

**FOOD SECURITY PROJECT
M.S.U. - C.E.S.A.**

EXECUTIVE SUMMARY IN ENGLISH OF WORKING PAPER

No. 86-02

**Description of the Major Trade Routes for Cereals in Mali and an Analysis of Secondary
Price Data for Millet, Maize, and Sorghum**

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March 1986

The paper, which is the second working paper produced this year under the MSU/ST-CESA Food Security Project, provides an overview of the marketing system for millet, sorghum, and maize in Mali and examines the effects of the PRMC (Project de Restructuration des Marchés Céréalières) on the level and stability of cereals prices in Mali. Specifically, the paper:

- briefly describes the major cereal-surplus and deficit zones in the country;
- identifies the major trade routes between these zones;
- evaluates the degree of integration between the major cereal markets in the country since the beginning of the PRMC; and
- analyzes the changes that have occurred under the PRMC with respect to the level and stability of consumer grain prices in Bamako.

I. Production Zones, Consumption Zones, and Major Trade Routes

The major cereal production zones in Mali include:

- The Sudano-guinean zone (annual rainfall from 700 mm to 1400 mm). This zone includes: the southeast (Sikasso-Koutiala), including most of the CMDT region; the Haute Vallée region; and the Center-West.
- The Sahelian zone (annual rainfall from 200 to 650 mm);
- The flood plains of the Niger River.

For coarse grains (millet, maize, sorghum), the major surplus areas are the South and the Haute-Vallée, while the major deficit areas are in the North and, of course, in the main cities.

The main trade routes for cereals are shown on Map I. Particularly important are flows from the southeast to Bamako (Sikasso-Bougouni-Bamako), from the Koutiala region through Mopti to the deficit areas of the North (Tombouctou and Gao), and between Kayes and Bamako. Mopti is particularly important as both a center of grain consumption and as a redistribution market.

II. Analysis of Market Integration

Markets are said to be integrated if there is a rapid flow of information between them and if changes in the supply-demand conditions in one market are quickly reflected in changes in the other markets. When markets are not integrated, there are frequently gluts in some markets at the same time shortages exist in others. A major goal of the PRMC and marketing projects in general is to improve market integration.

Two ways of testing the degree of market integration are correlation of prices across markets (for example, testing whether prices in Bamako and Sikasso move in the same direction at the same time) and calculation of the margins between prices in different markets. A high correlation between the prices in two markets suggests that the markets are well-integrated; if the correlation is low, there are probably impediments to the free flow of information or commodities between those markets or there are other market disruptions (for example, large inflows of food aid). Similarly, stable price margins between markets over time suggest a high degree of market integration, while unstable margins may indicate poor integration.

Using retail price data (for millet, sorghum, and maize) collected by the PRMC for each of the regional capitals (Bamako, Sikasso, Ségou, Kayes, Mopti, Tombouctou, and Gao) over the period March 1983 through January 1985, we calculated correlation coefficients and price margins between various markets (see Tableaux II and III in the Working Paper). The results indicate that in general:

- a. Markets in the South, especially Sikasso-Bamako and Ségou-Bamako, are much better integrated than markets in the North. There seems to be a serious problem of poor market integration in the North, particularly between Mopti, Tombouctou, and Gao, and between Kayes and Bamako. This may be the result of poor transportation and communication and heavy inflows of food aid in these regions during the period under study.
- b. With a few exceptions (again, in the South), the markets for millet and sorghum are generally better integrated than the markets for maize. This is probably the result of the higher volumes of millet and sorghum marketed in most areas compared with maize.

In the future we plan to extend the analysis over a longer period, test the degree of market integration over additional trade routes that our field studies have indicated are important, and analyze in more detail the effects of food aid disbursements, other external shocks, and time lags in transport and communication on the degree of market integration.

III. Analysis of the Effects of the PRMC on the Level and Stability of Prices

The PRMC has several objectives, including:

- a. raising producer prices in order to encourage production;
- b. aligning official consumer prices with actual market prices;
- c. aligning producer and consumer and producer prices with prices in neighboring countries in order to discourage clandestine exports; and
- d. reducing the fluctuation in consumer and producer prices over time.

In order to analyze the effects of the PRMC on market prices for coarse grains, we compared the stability and level of retail prices for millet and sorghum in Bamako during two periods:

- 4-year period before PRMC (January 1978 - December 1981) and a
- 4-year period after PRMC (January 1982 - December 1985).

The effect of the PRMC on the stability of prices was analyzed by calculating coefficients of variation for prices and seasonal price indices for each period. The analysis showed that under the PRMC prices have become more stable from year to year but more variable within given years.

The paper concludes by outlining plans for further analysis, based on collection of primary data, in order to test hypotheses raised in this study.

TABLEAU II : CORRELATIONS DE PRIX INTER-MARCHES

MARCHES	PRODUIT	COEFFIC.R Tr	r ²	T POUR r	dl
Sikasso-Bamako	Mil	.745	.56	6.27	17xx
Ségou-Bamako	Mil	.809	.65	7.09	17xx
Mopti-Tombouctou	Mil	.580	.34	5.46	10xx
Mopti-Gao	Mil	.693	.48	5.30	14xx
Kayes-Bamako	Mil	.387	.149	5.00	20xx
Sikasso-Bamako	Sorgho	.608	.37	5.40	10xx
Ségou-Bamako	Sorgho	.807	.65	5.46	10xx
Mopti-Tombouctou	Sorgho	.576	.33	4.55	13xx
Mopti-Gao	Sorgho	.025	.000625	4.12	15xx
Kayes-Bamako	Sorgho	.552	.304	5.48	20xx
Sikasso-Bamako	Maïs	.433	.187	4.72	17xx
Ségou-Bamako	Maïs	.718	.51	6.02	17xx
Mopti-Tombouctou	Maïs	.199	.0396	3.90	13xx
Mopti-Gao	Maïs	.363	.131	3.09	7x
Kayes-Bamako	Maïs	.771	.59	7.10	20xx

MARS 1983 - JANVIER 1985

xx = Significatif au seuil de 1%.

x = signification au seuil de 2%.