Managing Agricultural Resources for Biodiversity Conservation

Case Study for **India**, the **Philippines**, and **Vietnam**

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Abstract

During the Third Conference of the Parties to the Convention on Biodiversity, agrobiodiversity arose as one of the poorly defined emerging issues by biodiversity conservation planners. Although indigenous domesticated crops and livestock hold a rich diversity of species and varieties, and other organisms around them hold the key to healthy agroecosystems, little has been done to catalogue, conserve, and promote them. Indeed, many are in the process of disappearing, especially in the Developing World, as biodiverse traditional agricultural systems are replaced by monocultures of high-yielding, high-risk exotic species and varieties, often with disastrous consequences. In an attempt to reverse this trend, the status of agrobiodiversity and existing or proposed policies for its conservation and use are examined in **India**, the **Philippines**, and **Vietnam**. The **Philippines** and **Vietnam** have existing National Biodiversity Strategy and Action Plans, whereas plans are still being conceived in **India**. The information and lessons learned will be compiled into a UNEP guide that will aid national biodiversity conservation planners to formulate their own strategies and action plans for conserving agrobiodiversity.

I. Impact of agricultural production systems in the region on the conservation and use of biodiversity

In response to unchecked human populations in the region, a number of agricultural production systems have developed within the past four or five decades in an attempt to increase food supplies and alleviate poverty. These consist of:

- conversion of wild land to agriculture,
- overexploitation of wild biodiversity resources,
- conversion of diverse small-scale farming to homogeneous large-scale commercial farming systems,
- increased utilisation of exotic and modified species and varieties that often require high inputs such as pesticides and fertilisers, and
- increased cultivation of exotic cash crops.

These shifts in types and intensity of production systems all lead to reduced biodiversity, both wild and domestic, and to reduced use of biodiversity, with long-term repercussions.

Conversion of forest to agriculture is a major cause of biodiversity loss throughout the region. In **Vietnam**, 50,000 hectares per year of forest are lost to unplanned agricultural clearances, the same amount to forest fires, and the rest to fuelwood and timber harvesting. In response, a large-scale reforestation programme is under way. Unfortunately, most of the land that is being deforested is natural woodland, while the reforestation is largely made up of industrial forest plantations of pines, rubber and eucalyptus that add little in terms of ecosystem restoration. Despite worthy government efforts for biodiversity conservation, existing programmes for protection of forests and watersheds have not met the need for integrated and sustainable approach to forest and community development, at least up to the writing of the **Vietnam** Biodiversity Action Plan (BAP) (**Vietnam**1995).

Market incentives that encourage commercialisation, especially for the export market, are heavily favoured by central governments in the region. In **India**, cash cropping, already a threat to small-scale biodiverse farms, has been given a major policy boost. New trends include floriculture, industrial aquaculture, and other forms of intensive farming that leave little scope for biologically diverse production systems (Kothari 1999). Modern cultivation has threatened the age-old bonds between local farmers and traditional crops. Thirty years ago, up to 75 varieties of millet, sorghum, lentils, pigeonpea, and cowpea were grown in the Deccan region of **India**. The advent of hybrid seeds, chemical fertilisers, bore wells, and government loans has since lured many farmers into gambling on cash crops like cotton and sugarcane — sometimes tragically (Lumb 1988). During **Vietnam**'s transition to market economy farmers are switching to new varieties and species in demand. This poses a danger to traditional varieties and species adapted to local conditions, which may have long-term rather than short-term benefits.

Modern farming practices that rely heavily on pesticides and chemical fertilisers impact the conservation and use of biodiversity. In many parts of the region, such practices have displaced traditional rice paddies where fish, frogs, and other species once supplemented local diets. Few of these species can survive with inputs of pesticides and chemical fertilisers. There is finally an increasing awareness of the issue of pesticides and other toxic chemicals in **India** as well as their effect on dwindling wildlife, especially birds. Awareness is also growing in **Vietnam** and the **Philippines**. The modern thrust toward elimination of wild plant borders around crop fields is also reducing diversity that once provided a variety of direct and indirect services to agriculture, including self-regulating pest control and genes from wild relatives of crop plants.

Over-introduction of new varieties in agricultural production, and over-exploitation of forest resources are also common causes of regional decline in agrobiodiversity. Agrobiodiversity in the **Philippines** has been heavily affected by importation of exotic species and varieties and by release for commercial planting of genetically altered varieties approved by the **Philippines** National Seed Industry Council (NSIC). From 1955 to 1975 the NSIC focused on rice and corn, but later expanded to field legumes, root crops, tobacco, sorghum, wheat, cotton, and vegetables. In1991 it began releasing registered fruit varieties. Threats to livestock diversity come from inappropriate breeding, importation of exotic breeds, reduction in grazing area, lack of conservation, lack of awareness of animal genetic resources conservation, and lack of policy (**Philippines** 1995a). Human-induced threats to forest biodiversity come mainly from extensive logging, habitat degradation, kaingin (slash-and-burn agriculture), and pests and diseases (**Philippines** 1995b). There is also increasing trade with neighbouring countries in human and animal food, medicinal plants, and raw materials for handicrafts and industry (**Vietnam** 1995), which is difficult to manage sustainably.

In addition, the widespread traditional practice of shifting cultivation in forests that once prevented destruction of biodiversity is experiencing grossly premature cultivation in some areas due to population pressures, leading to habitat degradation, biodiversity erosion, and reduced productivity. However, measures to reverse the degradation and to sustainably manage forest use are now in effect in some areas, such as Thailand. In **Vietnam**, highland populations appear to be largely untouched by the national birth control programmes and annual growth rates of 4% are reported. There are over 1.2 million people in the highlands still engaged in slash and burn agriculture, and their numbers are increasing faster than food supplies. Increasing demands for food, fuel, and income are driving the overexploitation of non-agricultural bioresources through hunting and fishing, wood cutting, harvesting of wild medicinal, food, handicraft, and industrial plants, and trade in pets and research animals. In the **Philippines**, kaingin plots in forest are abandoned after one or two years of cash-crop production (rice, maize, and vegetables) and do not regenerate for many years, if at all.

II. Summary of status and trends of key aspects of agrobiodiversity

II.1. Diversity of indigenous crop and livestock varieties is declining; utilisation of exotic high-yielding crop and livestock varieties is increasing.

Although there is no figure available for agrobiodiversity loss in the region, it is high. Some idea can be gained of crop diversity loss by an example from **India**: in

1882, 48 distinct varieties of rice, and thousands of nondescript varieties, were reported from the Himalaya, displaced now by a handful of high-yielding varieties (HYVs)(Maikhuri *et al.* 1997). The area under diverse traditional food crops has declined substantially too, replaced by monocultures of exotic cash crops. In the country as a whole only a handful of HYVs are now grown over 70% of rice paddy land and 90% of wheat land (**India** 1990).

Traditional homestead gardens in Kerala, **India**, are major sources of household requirements. Apart from non-paddy staple food (tubers, jackfruit, etc.), these gardens provided non-staple food (e.g. fruits), timber and other house construction materials, biomass energy, fodder, organic manure for the fields, medicinal plants, edible oils, spices, and even material for clothing. Over the last 4-5 decades, however, this traditional practice has considerably declined. Coconut plantations or other land uses have taken over. As a result a number of plants grown in homesteads have disappeared or declined substantially, with negative effects on both people and the environment (Kothari 1999). Modern cultivation has threatened the age-old bonds between local farmers and traditional crops, which include foxtail millet, finger millet, sorghum, lentils, pigeonpea, and cowpea. Thirty years ago, up to 75 varieties were grown in the region. The advent of hybrid seeds, chemical fertilisers, bore wells, and government loans has since lured many farmers into gambling on cash crops like cotton and sugarcane — sometimes tragically (Lumb 1988).

Livestock diversity has also suffered due to government attempts to increase productivity. In **India**, one breed of cattle is already extinct, and from 20% to 50% of breeds of various livestock are threatened, in addition to all poultry breeds (Kothari 1999). Poultry diversity is especially threatened, and probably will suffer more due to export-oriented incentives. One of the major causes of diversity decline is the displacement, even at smallholder farms, by exotic breeds that are better suited for large commercial farming systems.

II.2. Diversity of wild species within agricultural ecosystems is declining.

Fruit bats provide one example of wild species loss with direct impact on agriculture. The demise of fruit bats (flying foxes) (Megachiroptera) through over hunting in South Pacific islands has reduced the pollination and yields of some traditional fruits. It is likely that a similar scenario exists in parts of Southeast Asia. Many plants there rely solely on fruit bats for pollination. Overall, more than 92 genera of flowering plants in 50 families have been recorded as being visited by fruit bats. Yet the populations of these pollinators have plummeted, and three species have gone extinct.

II.3. Diversity at the landscape level is declining.

Between 1950 and 1990, clearing of old-growth forests in the **Philippines** for timber and agriculture (83% loss) and conversion of grasslands to agriculture (65% loss) were responsible for much conversion from high to low landscape biodiversity. Forest cover in the **Philippines** has decreased from 62% to 20% of land area between 1920 and 1991. Between 1948 and 1987 forest loss coincided with doubling in agricultural area and urban expansion. In total about 9.7 million hectares (33% of land area) have been converted to agriculture. About 24% of this land resulted in low agrobiodiversity areas generally devoted to monocropping systems such as irrigated rice, pineapple, sugarcane, and banana. An additional 34% became medium agrobiodiversity areas that are currently planted in coconuts with various types of understoreys. Lastly, 42% (4.2 million hectares) resulted in high agrobiodiversity areas supporting corn, rain-fed rice, cultivated/managed pasture lands, and other farm areas devoted to traditional systems that produce multiple crops in small spaces. About 63% of 19 million hectares of forest is extensively used for agricultural crops, and 4.3 million hectares are under agroforestry (**Philippines** 1997).

Similarly in **Vietnam,** forest cover fell from 46% in 1943 to less than 24% forty years later. Some 1.3 to 1.7 million cubic meters of timber are felled every year. In 1994, deforestation rates were around 150,000 to 200,000 hectares per year and reforestation about 100,000 to 150,000 hectares per year. Unfortunately, most of the land that is being deforested is natural woodland, while reforestation is largely by industrial plantations of pines, rubber and eucalyptus that add little to ecosystem restoration.

