

Biodiversity: negotiating the border between nature and culture

Sophie Caillon · Patrick Degeorges

Received: 26 October 2006 / Accepted: 17 January 2007 / Published online: 7 March 2007
© Springer Science+Business Media B.V. 2007

Abstract In a context of globalization, Article 8j. from the Convention on Biological Diversity recognizes the value of biodiversity and formalizes its mixed nature through its biological as well as cultural dimensions. This new definition raises questions more than it solves them. We demonstrate that national and international organizations, local communities, and even researchers from different disciplines (anthropology, botany or genetics) identify and evaluate biodiversity differently. The various stakeholder groups have developed an unavoidable social relation with multiple aspects of biodiversity that they relate to through their job or way of life. And therefore, they pursue various conservation purposes: the preservation of place's memory through ancestral links, cultural diversity, phenotypic variability or evolutionary potential. Which disciplinary and ethical boundaries are these actors willing to compromise, in order to preserve biodiversity in the name of development? Which indicators should we choose to fulfil which goals? The contrasting examples of taro (a socially valued object, planted on taro pondfields inherited "from the ancestors", linked to an important cultural diversity and to a narrow genetic-base) and coconut (a socially devalued object, cultivated in coconut plantations at the prompting of "the Whites" and genetically diverse despite few named types) demonstrate that same farmers from a village in Vanuatu (South Pacific) affirm traditional ecological knowledge though their management of taro, and still participate in a market economy by intensifying their crop of coconuts. Conservation and research programs should integrate ethical questions and political processes to reconcile systems of diversified values and representations.

S. Caillon (✉)

Département Hommes Natures Sociétés, Muséum National d'Histoire Naturelle,
CP no. 26, 57 rue Cuvier, Paris, 75005, France
e-mail: caillon@mnhn.fr

P. Degeorges

Institut d'Études Politiques de Paris, Chaire du Développement Durable, PROSES, 15 rue Ecole
de Médecine, Paris, 75006, France

Keywords Biodiversity conservation · Biological diversity · *Colocasia esculenta* · Coconut · *Cocos nucifera* · Cultural diversity · Environmental ethics · Melanesia · Taro · Vanuatu

Abbreviations

CBD	Convention on Biological Diversity
CIRAD	Centre de coopération International en Recherche Agronomique pour le Développement
FFEM	Fond Français pour l'Environnement Mondial
IRD	Institut de Recherche pour le Développement.
IFB	Institut Français de la Biodiversité

The concept of biodiversity affirms the unity of life in all its manifestations and at every level of organization. It expresses the inherent value of the extraordinary diversity produced by natural processes taking place through long evolutionary time and during the “human history of nature”. The imprecise definition has contributed to its success as an unifying ideal for nature conservation and the protection of cultural diversity. Since the term was coined by Walter G. Rosen in 1985 and its legal framework defined by the Convention on Biological Diversity (CBD) in 1992, the fight against the loss of biological diversity has led to a major change in nature conservation policies and programs. The erosion of biodiversity does not simply refer to the massive extinction of species or the disappearance of wilderness areas free from any human activity. Above all, it describes a common situation that shows the fragility of depleted or pressured natural and semi-natural systems struggling to answer societies’ needs and expectations. Far from being opposed to development, the conservation of both wild and domestic biological diversity is now seen to be an essential condition for sustainability. Biodiversity increasingly acts as a reference to assess and, when necessary, correct the impact of human beings on their environment. This questioning of the way in which industrial societies intensively exploit natural resources is accompanied by a reevaluation of “traditional” ways of inhabiting environments and their lifestyles attached to them. In recognizing that the disappearance of local practices and know-how form part of the mechanisms leading to erosion of biological diversity, Article 8j of the CBD requires the approval and involvement of “indigenous and local communities”.

However it is not always easy to defend cultural diversity in the name of biological diversity conservation. The reasons why communities single out certain aspects of biological diversity on their territories do not always coincide with the objectives and values of national or international conservation programs. The diversity which is important from a cultural stand point is not always regarded in the same manner by the agronomist or the ecologist.

How can these multiple ways of perceiving biodiversity and the sometimes contradictory values given to it by societies, as well as different scientific disciplines, be reconciled? What is being measured? What indicator should be chosen and why? Does biodiversity have the same meaning for an anthropologist, a botanist and a geneticist? What disciplinary axioms and ethical principles would they transgress to preserve biological diversity in the name of development? A case study derived from our research in agrobiodiversity helps shed some light on the problems and issues raised by these questions.

