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Food from the Forest – an Alternative to Agriculture in Crisis?

Christine Woda, Ph.D.

GIZ / GFA Consulting Group, PRORENA – Program for Sustainable Management of Natural Resources, Tegucigalpa, Honduras. E-mail: cwoda@web.de

Re-discovering ancient Mayan knowledge

The main food production system of small scale farmers in Honduras and neighboring countries is still shifting cultivation. Due to lack of access to adequate land, high diverse tropical rain forest is clear-cut to cultivate corn, yucca and red beans on steep hills, while causing several ecological damages as erosion, loss of biodiversity and fertile land. Today's debate about climate change and the importance of the forests as a CO2-sink and climate regulator shows even more the dilemma between traditional agriculture and sustainable land use. Meanwhile, subsistence agriculture is in crisis under the effects of climate changes, putting in risk the family production and local food source.

Therefore, the Maya Nut Institute promotes a radical turn back to ancient Mayan Food (Peters, 1983; Anabel, 2008), while producing and consuming the tree seeds of *Brosimum alicastrum* (Swartz) *Moraceae*, locally known as well as Ojoche, Ramon, Masica or Maya Nut. The nut is produced in native forest stands and is – freshly consumed or dried and roasted –delicious in beverages and pastries. With a nutrient value of 345 kcal/100 g it is nearly fat free, but a good source of dietary fibers (9 g/100 g), carbohydrates, sugars (maltose), potassium (1100 mg/100 g), calcium (140 mg/100 g), and the essential amino-acid tryptophan (1.1 g/100 g) (Silliker, 2007), which is poor in the tropical diet, and needed to produce melatonin and serotonin in the human organism.

Nevertheless, *B. alicastrum* is an old growing tree which contrasts to the cultivation circle of annual crops. Therefore it is questionable, if Maya Nut produced in native forests can be a real alternative for small scale farmers. This study quantifies the nut production of *B. alicastrum* in a humid rainforest and the demand by wildlife, which has to be considered in a sustainable management. It analyzes also the competiveness of Maya Nut compared to red bean produced under the traditional slash and burn system.

Methods and study area

The study was carried out in a tropical humid rain forest in UNESCO-Biosphere Reserve Rio Plátano, in northeastern of Honduras, Department Olancho. The forest is located next to the small village El Guayabo (677´500 y 170´600) within the buffer zone of the protected area, and

is managed by the local Women´s Maya Nut Cooperative COMGABIL. All data collection was done with active participation of the Maya Nut producers:

- ✓ Forest inventory of 45 ha: 20 m wide transects covering 10 ha (23 %), identifying position diameter and sex (male or female) of the trees,
- ✓ Registration of the nut harvest volume from seven trees which was collected from forest soil within two harvest periods (2011 and 2012)
- ✓ Installation of 13 plots with 30 fresh fruits (nuts with pulp) put on the forest floor to estimate the demand by wild life within main production period (june-july 2012)
- ✓ Three camera traps (Cudde Back) were installed during 107 days next to *B. alicastrum* trees to identify wild life species living in Maya Nut forest.

Results

a) A key species for neo-tropical forest wildlife

The experiment with Maya Nut fruits put on the forest floor shows a very high demand by wild life. Two weeks after experiment start, more than 75% of the 390 fruits in 13 different sites were disappeared, and 5 % of the remained fruits showed animal bits (Fig. 1). One month after experiment start, less than 10 % of the original amount was left, and two month after experiment start, all fruits of *B. alicastrum* were disappeared and probably eaten up by wildlife.

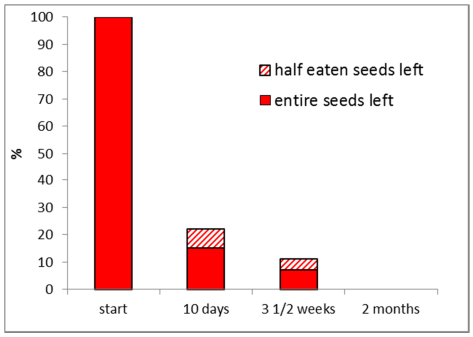

Fig. 1: B. alicastrum fruit consumption by wild life observed at 13 experimental plots installed in the forest, each with 30 fruits at experiment start, within main fruit production period (06-07/2012).

