Maize post-harvest situation in Cameroon

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Résumé. La situation postrécolte du maïs au Cameroun

LE CLIMAT ET LA TOPOGRAPHIE

Au Cameroun, le maïs a longtemps été cultivé dans les hauts plateaux de l'ouest, c'est-à-dire dans les provinces du nord-ouest et de l'ouest. L'altitude varie entre 2 100 m et 3 000 m. Le climat y est généralement frais, avec une pluviométrie moyenne oscillant entre 1 500 et 3 000 mm en fonction de l'altitude.

LA PRODUCTION DU MAÏS DANS LA RÉGION DES HAUTS PLATEAUX

En 1990-1991, les hauts plateaux de l'ouest ont produit 466 000 tonnes de maïs, soit environ 60 % de la production du Cameroun. Le système de culture reste traditionnel avec des superficies de 0,4 à 0,6 ha. Le maïs s'y cultive en association avec les autres cultures. La période de récolte s'étend de juin à septembre, en fontion de l'altitude, avec un pic au mois d'août qui correspond à une période de pluviométrie intense.

LA CONSOMMATION ET LA COMMERCIALISATION DU MAÏS DANS LA RÉGION DES HAUTS PLATEAUX

Le maïs est l'aliment de base des populations de la région des hauts plateaux. Pendant plusieurs années, cette culture a été pratiquée pour la consommation. Mais, depuis les années 1980, sa commercialisation a pris de plus en plus d'ampleur à cause de la chute du prix des produits d'exportation et de l'augmentation de la demande en maïs, due au développement des industries consommatrices (brasseries, provenderies). En 1992, le prix du kilogramme du maïs, qui était en moyenne de 60 FCFA en mars, a atteint au cours de ce mois 100 FCFA.

LES SYSTÈMES POSTRÉCOLTE TRADITIONNELS DU MAÏS

Quatre principaux systèmes de conservation et de séchage du maïs ont été identifiés dans la région.

Système 1

C'est le système le plus commun, il est pratiqué dans les zones de moyenne altitude. Dans ces zones, le maïs est cultivé deux saisons par an. Le présent système concerne le maïs de première saison, récolté en pleine période des pluies.

a) Le maïs est récolté dès la maturité en pleine saison des pluies, puis partiellement déspathé.
b) Il est ensuite stocké dans les greniers se trouvant dans les cuisines.
c) Il est séché par la chaleur dégagée par le feu de bois.

Système 2

Le système 2 est pratiqué dans les régions de grande altitude. a) Le maïs après maturité est laissé au champ et est récolté en octobre en ayant déjà subi un premier séchage au champ. b) Le maïs ainsi récolté est stocké dans les «taps» et est donc séché par ventilation naturelle.

Système 3

Le système 3 est pratiqué dans les régions d'altitude moyenne àdeux cycles de maïs par an.

Le séchage du maïs de première saison se fait comme dans le système 1. Le maïs de second cycle est laissé en champ pendant une bonne période; après avoir séché, il est récolté et stocké directement dans les greniers et ne nécessite plus de chauffage.

Système 4

Ce système est pratiqué dans les zones où le maïs ne constitue pas l'aliment de base.
a) Le maïs est récolté pendant la saison des pluies.
b) Les épis sont attachés sur les bambous à l'aide des spathes.
c) Ces bambous sont placés dans les greniers et le chauffage se fait comme dans le système 1.

Les systèmes traditionnels de postrécolte décrits ci-dessus ne sont pas le fait du hasard, mais plutôt le résultat de longues recherches par les agriculteurs.

Avec le temps, la culture du maïs a pris beaucoup d'ampleur, la production a augmenté considérablement en réponse à la demande qui devenait de plus en plus importante. Dès lors, les structures traditionnelles de conservation et de séchage devenaient inefficientes. De plus, les techniques de production ont été améliorées par l'introduction des fertilisants et des semences améliorées.