Socializing with biodiversity

We investigated the varietal or intraspecific diversity of taro (*Colocasia esculenta* (L.) Schott) on the island of Vanua Lava in Vanuatu (South Pacific) using anthropological, botanical and genetic tools. Taros are annual plants which are propagated vegetatively by horticulturists who treat this plant with extraordinary respect and attention because of its high social status due to generational links with ancestors. They are cultivated in irrigated pondfields that have been inherited from the mythic founding heroes and their ancestors. Each new “form” of taro, distinguished by its morphology, colour or taste, is captured, identified and propagated to constitute a population of clones. This population only becomes a cultivar when the association between its name, its history of origin and its morphotype is known by farmers. Rules of nomenclature are based on the circumstances of its discovery (Caillon and Lanouguère-Bruneau 2005). Taros “found” in fallow land bear the name of their discoverer or the place where they occurred. These taros are in fact plants growing from seeds. Another way to diversify the genome is through somatic mutations. Taros that “change” after replanting of a known cultivar retain the name of the mother-plant to which is added a determinant describing their new distinctive morphological modification which has appeared after a visible mutation. Finally, “introduced” taros are named by the eponym of the island from which they originate. Independent of the intrinsic qualities of the cultivar, its recognition at village level and then by the islanders therefore depends on the capacity of the “discoverer” to integrate this new product into the varietal portfolio of the village community through a codified social network. We were able to show that there was an almost perfect correspondence between a vernacular name, a morphotype and a genotype so that a cultivar locally designated by a single name corresponds to a group of genetically and morphologically similar individuals (Caillon et al. 2006). However, although the number of names (96) and morphological characteristics (96 single combinations) may seem impressive to an anthropologist or botanist, the geneticist regrets the low genetic diversity. Cultivars of this village are genetically close to those of other islands. Moreover, taro’s genome in Vanuatu only represents a low diversity at the scale of the Pacific (Quero-García et al. 2004), and the diversity in Oceania is much lower than that of South-East Asia (Lebot et al. 2000).

Although, in this case, biodiversity is identified in the same way by several disciplines there may be disagreement about its evaluation. The varietal diversity of taros may be assessed in several ways, depending on the chosen disciplinary angle. A rich local taxonomy does not necessarily imply an important biological diversity and it does not reflect the occidental systematic still mainly based on morphological criteria. There is no single way to measure such a term with so many meanings. The full significance of this diversity is only apparent when the different sciences are confronted and made aware of the limits of their respective approaches. Anthropologists, botanists, geneticists or agronomists attach different values to the multiple facets of biodiversity. The criteria they choose lead us to evaluate it differently depending on the analysis’ scale (from the gene to the landscape) and of objectives proposed: to protect cultural diversity, phenotypic variability or evolutionary potential. This analysis suggests that development of biodiversity depends on the degree of intimacy and forms of socialization that human kind maintains with it, both from the point of view of local representation and of different sciences. Hence, diverse

assessments of the diversity of living nature do not always faithfully reflect the existing morphological or genetic diversity.

Local populations also maintain different degrees of socialization with the diversity of life that characterizes the environments towards which they develop different kinds of relationships. The way in which biological diversity is perceived and understood by indigenous people may be comprehended by studying traditional identification and nomenclature processes. Hence, the inhabitants of Vanua Lava only have a single name, “qiatrev” (the walking taro), for all the taros described as wild. Although these plants eluding cultivation present a wide range of forms and original colours, cultivated taros and wild taros do not receive the same social status. Farmers are not interested in the variety of feral plants, as they do not tend them on a daily basis, unlike cultivated plants. A similar case takes place in French Guyana. The Amerindian population of Palikur (or Aukwayene) maintains 29 named varieties of cassava (*Manihot esculenta* spp. *esculenta*) (Ouhoud-Renoux 2000). This population gives only a single name to the associated wild species (*M. esculenta* spp. *flabellifolia*) growing in the surrounding forest-savanna ecotone, whereas the numerous morphotypes observed by scientists convinced them to distinguish several species (*M. digitiformis* Pohl, *M. flabellifolia* Pohl, *M. melanobasis* Müll.Arg., *M. esculenta* ssp., *M. peruviana* Muell. Arg., *M. sprucei* Pax, *M. saxicola* Lanj., *M. surinamensis* D.J. Rogers & Appan and *M. tristis* Müll.Arg.) (Pujol et al. 2005).