The camera traps next to *B. alicastrum* trees caught nine mammal species, of which six are known as Maya Nut seed consumers, and three as their predators (Fig 2 y 3). Local people confirmed as well the consumption of Maya Nut in tree crowns by bats, monkeys and birds, and the consumption of the leaves by sloth bear and others.

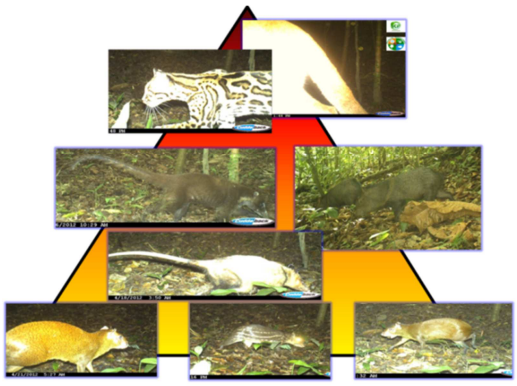

Fig. 2: Examples of the pictures taken by the camera traps next to B. alicastrum trees, may – july 2012.

Fig. 3: Species documented by camera traps installed next to B. alicastrum trees during 107 days from 05-07/2012.

Species	**Picture frequency**	**Function in Maya Nut alimentation pyramid**
Dasyprocta punctata (Guatuza)	41	Seed consumption
Caniculus paca (Tepezcuintle)	2	Seed consumption
Tayassu tajacu (Quequeo)	2	Seed consumption
Didelphis marsupialis (Guazalo)	2	Seed consumption
Dasypus novemcinctus (Cusuco)	2	Seed consumption
Nasua narica (Pizote)	1	Seed consumption
Eira barbara (Gato motete)	1	Predator of smaller mammals
Leopardus pardalis (Ocelote)	8	Predator of bigger mammals
Puma concolor (Puma)	1	Predator of bigger mammals

b) Maya Nut harvest volume

In the study area, *B. alicastrum* shows a density of 6.4 trees/ha > 10 cm DBH (Fig. 4). Nevertheless, the species is diploid and the abundance of female trees in productive age (> 30 cm DBH) is just 3.1 N/ha. Even with this relatively low abundance, *B. alicastrum* is one of the six most frequent tree species in the study area, were 71 trees species were identified.

To estimate the annual production volume one has to consider that *B. alicastrum* is a masting species. In 2011 there was a high harvest with an average of 49 kg of dry Maya Nut per tree, whereas in 2011 the harvest was low with just 10 kg nuts/tree (Fig 5). Considering the tree abundance per hectare, the total annual nut harvest volume varies in the study area from 31 to 152 kg/ha.

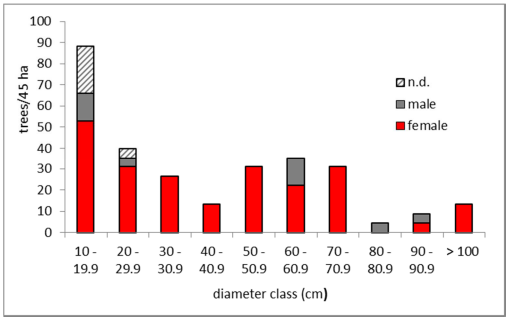

Fig. 4: Diameter distribution and abundance of B. alicastrum in the studied forest (45 ha).

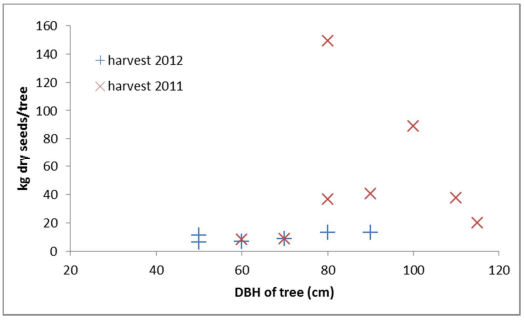

Fig. 5: Annual variation of harvest volume of B. alicastrum.

