

Cassava and Biofuels: Is this the Magic Vehicle that will Lift Millions of Cassava Farmers Out of Poverty?

When people hear about "mansampalang" or "tapioca" they usually think of poor Isarn farmers that can not grow anything better on their parched dry sandy soils. In fact, those poor farmers may not be so poor in the future, thanks to the "Green Cassava Revolution" that is currently sweeping most Southeast Asian countries. "Cassava" is actually the correct English term for the crop, while "tapioca" is often used for the products made from cassava roots. In Portuguese the crop is called "mandioca", in Spanish "yuca" and in French "manioc"

The center of origin of cassava is in Central Brazil, where it has been a staple food for the native Indian population for at least 4000 years, and continues to be so until this day. Brazil is still the second largest producer of cassava in the world, after Nigeria and followed by Thailand. In semi-arid northeastern Brazil, fariña, made from grated and roasted cassava roots, remains a very popular food. In Nigeria and much of West Africa, cassava is the most important food staple, eaten mostly as "gari", another toasted product made by household processors from grated cassava roots. Interestingly, being the third largest producer of cassava in the world, Thais have no tradition of eating cassava except as cassava starch in some traditional desserts; they much prefer eating rice.

In Thailand cassava production expanded rapidly in the 1970s and 80s in response to an ever increasing demand for dry cassava chips and pellets used as an energy source for animal feeding in Western Europe, especially in the Netherlands. The cassava production area, initially located in the southern part of Thailand, first moved to the eastern seaboard provinces of Chonburi and Rayong, and during the late 1970s and 1980s expanded greatly into the northeast, principally in Nakhon Ratchasima province, but also in the upper northeast of Khon Kaen, Kalasin and Roy Et provinces. Presently about 55% of cassava is grown in the Northeast, 30% in the East and Central Plain and 15% in the Northern region. During the late 1980s the cassava area of Thailand reached a peak of 10 million rai, almost all planted with one variety, called Rayong 1, and almost all destined for the lucrative export market of cassava pellets in Europe. At the insistence of the EU countries, Thailand had a quota of maximum 5.25 million tonnes of cassava pellets that could be imported annually at a low tariff rate. However, changes in the EU's agricultural policies introduced in 1993 lowered the support price of their own grain crops, mainly barley, wheat and oats, and made Thailand's cassava pellets much less attractive as a cheap source of energy in animal feed rations. Thus, Thailand's exports of cassava pellets to the EU dropped precipitously year after year and is now less than 400,000 tonnes. Those poor Thai farmers in the Isarn were stuck with piles of cassava roots that no one wanted to buy, and the price often dropped to less than 80 satang per kilogram. Foreseeing this problem the Thai government tried to decrease the cassava growing area by encouraging farmers to plant other crops like sugarcane, maize, cashew and even rubber trees. However, none of these was as well adapted to the poor soils and harsh climatic conditions in the Northeast as cassava, and farmers continued to grow cassava, *albeit* in a much reduced area of about 6.20 million rai. But while the planted area was reduced and partially replaced by some other crops, cassava yields started to go up and up, from about 2.24 tonnes per rai in 1995 to 3.55 tonnes per rai in 2006/07. The result was that total cassava production only decreased marginally, from a peak of 24 million

tonnes in 1989 to about 16 million tonnes in 1998/99, and back up to 25 million tonnes in 2006/07.

