Title:

Three declinations of the Polymotu Concept: “Inland ex Situ”, “Ecotourism on Islands”, “Urban” and their possible applications in Brazil, Côte d’Ivoire, Indonesia, French Polynesia and Samoa.

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Abstract

The Poly*motu* concept (*poly=many, motu=island*) is to use the geographical isolation of special sites for conservation and reproduction of individual varieties of plants, trees and even animals. This concept is mainly derived from previous initiatives in conservation of coconut palms by ancient Polynesians and some contemporary Thais. For instance, when a small island is planted with only one variety of coconut palms, breeding occurs only within this variety and certified seednuts are naturally produced. Not only islands can be used for this purpose; various kinds of sites inland can fit as long as they are protected from pollen contamination. Conservation is then secured by both the reproductive isolation and the availability of certified seednuts. In 2009, the Poly*motu* concept was included in the global coconut conservation strategy developed by the International Coconut Genetic Resources Network (COGENT) and the Global Crop Diversity Trust. It moves this global strategy towards the involvement of more countries, sites and stakeholders. Three possible declinations of the Polymotu concept are presented: Inland *Ex Situ* (to be applied in Côte d’Ivoire, Africa) “Ecotourism on Islands” (French Polynesia, Samoa and Indonesia) and “Urban” in Brazil. Factors influencing the acceptance of Poly*motu* by the various stakeholders are discussed, together with collaborative research to be conducted during implementation of the projects. By combining ancestral Polynesian practices with the recent progress made in biological and social sciences, a rational strategy for the conservation of genetic resources and associated traditional knowledge can be implemented. Implementing the Poly*motu* concept will strengthen the links between people, landscape and biodiversity. A significant outcome will be the safe conservation of the representative biodiversity of coconuts (*Cocos nucifera*), and increased availability of certified coconut seednuts for mainland farmers. Beneficiaries will be all those stakeholders who rely on coconuts for their livelihoods.

Key words: Islands, conservation, coconut, biodiversity, germplasm bank, COGENT network

Introduction

The Poly*motu* concept (*poly=many, motu=island*) is to use the geographical isolation of dedicated sites for conservation and reproduction of individual varieties of plants, trees and even animals. This concept is derived from previous initiatives in conservation of coconut palms by ancient Polynesians and contemporary Thais. A quite similar concept has also been used by New Zealanders for conservation of endangered bird species.

For instance, when a small island is planted with only one variety of coconut palms, breeding occurs only within this variety and certified seednuts are naturally produced[1]. In this case, both the geographical isolation of the islands and the availability of certified seednuts secure conservation. Not only islands can be used for this purpose; various kinds of sites inland can fit as long as they are protected from pollen contamination.

The Poly*motu* conservation concept fits into a multifunctional land management policy. Many different locations can be used for conservation of genetic resources and even seed production as far as they meet the specific criteria required for biological and reproductive isolation[2]. These dedicated sites can be small islands owned by communities or private individuals, public gardens, university campuses, golf courses, the backyards of resorts or research centers, or the bottom of small valleys. Even an entire village may well serve as a place for conservation of genetic resources and seed production of coconut, if people agree to cultivate only a well-defined set of cultivars.

This kind of multifunctional land management strengthens the links between people, landscape and biodiversity. It gives a special cachet to the sites, generates incomes and promotes ecotourism activities.

In this paper we will first discuss the origins and precursors of the Poly*motu* concept; then we will present the first initiatives to launch research actions linked to the Poly*motu* project. Research needed for the full implementation of the concept is also discussed.

1 Origins and precursors of the Polymotu concept

The geographical remoteness of small islands and other isolated sites can be used as a great advantage in the strategies for conservation of biodiversity. This section shows that this idea was already applied a long time ago, in an empirical manner, by the ancient Polynesians. Then two modern examples of use of conservation, using geographical isolation will be discussed.

[1] *Cocos nucifera* L. is mainly a cross-breeding (allogamous) species. Breeding coconut palm is indeed a difficult task. When selecting a coconut as planting material, you generally know which the mother is; but you do not know which the father is, as the pollen comes from any of the surrounding palms.

[2] For the coconut palm, one of the possible landscape design is any place where can be planted 50 to 100 coconut palms from the same varieties (1 to 3 varieties could be planted together) with no other coconut palms at a 500 m distance all around, or uniquely coconut palms from the same varieties. Various species can be conserved at the same location, but the designs will need to be adapted according to the biological requirements of each one.

