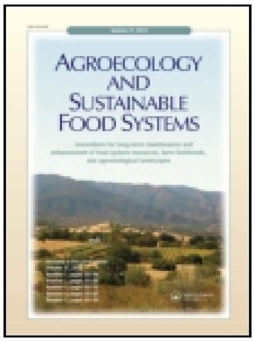

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Market for Amazonian Açaí (*Euterpe oleraceae*) Stimulates Pulp Production from Atlantic Forest Juçara Berries (*Euterpe edulis*)

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*Palm heart from juçara palm (*Euterpe edulis*) has been one of the most important non-timber forest products (NTFPs) from the Brazilian Atlantic forest since 1960s, but overharvesting, among other factors, drove the species near to extinction. However, the recent conversion from extraction of hearts of palm to berries harvesting for pulp production, a nondestructive use, had a remarkable effect on species conservation and its potential for cash provision and forest landscape restoration. Pulp production from* E. edulis *in the Atlantic Forest is strongly benefiting from the traditional and expanding market of açaí pulp produced from* Euterpe oleraceae *in the Amazon Basin. In this article, we assess the current status of this new NTFP from* E. edulis *in the State of Santa Catarina, tracing a parallel with the açaí production chain in the Amazon. In addition to a literature review, we surveyed the production chain and interviewed key stakeholders. Production of juçara pulp soared from 5 tons in 2010 to 97.76 tons in 2011, but production is clearly far from fulfilling the fast growing demand. With 115 fruit collectors, management in backyard agroforestry*

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represents 80% of production, with the secondary forests providing the remainder. Two types of producers in Santa Catarina —industrial and family farmers—are distinguished by their form of processing, production scale and sales. Familiarity of farmers with juçara palm as well as the better infrastructure of the region compared to the Amazon gives juçara pulp good condition for the development of the production chain. Nonetheless, it is clearly important to define strategies under public and private policies for research, development, and dissemination of sustainable production models, based on the ecology of the species, landscape structure, and sociocultural values.

KEYWORDS *Atlantic forest, non-timber forest products, forest production chain, forest management*

1. INTRODUCTION

The Atlantic Forest exhibits the greatest recorded diversity of tree species of any Brazilian terrestrial ecosystem (Critical Ecosystem Partnership Fund [CEPF] 2001), and the ecosystem services sustained by this diversity directly benefit the two thirds of Brazil's population residing within its borders. Santa Catarina, a state located within this biome, hosts 10% of described plant species in Brazil (Lewinsohn and Prado 2005; Vibrans et al. 2012). However, with only some 7% of primary forest still intact, the Atlantic Forest has suffered the worst deforestation (CEPF 2001) and, without significant reforestation, may suffer a dramatic loss of biodiversity and ecosystem services (Tabarelli et al. 2005; Metzger 2009; J. A. A. Silva et al. 2011).

Brazil's new national forest code (NFC) mandates forest protection or restoration of forest cover in areas of permanent protection (APPs)—riparian forest, steep slope terrain, and hilltops—as well as in legal reserves (RLs) (Brasil 2012). While compliance with the NFC may be adequate to protect and restore critical ecosystem functions in the Atlantic Forest, its enforcement would drive rural landowners to convert significant amounts of farmland to forest, threatening agricultural output and farmer livelihoods (Schmitt et al. 2013).

Brazil is experimenting with payments for ecosystem services, designed to pay individual landowners for forest conservation and restoration. One promising solution is to develop and promote non-timber forest products (NTFPs) integrated into agroforestry systems (AFSs) on family farms that can simultaneously enhance farmer livelihoods and ecosystem services (Van Looy et al. 2008). Research by H. N. Souza et al. (2010) suggests that such agroforestry systems could not only reduce deforestation pressures, but also actively stimulate reforestation.

Santa Catarina's biological heritage makes it particularly well suited for developing such systems with native species. The native *Euterpe edulis* has significant potential to serve as a foundation species for such AFSs in Santa Catarina. Since the 1960s, this palm tree has been largely used for palm of heart production, one the most important Brazilian NTFPs, but overharvesting, among other factors, drove it to near economic extinction. However, in the last decade, a shift in the economic use of the species by the harvesting and processing of its berries for pulp production revolutionized the socioeconomic and ecologic role of this palm. It is a unique case where a forest species suddenly moved from near to extinction to a position of strong potential for sustainable management in forest environments and AFSs.

In this study, we tell such a story. Because the success of the new use for *E. edulis* in the Atlantic Forest strongly took advantage of the traditional use of *E. oleracea*, a related species from the Amazon, we compared both production chains. To make this comparison stronger, we provide a lot of background information on ecological, economic, and social aspects of the two species. We also suggest policy strategies that will help develop and disseminate appropriate agroforestry systems for cultivating the juçara palm in AFSs in Santa Catarina.

1.1. *Euterpe* Species from the Amazon Basin to Southern Atlantic Forest

Euterpe oleracea, Euterpe precatoria, and *Euterpe edulis* are palm species with recognized social and economic importance. *E. oleracea* occurs mainly in the states of Pará and Amapá, while *E. precatoria* is found in Amazonas and in Mato Grosso states and in all four states in the Amazon Basin (Bacellar et al. 2006), while *E. edulis* is typical of the Southern Brazil Atlantic Forest (Reis and Reis 2000). This article focuses on *Euterpe edulis*, known by the popular names of juçara and palmiteiro, and *Euterpe oleracea*, whose popular name is açaí.

Juçara and açaí compose the production chain of two of the most important NTFPs in Brazilian and international markets: *E. edulis* in the production of hearts of palm and *E. oleracea* in the production of açaí pulp and juice (Queiroz and Melém Júnior 2001; Favreto et al. 2010). Historically, juçara was important for the production of high quality hearts of palm, considered to have a taste and quality superior to other species of the same genus (Mantovani and Morellato 2000). Meanwhile, açaí has been known for ages for its pulp, produced by maceration of the pericarp with water (Lichtenthäler et al. 2005).

1.1.1. The juçara palm

Euterpe edulis is a dominant species of the middle strata of forests across a broad latitudinal range in the Atlantic forest biome, predominately along the coast from southern Bahia (18°S) to northern Rio Grande do Sul (30°S). The species prefers moist dense and deciduous forests, and grows under various conditions of temperature and annual precipitation (J. Z. Silva 2011). It is also found in the gallery forests of the Cerrado (Salomão et al. 2009) and forests in Paraguay and northern Argentina (Gatti et al. 2008). Producing an abundant quantity of fruit during a long period of the year, *E. edulis* is a keystone species in its native ecosystems (Mikich 2002).