c) Maya Nut versus red beans

The opposite costs for Maya Nut production in a native forest in El Guayabo village is red bean production on clear cutted forest areas on steap hills. Without using any fertilzers, the local annual production is about 520 kg/red beans/ha. In terms of quantity, this harvest volume is clearly higher than the annual Maya Nut harvest volume of 31 to 152 kg/ha. Nevertheless, this advantage becomes smaller while considering a longer production period as for 10 years. The slash and burn system allows bean production just for two following years. Then, forest-shrub vegetation has to develop before using the land again. Therefore, total bean production within 10 years is 1040 kg, or 104 kg/year. In contrast, Maya Nut production in the native forest is given every year in a sustainable way. Even with its varying harvest volumes and very low abundance

of just three productive trees per hectare, the annual harvest volume of the nut is similar to the beans with 92 kg/ha.

The nutrition value in calories produced per hectare by both products is similar, beside of the differences in single nutrient composition of each product (Fig. 6). Significantly higher is the income raised by Maya Nut production (323 Euros/ha) compared to red beans (65 Euro/ha) due to higher prices paid for the nut. In this, there is still not considered that red bean production is labor intensive (preparing of the area, seeding, competition control), whereas by now the Maya Nut production is just done as wild harvest collection in already established natural forest without any previous investment.

Even more drastically is the competiveness strength of Maya Nut as a tree product produced in a natural forest, considering the ecological services as CO2 sink, biodiversity and soil protection and its contribution towards a balanced climate circle. And for topping, as an old growing species, *B. alicastrum* is supposed to have a higher resilience than annual crops under changing climate change conditions (Diaz et al., 2011).

Fig. 6: Maya nut production versus red beans.

	Nuez Maya in natural high diverse humid rain forest	Red Beans in shifting cultivation*
yearly production over 10 years	92 kg	104 kg
Calories/year	318,228	360,880
Actual price	3.52 Euro/kg	0.62 Euro/kg
Yearly producers income	323 Euro/ha	65 Euro/ha
Investment level	low	high
CO2 sink	conserved	destroyed
Biodiversity	conserved	destroyed
Food source for wild animales	conserved	destroyed
Soil fertility	permanent	degradent
Resilance to climate changes	high	low
Impact to clima	positive	negative
		*two productive years within ten years

Discussion

The study shows the high importance of *B. alicastrum* as a food source for animals of the tropical rain forest, which is also descripted by other authors (Sanchez-Cordero, 1998; Estrada et al., 2001; Cortez & Perez, 2010), of why the tree can be considered to be a key species for the ecosystem. The experiment of Maya Nut consumption by wild life shows the high demand on the seeds, especially in low production years. For a sustainable harvest in native forests, reserve areas should be declared where no seed collecting should be allowed, at least as the same size of the collecting area.

The further analysis shows that Maya Nut production in natural forest stands a highly competitive, especially on tropical hill land, were slash and burn agriculture cannot compete with the ecological services provided by forests, neither with long term food production for human and wild life. This was proven within this study for a high divers tropical rain forest, were the density of productive individuals is very low with 3 N/ha. The competitiveness of B. *alicastrum* will be even higher in dry areas of Central America and Mexico, where *B. alicastrum* forms nearly pure forests (Lopez et al., 2003), and were its potential to contribute to fodder production for cows is already known (Jimenez-Ferrer et al., 2008).

Mankind´s history is based on forest food. Beside of *B. alicastrum*, seeds from *Quercus* in America, *Avellana* and *Fagus* in Europa, or more exotic nuts from Brazil (Zuidema et al., 2002) or the Himalaya (Bhatt, 2000) were an important food source for humans, but lost their importance with the first "agriculture revolution" in the Neolithic Age. 10,000 years later, we begin to understand the importance of "ecosystem services" of the forests to conserve climate, biodiversity and to maintain the conditions for further food production. It´s time for a new "agriculture revolution", were forests have to play again a central role in food production, as in agroforestry systems or in pure forest production systems. The high potential of *B. alicastrum* in Central America might help to end up with the old dilemma of food production, deforestation and climate change: not agriculture *versus* forest, but food from the forest!

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