1.1 Polynesian traditional conservatoires

The oldest description of coconut varieties in French Polynesia can be found in the book "Ancient Tahiti" by Teuira Henry, published in 1928 from data collected by her grandfather in 1840. Teuira Henry reports that the Tahitians knew of the existence of particularly enormous coconuts growing the island of Niu-Fou (now known as Niuafo'ou). Niuafo'ou Island means "New coconut". It is a remote and tiny island in the Tonga group, with an area of 52 sq. km. It is located at 200 km from the nearest island and at 2800 Km from Tahiti. Niuafo'ou is a very active volcano that slopes steeply down to the sea floor[3]. There is no safe anchorage for boats. Repeated volcanic eruptions[4] have destroyed many plantations and villages.

Another example of traditional conservatoire also comes from Tonga. In the 2000s, we visited numerous Pacific islands in the framework of surveys organized by Bioversity International (formerly IPGRI and INIBAP). L. M. Fili and T.H. Hoponoa, from the Ministry of Agriculture and Forestry of Tonga, tell us about the highly prized, traditional coconut variety called «Niu utongau ». This variety belongs to rare forms of coconut, highly threatened, and known as « Sweet husk »[5]. In most coconuts, this husk is hard and inedible. But sometimes, the whole husk of the young fruit is sweet and can be chewed like sugar cane. Its taste resembles that of coconut heart. Once the fruits are ripe, the husk fibres are white and thin. There exist various names and various types, in which husk characteristics are more or less accentuated. Those varieties have yet to be scientifically described. The «Niu 'utongau » coconut variety can be found in quantity only on the small coral islet of Onoiki in the Ha'apai group. Tongans are still sometimes taking seedlings from that islet, which is too small to appear on most maps.

Another isolated place famous for its coconuts is Rennell, a high volcanic island located in the Solomon archipelago, with an area of 660 sq. km. Its two main features are its volcanic lake, now registered as a world heritage site, and its Polynesian population, when other Solomon Islands are mainly populated with Melanesians. Except for the small island of Bellona, also populated with Polynesians, the distance from Rennell to the nearest island is 170 km.

[3] Given its unusual geography, Niuafo'ou was named « Tin can island », because of a strange way of receiving its postal communications was adopted. The mail was cast into the sea in a tin box and recovered by men in pirogues.

[4] In 1867, 1886, 1912, 1929, 1935-36, 1943, 1946, and 1985

[5] The coconut husk is the fibrous layer forming a strong, shock-absorbing mesh which protects the seed from mechanical damage. Sweet husk varieties are described in the book « Ancient Tahiti » by Teuira Henry, and in the book « By Reef and Palm » published by Louis Becke in 1894 : « The boy returned with a young coconut, unhusked. "Behold, Tialli. This nut is a UTO GA'AU (sweet husk). When thou hast drunk the juice give it me back, that I may chew the husk which is sweet as the sugar-cane of Samoa," and he squatted down again on the gravel. »

Fig. 1: *Genetic diversity of the fruits of various coconut varieties (Bourdeix et al. 2005).*
From left to right, then top to bottom: First rank: Papua Yellow Dwarf (PNG), Tahiti Red dwarf (French Polynesia), Madang Brown Dwarf (PNG), Cameroon Red Dwarf (Cameroon), Spicata Tall Samoa (Western Samoa), Rotuman Tall (Fiji), Rennell Tall (Solomon Islands); Second rank: *Niu afa* Tall (Western Samoa), Comoro Moheli Tall (Comoro Islands), Sri Lanka Tall Ambakelle (Sri Lanka), West African Tall Akabo (Côte d'Ivoire), Tuvalu Tall Fuafatu (Tuvalu Island), West African Tall Mensah (Côte d'Ivoire), Micro Laccadives Tall (India); Third rank: Vanuatu Tall (Vanuatu), Malayan Yellow Dwarf (Malaysia), Malayan Tall (Malaysia), Tagnanan Tall (Philippines), Tampakan Tall (Philippines), Kappadam Tall (India).

The fruits of the variety known as Rennell Island Tall (RIT) are among the biggest coconuts in the world[6]. RIT is now involved worldwide as parental material in many coconut breeding programmes[7].

The role of the Rennell Island as a traditional conservatoire is not proven, as we did not record the information that other islanders use this place for exporting coconut seednuts. In

[6] The fruit shapes are quite variable, from oblong to pear shaped. Some of the fruits have a long nipple at the bottom, which is very specific to the RIT. The fruits have a good composition with a high content of solid albumen and free water.

