

Western Africa: maize or sorghum

Will millet and sorghum, the dominant food crops in savanna areas of western Africa, be gradually replaced by maize?

Although maize is a productive cereal that is often grown successfully, its extension is dependent on agricultural policies and particularly on the future of the cotton sector.

Over the past 20 years, the courses of development of various cereal crops (e.g. millet, sorghum, maize and rice), staple foods in savanna areas of western Africa, have differed markedly.

Rice cropping in these parts of Africa has long been the focus of government and sponsor attention. Most of the support available for cereal production is tapped to fund rice production in irrigated areas, but the rising food demand is still not being met.

Rainfed millet and sorghum are still the dominant cereal crops (Figs. 1 & 2), accounting for almost 80% in the Sahel region and 60% in the coastal countries (source: FAO). However,

millet and sorghum production has been moderately increasing, +3.3% per annum from 1974-1977 to 1989-1991 in the Sahel region and +2.1% in the coastal countries, with sharp between-year fluctuations. At the same time, maize production took off in the Sahel region, +8.6% per annum, as compared to a rise of +4.7% in the coastal countries where maize is traditionally grown.

These buoyant conditions for maize could indicate partial substitution of this crop for sorghum. Here we attempt to clarify the conditions of this progress by assessing the geographical areas and factors involved. The prospects for these crops are also considered in the light of the current economic setting.

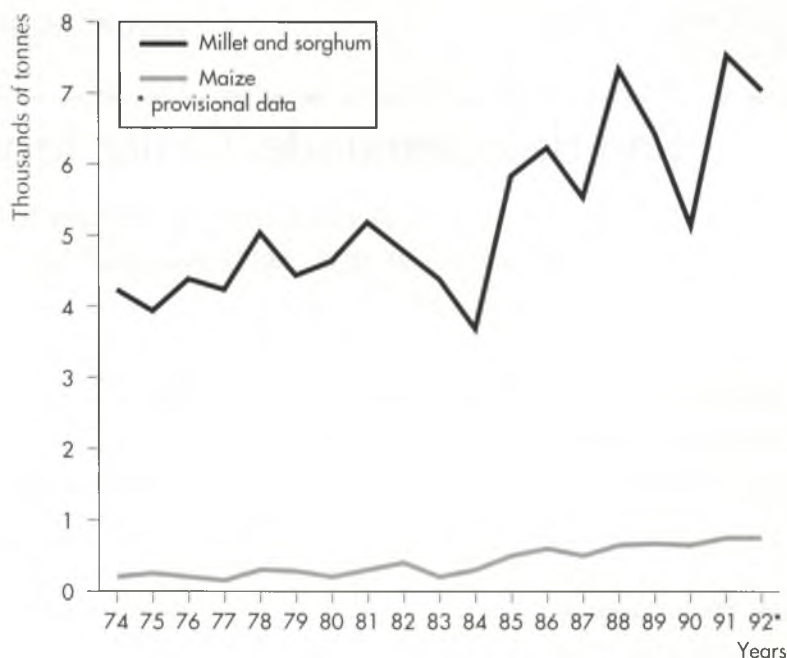


Figure 1. Maize, millet and sorghum production in the Sahelian countries (FAO).