Likewise, certain forms of diversity may pass unnoticed through lack of interest when drawing up an inventory, or because of the practical difficulties and the financial and human costs required to measure them. If one refers to the Kergelen index in use today, the French flora identifies a significant number of subspecies and varieties, whereas tropical flora often stop at the species level (e.g. Flora Neotropica) due to lack of prospecting or detailed taxonomic work (Lescure Personal communication). Other forms will be better recognized because those studying them will be more able to defend or promote them. In this respect scientists, whatever their discipline, are not neutral, because, as pointed out by Takacs (1996, pp. 195–196), when biologists, for example, advocate the protection of biodiversity, they renegotiate the border between scientific expertise and political legitimacy. “[...] All conservation prescriptions are value-laden, even if prescription is something as innocuous as “biodiversity is good”” (Takacs 1996, p. 189). It is also necessary to agree about the composition or the level of organization of the diversity to be protected. Because of the multiple meanings and values that it encompasses, the concept encourages our propensity to recognize our own preferences, convictions and aspirations in the “nature’s mirror” (Takacs 1996, p. 194). This ambiguity is a potential source of conflict and misunderstanding, in particular when it is a question of reconciling the cultural and biological dimensions of biodiversity.

Linking biological diversity to cultural diversity: a dangerous liaison?

In Vanua Lava, in the same village where the numerous taro cultivars are found, large numbers of coconut palms are cultivated and these provide the major source of revenue in the form of copra, the desiccated endosperm of the fruit from which coconut oil is extracted. About 38 named-types of coconut palm were listed in the village and less than 10 are planted per family. They are named by the basic term “coconut palm” to which is added a determinant qualifying the morphological

features distinguishing it from other coconuts (e.g. the large husk coconut “môtô vingaô” with “môtô” coconut palm, “vin” husk and “gaô thick”) (Caillon and Malau 2002). The same nomenclature construction is used for the different categories of coconut palms throughout the country (Caillon 2007a). However, despite this relative uniformity in terms of named types, a large variety of forms and genes may be measured. To set up a copra economy, foreign exporters encouraged local farmers to transform their few garden trees into vast coconut plantations. Small numbers of coconut palms were planted in this village before colonization (about 10 trees per household). Today, the small growers of Vanua Lava now own nearly 400 trees per household (means are calculated with 24 households). In this context of transformation of the economic and social system, a biological diversification occurred following the planting of new trees with new genes, from other islands. While growing in numbers (40-fold), the coconut palm has gained in diversity and cross-fertilization gene flow between individuals has extended this genetic enrichment program begun by introduction.

The coconut palm has a hybrid status: the “tree” is a legacy of the past, but its economic exploitation dates from colonial times. The few fruits produced were not eaten on a daily basis and were reserved for festive occasions or for exchange. Rarity was a factor of its social value. Today coconut palms are still part of all aspects of a villager’s life from birth to death in numerous daily or ceremonial uses in the form of immature fruits to be drunk, milk incorporated into traditional dishes and germinated fruits for planting. They also serve as ingredients for magic concoctions, building materials and often hold the main role in mythical stories. However, in spite of the traditions with which it is linked, the coconut palm on Vanua Lava is discredited as a “White man’s” tree and symbol of Western economic imperialism. Both young and old sometimes go as far as adopting an attitude of rejection of this plant, considering that the men behave like “pigs” when they use coconut milk each day in their meal. In this context, it’s not in fact the tree status itself that has been modified, but the fact that coconuts are cultivated in the coconut plantations brought by “the Whites”. Therefore if the coconut is perceived as the tree “of the Whites”, it is mainly because of its association to the place that was designed by them for its copra exploitation (Caillon 2007b).

In this small village of Vanuatu, two worlds could be confronted: the world of “taro-men” and the one who deals with coconuts. They also can be called the worlds of “taro eaters” and “rice eaters”; this last easy cooking starchy food is bought thanks to copra money. The first are the curators of tradition, whereas the second are engaged in modernity. In fact, the separation is never clear and almost all “taro-men” are making copra to acquire a minimum income as well as all “copra-men” cultivate a few taros for food. The difference is the time spent on the taro and coconut grows. Taro pondfields have been inherited from the mythic heroes and the ancestors; coconut plantations have been introduced by “White men” in order to adapt the local economy to “modernity”. People’s identity is located in place (Hess 2005). Taro-men need copra-men to maintain open commercial roads (though copra-boats) and also small shops where Western goods such as rice, tinned fish, matches and kerosene for lamps can be found. They are the links with the outside world. Taro-men are also essential to the livelihood of the village: through the multitude of taro cultivars bearing names that farmers plant, they conserve a piece of Vê tuboso’s heritage and, as we will see later on, they keep alive the memory of their ancestors.

