

Mauritia flexuosa (Arecaceae: Calamoideae), an Amazonian palm with cultivation purposes in Peru

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Mauritia flexuosa (Arecaceae: Calamoideae), an Amazonian palm with cultivation purposes in Peru.

Abstract – The plant. The *aguaje* (*Mauritia flexuosa* L. f.) is an Amazonian palm which grows naturally on flooded soils, forming dense gatherings called *aguajales* in Peru. It can reach a height of 35–40 m. Each tree has an average of 8 inflorescences per year and each inflorescence produces about 900 fruits. This palm is in the domestication process. A dwarf form, recently discovered, could permit the improvement of the methods of production. **The fruit.** The fruit is an ellipsoid oval-shaped drupe, covered by red or dark red-coloured cornea scales. It measures (5 to 7) cm long and (4 to 5) cm in diameter. The pulp has a high content of β -carotene (260 mg·100 g⁻¹ of pulp). **Marketing.** Marketing is carried out for fruits coming from the natural environment. There is a local consumption of approximately 150 t·month⁻¹ and it can be of raw or processed fruit. For this fruit's demand, it is necessary to cut down approximately 24 000 palms a year. **Discussion.** The *aguaje* has big social and economical importance to these regions' inhabitants. It represents great potential for the national as well as the international market. The Research Institute of the Peruvian Amazon (IIAP) is developing technologies for agronomical management of the species, and for production and processing of the fruit. Studies on *aguaje* growth and genetic diversity in the natural conditions also have to be carried out.

Amazonia / Peru / *Mauritia flexuosa* / botany / cultivation / pests of plants / uses / domestication / proximate composition / marketing / storage / carotenoids

Mauritia flexuosa (Arecaceae : Calamoideae), un palmier amazonien à cultiver au Pérou.

Résumé – La plante. L'*aguaje* (*Mauritia flexuosa* L. f.) est un palmier amazonien qui croît naturellement dans les zones inondables formant de denses étendues appelées *aguajales* au Pérou. L'arbre peut atteindre (35 à 40) m et porter une moyenne de 8 inflorescences par an, chaque inflorescence portant environ 900 fruits. Ce palmier est en cours d'adaptation à la culture. Une forme naine, récemment découverte, permet d'espérer une amélioration des méthodes de production. **Le fruit.** Le fruit est une drupe de forme ovoïde recouverte d'écailles lisses de couleur brun-rouge de (5 à 7) cm de long et (4 à 5) cm de diamètre. La pulpe est riche en β -carotène (260 mg·100 g⁻¹ de pulpe). **Le marché.** Le marché est alimenté par des fruits provenant du milieu naturel. La consommation locale est d'environ 150 t·mois⁻¹ et la pulpe est consommée directement ou transformée localement. Pour satisfaire à la demande, environ 24 000 palmiers sont coupés chaque année. **Discussion.** L'*aguaje* présente une grande importance socio-économique pour les habitants de l'Amazonie péruvienne et représente un potentiel élevé pour le marché national et international. L'Institut de recherche de l'Amazonie péruvienne (IIAP) met au point des pratiques agronomiques pour la mise en culture de *M. flexuosa*, ainsi que pour la production et l'industrialisation des fruits. La croissance ainsi que la diversité génétique de ce palmier dans les conditions naturelles doivent également être étudiées.

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Amazonie / Pérou / *Mauritia flexuosa* / botanique / pratique culturelle / ravageur des plantes / utilisation / domestication / composition globale / commercialisation / stockage / caroténoïde

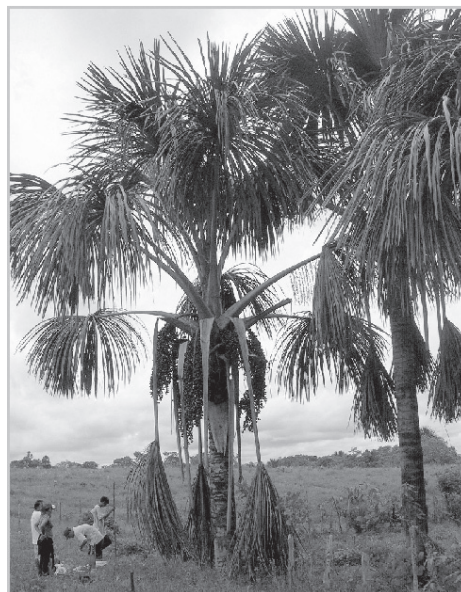
1. Introduction

The Amazonia lodges approximately 50% of all palm genera and 30% of the New World palm species [1], which hold ecological, ornamental, nourishing and medicinal importance for the people in the region.