[7]RIT variety is now available in Brazil, Côte d'Ivoire, Fiji, India, Indonesia, Jamaica, Papua New Guinea, Samoa, Solomon Islands, Tanzania and Vanuatu. The coconut hybrid Malayan Red Dwarf x RIT is planted in many countries in the Pacific region. In Vanuatu, the hybrid between the Vanuatu Tall and the RIT is currently being improved. In Côte d'Ivoire, all the tall cultivars introduced are systematically crossed with the RIT. One of the two improved hybrids currently distributed to farmers is the cross between the Cameroon Red Dwarf and RIT.

any event, the Rennell Lake is an example of a remote location conserving a unique coconut variety[8].

1.2 Modern use of island geographical isolation for conservation of biodiversity

In Thailand, two islands were recently devoted to conservation and production of palms varieties. The opportunity to create a Makapuno Island in Thailand was seized 25 years ago, when the Thai government built the huge Srinakharin dam at Kanchanaburi, near the Burmese border at about 200 km North-West from Bangkok. The hills were submerged and their peaks turned into islands.

Makapuno is an economically important coconut variety. Instead of coconut water, this coconut contains a soft, white jelly-like mass which is considered a delicacy. Makapuno is preserved in heavy sugar syrup and bottled for local consumption and export. One of the islands was then planted with Makapuno embryos rescued by using *in vitro* culture. All the other coconut palms were removed. No stray coconut pollen can reach the island because of the distance across the water barrier.

Another island on the same lake was designed for producing oil-palm seeds. As this island is completely isolated from any other pollen source, there is no need to bag the inflorescences for producing seedlings. This generates subsequent economy of manpower.

During our 2010 visit, we made the remark that, according to the Poly*motu* concept, producing Makapuno coconut and oil-palm seeds could well be conducted on the same island. Furthermore, Makapuno Island is a great success story: it is a profitable business, its conservation and ecotourism values are huge; and last but not least, it could also lead to a major improvement of the Makapuno coconut variety[9].

We discussed Poly*motu* concept with Dr Jean-Dominique Lebreton, the director of the Centre for Functional and Evolutional Ecology at Montpellier, France. Then Dr Lebreton made a very interesting connection between Poly*motu* and what is achieved in New Zealand in the field of conservation of endangered birds. Translocations involve moving populations of threatened species into areas of suitable habitat currently unused by the species. There are several reasons for doing this; the creation of secondary populations that act as an insurance against disaster, or in many cases threats faced by the original population in its current location.

One famous translocation was of the Kakapo bird (*Strigops habroptilus* Gray 1845) from New Zealand. The kakapo is an endemic, large, flightless, nocturnal parrot. Once abundant throughout New Zealand, the whole population in the wild was reduced to approximately 50 individuals. In situ conservation of natural populations has proved impracticable. These large flightless parrots were unable to cope with introduced predators, such as rats and cats in their remaining habitat on Stewart Island. Between 1974 and 1992, kakapo birds were translocated to four of New Zealand's offshore islands (Maud, Little Barrier, Codfish, and Mana). Few, if any, kakapo now remain within their former range.

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[8] M.A. Foale, who visited the Rennell Island in 1964, said that the true-to-type Rennell, with big and pointed fruits, is found only around the volcanic lake on the eastern part of the island. The access from the coast to the volcanic lake is very difficult. It is necessary to climb a rocky track with a steep slope, in a forest populated with endemic species of poisoning snakes (Laticauda sp.). But in other places, such as the coastal area, there is a mix between the Rennell Island Tall and the ordinary type, known as the Solomon Island Tall, which has smaller oblong fruits.

[9] See http://poly*motu*.blogspot.com/2008/10/message-4.html for details

2 Implementation of the Polymotu concept

In 2009, the Poly*motu* concept was included in the global coconut genetic resources conservation strategy developed by the International Coconut Genetic Resources Network (COGENT) and the Global Crop Diversity Trust.

In classical coconut genebanks, coconut cultivars are conserved as accessions, generally planted close together in the same fields. Each accession generally counts 75 to 100 coconut palms from the same cultivar. For reproducing these accessions, the technique of controlled pollination with bagging of the inflorescence is used (Konan & al., 2008). For coconuts, this technique is very costly. It requires a well-equipped laboratory, well-trained technicians able to climb the palms and a huge amount of manpower. Not all the gene banks can afford it.