The juçara is a monoecious palm tolerant to shade with a single stem reaching a height of 12 meters (Veloso and Klein 1957). The natural density of the species is usually high, but varies widely, with records of 60–1,000 adult individuals per hectare (Fantini and Guries 2007). With a pyramid type population structure, 70% of the individuals are young (Raupp et al. 2009).

The species reproduces annually but with considerable variation across years. Maintenance of a large pool of seedlings, with recorded densities varying from 450 to nearly 60,000 per hectare (Silva 2011) plays a strategic role in the regeneration of the species (Fantini et al. 2004). The number of inflorescences per plant varies in accord with the number of seed trees per area. Mantovani and Morellato (2000) found up to six inflorescences per individual.

Because it has a single stem, the extraction of palm hearts requires killing the plant and such intense harvesting pressure on the natural populations placed the species on the list of those threatened with extinction (Ministério do Meio Ambiente [MMA] 2008). This action was criticized by producers who manage the species for the production of pulp, given that its threatened status incurs numerous bureaucratic difficulties for managing pulp production. Studies by Portela et al. (2010) show that juçara populations are decreasing in large protected areas, where the control of clandestine exploitation is more difficult, and increasing in small and disturbed fragments. Nevertheless, despite the pressure exercised on the natural populations, the broad ecological plasticity of the species creates opportunities for the development of other management strategies that reconcile commercial management with conservation.

1.1.2. Açaí—*Euterpe oleracea*

Euterpe oleracea is a caespitose palm, with stalks up to 30 m tall, whose traditional management promoted the formation of oligarchic forests known as açaizais or açaí groves (Homma 2012). It is multi-stemmed, and each year the plant emits new stems from the base of the root clump, which can have up to 25 shoots (Gantuss 2006). This high capacity for sprouting, mainly after cutting of one or more stems of the root clump, makes the species ideal for management by means of periodic cutting.

The species is typical of regions known as várzeas (seasonally flooded fields bordering rivers) and igapós (seasonally flooded forests along riverbanks), but can also be found in areas not subject to flooding (Lewis 2007). Dense groves of açaí dominate regions with annual precipitation from 2,000 to 2,700 mm that is well distributed throughout the year, and with relative humidity above 80%. *E. oleracea* is a light-demanding species whose growth is stimulated by the opening of forest clearings, which is the determining factor for fruit production (Gantuss 2006). According to Rogez (2000), there are two well-known varieties of açaí trees that are distinguished only by the color of the mature fruits: the purple açaí (also known as black açaí) is the predominant variety, and green açaí, whose fruits mature to a shiny dark green. The species stands out for its natural abundance, with up to 400 root clumps per hectare in açaí groves in várzeas (Shanley 2005) and for constituting an important element in the agroforestry systems in the Amazon region (Miller and Nair 2006).

It is nearly impossible to exaggerate the social importance of this species, which provides a staple food for most of the populations that live along rivers in the Amazon region (Lewis 2007). They are valuable for both subsistence and commerce (Yamada and Gholz 2002; J. S. R. Oliveira et al. 2010). The traditional pulp extraction process involves various steps for the separation of the edible portion, the exocarp and the mesocarp, from the seed. The pulp is consumed without cooking as part of the diet of Amazon residents, but is also widely used to prepare ice creams, creams, yogurts, wine, and liquors (M. A. C. Souza et al. 2006).

Due to the increasing popularity of the pulp in Brazil and strong growth in the international market (Sabbe et al. 2009), the area planted is expanding in the Amazon and various Brazilian states (Lewis 2007). Nevertheless, the fruit is highly perishable, and should be frozen or consumed within 24 h of harvest and pulp removal (Tonon et al. 2009). The determining factors in the quality and quantity of the pulp are the season of harvest, form of storage, time of softening of the fruits, and depulping and proportion of water added. Abundant anthocyanins with high antioxidant capacity (Schauss et al. 2006) drives its reputation as a “super food,” and demand for export to regions without a prior tradition in its consumption (Mertens-Talcott et al. 2008).

1.2. Products from the Juçara Palm, the Southern Palm

The economic use of *E. edulis* has been marked by three distinct cycles. The first was characterized by the periodic extraction of all the plants to produce hearts of palm, without leaving mature individuals for the production of seeds. The repetition of this harvest at short intervals drastically reduced seed production and, consequently, the regeneration of the natural populations of the species, to the point of provoking its local commercial extinction (Fantini et al. 2004). The second cycle was marked by the introduction in various Brazilian states of a specific law to govern management of the species, in an attempt to make the hearts of palm production sustainable and to promote the conservation of the ecosystems in which it occurs. Few projects, however, were approved and conducted according to the established regulations. The low effectiveness of the strategy was the result of a combination of factors, including the high bureaucracy and cost of the legal procedures, the low productivity of hearts of palm production in natural forests and the theft of palms, mainly of the adult palms that were left as seed producers to maintain the populations of juçara (Fantini et al. 2004).

To the degree that the stocks of juçara palms were reduced and thus the price of the product increased, there was hope that the species would be domesticated, as predicted, for example, by the theory of Homma (2012) for NTFPs produced for the market. However, the monoculture of juçara palm for production of hearts of palm did not occur. As a consequence, nearly all of the juçara palm hearts in the market today come from illegal extraction and despite the great potential of the species for the production of this delicacy, it is expected that the supply of the product will continue to decline and be totally substituted by other species (Fantini et al. 2004).

We are currently witnessing the third cycle of economic utilization of the juçara palm, which recently began with the use of the mature fruits for pulp production. The harvest of fruits for pulp or juice production is becoming established as an economic alternative for small farmers (Mac Fadden 2005; Farias 2009).This recent NTFP from the juçara palm emerges as a strategic activity for conservation of the species, contrary to the extraction of hearts of palm, the collection of mature fruits for pulp removal does not compromise the plants which become palm trees for production (Troian 2009). Moreover, the pulped seeds do not lose their ability to germinate and can be used for the production of seedlings to enrich the altered forests. Fruit extraction, thus, involves a significant change of paradigm in the use and conservation of an endangered species.

This new cycle of the production chain of *E. edulis* describes a unique trajectory in relation to the sale of NTFPs. The production of juçara pulp is inserted in the açaí pulp sales chain with a series of competitive advantages, and exactly at a time when this chain is undergoing great expansion with higher demand (Mac Fadden 2005). *E. edulis* succeeded in borrowing from the fame of *E. oleracea* and inserted itself in the booming pulp market (Kugel 2010). The production of juçara palm for pulp extraction has grown rapidly in recent years involving producers in Brazil's south and southeast in the Atlantic Forest region (Rede Juçara 2012).