J.-L. FUSILLIER
CIRAD-CA, BP 5035
Montpellier Cedex 1, France

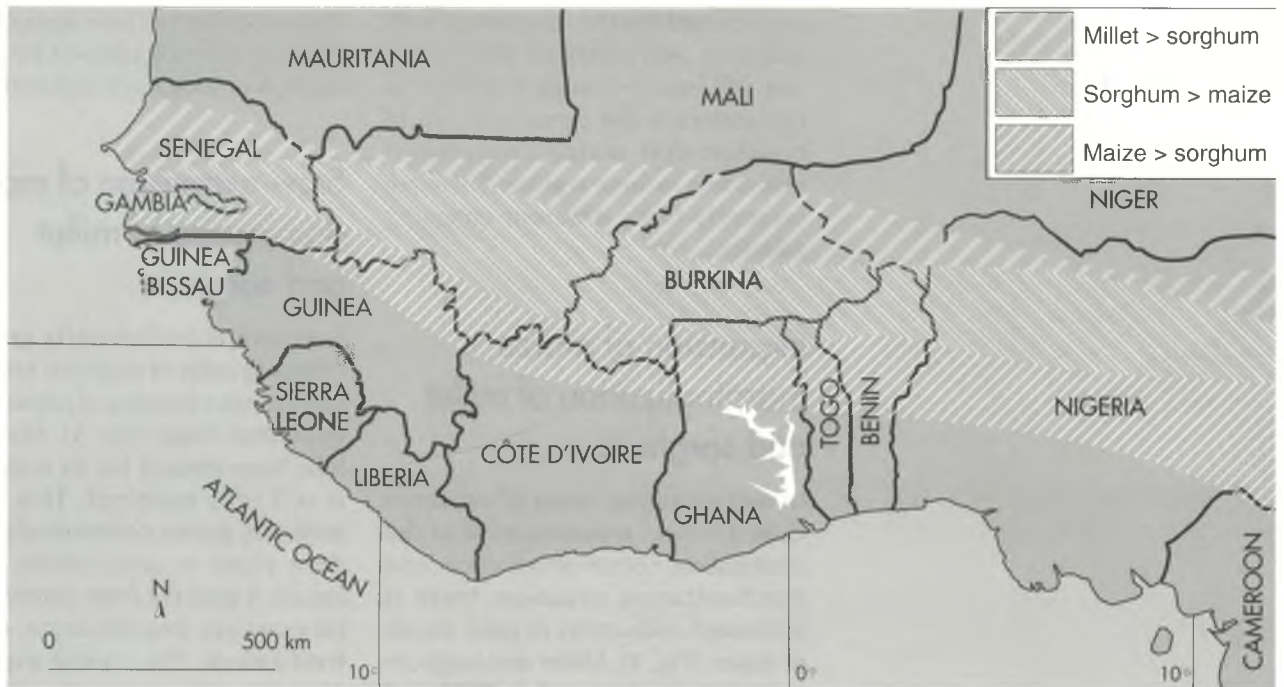


Figure 3. Cereal crop zones in western Africa.

The importance of different cereals in cropping systems

Millet, sorghum and maize cropping patterns in western Africa generally coincide with climatic zones,

depending on the degree of drought tolerance of the crop (Fig. 3). Annual rainfall in millet cropping zones is less than 800 mm, in sorghum cropping zones it is 800-1 000 mm, and maize is dominant when precipitation levels are above 1 000 mm per annum.

It is not easy to investigate variations on a country or regional scale since available data on crop production and components (e.g. areas, yields) are too unreliable for statistical analysis. The problem is further increased by the fact that these subsistence crops are consumed by the producers. A more suitable approach would be to compare local situations, for instance on village croplands. After conducting field surveys, cropping patterns were analysed at the following 11 sites: Syonfan and Karakpo in northern Côte d'Ivoire, Kourouma and Daboura in Burkina, Manga and Waragni in central Togo and Poissongui in the north of the country, Fonsébougou and Niaradougou in southern Mali, Terres neuves de Koumpentoum-Maka in Senegal, and the cotton belt of southern Chad. These geographically scattered sites do not entirely characterize the diversity in this savanna area where

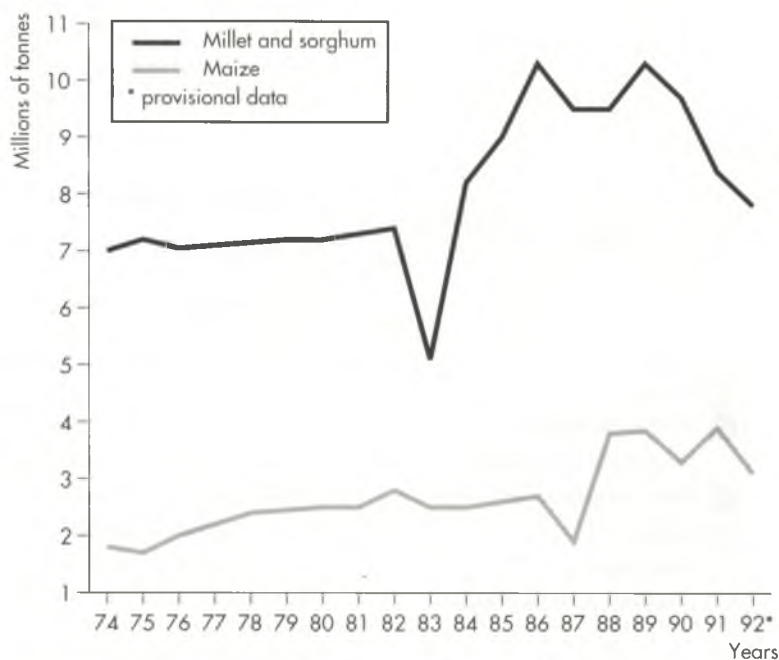


Figure 2. Maize, millet and sorghum production in the coastal countries (Côte d'Ivoire, Ghana, Togo, Benin, Nigeria) (FAO).

acclimated maize competes with sorghum. Nevertheless, the sample was still varied enough to enable us to moderate the commonly-held opinion that maize cropping is expanding in these regions. There are presently three different cropping patterns.

Expansion of maize, marginalization of millet and sorghum

In two cropping areas of northern Côte d'Ivoire, representative of the contrasting cotton production and mechanization situation, there is increased cultivation of pure stands of maize (Fig. 4). Millet and sorghum cropping was marginal in 1975 and had completely disappeared by 1989.

At Kourouma (Burkina), substitution of maize for sorghum, the traditional crop in this region, is underway. Farm mechanization is quite advanced in this cropping area, small tractors were introduced in the early

1980s. Maize has been favored since 1984 on farms equipped for animal traction or motorized cultivation.

Slow expansion of maize, dominance of millet and sorghum

Sorghum is traditionally grown in cropping areas of southern Mali, central-western Burkina (Daboura) and in central Togo (Fig. 5). Maize has long been present but its importance is still only marginal. This crop is generally grown continuously in gardens close to settlements, which means it benefits from careful cultural practices (maintenance, organic fertilization). The present expansion of maize represents a shift of the crop from the village gardens to more remote fields which are usually cropped with millet and sorghum.