One of these species is the *aguaje* (*Mauritia flexuosa* L. f.), which represents the greatest economical and cultural value resource in the Peruvian Amazon, especially for women, who consume it raw [2, 3]. The main importance for the cultivation of this palm is the high content of β -carotene in the fruits (up to 260 mg β -carotene \cdot 100 g⁻¹ pulp) [4]. This potential exceeds that of any other known fruit of fruit trees up to now. In the Amazonia, the *aguaje* can be exploited for bioindustry development.

The *M. flexuosa* tree grows naturally on flooded soils, forming dense gatherings known as *aguajales*. In the Peruvian Amazon, there are (6 to 8) Mha of *aguajales*. Dense and monospecific populations of *aguaje* species cover 2.5 Mha and the other *M. flexuosa* trees grow among mixed species [2, 5]. The density of the *aguajales* varies according to the zones; it can be between (170 and 368) palms \cdot ha⁻¹ [6–8]. These gatherings have been reduced at an accelerated rate because of the increasing market

Figure 1. Adult specimens of *aguaje* (*Mauritia flexuosa*) in Jenaro Herrera, department of Loreto (Peru).



demand. It lacks: (1) the use of good harvesting methods to preserve the female palms; (2) farming techniques to cultivate this palm, and (3) promotion to grow it on farms or agroforestry systems.

2. Botany

Mauritia flexuosa L. filius (synonym: *Mauritia vinifera* Mart., *M. sphaerocarpa* Burret, *M. minor* Burret or *M. flexuosa* var. *venezuelana* Steyerem. [9]), is commonly known as *aguaje* in Peru (figures 1, 2), *buriti*, *buriti-do-brejo*, *caranda-guassu* and *moriti* in Brazil, *caranday-guassu*, *palma real* and *ideui* in Bolivia, *canangucha*, *oriche* and *miriti* in Colombia, *morichi* in Venezuela, *morete* in Ecuador, *aete* palm in Guyana and *palmier-bâche* in French Guyana. It is a dioecious palm, male and female inflorescences (figure 3) are on separate plants (figure 2), and it is impossible to distinguish the sexes before the first flowering. The tree is monocaulous and can reach (35 to 40) m high and 50 cm in diameter. The stem is straight, smooth and cylindrical with interfoliar space always superior to 10 cm. The 8 to 25 leaves per plant are of costapalmate type. They measure up to 5.83 m long, and each leaf has 120 to 236 segments; the petiole measures from (1.6 to 4) m long. There is an average of eight inflorescences per adult plant, each one from (2 to 3) m long. In Peru, the fruit is an ellipsoid oval-shaped drupe covered by red or dark red-coloured cornea scales; it measures between (5 and 7) cm long and (4 to 5) cm in diameter. *Aguaje* flowering, for male and female, and fructification, start at the age of (7 or 8) years when the plant reaches a height from (6 to 7) m [9–13]. The *aguaje* reaches its commercial fructification between (12 and 20) years [8].

3. Variability in Peru

In Peru, there are several varieties of *aguaje*, depending on the fruit shape and size, but the most important characteristic for the consumers is the pulp colour, associated



Natural planting of aguaje (*Mauritia flexuosa*), young specimens, in Jenaro Herrera, department of Loreto (Peru).



Detail of an infructescence of aguaje (*Mauritia flexuosa*).



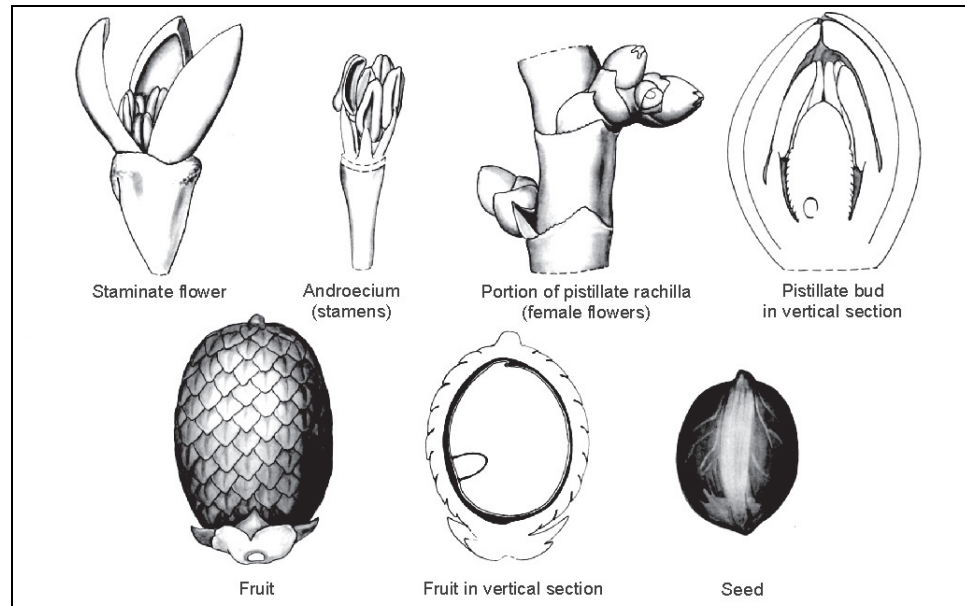
Male inflorescence of aguaje (*Mauritia flexuosa*).