The contrasting examples of the taro (a socially prestigious object cultivated by the guardians of tradition on land inherited “from the ancestors”, and linked to an important cultural diversity and a narrow genetic-base) and the coconut palm (a socially devalued object planted by the “moderns” in coconut plantations at the prompting of “the Whites” and genetically diverse despite few named types), underlines the plurality of practices and local knowledge of this traditional population isolated from major trade and transport routes. Although certain studies on agrobiodiversity show a positive correlation between biological and cultural diversities, our work shows that the situation is more ambiguous. From the point of view of biodiversity conservation, the society living on Vanua Lava island presents at least two aspects. According to its management of taros in the framework of a traditional subsistence economy, it may be considered as a society with true “traditional ecological knowledge” valuing biological diversity. However, according to its management of coconut palms it appears to be a society that has preferred to invest in a market economy advocating intensification. Both these assessments must however be moderated. On the one hand, although the economic development of the coconut has been accompanied by an increase in its morphological and genetic diversity guaranteeing its adaptive potential, it is certain that further exploitation of this resource would lead farmers to establish high yield hybrid varieties with a consequent standardization of the Ni-Vanuatu plantations. On the other hand, according to a strictly agronomic evaluation, local know-how cannot alone compensate for the relative genetic poverty of the taro population which, in view of the accelerated globalization of exchanges, constitutes a threat for its conservation.

Evaluation of the “ecological value” of practices implemented by a community therefore depends as much on the observer’s point of view and objectives as well as on the object concerned. A study of the techniques and knowledge involved in the management of a plant resource which only investigates their environmental impact or action on biological diversity cannot apprehend the complexity of contexts in which they are used. Natural and cultural objects cannot be dissociated as they are generated by a social system including material support (production system and produced objects) and by an ideal foundation (society’s representation of its place in the world and the surrounding world) (Godelier 1984; Descola 1986; Friedberg 1992). Research in Melanesia confirms that the relations maintained with the “resource” are linked to a history and organization of social life, which involves identity issues that must therefore also be taken into account (Clarke 1971; Panoff 1972; Hays 1974). Since the formal description of the relation between biological and cultural diversities in 1992 within the biodiversity concept, numerous research and development projects have unfortunately only examined “traditional” practices in the hope of discovering natural methods revealing “ecological wisdom” that may be transposed to other societies. The interpretation of this knowledge could generate anthropological nonsense (Bahuchet et al. 2001) when it is reduced to the role of recipes and taken out of its cognitive and sociocultural context (Friedberg 1997; Roué 1998). It is true, for example, that for those using them, the meaning and in particular the religious significance of these practices, does not illustrate as such the “secular” effectiveness that conservation sciences have subsequently discovered for the sustainable management of resources. But the beliefs and conventions ensuring that this know-how is passed on from one generation to another cannot simply be reduced to the inadequate and confused ideas that such a prescientific society is able to have about the evolutionary pro-

cesses its survival depends on (Gadgil et al. 2002, p. 31). This utilitarian interpretation is implicitly based on a debatable idealization of the indigenous populations as being “close to nature”. It is an ideological construction. The value that recent developments in ecology have led us to give to processes governing the evolutionary potential of ecosystems, is the unique result of Western history and cosmology. The positivist approach to conservation should always be aware of this fact in order not to exclude the dimension of cultural diversity. It should be ready to confront the political consequences of the polemics that it generates. If not, it reproduces the typical dualism of modernity, distinguishing a “transcultural” nature, which may be analyzed by objective science, from the meaning that humans attach to their practices and to their representations (Descola and Pálsson 1996).

However good the intentions of those who promote biodiversity, this simplification of the issues involved in conservation constitutes a threat to the future of communities, who are “judged” according to alien criteria which tend to reduce the respect for their way of life to an estimation of its environmental benefits. By adopting the “ecologico-indigenous” vocabulary of certain NGOs, social or religious institutions, or even scientists (Chartier 2005), local populations go as far as “reformatting” (Michon 2002) their political claims and practices in order to benefit from funding organizations. After rejecting their indigenous identity at the end of the 1980s, inhabitants of the Brazilian forest now plead for a traditional population status (Pinton 2005) which would allow them to acquire international recognition. This identification may go as far as imitation of the practices and knowledge of “true” forest Indians. This “naturalization” of cultures and traditions hinders change as it does not encourage these people to use their capacity to deploy their own powers of invention. It could rather contribute to their cultural homogenization. The integration of biological and cultural diversities into one concept of biodiversity could create a dangerous liaison.

The appropriation by indigenous populations of the objectives of biodiversity conservation in the name of their territorial and cultural claims shows that the local naturalist know-how cannot simply be understood as good practice for sustainable exploitation and use of the environment. The recognition of the value of various traditional practices involves identity and political issues which extend far beyond questions concerning the conservation of resources and the protection of the environment.