So, what does Thailand do with 25 million tonnes of cassava roots if no respectable Thai wants to eat the stuff, and the export market of cassava pellets to Europe has all but collapsed? Fortunately, Thailand has an excellent entrepreneurial class that was able to adapt quickly to a new situation and to turn a potential disaster into a new opportunity. They were also greatly assisted by our big next-door neighbor, China. First, the Thai cassava industry quickly changed from making mainly cassava pellets for export to making more and more cassava starch for both the domestic and export markets. Currently the cassava starch and modified starch industry absorbs over 50% of all cassava roots produced in the country, as compared to 36% in 1991. Secondly, our Chinese neighbours to the north also built more and more starch factories, especially in Guangxi province, to the point that domestic production could not keep up with demand. Besides native starch, these factories also needed cassava for production of various modified starches for the food, paper and textile industries, for production of monosodium glutamate (MSG), sobitol, vitamin C, various sweeteners and alcohol for drinking and industrial purposes. Thus, in 2001 they started importing cassava chips from Thailand, first in very modest quantities, but increasing every year to a level of 4 million tonnes in 2006. Until the end of August 2007, Thailand has already exported 2.5 million tonnes of cassava chips to China. Meanwhile, similar starch-based industries in Thailand as well as the exporters of dry chips keep increasing their need for cassava roots. Finally, in 2000 in response to an expected rise in oil prices, Thailand was one of the first countries in Asia to initiate a “gasohol” or E10 program, with the aim of replacing 10% of normal gasoline with fuel-ethanol, which is a renewable energy source made from locally produced sugarcane (or molasses), maize or cassava. Thus, many gas stations in Bangkok and upcountry now sell “gasohol 91” and “gasohol 95” which are considerably cheaper and can perfectly replace the traditional gasoline 91 and 95, respectively, in most cars. There are several advantages to the use of “gasohol” over normal gasoline: 1. It reduces the consumption of imported oil and thus saves foreign exchange and increases the country’s energy security; 2. Ethanol is an octane booster and can completely replace the additive MTBE; 3. Ethanol combustion in cars is less air polluting and produces less CO₂ than normal gasoline, thus reducing global warming; and 4. Ethanol is made from renewable and locally produced crops, thus helping Thai farmers increase their sales and improve their income. The rapid increase in demand for cassava roots has already resulted in a doubling of the price of fresh roots, dry chips and starch as compared to 2003. Thus, Thai cassava farmers are earning a much better income, allowing them to take better care of the crop and thus increasing yields and the supply of roots.

Presently, Thailand is producing about 1 million liters of ethanol per day, mostly made from molasses and sugarcane. There is only one factory in the country using cassava as the raw material and producing about 80,000 liters of ethanol per day. However, two additional factories are ready to start operation and another 12 factories should be completed by the end of 2008, producing a total of 3.4 million liters of ethanol per day; this will require an additional 6 million tonnes of fresh roots, on top of the 25 million tonnes produced currently. Since the cassava growing area of about 7 million rai can not increase substantially, due to competition from other crops, the increased supply can only be met through increases in yield, from the current 3.5 tonnes per rai (22 t/ha) to about 4.5 tonnes per rai (28 t/ha) in the next couple of years. How can this be achieved?

Thailand has currently the second highest cassava yields (22 t/ha), after India (28 t/ha) and nearly double the average yield in the world (11.5 t/ha). The rapid increase in yield from 14 t/ha in 1994/95 to 22 t/ha in 2006/07 was achieved through the hard work and excellent collaboration among the Departments of Agriculture (DOA), the Department of Agricultural Extension (DOAE) and Kasetsart University (KU) as well as with the private processing and trading sector and the Thai Tapioca Development Institute. The latter non-governmental institute was created in 1993 through a “special fund” of US\$ 30 million to establish the Thai Tapioca Development Institute Foundation; it has provided training to 30,000 cassava farmers and distributed millions of stems of the new high-yielding varieties to cassava farmers.