Dwarfish aguaje (*Mauritia flexuosa*) with infructescence in Nauta, department of Loreto (Peru).

Figure 2. Plants and inflorescences of aguaje (*Mauritia flexuosa*).

Figure 3.
Detail of flowers and fruit
structure of *aguaje* (*Mauritia*
flexuosa) [10].



with its flavour. In this context, they can be classified as the following types:

– Yellow *aguaje*: this type can be divided into yellow-yellow, pale yellow and dark yellow groups. The yellow-yellow group does not change the pulp colour some minutes after taking the scales out. It is the approximate variety for processed *aguaje* sale such as mashed *aguaje* (*masa de aguaje*) to prepare soft drinks, ice creams and popsicles. The pale yellow or *posbeco* group loses its colour some minutes after taking the scales out and the dark yellow one then acquires a blackish colour.

– Reddish *aguaje*: this type can be divided into the coloured form, when only the superficial part is reddish and the *shambo* form, when the whole pulp is reddish. It is the preferred variety for direct consumption and the one that has the highest price in the local market. The *shambo* variety is the one that rusts faster, making processed products lose their quality (the pulp becomes blackish).

– On the other hand, there exists a dwarfish form: this *aguaje* (*aguaje enano*) has been found in some specimens in the surroundings of Iquitos (3° 45' S, 73° 11' W) and some other localities in the department of Loreto (Nauta: 4° 34' S, 73° 46' W; Bagazán: 4° 46' S, 73° 36' W). It has not been found in natural conditions but only in anthropised situa-

tions (*figure 2*). This palm has a thick stem; the internodes are less than 6 cm long; fructification happens at the age of 5 years, before the stem is less than 1 m high. This form seems to have ecological significance. There are solitary individuals on upland soil (*tierra firme*), open areas free of shrubs and trees, and periodical seasonal floods [15]. Due to the precocity of its fructification and its short stem that permits easy collection of the fruit, this “variety” would be recommended for monospecific cultivations or forest-agricultural systems. In Iquitos, we have to improve the research on the agricultural management of this particular *aguaje enano*.

We must also report the distichous *aguaje*, an uncommon form of which the leaves are in two orders in opposite directions, which makes it look like a fan. This palm cannot produce inflorescences, due to the compression of the bunches between successive leaf petioles of the same order. There are some specimens in the surroundings of Iquitos but this kind of *aguaje* does not seem to have ecological significance [14].

4. Distribution and habitat

M. flexuosa is an Amazonian native species, that is distributed all over the American tropics, the West Andes, mainly in the Amazonian

basin, in areas such as Peru, Bolivia, Colombia, Ecuador, Venezuela, Brazil, the Guianas, north of Trinidad and Panama [1]. In Peru, it grows in the departments of San Martín, Huanuco, Madre de Dios, Cuzco, Loreto, Ucayali, Pasco [16, 17] and Amazonas (Ruiz, pers. commun.). The major concentration of the population is located along the Marañón River [18]. This palm grows naturally on flooded soils, on rivers and stream borders forming dense monospecific gatherings known in Peru as *aguajales*. When they are associated with other palm species such as *Oenocarpus bataua*, they are called *sacha-aguajales*. The stem remains immersed in the water for long periods, without causing damage to the plant; the presence of pneumatophores permits growth in anaerobic conditions.

5. Cultivation and spreading

The environmental conditions in which *aguajales* can be developed are a maximum annual average temperature of 25.1 °C and minimum annual average of 17.2 °C; maximum annual precipitation per year of 3 419 mm and minimum annual average of 936 mm; the altitude varies from (50 to 850) m above sea level (meteorological references, IAP, Iquitos). The tree grows on provisional or permanently flooded soils in swampy or badly drained areas. In cultivation, it adapts to soils with good or deficient drains. In Peru, there are two private plantations, one in Pucallpa city, Ucayali Region, another in Iquitos city, Loreto Region; many isolated palms, or 2 to 5 trees, are found in gardens and pastures. In plantation, the sowing distance can be from 6.7 m × 6.7 m to 8 m × 8 m. The production varies between (15 and 25) t·ha⁻¹ [8, 13, 19].