II.4. Agrobiodiversity is too narrowly defined

A major weakness in interpreting status and trends of agrobiodiversity, and indeed in planning what can be done about conservation, is the restricted definition of agrobiodiversity pervading the region. The definition of agrobiodiversity in the **Philippines** Sectoral Report on Agriculture and Livestock (**Philippines** 1995a), for instance, includes only crop and livestock species and their wild relatives, rather than also the broader ecosystems or landscapes in which these exist. The glossary in the Report provides the following definition: “Agrobiodiversity pertains to the plant and animal resources for agricultural development. It refers to that aspect of biodiversity which has been subjected to selection, modification, and adaption by the various generation [sic] of people to serve best their growing and changing needs for survival.” Likewise, the **India** Biodiversity Bill (**India** 2000), defines agrobiodiversity as “the biological diversity of agriculture related species and their wild relatives”. There is little room in such definitions for the wild diversity that exists within and around cultivated areas that provides services to agriculture, such as pollinators, soil organisms that contribute to nutrient recycling and soil formation, natural enemies of crop pests, and the species that provide habitat for beneficial organisms and prevent soil erosion. Nor is there room in these definitions for the broader agricultural landscape and much of the wild biodiversity within it.

II.5. Opportunities exist for positive change

Despite the many negative forces in the region, the predominance of traditional farmers, an increasing role by NGOs, and increasing awareness of the role of environment in rural development provide opportunities for positive change. In the case of livestock, a growing concern is being felt for conservation of the many available local varieties. The section on Best Practices (Section VI) in this report provides only a few examples of the many successes in conservation of agrobiodiversity experienced in the region.

III. Approaches to the conservation and management of the following components of agrobiodiversity, in national agricultural plans and in national biodiversity strategies and action plans (NBSAPs)

III.1. Pollinators

Pollinators are not mentioned directly in the NBSAP or national agricultural plan of any of the focal countries in the region. The **Philippines** National Biodiversity Assessment and Action Plan (NBAAP) project I.C.2 seeks to value and account for direct and indirect goods and services from biodiversity and bioresources (Table 2), which at least brings the conservation and management of pollinators within the scope of the action plan.

III.2. Soil biodiversity

The **Indian** NBSAP, which is still in progress, will cover micro-organisms in addition to wildlife, crop, and livestock diversity. Presumably, these micro-organisms will include those in soil, which are crucial for ecosystem functioning in both wild and agro-ecosystems. The **Philippines** NBAAP Project I.A.4 on Microbial Resource Inventory is more explicit, aiming to address the impact of habitat destruction, biological pollution, and chemical pollution on soil microbes (Table 2).

III.3. Biodiversity that provides mitigation of pests and diseases

A national integrated pest management (IPM) programme exists in **India**, as in other Asian countries, which uses farmer field schools (FFS) to build farmer capacity and knowledge on agroecology. Some 77,000 farmers have been trained in 2,600 FFS on rice, cotton, sugarcane and oilseeds. A further 12,400 demonstrations have been conducted after FFSs to help spread the concepts and practice of IPM. FFS are also being used to address wider soil, water and nutrient management issues. In Tamil Nadu, farmers are experimenting with row planting, planting distance, biofertilisers (e.g. *Azospirillum, Azolla*), organic manures, and basal fertiliser applications. Farmers' adoption of biocontrol agents (eg. *Trichogramma*, neem) means that conventional pesticide use has fallen by 50% on average. Incomes have increased by 1000-1250 rupees per hectare, and rice yields have increased by 250 kg per hectare. (Eveleens *et al.*1996).

Inherent, but not explicit, in the National Agricultural Plan of **India** is the promotion of biodiversity that may result in reduced pest and disease outbreaks, but only in a limited sense. This lies in Section 4.1.75 of the Agricultural Plan, which emphasises increasing the area under multiple- and inter-cropping to increase yield per unit area of pulses. Such polycultural methods have several benefits, including mitigation of crop pests and diseases.

Project I.C.2 in the **Philippines** NBAAP (**Philippines** 1997)(Table 2) addresses valuation and accounting of direct and indirect goods and services from biodiversity and bioresources, which paves the way to account for and promote the services provided by natural enemies of crop and livestock pests.

III.4. Crop and livestock genetic resources

III.4.1. *National ex-situ measures*

India and the **Philippines** have a large capacity for *ex-situ* conservation of genetic resources in their networks of gene banks. In **India**, a considerable amount of the genetic material which has been grown or bred by farmers may no longer be available in the field, but has been collected and stored in gene banks and breeding stations. The National Bureau of Plant Genetic Resources (NBPGR) and the **Indian** Council of Agricultural Research have several hundred thousand accessions in their network of gene banks (Kothari 1999). In 1996 the **Philippines** had programmes and projects on *ex-situ* conservation that focused on small endemic but endangered species of staple crops and other plants in agricultural ecosystems. Technologies employed include seed storage, tissue culture, and living collections of plants. The National Plant Germplasm and Resources Laboratory (NPGRL) had 32,446 accessions of 396 species in 1994, and is the world or regional germplasm repository of several important vegetable varieties. The **Philippines** Rice Research Institute (PHILRICE) maintains species of native and exotic wild rice from the International Rice Research Institute (IRRI) Germplasm Center and from collections throughout the country. The Bureau of Plant Industry and the National Tobacco Authority have capacities for conserving crop germplasm. Some important non-timber forest species are conserved in the Rattan Gene Bank, the Bambusetum,and the Palmetum. The Institute of Plant Breeding at the University of the **Philippines** at Los Baños has developed and conserves many varieties of high-yielding, mostly exotic, fruits, vegetable, grains, and ornamentals. The **Philippines** Republic Act 7308 (1992), called the seed Industry Development Act, promotes and accelerates the development of the seed industry and mandates the conservation, preservation and development of plant genetic resources of the nation. It vests upon the University of the **Philippines**, Los Baños, the leadership in plant biotechnology activities related to plant improvement, genetic resources conservation and *in-vitro* mass production of planting materials. The export of indigenous crop and animal species has been controlled to maintain the comparative advantage of the **Philippines** in these species (e.g. Administrative Order 14, series of 1987 on ramie).

There is also a system of botanical gardens in **India** for *ex-situ* conservation. Among them, the Tropical Botanic Garden and Research Institute is the largest botanical garden in Asia, and maintains a conservatory garden spread over 300 acres that is home to 50,000 accessions of 12,000 genetic variants of 7,000 tropical plant species. It's research and development wing is geared towards achieving the goals of conservation and sustainable utilisation of plant diversity in tropical **India**. In the **Philippines**, Project II.B.2 of the NBAAP (**Philippines** 1997) promotes establishment of botanical gardens (Table 2).

Vietnam's genetic resource conservation has leaned heavily toward *in-situ* methods. By 1985 it did utilise some *ex-situ* methods of medium-term conservation by freezing of some seeds, and preservation of rootstock as tissue samples; however, these technologies did not offer adequate security according to the Biodiversity Action Plan (BAP)(**Vietnam** 1995). The BAP advised at that time that government programmes should favour *in-situ* conservation.

III.4.2. *National in-situ measures*

In-situ conservation measures are less well defined, but efforts in that direction are being made. The **Philippines** BAAP (**Philippines**1997) Project II.A.4

aims to establish and improve *in-situ* conservation centres of wild relatives of domesticated species (Table 2). This project is important not only for protection of useful genotypes but often also for wild diversity within agroecosystems (see below). **India**'s National Bureau of Animal Genetic Resources (NBAGR), the central agency dealing with livestock diversity, has recently initiated some schemes to encourage farmers and pastoralists to continue or revive their use of indigenous breeds. The NBPGR is also exploring possible schemes to encourage on-farm conservation of crop diversity in **India** (Kothari 1999). A "gene sanctuary" has been established in the Garo Hills of **India** for wild relatives of citrus, and others were planned for banana, sugarcane, rice, and mango (Hoyt 1992).

By 1985, **Vietnam**'s genetic resource conservation utilised short-term conservation by propagation in fields, as well as *ex-situ* methods of medium-term conservation by freezing of seeds, and preservation of rootstock as tissue samples; however, these technologies were not advanced and did not offer adequate security (**Vietnam** 1995). The BAP advised that government programmes to establish and maintain viable populations of traditional domestic varieties of plants and animals must be extended and strengthened; that special breeding stations should be established on agricultural research farms; and that subsidies should be developed to encourage minority and local farmers to continue growing their own traditional varieties.

Vietnam has since then developed a national system of *in-situ* genetic resources conservation. This system involves 30 scientific research institutions and production units to carry out the conservation of genetic resources of agricultural plants and animals, medicinal plants, and forest trees. So far, there are 16 colonies of agricultural plants conserved with thousands of sample varieties regionally represented and naturally distributed throughout the country. **Vietnam** possesses 3,200 plant species used traditionally for medicines and their usefulness is well known, but of which only 500 species of commercial and medicinal values have been conserved so far. Loss of valuable medicinal herbs and other plant species is threatened by continuing loss of natural forests. The conservation of genetic resources of forest trees concentrates on native species with reforestation potential and fast growth, and in extinction-prone species. Others are mainly conserved *in-situ* in protected areas. Conservation of agricultural animal genetic resources is focused on native species and varieties of domestic livestock and poultry, and on preventing the depletion of these species due to "their lower productivity and ignorance by local people". Though the Government has given due attention to the conservation of genetic resources, the constraint of financial and technical investments, the lack of expert staff and the incomplete technical facilities make it impossible to meet requirements for a modern conservation of genetic resources (**Vietnam** 1998).

The predominant farming system in **Vietnam** is rice-based agriculture. The International Plant Genetic Resources Institute (IPGRI) currently coordinates an *in-situ* project in the country that addresses genetic diversity in the main ecosystems of the country: the Red River Delta (Nghia Hung district) and Mekong River Delta (Tra Cu district) lowlands, the central coastal zone (Hue), the mountains (Da Bac), and the highlands (Nho Quan, Sapa and Dac Lac districts). Target crops for study include mung bean (*Vigna radiata*), rice (*Oryza sativa*) and taro (*Colocasia esculenta).* The project has commenced with diagnostic surveys covering crop genetic diversity and farmer management. The project aims to integrate conservation and participatory breeding activities. Various governmental organizations are participating (www.ipgri.cgiar.org/themes/in situ project).

A regional on-farm conservation project of IRRI, completed in 2000, recorded the amount and distribution of rice varieties under farmer management in **India**, **Vietnam**, and the **Philippines**.

III.4.3. *National genetic inventories*

A national Genetic Inventory System for domestic animals and crops has existed in **Vietnam** since 1973, financed and coordinated by the Ministry of Science, Technology, and Environment.

A plan to compile a database on agricultural and livestock diversity is now coming into effect in some substates of **India**, under the implementation of the **India** Agriculture Department.

III.4.4. *Regional networks*

The South Asia Network on Plant Genetic Resources (SANPGR) (formerly The South Asia Coordinators' Network [SAC]) was established in 1990 and encompasses six countries in the South Asia region, namely, Bangladesh, Bhutan, **India**, Nepal, Maldives and Sri Lanka. The national Plant Genetic Resources (PGR) Coordinators and other specialists from member countries meet every two years to review the progress and to formulate plans for future activities of common interest. The objectives of the SANPGR are to improve conservation and use of PGR through collaborative efforts among the member countries (http://www.ipgri.cgiar.org/system/regional networks).

