimeter makes its own crop selections. No attempt is made to coordinate crop selections in order to avoid overproduction of some crops. Generally, selections are made depending on market perceptions.

1. Vegetables

Cabbage is a frequently chosen vegetable for fresh market production due to its comparative nonperishability. Solidity and firmness of head are the usual maturity characteristics. Seeds generally come from Bamako. Preferred varieties include Copenhagen and Express. Though cabbage can usually be held three to four days before it starts spoiling, many farmers prefer to grow tomatoes or eggplants for fresh marketing, as these plants produce many times over. Cabbage produces one head, and then is taken out of the garden. Nearly all cabbages are marketed fresh, though a small amount is consumed on-farm as a diet supplement.

Onion production is a popular choice for perimeters which have difficulty marketing fresh produce due to its exceptional storage ability. The most widely grown onion is a local variety, "logo".

It has a 100 day cycle and produces very small bulbs (about the size of a shallot). As the onion reaches maturity the leaves begin to fall. At this point, the leaves are cut to allow the onion to dry out. Leaves are pounded to make small balls which are left to sun-dry. These are used later as a condiment. Onions are generally stored in the bottom of traditional banco graneries. Most farmers avoid piling onions on top of one another. Some farmers put ashes over the onions in order to inhibit insect damage.

As many as three sacks of onions are saved for the next season's planting (1 sack = 60-80 kilos). The rest are sold during the year as income is needed. A small amount may be used for home consumption.

Garlic is grown in small quantities. It is usually sold as a condiment.

Sweet potatoes are grown for local village consumption and the market in Kayes. They are preferred by farmers because cuttings are easier to obtain and are much less costly than potato seeds. Sweet potatoes from Kayes are known for their sweet delicate flavor and are considered superior to sweet potatoes grown in other regions. Those which aren't sold are kept by the producer and dried in the sun. These generally are not sold.

Cowpeas are usually grown as a companion crop and are considered to be a soil improving plant. Both leaves and beans are harvested. Leaves in a fresh green state are sold locally for the preparation of cous-cous, a traditional dish. Dried leaves are used as fodder for animals.

Tomatoes were once more widely produced by the perimeters than they are today. The volume of production has decreased dramatically due to the fragile nature and perishability of tomatoes. Part of the problem is that the red, ripe tomatoes are preferred over immature green tomatoes for cooking sauces. Roma is the most widely produced variety because of its pulpiness and thick skin. Presently, tomatoes are produced by those perimeters which can easily market them in Kayes or sell them to neighboring villages.

Local eggplants are often grown for sale to neighboring villages. Since these are commonly grown during the wet season, most villages are accustomed to eating them. They also store well under warm conditions and cost the same as tomatoes (250 FM/kilo). The plant continues to produce throughout the hot season.

Chili peppers are often called "Or Rouge", due to the high sale price obtained at the Kayes market (1250 FM - 1500 FM/kilo). The main problem is that chili peppers are difficult to grow. Small plants in the nursery are often attacked by insects, diseases and mice.

Okra is grown for both fresh marketing and drying. Young tender pods are marketed fresh. Long stringy pods are cut and dried in the sun. The price of 500 FM/kilo for dried okra encourages farmers to bring home any pods which aren't sold fresh and dry them. Spineless varieties of okra are preferred over indigenous varieties, but they are difficult to find in the region.

Manioc is planted after the last rains around the edge of the perimeter. Harvest is usually six months from planting. It is a good insurance crop as the plants are very drought resistant. While manioc roots usually are harvested as needed, they can be kept for several weeks in a warm, dry place.

2. Fruits

Within the last year many perimeters have diversified their production to include fruits. Bananas, mangos, papayas and oranges are now being tried. Stocks generally come from Bamako or Kita. The most popular banana variety is "Naine", which produces a short stalk with long fruits after six months. A stalk sells for 2500 FM - 2800 FM/kilo.