Cette nouvelle approche n'a malheureusement pas été suivie par les structures traditionnelles de stockage qui semblaient
être dépassées. Les conséquences directes de l'augmentation de la production de maïs sont les suivantes:

- destruction du maïs stocké en bordure de route par les eaux de pluie à cause des contraintes de transport;
- destruction du maïs dans les greniers due à la pression de plus en plus forte des produits stockés;
- réaction des agriculteurs de zones forestières qui se sont lancés dans la production intensive du maïs à travers des champs de superficie parfois supérieure à 5 ha. Cette réaction s'est faite sans que les agriculteurs concernés réfléchissent sur les structures devant servir au stockage et à la conservation. La nécessité de développer les systèmes de post-récolte s'imposait alors.

LE DÉVELOPPEMENT DU PROJET DE PROMOTION DES SYSTÈMES DE POSTRÉCOLTE (PPSPR)

Le projet a été lancé en 1988 dans la région des hauts plateaux. il s'occupe des problèmes de postrécolte des principales cultures vivrières de cette région, en mettant un accent particulier sur le maïs. Une étude de base, menée par le projet, a révélé que le maïs était confronté à deux principaux problèmes: le transport depuis les champs jusqu'aux villages et le séchage par les paysans. Face à ces problèmes, le projet a développé les stratégies suivantes.

L'introduction de l'âne comme animal de transport

Afin de pallier aux problèmes de transport, et compte tenu du relief accidenté dans les hauts plateaux, 8 ânes ont été introduits grâce aux agriculteurs de contact dans deux villages du nord-ouest pour le transport des produits agricoles. Les agriculteurs ont été formés àl'utilisation de ces animaux, ainsi qu'aux soins à leur donner.

L'introduction et la vulgarisation des cribs de maïs

Une étude comparative entre les cribs et les systèmes de séchage traditionnels, menée par le projet, a révélé que l'humidité des graines baisse de 22 à 12 % après 4 mois de séchage dans les deux cas. Mais des différences ont été observées

- les cribs empêchent l'attaque de maïs par les rats;
- les cribs n'ont pas besoin de la chaleur du feu de bois pour le séchage.

Deux mille cinq cents agriculteurs dans 105 villages du nord-ouest et de l'ouest ont participé aux journées portes ouvertes organisées par le projet sur la «technologie des cribs». La première journée portes ouvertes a eu lieu quelques mois avant la récolte et concernait id construction des cribs avec le matériel local. La deuxième journée portes ouvertes a eu lieu pendant la récolte du maïs et concernait la mise en place du maïs dans ces cribs. La troisième journée portes ouvertes a eu lieu trois mois après la récolte, et le thème principal était la comparaison du maïs de cribs avec le maïs séché par système traditionnel: les résultats ont été très concluants.

Le test et l'introduction du séchoir Brook type

Le séchoir *Brook* type a été introduit dans la région parce qu'il présente les avantages suivants:

- il permet aux agriculteurs de réduire l'utilisation du feu de bois;
- il permet de sécher de plus grands volumes de maïs à cause de son espace de séchage plus grand que celui des cribs.

Le séchoir a été testé dans trois centres d'essais d'adaptation et de démonstration (CEAD), avant d'être introduit en milieu paysan.

Les résultats des tests dans les CEAD étaient les suivants 600 kg de maïs ont été séchés de 30 à 13 % d'humidité pendant 90 heures (environ 4 jours), et 180 kg de bois seulement ont été utilisés, en comparaison de plus de 2 000 kg de bois utilisés en 39 jours dans la méthode traditionnelle pour obtenir les mêmes résultats. La construction de ce type de séchoir a concerné environ 150 agriculteurs.

CONCLUSION

Après les années 80, une nouvelle tendance à la production intensive du maïs est apparue au Cameroun pour deux raisons:

- la demande intérieure a augmenté, de la part de populations urbaines croissantes (exode rural) et de la part des industries consommatrices de maïs - brasseries et provenderies - qui se sont développées;
- après la chute des cours des produits d'exportation (cacao, café), les agriculteurs ont commencé à diversifier leurs cultures.