Ethical and political issues of biodiversity conservation

In Vanua Lava, we found that the diversity of taros responds to daily culinary requirements: a villager eats 1.1 kg of fresh taro (0.4 kg of dry matter) per day cooked in four ways and prepared using 29 recipes. It also fulfils the curiosity, the desire to encounter otherness, the need for a means of exchange and furnishes a memory support as a patrimonial object. According to Haudricourt (1964), taro is linked to identity and ancestry. In this society with its oral tradition, the transmission from generation to generation of a name associated with a history is ensured by a living organism with the capacity of reproducing itself identically year after year, thanks to the hand of farmers who ensure the durability of clones by vegetative propagation. The taro cultivar is therefore the living illustration of a book telling a story of mythical heroes and relating the *res gestae* of families or their lineage. Taros

are the “witnesses from the past” (Barrau 1965). Dove (1999) rightly underlines that the permanence of underutilized species (coix, *Coix lacryma-jobi* L. and foxtail millet, *Setaria italica* (L.) Beauv.), but socially valued in agrosystem from Bornéo, could be explained by their role of mediator or witness between past and present by maintaining the mechanism of cultural and historical memory. In Vanua Lava, each cultivar represents a person or an event, and a garden of taros can be compared to an archival library of relations and events.

An object of cultivation and a cultural symbol of a society, taro in Vê tuboso, between earth and sky, establishes a link with the world inhabited by the spirits of the dead from whom knowledge, plant material and taro plantations are inherited. By consuming taro, the living are kept in contact with their dead and the social values embodied by the “place”. “Place” in Melanesia is a concept extending beyond simple geographical dimensions (Rodman 1987, 1992; Bolton 1999; Curtis 1999, 2002; Taylor 2003; Hess 2005). The network of social relations, so characteristic of Vanuatu, is based on the memory of origin and on routes of alliances which cross the geographical barrier formed by the sea and by the cultural via marriages and exchanges of goods (Bonnemaison 1996).

According to Vienne (1984), in a nearby island, Mota Lava, when their name and their lineage are lost, ancestors pass into a deeper underground world, where they die a “second time”. In general, distant ancestors join the undifferentiated group of the “community of the dead”. However, by associating his name with a new taro cultivar, each person makes a gift to his successors and consequently continues to live in the memory of future generations and thereby prevents this slipping into oblivion which is the effect of time. Though this traditional act, the community recognizes its debt to the discoverer who increased its heritage, by guaranteeing it an existence after death. Moreover, continuity maintained with the past illuminates the present (Bloch 1977). When a man sees a familiar cultivar on a walk with his children, he can use this occasion to transmit values and an ethical code brought to life by his interpretation. Biological diversity thus constitutes the vehicle and resource for a cultural richness.

In this article, we highlight that “conservation through use” is too simplistic; incentives to conserve biological diversity cannot simply be reduced to simple transmission of a successful “adaptation” to the environment and uses (i.e. agronomic, taste, colour, odour and texture criteria). According to the formula applied by Rodas et al. (in Alcorn and Toledo 1998) in 1940, to the relation of Quiche Indians with corn cultivation, one could say that Vanua Lavans do not cultivate taro to live, but “live to cultivate taro” in order to keep alive their ancestor heritage. Cultivars could only be comprehended as a “collection”, as only this latter could reveal the particularity of each one. The same conclusion was previously highlighted by Pinton and Empeaire (2001) in upper and medium Rio Negro. Women are looking for an unicity in their cassava composition in order to transmit this identity to the following generation.

Proud of this heritage, Ni-Vanuatu are conscious of its political significance and its fragility. The generation aged 40–60 years, who were 15–35 during the fight for independence, have understood that it is important for the country to rebuild a national identity around the concept of “kastom” or tradition. They have had to rebuild this tradition from their elders who were able to preserve it through the years of colonization, as well as from books written by missionaries and anthropologists at the beginning of the last century (In particular for the north of Vanuatu,

Codrington (1891), Rivers (1914) and Speiser (1990 [1923])). However in exchange for this knowledge on taros, the guardians of knowledge have asked us to register their “traditions” in handbooks for use by villagers and, in particular, in works kept safely in the Vanuatu Cultural Centre in the capital. Their knowledge will thereby be preserved “for ever”. In this context, anthropologists are confronted with a situation that cannot be answered by the epistemic values guiding their research alone.

In the village of Wujumel on Pentecost island, the customary chief was proud to show us a book where he had consciously listed 169 taro cultivar names. When we tried to observe this high diversity in their fields, only 34 cultivars could have been found. To our astonishment, he claimed that if the names and stories are protected in the book, the taros on which they are based may then be returned to the wild because “they will reappear one day”, they cannot “die” because they “belong to the place”. Consequently, an act of conservation of cultural diversity could indirectly dispossess a plant of one of its social functions by replacing the living support by an inert one, the paper conserved in a museum. It may then be allowed to risk disappearing at the expense of biological diversity.