The multiplication is sexual. The germination period is variable; it often depends on the seed condition and its physiological development, the substratum, the nursery humidity and the temperature. In a nursery constituting vegetal organic substratum, a maximum germination of 88% in 60 days, and a minimum germination of 9% in 61 days were registered. Certain authors reported that 40% of germination could happen in 82 days [13, 19]. It is advisable that

the young palms are moved to a field, when they reach more than 30 cm high.

Currently, the Research Institute of the Peruvian Amazon manages two experimental parcels of dwarfish *aguaje*. One of them is located in Pucallpa (8° 23' S, 74° 31' W) in high soils with a good drain, and the other one is located in Iquitos near a stream which floods temporarily with strong rains. Seeds were obtained from selected specimens of dwarf *aguaje* and in both places; all the plants obtained have kept the dwarfish character. They started fructification at the age of 5 years, and we have observed a good adaptation when the palm is growing out of the *aguajal*. Some private farmers have recently received selected seeds to test this new product.

6. Flowering and fructification

Flowering can occur during the whole year. The anthesis of female and male flowers usually begins at 16 h and lasts an average of 24 h. When the flowers open, they emit a strong and nice fragrance that probably works as a mechanism for attracting insects. Fructification can happen during the whole year, with major abundance between the months of August and October. A plant can have up to eight inflorescences a year in different developmental conditions. Each inflorescence can produce up to 900 fruits. In an *aguajal*, there can be 70% of the adult palms in fructification [8]. In the case of the dwarfish *aguaje*, we counted the production on two plants and six infructescences in Iquitos and Nauta: we found a production of 442 (sd = 14) fruits per bunch.

Because it is a dioecious palm, the fertilisation is compulsory xenogamic, and pollination by insects can apparently be crucial. However, this problem is exceeded by entomophily in the tropics. A great amount of insects associated with this palm has been registered in male and female inflorescences during anthesis [9, 11, 20]. Some of them are pollinators [11].

7. Pests and diseases

Evaluations of dwarfish *aguaje*, which were made mainly in Iquitos in the years 2004 and

Table I.

Main pest insects registered on the dwarfish *aguaje* (*Mauritia flexuosa*) by the authors in Iquitos (Peru) during the years 2004 and 2005.

Pest	Taxonomic group	Brief description	Damages
<i>Eupalamides cyparissias</i>	Lepidoptera: Castniidae	Big size, dark beige colour with white spots on the posterior wing. Cream-coloured larva.	It produces deep galleries in the peduncle, rachis, rachillae, petiole and stem.
<i>Cerataphis brasiliensis</i>	Homoptera: Aphididae	Small insects, from brownish to yellow colour.	It's found in the whole bunch. It eats the plant sap, gets the plant weak and excrete honeydew that produce sooty mould.
<i>Antiteuches</i> sp. ¹	Hemiptera: Pentatomidae	Medium sized bug, dark colour with small cream spots on the wings.	It eats the leaf sap.
<i>Leptoglossus hesperus</i>	Hemiptera: Coreidae	Medium sized bug, brown colour with an orange transversal band on the wings.	It eats the fruit sap and produces the fall or deformation of the fruit.
<i>Strategus surinamensis</i>	Coleoptera: Dynastidae	Medium size, from black to brownish colour.	The adult eats the root, attacks the radicle plate and the plant dies.
<i>Trigona</i> sp.	Hymenoptera: Apidae	Black-coloured bee.	The adult eats the <i>aguaje</i> pulp either ripe or in ripening process.

¹ It is a new species being studied by D. Rider (USA).

2005, allowed us to register 13 phytophagous insects associated with this palm. Some of them have already been identified (*table I*). Others are in the process of identification and will be presented in another publication. The main pest is *Eupalamides cyparissias* Fab. (Lepidoptera: Castniidae). The adult is a moth with a robust body which measures from (140 to 180) mm of wing expansion. The milky white-coloured larva damages the peduncle, rachis, rachillae, petiole and, rarely, the stem. It builds tunnels of 3.5 cm in diameter × 2.5 m long which interrupt the flow of water and nutrients and cause debility of the inflorescence; then the flowers and fruits fall. When the infestation occurs in the early stages, all the flowers and fruits fall but, when it appears at a more advanced age, the fruit loss is partial [15].

No serious problems were registered for diseases, but the presence of sooty mould produced by a fungus is frequent; it covers leaves, fruits and raceme. It is a consequence of the *Cerataphis brasiliensis* presence (Homoptera: Aphididae). On the leaves, we could also observe sclerotic spots provoked by the fungus *Colletotrichum* sp.

