CASE STUDY 1: New Rices for Africa (the NERICAs)

Rice. Credit : IRRI

Demand for rice in West Africa is rising rapidly, failing to be met by local production. More than 6 million tonnes of rice are imported each year,[1] accounting for half of the region's requirements. Nigeria's rice import bill alone exceeds US$2billion.[2] Population growth, rising incomes and changing consumer preferences will only encourage greater demand.

In order to address this production shortfall, Monty Jones, a Sierra Leone scientist working at the Africa Rice Centre (AfricaRice) began a programme utilising tissue culture technologies, to develop crosses between the African species of rice (*Oryza glaberrima*) and the Asian species (*Oryza sativa*). The former is more adapted to local environments but typically returns low yields of around 1 ton per hectare while the latter produces yields of around 5 ton per hectare. Crossing the 2 species created numerous embryos but these could only be grown to maturity after tissue culture. At first the tissue culture technique did not work well, but collaboration with Chinese scientists provided a new tissue culture method, involving the use of coconut oil, which proved highly successful.[3]

The resulting rice varieties, known as the New Rices for Africa (NERICAs), grow well in drought-prone, upland conditions, are resistant to local pests and disease, tolerant of poor nutrient conditions and mineral toxicity and show early vigorous growth crowding out weeds; all of which are characteristics of the African species of rice. Later in their development, characteristics of the Asian rice species appear: they produce more erect leaves and full panicles of grain and are ready to harvest after 90 to 100 days, 30 to 50 days earlier than current varieties. Due to significantly higher yields than current varieties (up to 4 tons per hectare under low inputs) Uganda was able to reduce its rice imports by half from 2002 to 2007. A shift from maize to NERICA production in Uganda with proper crop rotation was found to increase income by $250 per hectare.[4]

According to AfricaRice, 60 lowland and 18 upland NERICA varieties have been named and characterized through a process of **participatory varietal selection**.[56] As of 2009, an estimated 700,000 hectares across sub-Saharan African were planted with NERICA varieties, covering about 5% of the region's upland rice growing areas.[7] Uptake is likely to expand as more varieties are released.

Man and woman in rice field. Credit : Engility, Stéphane Tourné

Many NERICA varieties are particularly suitable for use in the rain-fed upland areas where smallholders lack the means to irrigate or to apply chemical fertilizers or pesticides.[8] In Benin, farmers that adopted NERICA varieties experienced yield gains of about 1 ton per hectare. Women also benefited considerably, generating a net income gain of $337 per hectare, becoming a key determinant in poverty reduction. In Uganda, farmers averaged 2.2 tons per hectare, twice the average rice yield for sub-Saharan Africa.

Adopters in Nigeria also witnessed significant gains: household gross income from NERICAs increased by US$555, raising the probability of escaping poverty.[9] In addition to benefiting rural economies, NERICA has the potential to assist cash-strapped national economies by reducing the cost of food imports. It has been estimated that the introduction of NERICA in Guinea alone led to import savings of US$13 million in 2003.[10]

CASE STUDY 2: Tissue culture cassava in Colombia

Plant samples in CIATgene bank, Colombia. Credit : Neil Palmer CIAT

Cassava is a dependable food crop for resource poor farmers in Colombia as it can in grow in harsh conditions – low soil fertility, limited water availability and with minimal inputs. A significant threat to cassava production, is the virus-like frog skin disease (FSD) that stunts root growth. In most infected plants, the symptoms are unobservable, and due to stems that sometimes become slightly enlarged, these stems are often selected for future plantings.[11] To control the disease, the International Center for Tropical Agriculture (CIAT) developed a tissue culture method to reproduce cassava through stem cuttings to create large amounts of quality, disease-free planting material.

CIAT's method was later configured to suit rural conditions. For example, for culture medium reagents, locally available fertilisers, fruits juices, table sugar and cassava starch were used whilst low-cost tools such as insulin syringes were used as micropipettes. An "informal farmer's seeds production system" was also established to distribute the disease free planting material to farmers in Colombia's Cauca Department, a low-cost tissue culture laboratory located in a rural area and run by trained farmers and their communities.

The project was a large collaboration, with each actor performing a specific role. The Women Farmers Group from Santa Ana community (ASOPROSA) served as the cassava experts; an NGO (Fundación para la Investigación y Desarrollo Agrícola, FIDAR) supported social work and personnel relationships; the International Centre for Tropical Agriculture (CIAT) provided experts in tissue culture, participatory research methodologies and the management of an *in vitro* gene bank; and the Cassava Biotechnology Network (CBN), and Participatory Research and Gender Analysis (PRGA) Programmes provided financial support.

Cassava production in Colombia. Credit: Neil Palmer CIAT

To begin the process of developing a laboratory that could be owned and run by farmers, a farmer from the region was selected and trained, followed by farmer-to-farmer trainings. The project reports many technical obstacles as well as challenges in communication between farmers and technicians. However, projects to establish and run farmer laboratories for the purpose of creating healthy cassava planting material through tissue culture has now been scaled up across 5 Colombian departments involving 119 farmers.[12]

CASE STUDY 3: Tissue culture bananas in Kenya

Tissue culturing on banana sigatoka disease. Credit_IITA

Bananas are a major source of food and income throughout the tropics and especially in East Africa. Banana plants are susceptible to disease because new plants are grown directly from suckers from a "mother plant," thus transferring any disease present, even if it is not visible. The black Sigatoka fungus, a leaf spot disease, has been particularly devastating to banana crops worldwide since its first outbreak in Fiji in 1963. It arrived in East Africa in the 1970s, decreasing productivity by as much as 40%. The fungus can be controlled with fungicides, but it has developed increasing resistance over the years, making the option both expensive and damaging to the environment.

After a visit to the work on tissue culture bananas in South Africa, Kenyan agricultural scientist Florence Wambugu applied the same technique in Kenya and found she could quickly generate healthy new plants. She persuaded the Kenyan Agricultural Research Institute (KARI) to undertake field trials on local varieties in the mid-1990s, and a training programme was initiated. During the last decade, more than 6 million tissue cultured banana stems have been planted in Kenya, producing additional income of around Ksh5.5 billion (US$64 million) to banana farmers. A business model known as Wangigi, piloted by Africa Harvest, has greatly increased access to tissue culture banana outlets for 3,500 farmers, with some farmers trained to teach others on how to use the technology. A farmer-owned marketing company, Tee Cee Banana Enterprises Limited (TBEL), has been established to handle everything from postharvest storage to setting industry standards.[13]

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