1.3. Production Chains and Legislation

The juçara pulp chain involves harvest, processing, storage, sales, and consumption. The production systems are related to the arrangement of the plants in the landscape and the practices conducted by the producers—the handling of the plants and collection of the fruits. The cottage production systems are conducted on a small scale by family farmers, normally with the intention of diversifying economic activity, while small industrial systems are using hired labor.

In addition to Santa Catarina, in the Atlantic forest there are reports of pulp production in the states of Rio Grande do Sul, Paraná, São Paulo, Rio de Janeiro, Espírito Santo, and Minas Gerais. The estimated production volume for these states varies from 1,500 to 16,000 kilos of pulp per year (Rede Juçara 2012).

From a legal perspective, the inclusion of juçara on the list of threatened species affects its handling. Although Brazil's Atlantic Forest Law (Brasil 2006) allows the unrestrained collection of fruits, a regulatory decree (Brasil 2008) requires authorization from the competent environmental agency for the collection and transportation of a subproducts for sale, which makes the process complex and costly. Thus, balancing commercial production to meet growing demand for the pulp with forest restoration requires knowledge of the forest ecology, development of production strategies and establishment of specific public policies for family farming.

2. MATERIAL AND METHODS

This study is inserted in the project "Innovative Processes for the Management of Non-Timber Forest Product Handling in the Santa Catarina's Atlantic Forest," financed by National Post-Doctoral Program/Coordination for the Improvement of Higher Level Personnel-CAPES and carried out by the Forest Ecosystems Ecology and Management Lab and the Redesigning Agroecosystems Research Group, University of Santa Catarina, Brazil. A literature review was carried out on ecological and socioeconomic aspects of both *E. edulis* and *E. oleracea*, highlighting their traditional uses. The current status of pulp production from *E. edulis* in the State of Santa Catarina was then assessed, tracing a parallel between this new NTFP production chain in the region, with the açaí pulp production in the Amazon.

This article reports the emerging scenario of pulp production like a new non-wood forest product in State of Santa Catarina, Brazil. Data reported here are from a survey on juçara pulp carry out in this region. Data collection was realized with all producers that process this new product. For identify this producers the "follow the actors" technique was used (Latour 2000). In this approach, an actor was identified who indicates another and so on, until the indications are repeated. After to identifying the key actors the data were collected in semistructured interviews (Lindlof and Taylor 2002). Fieldwork was carried out at five different locations during 2010 and 2011: four were located in the coastal region and one in the hinterland. The questionnaires addressed issues about quantitative and qualitative variables. The data were organized on spreadsheets according to the responses. Each question applied generated a response and this was interpreted as a variable, composing a set of 42 quantitative and qualitative variables. For the data analysis, the qualitative data were consolidated in a characterization table, while the quantitative data were grouped and tabulated in a spreadsheet.

3. RESULTS

Seven agribusinesses that process juçara were identified in Santa Catarina in 2011 (and to the best of our knowledge, this is the current sample universe). Five businesses were in full production, while two are preparing to begin processing. The characteristics of the juçara pulp productions system of these five producers are shown in Table 1. In Santa Catarina, the activity is emerging and is found mainly near the coast and in the Itajaí Valley region. Among the five producers interviewed, three conduct collection, processing, and sale of the pulp, thus, characterizing them as complete cycle producers. The other two producers contract the collection and are responsible for processing and sales. Trading is done through two channels, with three of the producers selling the pulp through their own company and two using a local cooperative.

Total juçara pulp production in Santa Catarina was 5,000 kg in 2010 and 97,760 Kg in 2011 (Figure 1). According to those interviewed, climate conditions hampered fruit production in the 2010 harvest, a situation that reversed in 2011. Considering that annual juçara pulp production from the other states oscillated from 1,500 to 16,000 kg (Rede Juçara 2012), Santa Catarina is the largest producing state. Nevertheless, the distribution of production in Santa Catarina is quite uneven. A single producer was responsible for 80,000 kg, approximately 82% of the juçara produced in 2011.

Three of the five producers studied are characterized as family farmers: They use only family labor, their production is domestic and small-scale, and their farm properties are smaller than 50 ha. The other two producers are characterized by industrial production, with salaried workers, indicating the increased production scale. According to the interviews conducted, juçara pulp production began in Santa Catarina in 2004, as described by Mac Fadden (2005). Since then, a new production unit has been established every two years.

3.1. Collection of Fruits for Juçara Pulp Production

In relation to the collection of fruits, it was found that four pulp producers only collect fruits on properties of other landowners and only one producer also collects on his own property. In this dynamic, the juçara production in Santa Catarina involves 115 collectors (Figure 2). Most of these collectors are

TABLE 1 Characteristics of the juçara pulp production system by five producers in Santa Catarina State

Characteristic	Producer 1	Producer2	Producer 3	Producer 4	Producer 5
Area (ha)	15	10	10	8	0
Family operation	Yes	No	No	Yes	Yes
Family members who work	2	0	0	1	3
Year production began	2007	2006	2004	2008	2010
Price per kilo (R$)	8	6	6	12	19
Place of collection	Own &Others	Others	Others	Others	Others
Form of collection	Climb&CutBelow	Climb&CutBelow	Climb&CutBelow	Climb&CutBelow	Climb&CutBelow
Main Material Used	Pruner&Machete	Pruner&Machete	Pruner&Machete	Machete&Saw	Machete
Color of fruit collected	Purple	Purple	Purple	Purple	Purple
Collects all the bunches	No	Yes	Yes	Yes	No
Criteria for collection	Homogeneous ripe	Homogeneous ripe	Homogeneous ripe	Homogeneous ripe	Homogeneous ripe
Collects from all the trees	No	Yes	No	Yes	No
Main problem in collection	Access	Fruit scarcity	Fruit scarcity	Access & Fruit scarcity Fruit	Access
Selects fruits	Yes	Yes	Yes	Yes	Yes
Time of moistening (min)	5	5	NP	10	40
Water Temperature C (°)	20/30	20/30	NP	40	45
Time in pulping machine (min)	4	4	NP	3	3
Quantity of water (700ml/kg)	700 (medium)	700 (medium)	SI (fine)	700 (medium)	350 (thick)
Equipment	Dep/freezer	Dep/freezer/ref/tank/	Dep/freezer/ref/tank/tunnel	Dep/freezer	Dep/freezer
Satisfied with equipment	Yes	Yes	Yes	Yes	No
Origin of pulping machine	NorthBrazil	NortheastBrazil	SouthBrazil	SouthBrazil	SouthBrazil
Certification	No	No	No	No	No
Destination of seeds	Donated	Refuse	Refuse	Refuse &Planting	Planting
Transports pulp	Yes	Yes	Yes	Yes	Yes
Received training	Yes	Yes	Yes	Yes	Yes
Institution	University	Extension agency	University	Extension agency	University