RECSEA-PGR is the Regional Co-operation in Southeast Asia for Plant Genetic Resources set up in December 1993. Membership in the RECSEA-PGR is open to countries in Southeast Asia. Current members are Indonesia, Malaysia, the **Philippines**, Papua New Guinea, Thailand, Singapore and **Vietnam** (http://www.ipgri.cgiar.org/system/regional networks).

The South East Asian Research Institute for Community Education (SEARICE) provides programme services to partners engaged in plant genetic resources conservation including training, education, information dissemination, technical consultancy and resource mobilisation. Among its projects are included: 1) Community Bio-diversity Conservation and Development, being implemented in Sabah, Northern Thailand, the Mekong Delta in **Vietnam,** and the **Philippines**, 2) The Seeds of Survival (SOS) Programme, and 3) The Anti-Bio-piracy Programme that seeks to advocate among the governments of Thailand, **Vietnam**, Indonesia, Malaysia and the **Philippines** the adoption of policies to regulate access to biological and genetic resources leading to the adoption of region-wide protocol.

III.5. Diversity at the landscape level

Little mention is made in national plans of conserving agrobiodiversity at the landscape level. This is partly due to the restricted definition of agrobiodiversity in use by planners.

III.6. Wild biodiversity in agroecosystems

As mentioned before, the **Philippines** BAAP (**Philippines** 1997) Project II.A.4 aims to establish and improve *in-situ* conservation centres of wild relatives of domesticated species and varieties. Wild relatives are often found in wild borders and fields around crop lands, but may also be found outside agroecosystems. Also, BAAP Project I.C.2 seeks to promote valuation and accounting of direct and indirect goods and services from biodiversity and bioresources. Because many wild species around croplands are beneficial to agriculture and household use, this project should promote their conservation, albeit indirectly. A few examples of such species are plants that repel pests or act as pest traps, natural enemies (parasites and predators) of pests, plants that attract natural enemies, alternative hosts for natural enemies that provide a reservoir for the natural enemies, pollinators, wild relatives of crop plants, plants that improve soil health and prevent erosion, and wild food plants of both humans and livestock.

III.7. Traditional knowledge of agrobiodiversity

Strong recognition of the value of traditional knowledge of agrobiodiversity is evident throughout the region. However, steps to conserve it are only now coming into existence. Some innovative pilot measures are found in the proposed **Indian** NBSAP, namely organisation of local farmers to display indigenous varieties of crops at mobile biodiversity festivals that travel from village to village, and holding discussions with them to result in strategy and action plans for conservation and enhancement of agrobiodiversity for each village. A plan to compile a database on agricultural and livestock diversity is now coming into effect in some substates, under the implementation of the **India** Agriculture Department. The **India** Biodiversity Bill (**India** 2000) proposes that the Central Government shall endeavour to respect and protect the knowledge of local people relating to biological diversity, as recommended by the National Biodiversity Authority, through such measures that may include registration of such knowledge at the local, state or national levels, and other measures for protection, including a *sui generis* system.

In 1995, the **Vietnam** BAP (**Vietnam** 1995) recognised the role of people and communities in managing natural resources; however, the role of indigenous traditional systems is only vaguely implied.

The **Philippines** NBAAP (**Philippines** 1997) notes that to some indigenous communities, some biological resources or sites are sacred and a source of cultural identity. This type of value attached to a resource contributes to its preservation or sustainable use. More fundamentally, local communities and especially indigenous peoples have a rich repository of knowledge and practices about the natural environment that contributes to biodiversity conservation. Many of these communities occupy territories, particularly forest areas, which harbour a variety of species. The cultural and spiritual values attached to biological resources by indigenous peoples constitute a part of the worth of these resources. Project I.C.1 recognises the usefulness of indigenous knowledge systems and practices on biodiversity conservation and sustainable development. Policy exists in the form of an enabling law (Republic Act 8371 of 1997) known as the "Indigenous Peoples Right Act". This act is meant to implement the constitutional mandate (1987) to recognise and promote the rights of indigenous cultural communities, including the rights to protect their traditional territories or ancestral domains, and with this their traditional resource management practices that have hitherto contributed to the protection of biodiversity-rich areas. It does not guarantee biodiversity conservation, however, and may be weakened in the face of intensifying exposure of indigenous peoples to the forces and agents of environmentally unsustainable economic growth. The people are in effect left to improve their own resource management and strengthen their organisational capability to deal with threats to their land and biodiversity.

Philippines Executive Order 247 (1995) on bioprospecting includes a provision for prospecting of biological and genetic resources in ancestral lands and domains only with prior informed consent of the Indigenous Cultural Communities (ICCs) concerned, obtained in accordance with their customary laws (Madulid *et al.* 1995).

IV. Policies, regulatory mechanisms and the implications of agricultural development plans on agrobiodiversity management

IV.1. *Policies and Regulatory Mechanisms for Management of Genetic Resources*

Philippines Executive Order 247 (Series of 1995) prescribes the guidelines and establishes a regulatory framework for the prospecting of biological and genetic resources, their by-products and derivatives for scientific, commercial, and other purposes. The **Philippines** Agricultural Sector Report to the Convention on Biological Diversity (CBD) (**Philippines** 1995a) states that the Trade Related aspects of Intellectual Property Rights (TRIPS), provides for the option to patent plant varieties or to adopt an effective *sui generis* protection.

The **Philippines** Republic Act 7308, or the Seed Industry Development Act of 1992, is policy meant to promote and accelerate the development of the seed industry, particularly to conserve, preserve, and develop the plant genetic resources of the nation. It should encourage and hasten the organisation of all sectors engaged in the industry, integrate all their activities, and provide assistance to them. Furthermore, it is aimed to promote the seed industry as a preferred area of investment. It should provide the private sector with encouragement to engage in seed research and development, and in mass production and distribution of good quality seeds. Lastly, the policy is meant to provide the local seed industry with protection against unfair competition from imported seeds. Section 15 prohibits export of rare species, varieties, lines, and strains of plants from the country except for scientific and international exchange purposes.

IV. 2. *High-Value Crops and Market-Oriented Production Systems*

The **Philippines** Republic Act 7900, or the High-Value Crops Development Act of 1995, promotes production, processing, marketing, and distribution of high-value crops for export to augment the foreign exchange earnings of the country.

These high value crops are defined as non-traditional crops that include, among others, coffee, cacao, various fruits, potato, ubi (a purple yam), various vegetables, spices and condiments, and cut flower and ornamental plants. The “traditional” crops include rice, maize, coconut, and sugar, although these are not necessarily indigenous.

The National Agricultural Plan of **India** (Ninth Plan Document: Agriculture and Allied Activities, section 4.1 in the Plan) deals little with biodiversity except in a few implied cases, and is heavily slanted toward market-oriented production systems that may undermine biodiversity in and around agricultural ecosystems. In section 4.1.141, the major objectives of the Ninth Plan are stated to include conservation, planned enhancement and utilisation of agrobiodiversity through evolution of high-yielding hybrids and varieties. Clearly, though conservation is mentioned, the thrust is not toward conservation of traditional varieties but toward a shift to new commercial varieties with all of their inherent problems for the small-holder traditional farmer and for biodiversity conservation in general.

IV.3. *Rights of Indigenous Peoples, Equitable Sharing of Agricultural Genetic Resources, and Intellectual Property Rights (IPR)*

The **Philippines** BAAP (**Philippines** 1997) is geared mostly toward non-agricultural biodiversity but Strategy III promotes formulation of an integrated policy and legislative framework for the conservation, sustainable use, and equitable sharing of benefits of biological diversity. Within it, Activity III.3 addresses identification, delineation, and management of ancestral domain of indigenous peoples. To promote the rights of indigenous cultural communities (ICCs), the **Philippines** passed an enabling law (Section III.7, in this report).

The **India** Biodiversity Bill proposes to protect the intellectual property rights of its people. It holds that the Central Government shall endeavour to respect and protect the knowledge of local people relating to biological diversity, as recommended by the National Biodiversity Authority. It shall do so through such measures that may include registration of such knowledge at the local, state or national levels, and other measures for protection, including the *sui generis* system (**India** 2000).

After an extensive and intensive consultation process involving the stakeholders, the Central Government of **India** (**India** 2000) has decided to bring legislation with the following salient features:

- to regulate access to biological resources of the country with the purpose of securing equitable share in benefits arising out of the use of biological resources; and associated knowledge relating to biological resources;
- to conserve and sustainably use biological diversity;
- to respect and protect knowledge of local communities related to biodiversity;
- to secure sharing of benefits with local people as conservers of biological resources and holders of knowledge and information relating to the use of biological resources;
- to conserve and develop areas important from the standpoint of biological diversity by declaring them as biological diversity heritage sites;
- to protect and rehabilitate threatened species;
- to involve institutions of self-government in the broad scheme of the implementation of the Act through constitution of committees.

The proposed legislation primarily addresses the issue of access to genetic resources and associated knowledge by foreign individuals, institutions or companies, and equitable sharing of benefits arising out of the use of these resources and knowledge to the country and the people. Some exemptions are proposed to allow **Indian** citizens within the country to carry out research on genetic resources. Traditional healers may also be beneficiaries of proposed exemptions from requirements by citizens, corporations, and associations or organisations to give prior intimation to the State Biodiversity Board about obtaining biological resources for commercial utilisation (**India** 2000).

With regard to equitable sharing of benefits, the **India** Biodiversity Bill (**India** 2000) stipulates that the Biodiversity Authority consult with local bodies before imposing terms and conditions for securing equitable sharing of benefits. Monetary benefits would be deposited into a National Biodiversity Fund except in cases where biological resources and knowledge are accessed from a specific individual or group of individuals, in which case monetary benefits will be made directly to the providers.

Conflict exists over the interpretation of proposed policy to protect the rights of farmers and their plant varieties. The M. S. Swaminathan Foundation in **India** (MSSRF) reported that it has been working with the Government of **India** (Ministry of Agriculture and Cooperation and Ministry of Environment and Forests) in the development of the following two pieces of legislation:

- Plant Variety Protection and Farmers' Rights Act
- Biodiversity Act

It claims that the draft Acts prepared by MSSRF protect the interests of both farmer-cultivators and farmer-conservers, and that the draft Biodiversity Act provides for peoples' participation in biodiversity conservation and sustainable and equitable use through *Panchayat* level Biodiversity Councils and State Biodiversity Boards. A Voluntary Code of Conduct was developed to ensure that symbiotic bio-partnerships, and not bio-piracy, govern the relationships between the primary conservers and holders of knowledge and the commercial companies, who use their knowledge and material.

