Analysis of the postharvest knowledge system in Senegal:
Case Study of the rice sub-sector

Fallou Sarr, Institute of Food Technology (Institut de Technologie Alimentaire, ITA), Dakar, Senegal

Commissioned by
Technical Centre for Agricultural and Rural Cooperation ACP-EU (CTA)

SUMMARY

This report presents the results of a case study on postharvest knowledge systems in Senegal. It aims to help CTA, who sponsored the study, to improve and target its interventions and activities in favour of potential partners and beneficiaries in Senegal, to draw a more detailed picture of their needs and to develop a plan of action accordingly. This report also highlights needs specific to Senegal and proposes solutions to better meet said needs.

Keywords: *Knowledge system; postharvest; rice; Senegal*

The ten most common agricultural, livestock and fishery products

Statistics on agricultural, livestock and fishery production reveal that Senegal mainly produces cash crops and cereals. Fishery production (an average of 392,601.5 t), largely dominated by caught fish itself (94%), account for the largest export volumes, along with cash crops, including an average yearly production of 894 566.25 t of groundnut. The main foods produced are millet (an average of 695,586.5 t per year), rice (480,047.5 t), cassava (380,628.5 t), maize (256,643.25 t) and sorghum (181,483.75 t). Watermelon (226,854.25 t), onions (162,500 t) and mangoes (103,750 t) dominate the horticultural sector.

Priority agricultural commodities

In the case of groundnuts and millet, most research has focused on postharvest losses in the field and in storage, including the causes of pest and insect outbreaks and their biology and physiology, to develop improved strategies to combat and eradicate the threat, for example through chemical, biological, integrated means. With regards to groundnuts, losses can reach catastrophic levels: according to Ndiaye (1990), they can affect 83% of stock in six months of storage. With regards to millet, FAO (1987) estimated that postharvest losses ranged between 10% and 15% during the field drying period, and between 15% and 20% during field storage. When threshed grain is stored, postharvest losses are estimated to be over 30%. For rice, the surveys conducted in irrigated rice area (Senegal River Valley) show that the most significant post-harvest losses occur during storage (10 to 20% in both irrigated and upland rice zones), than during drying (5 to 10% in both types of rice culture). This is explained by the lack of appropriate infrastructure such as warehouses and drying areas. In upland rice area, the most significant losses occur during threshing

(10-20%) and storage (10-20%). Indeed, threshing is carried out on the floor and with the aid of a stick, which results in losses while the presence of rodents and the lack of bags explain losses during storage. In total, based on the results of surveys conducted in both types of rice-growing areas, postharvest losses are less important in the irrigated zone of Senegal River valley (34.5%) than in the upland rice area (40%).

Priority agricultural commodity for case study

Rice occupies a prominent place in Senegal's economy and in food consumption for both urban and rural households. Since independence in 1960, rice consumption in Senegal has increased by almost 1,000% and has now reached 1 million t of milled rice. Population growth and increased urbanisation led to an increase in rice consumption needs, which today is 74 kg per year per person, taking precedence over dry cereals that used to be the nutrition base in rural areas. In Senegal, the consumption of rice rose from 400,000 t in 1995 to 800,000 t in 2007, costing 106 billion CFA Francs (€160 million) in terms of net imports. Rice imports contribute 16% to the trade balance deficit. This phenomenon has increased because national production has not progressed as fast as consumption, with production now only covering 20% of the demand. However exceptional performances in the rice sector have been seen (the national private sector investing in production and processing, increased farmed acreage, yields, production, quality of the rice and its competitiveness), particularly since the implementation of various government stimulus programs for rice cultivation.

The gender dimension

For many years, the rice sector remained the monopoly of men in Senegal, with the exception of the region of Casamance where women are the main stakeholders. Strategies aimed at promoting production with the most disadvantaged communities – mainly women – are underway, essentially due to the rural and feminine character of poverty. In the Senegal River valley, the Senegal River Delta Development and Exploitation Corporation (Société d'aménagement et d'exploitation des eaux du delta du fleuve Sénégal, SAED) works hard at reinforcing the integration of Women's Advancement Groups (groupements de promotion feminine, GPF) in hydro-agriculture and increasing areas cultivated by women to 10%. SAED has created a new advisory body for the advancement of women, coordinated by the Directorate General's Gender Bureau. Moreover, alongside the advent of the Great Agricultural Offensive for Food and Abundance (Grande Offensive Agricole pour la Nourriture et l'Abondance, GOANA), which facilitates access to land and policies that benefit women, women – often grouped into structured associations – are becoming increasingly involved in agricultural activities, including postharvest activities (processing, preparation, packaging and marketing).