The cropping trend in the Daboura (Burkina) region demonstrates that maize is reaching quite northern zones.

Maize is even intercropped with sorghum, but not in pure stands as occurs at Fonsébougou in southern Mali and at Waragni in central Togo.

The expansion of cotton production is the most striking feature in the development of these cropping systems. The spread of maize seems to be but a secondary phenomenon.

Maize production is stagnant

The situations are very different in the cropping areas of Terres neuves in eastern Senegal, in northern Togo (Poissongui) and in southern Chad (Fig. 6). Eastern Senegal is an immigration zone with substantial available funding. In 1974, migrant farmers setting up operations in the area as part of a development project ignored recommendations to crop cotton and maize. This rejection seems to have been based on the fact that groundnut production was a more cost-effective alternative.

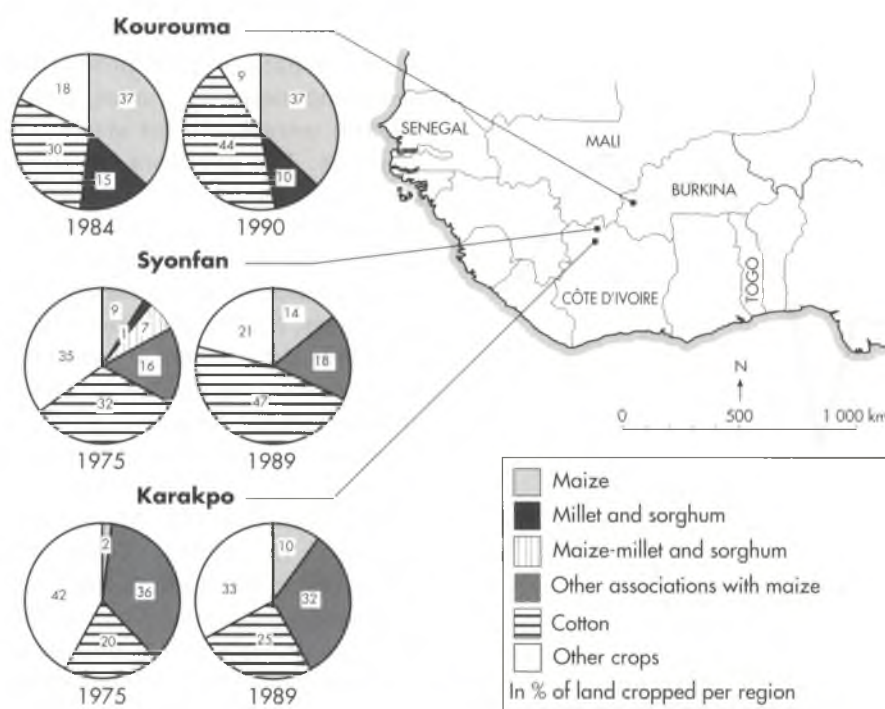


Figure 4. Extension of maize and marginalization of millet and sorghum. Cropping system changes in the savanna zone of western Africa (% of cropland in the village lands on which the considered crop is grown).