8. Fruit harvesting

The fruit harvesting is usually done in the natural environment and in an insignificant amount of yards and backyards of houses. The major amount of fruits commercialised in Iquitos city comes from the basins of the rivers Tigre, Chambira, Ucayali, Napo, Pastaza, Huallaga and Marañon [2, 18]. To harvest the fruits the local people cut down the palm, and then they collect the fruits and place them into sacks (40 kg per sack, *figure 4*). During the following season, when the water covers the forest, people get to the plants by small crafts which allow them to harvest and transport the major amount of fruits. However, during the dry season, the harvesting becomes difficult; the sacks are carried on the people's shoulders, who have to walk from (2 to 4) h.

In Iquitos, the *aguaje* consumption is approximately 124 sacks per day or 3720 sacks per month, which represents 148.8 t·month⁻¹ [22]. If we consider the total of racemes that a palm has, only 50% of them have mature fruits in a condition to be sold when cutting down the tree. It is assumed that a similar amount is lost because of the lack of an appropriate harvesting technique.

Table II.

Some elements of the chemical composition of the pulp of *aguaje* (*Mauritia flexuosa*) (in base to 100 g of fresh weight).

Reference	Energetic value (cal)	Humidity (%)	Proteins	Fats	Extract free of N	Fibre	Ash	Calcium	Phosphorous	Iron	Vitamin A			Thiamine		Vitamin C	
											(g)						
Chávez & Pechnik (1946, 1949) ¹	120.0	71.8	2.9	10.5	2.2	11.4	1.2	158.0	44.0	5.0	30.0	–	–	–	–	–	50.5
FAO (1986) ¹			5.5	31.0	38.0	23.0	2.4	–	–	–	30.0	0.1	–	–	–	–	52.5

¹ Quoted by Villachica [13].

Other amounts are lost in smaller proportion due to the lack of opportune and appropriate transportation towards Iquitos. Some fruits are also dispersed or buried when the tree is cut down for harvesting.

9. Chemical composition of the fruit

Among other nutritional qualities that *aguaje* has (*table II*), it presents, in Peru, a high content of provitamin A as β -carotene. The fruit has the major potential of this component known up to now [23]. The amounts of β -carotene vary from 77.7 mg·100 g⁻¹ pulp [24] and 110.46 mg·100 g⁻¹ pulp [25], up to 260 mg·100 g⁻¹ pulp [4]. The variation in this provitamin is related to the fruit variety (*shambo*, yellow, etc.). Another important aspect is that the β -carotene of *aguaje* has a high biodisponibility in rats [24], which should be tested in human beings. The content of oil and fat is another potentiality of the fruit, as well as the presence of lauric and myristic acids that can be used in the pharmaceutical industry [2].

10. Use

The fruit pulp is eaten directly, dried, fermented or as flour. It constitutes an important part of many Amazonian Indians' diet. Fruits are sold and consumed directly, or as pulp, to prepare an *aguaje* soft drink called *aguajina*, ice creams, popsicles (*chupete*), frozen in plastic bags (*curichis*), etc. (*figure 4*). Petioles are used in handicrafts, timbers (*esteras*) to build typical houses or

to decorate bars or restaurants. Leaves are used to cover the house roofs or as fibres, fuel and medicine. The larva of the weevil *Rhynchophorus palmarum* (Insecta: Dryophthoridae) develops in the fallen stem. Commonly known as *suri*, it is consumed by local people [8, 19, 26]. In Brazil, oil is extracted from the *aguaje* fruit for domestic use, and fibres are extracted from the leaves to make clothes, hammocks, baskets and toys. The spongy part of the petiole can be used for the production of paper; wine and starch are obtained from the stem pith [1].

11. Commercialisation and market

The major amount of *aguaje* harvested in Peru is commercialised in Iquitos city, and a few of them are sent to Pucallpa, Tarapoto and Lima cities. In Lima, it is possible to find *aguaje* in big supermarkets such as "Metro".

In Iquitos, the fruit is bought by the wholesale merchants, locally known as *rematistas*. These people distribute the fruit to the main markets, small markets and factories which sell it as mashed *aguaje*, unripe fruit, and processed products such as popsicles (*chupete*, ice creams and *curichis* (frozen in a little plastic bag), *figure 4*). The commercialisation flux is not tacit: in some cases, the *rematistas* travel to the communities to store the product, or the people who sell mashed *aguaje* or unripe fruit buy directly in the port or in the ferries (*lan-chas*). All this flux is altered with the objective of making better profits.

The price for each *aguaje* sack varies according to seasons and fruit varieties.

When the offer is significant, the *aguaje* sack to produce mashed *aguaje* (*masa*) costs approximately S/. 9¹. The mashed *aguaje* vendors commercialise 3 sacks a day (63 sacks among all of them), which represents a net profit of S/. 1020 per month. The sack for direct consumption (unripe fruit) costs S/. 10 and the vendors commercialise about 2 sacks a day (61 sacks among all of them), which represents S/. 210 per month. When the offer is reduced, the sack for mashed *aguaje* costs S/. 37 and can rise up to S/. 60: the profit for the vendor is S/. 460 per month. The sack for direct consumption costs S/. 40 and can rise up to S/. 70: the profit for the vendor is S/. 2250 per month.