For the agronomist, the “taro civilization” (Haudricourt 1964) of Vanua Lava and other Vanuatu societies cultivating taro is threatened by a fungus, *Phytophthora colocasiae* Racib. Its arrival in Vanuatu, facilitated by the numerous air and sea exchanges, could wipe out these taros, genetically very close to those of Samoa which were eradicated under similar conditions in 1993. The risk of a food shortage may easily be circumvented by the development of other cultivated species such as cassava (*Manihot esculenta* Crantz), sweet potato (*Ipomoea batatas* (L.) Lam.) or the American taro (*Xanthosoma sagittifolium* (L.) Schott). Cultural diversity, however, would be jeopardized not only by the disappearance of the knowledge and practices related to taro cultivation, but also by the loss of village identity born in particular by the names of its ancestors and heroes, attached to the taros. The imminence of such a tragedy places agronomists before considerations which extend beyond the simple respect of standards governing their activity.

However, the scientific and financial management of the variability of native soils and social expectations is difficult with conventional improvement programs as taros change colour, form and taste according to their environment. Vanuatu horticulturists, on the other hand, who perfectly understand the intrinsic properties of the cultivars, are the best able to judge by means of a series of empirical experiments the suitable association between a cultivar and a soil related to specific practices. They are specialists of the local situation whereas scientists have a more global understanding. Scientists best understand the fungal invader and in particular the resistant plant material coming from other countries where it has been present for many years, such as Indonesia or Papua New Guinea. The French Fund for World Environment (FFEM), in collaboration with the French agricultural research centre for international development (CIRAD) from Vanuatu, are in fact funding a participative plant breeding project in which hybrids obtained by crossing national and exotic cultivars, some of which are resistant to the fungus, will be distributed without preliminary tests on a national scale. Farmers will choose the most appropriate cultivars for their soil. Food safety and also local genes will therefore be protected within these “hybrid” cultivars. The scientists will also teach them the crossed pollination stage so that they select the best seedlings for propagation in order to create a new cultivar. But what name will this cultivar derived from the hands of a horticulturist trained by a scientist bear? Will farmers apply the naming process used for “found”

taros or that specific to “changing” taros? From our point of view these cultivars are derived from seeds like found taros so it would be logical to give them the name of their “creator”. However, according to their current knowledge on taro reproduction, the inhabitants of Vêtuboso will probably apply the nomenclature for changing taros by juxtaposing the names of both parent cultivars which they have decided to cross. The persistence of the names of ancestors and heroes, the memory of their history and the village identity, will depend on this choice. If the objective is to preserve *in situ* agrobiodiversity, it is therefore difficult to evaluate the cultural consequences of the use of these adaptations suggested by scientists and managers.

By crossing national taros with exotic ones, the transformation could be perceived in a more violent way than a change of name. Taro’s ‘blood’ is then mixed with a foreigner, one that does not belong to the place. Ni-Vanuatu more engaged in tradition could react against this artificialisation of the taro’s life, as has been done by the Hawaiians. On the 24th of May 2005, the University of Hawaii had to sign an agreement stipulating that no researchers could carry on their research on genetically modified taro (conducted for 3 years) until a forum of local Hawaiians had discussed the matter. To reassure the population, researchers have insisted on the fact that local taros were not under experimentation: they tried to transform a Chinese one with a rice gene (Hao 2005). Hawaiian taros, which are born from the body of their mythic hero Haloanakalaukapalili, are, according to this justification, thus not polluted by foreigner genes. At the same time, under the Hawaiians pressure, the University had to relinquish its patents on three taro varieties that have been improved by conventional selection to resist the leaf-blight disease; taros are owned collectively and could not be placed under the private domain (Theodoropoulos 2006). In Vanua Lava, even if taros could bear a man or a woman name, all the community has the right to plant them. No property rights could alienate one particular cultivar to a single person.

Whether biodiversity conservation is examined from the point of view of anthropology or agronomy, it is not sufficient to simply assess the value of work from the criteria of excellence of the discipline alone. The anthropologist and agronomist must have a simultaneous interdisciplinary and introspective point of view on their own practices, to take into account the collateral effects of the interactions which they generate by collaborating with local populations. The ethical and political aspects of conservation objectives are taken into consideration by allowing the circulation of information and participation of farmers.

In a time of global exchanges, previously isolated populations have become conscious of their “common position” with groups of other traditional populations and which distinguish them from modern societies. Because of this “mutual copenetration” system it is now impossible to consider parallel evolution because of the multiplication of both voluntary and involuntary flows of knowledge, techniques and living or inert materials (Lévi-Strauss 2005). In this context of global environmental as well as social changes, these communities depend on their capacity to build an inseparable biological and cultural heritage in order to faith the future.