The lifespan of such accessions is only 25 to 30 years. After this period, most non-dwarf coconut varieties reach 15 m high or more. At this stage, it becomes difficult to make the requested controlled pollinations. It is therefore necessary to rejuvenate the accessions before the inflorescences become inaccessible. In the Côte d'Ivoire African genebank, workers use costly triple ladders that can reach a height of only 14 metres. In some other places, like India or Indonesia, palms are climbed mainly manually, which is risky. Rejuvenation programmes require climbing roughly 75 palms each about 15-20 times. Basically, for rejuvenating an accession, the controlled pollinations are implemented over a 6-month period; the mature seednuts are harvested one year later, also over a 6-month period; then the old accession is removed from the field and replaced by a new one. Production of the 200 seednuts requested for the duplication of an accession will demand one and half year's preparation; and it will cost more than 2000 USD. Only scientists with healthy research budgets can afford to order varieties from classical coconut genebanks. Most of farmers cannot afford this.

Alternatively, the coconut palms could be planted in geographical and reproductive isolation, according to the Poly*motu* concept. In this way, the constraints linked to the heights and ages of the palms are removed. Instead of climbing the palms for making controlled pollination, people only have to wait for the coconut to fall naturally to the ground. Open-pollination will provide true-to-type and cheap seednuts. Thus, the same accession can be kept as long as a sufficient number of palms remain alive in the field. In most cases, the duration of a coconut accession will then be extended to 75 to 100 years. Even if some of the palms die, there is no need to remove the remainder, as is done in a classical genebank. Dead palms can be replaced by new ones, without removing the old palms remaining alive. Extending the lifespan of a coconut accession from 25-30 years to 75-100 years represents a huge saving of time, manpower and money. Seednuts will be more affordable for farmers.

2.1 Polymotu Inland Ex Situ in Côte d'Ivoire

One of the five COGENT International Coconut genebanks is located in Côte d'Ivoire. The Marc Delorme Research Centre (MDC), founded in 1951, houses the International Gene Bank of coconut for Africa and Indian Ocean (IGCAIO). This collection, managed under an international convention by the Agricultural Research Centre of Côte d'Ivoire (CNRA), is of crucial relevance for the international community, in fact, over the past decade, more than 80% of international coconut germplasm came from Côte d'Ivoire. The collection is currently threatened by lethal yellowing disease which has devastated coconut plantations in Ghana. This was the result of inevitable land pressure arising from the urban spread of Abidjan and by a chronic budget deficit that could ultimately jeopardize the existence of the center's research.

In order to address the two first constraints, we convinced the Centre National de Recherche Agronomique (CNRA) de Côte d'Ivoire to duplicate the Coconut Genebank on 5 of the 13 experimental sites belonging to the institute and scattered in across the country. Each accession of tall varieties will be planted in geographical and reproductive isolation, in the middle of other tree crop plantations (Rubber, oil-palm). The project comprises two main components: 1) duplication of fifty accessions of Tall-type coconut cultivars by plantation in geographical and reproductive isolation in the other experimental sites of CNRA. 2) Reorganization of the Marc Delorme Centre to include the conservation of other tree crops and increase its economic and scientific efficiency. For example collections of rubber, palms and other tree crops will serve as natural barriers for isolation of coconut seed gardens. This project will secure the conservation of coconut germplasm and other crops, and will contribute to reducing the budget deficit of the Marc Delorme Centre.

2.2 Polymotu "Ecotourism and islands" in Polynesia and Indonesia

For the tourism industry evolving in a very competitive environment, it becomes more and more important to stand out from the standard fare that tourism offers. The coconut palms should no longer serve as symbols of anonymous and counterfeit exoticism: they tell true stories, specifically related to local cultures.

Tetiaroa is an atoll in the Windward group of the Society Islands of French Polynesia. The atoll is located 53 km north of Tahiti. The atoll stretches across a total surface of 585 hectares of sand are divided in 13 motu (islets) with varying surface areas. Tetiaroa is under a long term lease by the family of the late actor Marlon Brando. We obtained the agreement of the Brando family and Beachcomber SA, a company which is building a new eco-friendly resort on Tetiaroa, to integrate 5 locations (4 motu and a small peninsula) for conservation of coconut varieties using the Polymotu concept. Figure 2 gives an illustration of the proposed landscape design. We proposed to remove about 1500-2000 coconut palms in order to favor endemic vegetation and bird nesting, and to replant about 500 coconut palms from five traditional varieties. In 2010, we started to replant one of the islands of the Tetiaroa atoll with a very rare form of horned coconut, as shown in the picture on the right side.