III. QUANTITIES OF VEGETABLES AND SELECTION

At the perimeters visited, an attempt was made to determine the quantities of each vegetable grown. Exact quantities are difficult to determine as individuals have separate plots which contain a variety of vegetables. A representative sample of perimeters was picked from the thirteen perimeters: three upstream and three downstream. Consideration was also given to choosing three perimeters relatively close to Kayes (within 36 kilometers) and three perimeters far from Kayes (further than 60 kilometers). See table for figures.

It is recommended that farmers decide among themselves a joint crop selection plan before the start of each season. This would avoid the problem of overproduction of certain crops. It is further recommended that crop selection be diversified to include spices and melons. Spices can be stored in a dry state. Melons can be easily transported with few losses due to cracking or bruising.

IV. VEGETABLE TRANSPORT AND STORAGE

A. Present conditions

Aside from traditional grain storage structures, no means exist either on the perimeters or in the villages to store vegetables after harvest. Vegetables are either sun-dried for storage in granaries or they are stored in baskets for immediate evacuation to market. Those vegetables which can be dried and stored are okra, chili peppers, sweet potatoes, maize, cowpeas and groundnuts. Families take from these stocks as their own needs for food or money occur. When asked, most farmers had difficulty determining the amount of their production consumed by the family and the amount marketed.

Transportation of produce to market is difficult because of the extremely poor roads between the respective perimeters and Kayes. Farmers close to Kayes wait roadside for the arrival of small trucks which pass irregularly. Produce in sacks or baskets is transported on top of the canopy or inside the canopy, space permitting. Farmers far from Kayes transport produce by donkey-cart to neighboring villages.

Baskets of produce remain uncovered during transit. Though baskets are cheap and sturdy, they are inefficient. Produce at the bottom of the basket is often crushed due to excessive layering. Also, the basket's

DRY SEASON SURFACE AREAS
OF SELECTED CROPS FOR IRRIGATED PERIMETERS
(ALL FIGURES IN HA)

	Local Eggplant	Maize	Cabbage	"Logo" Onion	"Grano" Onion	Sweet Potato	Cowpea "Niebe"	"Roma" Tomato	Chil. Pepper	Okra	Manioc	Orange	Mango	Papaya	Banana	Ground- Nut	TOTAL AREA PER PERIMET
SAPOU- KAKOULO 27km fr. Kayes	--	--	0.9056	0.3890	0.35	0.3444	0.2050	0.5024	0.3848	0.2050	--	--	--	--	--	--	3.4107
MALOU 36km fr. Kayes	--	--	0.1000	5.000	--	--	0.0050	--	--	--	--	--	--	--	--	--	5.150
SOBOXOU 70km fr. Kayes	0.3200	--	0.2000	0.0350	0.0350	0.1800	2.0000	1.0000	--	1.0000	0.2500	1.0000	2.0000	--	1.5000	0.1800	8.6910
GAKOURA 60km fr. Kayes	1.5000	6.0000	0.5000	--	--	0.5000	--	0.5000	1.0000	3.0000	--	--	0.8000	--	1.0000	--	14.8000
SANGALOU 111km fr. Kayes	--	17.0000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17.0000
SOMANKIDI- COURA 20km fr. Kayes	--	--	--	0.3500	--	--	--	0.1000	0.3000	0.0200	--	--	--	0.2000	1.0000	--	1.9700
Total area per crop	1.7200	17.0000	1.7056	5.7740	0.5185	1.0244	2.2100	2.1024	1.6848	4.2250	0.2500	1.0000	2.3000	0.2000	3.5000	0.1800	

shape is inappropriate for stacking. Efforts are made to keep vegetables as open to the air as possible. Fresh vegetables arrive at market bruised and retaining field heat. Some perimeters have small storage buildings at the Kayes market. These are constructed of cement walls with tin roofs. The buildings are poorly ventilated and retain heat. Both fresh and dried vegetables are stored overnight in these buildings.

B. Recommendations

Though little can be done by farmers to improve the state of their roads, much can be done to protect produce against physical damage and extremes of temperature.