The last group of the chain is represented by the people who commercialise the fruits in small trays, in squares, parks, or street corners and some specialised stores (*figure 4*). The unripe fruits are submerged in water and exposed to the sun's heat for a few hours until the scales have softened. This process is known as ripe *aguaje* for direct consumption. The sale generates an average of S/. 11.5 daily for each vendor [19]. The sale of ripe fruits is done mainly by women. It involves all the productive forces of this gender (single, widowed, divorced, etc.) from (15 to 82) years old.

With regard to the processing industry, the products, which are commercialised, are popsicles and ice creams. The *aguaje* consumption for these two industries is (73 to 93) sacks a day, or from (2 190 to 2 910) sacks a month, which means (87.6 to 116.4) t·month⁻¹ [21]. Monthly, each popsicle factory sells for an amount between S/. 3 000 and S/. 45 000 [26].

Even though the product sale is local, there is a great chance that it would open up to other geographical regions, and other processing systems. The Instituto de Investigaciones de la Amazonía Peruana (IIAP) is producing at experimental levels marmalades, nectars and yogurt, with a good acceptance. In Brazil, the oil extracted from the pulp is sold as sun protector and soap.

¹ One Peruvian sol (S/. 1) = 0.3 \$US and 0.24 € in July 2005.

12. Conditions for conservation of the *aguaje*

The indiscriminate cutting down of *M. flexuosa* with the objective of making profits from the fruit is threatening: (1) the ecological and evolutionary processes that happen in this peculiar type of ecosystem, (2) the species (it is running out) and the genetic resource, and (3) the animal feed. It also causes social and economic problems for families who depend on this resource.

To satisfy the fruit consumption demand in Iquitos city, approximately 1000 palms·month⁻¹ have to be cut down, which would be equivalent to 12 000 palms·year⁻¹ [22], if we consider all the bunches of a palm as being suitable for harvesting. However, according to our observations, only 50% of them are in good condition. If we take into account the fruit lost at the moment of harvest and transport, the figure would easily exceed 24 000 palms·year⁻¹. Another aspect that must be considered is that only female palms are cut. After such harvests, reduced gatherings constitute male palms and the few productive females that have the least commercial and ecological value. These aspects reduce the probabilities of survival and limit the genetic variability of the species.

The *aguaje* fruit plays an important role in some mammal animals' diet such as the *huangana* (*Tajassu pecari*), *sajino* (*T. tajacu*), *majas* (*Agouti paca*), *añuje* (*Dasyprocta variegata*), *sacha vaca* (*Tapirus terrestris*), *huapo colorado* (*Cacajau calvus*) and *choro* (*Lagothrix lagothrichia*). It is also the case for birds such as the macaw *Ara ararauna*, *A. macao*, toucans *Ramphastus tucanus*, and turtles and fish; some of them carry the seeds everywhere [1].

It is possible to harvest the fruits using climbing methods that are used in other regions for other palms [27]. The first needs the use of a rope system (*figure 5*). Another method consists of assembling six pieces of wood as a seat for the harvester who can climb safely up the palm to cut the bunch (*figure 6*). Those methods do not seem to be successful for the native people. As an alternative to protect the species and enhance its rational management, the IIAP is carrying out series of germplasm banks,



Sacks of fruit of *aguaje* ready for sale



Mature fruits of *shambo*



Woman (*aguajera*) selling peeled fruits of *aguaje* and the beverage *agajina* in a street of Iquitos



Bags containing past of *aguaje*



Machine to make ice creams



Bags with freezed juice



Stand in a street of Nauta selling ice creams of *aguaje*



Store specialized for *aguaje* products, ice creams, past and juice

Figure 4. Different forms of *aguaje* (*Mauritia flexuosa*) commercialisation.