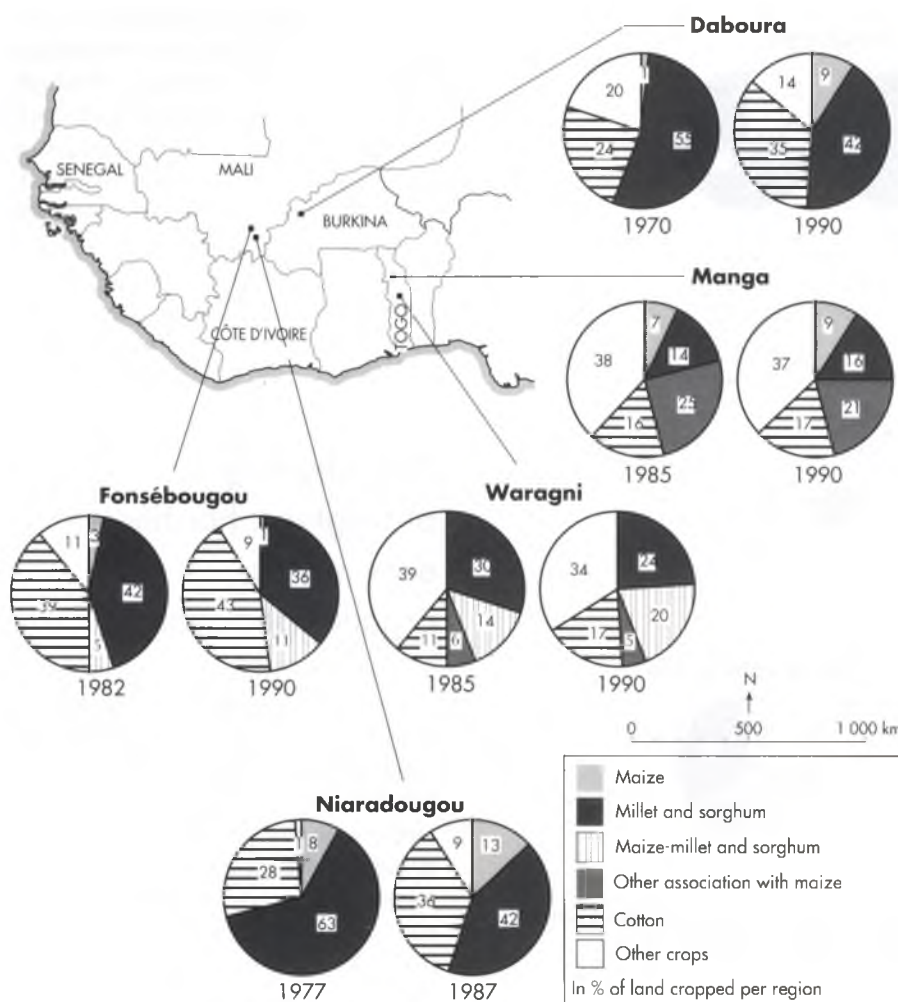


Figure 5. Limited extension of maize and steady dominance of millet and sorghum. Cropping system changes in the savanna zone of western Africa (% of cropland in the region on which the considered crop is grown).

In northern Togo, the introduction of cotton was unsuccessful for other reasons. In the cropping region of Poissongui, soil degradation has occurred as a result of high population pressure. To an increasing extent, farmers are focusing their efforts on monocropping cereals (but not maize) in order to meet basic food requirements. Maize cropping would be too demanding in this situation of declining soil fertility and low farm mechanization. The lack of progression of maize in the cotton basin of southern Chad could be explained by the extensive practices of farmers.

The respective qualities of maize and sorghum

Producers' choices are based on certain key elements: productivity, adaptation to climate and soil, flexibility of the cropping schedule, ability to meet consumer requirements, facility of postharvest processing.

Advantages of maize: productivity and earliness

With its higher yield potential maize offers better labour productivity even though the workload is considerably higher for this crop (sorghum easily adapts to low maintenance conditions).

Maize is, however, fully productive with sufficient water supplies and fertilization, and the needs for these inputs is much higher than for sorghum. Water requirements for maize vary according to the length of the growth cycle of the variety. In the Sudanian zone, it is generally established that 600-900 mm per annum of evenly distributed rainfall is necessary. From the mid-1980s, the more favorable precipitation levels in this zone were probably instrumental in the northward expansion of maize from the savanna regions.

Maize requires fertile soil, and yield differences vis-à-vis sorghum thus become greater with increased mineral fertilization. The different specific uses of farmlands are noteworthy, i.e. the best soils are cropped with maize and the poorest with sorghum, which means that these two crops are relatively complementary. The superiority of maize is further enhanced by the use of improved varieties.

The yield differences between sorghum and maize also reflect differences in the cropping systems used (Fig. 7). The overall peak millet/sorghum yields are 1-1.2 t/ha (excluding irrigated systems), whereas maize yields are usually 1.5-2.5 t/ha. Manure is almost never applied to

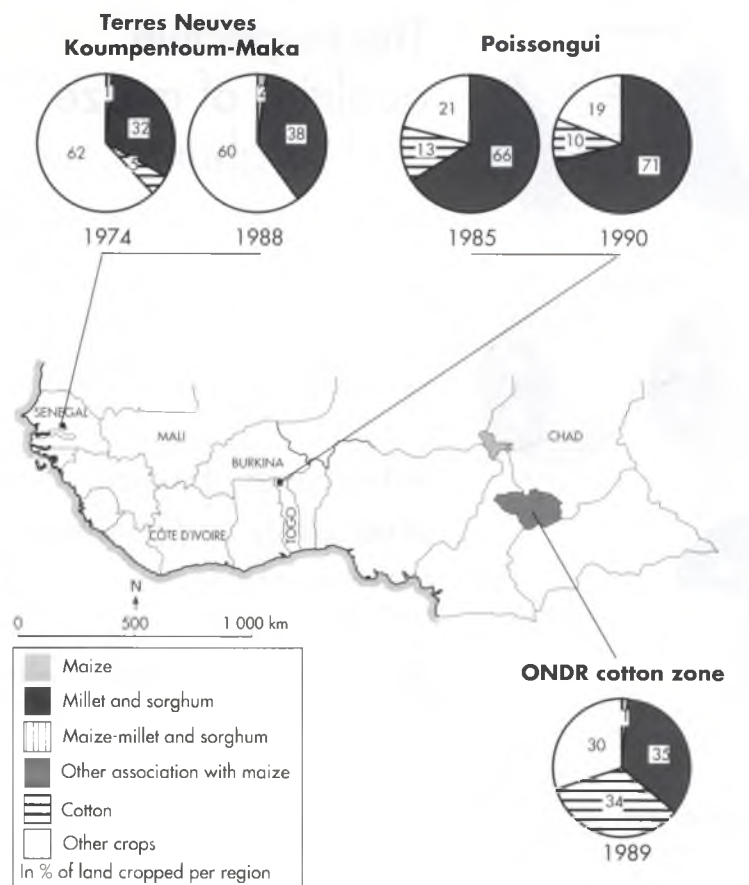


Figure 6. Absence of extension of maize. Cropping system changes in the savanna zone of western Africa (% of cropland in the region that is intercropped).

fertilize millet and sorghum crops. Otherwise, there are wide between-country and -year variations in the proportion of fertilized maize area monitored by various development agencies. There is almost no fertilized area in central-southern Togo, 20-50% in Senegal and 50-70% in Mali. This explains the wide range of maize yields obtained (from less than 1 t to almost 4 t/ha).