Kothari (1999), however, stresses that the draft Bill leans heavily towards the formal sector breeders, and that farmers' rights are restricted to the ability to save, use, exchange, share, or sell (except sale for the purpose of reproduction under commercial marketing arrangements), varieties that are given IPR protection. While providing breeders the possibility of receiving IPRs (and thereby exclusive marketing rights for a specified period), the Bill does not provide corresponding protection to the varieties and knowledge already developed by farmers over millennia. It gives no incentives to farmers to continue innovating. The national authority that is to be set up under the Bill apparently does not contain representative farmers or NGOs.

The Bill, however, does contain some advantages to traditional farmers (Kothari 1999). It contains critical clauses that allow the government to exclude plant varieties from the purview of IPRs if necessary, in public interest, or to compulsorily shift licence for protected varieties to certain breeders if it is felt that the IPR holder is acting against public interest. Also, farmers will be able to appeal to the relevant authority if they feel that their variety has been used by an IPR holder, and receive appropriate compensation if their appeal is upheld. However, Kothari (1999) has little confidence that the government will act in the interests of small farmers and local communities, and will rarely use these clauses. More explicitly farmer- and biodiversity-oriented legislation is necessary, as are mandatory clauses to conduct environmental impact assessments to ensure that new varieties do not displace traditional biodiversity.

IV.4. *Decentralisation in Resource Management*

Philippines Local Government Units (LGU), under existing Local Government Code Republic Act 7160, are given authority to exercise their power in managing the country's resources. The decentralisation of resource management is a positive development. LGUs can reclassify agricultural lands and provide for the manner of their utilisation and disposition. The national government is required to consult with LGUs to regulate implementation of projects that could cause, among others, loss of crop land, range land, or forest cover and the extraction of animal or plant species. LGUs can implement community-based forestry projects, and support the agricultural sector through the distribution of planting materials, provision of agricultural extension and on-site research services and facilities. The Local Government Code provides for preferential treatment and protection for the marginalised sectors such as the community-based forestry and other agriculture-related projects by providing extension services and research facilities. Provincial governments, in particular, are required to enforce forestry laws on community-based projects and the protection of the environment.

After a new National Forest Policy was passed in **India** in1988 that identified the need to motivate forest communities to develop and protect their forests, several states allocated partial public forest management authority to forest communities. The National Joint Forest Management resolution in 1990 supported the rights and responsibilities of forest communities (Poffenberger and McGean 1996). This has resulted in about 30,000 village-level committees conserving and regenerating 10 million hectares of forest land (McNeely and Scherr 2001). Also, a greater role for the *panchayat* (a local governing body made up of small wards) in ecosystem management has been envisaged by the 73rd Amendment Act to the Constitution of **India** by placing new matters under its jurisdiction, including land improvement, land consolidation and soil conservation, social forestry and minor forest produce.

IV.5. *Protected Agricultural Land*

A network of protected areas for agriculture has been established by the **Philippines** Department of Agriculture (**Philippines** 1998) to cover the following:

- all irrigable and potentially irrigable lands
- all alluvial plains highly suitable for agricultural production as determined by the Bureau of Soils and Water Management
- all sustainable lands that are traditional sources of food
- all croplands that support the existing economic scale of production required to sustain the economic viability of existing agricultural infrastructure and agro-based enterprises in the province or region
- all productive lands in low calamity-risk areas suited for the production of economic trees and other cash crops, and
- all agricultural lands that are ecologically fragile and whose conversion will result in serious environmental problems.

IV.6. *Integration of NBSAPs with National Sectoral Plans, Programmes, and Projects*

Philippines Memorandum Order No. 289 (1995) directs the integration of the **Philippines**' strategy for biological diversity conservation in the sectoral plans, programmes and projects of the national government agencies and the operationalisation of the objectives of sustainable biological diversity resource management and development as embodied in the strategy. The **Philippines** BAAP (**Philippines** 1997), Strategy III, promotes formulation of an integrated policy and legislative framework for the conservation, sustainable use, and equitable sharing of benefits of biological diversity. Within it, Activity III.5 addresses formulation of guidelines on land use planning and biodiversity conservation and integration thereof in the plans of concerned agencies (Table 2).

IV.7. *Biodiversity Management Committees*

The Biodiversity Bill of **India** (**India** 2000) section 41 proposes that:
(1) Every local body shall constitute a Biodiversity Management Committee within its area for the purpose of promoting conservation, sustainable use and documentation of biological diversity including preservation of habitats, conservation of land races, folk varieties and cultivars, domesticated stocks and breeds of animals and micro-organisms and chronicling of knowledge relating to biological diversity.

(2) The National Biodiversity Authority and the State Biodiversity Boards shall consult the Biodiversity Management Committees while taking any decision relating to the use of biological resources and knowledge associated with such resources occurring within the territorial jurisdiction of the Biodiversity Management Committee.

(3) The Biodiversity Management Committees may levy charges by way of collection fee from any person for accessing or collecting any biological resource from areas falling within its territorial jurisdiction.

Environmental Impact Assessment

The **India** Biodiversity Bill (2000) proposes that the Central Government shall undertake measures:
(1) Wherever necessary, for assessment of environmental impact of that project which is likely to have adverse effect on biological diversity, with a view to avoid or minimise such effects and where appropriate provide for public participation in such assessment;

(2) To regulate, manage or control the risks associated with the use and release of living modified organisms resulting from biotechnology likely to have adverse impact on the conservation and sustainable use of biological diversity and human health.

The **Philippines** Investment Priorities Plan (IPP)(Executive Order 226) of 1992 at present includes both agricultural and non-agricultural based industries. Among these are projects in crops and aquaculture. The IPP contains a provision that requires compliance with existing environmental and pollution standards for projects critical to the environment in general. In theory, the provision should address the same environmental impact concerns brought out in the **India** Biodiversity Bill (**India** 2000).

Inclusion of Agrobiodiversity in National Biodiversity Action Plans

The **India** Biodiversity Bill proposes a measure to provide a framework for information exchange between general and agricultural biodiversity planners. Section 13(1) proposes that the National Biodiversity Authority (NBA) of **India** may constitute a committee to deal with agrobiodiversity**.** (Agrobiodiversity is defined there as the biological diversity of agriculture-related species and their wild relatives.) Section 13 (2) states: Without prejudice to the provisions of sub-section (1), the NBA may constitute such number of committees as it deems fit for the efficient discharge of its duties and performance of its functions under this Act. It continues: 13 (3) A committee constituted under this section shall co-opt such number of persons, who are not members of the NBA, as it may think fit and the persons so co-opted shall have the rights to attend the meetings of the committee and take part in its proceedings but shall not have the right to vote (**India** 2000). The inclusion of an agrobiodiversity committee in the NBA is a step in the right direction toward inclusion of agrobiodiversity concerns in the country's NBSAP.

The **Vietnam** BAP (**Vietnam**1995) was created with consultation of high-level government, local and international scientists, planners, managers, villagers, and resource users. The Plan added to previous planning documents by including agricultural systems as targets of biodiversity conservation. It also advocates the role of local government in decision-making, as well as the role of people, communities, and NGOs in managing natural resources.

The **Philippines** BAAP (**Philippines** 1997) has already integrated many components of agrobiodiversity conservation (Table 2). Among them are production of plant, animal, and microbial resource inventories, inventories of indigenous knowledge and practices and protection thereof, valuation and accounting of goods and services from biodiversity, establishement of *in-situ* agrobiodiversity conservation centres and of gene banks, and formulating policy and frameworks for the conservation, sustainable use, and equitable sharing of benefits of biodiversity.

V. Constraints to the use of sound policies and practices

The following constraints are generally regional in nature, but some may be more relevant in some countries than in others:

- Lack of land-use policies
- Conflicting agendas of government and small-holders: subsidised supply of HYV seeds and other inputs by governments, and lack of incentives for marketing traditional crops
- Weak economies, necessitating external input to meet planning goals
- Poor knowledge, communication, and education on existing agrobiodiversity
- Knowledge and policy gaps in agricultural biotechnology
- Weak enforcement or compliance with environmental standards
- Population pressure and poverty
- Lack of commitment/enforcement of trade issues that are linked to the environment

- The incentive structure for agriculture is still mainly subsidy-based and not geared to sustainability
- Policy trend toward maximising profit has severely threatened species and breeds that were bred for domestic uses
- Policies are still geared toward development rather than management of agricultural resources
- Weak implementation of management policies
- Monitoring and evaluation plans for biodiversity in the agricultural sector are focusing on domesticated **exotic** species and varieties, especially livestock.

Table 1 presents the major threats and concerns for **Philippines** agrobiodiversity, which can generally be used as examples for the region.

More specific to **India** are the following constraints that need to be addressed:

- Many clauses in the national agricultural plan of **India** conflict with the Biodiversity Bill although the listed duties of the Central Government include integration of biodiversity conservation and sustainable use into relevant sectoral and cross sectoral plans, programmes and policies.
- There have been recent moves by the **Indian** government and some state governments to relax land ceilings and other regulations that restricted the conversion of agricultural into non-agricultural land. The result will be that industrial level agriculture, or even non-agricultural land uses such as industry, will find it easier to acquire land.
- The introduction of compulsory environmental impact assessment (EIA) for agricultural projects is incomplete. While EIA is now compulsory for most development projects like dams and industries, it is not yet geared towards looking at the impacts on agricultural biodiversity. In addition, many agricultural development projects are not subject to any EIA at all. Finally, the process is not participatory (Kothari 1999).
- Freeing of trade restrictions through World Trade Organisation (WTO) agreements will threaten the livelihood of small and marginal farmers when the markets are open to large quantities of imports from the West. **Indian** markets are expected to be flooded with cheap grains, pulses, fruits, and vegetables that will compete heavily with locally-grown produce (S. Padmanabhan and A. Kothari, personal communication).

Vietnam suffers especially from financial and technical problems leading to the following constraints:

- By-law regulations and supporting documents are needed to strengthen enforcement of the Law on Environment Protection (**Vietnam** 1995).
- The NBSAP is promoting an end to traditional shifting cultivation because population pressure is too high to allow it to be sustainable; it aims to stabilize the lives of people and raise their awareness so they will join the protection force voluntarily.
- Constraints to conservation in general include insufficient institutional arrangements, limited community participation, and insufficient expertise in social and economic development (**Vietnam** 1995).
- Though the **Vietnamese** Government has given due attention to the conservation of genetic resources, the constraint of financial and technical investments, the lack of a contingent of highly qualified staff, and incomplete technical facilities make

it impossible to meet requirements for a modern conservation of genetic resources (**Vietnam** 1998).

A major regional weakness in interpreting agricultural biodiversity issues is that national documents appear to restrict the definition of agrobiodiversity to crop and livestock species and their wild relatives, rather than the broader ecosystems in which these exist (see Section II.4 , this report). Such views exclude wild species that provide services to agriculture, such as pollinators, natural enemies, soil organisms, and other species that make up the agroecosystem.