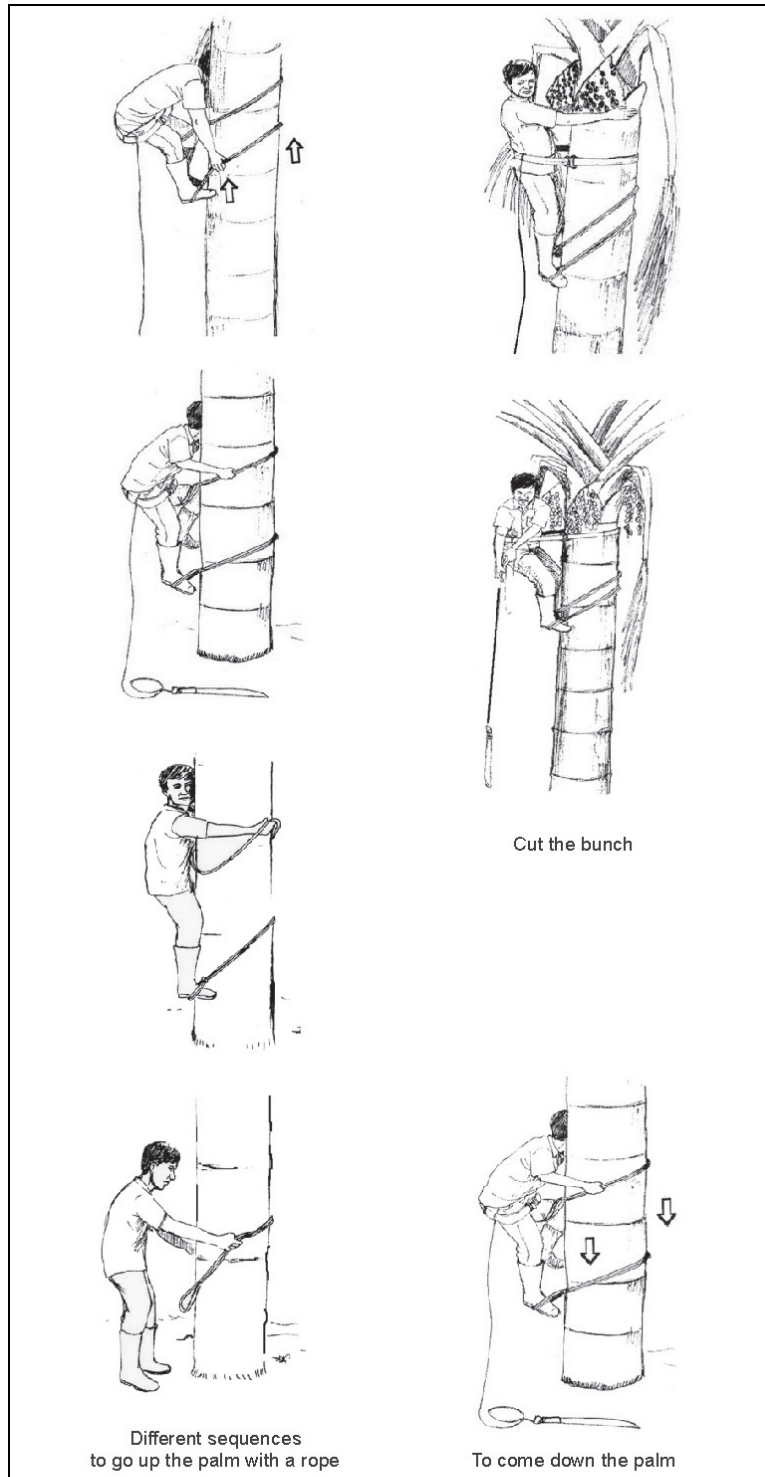


Figure 5. Harvesting a bunch of *aguaje* (*Mauritia flexuosa*) [27].

studies on the agronomy of the species, pollination experiments and, lastly, distributing *aguaje* seeds of the dwarfish variety to the farmers.

13. Discussion

In Peru, the fruit of the Amazonian palm *Mauritia flexuosa*, known as *aguaje*, is much appraised in different forms of consumption. It has a great social and economical importance for the local population. With the increase in the population in the city of Iquitos, the demand for fruit of *aguaje* also increases.

Moreover, the fruit presents great potential for the national and international market, for its highly nutritional qualities (β -carotene). For example, one of the authors has been contacted recently by a French firm to purchase fruits.

At present, most of the production available on the market comes from the swamp forest by cutting the palms to harvest the fruit. This habit reduces the biodiversity of the Peruvian Amazonian forest considerably, year after year, and could have consequences, in the medium term, on the associated fauna that depends on the fruit for its survival.

Fruit harvest carried out using simple equipment that permits one to climb easily on the palm could save a great number of palms each year. It is not sufficiently used. Therefore, cultivation is an interesting alternative and, in the long term, indispensable. It is necessary to develop techniques of cultivation to improve production and quality through new agricultural management. Studies of the natural environment are necessary to avoid running out and genetic erosion of the species, and to guarantee the maintenance of the animal and human populations who depend on this resource.

For some years, the IIAP has initiated research on the domestication and selection of the *aguaje* in the regions of Iquitos and Pucallpa, particularly on the dwarf *aguaje*. This last variety seems to be of interest for private farmers.