NP = information not provided by producer, Own = Own property, Others = Property of others, Climb&CutBelow = Climb and cut below palm, Homogeneous Ripe = Homogeneously Ripe, Dep = pulping machine, Frez = freezer, Ref = Refrigerated Chamber, Tank = tank; Tun = tunnel

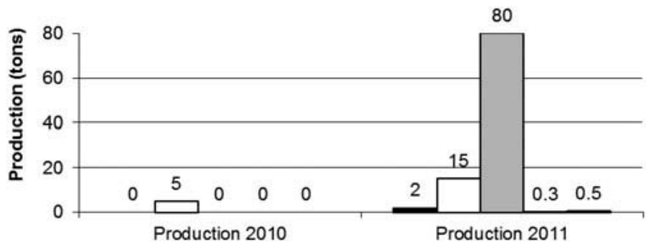

FIGURE 1 Production of juçara pulp per each of the selected producers.

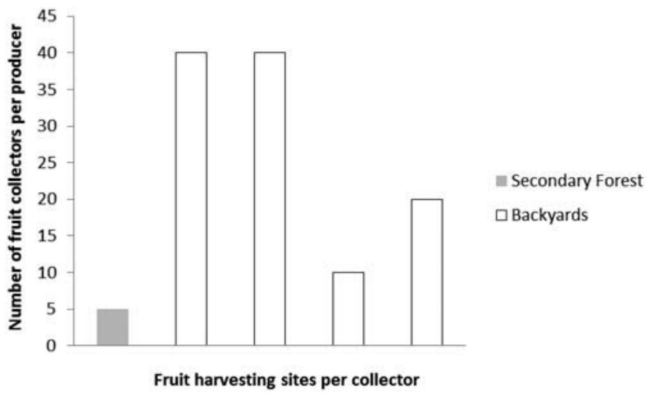

FIGURE 2 Number of collectors and fruit harvesting sites per producer.

small farmers who are seeking to increase their family income with the activity.

Harvesting locations are characterized as backyard agroforestry and borders of secondary forests. There is practically no collection of juçara berries in a typical forest environment (Figure 2). Studies show that fruit production is significantly higher and fruit maturation more homogeneous in juçara plants in open ecosystems compared with those below a forest canopy (Mac Fadden 2005; Silva 2011). The production of good quality fruits has a positive relation with the luminosity of the ecosystem (Silva 2011), which also suggests that the species has good potential for cultivation in pure stands or together with other species for the purpose of pulp production.

3.2. Collection Methodology

For harvesting fruits, all those interviewed reported that the collectors climb the tree and cut the bunch with a pruner as is normally done with açaí collection in the Amazon (John 2011). While in the Amazon harvesting still involves climbing trees with bare feet protected only by a strap made from bark strips or leaves (Kugel 2010), in Southern Brazil scaling trees have been done with forged metal J climbing hooks clipped to a pair of heavy duty boots, climbing harness, and leather or nylon straps.

In Santa Catarina, harvesting juçara fruits from tall plants can be considered a limiting factor for the collectors, increasing the risk of the activity. In the case of açaí, the traditional populations along the Amazon rivers typically remove the stalks that become too tall (Quaresma and Cunha 2012). There has been, however, a clear tendency in northern Brazil to introduce improved genotypes, which mainly combine high productivity with short plants, two characteristics that considerably assist the work of the collectors (M. S. P. Oliveira and Neto 2004). One of the producers interviewed in Santa Catarina is already producing juçara saplings and is successfully planting them in open ground, which suggests that the species has the flexibility for genetic improvement in the search for more productive and shorter plants.

In relation to the timing of harvests, all those interviewed determine the time to collect the fruits by their purple, nearly black coloring. Three producers use the criteria of collecting all the fruits from the collection area, even if they are not completely homogeneous. The other two producers instruct their collectors to not remove the bunches that are not homogeneous in terms of ripeness. The main problems in this production phase, according to those interviewed, are the difficulty in accessing the collection areas and the scarcity of the fruits. In addition, one of the industrial producers reported that the supply of fruits is far below his production capacity. These facts reveal, in addition to growing demand for pulp in the markets, that there is a clear opportunity for the expansion of fruit production.

3.3. Fruit Processing

In the processing phase, all those interviewed report conducting the selection of fruits after cutting down the bunch, which is followed by a triple washing of the fruit. Information referring to the time of moistening in the water, the water temperature, and the time of depulping were obtained from four of those interviewed. The largest producer did not want to provide this information. The results show that the four producers use different criteria for processing the fruits. The time of moistening varies from 5 to 40 min, while the water temperature varies from 20 to 45°C, and the time of pulping from 3 to 4 min. In relation to the addition of water in pulp removal, three producers produce medium pulp while the others produce fine and thick pulp respectively. The quantity of water added during processing determines whether the pulp is thick, medium, or thin (Sabbe et al. 2009).

In terms of equipment, only a pulping machine and freezer are used by three of those interviewed. The other two producers with higher production are more established, and have a cold chamber and specific cleaning tank. In addition, the producer with the highest production also has a freezing tunnel and pasteurizes the final product. This producer has also invested in diversification of the product and offers the pulp in different packages and combined with other fruits and granola.

No certification process was found among the producers and all of them said that, at the beginning, they participated in training for production offered by the Federal University at Santa Catarina and by EPAGRI, the State Agricultural Research and Rural Extension Company.

All of those interviewed deliver the frozen juçara pulp in their own vehicle. Another issue worth noting is the destination of the seeds—as in the Amazon, most of the resources generated in the pulp production become refuse and are discarded.