Conclusion

The multiplicity of measurements, evaluations and perceptions of biodiversity that we observed in our analysis of the management of taro and coconut in Vanuatu

shows that the crop's management is evaluated differently according to the methods and objectives chosen by the disciplines that study it. These different points of view clearly show the difficulty in reconciling the cultural and biological dimensions of biodiversity. However, to deal with the political issues and ethical demands involved in any conservation strategy, we must be able to understand the meaning and consequences of our practices “beyond nature and culture” (Descola 2005). To this end, an interdisciplinary approach is not only essential in order to optimize the effectiveness of conservation and development programs among populations, but also for deontological reasons. By this term, we do simply mean the specific ethics related to the exercise of a profession, but underline in particular the moral necessity to use an interdisciplinary approach to implement biodiversity conservation policies. An understanding of the relationships of the various levels of organization of biodiversity made possible by this interdisciplinary approach is an essential condition for establishing a basis for co-operation with local communities, enabling them to decide for themselves their place in the process of globalization.

Acknowledgements The authors would like to thank all villagers from Vêtuboso—especially Chiefs Eli Field Malau and Hosea Waras—the geneticists José Quero-García for the taro, and Patricia Lebrun and Angélique Berger for the coconut, without whom this work could not have reached such an interdisciplinary width. We thank the anonymous reviewer for his/she comments on earlier draft of this paper. We are also grateful to the French Institute of Biodiversity (IFB) that allowed us to examine our ideas on biodiversity in the framework of the “Young-Researchers” competition organized in 2004. The project “conservation of coconut-taro in Vanuatu” (2001–2003) was financed by the Région Centre, CIRAD and IRD.

References

- Alcorn JB, Toledo VM (1998) Resilient resource management in Mexico's forest ecosystems. In: Berkes F, Folke C (eds) Linking social and ecological systems. Cambridge University Press, Cambridge
- Bahuchet S, de Maret P, Grenand F et al (2001) Un regard sur les peuples des forêts tropicales. Editions de l'Université, Bruxelles
- Barrau J (1965) Witnesses of the past: note on some food plants of Oceania. *Ethnology* 4:282–294
- Bloch M (1977) The past and the present in the present. *Man* 12:278–292
- Bolton L (1999) Women, place and practice in Vanuatu: a view from Ambae. *Oceania* 70(1):43–55
- Bonnemaison J (1996) Gens de pirogue et gens de la terre. Editions de l'ORSTOM, Paris
- Caillon S (2007a) Le cocotier, un indicateur de changement? Etude ethnobotanique dans un village de Vanua Lava (Vanuatu-Mélanésie). *Journal d'Agriculture Tropicale et de Botanique Appliquée* 47
- Caillon S. (2007b) Arbre d'antan, arbre “des Blancs”. Evolution de la valeur sociale des cocotiers et de leur espace à Vanua Lava (Vanuatu). *Géographie et Culture* 64
- Caillon S, Lanouguère-Bruneau V (2005) Gestion de l'agrobiodiversité dans un village de Vanua Lava (Vanuatu): stratégies de sélection et enjeux sociaux. *Journal de la Société des Océanistes* 120–121(1):129–148
- Caillon S, Malau EF (2002) Coconuts and taro from the West Coast of Vanua Lava (Vanuatu): an ethno-agronomic inventory. IRD, Orléans
- Caillon S, Quero-García J, Lescure J-P et al (2006) Nature of taro (*Colocasia esculenta* (L.) Schott) genetic diversity prevalent in a Pacific Ocean island, Vanua Lava, Vanuatu. *Genet Resour Crop Evol* 53(6):1273–1289
- Chartier D (2005) ONG internationales environnementales et politiques forestières tropicales. L'exemple de Greenpeace en Amazonie. *Anthropologie et société* 29(1):103–120
- Clarke WC (1971) Place and people: an ecology of New Guinean community. University of California Press, Berkeley
- Codrington R-H (1891) The Melanesians: studies in their anthropology and folklore. Clarendon Press, Oxford