Some early varieties of maize (90-day growth cycle) are highly beneficial in the Sudanian zone during the between-harvest "bridge" period. Maize, consumed in the green ear stage, is often the best supplementary crop to bridge the gap before the new harvest of other longer growth cycle food crops. Marketing of this crop as of the month of September could

provide funds to surmount the difficult financial period before cotton revenues come in. Although there are some early and productive selected varieties, they are not widely used for two reasons: first, there are often problems of seed rot since the panicles are very compact; secondly, consumers prefer traditional varieties which have more appealing culinary and organoleptic qualities.

The advantages of sorghum: hardiness, easy milling, organoleptic qualities

Sorghum is an easy-to-grow plant that is fully adapted to the natural environments of the region, e.g. extreme climatic variations, low soil fertility, etc.. It is a secure crop for farmers, contrary to maize. The lower drought tolerance of this latter crop means that maize farmers run a food risk (self-sufficiency in cereal production is often a prime objective of producers because of the volatile cereal markets), and a financial risk, especially for maize grain (repayment of inputs required to obtain high productivity). In southern Mali, in 1992-1993 (before devaluation of the CFA franc), per hectare fertilizer costs matched the price of 500-700 kg of maize.

Easy milling is an important criterion since this operation is usually done manually by women. Hulling and milling are easier and shorter for millet and sorghum than for maize because of the hardness of maize seeds (Table 1).

Maize is not always hulled. However, milling is so difficult that it is an obstacle to the extension of this crop. In northern Cameroon, mills had to be set up to enable farmers to switch to maize. Mechanical milling of maize is more costly than for millet or sorghum, e.g. 25-50% more expensive in northern Cameroon.

Finally, many food studies in the Sahelian countries indicate that

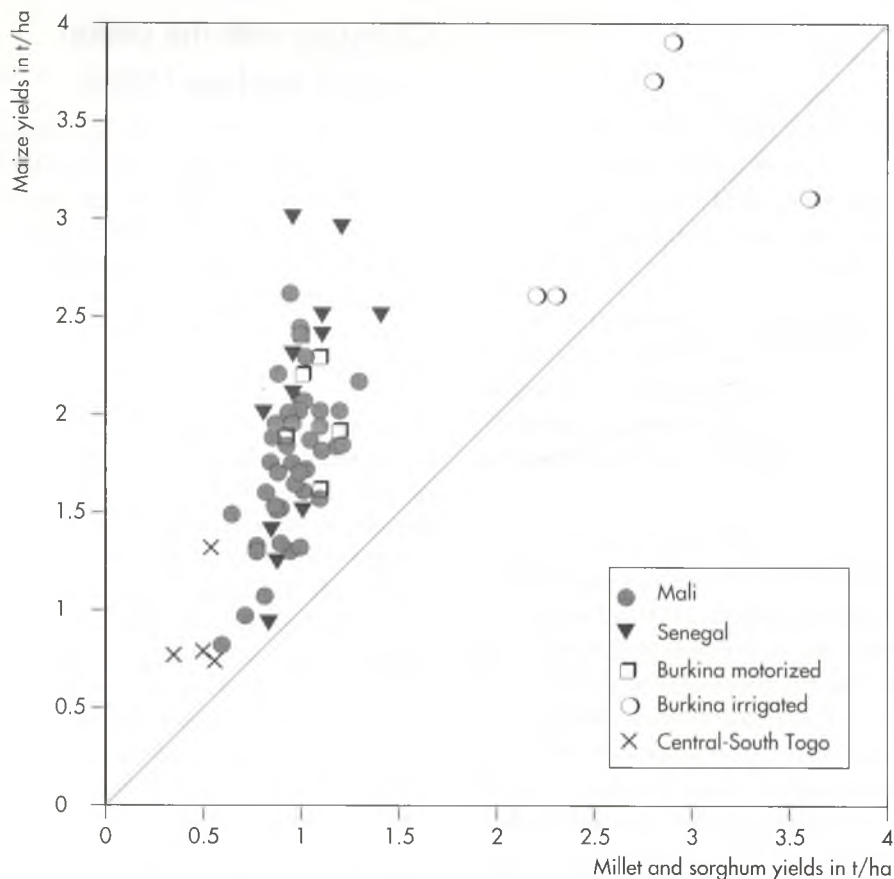


Figure 7. Maize, millet and sorghum yields in the cotton belt during the 1984-1992 period. Each point represents mean maize, millet and sorghum yields for a region supervised by a cotton-producing company, for a given year (sources: CIRAD-CA Togo and cotton-producing companies CMDT, SODEFITEX, SOFITEX).

urban and rural consumers are still very attached to millet and sorghum. These staple foods are appreciated for their organoleptic qualities and traditional importance, closely linked with positive social values. This high status is reflected in the fact that millet and sorghum are often included in festive dishes, particularly some varieties such as mouskwari sorghum in northern Cameroon. Conversely, maize is simply used as an "ordinary" cereal in daily dishes (couscous, mash).