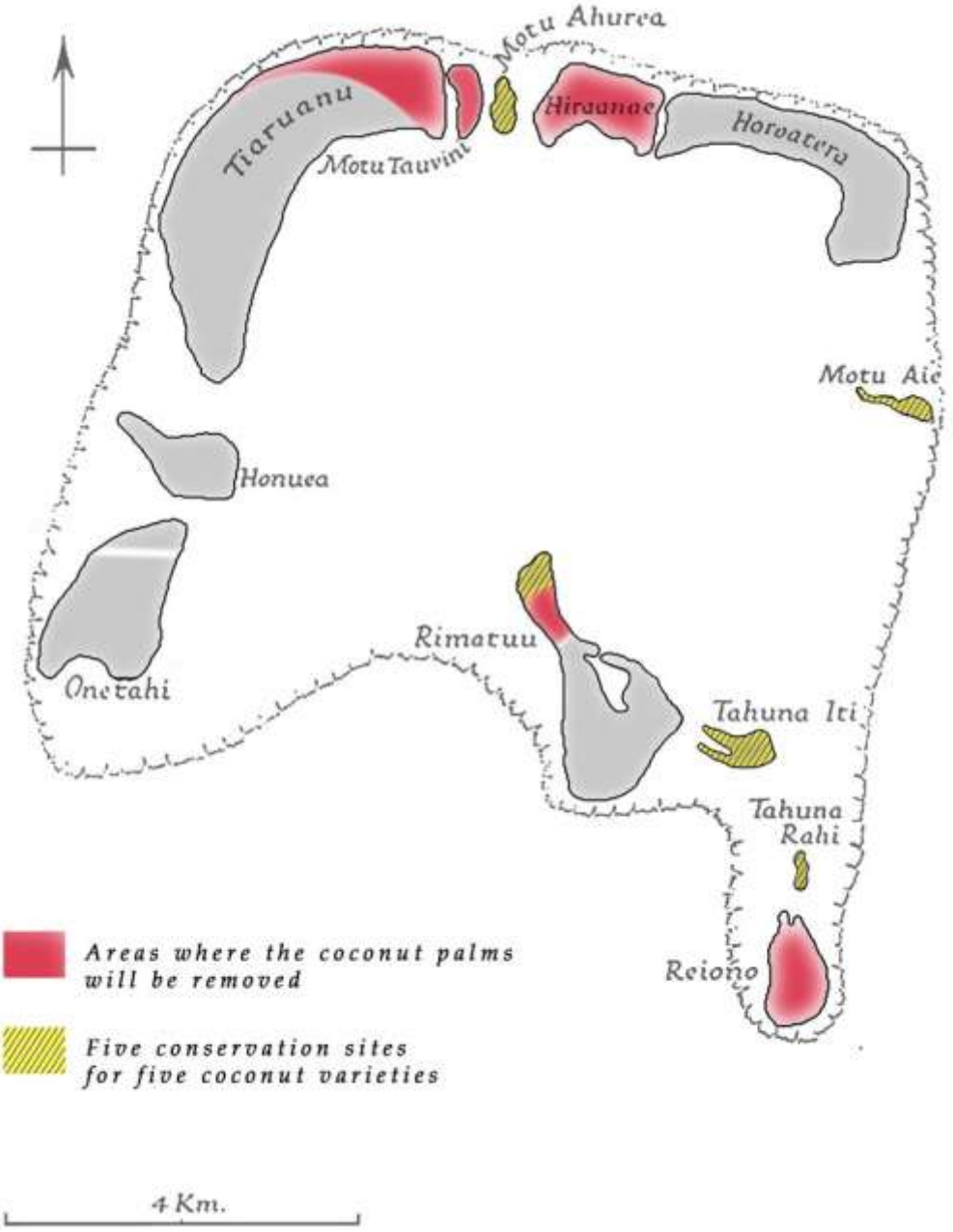

Fig. 2. Landscape design for the implementation of the Poly*motu* project on the Tetiaroa Atoll.

In 2010, we began to replant one of islands of the Tetiaroa atoll with a very rare form of horned coconut, as shown in Figure 3.

Fig. 3. A rare form of horned coconut found and being replanted on Tetiaroa Atoll.

Another example comes from Samoa. A prestigious resort organizes regular visits to a small island. This tour will better impress customers if the island is planted with the traditional variety Niu Afa created in Samoa and which produces the longest coconuts in the world. This amazing variety was initially created for making ropes with the long and resistant coir fibers from the husk. The Niu afa variety is also producing big coconut with sweet water to drink and tasty kernel.

Samoans produce less coconut ropes than in the past. The Niu Afa variety, was until recently in danger of extinction. A project funded by the Global Crop Diversity Trust led by the Secretariat of the South Pacific Community has served to multiply and conserve it. Respect for tradition can foster economic competitiveness. The regeneration of plantations of the Niu Afa variety could generate and service a lucrative «niche» market. Samoan communities in Australia and elsewhere will prefer to buy products made from this special variety bred by their Samoan ancestors. Making better use of their heritage varieties, Samoan farmers and small producers of virgin coconut oil will increase their incomes and will improve their livelihoods.