- Curtis T (1999) Tom's *Tambu* house: spacing, status and sacredness in south Malakula, Vanuatu. *Oceania* 70(1):56–71
- Curtis T (2002) Talking about place, PhD thesis. The Australian National University, Anthropology, Canberra
- Descola P (1986) *La Nature Domestique: symbolisme et praxis dans l'écologie des Achuar*. Edition de la Maison des Sciences de l'Homme, Fondation Singer, Paris
- Descola P (2005) *Par delà nature et culture*. Editions Gallimard, Paris
- Descola P, Pálsson G (1996) *Nature and society. Anthropological perspectives*. Routledge, Londres
- Dove MR (1999) The agronomy of memory and the memory of agronomy. Ritual conservation of archaic cultigens in contemporary farming systems. In: Nazarea VD (ed) *Ethnoecology. Situated knowledge/located lives*. The University of Arizona Press, Tucson
- Friedberg C (1992) La question du déterminisme dans les rapports homme-nature. In: Jollivet M (ed) *Les passeurs de frontières. Sciences de la nature, Sciences de la société*, CNRS Editions, Paris
- Friedberg C (1997) Diversité, ordre et unité dans les savoirs populaires. *Natures Sciences Sociétés* 5(1):5–17
- Gadgil M, Henam NS, Reddy M (2002) People, refugia and resilience. In: Berkes F, Folke C (eds) *Linking social and ecological systems*. Cambridge University Press, Cambridge
- Godelier M (1984) *L'idéal et le matériel. Pensées, économie, sociétés*. Fayard, Paris
- Hao S (2005) Taro forum to discuss genetic research. In: The Honolulu Advertiser. <http://the.honoluluadvertiser.com/>. Cited 20 May 2005
- Haudricourt AG (1964) Nature et culture dans la civilisation de l'Igname: l'origine des clones et des clans. *L'Homme* 4(1):93–104
- Hays TE (1974) *Mauna: explorations in Nbumba ethnobotany*. University of Washington, Seattle
- Hess S (2005) *Person and place on Vanua Lava, Vanuatu*, PhD thesis. The Australian National University, Anthropology, Canberra
- Lebot V, Hartati S, Hue NN et al (2000) Genetic variation in taro (*Colocasia esculenta*) in South East Asia and Oceania. In *Cultio Corp.: Proceedings of the twelfth symposium of the ISTRC*, Tsukuba, Japan
- Levang P (2001) Is tenure security/insecurity the determining factor in sustainability of local systems of forest management? In: Michon G (ed) *Alternative strategies to forest resource development, FORRESASIA, Rapport final à la Commission européenne*
- Lévi-Strauss C (2005) Entretien. *Le Monde*, Paris, 23 February 2005
- Michon G (2002) Du discours global aux pratiques locales, ou comment les conventions sur l'environnement affectent la gestion de la forêt tropicale. In: Martin J-Y (ed) *Développement durable? Doctrines, pratiques, évaluations*. IRD Editions, Paris
- Ouhoud-Renoux F (2000) Le cas Palikur: un combat pour une adaptation à des contraintes fortes. In: Grenand P (ed) *Les peuples des forêts tropicales aujourd'hui*. APFT, FRP, Bruxelles
- Panoff F (1972) *Maenge gardens. A study of Maenge relationship to domesticates*. PhD thesis, The Australian National University, Anthropology and sociology, Canberra
- Pinton F (2005) *Gestion environnementale en Amazonie brésilienne. Le local redéfini par la tradition*. In *Biodiversité. Science et gouvernance*, UNESCO, Paris
- Pinton F, Emperaire L (2001) Le manioc en Amazonie brésilienne: diversité et marché. *Genet Sel Evol* 33:S491–S512
- Pujol B, Mühlen G, Garwood N et al (2005) Evolution under domestication: contrasting functional morphology of seedlings in domesticated cassava and its closest wild relatives. *New Phytol* 166(1):305–318
- Quero-García J, Noyer JL, Marchand JL et al (2004) Germplasm stratification of taro (*Colocasia esculenta*) based on agro-morphological descriptors. Validation by AFLP markers. *Euphytica* 137:387–395
- Rivers WHR (1914) *The history of Melanesian society*. Cambridge University Press, Cambridge
- Rodman M (1987) *Masters of tradition: consequences of customary land tenure in Longana, Vanuatu*. University of British Columbia Press, Vancouver
- Rodman M (1992) Empowering place: multilocality and multivocality. *Am Anthropol* 94:640–656
- Roué M (1998) Anthropologie et environmentalism: pour une mise au point. *Natures Sciences Sociétés* 6(2):50–54
- Speiser F (1990 [1923]) *Ethnology of Vanuatu. An early twentieth century study*. Crawford House Press, Bathurst, Australia
- Takacs D (1996) *Idea of biodiversity, philosophies of paradise*. John Hopkins University Press, Baltimore and London

- Taylor JP (2003) The ways of the place: history, cosmology and material culture in North Pentecost, Vanuatu. PhD thesis, The Australian National University, Anthropology, Canberra
- Theodoropoulos D (2006) Germplasm news and views. Society for Economic Botany Newsletter 20:7
- Vienne B (1984) Gens de Motlav. Idéologie et pratique sociale en Mélanésie. Société des Océanistes, Musée de l'Homme, Paris