4. DISCUSSION

Açaí has been for ages a vital part of the diet of several Amazon ethnic groups. With the birth of many small urban clusters, it became an everyday meal of the newcomers. Today "most neighborhoods have stands or small stores where customers can get a daily supply" (John 2011). With studies confirming the exceptional antioxidant and natural energy boosting properties of the fruit, its popularity has soared in the most populated areas of Brazil, North America, and Europe. The purple–black berries from a dark green palm unknown outside of Amazon Basin two decades ago are now globally recognized as the new super fruit from the Brazilian Rain Forest. American markets have avidly mixed the super fruit into an enormous array of products from juices to beauty products (Kugel 2010). Suddenly, the main ethnic food of the Amazon became one of the leading Brazilian NTFPs (John 2011).

In contrast to açaí, the use of juçara as a food source was restricted to hearts of palm until a decade ago. Before that, there were no publications in popular or scientific literature related to the utilization of juçara pulp as a food source. Research at the Neolithic Technology Laboratory, University of Santa Catarina, reported that the utilization of pulp from juçara palm was "accidentally rediscovered" by "Amazoninos" that moved to Southern Brazil around 1996 (Farias 2009). Nowadays, several innovative production systems for pulp production are under development by other researchers from the University of Santa Catarina.

The pulp of the juçara palm is only beginning to be commercialized. Nevertheless, the market possibilities are exactly the same as those for açaí pulp and the potential production arrangements promise success for the activity, mainly because of the competitive advantages in favor of the *E. edulis*. Some of these are its proximity to consumer markets, good routes for shipping production, regional infrastructure, existing social capital, and the extent of the areas suitable for its management.

Thus, there is strong reason to be optimistic in relation to juçara pulp production, because in addition to the good conditions found in the Atlantic forest region, there are possibilities for learning from the Amazon production chain, both the age-old methods and innovations in the productive arrangements of the large açaí production chain. Now the açaí of juçara is riding the wave of açaí from *E. oleracea*. In Table 2, we sketch a parallel between the ecological, cultural, and economic characteristics of pulp production in the two regions.

TABLE 2 Characteristics related to the production of pulp of *Euterpe oleraceae* and *E. edulis*

Characteristics	*Euterpe oleracea*	*Euterpe edulis*
Ecological	Typical of the Amazon	Typical of Atlantic Forest
	Flooded forests	Non-flooded forests
	Typical of tropical climate	Tropical and subtropical climates
	Caespitose	Single stipe
	Climax	Late secondary
	Not threatened by extinction	Threatened by extinction
Management	Native açaí groves, managed and cultivated	Secondary forests and backyards
	Traditional collection with spike and machete by collector	Collected with spike, ladder, or pruning hook
	Artisan removal method in baskets or jute bags by the collector	Artisan removal method in baskets or jute bags by collector
	Processed with sieves, pulping machine, and more sophisticated equipment	
		Processed with pulping machine and more sophisticated equipment
Production (fruit)	High (125.000 tons - 85% Pará)	Low (210 tons—85% Santa Catarina)
	Winter harvest (rainy season) and summer (dry)	Wide variation of production of fruits during the year
	Low technology predominantly with insertion of high technology to the products for export	Low production predominantly on small scale and high technology in expanded production
Market	Price related to distance covered by the collector and time of collection	Price according to type of pulp and availability of fruit
	Price from R$ 1,00–3,50 per kilo of fruit	Price of R$1,00–2,50 per kilo of fruit
	Price of R$ 6,00 to R$ 8,50 kilo of thick pulp	Price of R$ 19,00 per kilo of thick pulp
	Local and international market (10% of production)	Local market on the coast
Cultural	Main food source	New food
	Cultural use of the forest	Opportunistic use
	Economic base	Economic opportunity
Legal framework	IN-MMA/04/2002 Forest Plan for Multiple Use Palms	Atlantic Forest Law 11428/06/ Decree 6660/2008
	Minimum price R$ 0,90/kg of fruit (CONAB/MOC 015/2012)	No incentive policy
	Forest Products Management System	Discussion of the norm for organic production

Sources: Fantini et al., 2004; Shanley, 2005; John, 2011; Companhia Nacional de Abastecimento (Conab/ MOC), 2012; Rede Juçara 2012.

In the ecological dimension, while *E. oleracea* is managed in river-edge environments, both natural as well as planted (M. S. P. Oliveira and Neto 2004), *E. edulis* is mainly produced in backyard agroforests and secondary forests. Sunlight and ease of access are the main factors that enhance productivity and facilitate the fruit collection. Secondary forests could be managed to reduce the basal area of other species to promote fruit production and uniform ripening, although there may be tradeoffs with other ecosystem services, such as biodiversity habitat. Like açaí in the Amazon, there are successful experiences with monocultures of juçara in Santa Catarina, but there are no records of improved populations of this species, as in the case of açaí, which indicates that continued research, development and dissemination of new varieties and production practices for *E. edulis* would offer high returns.

Given that juçara production is enhanced by greater exposure to sunlight, agroforestry systems using juçara as a core species may be particularly well suited to bringing APP zones into compliance with the NFC (Alvez et al. 2012). Furthermore, juçara could also be incorporated into silvopastoral systems, together with other native species. Achieving 20% forest cover in pastures would not only bring farmers into compliance with the legal reserve requirements of the NFC, but would also provide shade cover that can increase cattle productivity (Schmitt et al. 2013). Such a system could help forest species move across open pastures, increasing connectivity between remaining forest fragments, cycle nutrients from deeper soil layers, provide habitat for pollinator species (particularly useful if farmers diversify into other crops), and generate a variety of other ecosystem services. In all of these cases, forest conservation and restoration can promote economic growth and poverty alleviation, thus, fulfilling Brazil's otherwise conflicting economic goals (Schmitt et al. 2013).

It will of course be necessary to pay attention to cultural dimension. The populations that live along the rivers of northern Brazil have a long tradition of managing açaí groves and collection of their fruits for pulp production. These people interact with this species every day, and often all year long, whether because it is a component of the family diet, or a product to be sold in the market (John 2011). Logistics for the sale of fruits, mainly focused on the middlemen, is well established. The Atlantic Forest communities do not have this experience with production methods and do not use the plant as a main food source.

Appropriate regulations for the management and harvest of the juçara fruit are also important, in the context of *E. edulis* status as an endangered species. The existing laws concerning açaí offer suggestions for appropriate legislation in the south, although the considerable differences in the context in which the two species are found must be considered. While the communities of the Amazon have practically complete freedom to manage the açaí groves, the Atlantic Forest Law, the legal base for forest management in this region, imposes strong restrictions on the management of ecosystems to promote the increased productivity of juçara. For example, the management of secondary forests to reduce competition from other species is essentially illegal, and the endangered status of the species presents greater difficulty for commercial licensing. However, it is important to not repeat the regulatory history of juçara for hearts of palm production, in which the restrictions on silvicultural practices for the species and mainly for its ecosystem, in addition to the bureaucracy required, discouraged farmers and other land owners interested in the activity (Fantini et al. 2004).