Another problem that pervades conservation issues is the notion that human population growth is inevitable, and that conservation must necessarily come for the sustainability of a burgeoning population. However, unchecked population growth in developing countries whose economies are agriculture based, whose people are impoverished, and whose resources are already being depleted can only exacerbate the problem and slow development. The governments of **India** and **Vietnam** are, at least in principle, taking up the challenge to slow population growth.

VI. Examples of best practices

VI.1. Soil Biodiversity

VI.1.1. *Soil fauna and organic fertilisers in tea gardens of Tamil Nadu,* ***India***

Tea is a high-value plantation crop in **India**. In recent years, green tea production has stopped increasing, despite increasing application of external inputs such as fertilisers and pesticides. The long-term exploitation of soil in tea gardens has led to important changes in various physical, chemical and biological attributes of the soil, decreasing organic matter content, cation exchange, water-holding capacity, soil biota (reduced up to 70%) and pH, simultaneously increasing concentrations of toxic aluminium.

In response to these limitations on tea production, a patented technology entitled "Fertilisation Bio-Organique dans les Plantations Arborées" (FBO, for short), was recently developed by Parry Agro Industries Ltd., in association with the French Institut de Recherche pour le Développement (IRD) and Sambalpur University (Orissa, **India**). This technology aims to improve the physical, chemical and biological soil conditions by inoculating a mixture of low and high quality organic materials (tea prunings and manure) and earthworms into trenches dug between the rows of tea plants. Measurements performed at two sites, beginning in 1994, have shown that this technique is much more effective than either100% organic or 100% inorganic fertilisers alone. It increased yields on average by up to 276% and profits by an equal percentage (from around US$2,000 per hectare using conventional techniques to about US$7,600 per hectare using FBO) in the first year of application. This technique has been extended to other countries and is now being used in over 80 hectares, and over 20 million earthworms are being produced each year. Details on the methodology for its application are described in the patent document (ref. PCT/FR 97/01363) (M. Swift, Tropical Soil Biology and Fertility Program, c/o UNESCO, Nairobi, personal communication).

VI.2. Biodiversity that Provides Mitigation of Pests and Diseases

VI.2.1. *Integrated Pest Management and Biodiversity Utilisation in Cotton in* ***India***

There is a success story from the cotton belt of Karnataka, where an FAO supported, Integrated Pest Management (IPM) project has been operating in six villages. IPM is the careful integration of a number of available pest control techniques that discourages the development of pest populations. It keeps pesticide use and other interventions to levels that are economically justified and safe for human health and the environment, and enhances production of all functionally important species. Fifty-two percent of the total pesticides used in **India** are on cotton and the expense to the farmer is very high, often resulting in net loss. The project has succeeded in changing farmers' thinking about pest control. An intensive training of trainers was accomplished at a cost of half a million rupees. These trainers now train the farmers over the whole cycle of the crop. The farmers become as knowledgeable as the experts about cotton IPM. They are able to explain IPM, the Integrated Nutrient Management system (INM), point out beneficial and harmful insects and birds, explain the uses of various traps and even some economic models. It has had a great impact and they have now formed their own club and are spreading their knowledge to others. They are expecting a good harvest without resorting to any synthetic insecticide spray where they were using 15-20 rounds earlier.

The approach used to reach and enhance local human expertise for IPM in the region is through Farmer Field Schools (FFS), which build on local knowledge and expertise. About 25 farmers in FSS spend five to six hours together weekly; two hours are spent in the field observing the ecosystem and analysing its biodiversity. They collect arthropods in plastic bags and after the field work discuss what they have observed, prepare poster diagrams and present findings to their fellow farmers. They classify populations into functional groups depending on their trophic position in the agro-ecosystem (herbivores, predators, etc.). Farmers observe populations in the field but also test their trophic linkages by setting up “insect zoos”. These answer their questions on “what eats what” and “how many are eaten”, etc. Such experiments advance farmers’ knowledge and lead to further experimentation with agricultural biodiversity, for example, the planting of different rice varieties that can make a big difference to disease resistance or other factors. In the case of double cropped irrigated rice in **Vietnam**, with annual yields over 300% of the world average, farmers’ advanced knowledge about rice field biodiversity has also led to experimentation with different management options. One example is growing a crop of fish with rice in the same field, using the rice field to grow fish between two rice crops, or growing fish after rice instead of a second rice crop. Financial benefits per hectare surveyed in a sample of FFSs in more than 1,300 villages averaged from 20 to 25% higher in IPM fields than in regular fields. Better utilisation of resources, healthy crops of rice and fish and increased income and food security reinforce farmers’ acceptance of IPM and their rejection of pesticides. However, a prerequisite for these changes to take place is an enabling policy environment, for example, removing perverse pesticide subsidies or, as in **India**, putting a tax on pesticides. The increased skill and empowerment of farmers’ groups through FFSs also leads to stronger local accountability and the ability of farmers to determine local policies that increase benefits to production, income and the environment, including agricultural biodiversity (adapted from a case study presented by Peter Kenmore and Matthias Halwart, FAO).

VI.2.2. *IPM for Highland Vegetables in the **Philippines***

The Commonwealth Agriculture Bureau International (CABI) Bioscience IPM for Highland Vegetables project was set up in 1994 and is funded by the Asian Development Bank. Insecticide resistance and human health problems had become so severe that the IPM project set up FFSs to increase awareness about the harmful effects of pesticides, increase knowledge of natural enemies, and encourage discussion on best husbandry practice among farmers. The project reached 1,719 farmers in 65 FFS groups, and trained 48 trainers, mainly from local government. Resulting from this was the development by farmers of a range of alternative pest-control methods. There has been an 80% decrease in pesticide use in the wet season (55% in the dry season) and the synthetic fertiliser rate has halved, giving farmers a net rise in income of 17%. Vegetable yields have also increased by about 20%. FFSs are now considered a good investment by municipal authorities (Pretty and Hine 2000).

VI.2.3. *Pest amelioration through modified resource management in the **Philippines***

Simple intercrops of maize and peanuts help to control the maize-stem borer. Populations of a spider that feeds and controls the stem borer caterpillars are encouraged to develop in maize crops by intercropping with peanuts that provide habitat and prey (springtails) for the juvenile spiders (McNeely and Scherr 2001).

VI.2.4. *Rice IPM in the Mekong Delta, **Vietnam*** (Pretty and Hine 2000)

Researchers with the International Rice Research Institute (IRRI), Ministry of Agriculture and Rural Development of **Vietnam**, and Visayas State College of Agriculture, **Philippines**, have been engaged in a unique and successful initiative to encourage the adoption of more sustainable rice production in the Mekong Delta, **Vietnam**. Surveys in the early 1990s showed that insecticide use by farmers was high, particularly to control leaf-feeding larvae that caused visible defoliation. Farmers believed that such visible damage caused yield loss, but researchers discovered that leaf-damage during the vegetative stages of rice rarely reduces yields. Indeed, use of insecticides was more likely to kill beneficial insects and lead to outbreaks of secondary pests.

Through an innovative media campaign backed with FFSs, farmers in Long Am Province were encouraged to test whether insecticide spraying is needed for leaf-folder control in the first 40 days after sowing. The campaign distributed 380,000 leaflets and 35,000 posters, organised 1,390 demonstrations and broadcast a radio drama 1,550 times. This reached 97% of the 20,000 farmers in the study region, and 82% of those in the whole province, a total of 172,000. In the two and a half years after the campaign, mean insecticide spraying fell from 3.35 to 1.56 sprays per farmer per season. Farmers' perceptions had changed substantially – 77% had stopped early season spraying, and 20-30% had stopped using insecticides altogether.

Other provinces in the Mekong Delta adopted the approach, and their campaigns have reached 92% of the 2.3 million farmers – who have now reduced spray frequencies to one per season (a 70% reduction). Rice yields have not changed during this period – remaining at about 4tons per hectare. Researchers concluded that the two interventions – detailed understanding provided by FFSs, combined with dissemination through the media campaign -- played complementary roles in changing both farmers' beliefs and practices. Researchers are now exploring ways to develop targeted advice for other phases in the rice cycle, as the total potential audience of rice farmers in Asia is more than 200 million.

VI.2.5. *Improving agricultural biodiversity functions in intensive rice production through Integrated Pest Management and Aquatic Life Management in* ***Vietnam***

Farmers who achieve higher production of rice and other crops by using IPM systems are also conserving and enhancing agricultural biodiversity. Conservation of agricultural biodiversity is an essential part of intensification to increase agricultural productivity. In rice monocultures, wider agricultural biodiversity is important. For example, species that decompose organic matter contribute through an aquatic food chain to the build up of predator populations early in the season, even before the rice is planted. Ecologically, this renders the agroecosystem more resilient and therefore more productive. When pesticides are not used, about 700 arthropod species can be found in paddies that keep the balance between pests and their natural enemies (predators and parasites) and prevent pest outbreaks. Populations of fish, snails, frogs, aquatic insects and other species that constitute an important part of the diet of many rice-farming households are also enhanced in these IPM systems.

VI.3. <u>Crop and Livestock Genetic Resources</u>

VI.3.1. *Regional networks*

The South Asia Network on Plant Genetic Resources (SANPGR) was renamed in 1988 from the earlier South Asia Coordinators' Network that was established in 1990. Six countries in the South Asia region, namely, Bangladesh, Bhutan, **India**, Nepal, Maldives and Sri Lanka are the members of this Network. The secretariat (interim) is located at IPGRI South Asia Office in New Delhi. The national plant genetic resources (PGR) Coordinators and other specialists from member countries meet every two years to review the progress and to formulate plans for activities of common interest. The objectives of the SANPGR are to improve conservation and use of PGR through collaborative efforts among the member countries, as follows:

- To enhance scientific interaction among the National Programmes and identify priorities for research and training
- To promote exchange of germplasm and sharing of information and technologies
- To foster collaboration for joint research and development activities
- To derive greater benefits for human resource development from the strengths of the partners
- To provide a platform for developing common policies and harmonising regional views on PGR issues and related policy matters.

The Regional Co-operation in Southeast Asia for Plant Genetic Resources (RECSEA-PGR) was set up in December 1993. Membership in the RECSEA-PGR is open to countries in Southeast Asia. Current members are Indonesia, Malaysia, the **Philippines**, Papua New Guinea, Thailand, Singapore and **Vietnam** (<u>http://www.ipgri.cgiar.org/system/regional networks</u>).