Cependant, malgré cette augmentation très importante de la production du maïs, la demande intérieure n'est pas satisfaite. En 1992, par exemple, 25 600 tonnes de maïs ont été importées. Pour tenter de satisfaire à la demande, les régions forestières moins favorables se sont lancées dans la culture intensive du maïs sur des superficies dépassant parfois les 5 ha.

Pour que la production soit soutenue et que les agriculteurs (producteurs) soient motivés dans ces régions forestières, il est nécessaire de développer des équipements de conservation performants et de grande capacité. C'est pourquoi le projet de promotion des systèmes de postrécolte se propose d'importer un séchoir *Batch type* pour l'adapter aux conditions locales, afin qu'il soit ensuite produit sur place.

Climate and topograghy

The grassland region of the North West and West provinces of Cameroon is in general an upland area, much of which is above 1000 metres in altitude. There is a great diversity of climates within the region due to its topography, which varies in altitude from 200 metres in some of the river valleys to 3000 meters at Mount Oku. Although temperatures obviously differ with altitude and vary accordingly, they are generally cool, rarely averaging more than 25°C in the day and less than 10°C at night.

Local rainfall is also affected by the highland terrain and varies considerably within a small area, from 1,500 mm per annum up to 3,000 mm per annum in the higher elevations. The rainy season begins in March and lasts until early November, but the months of greatest precipitation are generally from July to September.

Importance of maize production

According to estimates, the maize traditional sector produced a total of 466,000 tons in 1990-91.
The Western Highland region accounted for about 60% of this total (CONTE, FUSILLIER 1993).

Cultivated in small plots of 0.4 to 0.6 ha, maize is usually intercropped with beans, potatoes, groundnuts and yams, according to locations. The crop is planted throughout the region at the onset of the rainy season, between the second half of March and early April. The land is often prepared by clearing and burning off the weeds at the end of the dry season, followed by digging and ridging of the cleared land with a local hoe. Alternatively the land is weeded by hand and the weeds are left to dry in the sun and then collected, heaped into ridges and covered with the surrounding soil, prior to burning.

Since the temperatures vary according to altitude and the rainfall differs so markedly, the harvesting of maize around this region spans an extremely long period of time, despite the fact that the maize is planted within the same one or two week period throughout. in the lower areas below 1,000 meters,

harvesting begins as early as the middle of June, while in the higher areas, above 1,800 meters, harvesting is not done before September.

In general, traditional varieties of the flint type and dark yellow grain are commonly planted. However, through breeding, new high yielding varieties have been introduced, i.e. Coca, a white dent grain common within the mid-altitude areas.

Maize consumption and marketing

For a typical rural adult person from this grassland area of Cameroon, maize is the single most important diet food. Such a person will generally not hesitate to admit that he feels like he has not eaten at all if he has not had a maize meal at least once a day.

Up until the late 80's, maize was regarded by the majority of people as a crop solely for home consumption rather than for cash. Nevertheless, it could always be found in the weekly markets of the region where it is sold in "tins", buckets or bags. Maize is increasingly gaining importance as a cash crop, following the large decrease in the prices of the main cash crops, i.e. cocoa, coffee and cotton. According to the longterm food plan prepared by the Ministry of Planning in 1986, the increase in the demand for maize is estimated at 41 % for the period 1985-96.

This relatively new trend has been encouraged by high demand, particularly from large scale buyers such as MAISCAM, *SCTC (Société camerounaise de transformation des céréales)* and animal feed mills (NUTRICAM, SPC, etc.). Thus, in March 1992 the price per kg, which used to be 60 CFAF on average, went over 100 FCFA (Table 1).

Table 1. Average monthly maize market prices in the North West Province (FCFA/kg).