It is important to minimize produce field heat. Farmers can cool food considerably below the prevailing air temperature by using evaporative food coolers. An evaporative food cooler is basically a screened box made with a wooden frame. Cloth covers the top and sides of the box. The box rests within a water storage pan. An evaporative food cooler cools by evaporation of water from its cloth cover. The cloth is moistened as capillary action moves water from the pan it rests within.

Once produce has been cooled it is important to keep it protected from the sun and well ventilated. Wooden cases can be constructed with a rigid shape; light weight, and with ventilation apertures to minimize heating. First priority in the design of a packing case is whether it will enable the product to arrive in good condition. The following points merit consideration:

1. How many layers of the product can be put on top of each other without running the risk that the bottom layer may be crushed.
2. The method of stacking the cases for transport. This influences the relative strength of ends and sides.

If wood is difficult to obtain, an alternative choice may be bamboo.

Improved ventilation is one means of reducing heat retention in the small storage buildings of the Kayes market. Small air holes at the top of the walls would increase cross ventilation. Straw mats placed over or under the tops of tin roofs would also reduce heat accumulation.

C. Concerning the cold storage room

Access to suitable storage can help greatly in the marketing of fruit and vegetables. Deterioration and wastage can be reduced considerably. Supplies from seasonal production can be marketed over a much longer period, reducing the impact of short-term gluts and facilitating a more even flow of produce to consumers.

The Dutch government recently built a cold storage room (capacity 2000 tons) in Kayes. Through a series of unfortunate circumstances, the cold room has never functioned. Though it is operational, there are three problems which must be solved before it can be used:

1. Some parts of the electric refrigerating unit must be replaced.
2. A technician to operate the facility must be found.

3. A system of financing must be devised.

At present the responsibility of finding a solution to these problems rests with the Dutch government.

V. VEGETABLE PROCESSING

A. Present conditions

The sole method farmers use to preserve vegetables is sun drying. With the traditional method of sun drying vegetables, dirt and dust blowing on the drying produce is a problem.

Farmers frequently complain about tomato losses due to rotting before the tomatoes are sold. Rotting tomatoes are usually dumped. This happens when the tomato market is glutted. Farmers are quick to suggest that there should be a tomato paste factory built in the Kayes region to prevent such losses. When asked why they didn't dry their tomatoes, the farmers responded that they were unaccustomed to this practice. One farmer responded that he had tried this but his tomatoes had rotted before they dried.

B. Recommendations

An alternative method to traditional sun drying of vegetables is a solar dryer. A solar dryer is an insulated box which uses the sun's heat to dry food. The box is painted a dull black color inside and out in order to absorb the heat from the sun. Insulation, a porous material placed between a double wall, acts as a barrier against heat loss. This box is then covered with clear plastic, which lets infrared light into the box. Once inside, it is absorbed by the black surfaces of the box, making the air in the box hotter. Food dries faster when air is moving inside the box. Two holes are made: one at the bottom to let air in, and one at the top to let air out. A solar dryer would eliminate the problem of dust and dirt getting on vegetables. It would also insure that vegetables dry quickly and without rotting.

Another processing method which needs to be further researched is that of home canning. If canning were determined to be economically feasible, farmers would have to be taught sterile procedures to avoid Botulism and other health hazards.

APPENDIX 4

Diesel Fuel Consumption and Cost for Seven Irrigated Perimeters,
Kayes Region, Mali, Dry-season, 1983-84

Cooperative	Barrels of Fuel Consumed (a)		Cost per Barrel (in FM) (b)	Estimated Area under Production (in Ha.)	Estimated Fuel Cost per Ha. (in FM)
	Actual/Projected				
Fanguiné	-	4	77,000 (3,000)	1.4	228,570
Moussala	4	7 (c)	80,000 (5,000)	3.5	170,000
Maloum	-	8	75,000 (3,000)	5.1	122,355
Sapou-Kakoulou	-	5	77,000 (2,000)	3.8	101,315
Sangalou	17	20	70,000 (d) (8,000)	17.0 (e)	91,765
Sobokou	-	-	80,000 (5,000)	3.6	-
Gakoura (by train)	-	-	77,100 (1,100)	14.8	-
(by road)	-	-	80,000 (7,000)	14.8	-

Sources: Fuel consumption and cost data from members of cooperatives; production data from OVSTM and WFP.