Its objectives are:

- To develop information systems that can be used to rationalise collections and provide information on germplasm technologies and related policies to member countries.
- To identify research topics that can strengthen national plant genetic resources (PGR) programmes.
- To identify appropriate *in-situ* and *ex-situ* conservation strategies for the region's PGR.
- To identify the training needs and provide information on training opportunities to member countries.
- To identify and solicit funding to achieve these objectives.
- To interact with regional and international PGR-related organisations like IPGRI and FAO on projects and activities.
- To identify the common elements to strengthen the position of Southeast Asian countries in international fora.
- To facilitate, exchange information, and interact with regional fora.
- To promote public awareness on the value, conservation and use of PGR.

The South East Asian Research Institute for Community Education (SEARICE) provides program services to partners engaged in PGR conservation including training, education, information dissemination, technical consultancy and resource mobilisation. Among its projects are included: 1) **Community Bio-diversity Conservation and Development (CBDC)**, where SEARICE is implementing the Asian component of the global Community Biodiversity Conservation and Development (CBDC) Program. The CBDC is a partnership between formal and informal systems aiming towards strengthening community PGR conservation and development. The program is being implemented in Sabah, Northern Thailand, the Mekong Delta in **Vietnam** and the **Philippines**. 2) The **Seeds of Survival (SOS) Program**, under implementation since 1992, aims to promote PGR conservation and development at the community level. SEARICE continues to provide technical assistance, management advice and education materials to local NGOs and people’s organisations involved in PGR conservation and development under this program. 3) The **Anti-Bio-piracy Program** is a community-oriented investigative research and policy advocacy work that seeks to advocate among the governments of Thailand, **Vietnam**, Indonesia, Malaysia and the **Philippines** the adoption of policies to regulate access to biological and genetic resources leading to the adoption of region-wide protocol. The program seeks to identify trends in bio-prospecting activities in Southeast Asia, heighten public awareness on bio-piracy activities in the region and their impact, develop the capacities of local communities, people’s organizations and NGOs to protect their interests, and preserve bio-diversity and indigenous knowledge systems.

VI.3.2. *In-situ conservation guidelines*

Guidelines for southern **India** on *in-situ* conservation of wild relatives and related taxa of cultivated plants are offered online, including case studies (http://ces.iisc.ernet.in/hpg/cesmg/situfin.html#SEC1). The guidelines are well designed and applicable to much of the region.

VI.4. Diversity at the Landscape Level

VI.4.1. *Reduction of land conversion by increasing productivity:*
VI.4.1.1. *Increasing yields of lowland rice reduces extensive hillside farming in the* **Philippines**

Population growth in the **Philippine** frontier province of Palawan has been particularly high (4.6% per year), and resulted in agricultural expansion into marginal and environmentally sensitive areas, promoting acute upland deforestation. The area's main staple is rice and its main cash crop is maize; farm size averages 2.6 to 5.1 hectares. To intensify and raise agricultural production, the **Philippine** National Irrigation Administration constructed or upgraded a number of small-scale communal irrigation systems in Palawan. These are in the lowlands, but most are adjacent to inhabited upland forest areas.

Household surveys show that irrigation allowed farmers to increase cropping intensity to 1.9 crops per year, whereas on rainfed farms it was only 1.2. They used less family labour and less overall labour during each cropping season, but more hired labour. By raising the opportunity for paid labour, intensification of lowland irrigated cropping induced upland farmers to participate less in lower-paying forest-clearing and forest product extraction (hunting, charcoal making, resin collection), and more in lowland cropping. After the irrigation systems were installed in the lowlands, annual forest clearing by upland households declined by 48%. After the introduction of lowland irrigation, average wage income rose nearly three-fold among upland households that engaged in work outside their own farms. These positive impacts resulted in part from the fact that the upland area is physically adjacent to the lowland irrigated area, reducing the cost of working outside their own farms. Also, there was relatively little investment needed in labour-saving technology among lowland farmers, which would have partly offset the employment gains (Shively and Martinez 2001).

VI.4.2. *Develop Habitat Networks in Uncultivated Areas:*
VI.4.2.1. *Soil erosion barriers with native plants in the* **Philippines**

Contour hedgerows are rows of perennial shrubs established along the contour that have been promoted on steep lands to reduce erosion and produce organic matter for soil improvement. Most contour hedgerows in the country used exotic grasses or shrubs that require nursery development and considerable labour for establishment. In the early 1990s, researchers at the International Centre of Research in Agroforestry (ICRAF) in the **Philippines**, frustrated at farmers' low adoption of hedgerow technology, began a series of studies to identify the most cost-effective approach to contour planting of perennials. They discovered that natural vegetative strips (NVS) – contour rows left uncultivated during ploughing so that natural vegetation could grow there – were not only the least expensive (zero cost for planting materials and establishment), but erosion control was nearly as effective as by planted shrub hedgerows. Studies found rows as far apart as 2 to 4 meters elevation distance served nearly as well for erosion control as more closely-spaced rows, but removed much less area from production (Mercado *et al.* 1997). Further research developed a very low-cost method for laying out initial contour lines, and for enriching the natural vegetative strips with high value fruit trees from which farmers could earn cash income.

Since its introduction in1996, thousands of farmers have adopted this low-cost technology in the densely populated steep farmlands of northern Mindanao. The natural vegetative strips are not only valuable for maintaining soil fertility on farms and protecting local watersheds, but they also provide important habitat for wild biodiversity. A study of floral composition and community characteristics of fields with NVS confirmed the high diversity of native plant species, while the presence of untilled areas provided habitat for native fauna (Ramiaramanana 1993). Economically profitable timber and fruit tree species in the NVS further expand their habitat value for wildlife.

VI.4.3. *Modify resource management practices:*

VI.4.3.1. *Regenerating native forests through joint management in **India***

Following **India**'s independence in 1947, forest policy emphasised nationalisation and commercial utilisation of the country's national forests. The national government, however, was unable to manage these resources effectively, instead expanding exotic tree species plantations to supply fast-growing demand. By the 1980s, less than half of this "forest" land had good tree cover, and subsistence forest products became scarce. In response to this degradation, thousands of communities, primarily in eastern **India**'s tribal forest tracts, took action to protect their degrading forests. They organised hamlet-based forest protection groups who halted cutting and grazing, often initiating rapid regeneration of the natural forests. Researchers and NGOs, recognising the potential of natural forest regeneration, began to support these village initiatives by developing methods to accelerate natural regeneration and sustainably manage product extraction. After a new National Forest Policy was passed in 1988, identifying the need to motivate forest communities to develop and protect their forests, several states allocated partial public forest management authority to forest communities. The National Joint Forest Management resolution in 1990 supported the rights and responsibilities of forest communities (Poffengerger and McGean 1996).

Today, an estimated 30,000 village-level committees are protecting and regenerating 10 million hectares of forests (Bahuguna 2000). Village forests are managed to provide a flow of subsistence products like fuelwood, medicines, fodder and condiments, and some income from commercial timber sales. Their biodiversity value is enhanced many-fold relative to their previous degraded state, while biodivrsity is also enhanced in adjacent areas because environmental services of forests are recovering. The extent of habitat improvement for many types of wildlife may be greater than that provided by many of **India**'s official protected areas.

VI.5. <u>Wild Biodiversity in Agroecosystems</u>

VI.5.1. *Expand wild biodiversity Reserves:*

VI.5.1.1. *Buffer zones to protect rhinos and tigers in a national park in Nepal*

Competition between humans and rhinos, tigers, and other large mammals around the Royal Chitwan National Park has caused major conservation problems. Tigers are major predators of cattle, and rhinos can significantly damage rice and other crops. People living around the park derive up to 80% of their needs for firewood and fodder from the forest. In 1993, pioneering legislation empowered the government of Nepal to declare areas surrounding Chitwan as a buffer zone, and for local User Group Committees to use 30-50% of park revenues for managing community forests, income generation activities, community development work, etc. A community-based ecotourism project, under the auspices of the Baghmara User Group Committee, was granted land management rights by the government in 1995.

The Baghmara Group constructed nature trails for elephant-back safaris and a wildlife viewing tower where tourists can stay overnight. Within the first six months of operation, nearly 8,000 tourists visited the Baghmara wildlife viewing area and generated nearly US$200,000 in revenues, allowing the Baghmara Group to refurbish three schools and a clinic. Half of annual income will go to support the National Park and about 5% will be retained by the Baghmara Group. An area that had been largely deforested and supported little wildlife before this conservation investment has now become one of the most popular tourist destinations in Nepal (83,000 tourists per year), based on elephant-back tours into the riverine grasslands to view rhinos and other mammals, birds, and reptiles. Villagers in the area receive incomes of about $200 per elephant, plus $3 per trip. The income has enabled them to build biogas plants and smokeless stoves, provide training to local women's groups, and carry out numerous other activities that reduce human pressure on the park. The local villagers are now convinced that rhinos are a critical tourism attraction and they claim to do whatever they can to support conservation (McNeely 1999).

VI.6. Traditional Knowledge of Agrobiodiversity

VI.6.1. *Innovations in the NBSAP Process and Revival of Indigenous Crops in* ***India***

The Deccan area succeeded in bringing farmer participation to the ongoing NBSAP process, which proved to be useful also in reviving nearly extinct crop varieties. A biodiversity festival was organised in which about 70 villages around the Zaheerabad region of Deccan were visited by bullock carts displaying seeds of a variety of crops. Discussions with farmers took place in each village about agrobiodiversity that they planned to conserve, enhance for sustainable use, and equitably distribute. This resulted in a BSAP for agrobiodiversity conservation for each village.

Key participants reported that the response to the festival had been enormous, including from many big cash-cropping farmers who were sceptical of the return to traditional seeds, but nevertheless were sufficiently impressed to promise to try them. In many villages, elders recounted how in so many ways their lives were better off when they had the old seeds now nearly gone.

The discussions amongst the farmers brought up many crucial benefits of mixed organic farming: an increase in the nutritive values of the food they consumed, a variety of fodder available for their cattle, an enhancement of soil fertility and prevention of its erosion, an increase in immunity against illnesses and disease, a decline in pest attacks, and a means of managing climatic unpredictability. Many challenges and constraints were also voiced, one of the biggest ones being the shortage of farmyard manure. Over the years it has become increasingly difficult for farmers to maintain their livestock. There has been a reduction in the availability of fodder. Grazing lands previously available to rural communities are often appropriated for various developmental purposes, with little thought about the consequences to villagers. What also came up repeatedly was the need for a change in government policies to boost to the marketing value of traditional varieties, by even including them in the Public Distribution System of the State (S. Padmanabhan and A. Kothari, Kalpavriksh - Environmental Action Group, personal communication).

VI.6.2. *Reviving Traditional Crops and Practices in Jardhargaon,* ***India***

Recognising that modern techniques of agriculture that government extension officers were bringing them are yielding only short-term benefits, some farmers have revived traditional practices in the village of Jardhargaon. One farmer, for instance, is trying out 150 varieties each of rice and beans, along with other traditional crops like millets, and then spreading back to other farmers those varieties that are particularly useful. He and others have formed a Beej Bachao Andolan (Save the Seeds Movement). The Andolan has actively pursued the revival of traditional farming methods, such as *baranaja*, in which about a dozen crop species grown together yield a variety of produce that fulfil a variety of domestic requirements, while maintaining soil fertility (A. Kothari, Kalpavriksh – Environmental Action Group, personal communication).

