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AGRICULTURAL BIODIVERSITY IN LAO PDR



Photo: FAO/IFPRI Project

its importance and contribution to food security, sustainable livelihoods and nutrition

Human beings manage and depend on a diverse range of living resources for their survival. In agricultural ecosystems, the maintenance of biodiversity is important for the production of food, and to conserve the ecological foundations to sustain life, ensure food security and rural peoples' livelihoods.

Agricultural ecosystems are dynamic communities of living organisms managed by human beings to produce food, fuel, energy and other goods. They are constantly in evolution to adapt to variations in resources status, population dynamics, knowledge and technological advances, markets and trade, and the policy environment. In light of major global trends such as climate change, the role, functioning and resilience of agricultural biodiversity in ecosystems becomes increasingly important. An integrated and adaptive approach is needed to respond effectively to the pressures and demands inherent in a dynamic living system resilient to change. People and their cultural diversity are an integral part of agricultural ecosystems, and building on their local knowledge systems and social organization is indispensable for sustainable agricultural development.

Lao PDR is a biodiversity mega-diverse country, and one of Vavilov's "Centres of Origin" of domesticated plants. The people of Lao PDR make tremendous use of this biodiversity, particularly in the agriculture sector, which by far is the most important economic sector in the

country. Over 80 percent of the labour force is employed within the agriculture sector, which is largely subsistence agriculture that is characterized by low inputs and low outputs. In Lao PDR, a wide-range of wild plants and animals contribute significantly to day-to-day basic nutrition of both rural and urban residents.

Agricultural biodiversity in Lao PDR is considered a crucial resource for food security, sustainable livelihoods and adequate nutrition. While these resources have benefited the country for centuries, better use, improved development and enhanced conservation of agricultural biodiversity are required to meet both current and future demands for food, to decrease chronic malnutrition, and to reduce rural poverty.



Photo: FAO/B. Barten

What is agricultural biodiversity?

Agricultural biodiversity is the variety and variability of domestic and wild biological diversity of relevance for food and agriculture, at the genetic, species and ecosystem levels. It includes:

- 1) Plant, animal, microbial and fungal genetic resources.
- 2) Organisms that are necessary to sustain key functions of the agro-ecosystem, its structure and processes, such as pest and disease regulation, pollination and nutrient cycling, and their interactions.
- 3) Abiotic factors such as physical landscapes within which agriculture occurs.
- 4) Socio-economic and cultural dimensions such as traditional and local knowledge that shape agricultural biodiversity.

Adapted from the Convention on Biological Diversity (www.biodiv.org)

Who maintains agricultural biodiversity?

Farmers, pastoralists, fisher-folk and forest dwellers

Through wise farming practices.

Researchers

Through enhanced ecological knowledge and technology development.

Policy-makers

Through appropriate agro-environmental policies at local, regional and global levels.

Consumers

Through consumption choices that influence market demand for ecological and fair agricultural products, promoting sustainable agricultural practices.



Photo: NAFRI/A. Pheng/laysook

THE LAO PDR NATIONAL AGRICULTURAL BIODIVERSITY PROGRAMME

In December 2004, the Ministry of Agriculture and Forestry endorsed the Lao PDR “National Agricultural Biodiversity Programme” (NABP) as a policy document. The NABP was developed to act as the framework and long-term strategy for implementing a coordinated approach to better using, developing and conserving agricultural biodiversity. It was prepared to support two of the main development priorities for Lao PDR: to achieve food security and improve the livelihoods of the rural communities; and to enhance the Government’s capacity to ensure the sustainable use of natural resources. The NABP is consistent with, and was designed to be integrated with the implementation of the National Biodiversity Strategy (2020) and Action Plan (2010), the Government’s Strategic Vision for Agricultural Sector, and the National Growth and Poverty Eradication Strategy. It is also consistent with other national sustainable development strategies and plans.

The NABP is a structured policy framework which addresses the following thematic components:

- (i) Crop and Crop Associated Biodiversity;
- (ii) Livestock Development and Management;
- (iii) Non-Timber Forest Products and other Terrestrial Biodiversity;
- (iv) Sustainable Use and Conservation of Aquatic Biodiversity;
- (v) Household-based Integrated Agriculture Production Systems.

Two cross-sectoral components complete the framework of the NABP, to ensure its successful implementation:

- (vi) Management Arrangements; and
- (vii) Integrated Participatory Planning Approaches.

For each component, the NABP outlines a work plan, identifying intended outputs and activities that need to be undertaken in order to implement the NABP.

The National Agricultural Biodiversity Programme acts as a framework for action providing a long-term perspective for implementing a coordinated approach to improved management of agricultural biodiversity in Lao PDR.



Photo: NAFRI/A. Pheng/laysook



Photo: FAO/TA.Va



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THE INTERNATIONAL TREATY ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

A legally-binding Treaty, the International Treaty on Plant Genetic Resources for Food and Agriculture came into force on 29 June, 2004. The International Treaty covers all plant genetic resources relevant for food and agriculture.

Lao PDR acceded to the International Treaty on Plant Genetic Resources for Food and Agriculture on 14 March, 2006.