The cultural status of millet and sorghum probably enhances the cost-effectiveness of these traditional cereals which are more expensive than maize, e.g. producer price differences are 15-25% higher for millet and sorghum in Mali.

Table 1. Manual processing of maize and sorghum expressed in kilogrammes of seeds per hour of work (Agel & Yung, 1985).

	Maize	Millet and sorghum
Hulling	8-12	9-15
Milling	2-3	4

Maize diffusion, reflection of the economic situation

The institutional support received from the late 1970s to the mid-1980s contributed substantially to the spread of maize. Introduction of this crop was seen as a suitable way of boosting cereal productivity. This met with government objectives improving national food supplies, while tapping land and manpower resources in order to increase export crops, mainly cotton.

Parallel development of maize and cotton

This support was chiefly provided through cotton companies involved in the overall agricultural development of cotton growing areas in Mali, Senegal, Côte d'Ivoire and Cameroon. Maize was the main recommended, and sometimes compulsory, rotation crop with cotton and food crop intensification activities favored maize, i.e. improved seed, fertilization, herbicides (often on credit). The results varied between countries and according to the cropping techniques used.

Improved maize seeds were widely used, as much as 800 t per annum in the cotton belt of Côte d'Ivoire until 1988, representing about 40 000 ha of crops. This contrasted with the situation in the other countries where less than 100 t per annum of improved seeds were used.

The use of fertilizers on maize has only been widespread in the cotton belt of Mali. The areas fertilized increased from 10 000 ha in 1981 to 70 000 ha in 1992 but the doses were reduced. Mineral fertilization was initially promoted through incentive measures. Mali is the only country to have taken public steps for large scale collection of maize crops (up to 8 000 t collected) at a price that



Photo B. Reynaud

makes the use of fertilizers worthwhile. The CMDT abandoned this collection after the cereal market was liberalized in 1986. Since then, cropping patterns on maize croplands have clearly changed and many producers are now intercropping maize and sorghum.

Herbicide use has been increasing in Mali and Côte d'Ivoire, but not in Senegal and Cameroon. Cropland extension, rather than crop intensification, seems to be the objective here.

Aid for the mechanization of cotton plantations (funds to buy equipment and train planters) has been more effective in promoting the extension of maize cropping than crop intensification programmes. Maize has benefitted considerably from the extension of cotton croplands since it is a choice rotation crop with cotton, and mechanization has further enhanced this progress (Fig. 8). For instance, at Daboura in Burkina, the increase in motorized and animal traction equipment coincided with a reduction of sorghum in cropping plans.

Changes with the cotton crisis of the late 1980s

After 1986, cereal dynamics were upset by a crisis in the cotton sector subsequent to a worldwide slump in cotton prices. Budgetary deficits forced cotton-producing companies to reduce their support to producers. Food crops were immediately affected by this divestiture.

Subsidies and distribution for food crop inputs are now challenged. The private sector is still not developed enough to offer an alternative to the established order. Private involvement will probably be limited to easy-access zones that are likely to bring the highest profits, thus neglecting many rural communities. Organizations of producers are taking shape, but their representatives will require training, especially in management.

The crisis has caused a marked drop in profit margins for cotton planters. Input prices have increased with concomitant stagnation or even decline of cotton prices in some countries. The situation is jeopardizing maize crop intensification practices which are generally funded with cotton profits. The market development of maize usually does not generate enough income to cover cropping expenses. For instance, in one of the most advanced regions of Mali (Koutiala), the marketable share of the maize crop is too low, i.e. about 20% in 1992 or 500 kg of seed/ha. In 1993 (before devaluation of the CFA franc), this was able to cover the costs for 50 kg of NPK and 100 kg of urea per hectare.

The reaction of producers in cotton growing areas of Mali, Burkina and Togo has been to reduce inputs for cotton and maize. In Mali, despite the fact that the CMDT recommends application of 100 kg/ha of NPK complete fertilizer (standard cereal fertilizer 15-15-15) and 150 kg/ha of urea, the actual application rates used by farmers in 1993 were as follows: 53% of maize area under