These various Thai institutions have also had a very productive collaboration with an international agricultural research center, called the Centro Internacional de Agricultura Tropical (CIAT) located in Colombia, South America; this Center also has a Regional Cassava Office for Asia in Bangkok. CIAT has the world mandate for cassava research and development, and maintains the world’s largest collection of over 6000 cassava varieties, mostly from its center of origin in Latin America, but also about 200 varieties from Asia. The CIAT-Thai collaboration started as far back as 1975 when a group of Thai researchers from DOA and KU spent over a year for training in cassava research at CIAT in Colombia. Over the past 30 years about 40 Thai researchers have received training at CIAT, thus establishing a very close working relationship among the relevant national institutes and with CIAT. In addition, CIAT has provided over the years about 170,000 sexual seeds of cassava from Latin America, each with their own genetic background, to cassava breeders in DOA and KU. Thailand is the only country in the world that has also received in tissue culture the world’s “core” collection of cassava, which is about a 10% selection (600 varieties) of the whole collection, but representing the whole spectrum of genetic variability of the crop. This collection is presently being maintained and evaluated at DOA’s Field Crops Research Center in Rayong.

While farmers grow cassava from stem cuttings (each about 20 cm long) using clonal propagation, in order to produce new and better varieties cassava breeders have to make crosses between male and female parents and then plant the sexual seed produced to evaluate the yielding ability and other quality characteristics of the progenies. Usually, from the planting of 10,000 seeds, only one new variety will eventually be released after 8-10 years of intensive and continuous selection. During the past 30 years the Thai breeders have made thousands of their own crosses, often involving Latin American germplasm with their own best varieties, to produce and finally release 11 new cassava varieties. Five of these are now grown by farmers in nearly 100% of the total planted area of 7 million rai, having thus entirely replaced the original Thai variety, Rayong 1. However, the genes of Rayong 1 are still present in three of the five most commonly planted varieties. Among these is Kasetsart 50, selected from a cross between Rayong 1 and Rayong 90 by breeders from Kasetsart University. This is probably the most successful cassava variety in the world, now planted in about 4 million rai (640,000 ha) in Thailand and about 500,000 ha in other Southeast Asian countries. In addition, Thailand has contributed about 100,000 sexual seeds from its own crossing program to its Southeast Asian neighbours, which has resulted in the release of several excellent varieties by those countries.

Besides a very strong collaboration in the area of cassava breeding, there has also been a very productive collaboration in the area of agronomy research and the extension of new

varieties and improved production practices, especially erosion control, to farmers, using a farmer participatory research (FPR) approach. This program was funded entirely by the Nippon Foundation of Japan, from 1994 to 2003. This Foundation is a philanthropic organization which financially supports worthy projects in Japan as well as all over the world, mainly in the areas of education, cultural exchanges, assisting disabled people and agricultural development. During the ten-year period mentioned above, they funded the cassava FPR project in Thailand, Vietnam, China and Indonesia, and since 2004 are also funding a similar project in Laos and Cambodia. The previous project resulted (or at least contributed significantly) to the doubling of cassava yields in Vietnam, a 60% increase in yield in Thailand, and a 20% increase in yield in China since the project started in 1994. Hopefully, similar increases will be achieved in Laos and Cambodia, where traders and cassava processing factory owners from China, Korea and Vietnam are already looking for large new areas to plant cassava to supply their rapidly increasing demand for cassava roots.

So what does the future hold for cassava in Asia? In many countries the increasing demand of roots for processing into dry chips, both for domestic use in animal feed rations and for export (mainly to China), for production of starch and starch derived products, for ethanol and for biodegradable plastics, can only be achieved through marked and rapid increases in yield. This will require renewed efforts in breeding, agronomy, biotechnology and improvements in processing technologies, coupled with a dynamic and effective extension program using a farmer participatory approach. It will also require good coordination and collaboration among the various research organizations in Thailand, as well as with international organizations like CIAT. Even though cassava is the third most important food crop in Southeast Asia, after rice and maize, it has always been considered as an “orphan crop”, with very little funding allocated for research and development. While there are thousands of researchers all over the world working on important crops like rice, maize, soybean, oil palm and rubber, there are only a few dozen researchers working on cassava. Unless this situation improves and the crop receives adequate funding and research attention, it will remain an “orphan crop”, only grown by the poorest farmers and eaten by the poorest people, except that the increased demand for fuel-ethanol, if not met through rapid increases in production, will push up the price until the poor will no longer be able to afford it.