What are "plant genetic resources for food and agriculture" (PGRFA)?

The Treaty defines PGRFA as "any genetic material of plant origin of actual or potential value for food and agriculture".

What are the Treaty's objectives?

Its objectives are the conservation and sustainable use of plant genetic resources for food and agriculture and the fair and equitable sharing of benefits derived from their use, in harmony with the Convention on Biological Diversity, for sustainable agriculture and food security.

What is the Multilateral System for Access and Benefit-Sharing?

Through the Treaty, countries agree to establish an efficient, effective and transparent Multilateral System to facilitate access to plant genetic resources for food and agriculture, and to share the benefits in a fair and equitable way. The Multilateral System applies to over 64 major crops and forages. The Governing Body of the Treaty, which is composed of the countries that have ratified it, has set out the conditions for access and benefit-sharing in a "Standard Material Transfer Agreement".

What are the conditions for access in the Multilateral System?

Resources may be obtained from the Multilateral System for utilization and conservation in research, breeding and training. When a commercial product is developed using these resources, the Treaty provides for payment of an equitable share of the resulting monetary benefits, if this product may not be used without restriction by others for further research and breeding. If others may use it, payment is voluntary.

How does the Treaty protect Farmers' Rights?

The Treaty recognizes the enormous contribution that farmers and their communities have made and continue to make to the conservation and development of plant genetic resources. This is the basis for Farmers' Rights, which include the protection of traditional knowledge, and the right to participate equitably in benefit-sharing and in national decision-making about plant genetic resources. It gives governments the responsibility for implementing these rights.



Photo: FAO/B. Barten

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Who benefits from the Treaty and how? All benefit, in many ways:

- Present and future generations, because of increased food security;
- Farmers and their communities, through Farmers' Rights;
- Consumers, because of a greater variety of foods, and of agriculture products, as well as increased food security;
- The scientific community, through access to the plant genetic resources crucial for research and plant breeding;
- International Agricultural Research Centres, whose collections the Treaty puts on a safe and long-term legal footing;
- Both the public and private sectors, which are assured access to a wide range of genetic diversity for agricultural development; and
- The environment, and future generations, because the Treaty will help conserve the genetic diversity necessary to face unpredictable environmental changes, and future human needs.



Photo: FAO/B. Barten



Source: FAO

MAPPING GENETIC DIVERSITY

Even foods that have been part of a culture for centuries often are indigenous to a region on the other side of the world. This global dispersal shows the generosity with which farmers and farming communities have always shared and exchanged seeds and genetic materials with neighbors. As people ventured forth, looking for new lands, their seeds were part of their diasporas. As a result, we now live in a world in which not one country can be considered self sufficient in terms of being able to survive solely on crops indigenous within its borders. The Treaty facilitates the continued open exchange of food crops and their genetic materials.

<http://www.planttreaty.org>



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POLLINATION IN AGRICULTURE

THE IMPORTANCE OF POLLINATION FOR AGRICULTURE

Pollinators provide an essential ecosystem service to both natural and agricultural ecosystems. Growing evidences suggests that healthy pollination services are threatened in many parts of the world. Pollinators ensure reproduction, fruit set development and dispersal in the vast majority plants, both in agro-ecosystems and natural ecosystems. In turn, plants provide food and nesting resources for pollinators. Some pollinators such as bees also provide food and additional income for rural families, in the form of honey and other by-products – thus, declining pollinator populations impact on the sustainable livelihoods of rural families. A decline in pollinator populations also affects plant biodiversity. Native pollinator species may decrease when their nesting habitats are destroyed, when they find less wild flowering plants to forage on throughout their life cycle, and when they are impacted by injudicious use of pesticides.

At least one-third of the world's agricultural crops depend upon pollination provided by insects and other animals. As farm fields have become larger, and the use of agricultural chemicals increases, mounting evidence points to a potentially serious decline in pollinators. In Asia, the domesticated honeybee, *Apis mellifera* (and its several Asian relatives) have been utilized to provide managed pollination systems, but for many crops, honeybees are either not effective or are optimal pollinators. The process of securing effective pollinators to service agricultural fields is not always easy, and there is a renewed interest in ensuring pollination services through practices that support wild pollinators.

In response to these realizations, during the development of the National Agricultural Biodiversity Programme (NABP) - as part of the NABP thematic area of crop-associated biodiversity - the issue of conducting activities related to the conservation and sustainable use of pollinators was given priority. Government priorities for the activities on pollinators focused on fruits and vegetables of importance to Lao PDR. The documentation of local knowledge and building capacity was also seen as a priority.



Photo: FAO/D. Vandame



Photo: FAO/J. Vandame

POLLINATION MANAGEMENT AND BUILDING CAPACITY IN LAO PDR – A PRIORITY

In order to raise awareness on the issue of pollinators in Lao PDR – and more specifically, to build capacity and document knowledge on pollinators and pollination management for agricultural production, a series of activities were undertaken. After a first evaluation period, which took stock the level of understanding of ten participants and permitted the adaptation of curricular material to the needs of the national team, three set of curricular material were sent to the participants to permit them to master basic concepts of classification, flowering plants and pollinators. Participants studied the material and responded to questions, through a distance learning format.