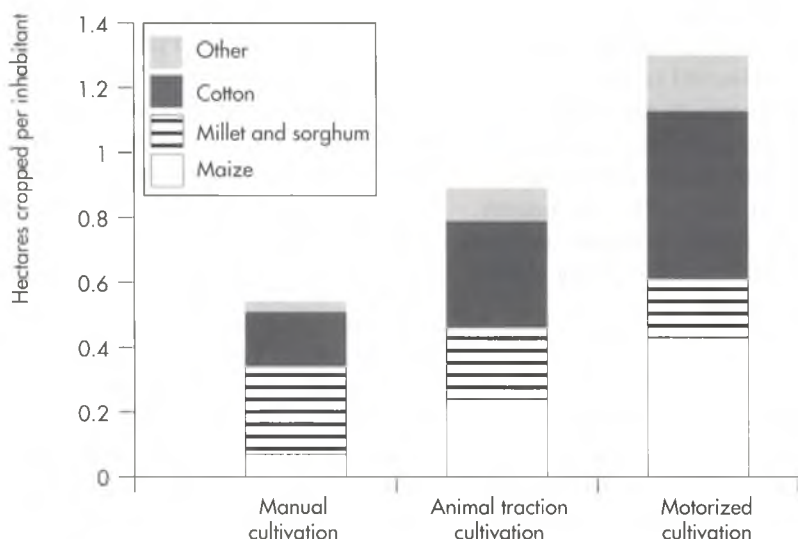


Figure 8. Effect of mechanization on the surface area cropped per farm in western Burkina (Faure, 1991, 1992).



Photo J. Chantereau

CMDT supervision was fertilized with NPK (mean 40 kg/ha), 62% received urea (mean 72 kg/ha).

Devaluation of the CFA franc: an uncertain future for maize

Devaluation of the CFA franc is the latest economic adjustment measure. It could penalize crops that require imported inputs, such as maize but not sorghum and millet. To what extent will potential cotton export earnings be passed on to the farmers? Cotton could again have a key role in funding maize crop intensification if cotton profit margins for producers increase significantly.

References

- AGEL C., YUNG J.-M., 1985. La filière maïs au Sénégal. Paris, France, the French ministère des relations extérieures, 109 pp. + annexes.
- BENHAMOU J., RAYMOND H., ZASLAVSKI J., 1983. Evaluation des filières coton et maïs au Mali. Paris, France, the French ministère des relations extérieures, 250 pp.
- BENOIT CATTIN M., KEBE D., 1992. Modélisation des économies locales Ouest-africaines pour évaluer l'impact des mesures d'ajustement structurel : le cas du maïs en zone cotonnière du Mali. *In Abstracts, 29th EAAE Seminar Food and Agricultural Policies under Structural Adjustment*, Hohenheim, Germany, 21-25 September 1992, p. 19. Hohenheim, Germany, University of Hohenheim.
- BENOIT M., 1977. Mutation agraire dans l'Ouest de la Haute Volta : le cas de Daboura. *Cahiers ORSTOM Sciences humaines*, 14 (2) : 95-111.
- BIGOT Y., 1983. Le maïs de rente dans l'extrême nord de la Côte-d'Ivoire. Opportunités de production, problèmes de commercialisation. *In Actes du séminaire sur les cultures vivrières, élément stratégique du développement agricole ivoirien*, Abidjan, Côte-d'Ivoire, 11-15 mai 1982, p. 175-200. Abidjan, Côte-d'Ivoire, CIRES.
- CIMMYT, 1991. Réalité et tendances. Le maïs dans le monde. Le potentiel maïsicole de l'Afrique subsaharienne. Mexico, Mexico, CIMMYT, 71 p.
- GIRAUDY F., 1993. L'utilisation d'intrants sur les céréales dans la zone Mali-Sud. Rapport de suivi-évaluation. Bamako, Mali, CMDT, 18 pp.
- CONTE S., FUSILLIER J.-L., 1993. Analyse économique de la filière maïs au Cameroun. CAPP-USAID/FAC. Yaoundé, Cameroon, the French ministère de l'agriculture.
- COUSINIE P., DJAGNI K., 1992. Rapport annuel 1991-1992 de la section d'agro-économie. Anié-Mono, Togo, CIRAD-IRCT. Montpellier, France, CIRAD-CA, 81 pp.
- DELGADO C. *et al.*, 1987. La dynamique de la consommation et la production de céréales en Afrique de l'Ouest. July 15-17th 1987 Seminar. Dakar, Senegal, IFPRI/IFRA.
- DUBOIS J.-P., MILLEVILLE P., 1975. Opération Terres neuves. Projet pilote Koumpentoum-Maka. Etude d'accompagnement, rapport de fin de campagne 1974-1975. Dakar, Senegal, ORSTOM.
- FAURE G., 1991. Systèmes de production et petite motorisation. Rapport annuel 1990-1991. Bobo-Dioulasso, Burkina, INERA. Montpellier, France, CIRAD-CA, 53 pp.
- FAURE G., 1992. Intensification et sédentarisation des exploitations mécanisées. Rapport annuel 1990-1991. Bobo-Dioulasso, Burkina, INERA. Montpellier, France, CIRAD-CA, 52 pp.
- FOK M., 1987. Un cas de recherche-développement en Afrique de l'Ouest, le projet maïs en zone CMDT. Montpellier, France, CIRAD-IRAT, unpublished.
- FOOD AND AGRICULTURAL ORGANIZATION OF THE UNITED STATES (FAO), 1988, 1989, 1990, 1991, 1992. Yearbook production 1988, 1989, 1990, 1991, 1992. FAO, Rome, Italy.
- FUSILLIER J.-L., 1993. La filière maïs au Cameroun. Quelles perspectives de développement de la production de maïs ? Contribution à l'étude FAC-CAPP/USAID. Montpellier, France, CIRAD-CA, 60 pp.
- DEMBA K., 1989. Les relations agriculture-élevage et le devenir des systèmes de production, Fonsébougou Sud-Mali. Mémoire de fin d'études, économie du développement agricole agro-alimentaire et rural, Montpellier, France, ENSAM, 103 pp.
- LE ROY X., 1992. Evolution des systèmes agraires de deux communautés Sénoufo du département de Boundiali dans le Nord de la Côte-d'Ivoire. Montpellier, France, ORSTOM, 26 pp.
- RAYMOND G., TCHILGUE Y., BELIAZI K., 1990. Enquête suivi-évaluation 1989-1990 : 30 villages de la zone soudanienne Sud-Tchad. N'Djamena, Tchad, ONDR. Montpellier, France, CIRAD-IRCT, 36 pp.
- REQUIER DESJARDINS D., 1990. La consommation alimentaire à Garoua. Permanences et changements. *In Alimentation, techniques et innovations dans les régions tropicales*, Paris, France, L'harmattan, pp. 53-92.
- SAUTIER D., O'DEYE M., 1989. Mil, maïs, sorgho. Techniques et alimentation au Sahel. Paris, France, L'harmattan, 171 pp.
- SILVESTRE A., MUCHNIK J., 1993. Quel regard sur la complexité des innovations ? La diffusion du maïs au Nord-Cameroun. Communication au séminaire Innovations et sociétés, Montpellier, France, 13-16 September 1993. Montpellier, France, CIRAD, 18 pp.