One particularly promising option is extensive public investment in research and development of juçara varieties that enhance production and profitability, and of management practices that are well suited to local communities and that enhance ecosystem services. Research and development must be coupled with agricultural extension services that can disseminate appropriate technologies rapidly and broadly. Numerous studies have found that agroecosystems can produce as much food and profit as conventional systems while protecting and enhancing ecosystem services (Pretty et al. 2006; Schutter and Vanloqueren 2011) in spite of very limited investments in research and development (Vanloqueren and Baret 2009). Agricultural extension in Santa Catarina supported by its Federal University has proven highly effectively at developing and disseminating agroecological pastoral management that enhances both farmer livelihoods and ecosystem services, but the ongoing program has been conducted on a shoestring budget. The potential for providing ecosystem services and poverty alleviation coupled with large economic returns justifies major public sector investments in the juçara based agroforestry systems. Rather than reinforcing conflicts between the three policy goals under discussion, such investments would help to achieve all three simultaneously.

5. CONCLUSIONS

The conversion from extraction of hearts of palm to harvesting of berries for pulp production from *E. edulis* is a rare case of a successful change in the economic use of a forest species. Under all aspects the new NTFP from *E. edulis* is revealing to be advantageous compared to production of palm hearts. The potential for cash provision of the yearly harvesting of berries far exceed the single extraction of palm heart of each stem, a fact that farmers soon recognize. Also, *E. edulis* can be managed under a wide range of ecological conditions, from forest to agroforestry systems, a plasticity that favors its use in degraded areas recovery and to enrich areas that must be set aside for conservation according to the forest regulations. These reasons may be sufficient to change the willingness of farmers to engage in restoring and conserving areas of woody vegetation in their farms. Payment for the ecosystem services provided by such areas is another possibility for increasing farm revenue, incentivizing a positive feedback loop of conservation, and local development.

The concretization of this potential, however, can be accelerated and improved through public policies for this activity. The tasks involved in the fruit production chain, from the production of saplings to berries harvesting are simple, but studies are required to improve the productivity of the ecosystem and a rural extension program is needed to support farmers in these practices. The logistics of processing and sales, however, which involve factors of infrastructure and production scale as well as regulation of the activity, are issues that require greater care by public institutions. The creation of quality seals and certificates of origin, as well as the creation of an identity for the juçara pulp are examples of potential government initiatives to accelerate and improve the activity. In the case of açaí, there is a notorious discrepancy between the socioeconomic importance of the product and the volume of public actions dedicated to the activity. This experience reveals the need to seek alternatives to promote government initiatives aimed at stimulating production of juçara pulp as a new NTFP that brings with it the reality of conservation through use.

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REFERENCES

Alvez, J. P., A. L. Schmitt, Fo, J. Farley, G. Alarcon, and A. C. Fantini. 2012. The potential for agroecosystems to restore ecological corridors and sustain farmer livelihoods: Evidence from Brazil. *Ecological Restoration* 30:288–290. DOI: 10.3368/er.30.4.288. http://er.uwpress.org/cgi/doi/10.3368/er.30.4.288

Bacellar, A. A, R. C. R. Souza, J. C. X. Diogo, O. Seye, E. C. S. Santos, and K. T. Freitas. 2006. *Geração de renda na cadeia produtiva do açaí em projeto de abastecimento de energia elétrica em comunidades isoladas no município de Manacapuru-AM*. In Encontro de Energia no Meio Rural. Campinas, Brazil, 1–8. http://www.proceedings.scielo.br/scielo.php?pid=MSC0000000022006000200001&script=sci_arttext&tlng=pt

Brasil. 2006. Lei da Mata Atlântica, no. 11428 de 22 de dezembro de 2006. Brasília: Presidência da República. http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/lei/l11428.htm

Brasil. 2008. Decreto da Mata Atlântica, no. 6.660 de 21 novembro de 2008. Brasília: Presidência da República. http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2008/decreto/d6660.htm

Brasil. 2012. Código Florestal, Lei no. 12651 de 24 de maio de 2012. Brasilia: Presidência da República. http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm

Companhia Nacional de Abastecimento. 2012. Normas Específicas do Açaí (fruto)–Extrativista–Safra 2012/2013, Comunicado CONAB/MOC, no. 15 de 16/08/2012. http://www.conab.gov.br/conabweb/download/moc/titulos/T70s2012-2013.pdf%20 (accessed December 20, 2012).

Critical Ecosystem Partnership Fund. 2001. *Ecosystem profile Atlantic Forest biodiversity hotspot Brazil*. CEPF and Conservation International. http://www.cepf.net/Documents/final.atlanticforest.ep.pdf

Fantini, A. C., and R. P. Guries. 2007. Forest structure and productivity of Palmiteiro (*Euterpe edulis* Martius) in the Brazilian Mata Atlântica. *Forest Ecology and Management* 242:185–194. DOI:10.1016/j.foreco.2007.01.005. http://linkinghub.elsevier.com/retrieve/pii/S037811270700045X

Fantini, A. C., R. P. Guries, and R. J. Ribeiro. 2004. Palmito (*Euterpe edulis* Martius) na Mata Atlântica Brasileira: um recurso em declínio. In *Productos Forestales, Medios de Subsistencia Y Conservación*, eds. P. Alexiades and M. N. Shanley, 141–161. Indonésia: CIFOR.

Farias, M. 2009. *Reinventando a relação humano-Euterpe edulis: do palmito ao açaí*. Dissertação de Mestrado, Universidade Federal de Santa Catarina, Florianópolis, Santa Catarina, Brazil.

Favreto, R., R. S. P., Mello, and L. R. M., Baptista. 2010. Growth of *Euterpe edulis* mart. (Arecaceae) under forest and agroforestry in southern Brazil. *Agroforestry Systems* 80:303–313. DOI:10.1007/s10457-010-9321-z. http://www.springerlink.com/index/10.1007/s10457-010-9321-z

Gantuss, C. A. R. 2006. *Caracterização física e química de locais de ocorrência do açaizeiro (Euterpe oleracea, Mart) no Estado do Amapá e sua relação com o rendimento e qualidade do fruto*. Dissertação de Mestrado. Universidade Federal da Paraiba, Areia, Paraíba, Brazil.