The next step was the implementation of a series of field-based activities for collecting, identifying and mounting pollinators, and measuring their abundance, diversity and impact on the yield of three crops. Following field training sessions with an instructor, the national team continued to work on these measurements and compare data with the references collected in the literature. Information collected was used during a second stage to edit reference documents on the pollination of loofah, cucumber and jujube in the vicinity of Vientiane Capital (Lao PDR).

Through these activities on pollinators, awareness of the importance of pollination has been raised, and more importantly, technical officers at NAFRI have been trained in basic notions of pollination management. Recognizing the need for improved understanding of pollination management, today, these technical officers are equipped with the basic knowledge of how to train other technical officers, and to use this training to raise awareness, and develop pollinator management at the farm level, with farmers and extension agents.



Photo: FAO/J. Vandame



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Photo: FAO/B. Barten



Photo: NAFRI

FARMER ACCESS TO SEEDS AND THEIR CONTRIBUTION TO SUSTAINABLE RURAL LIVELIHOODS IN THE VIENTIANE PROVINCE OF LAO PDR

CHANGES IN LIVELIHOOD STRATEGIES

The growing economy in Lao PDR has resulted in an increasing demand for rice, vegetables and other products produced in the rural areas. This increasing demand spurred a new type of growth in which new market opportunities influence the orientation of farming systems and where new economic roles, outside the traditional crop production, are emerging in rural villages.

A case study on “Plant Genetic Resources Access and Utilization: Understanding and Contributing to Sustainable Livelihoods in Lao PDR”, carried out in the Vientiane province, showed that small scale rural farmers are combining their efforts in agriculture to produce both for their home consumption and for the market. They are increasingly shifting from mainly subsistence production to market-oriented farming and are including off-farm sources of income like services, small business enterprises, employment and seasonal labour wage labour in their livelihood strategies.

CHANGES IN LIVELIHOOD STRATEGIES DEMAND CHANGES IN SEED SYSTEMS

The case study showed that seeds are a vital component for farmers to pursue these emerging livelihood strategies. Outcomes of the case study also showed a gap between farmer needs and access to seeds. Examples that illustrate linkages between access to seeds and livelihood strategies are the following:

- Demands from consumers in city markets require farmers to look for crop varieties with new traits and quality standards of seeds that cannot be produced by and accessed in local seed systems.
- The growing importance of off-farm sources of income spur an increasing demand for rice varieties that are well adapted to local conditions and early ripening in order to save labor for other livelihood activities.
- Farmers need to rely on quality seed that is imported. These seeds are now external inputs

over which farmers have little control. Farmers reported that generally, seed supply is ad hoc, and the main source of vegetable seed is through the import from private sector companies, mainly from Thailand.

- The disadvantage of imported seed is that it is not well adapted to their agro-ecologic conditions, thereby increasing the risk of crop failure compared to local varieties.
- Increasing intensive market oriented farming leaves less resources available for the cultivation of local crop varieties; as a result the genetic base of crops cultivated under these intensive systems is becoming narrow.



Photo: FAO/B. Barten



Photo: FAO/T.A. Vu



Photo: FAO/T.A. Vu

With increasing market orientation also comes increased risks and vulnerabilities to external shocks and crises. A narrowing genetic base increases the risk of crop loss to natural shocks such as droughts, flooding, pests and diseases. The stronger dependence of farmers on market prices for their livelihoods increases the impacts of national and international economic crises at the village level. Price fluctuations are now related to other factors (including production activities and market demands in other provinces and/or neighboring countries, currency fluctuations, etc).



Photo: SEARICE



Photo: NARRI

STRENGTHEN SEED SYSTEMS TO IMPROVE LIVELIHOODS

Strengthening farmer access to seeds and local seed systems will be essential to improve income, maintain domestic food production and decrease risks and vulnerabilities of farmer livelihoods to external shocks and crises. Strengthened farmer access to seeds should be seen in the context of improved access to a larger amount and number varieties of higher quality seeds, at the time when farmers need them.

Efforts to strengthen access to seeds in the Vientiane province should focus on: (i) developing and releasing varieties with traits for market oriented production that are adapted to local agro-ecological conditions; (ii) increasing farmer involvement in variety development; (iii) increasing systematic mass production of good quality seed; and (iv) conserving the large diversity of local crop varieties and associated farmer knowledge.

In the Vientiane province, a contribution to strengthening farmer access to seeds was to organize two farmer training sessions on good quality vegetable seed production.



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AQUATIC BIODIVERSITY AND HUMAN NUTRITION - THE CONTRIBUTION OF RICE-BASED ECOSYSTEMS

AQUATIC BIODIVERSITY, RICE FIELDS AND FOOD SECURITY

The Lao PDR is a country with a rich aquatic biodiversity in its rivers, lakes and wetlands. This richness has always been tapped by humankind for food, barter and income, and numerous studies have shown its importance for the nutrition and livelihood of the Lao people.