Notes:

- (a) One barrel equals 200 litres of diesel fuel. Actual figures represent fuel consumption through mid-February. Projected figures represent estimated consumption through the end of the dry season.
- (b) Standard cost for one barrel of diesel fuel in Kayes is 72,000 FM. Figures given include cost of transportation. Bracketed figures represent cost of round trip transportation for one person sent to purchase the fuel. Approximate exchange rate is \$1.00 = 810 FM (Malian Francs).
- (c) Moussala uses 22 litres of diesel fuel per irrigation. Estimated average use of perimeters is approximately 25 litres per irrigation.
- (d) Sangalou purchases fuel in Bakel, Senegal for 66,000 FM/barrel.
- (e) Sangalou primarily produces maize.

V. ANALYSES
IV. ANALYSES

1) Superficie en pépinières (ha)

COMMUNES	Départ	S			U			I		
		Arca	Forate	Olignon	Piment	Laitue	Aspergine			
AL HADJ	Alouala	0,0046	0,0034	0,0050	0,0005	0,0030	0,0012			
	Abouira	0,0043	0,00355	0,0031	0,0004	0,0041	0,0005			
	Aboukou	0,0020	0,0015	0,0025	-	0,0015	-			
	Aboualou	0,0002	0,0001	0,0004	-	0,0002	-			
	Abouhadé	-	-	-	-	-	-			
	Total/Secteur	0,0111	0,00855	0,0110	0,0009	0,0028	0,0017			
AL HADJ	Abouabou	0,0022	0,0011	0,0022	-	-	-			
	Abou	0,0057	0,0037	0,0002	-	-	-			
	Aboukhalé	0,0009	0,0011	0,0003	-	-	-			
	Aboukou-cour	0,0019	0,0020	0,0015	-	-	-			
	Total/Secteur	0,0107	0,0079	0,0042	-	-	-			
	AL HADJ	Abou-kouya	-	-	-	-	-	-		
Abou		-	-	-	-	-	-			
Aboukhalé		-	-	-	-	-	-			
Abou		0,0070	0,0001	0,0004	-	0,0002	-			
Abou-koukou		0,0036	0,0011	0,0033	0,0007	0,0001	0,0015			
Total/Secteur		0,0106	0,0012	0,0037	0,0007	0,0003	0,0015			
AL HADJ	Aboukhalé	0,0044	0,0029	-	0,0005	0,0056	-			
TOTAL/SYSTEM		0,0362	0,02055	0,0189	0,0021	0,0147	0,0032			