VI.7. Policies and Regulatory Mechanisms

VI.7.1. *Individualized Land Rights Reduce Deforestation in* ***Vietnam***

Individualized land rights in **Vietnam** have led to agricultural intensification and regeneration of forests. Based on community-level data from three decades, Tachibana *et al.* (2001) compared agricultural intensification with extensification due to shifting agriculture. They stress the relevance of agricultural practices for deforestation in hilly areas, and conclude that strengthened land rights tend to deter deforestation.

VI.8. Multi-faceted Conservation Approaches

VI.8.1. *Permaculture Practice and Agrobiodiversity Conservation in* ***India***

The Deccan Development Society (DDS) was started in 1983 in the Zaheerabad region of Medak district, Andhra Pradesh, by a group of professionals from nearby Hyderabad. Its main aim was to regenerate the livelihoods of the people by linking crucial environmental and economic factors to bring true developmental change in the region. The promotion of permaculture, a variant of organic or nature-based farming, has been one of its main activities.

DDS works with small-holder and marginal women farmers, mostly Dalits. The women have organised themselves into *sanghas*, and today there are over 4,000 members in about 75 villages. A number of programmes linked to agriculture have been initiated. The establishment of a community grain-fund programme saw the regeneration of over 1,000 hectares of fallow land, and the start of a Public Distribution System (PDS) that the women own and run. Collective farming was initiated for women with very small land-holdings. A community gene-fund programme established seed banks in over 30 villages, and revived over 60 crop varieties that are now under cultivation. Some traditional foods, once almost forgotten, are again common in many households. At the seed bank there is no exchange of money; instead, the women return double the amount of seeds that they have taken from the bank. They are also establishing an alternate market that is under their control, where they can fix prices that are higher than in regular markets. Through all these activities, DDS has generated the equivalent of over a million new jobs over a decade, increased food availability by 100 to 200 kg per acre, and enhanced per acre earnings by an average factor of 12. Chemical inputs have been eliminated and the use of biodiversity in the fields has increased. Several of the women and men farmers were honoured for their outstanding work in conserving seeds and demonstrating sustainable productivity (S. Padmanabhan and A. Kothari, Kalpavriksh - Environmental Action Group, personal communication).

The M. S. Swaminathan Foundation in **India** has five major programme areas (PAs) that include the following relevant activities:

PA 200: Biodiversity and Biotechnology

The three principal goals are to:

- Develop an implementation framework for achieving the triple aims of CBD, namely, conservation, sustainable use and equitable sharing of benefits
- Save endangered habitats and species
- Use genetic enhancement, bio-monitoring, and micro-propagation techniques for promoting the cause of conservation and sustainable use

Good progress was made in achieving these goals. A large number of tribal and rural women and men were trained in the art and science of biodiversity conservation and in chronicling local biodiversity resources. Trained youth constitute a Community Agro-Biodiversity Conservation corps, who will be able to assist their respective communities in taking decisions on questions like "prior informed consent" and "access and benefit-sharing", after the national Biodiversity Act comes into force.

In the area of sustainable use, further progress was made to link conservation and commercialisation in a mutually supportive manner and to promote participatory plant breeding. The work on the revitalisation of the *in-situ* on-farm conservation traditions of tribal and rural families, and on sustainable and equitable use, received generous support from the Swiss Agency for Development and Cooperation (SDC). This project is in progress in the States of Tamil Nadu (Kolli Hills), Kerala (Way-anad) and Orissa (Jeypore). A Voluntary Code of Conduct based on the principles of CBD guides the work of all researchers working in this project.

The participatory plant breeding work initiated this year in collaboration with the farming families of Kolli Hills, Wayanad and Jeypore has made a good beginning. The methodological underpinning of the project was discussed at a workshop jointly organised by MSSRF and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) at Hyderabad. An important component of this work relates to the improvement of *njavara*, a rice strain widely used in Ayurvedic medicine in Kerala.

The community *in-situ* and *ex-situ* conservation activities were streamlined through a linked network of *in-situ* Field Gene Banks (on-farm) and *ex- situ* Cryogenic Gene Bank. This represents the first scientifically structured *Community Gene Management System* in **India** (the term "gene management" refers to conservation and sustainable and equitable use of genetic resources).

Several training programmes for rural youth were organised by the B. R. Barwale Chair in Biodiversity. Steps were also taken to assist local communities in the preparation of People's biodiversity registers. Pending the setting up of official-level Panchayat Biodiversity Councils, the formation of broad based village level Biodiversity Management Committees including the Panchayat President, Village Officer and Local School Headmaster, is being promoted. This voluntary code of conduct calls for adherence to the principle of prior informed consent.

In the field of molecular mapping and genetic enhancement, a binary vector carrying the BADH gene cloned from mangrove species was constructed. Methods of integrating the BADH gene, which confers tolerance to sea water salinity, into the tobacco genome were standardised. The work on biomonitoring of ecosystem health using *Pseudomonas* and lichen species made further progress. Micropropagation protocols were standardised for 14 species (10 endangered and medicinal and 4 mangrove species). These protocols have been made available to the Department of Biotechnology for commercialisation.

PA 300: Ecotechnology and Sustainable Agriculture

The Ecotechnology programme aims to promote sustainable livelihoods in rural areas by undertaking the technological and skill empowerment of the poor. The seed village programme at Kannivadi led to the distribution of nearly a million rupees as wages to women. The ornamental fish production and Low External Input Sustainable Aquaculture (LEISA) programmes at Keelamanakudi and Chidambaram helped to improve household income substantially. The work on creating markets for traditional grains like *Panicum*, *Paspalum* and *Setaria* species made good progress. Wheat bread prepared with 10% flour of *sadan samai* (*Panicum sumatrense*) was substantially high in micronutrients like calcium, iron and vitamins. Negotiations are in progress for introducing a new brand of bread prepared with the flour of wheat and minor millets.

VI.8.2. *Area-wide integration of crop and livestock production,* ***Vietnam***

Periurban dairy centres pose the threat of a net accumulation of phosphorus and potassium in urban drinking water and soil. A report by Bob Orskov of Aberdeen, Scotland, to a recent electronic conference on area-wide integration of crop and livestock production revealed a solution to this problem in **Vietnam**. Dairy units around Ho Chi Minh City sell manure to coffee farmers far from the city. The cows are fed mainly on city by-products delivered from urban factories, including brewer's waste grain, cassava waste, tofu waste, etc., in addition to some green feed and rice straw. The cows are therefore extracting nutrients from city wastes. Milk and other products are returned to the urban environment and the manure is again sent away to fertilise coffee and other crops, reducing the threat of degradation of urban water and soil quality.

VII. Results and lessons learned

Agrobiodiversity includes not only agricultural species, varieties, and their relatives, but all living elements within the agricultural landscape that provide support and services to agriculture.

Services provided by wild biodiversity in agroecosystems, such as pollination, soil quality enhancement and reduced erosion, and pest amelioration, have not been sufficiently addressed in NBSAPs or agriculture sector reports.

Departments of agriculture must work together with NBSAP planners to maximise agrobiodiversity conservation and sustainable productivity.

National agricultural plans must be revised with a grassroots – up approach. Input by small-scale farmers, women, and indigenous peoples must be incorporated into agricultural plans and the NBSAP.

Indigenous cropping systems should be given incentives to flourish, and riskier, less biodiverse production systems like cash-cropping should be given reduced incentives.

Multiple cropping in space and/or time intensifies productivity and reduces risk of pest and disease outbreaks compared with monocropping.

Open trade with foreign countries may result in hardship to small farmers.

Communities can work on their own if empowered to revive and conserve their own indigenous crops and livestock.

Communities can work to improve market potentials by combining small farms into larger co-operatives and fixing higher prices.

Strengthened individual land rights tend to lead to agricultural intensification and to deter deforestation and other habitat degradation.

On-farm training can result in increased capacity to use novel means to increase production without risk to biodiversity, such as IPM.

Human population pressure is a major cause of biodiversity erosion in the region. Agricultural intensification can support some increase in demographic pressures.

VIII. Guidelines or policies that resulted from this experience

The **Philippines** Agriculture Sector Report (1995) recommends biodiversity conservation and sustainable use strategies that include the following:

- In-situ conservation of traditional farming systems
- In-situ conservation of wild relatives of domesticated species – this will require the basic understanding of the needed interphase between varietal agrobiodiversity and ecosystem agrobiodiversity. The wild germplasm of use in agriculture and forestry should be maintained within its natural ecosystem.
- Promotion of equitable benefits from agrobiodiversity
- Enhancement of agrobiodiversity value

Specifically for the livestock sector, the Report recommends the following strategies:

- Information and education campaign among farmers
- Setting up a buy-back/save-the-herd scheme
- Establishment of a nation-wide livestock diversity conservation network
- Inclusion of a livestock diversity conservation programme in the government's livestock development programme
- Capacity building on relevant technologies for livestock biodiversity conservation
- Inclusion in school curricula issues of domestic indigenous animal conservation in addition to wildlife conservation

Development opportunities for forest biodiversity include:

- prospecting for economically important products
- species domestication and breeding for productivity
- biodiversity conservation and management by local/indigenous communities
- ecotourism
- biotechnology.

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Tables

Table 1. Problems, threats, and issues in forest- and agro-ecosystems (excerpted from **Philippines** Biodiversity: an Assessment and Action Plan, 1997)

Major Concerns	**Forest Ecosystems**	**Agroecosystems**
A. Problems and threats		
1. Habitat destruction	Forest fires	
	Logging	
	Conversion	Conversion
	Natural calamities	Natural calamities
	Pests and diseases	
2. Overexploitation	Commercial timber and non-timber species	
	Increased demand due to population growth	Increased demand due to population growth
	Open access	Open access
3. Biological pollution (species level)	Introduction of alien species	Inappropriate breeding
4. Chemical pollution	Chemical defoliants	Inappropriate farming systems
5. Weak institutional and legal capacities	Inappropriate policies	Inappropriate policies
	Lack of technical expertise	
	Shortage of funds	
	Weak IEC	
B. Issues		
1. Biotechnology	Developments of undesirable mutants	Developments of undesirable mutants
	Genetic erosion	Genetic erosion
	Biological warfare	Biological warfare
	Pest resistance and introgression	Pest resistance and introgression
2. Ecotourism	Ecological stress	--
	Cultural stress	
	Commercialisation	
3. Domestication	Genetic erosion	Genetic erosion
4. Bioprospecting	Species extinction	Species extinction
	IPR	IPR
	Genetic erosion	Genetic erosion
	Overexploitation	
C. Gaps		
1. Knowledge	Baseline	Baseline
2. Management*	Various aspects	Various aspects
3. Policy**	Various aspects	Biotechnology
	Biosafety	Biosafety

*Management: means of intervention such as conservation of biodiversity or bioresources.
**Policy: definite course of action adopted and pursued by government such as biodiversity conservation and bioresource utilisation.