Rice-based ecosystems, that is, rice fields and the small water bodies in their immediate neighborhood, have been less recognized as a source of aquatic animals for human nutrition and food security; they are usually seen as a source for rice only. However, rice fields form part of the intricate system of wetlands that can be found throughout the country, and therefore also harbor a highly diverse set of aquatic organisms. The catch from rice fields is usually modest and only sufficient for a single day. For this reason, the fish and other aquatic animals caught from rice-based ecosystems go largely unnoticed - making it an 'invisible' fishery. Nevertheless, since many people are involved in this type of fishery day after day, the total amount can be quite significant.

ASSESSING THE IMPORTANCE OF RICEFIELD FISHERIES IN LAO PDR

In realizing the need to 'make the invisible fishery visible', the Laotian Government gave priority to the assessment of the contribution of rice-based ecosystems to the nutrition of rural households. Through its Ministry of Agriculture and Forestry's (MAF) Living Aquatic Resources Research Center (LARReC) and with support from the FAO-Netherlands Partnership Programme (FNPP) it initiated a household survey in an attempt to create a suitable methodology to collect data on fish catch and consumption on a larger scale. A questionnaire was developed, field tested and improved, 240 households were selected in three provinces, and field staff of the Department of Livestock and Fishery (DLF), MAF, were trained to conduct interviews in a one-year pilot study. Since late 2006, the field staff have visited target households once every month to conduct interviews and learn about local indigenous knowledge and all information was subsequently submitted to

LARReC where data have been entered into a comprehensive data base developed for their analysis. Capacity building of the field staff was considered critically important, and several training workshops were held to create a sound understanding of the purpose and process of data collection. Also, LARReC staff received additional training for the handling of the data input process and the data base management.

To date, ten months worth of data have been analyzed to gain preliminary insights. The findings clearly stress the crucial importance of rice fields as a source of aquatic foods: More than 50% of the fish caught by households come from rice-based ecosystems. In other words, in the areas surveyed the majority of fish no longer comes from rivers, lakes and reservoirs, which reportedly was the case in the past.





This implies that the value of rice fields as a source for utilized aquatic animals has apparently increased, and the connectivity to other aquatic habitats as well as a healthy rice ecosystem are likely to be key determinants in this process. Furthermore, amphibian catches are very high; whilst fish amount to approximately half of the total household catch coming from all aquatic ecosystems, amphibians make up another third. This study established that ninety percent of the frogs consumed come from rice fields! The finding is of particular nutritional relevance since fish are often mentioned as the key source of protein for the Lao population, whereas the importance of other aquatic animals is much less acknowledged. Finally, rice fields are also important for a wide range of crab and snail species, also important to the Lao diet, and, to a lesser extent, aquatic insects. These results point to the incredible importance of rice fields and their associated habitats, not just as a source of rice, but as a source of animal protein, fatty acids, and essential minerals and vitamins.

VALUING NATURAL RESOURCES - IMPACTS ON AGRICULTURE, FISHERIES, NUTRITION AND ENVIRONMENT

No other study has revealed in such depth the importance of rice-based ecosystems as a fishery resource, and the potential impacts are numerous. Most immediate, its results are currently being fed into the process of reviewing the

fishery legislation in Lao PDR, and are expected to ensure that the importance of rice-based ecosystems as part of the overall fishery is adequately reflected in a new fisheries bill and related policies. Secondly, to date no systematic data collection on catch and consumption of fish and other utilized aquatic organisms from rice-based ecosystems exists. Current official production figures are rough estimates. Inaccurate figures however can become problematic and misleading when they are used as the basis for policy decisions. With new tools at hand, the Government is currently considering ways and means to address this shortcoming by considering how to make this newly developed methodology, which is inherently efficient and relatively cheap, part of regular official quality data collection.

Ultimately, it is expected that the systematic collection of reliable data on fish catch and consumption will allow an accurate valuation of natural resources, which in turn will have implications for policy decisions in the agriculture, fishery, nutrition and environment sectors. Particularly, the study is expected to inform and guide policy makers when decisions on the further development of rice production are to be made. The results show that the contribution of rice-based ecosystems to the nutrition of the Lao people is by no means limited to rice alone, and policy decisions on future development should take this into account.



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LIVESTOCK DIVERSITY IN LAO PDR

LIVESTOCK PRODUCTION IMPROVES RURAL LIVELIHOODS

Agriculture is the mainstay of the economy in Lao PDR, contributing 40.7 % of GDP¹ and employing more than 80% of the population. For the rural smallholders, who contribute most of the country's agricultural output, livestock keeping is often a vital source of cash income, a means to accumulate assets, and a provider of inputs to crop production (manure and draught power). Cattle, buffaloes, pigs, chickens and goats are the most important livestock species in the country. Demand for meat is increasing, and there is growing potential for exporting livestock and their products to neighbouring countries. The government has adopted a livestock development plan to strengthen and promote animal production and enhance national food security.