2. STATISTIQUE MONDIALE DE LA PRODUCTION (M)

Secteur	Café	Productions (M)												Total
		S	F	B	C	V	L	A	T	I	O	H	E	
		Obou	Fonate	Cignon	Piment	Laiter	Albar	Goabe	Male	Haricot	Picot	Potato		
Mali	Moussaka	1,5600	1,1450	0,1012	0,1174	0,0115	0,2347	0,0540	0,0150	-	0,0110	0,1210	1,543	
	Galura	0,4250	0,4190	0,0140	0,0315	0,0350	0,0770	2,4000	0,0010	0,2700	0,0000	0,0730	11,945	
	Soleon	0,0000	0,2100	0,0500	-	-	0,1000	0,2000	0,0000	-	-	-	1,400	
	Amadou	0,0000	0,0300	0,0000	0,0000	0,0000	-	-	12,0000	-	-	-	12,120	
	Soja	-	-	-	-	-	-	-	7,0000	-	-	-	7,000	
	Lumière	-	-	-	-	-	-	-	2,0000	-	-	-	2,000	
	Total/Secteur	2,1700	1,8040	0,1952	0,5709	0,0730	0,3017	2,6940	29,9160	0,2700	0,1390	0,1940	20,230	
Mali	Mali	1,1000	0,4750	-	0,1500	-	-	-	-	-	-	1,9050	1,710	
	Dielle	0,2250	0,0000	-	0,7250	-	-	-	-	-	-	2,2250	4,675	
	Kimballé	0,0000	0,0000	-	0,1200	-	0,0700	0,1500	-	-	-	1,5200	1,600	
	Mali-cours	0,0000	0,1250	-	-	-	-	0,3750	-	-	-	1,2700	2,515	
	Total/Secteur	1,3250	0,6000	-	0,9950	-	0,0700	0,5250	-	-	-	7,0100	13,950	
Mali	Moussa-Kaya	-	0,0100	2,0500	0,0400	-	-	0,0740	-	0,0130	-	-	2,245	
	Kakou	0,0100	0,2370	0,7450	0,2000	0,0070	0,2040	0,0400	-	0,0240	0,0120	0,1100	2,080	
	Dielle	-	-	-	-	-	-	-	-	-	-	-	-	
	Dielle	0,0450	-	0,0000	0,0500	-	-	0,0000	-	-	-	-	1,010	
	Mali	0,0510	0,0100	0,1070	0,0000	0,0050	0,0100	-	-	0,1240	-	-	0,240	
	Total/Secteur	1,0100	0,2800	2,8520	0,3000	0,0330	0,2740	0,1350	-	0,1830	0,0420	0,1100	11,251	
Mali	0,0000	0,0000	0,0000	-	-	-	0,0350	0,0700	0,0170	0,0000	-	0,1200		
Total/Secteur	0,0000	0,0000	0,0000	0,0000	0,0000	0,0000	0,0700	0,1350	0,0470	0,0000	0,1200	0,330		

APPENDIX 6

Retail Prices for Selected Vegetables,
Kayes market, mid-February, 1984

Crop Selection	Origin	Quantity	Price in FM (a)
Onions, small "Logo" variety	Kakoulou	10-12 small	50
"	"	6-7 medium	50
"	"	8-10 large	100
Onion greens, fresh	-	at 50	25
Onions, "Logo" with greens	Kayes	5 small	25
Onions, large with greens	Kakoulou	4	50
Dried onion greens	-	1 ball	25
Gumbo, fresh	Kayes	5 medium	50
Gumbo, dried	-	1 handful	50
Cabbage, poor quality	Kayes	1 large head	250
Cabbage, dense, good quality	Bamako	1 large head	500
Cabbage	Kakoulou	1 medium head	250
Cabbage	"	1 small head	100 +
Tomatoes, fresh	Kakoulou	4 medium	100
"	Kayes	5-6 small	100
Hot peppers, fresh	Kakoulou	1	5
Sweet potatoes	Kayes	6-7 medium	200
Eggplant, local variety	Kakoulou	1 large	50
"	"	1 medium	25/30
"	"	2 small	50

Source: Interviews with vendors in Kayes market

(a) Approximate exchange rate is \$1.00 = 810 FM (Malian Francs).

APPENDIX 7 : Miscellaneous Data for the Irrigated Perimeters
(Assembled by RBDO, Dakar, Senegal)