Table 2: Matrix showing the primary problems, threats, issues, and gaps addressed by the programs and projects of the **Philippines** Biodiversity Assessment and Action Plan (PBAAP) for the forest and agriculture ecosystems (excerpted from the PBAAP 1997, TABLE 97)(legend follows).

Programs, projects, activities		**Problems addressed**		**Gaps Addressed**	
		Forest ecosystem	Agro-ecosystem	Forest ecosystem	Agro-ecosystem
Strategy I	Expanding and improving knowledge on the characteristics, uses and values of biological diversity				
I.A Biodiversity inventory programme					
Project I.A.1	Plant resource inventory	HD BP	HD BP	GK	GK
Project I.A. 2	Animal resource inventory	HD BP	HD BP	GK	GK
Project I.A. 4	Microbial resource inventory	HD BP CP	HD BP CP	GK	GK
Project I.A.5	Carrying capacity assessment of critical forest habitats and ecosystem	HD OE		GK	
Project I.A.8	Carrying capacity of major critical watersheds in the country	HD OE	HD OE	GK	GK
Project I.A.10	Interhabitat connectivity studies	HD OE CP	HD OE CP	GK	GK
Project I.A.11	Ecological and population studies of forest species	HD OE BP		GK	
I.B Ecosystem mapping and data validation programme					
Project I.B.1	Identification and mapping of biodiversity-rich areas not covered by NIPAS or declared protected areas	HD	HD	GK GM	GK GM
Project I.B.2	Detailed mapping of biodiversity-rich areas and proposed infrastructure development	HD	HD	GK GM	GK GM
Project I.B.4	Foundation GIS of biodiversity-rich areas using updated data	HD	HD	GK GM	GK GM
I.C Socio-economic studies programme					
Project I.C.1	Indigenous knowledge systems and practices on biodiversity conservation and sustainable development	OE WILC	OE WILC	GK GM GP	GK GM GP
Project I.C.2	Valuation and accounting of direct and indirect goods and services from biodiversity and bioresources	HD OE WILC	HD OE WILC	GK GM GP	GK GM GP

Programs, projects, activities		**Problems addressed**		**Gaps Addressed**	
		Forest ecosystem	Agro-ecosystem	Forest ecosystem	Agro-ecosystem
Project I.C.4	Integrate a biodiversity component to the population-development-environment framework of the **Philippine** population management programme	OE WILC	OE WILC	GK GM GP	GK GM GP
Project I.C.5	Development and institutionalisation of an ecologically-oriented and disaggregated population data	OE WILC	OE WILC	GK GM GP	GK GM GP

Programs, projects, activities		Problems addressed		Gaps Addressed	
		Forest ecosystem	Agro-ecosystem	Forest ecosystem	Agro-ecosystem
	base				
Strategy II.	Enhancing and integrating existing and planned biodiversity conservation efforts with emphasis on *in-situ* activities				
II. A *In-situ* conservation programme					
Project II.A.1	Rehabilitation of damaged critical habitats and ecosystems	HD OE BP	HD OE	GM	GM
Project II.A.3	Conservation of mother trees for seed and sapling production	HD OE BP			
Project II.A.4	Establishment of in-situ conservation centres of wild relatives		HD OE BP		GM
Project II.A.5	Establishment of on-farm agrobiodiversity conservation centres		HD OE		GM
Project II.A.6	Piloting of landscape-lifescape approach to watershed and biodiversity conservation and management	HD OE BP CP WILC	HD OE BP CP WILC	GM	GM
Project II.A.7	Development and piloting of management and utilisation systems for old growth and secondary tropical forests.	HD OE BP CP WILC		GM	
Project II.A.8	National ecotourism development plan	HD OE		GM	
Project II.A.9	Ecotourism as a tool for forest biodiversity conservation and management	HD OE BP CP		GM	
II.B *Ex-situ* conservation programme					
Project II.B.1	Recovery and reintroduction of rare and endangered species	HD OE BP	HD OE BP	GM	GM
Project II.B.2	Establishment of botanic gardens	HD OE BP	HD OE BP	GM	GM
Project II.B.3	Establishment of wildlife rescue and refuge centres	HD OE		GM	
Project II.B.4	Establishment of gene banks	HD OE BP	HD OE BP	GM	GM
Strategy III	Formulating an integrated policy and legislative framework for the conservation, sustainable use and equitable sharing of benefits of biological diversity				
Project III.1	Codification of laws related to biodiversity	WILC	WILC	GP	GP
Project III.2	Development of a realistic system of economic instruments such as: access fees, incentives and penalties for the utilisation of biological resources and biodiversity	HD OE BP CP WILC	HD OE BP CP WILC	GM GP	GM GP
Project III.3	Identification, delineation, and management of ancestral domain	HD OE BP CP WILC	HD OE BP CP WILC	GK GM GP	GK GM GP
Activity III.1	Policy advocacy	HD OE BP CP WILC	HD OE BP CP WILC	GM GP	GM GP
Activity III.2	Formulation of guidelines on land use planning and biodiversity conservation and integration thereof in the plans of concerned agencies	HD OE BP CP WILC	HD OE BP CP WILC	GM	GM
Strategy IV	Strengthening capacities for integrating and institutionalising				

Programs, projects, activities		Problems addressed		Gaps Addressed	
		Forest ecosystem	Agro-ecosystem	Forest ecosystem	Agro-ecosystem
	biodiversity conservation and management				
IV.A Institutional capacity programme					
Project IV.A.1	Creation of a **Philippine** biodiversity centre	WILC	WILC	GM	GM
Project IV.A.2	Establishment of an inter-agency advocacy group on population-biodiversity-environment	WILC	WILC	GM	GM
Project IV.A.3	Enhance the population-biodiversity-environment specification of the environmental impact assessment instrument	HD OE BP CP WILC	HD OE BP CP WILC	GM GP	GM GP
Activity IV.A.2	Expansion of the membership of the sub-committee on biodiversity of the **Philippine** Council for Sustainable Development	WILC	WILC	GM GP	GM GP

Programs, projects, activities		Problems addressed		Gaps Addressed	
		Forest ecosystem	Agro-ecosystem	Forest ecosystem	Agro-ecosystem
IV.B Human resources development					
Project IV.B.1	Development of capacity on biodiversity planning: I. Private sector stakeholders	WILC	WILC	GM	GM
Project IV.B.2	Development of capacity on biodiversity planning: II. Government decision makers	WILC	WILC	GM	GM
Project IV.B.3	Formation of a curriculum drafting committee	WILC	WILC	GK GM	GK GM
Strategy V	Mobilising an integrated information, education, and (IEC) system for biodiversity conservation				
V.A. Biodiversity conservation awareness and information programme for local communities					
Project V.A.1	Popularisation of educational materials on biodiversity conservation ethics and strategies	WILC	WILC	GM	GM
Project V.A.2	Support for the integrated IEC system implementation for biodiversity conservation	WILC	WILC	GM	GM
Project V.A.3	Community organising and biodiversity conservation training for local stakeholders	WILC	WILC	GM	GM
V.B. Community-based biodiversity conservation education and research programme					
Project V.B.1	Technical competency training on biodiversity research and management information system	WILC OE	WILC OE	GM	GM
Project V.B.2	Establishment of a pilot village biodiversity research and management information system	WILC	WILC	GM	GM
Project V.B.3	Community-based development and management for biodiversity	WILC	WILC	GM	GM

Programs, projects, activities		**Problems addressed**		**Gaps Addressed**	
		Forest ecosystem	Agro-ecosystem	Forest ecosystem	Agro-ecosystem
	education for local communities				
V.C. Value-added products and alternative sustainable livelihood development for bioresources-dependent communities					
Project V.C.1	Local capability building for development and management of livelihood enterprises	OE	OE	GM	GM
Strategy VI	Advocating stronger international cooperation on biodiversity management				
Project VI.1	Establishment of the ASEAN Regional Centre for Biodiversity Conservation	WILC	WILC	GM	GM

Legend:

Problems addressed:
HD - Habitat destruction
OE – Overexploitation

BP – Biological pollution
CP - Chemical pollution
WILC – Weak institutional and legal capacities

Gaps addressed:
GK – Gaps in knowledge
GM – Gaps in management

GP – Gaps in policy

Annexes

Annex 1. The Proposed India Biological Diversity Act, 1998: Important Provisions with Relevance to Agrobiodiversity (Source: Kothari 1999?)

The Government of **India**, in a follow-up action to the international Convention on Biological Diversity, has drafted a Biological Diversity Act. Set to go to Parliament by early 1999, the proposed Act aims to conserve biodiversity, achieve sustainable use of biological resources, and ensure equitable sharing of the benefits arising from such uses. Amongst its important provisions, with relevance to agro-biodiversity, are the following. It:

1. prohibits transfer of **Indian** genetic material outside the country, without specific approval of the **Indian** Government through a due process;
2. stipulates that anyone wanting to take a patent or other intellectual property right (IPR) over such material, or over related knowledge, will have to seek permission in advance;
3. provides for the levying of appropriate fees and royalties on such transfers and IPRs;
4. regulates access to such material by **Indian** national also, to ensure that there is some control over over-exploitation (e.g. of medicinal plants), and that there is some sharing of benefits to all concerned parties; however, it provides some relaxation in the case of research;
5. provides for measures to conserve and sustainably use biological resources, including habitat and species protection, conservation in gene banks, environmental impact assessments of all projects which could harm biodiversity, and so on;
6. empowers local communities to have a say in the use of resources and knowledge within their jurisdiction, and to enter into negotiations with parties who want to use these resources and knowledge;
7. provides for the development of an appropriate legislation or administrative steps, including registration, to protect indigenous and community knowledge;
8. empowers governments to declare Biodiversity Heritage Sites, as areas for special measures for conservation and sustainable use of biological resources, as also notify threatened species to control their collection and use;
9. stipulates that risks associated with biotechnology (including the use of genetically modified organisms), will be regulated or controlled through appropriate means;
10. provides for the designation of repositories of biological resources, at national and other levels.

The BDA envisages the creation of Funds at local, state, and national levels, which will be used to support conservation and benefit-sharing activities. These funds will be generated from fees, royalties, donations, etc. The BDA proposes to set up bodies at the national, state, and local levels, to carry out the above functions. Whether this Act will indeed help to protect agrobiodiversity and farmer community rights, only time will tell.