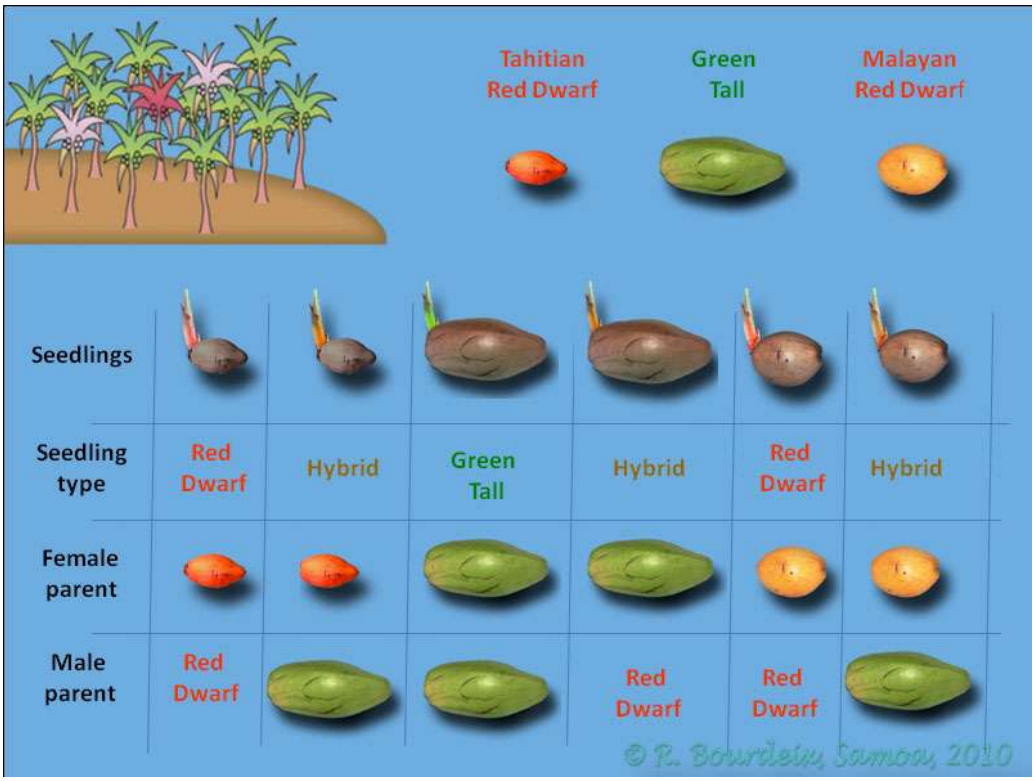

Fig. 5. Plantation of three coconut cultivars in the same island for harvesting seedlings of both the three varieties and coconut hybrids (distinction made on the colour of the sprout).

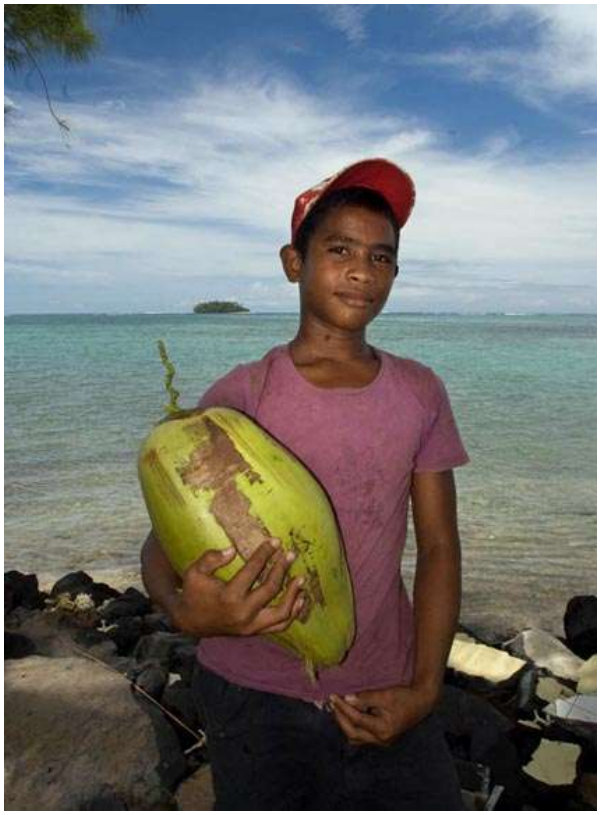

Fig. 6. A Samoan teenager, the huge *niu afa* coconut fruit and the Nuusafee Island.