	1989-1990	**1990-1991**	**1991-1992**	**1992-1993**	**Average**
Jul	108	51	78	119	89
Aug	104	61	81	82	82
Sep	71	46	69	76	65
Oct	64	43	87	71	66
Nov	36	35	83	71	57
Dec	38	37	93	67	59
Jan	45	36	72		51
Feb	46	40	92		59
Mar	51	44	111		69
Apr	62	47	102		70

May	62	56	130	83
Jun	65	56	127	83

Maize traditional post-harvest systems

Since time immemorial, farmers in the Western Highlands of Cameroon produced maize mostly for their own family consumption. Many different types of drying and storage structures have therefore been empirically developed through the years by the farmers of this region. Hence, one can distinguish four specific post-harvest systems, as a result of the agroecological diversity of the region.

System 1

This is the commonest system of drying and storage in the Highlands and is characteristic of the singlecropping areas and also of the first cycle crop of the double-cropping areas. Within the mid-altitude areas of the Highlands where this post-harvest system prevails, the maize crop matures and is harvested at moisture contents of 30% to 35% during the period of heavy rainfalls of July through September. Thus, the crop has to be dried considerably before safe storage can be achieved.

The maize cobs are picked by hand from the plant and the outer sheaves of each cob are stripped off and discarded, leaving the tightly clasping inner sheaves intact around the cob. The partially dehusked cobs are then carried home in baskets and placed within a structure called a "banda", or kitchen ceiling (figure 1). Normally the cobs are spread out evenly over this ceiling to form a layer of not more than 30 to 40 cm, for adequate drying. Drying is then carried out with supplemented firewood heat provided by a strong fire, which is kept continuously burning in the kitchen for at least two weeks after harvest. It is believed that the smoke of the family's cooking fire has a repelling effect against insects.

The drying operation lasts for about two months during which the layer of cobs is turned at regular intervals, so that the driest cobs are placed at the top of the layer and the wettest at the bottom. in this way, the maize slowly dries down to a safe moisture content. After drying is achieved, the crop remains in the "banda" throughout the season whilst the family consumes it until it is finished or until the next harvest is ready.

System 2

In the higher altitudes - 1,500 to 2,200 meters above sea level such as the high plateau of Donga-mantung division, the maize crop takes longer to mature and is harvested in late October when the dry season has started. The maize cobs are stripped of their outer sheaves, as in the post-harvest system 1, before being spread out for drying in a raised platform structure built right in the corn fields. The structure, locally called a "tap" (figure 2), serves, in fact, two purposes: its upper section is used for drying through natural ventilation, while the lower section is used as a farm shelter.

The drying operation is normally completed by early December, when the crop is moved to the dwelling house using baskets. Women and children are usually responsible for this transport operation. The crop is sorted on arrival at home. Only healthy cobs are stored in a structure called a "tchang" - a box made of raffia sticks and supported by stones (figure 3).

System 3

In some areas of the region, the farmers cultivate maize twice a year. The first cycle crop is harvested in July-August during the rainy season, while the second is harvested in the dry season in DecemberJanuary. The first cycle crop is handled in the same way as the post-harvest system 1, whereas for the second cycle crop maize cobs are left to dry on the stalk. They are only picked when completely dried, before being stored in the banda.

System 4

This method of drying is a bit similar to system 1 in the sense that the maize is dried out in the dwelling house over the cooking fire. However, instead of being placed inside the ceiling, the cobs are hung in pairs from raffia poles above the fire (figure 4). The outer sheaves of the cobs, instead of being stripped off immediately following harvest, are peeled back and used for tying the *cobs together in pairs. Using this method, the cobs are more exposed to the heat of the fire, but the labour involved is much greater than in system 1. Thus, the use of this system is limited to places where maize is less important in the local diet than root crops, i.e. yams and cocoyams.

All these traditional post-harvest structures were not developed overnight. They certainly are the results of series of "trials and errors" that farmers took many years to develop. The post-harvest systems reached a certain level of equilibrium which satisfied the local needs for maize handling, drying and storage, mainly for home consumption.