Abstract... Resumen... Résumé

J.-L. FUSILLIER – Western Africa: maize or sorghum?

Maize has been widely cultivated in savanna areas of Western Africa since the 1970s. However, in the northern part where sorghum and millet are traditionally grown, substitution of maize for either of these crops appears to be limited. These three species could be complementary companion crops since their requirements and capabilities are quite different, i.e. sorghum and millet are stable food crops in climatic and economic risk situations, whereas maize is a high yield crop. The cotton crisis and divestiture of development agencies at the end of the 1980s challenges the intensification of cereal cropping. This will probably lead to renewed interest in sorghum and millet to the detriment of maize, which requires additional inputs such as fertilizers. The future of maize is now uncertain, due to devaluation of the CFA franc, and depends on whether cotton export earnings will be passed on to the farmers.

Key words: maize, sorghum, millet, cotton plant, cropping system, farming system, economy, Burkina, Côte d'Ivoire, Mali, Senegal, Chad, Togo.

J.-L. FUSILLIER – Africa del Oeste: ¿maíz o sorgo?

El cultivo de maíz está muy extendido en la zona de sabana de África del Oeste desde la década del 70. En la parte septentrional, área de cultivo tradicional de sorgo y mijo, la sustitución del sorgo o del mijo por el maíz resulta no obstante limitada. Por tener exigencias y potencialidades muy distintas, estas tres plantas pueden presentar ciertos caracteres complementarios en los sistemas de cultivo: el sorgo y mijo constituyen una seguridad para la producción de plantas comestibles de la explotación frente a los riesgos climáticos o económicos, mientras que el maíz corresponde a un objetivo de productividad. La crisis algodonera y el desinterés por las estructuras de desarrollo, que se produjeron a finales de la década del 80, ponen en entredicho de nuevo la intensificación de los cereales, por lo que habría que esperar que el sorgo y mijo puedan adquirir nuevo auge, en detrimento del maíz, el cual necesita insumos como los abonos en particular. La devaluación del franco CFA deja cierta incertidumbre en cuanto al porvenir del maíz, que depende de la repercusión de la ganancia para la exportación del algodón en las explotaciones agrarias.

Palabras clave: maíz, sorgo, mijo, algodonero, sistema de cultivo, sistema de producción, economía, Burkina, Costa de Marfil, Mali, Senegal, Chad, Togo.

J.-L. FUSILLIER – Afrique de l'Ouest : maïs ou sorgho ?

La culture du maïs s'est largement répandue dans la zone de savane d'Afrique de l'Ouest depuis les années 70. Dans la partie septentrionale, aire de culture traditionnelle du sorgho et du mil, la substitution du maïs au sorgho ou au mil apparaît cependant limitée. Ayant des exigences et des potentialités bien distinctes, ces trois plantes peuvent présenter une certaine complémentarité dans les systèmes de culture : le sorgho et le mil sécurisent la production vivrière de l'exploitation face aux risques climatiques ou économiques, tandis que le maïs répond à un objectif de productivité. La crise cotonnière et le désengagement des structures de développement, intervenus à la fin des années 80, remettent en cause l'intensification des céréales. On pourrait donc s'attendre à un regain d'intérêt pour le sorgho et le mil, au détriment du maïs, qui nécessite des intrants comme les engrais en particulier. La dévaluation du franc CFA laisse une incertitude quant à l'avenir du maïs, qui dépend de la répercussion du gain à l'exportation du coton sur les exploitations agricoles.

Mots-clés : maïs, sorgho, mil, cotonnier, système de culture, système de production, économie, Burkina, Côte d'Ivoire, Mali, Sénégal, Tchad, Togo.