Gatti, M. G., P. I. Campanello, L. F. Montti, and G. Goldstein. 2008. Frost resistance in the tropical palm Euterpe edulis and its pattern of distribution in the Atlantic Forest of Argentina. *Forest Ecology and Management* 256:633–640. DOI:10.1016/j.foreco.2008.05.012 http://linkinghub.elsevier.com/retrieve/pii/S0378112708004167.

Homma, A. K. O. 2012. Plant extrativism or plantation: what is the best option for the Amazon? *Advanced Studies* 26(74):167–186. http://www.scielo.br/pdf/ea/v26n74/a12v26n74.pdf.

John, L. 2011. *Na trilha da sustentabilidade*. *Revista Horizonte Geográfico*. http://horizontegeografico.com.br/exibirMateria/1160

Kugel, S. 2010. Açai, a global super fruit, is dinner in the Amazon. *The New York Times*. http://www.nytimes.com/2010/

Latour, B. 2000. *Ciência em ação–como seguir cientistas e engenheiros mundo afora*. São Paulo: EDUSP.

Lewinsohn, T. M., and P. I. Prado. 2005. Quantas Espécies Há No Brasil? *Megadiversidade* 1(1):1–7.

Lewis, J. A. 2007. The power of knowledge: Information transfer and açaí intensification in the peri-urban interface of Belém, Brazil. *Agroforestry Systems*

74(3):293–302. DOI:10.1007/s10457-007-9096-z. http://link.springer.com/10.1007/s10457-007-9096-z

Lichtenthäler, R., R. B. Rodrigues, J. G. Maia., M. Papagiannopoulos, H. Fabricius, and F. Marx. 2005. Total oxidant scavenging capacities of Euterpe oleracea mart. (açaí) fruits. *International Journal of Food Sciences and Nutrition* 56: 53–64. DOI:10.1080/09637480500082082. http://www.ncbi.nlm.nih.gov/pubmed/16019315

Lindlof, T. R., and B. C. Taylor. 2002. *Qualitative communication research methods*, 2nd ed. New York: Sage.

Mac Fadden, J. 2005. *A produção de açaí a partir do processamento dos frutos do palmiteiro Euterpe edulis Martius) na Mata Atlântica*. Dissertação de Mestrado, Universidade Federal de Santa Catarina, Florianópolis, Santa Catarina, Brazil.

Mantovani, A., and L. P. C. Morellato. 2000. Fenologia da floração, frutificação, mudança foliar e aspectos da biologia floral do palmiteiro. In *Euterpe edulis Martius (palmiteiro): biologia, conservação e manejo*, ed. A. Reis, 335. Itajaí, Santa Catarina: Herbarium Barbosa Rodrigues.

Mertens-Talcott, S. U., J. Rios, P. Jilma-Stohlawetz, L. A.Pacheco-Palencia, B. Meibohm, S. T. Talcott, and H. Derendorf. 2008. Pharmacokinetics of anthocyanins and antioxidant effects after the consumption of anthocyanin-rich acai juice and pulp (*Euterpe Oleracea* Mart.) in human healthy volunteers. *Journal of Agricultural and Food Chemistry* 56:7796–802. DOI:10.1021/jf8007037. http://www.ncbi.nlm.nih.gov/pubmed/18693743

Metzger, J. P. 2009. Conservation issues in the Brazilian Atlantic Forest. *Biological Conservation* 142:1138–1140. DOI:10.1016/j.biocon.2008.10.012. http://linkinghub.elsevier.com/retrieve/pii/S0006320708003935

Mikich, S. B. 2002. A dieta frugívora de *Penelope superciliaris* (Cracidae) em remanescentes de floresta estacional semidecidual no centro-oeste do Paraná, Brasil e sua relação com *Euterpe edulis* (Arecaceae). *Ararajuba* 10:207–217.

Miller, R. P., and P. K. R. Nair. 2006. Indigenous agroforestry systems in Amazonia: From prehistory to today. *Agroforestry Systems* 66:151–164. DOI:10.1007/s10457-005-6074-1. http://link.springer.com/10.1007/s10457-005-6074-1

Ministério do Meio Ambiente. 2008. Instrução Normativa no. 06 de 26 setembro de 2008. http://www.mma.gov.br/estruturas/179/_arquivos/179_05122008033615.pdf

Oliveira, J. S. R., O. R. Kato, T. F. Oliveira, and J. C. B. Queiroz. 2010. Evaluation of sustainability in Eastern Amazon under Proambiente Program. *Agroforestry Systems* 78:185–191. DOI:10.1007/s10457-010-9276-0. http://www.springerlink.com/index/10.1007/s10457-010-9276-0

Oliveira, M. S. P., and J. T. F., Neto. 2004. Cultivar BRS-Pará: Açaizeiro para Produção de Frutos em Terra Firme. Comunicação Técnica, *Embrapa* 114(1):1–3.

Portela, R. C. Q., E. M. Bruna, and F. A. M. Santos. 2010. Are protected areas really protecting populations? A test with an Atlantic rain forest palm. *Tropical Conservation Science* 3:361–372.

Pretty, J. N., A. D. Noble, D. Bossio, J. Dixon, R. E. Hine, F. W. T. Penning de Vries, and J. I. L. Morison. 2006. Resource-conserving agriculture increases yields in developing countries. *Environmental Science & Technology* 40:1114–1119. DOI:10.1021/es051670d. http://pubs.acs.org/doi/abs/10.1021/es051670d

Quaresma, S. M., and E. B. Cunha. 2012. Acai tree management, as managing practice and education environmental: A case estudy of community Franco Grande do Balique/Amapá. *Journal Environment and Sustainability* 2(1):1–21. http://www.grupouninter.com.br/revistameioambiente/index.php/meioAmbiente/article/view/118/52

Queiroz, J. A. L., and N. J. Melém Júnior. 2001. Effect of the recipient size on the growth of açaí (Euterpe Oleracea Mart.) seedlings. *Journal of Fruit Crops* 23:460–462. DOI:10.1590/S0100-29452001000200054 http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0100-29452001000200054&lng=pt&nrm=iso&tlng=pt

Raupp, S. V., P. B., S. L. Carvalho Leite. 2009. Aspectos demográficos de palmiteiro (*Euterpe edulis* Mart.) em uma área da Floresta Atlântica de Encosta em Maquiné, Rio Grande do Sul. *HERINGIA* 64(1):57–61. http://www.fzb.rs.gov.br/upload/20140328113244ih64_1_p057_061.pdf

Rede Juçara. 2012. Relatório da Oficina de Mapeamento da Cadeia de Valor da Polpa de Frutos da Palmeira Juçara e Priorização de Territórios. Associação Nascente Maquiné. Subprograma Projetos Demonstrativos do Ministério do Meio Ambiente, Rio de Janeiro, Brazil.