However, following the new trends of market oriented production, with the introduction of improved maize varieties and the use of fertilizer during the late 70's and early 80's, the larger quantities that farmers are now producing have not been matched by improved techniques or increased size of drying and storage facilities. Hence, most maize producers, particularly those who use post-harvest system 1 (previously described), have serious problems in achieving adequate and timely drying of the harvest during the rainy season. In addition, the transportation of these larger quantities from the fields to the dwelling house for drying always presents a challenge to many farmers. During this wet harvest period, it is quite common to see heaps of maize cobs on the roadsides waiting for transport. Thus, health hazards associated with mouldy grains are high, besides the subsequent losses due to poor drying.

A new trend observed since 1989-90 is the development of many medium sized maize farms - more than 5 ha -particularly in areas of the country that were not traditionally producing maize. This trend has been favoured by the increased demand for maize in the country, coupled with the failing prices of the main cash crops, coffee and cocoa. These emerging maize producing areas are in the southern part of the country, characterised by its equatorial climate -long rainy season, high relative humidities and temperatures much higher than in the Highlands region. Although the production potential is high in this region, the new maize farmers have not yet got appropriate solutions for the handling, drying and storage of their crops.

Figure 1. The "banda ". for drying, storage and cooking place all together.

Figure 2. The "tap", a dual prropose structure: a maize dryer and a farm shelter (Donga-mantung division Cameroon)

Figure 3. The "tchang" or raffia box, used for the storage of unhusked maize cobs in Donga-mantung division, Cameroon.

Figure 4. Drying method within banda used in post-harvest system 4.

The development of post-harvest systems project

Since 1988, the Post-Harvest Development Project (PDP) has been implemented in Cameroon, with the assistance of UNDP and FAO. The Project covers primarily the Highlands region, with main immediate objectives to develop and disseminate improved post harvest technologies for the main food crops. Maize being an important food and cash crop in the region, particular attention has been given to the maize crop by the Project.

Concerning maize post-harvest activities, baseline studies carried out at the onset of the Project helped to draw up the following priority lines of actions:

- Improved farm-to-village transportation with the introduction of donkeys as pack animals for the transport of crops from the farm to the dwelling house and from the house to the market.

Improved maize drying at farmer level: the introduction and extension of the use of maize cribs;

- the trials and introduction of the "Brook-type" dryer.

Introduction of donkeys as pack animals

The topography of the Project area is characterised by hills and valleys, usually without roads or even small tracks linking farms to villages. With the increasing food crop production, the transportation of farm goods constitutes one of the main post-harvest constraints facing the farmers.

The project has introduced the use of donkeys as pack animals to eight contact farmers in two villages on a pilot basis. Three animals were first introduced in the village of Mendangkue, an important potato producing area characterised by steep hills only accessible by footpaths. Later, five more donkeys were placed in Balligham, a village well known for its cassava production, processing and garri marketing all year round. Following practical training on the use and care of the donkeys, the animals were distributed to selected contact farmers, on a cost sharing basis.

The introduction and extension of the use of maize cribs

A comparative study carried out by the Project on the efficiency of drying maize in cribs, against the traditional method, indicated that in both cases, the grain moisture content of 11 to 12% was reached after four months' drying. However, the crib has the advantage of limiting attacks by rodents and does not require any use of fire-wood. Therefore, the natural air-drying technique with the crib (figure 5) was demonstrated to maize producers at the contact farmer level.

Figure 5. The maize crib.

The use of cribs was demonstrated to about 2,500 farmers in 105 villages in the North West and West Provinces, following the training of extension staff. The purpose of these demonstrations was to extend the technology of maize drying in cribs to as many villagers as possible through the network of contact farmers in the target villages. Field days were organised in three separate phases: (i) a first field day on the basic principles of contruction, held a few months before harvest, when the participants, extension staff and villagers alike build a crib togetherin the contact farmer's compound (ii) a second field day at the time of harvest, when the same villagers are convened for the filling of the crib and the treatment of

the maize cobs with the recommended insecticide (iii) a third field day after three months of drying, to allow the participants to compare the efficiency of crib drying against the prevailing drying method. The abovementioned number of farmers has been exposed to the technology of crib construction, operation and management through this series of demonstrations between 1989 and 1992.