¹ Ministry of Planning and Investment, 2007

LIVESTOCK PRODUCTION IS CHANGING

Farmers raise animals predominantly by traditional methods, and output per animal is not high. The animals are mainly indigenous and are kept mostly under free range conditions; they graze on natural grasslands, in paddy fields after the harvest, on fallow land and in the forest. Feed resources are inadequate, and diseases and parasites are serious constraints. The free range system means that there is often no selection of breeding animals. Livestock support services, research and extension, marketing networks, transport and communication links, and access to inputs and credit all need to be improved.

Despite the continued dominance of smallholder production, the country's livestock production systems are changing. In lowland areas, crop

production is being intensified and there is increased use of mechanized power. This restricts the grazing land available for cattle and buffaloes, and limits their importance as draught animals. In the cities, commercial pig and poultry enterprises are emerging in response to rising demand, and one commercial dairy cattle farm has been established. Lao PDR has a comparative advantage in large ruminant production over neighbouring countries, with scope for further development of cattle, buffalo and goat production in the uplands. Growing demand for goat meat has resulted in quite a rapid increase in the national goat population (around 8 percent per annum) over the last 20 years, the animals largely being kept by smallholders in mountainous areas. More recently, some districts have seen a huge boom in goat numbers, with the population rising tenfold within a period of six years.

These trends place new demands on the country's livestock populations and on the agro-ecosystems of which they are a part. It is vital to ensure that the resources that underpin animal production and the wider farming system are maintained and developed sustainably so that they provide ongoing livelihood opportunities for local people and remain available for the future. The management of livestock genetic diversity is one important element of this approach.



Photos: MAFF/VA Phengvilaysouk

Photo: IFAD/ J.Holmes

Photo: IFAD/R.Grossman



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Photos: MAFRI/A. Phengvilaysouk

AUTOCHTHONOUS LIVESTOCK DIVERSITY IS AN ASSET

At present, local livestock breeds provide most of the country's animal products. Exotic animals are utilized by urban commercial pig and poultry producers and some exotic cattle breeds have been introduced. However, attempts to introduce exotic breeds among smallholders have had little success, principally due to a lack of good quality feed and high levels of disease and parasite challenge. Cross-breeding involving exotic cattle has shown success on the research station, but resources to spread cross-breeding schemes more widely have been limited. Indigenous breeds currently provide by far the largest share of the country's animal products. They are well adapted to local conditions, and there is potential to improve their productivity through selective breeding. The Northern Cattle Station has worked in cooperation with local farmers to improve local cattle by selecting the best bulls for mating. However, such activities have had little impact on the livestock population as a whole.

WHAT IS REQUIRED TO IMPROVE LIVESTOCK PRODUCTIVITY?

Accurate information on breed characteristics is a key requirement for planning improved management. Improved inventory and characterization is identified by the Country report for animal genetic resources management in the Lao PDR as a critical area for improvement. Much remains to be done to improve knowledge of local animal genetic resources. For example, indigenous poultry – chickens, ducks, geese, and turkeys – are yet to be studied systematically. Pigs have been the subject of a country-wide characterization programme, which identified four types of indigenous pig, but further work on breed identification and genetic analysis is required.

Other potential developments identified in the Country Report include community-based breeding programmes, better strategies for the transfer of improved genetic resources to farmers, and the introduction of animal identification and recording schemes. However, it is also recognized that if measures of this type are to succeed, parallel improvements in management, nutrition and animal health care are required.

HOW TO IMPROVE GOAT PRODUCTIVITY – LESSONS LEARNED FROM CHOMPET AND PAK OU DISTRICTS, LUANGPRABANG PROVINCE

Participatory rural appraisals conducted in Chompet and Pak Ou districts, Luangprabang province identified diseases and parasites as among the key constraints faced by local goat keepers. Goat keepers also mentioned damage to crops, and soil degradation/low fertility as priority concerns. This illustrates that livestock development efforts have to take account of interactions between animal and crop production and consider the impacts of livestock keeping on the wider ecosystem. To address these concerns, initial activities included the provision of de-worming treatment for local goats, planting Guinea grass and *Stylosanthes 184* as forage crops, and providing training for the goat keepers. Further efforts are needed to complement these activities by identifying achievable strategies for genetic improvement in the local goats. A curriculum for goat production was produced, that could be utilized as a standard tool to train farmers countrywide to improve their skills in goat production and ultimately their livelihoods.



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ENHANCING FOOD SECURITY THROUGH SUSTAINABLE MANAGEMENT PLAN FOR NON-WOOD FOREST PRODUCTS

Non-Wood Forest Products (NWFPs) play an important role for Lao people's daily livelihoods, especially in rural areas. They are used for food, medicines, provide a source of income and have many other uses. NWFPs are estimated to make up over 40 percent of total rural income in Lao PDR, and they play a central role in maintaining food security .

Recent field surveys revealed the high proportion and variety of gathered forest products of importance to the daily diet of rural Lao families. In upland and arid areas, for example, rural people have limited access to paddy fields or fertile land, and hence directly depend upon NWFPs. In Lao PDR, NWFPs such as various species of wild tubers are considered "safety nets", acting as buffers during seasonal and emergency food shortages. Fish from forest streams play a critical role in food security and nutritional diversity – a major source of protein, fish accounts for as much as 70-90% of protein intake in lowland areas of Lao PDR².