It is also envisioned to develop a similar project in the Kepulauan Seribu (literally: thousand islands), a string of 110 islands with the closest only a few kilometers off mainland Jakarta, Indonesia. In this case, the project will not focus only on the ecotourism aspects, but also on production by local islanders of high value seednuts and coconut products, such as the Kopyor or Makapuno varieties with soft kernels, with fruits valued ten times the price of a normal coconut.

A project was submitted to the Canadian International Development Research Centre. This project gathered research teams from Bioversity international (Italy), CEFE/CNRS and CIRAD (France), the Centre for World Trade Studies in Gadjah Mada University and the University of Pembangunan Nasional "Veteran" (Indonesia). In Kepulauan Seribu the closest island is only a few kilometers off mainland Jakarta, Indonesia. In 1998, more than 16,000 people lived there; the most inhabited island is Kelapa (coconut) island. In many of these islands, people are presently cutting down the coconut palms. They believe that the palms absorb the mineral water from the ground, thus decreasing the quantity of available drinkable water. Huge imported trees (Casuarina) are often replanted, although the same problem of water consumption occurs.

Coconut palms tolerate salinity. They can be planted in selected locations, and especially along coral coasts where the water is saline. When used for beach landscaping, they tolerate flooding better than Casuarina and also serve as a buffer against marine erosion. Dwarf coconut varieties can sustain themselves with household wastewater without significantly affecting the water table; they also provide shade and a sweet nutritious drink. High-valued varieties such as Makapuno/Kopyor and production of seednuts can generate income for islanders and especially for women; this will decrease the pressure on marine resources. Taking in account the 505 cottages existing in K.Seribu for tourist accommodation (Zainal, 2004), the role of coconut palms in ecotourism also needs to be greatly strengthened. Although the first proposal for this project was not endorsed, other versions will be submitted in the near future.

2.3 Polymotu "Urban" in Brazil

The International Genebank for Latin America and Caribbean is located close to the City of Aracaju in Sergipe, Brazil. During a recent visit, it appears that some interesting and useful varieties introduced about 30 years ago they were never used, neither by researchers, nor by other stakeholders.

The role of a genebank is not only to conserve but also to ensure that the available germplasm is used by stakeholders. The following proposal was submitted to the genebank: In Aracaju for instance, the municipality could be engaged to plant in the city 100 to 300 coconut palms from an exotic accession, such as Tahitian palms. People would be interested to see these exotic coconut palms; citizens would like to taste the fruits and maybe to collect some seednuts to plant in their gardens or in farmers' fields. The city will communicate about its involvement in conserving genetic resources and will develop a positive and popular image. The same kind of "marketing of genetic resources" could be used for interaction with hundreds of municipalities and stakeholders such as: tourist centers, university campuses, research institute sites, golf courses, and farmers. This will diversify the coconut plantations in Brazil, which are planted mainly with a tall variety quite homogenous and sensitive to lethal yellowing disease.

3 Research needed for further development of the Polymotu concept

The research packages needed for implementing Poly*motu* projects will depend upon the geographical zones and the species to which the concept will apply. Presently, the Poly*motu* initiatives are more orientated towards tropical islands. The model species is presently the coconut palm, although other species, such as Red Sandal Wood, Kofai and even Coconut Crab[10], could sometimes be conserved in the same sites.

Poly*motu* projects combine multidisciplinary scientific research with immediate and participative applications that can be measured by quantitative indicators. These projects require scientific studies in numerous research fields: conservation policies, anthropology, territorial management studies, geographical information systems, ecology, socio-economy, water management, genetics, reproductive biology and post-harvest technology.

In the field of conservation policy, we started to develop the concept of a networked collection, also called a virtual collection, in the framework of the Global Coconut Conservation Strategy (Bourdeix et al. 2009). A networked collection is located at more than one geographical/institutional site, spans the genetic diversity of a given species (genepool) and gathers stakeholders having a mutual interest in rationally conserving and exchanging germplasm. In the extreme application of this concept, several accessions could be conserved, each at a distinct site.

As mentioned earlier, a global coconut conservation strategy (GCCS) has been developed by the International Coconut Genetic Resources Network (COGENT) and the Global Crop Diversity Trust. This strategy is mainly based on *ex situ* conservation in five large regional field genebanks. The implementation of a networked collection could allow this system to involve more countries, sites and stakeholders. A challenge being faced is that of gathering (in the same legal frame, network and database) accessions held in international genebanks, as well as accessions conserved on islets owned by municipalities, islanders' families or tourism enterprises. Being an Annex 1 crop of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), coconut germplasm can be accessed by countries which have ratified the International Treaty and which have declared these collections in the public domain.