Rice value chain and current postharvest practices

The form of organisation and structure of the rice sector varies depending on agro-ecological areas and production systems. Nevertheless, one can list seven activities that occur through the rice value chain in Senegal. These are:

- Agricultural and agri-food research by Institut Senegalais de Recherches Agricoles (ISRA), AfricaRice, Institut National de Pedologie (INP), ITA and universities.
- Supply of inputs, agricultural equipment and services. Service providers deliver technical advice on harvesting, threshing and processing, while equipment dealers and manufacturers and input providers stock seeds, fertilisers and phyto-sanitary products.
- Funding is mainly provided by the National Agricultural Credit (Caisse nationale de crédit agricole, CNCAS) and decentralized financial system (SFD)s. These entities allocate crop, equipment and marketing credit. It should also be noted that some rice millers, such as Coumba Nor Thiam, allocate loans to their own farmer networks in order to ensure sufficient paddies and to run their factories over longer periods of time throughout the year. Coumba Nor Thiam mill also provides services to its farmers. This rice mill exploits 7,000 ha, 6,000 ha of which belongs to a network of 3,000 farmers who do not have access to CNCAS credit. Coumba Nor Thiam provides a variety of services: from soil preparation to rice threshing, via the provision of inputs. It is after threshing that farmers fully reimburse the loan in kind (paddy rice). Transport and bagging of the paddy rice to be used as reimbursement is provided by the rice mill. During the 2011 crop year, a loan of 1,087,351,067 CFA Francs (€1.6 million) was distributed between the farmers and, by October 2011, 93.6% of that amount had been reimbursed.
- Paddy rice production is the responsibility of farmers in irrigated areas and rain-fed areas. Paddy production is followed by harvesting, drying and threshing.
- The collection of paddy rice, in irrigated areas, is an activity undertaken by traders, rice millers and farmers. However, in rain-fed areas, this activity is mainly carried out by women and children in the Southern area (more than 90%) and with carts (70% to 80%) in the Central area. In the Senegal River valley, paddy rice collection is a real challenge for factories who struggle to secure a large quantity of paddy rice in a single collection area.
- Processing is done by rice millers via industrial mills, mini-mills and village rice hullers (who process more than 80% of the production in irrigated environments), or with simple pestles in rain-fed areas.
- Marketing of white rice is carried out by private agents (banabanas), rice millers, farmers' organisations and farmers. There is no apparent specialisation in terms of this activity or organisation. Women in Pont-Gendarme sell rice processed in mini rice mills or by village rice hullers, who do not generally have access to a cleaner or a sorter. Therefore, they do the extra work by thoroughly cleaning and sorting the white rice with the help of small equipment (sieves, gourds, bowls, basins, etc.) in order to produce quality rice.

Evaluating postharvest losses

There is a clear difference between both rice cultivation systems and this is also reflected in postharvest losses. However they have a common point: the drying of paddies, which is critical for both systems with losses ranging from 5 to 10%. Irrigated systems face two additional critical issues: paddy rice harvest (ill-adapted harvesters) and drying (insufficient drying areas). Rain-fed rice culture environments

suffer from threshing losses, which is mainly manual and represents the stage where most postharvest losses are recorded (40 %). Within this general value chain, important links were lacking such as cleaning prior to hulling, sorting or calibration.

Engineering and equipment design capacities

Research institutions such as ISRA, SAED and AfricaRice contribute to the field of adaptive research on certain equipment so as to make using it easier, to reduce costs and increase efficiency. They have indeed collaborated to develop a harvester called ISA (I=ISRA, S=SAED, A=AfricaRice) and a thresher named ASI (A=AfricaRice, S=SAED, I=ISRA). Dissemination of the harvester and thresher has been carried out by Economic Interest Grouping (GIE) AGRITECH, which is a company that designs and manufactures agricultural equipment. There are other well-known companies that design and manufacture agricultural equipment in Senegal and its sub-region, including SISMAR, MATFORCE, EquiPlus, ERECA, and Energeco.

Centres of knowledge/excellence in teaching and research on postharvest

The Centres of knowledge/excellence in charge of teaching and research on postharvest are research and development institutes (ISRA, ITA, AfricaRice, SAED) and universities (University Cheikh Anta Diop in Dakar (UCAD), Université de Thiès (UT), Université de Ziguinchor (UZ), and Université Gaston Berger (UGB)).

Creation, dissemination and exploitation of post-harvest knowledge

In 1999, a National Strategy for Rural and Agricultural Training (Stratégie Nationale de Formation Agricole et Rurale, SNFAR) was developed because agricultural and rural training officers (formation agricole et rurale, FAR) from public institutions were increasingly out of sync with the needs of Senegalese agriculture that is undergoing a profound change (SNFAR, 1999). Therefore, as of 2003, the Office of Agricultural Vocational Training (Bureau formation professionnelle agricole) was created in the Ministry of Agriculture to implement this strategy. By Decree no 2008.1259 dated 10 November 2008, the State of Senegal officially created the National Agro-forestry-pastoral Research System (SNRASP) as per the agro-forestry-pastoral policy act (LOASP, 2004). SNRASP was created to develop synergy, help organise and systematise cooperation between all structures with research expertise and skills in agricultural and agri-food fields, and place national research in a globalised context. In order to consolidate this system, the Senegalese Government, researchers, users of the research's results and development partners decided to set up a National Fund to finance agricultural and agri-food research based on healthy and organised competition amongst the research teams.