On average, it has been estimated that forest foods provide 11% of the total value of food consumption during dry season, and up to 19% in the wet season. In poorer families, NWFPs can account for over 50% of the diet, especially when tubers, roots and

bamboo shoots replace rice. Over 450 of edible NWFP have been recorded so far, and include edible shoots and other vegetables, fruits, tubers, mushrooms, small water animals and wildlife. The diversity of NWFP consumed reflects the rich agricultural biodiversity of the rural landscape in Lao PDR.

The priority threats to natural forests in Lao PDR are unsustainable forest management (including NWFPs) and forest conversion for agriculture and tree plantations. Root causes are increasing regional and global market demand for wood, forest products, and cash crops, in combination with weak



Photo: NAFRI/V. Vongkhamkao

NWFPs are products of biological origin other than wood derived from forests, other wooded land and trees outside forests. NWFPs may be gathered from the wild, or produced in forest plantations, agroforestry schemes and from trees outside forests.

institutional capacity to implement relevant policies and legislation. Short-term economic benefit from plantations (rubber, eucalyptus, etc) is leading community and authorities to convert forested area without undertaking environmental impact assessment that considers the recognition of the potential of forest ecosystems to support local and national economic development.

The National Agricultural Biodiversity Programme recognizes the importance of the NWFP resources to food security as well as poverty alleviation and includes it as one of the five thematic components.

The National Agriculture and Forestry Research Institute (NAFRI) has been involved in improving understanding of existing NWFPs relevant to food security and sustainable livelihoods, and of human management of economic markets for NWFP contributing to food security and sustainable livelihoods. Sustainable and profitable participatory management (harvesting, processing, marketing, domestication and cultivation) of NWFPs at pilot project field sites (both sedentary and rotational cultivation) have also been demonstrated.

1 Lao PDR National Agricultural Biodiversity Programme
 2 Non Timber Forest Prorest Products in the Lao PDR.
 3 A manual of 100 commercial and traditional products (2007)
 3 *ibid*



Photo: NARFI/V. Vongkhammasao



Photo: NARFI/V. Vongkhammasao

As an example, in Savannakhet, activities were undertaken in five pilot villages to (i) demonstrate to policy makers and villagers the importance of NWFP biodiversity and its importance for food security as well as poverty alleviation, and the need to integrate the NWFP into forest management plan to ensure the long term access to food for the rural community; and (ii) demonstrate to the policy makers and provincial and district staff the usefulness of the Market Analysis and Development (MA&D) approach aiming at increased income generation based on NWFP while conserving the resource base.

Some of the outcomes of these activities have been:

- Capacity building of farmers and district authorities on forest and sustainable NWFP management and domestication, and on the MA&D approach for increased income generation;
- Case study on the impact of rubber plantation to the forest ecosystem and livelihood;
- Establishment of NWFP Marketing groups and NWFP markets along the road;
- NWFP Plantations and NWFP Management Plan;
- Fish production techniques; and
- Nutrition study on role of NWFP in diet of communities; networking with authorities and other organizations.

Furthermore, a result of these activities has been to bring to the forefront the importance of NWFPs to the livelihoods of rural peoples, as well as the value of NWFPs for the forest ecosystem. Results of the field experience confirmed the importance of NWFPs as source of food, quantitatively and qualitatively, as well as source of local medicine and cash. The case study on natural forest conversion to rubber plantation demonstrated that loss of NWFPs can have a negative economic, social and cultural impact to the local community.



Photo: NARFI/V. Vongkhammasao



Photo: NARFI/V. Vongkhammasao



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00153 Rome - Italy

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Photo: A.O.E. Guymardes

CONSERVATION AND SUSTAINABLE UTILIZATION OF PLANT GENETIC RESOURCES

INTRODUCTION

Plant genetic resources are deeply rooted in our culture and economy. Their wide diversity, still present in the country, needs to be preserved and wisely managed. In fact, it represents an immense treasure for the development of our society, in particular agriculture, the principal economic sector accounting for about half of the total Gross Domestic Product

and employing more than 80% of the national labour force.

As part of the component on plant genetic resources for food and agriculture (PGRFA) under the Agricultural Biodiversity Project, funded by the FAO - Netherlands Partnership Programme, the following activities have been implemented during 2006 and 2007:

- A *National Information Sharing Mechanism on PGRFA (NISM)* was established in 2006. It consists of a network of five research centres from the National Agriculture and Forestry Research Institute (NAFRI) which conserve and/or use plant genetic resources. Through this Mechanism, participating institutions are given an opportunity to (a) increase understanding about the status and dynamics of PGRFA, (b) contribute to decision-making processes, (c) strengthen partnerships and (d) widen their visibility at national and international levels. The Mechanism relies on a database, built by participating institutions, addressing *in situ* and *ex situ* conservation, as well as utilization of PGRFA, and a web portal. (see Figure 1 and <http://www.pgrfa.org/gpa/lao>).