Anthropological issues arise in two distinct areas. Although there is abundant anthropological literature on insularity, no study has focused specifically on what we call “insularity within insularity”. What is an islet for an islander? It is a matter of studying the perceptions, representations, practices and right of access of islanders with regard to islets, which are generally uninhabited and satellites of a larger inhabited island, along with anthropological factors affecting decisions relative to the management of those islets. The second anthropological issue involves seednut networks. Many studies conducted in tropical countries on food crop seed exchanges highlight that more than 80% of seeds come from the informal network. But the typology used in distinguishing between "formal" and "informal" generally neglects the fact that the "informal" network is itself structured by social organization. One hypothesis is that the structuring of genetic diversity and its distribution

[10] *Santalum insulare, Sesbania coccinea* and *Birgus latro*. *S. coccinea* is an endemic leguminous plant listed as protected species under category A (Order No. 296 CM of 18 March 1996): all its sub-species are protected in French Polynesia.

depends not only on the type of plant reproduction and selective practices, but also on associated social distinctions.

In the fields of territorial management studies and geographical information systems, the focus will be to identify the numerous conservation sites requested for implementing Poly*motu* projects. In Polynesia, the conservatoire is to be integrated into a complex system of joint possession that varies depending on the island groups, which has been in place since the beginning of the 19th century. That system of joint possession, which backs up an effective social organization, is not acknowledged by official law. To that is added the regulation of land leases (introduced in 1984 in French Polynesia) which has considerably slowed down land rentals.

Socio-economics studies will estimate the value of biodiversity and ecosystems services provided by the conservation sites, including agriculture and ecotourism. As underlined in the Convention on Biological Diversity, ecotourism is increasingly viewed as an important tool for promoting sustainable livelihoods, cultural preservation, and biodiversity conservation. Post-harvest technologies and market studies will assess how traditional coconut varieties and other conserved species could be used to diversify products and create niche markets.

As partial replanting will be conducted on the conservation sites, their ecology will need to be studied. The biodiversity available on these sites will be assessed. Research questions would include: How could this biodiversity be increased using the Poly*motu* concept? and which other species could be conserved in the same locations than the coconut palms for an economy of scale?. In the Indonesian islands Kepulauan Seribu, a key point will be to document the links between plantation of trees and water management in small coral islands: influence of trees on the water table and drinkable water, assessment and management of coastal erosion using trees and especially the coconut palm, in link to climate change mitigation.

Genetic surveys will have to be conducted to identify the coconut varieties and other species to be conserved in the Polymotu sites. These participative surveys will include interactions with local stakeholders in order to select and to obtain the germplasm to be conserved. In Indonesia, a research package will be specifically dedicated to the creation of islands to be planted with m*akapuno/kopior* coconut variety; analyzing the available diversity for k*opyor* coconut germplasm in Indonesia, collecting k*opyor* seednuts and develop them through *in vitro* culture of embryos.

4 As a conclusion

Coconut remains one of the crops most neglected by scientists, in regards of its economic value and cultural importance. Despite the enormous potential of the crop, coconut farmers often scrape a living below the poverty line. About 96% of the 10 million farmers, who collectively grow coconuts on 12 million hectares worldwide, are smallholders tending less than four hectares (Frison, 2006). Coconut farmers were marginalized. Many do not own the land they work, lack the resources to invest in technologies that would improve production, and are considered non-bankable by the formal banking sector. Many traditional varieties of coconut palms are presently disappearing and there is a huge and urgent need to safeguard the remaining.

By combining ancestral Polynesian practices with the recent progress made in biological and social sciences, a rational strategy for the conservation of genetic resources and associated traditional knowledge can be implemented. Implementing the Poly*motu* concept will strengthen the links between people, landscape and biodiversity. It gives a special cachet to the sites, generates incomes and promotes ecotourism activities. We expect 50 to 100 islands and other sites to be partially replanted as conservatoires during the next 10 years. A significant outcome will be the safe conservation of the representative biodiversity of coconuts (*Cocos nucifera*), and increased availability of certified coconut seednuts for mainland farmers. Beneficiaries will be all those stakeholders who rely on coconuts for their livelihoods. A main impact will be enhanced livelihoods for islanders.

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Coconut palms of French Polynesia (in French): http://cocotierpolynesie.blogspot.com/

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