PAGE NO. 00001
01/05/84

IRRIGATED PERIMETERS - DATA ON AREA DEVELOPED

VILLAGE	POP.	ETHNICITY	BEG. DATE	TYPE	MEMBERS	ORIG. AREA	PRES. AREA	EXT-83	IDP-REHAB	IDP-NEW
KAMANKOLE	430	Kassonke	1973	Cooperativ	55	32	40	0	40	0
FANGUINE	410	Khassonke	1975	Groupeement	33	15	15	0	15	0
DJIMEKON	424	Khassonke	1975	Groupeement	16	12	12	0	10	8
MALDUM	424	Khassonke	1974	Groupeement	50	26	26	0	26	0
MOUSA GOUYA	138	Khassonke	1976	Groupeement	16	9	9	0	9	0
SAPOU	150	Khassonke	1974	Groupeement	17	15	15	0	15	0
ANKOUA	1426	Soninke	1978	Groupeement	51	25	25	0	25	0
MOUSSALA	958	Soninke	1978	Groupeement	48	20	20	0	20	0
SOBOUKOU	1350	Soninke	1980	Groupeement	39	30	50	0	20	0
SOMANKIDI	2825	Soninke	1977	Cooperativ	12	20	20	0	20	0
KAKOULOU	623	Khassonke	1978	Groupeement	60	50	50	0	50	60
** TOTAL **	9158				397		282	0	250	68

IRRIGATED PERIMETERS - PHYSICAL DATA

VILLAGE	KM. TO VIL.	SOIL ANAL	TOPD. SUR.	WATER	TOPOGRAPHY	LEVELLING	SOILS	CANALS
KAMANKOLE	1.5	None	G.R.	Year-round	Poor	Fair	Fair	Poor
FANGUINE	1.5	After	After	Year-round	Bad	Bad	Good	Fair
DJIMEKON	1.8	After	After	Year-round	Fair	Poor	Fair	Poor
MALDUM	2.0	After	After	Year-round	Fair	Fair	Good	Fair
MOUSA GOUYA	0.5	G.R.	After	Year-round	Bad	Fair	Fair	Poor
SAPDU	2.0	After	G.R.	Year-round	Poor	Poor	Good	Fair
BAKOURA	2.5	None	G.R.	2 seasons	Good	Fair	Good	Fair
MOUSSALA	2.0	None	G.R.	2 seasons	Poor	Fair	Fair	Poor
SOBOUKOU	0.1	None	G.R.	2 seasons	Good	Fair	Good	Fair
SOMANKIDI	0.1	After	G.R.	2 seasons	Fair	Fair	Fair	Poor
KAKOULOU	0.5	None	None	Year-round	Fair	Poor	Fair	Poor

IRRIGATED PERIMETERS - PUMPSET AND DEBT DATA

VILLAGE	GMP YR.	TYPE DIESEL	TYPE PUMP	GMP COST	YR. DEBT	TOT. DEBT
KAMANKOLE	1977	Electric	Guinard	1761550	0	0
FANGUINE	1980	Bernard	Bernard	0	0	0
DJIMEKON	1980	Bernard	Bernard	0	0	0
MALOU	1981	ListerHR2	Deloule	0	0	0
MOUSA GOUYA	1978	ListerHR3	Deloule	0	0	0
SAPOU	1990	ListerHR2	Deloule	0	0	0
BAKOURA	1978	ListerHR3	Deloule	0	0	0
MOUSSALA	1978	ListerHR3	Deloule	5036500	0	0
SOBOUROU	1980	ListerHR2	Lister	5036500	0	0
SOMANKIDI	1977	ListerHR3	Deloule	4172000	0	0
KAKOULOU				1983480	0	0
** TOTAL **				0	0	0
				17990030	0	0

PAGE NO. 00001
01/05/84

IRRIGATED PERIMETERS - PROBLEMS, NEEDS AND COMMENTS

VILLAGE	PROBLEMS	NEEDS	COMMENTS
KAMANKOLE	Weak current--pumping problems in off-season.	General upgrading.	Copp. of 4-perimeters.
FANGUINE DJIMEKON	Poor land development, high water waste.	Possible development of Djimekon cumette --43 ha.	Perimeter not cultivated in off-season 1983. Have lined main canal with flagstone.
MALOUM			
MOUSA GOUYA SAPOU SAKOURA MOUSSALA SOBOUKOU SOMANKIDI			Dynamic leadership--URCAK founders.
KAKOULOU	Perimeter poorly developed--used only in hivernage	General upgrading.	