The following weaknesses should however be noted:

- Research institutes have aging personnel, lose expertise through the brain drain phenomenon, and lack adequate staffing and proper budgets to conduct research, training and provide adequate salaries for staff.

- Universities struggle with large numbers of students, inadequate numbers of teachers, recurring teacher and student strikes, and weak research, educational and social infrastructures.

Additional data needed to improve the postharvest knowledge system

In order to improve the postharvest knowledge system, it is necessary to:

- **Research:**
    - systematically assess postharvest losses at all stages of the rice value/supply chain, thereby indicating critical points and the best ways to address them;
    - study, experiment and disseminate local knowledge in terms of rice postharvest handling (rice conservation/storage);
    - adapt technological innovations in postharvest handling and equipment for greater efficiency, effectiveness and accessibility (harvester, thresher, sorter);
    - assist in reviewing and developing standards for quality criteria for each step in the value chain in order to produce white rice that corresponds consumer expectations;
    - adapt or develop regulatory packaging; and
    - develop a guide for good postharvest practices.

- **Government and universities:**
    - develop a national programme entirely focused on improving rice postharvest systems (equipment, infrastructure, processing, training, organisation, marketing, access to credit). This programme would provide the processing chain – including mini-mills – with missing equipment (cleaner, calibrator, sorter and maybe eventually a forklift) in order to produce quality rice;
    - create a doctoral programme with a specific curriculum on postharvest systems at: UFR Sciences agronomiques, Aquaculture et Technologie alimentaire (Department of Agronomical Sciences, Aquaculture and Food Technology) at the Université de Saint-Louis; École nationale supérieure d'agriculture (National School of Agriculture) at UT; and the Institut supérieur d'agriculture (Higher Institute of Agriculture) that will open this year at UCAD in Dakar;
    - upgrade salaries and improve the working environment for staff members of research institutes via performance contracts between the government and the institutes; and
    - revise and implement the 1999 National Strategy for Rural and Agricultural Training.

- **Regional organisations for agricultural development**:
    - Regional organisations such as CORAF/WECARD should include more projects specific to postharvest treatment in their programmes on food crops;

- AfricaRice, in collaboration with other research institutes, should create a "research and development unit of post-harvest facilities."

BIBLIOGRAPHY

1. Ashamo M.O. 2006. Relative susceptibility of some local and elite rice varieties to the rice weevil, Sitophilus oryzae *L. (Coleoptera: Curculionidae)*. Journal of Food, Agriculture and Environment. 4(1):249-252.

2. DSRP. 2000. Document de Stratégie de Réduction de la Pauvreté: 2000 – 2015. (Strategy Document on Reducing Poverty). Gouvernement du Senegal, http://www.gouv.sn

3. FAO.1987. Mission de formulation d'un projet d'études et d'amélioration des greniers et stocks villageois. (Formulation of a research and improvement project on village granaries and storage). FAO, Rome.

4. GOANA. 2008. Bilan de l'An 1 de la Grande Offensive agricole pour la nourriture et l'abondance. (Review of Year 1 of the Great Agricultural Offensive for Food and Abundance). Gouvernement du Senegal, http://www.gouv.sn

5. PASA. 1995. Plan d'ajustement sectoriel de l'agriculture. Ministère de l'Agriculture. (Agricultural Sectoral Adjustment Plan, Ministry of Agriculture). Gouvernement du Senegal, http://www.gouv.sn

6. Philogène, B.J.R, Armson J.T. and Lambert, J.D.H. 1989. Facteurs contribuant à la protection du maïs contre les attaques de Sitophilus et Prostephanus. Céréales en régions chaudes. (Factors contributing to maize protection against Sitophilus and Prostephanus. Cereal in hot regions). Aupelf-Uref, John Libbey Eurotext, Paris.

7. Ratnadass, A. and Sauphanor, B. 1989. Les pertes dues aux insectes sur les stocks paysans de céréales en Côte d'Ivoire. Céréales en régions chaudes. (Losses due to insects on peasant cereal stock in Côte d'Ivoire. Cereal in hot regions). Aupelf-Uref, John Libbey Eurotext, Paris.

8. SAED. 2009. Bilan de la campagne agricole 2008 dans la vallée du fleuve Sénégal. (Review of the 2008 crop year in the River Senegal valley). SAED, http://www.saed.sn

9. SCA. 2005. Stratégie de croissance accélérée: 2005 – 2015. (Accelerated growth strategy). Gouvernement du Senegal, http://www.gouv.sn

10. Seck, D., 1992. Importance économique et développement d'une approche de lutte intégrée contre les insectes ravageurs des stocks de maïs, de mil et de niébé en milieu paysan. (Economic significance and development of an integrated combat approach against insect infestations in maize, millet and cowpea in rural areas). P.155-160. In: La post-récolte en Afrique. (Post-harvest in Africa). Aupelf-Uref, Paris.

Published by CTA, http://knowledge.cta.int/
Edited by J.A. Francis, CTA