- A *National Plant Breeding and Biotechnology Capacity Assessment* was carried out in 2007. Results from this assessment were analyzed and discussed by a composite team from national agricultural research institutions. Collected data together with the final report are published in a dedicated website within the framework of the Global Partnership Initiative for Plant Breeding Capacity Building (GIPB) (see <http://waicent.fao.org/test/agricult/agp/agpc/Nordat/>).

- A *Country Report on the State of Plant Genetic Resources for Food and Agriculture*, based on the information available under the NISM and through the National Plant Breeding and Biotechnology Capacity Assessment, was prepared in 2007. It will be submitted to the FAO Commission on Genetic Resources for Food and Agriculture as the Lao PDR contribution to the preparation of the *Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture*.

Findings, as well as priorities and recommendations, which resulted from these participatory processes are hereunder summarized.



Photo: R. Grossman

CONSERVATION

Since the early 1990s, the changing socio-economic situation has increasingly put pressure on plant genetic resources, in some cases leading to a severe loss of their diversity. For this reason, most vulnerable areas at risk of genetic erosion have been demarcated and protected by forest law and regulations. However, law enforcement in most of the protected areas has not been as effective as expected. Therefore some improvements in this regard urgently need to be considered. This particularly applies to the *in situ* conservation of wild species from the forest and wetland ecosystems, including wild vegetables and fruits, which play an important role for rural people in terms of food security, both quantitatively and nutritionally. It is also urgent to make provisions for the preservation of the indigenous knowledge associated with the culinary and medicinal use of wild species, a knowledge that is being lost due to urbanization and lifestyle changes of younger generations. Likewise, it is necessary to assist the on-farm management of traditional landraces, which bear adaptive traits essential for crop improvement programmes, and complement it with an adequate *ex situ* conservation strategy of these resources.

During the past 12 years NAFRI's Naphok Agricultural Research Center (ARC) and Haddokkeo Horticulture Research Centre (HRC), in collaboration with international organizations, have carried out systematic PGRFA surveys and collecting missions targeting mainly rice, whose primary centre of origin includes our country, and vegetable crops. Additional sporadic surveys have been conducted for maize, cassava, sweet potato and sugarcane, as well as species for non-wood forest products and medicinal plants. Surveyed materials have also been collected and conserved *ex situ* in medium term storage facilities set up in our country. These account for about 15,000 traditional cultivars/landraces and wild accessions, rice being the biggest collection with more than 13,000 samples conserved at ARC, followed by the vegetable collection, which consists more than 2,130 landraces held at HRC. The rice collection represents one of the largest collections of glutinous rice, worldwide. During the past years despite serious measures taken by the genebank for the



Figure 1. The portal of the National Information Sharing Mechanism on PGRFA (<http://www.pgrfa.org/gpa/lao/laowelcome.html>).

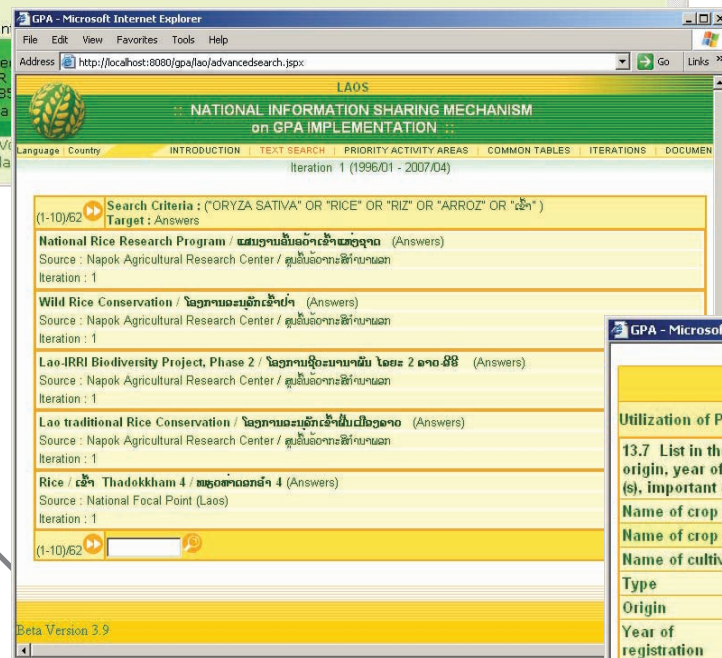


Figure 3. Results from the search for "rice" in the NISM database: 62 hits are found.

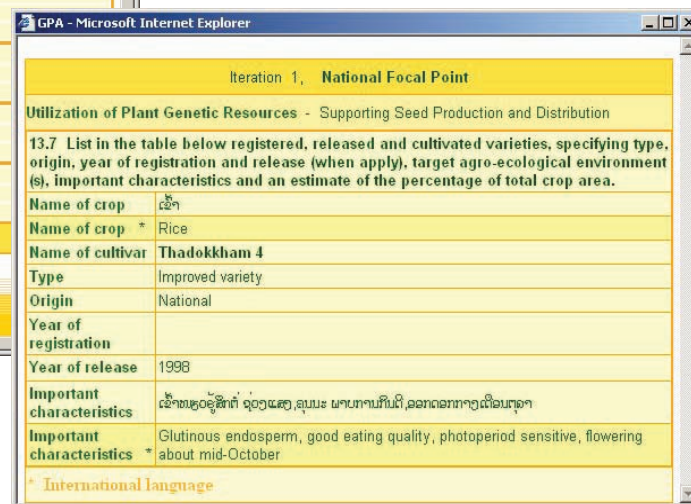


Figure 4. "Thadokkham 4", one of the results of the search, is displayed.