Reis, M. S., and A. Reis. 2000. *Euterpe edulis Martius-(Palmiteiro): Biologia, conservação e manejo*. Itajaí, SC: Herbário Barbosa Rodrigues.

Rogez, H. 2000. *Açaí: Preparo, Composição e Melhoramento da Conservação*. Belém: Universidade Federal do Pará.

Sabbe, S., W. Verbeke, R. Deliza, V. M. Matta, and P. Van Damme. 2009. Consumer liking of fruit juices with different açaí (Euterpe oleracea Mart.) concentrations. *Journal of Food Science* 74(Suppl.):S171–S176. DOI:10.1111/j.1750-3841.2009.01146.x. http://www.ncbi.nlm.nih.gov/pubmed/19646053

Salomão, A. N., G. O. Lopes, and A. Scariot. 2009. Germination behavior of *Euterpe edulis* Mart. seeds from of Galery Forest. *Journal of Agricultural Sciences*, 51: 51–67. http://www.periodicos.ufra.edu.br/index.php?journal=ajaes&page=article□view&path%5B%5D=142&path%5B%5D=53

Schauss, A. G., X. Wu, R. L. Prior, B. Ou, D. Huang, J. Owens, A. Agarwal, G. S. Jensen, et al. 2006. Antioxidant capacity and other bioactivities of the freeze-dried Amazonian palm berry, Euterpe *oleraceae* Mart. (acai). *Journal of Agricultural and Food Chemistry* 54: 8604–8610. DOI:10.1021/jf0609779. http://www.ncbi.nlm.nih.gov/pubmed/17061840

Schmitt, A., J. Farley, J. Alvez, G. Alarcon, and P. M. Rebollar. 2013. Integrating agroecology with payments for ecosystens services in Santa Catarina's Atlantic Forest. In *Governing the provision of ecosystens services, studies in ecological economics*, eds. R. Muradian and L. Rival, 333–356, London: Springer-Verlag. DOI:10.1007/978-94-007-5176-7_17

Schutter, O., and G. Vanloqueren. 2011. The new green revolution : Can feed the world. *Solutions* 2(4):33–44.

Shanley, P. 2005. Palmeiras. In *Frutíferas e Plantas Úteis na Vida Amazônica*, eds. P. Shanley and G. Medina, 158–175. Belém CIFOR/Imazon.

Silva, J. A. A., C. A. Nobre, C. V. Manzatto, and C. A. Joly. 2011. O Código Florestal e a Ciência: Contribuições Para o Diálogo. Sociedade Brasileira para o Progresso da Ciência. Academia Brasileira de Letras. São Paulo: SBPC. http://www.sbpcnet.org.br/site/arquivos/codigo_florestal_e_a_ciencia.pdf

Silva, J. Z. 2011. *Fundamentos da Produção e Consumo de Frutos em Populações Naturais de Euterpe edulis Martius*. Tese de doutorado, Universidade Federal de Santa Catarina, Florianópolis, Santa Catarina, Brazil.

Souza, H. N., I. M. Cardoso, J. M. Fernandes, F. C. P. Garcia, V. R. Bonfim, A. C. Santos, A. F. Carvalho, and E. S. Mendonça. 2010. Selection of native trees for intercropping with coffee in the Atlantic rainforest biome. *Agroforestry Systems* 80:1–16. DOI:10.1007/s10457-010-9340-9. http://www.springerlink.com/index/10.1007/s10457-010-9340-9

Souza, M. A. C., L. K. O. Yuyama, J. P. L. Aguiar, and L. Pantoja. 2006. Suco de açaí (*Euterpe oleracea* Mart.): avaliação microbiológica, tratamento térmico e vida de prateleira. *Acta Amazonica* 36: 1–6. DOI:10.1590/S0044-59672006000400010. http://www.scielo.br/scielo.php?pid=S0044-59672006000400010&script=sci_arttext

Tabarelli, M., L. P. Pinto, M. C. Silva José, M. Hirota, and B. Lúcio. 2005. Challenges and opportunities for biodiversity conservation in the Brazilian Atlantic Forest. *Conservation Biology* 19:695–700. http://onlinelibrary.wiley.com/doi/10.1111/j.1523-1739.2005.00694.x/full

Tonon, R. V., D. Alexandre, M. D. Hubinger, and R. L. Cunha. 2009. Steady and dynamic shear rheological properties of açai pulp (*Euterpe oleraceae* Mart.). *Journal of Food Engineering* 92: 425–431. DOI:10.1016/j.jfoodeng.2008.12.014 http://linkinghub.elsevier.com/retrieve/pii/S0260877408005980

Troian, L. C. 2009. *Contribuições ao manejo sustentável dos frutos de Euterpe edulis Martius: estrutura populacional, consumo de frutos, variáveis de habitat e conhecimento ecológico*. Dissertação de Mestrado. Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil. http://www.lume.ufrgs.br/handle/10183/26603

Van Looy, T., G. O. Carrero, E. Mathjis, and E. Tollens. 2008. Underutilized agroforestry food products in Amazonas (Venezuela): A market chain analysis. *Agroforestry Systems* 74:127–141. DOI:10.1007/s10457-008-9110-0. http://www.springerlink.com/index/10.1007/s10457-008-9110-0

Vanloqueren, G., and P. V. Baret. 2009. How agricultural research systems shape a technological regime that develops genetic engineering but locks out agroecological innovations. *Research Policy* 38:971–983. DOI:10.1016/j.respol.2009.02.008. http://linkinghub.elsevier.com/retrieve/pii/S0048733309000614

Veloso, H. P., and R. M. Klein. 1957. As comunidades do Município de Brusque Estado de Santa Catarina. Sellowia, Itajaí. *Sellowia* 9(8):81–235.

Vibrans, A. C., L. S., A. L. Gasper, and D. V. Lingner. 2012. Diversidade e Conservação dos Remanescentes Florestais. In *Inventário Florestal de Santa Catarina*, eds. D. V. Vibrans, A. C. Sevegnani, L. Gasper, and A. L. Lingner, 1–9. Blumenau, SC: Edifurb.

Yamada, M., and H. L. Gholz. 2002. An evaluation of agroforestry systems as a rural development option for the Brazilian Amazon. *Agrofosrestry Systems* 55:81–87.