The construction of a crib requires the following materials: bambo wood sticks, thatch and tying ropes or nails. All these construction materials are easily available at the level of villages, and the design is simple. Most of the contact farmers did not make any cash disbursement for the construction of their cribs, as the materials were readily available on their farms.

The testing and introduction of the "Brook-type" dryer

In response to the need for an improved drying technique that consumes less firewood and has larger drying capacity, a modified Brooke-type dryer (figure 6) has been tested in three Trial and Demonstration Centres (TDC), before being introduced at the level of contact farmers.

One important and new feature of this dryer is that it has been designed to be fitted within the farmer's existing kitchen. Thus, instead of cooking over three large stones, as is traditionally the case, a more energy-efficient fireplace can be used for cooking while the crop is drying. Therefore, significant savings are made as there is no need to construct a separate shed to house the dryer.

Figure 6. The Brook-type dryer, a funnel made of metal drums conducting firewood heat for drying.

Tests at the level of TDC indicated that the dryer can dry about 600 Kg of maize, reducing the grain moisture content from 30% down to 13% in approximately 90 hours. During the tests, 180 Kg of firewood were consumed, compared to over 2000 Kg and 39 days of drying with the traditional method (Table 2). In 1990, the cost of a modified Brooke dryer was about 32,000 FCFA when all the material and the labour were paid for by the farmer. However, this cost can be reduced by 35% if materials like mudblocks, stones and unskilled labor can be provided by the farmer.

Following the tests on-station, a series of on-farm trials and demonstrations were carried out with contact farmers in nine villages. Five field days were also organised within selected villages in collaboration with contact farmers and village extension workers. During the field days, the construction and operation of the dryer were explained to about 150 attending farmers (average attendance of 30 farmers per field day), who witnessed the drying performance.

Conclusions

Since the late 80's, maize has become the new cash crop for many farmers who now diversify their crop production because of the new trend in the market forces: (i) increased local demand for maize to satisfy the needs of the growing urban population (7% annually), the animal feed mills and the maize processing industries and (ii) large decreases in the price of the two main cash crops, coffee and cocoa. Although the production increased from about 370,000 tons in 1988-89 to over 500,000 tons in 1991-92, the internal demand for maize was still not fully satisfied. Thus, 25,600 tons were imported in 1992 (CONTE, FUSILLIER 1993). There is still a potential to increase the maize production in Cameroon, particularly in the central and southern regions and Adamaoua province.

While the simple technologies for drying and storage of maize, already developed and extended in the Western Highlands, are applicable in the Adamaoua province, new technologies for drying need to be

adapted for the central and the southern regions of the country. These regions, characterised by equatorial climate, are less favorable for drying and storage of food grains. in addition, new medium-to-largesized farms - 5 ha and more - are now rapidly developing in these regions, necessitating drying equipment of higher performance and capacity.

During the next phase of the Project (1994-96), which will focus on assistance to small and mediumsized agricultural enterprises, the adaptation and the local manufacturing of a batch-type forced air dryer, using the IRRI design (figure 7), is envisaged. This will hopefully satisfy the drying needs of the small to medium-sized farms in the more humid areas of Cameroon.

Table 2. Drying capacity and fuel efficiency (modified Brooke-type dryer).

Test No	Initial Weight (kg)	initial Mc(%)	Final Mc(%)	Drying Duration (Hrs)	Water Removed (kg)	Wood Used (Tons)	Drying efficiency	Fuel (kg water/hr/ton) of wood
N1	230.0	30.2	14.3	84	42.7	0.210	0.51	2.43
B1	310.5	30.1	13.3	86	60.2	0.155	0.70	4.52
B2	585.0	29.6	13.3	86	110.0	0.180	1.28	7.11
B3	234.5	38.0	14.2	125	65.0	0.195	0.52	2.67
B4	495.0	32.5	14.3	144	105.1	0.315	0.73	2.32
CTRL	495.0	35.0	12.5	936	127.3	2.020	0.14	0.07

Figure 7. The IRRI-type forced air batch dryer.

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Table des matières - Précédente - Suivante