The cultivation of the *aguaje* and particularly of the dwarfish *aguaje* is a good

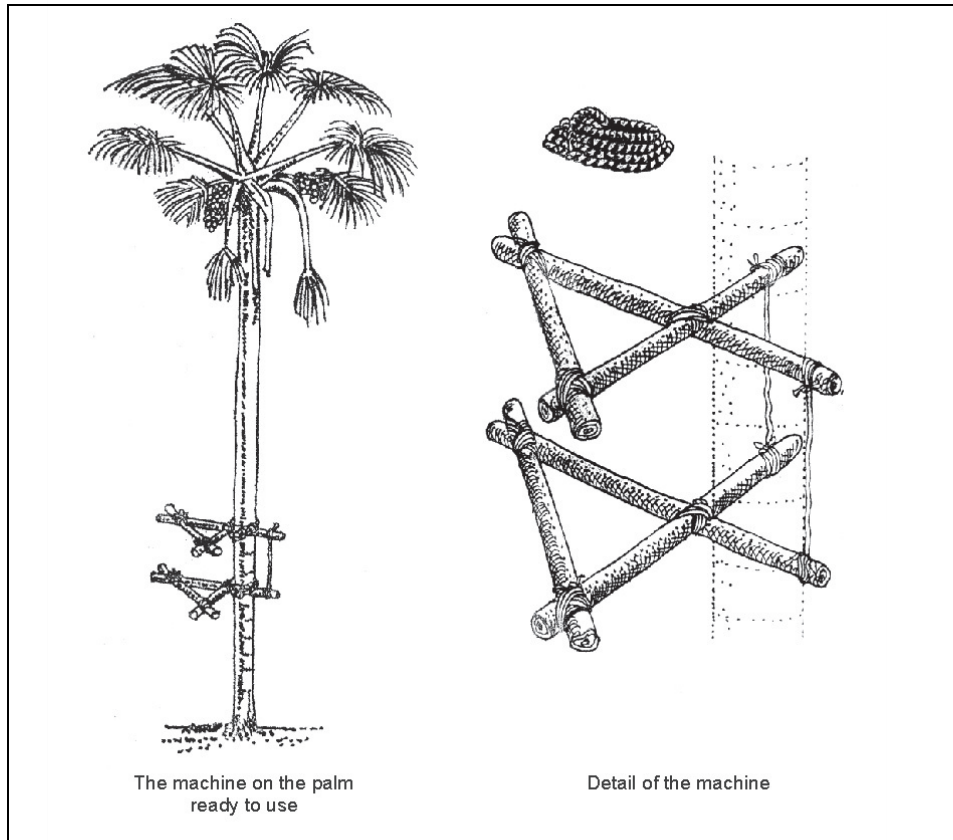


Figure 6. Wooden machine to climb up the palm [27].

opportunity to permit a controlled production, to offer to the consumer a selected fruit, and to reduce the felling of female palms in the forest. In this context, the exploitation of the *aguaje* fruits could be developed more in the Iquitos area, and exportation could be possible.

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***Mauritia flexuosa* (Arecaceae: Calamoideae), una palmera amazónica por cultivar en el Perú.**

Resumen – La planta. El aguaje (*Mauritia flexuosa* L. f.) es una palmera amazónica que crece naturalmente en las zonas alagadas formando densas áreas llamadas aguajales en el Perú. La palmera puede alcanzar (35 a 40) m y tiene un promedio de 8 inflorescencias por año, cada inflorescencia produciendo alrededor de 900 frutos. Esta palmera está en proceso de adaptación al cultivo. Una forma enana, recientemente descubierta, permite esperar un mejoramiento de los métodos de producción. **El fruto.** El fruto es una drupa de forma ovoide cubierta de escamas lisas de color marrón-rojizo de (5 a 7) cm de largo y (4 a 5) cm de diámetro. La pulpa está rica en β -caroteno ($260 \text{ mg} \cdot 100 \text{ g}^{-1}$ de pulpa). **El mercado.** El mercado está alimentado por frutos procedentes del medio natural. El consumo local es aproximadamente de 150 t por mes y la pulpa está consumida directamente o procesada localmente. Para satisfacer a la demanda, aproximadamente de 24 000 palmeras están cortadas cada año. **Discusión.** El aguaje presenta una gran importancia socio-económica para los habitantes de la Amazonía peruana y representa un potencial elevado para el mercado nacional y internacional. El Instituto de investigaciones de la Amazonía peruana (IIAP) estudia técnicas para el manejo agronómico: cultivo, producción así como procesamiento de los frutos. El crecimiento, así como la diversidad genética de esta palmera en condiciones naturales, deben también estar estudiados.

Amazonia / Perú / *Mauritia flexuosa* / botánica / cultivo / plagas de plantas / usos / domesticación / composición aproximada / mercadeo / almacenamiento / carotenoides