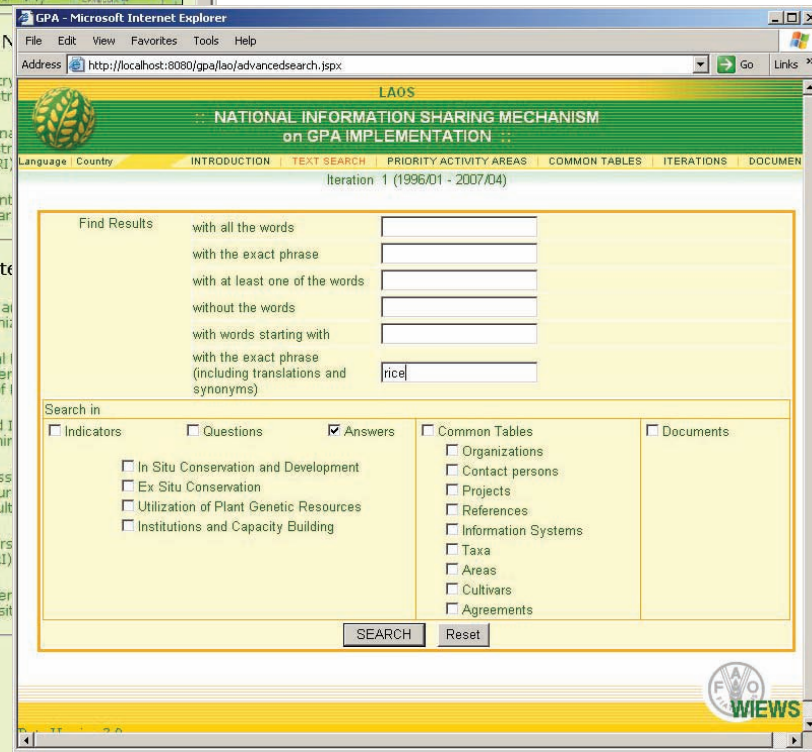


Figure 2. Searching for "rice" in the NISM database through its Google-like text-search window.

proper management of this collection, some losses due to electrical power failure had occurred. In order to reduce risks of further losses of materials of this unique rice collection, the entire collection was duplicated and put in long-term storage at the International Rice Research Institute (IRRI), as per an agreement signed by the Ministry of Agriculture and Forestry and this institute.

Both *in situ* and *ex situ* conservation policies of plant genetic resources in the country have made important achievements in the past twelve years. However an integrated strategy for PGRFA conservation and management has not yet been fully developed and implemented. Insufficient human and financial resources are among the main constraints that prevent the National Programme from adequately dealing with the increasing needs of communities that depend on these resources.

UTILIZATION

The national policy for PGRFA aims to establish sustainable food security systems and to alleviate poverty in the rural sector, while protecting the diversity of plant genetic resources. Rice is the most important agricultural product of the country. With the significant contribution of national and international germplasm, substantial progress has been made in increasing the productivity of rice during the past decade. However, to meet the internal demand in 2010, rice production should increase up to 3.2 million tonnes, almost 1.0 million tonnes more than currently produced. Crop improvement is therefore a high priority of the rice industry. Traditional breeding can still play a major role in rice improvement. The genebank's rice collection is an important source of traits for stabilizing yield under low input management where modern varieties do not achieve high yields. Recent genetic evaluation programmes with landraces have shown positive results on drought adaptation and high yielding in aromatic rice. The country has also benefited from collaborative efforts with international programmes. The introduction of genetic material from breeding programmes of IRRI, Thailand-IRRI and the Australian Center for International Agricultural Research (ACIAR) has contributed to significant increases in rice yield over the last 10 years.

Corn varieties with high and low waxy endosperm have been identified following evaluation trials of the collection at ARC. The existing corn improvement programme aims to improve yield and agronomic characters of non-waxy varieties for use in animal feed. Currently, a selection programme is being implemented by ARC for non-waxy germplasm. ARC is receiving a corn population (F_1) from the International Maize and Wheat Improvement Center (CIMMYT) and a cassava population (F_2) from the International Center for Tropical Agriculture (CIAT) for the development of new corn and cassava varieties. ARC also implemented a soybean breeding programme in which several crosses were made with locally available material and introductions. The vegetable seed development programme at the HRC mainly concentrates on leafy vegetables as well as eggplant, chilli, tomato and others. The pure line selection programmes for wet and dry season vegetables are highly successful. Descriptors from the Asian Vegetable Development Research Center (AVDRC) are usually applied for the selection of materials.

As a result of the emphasis placed on PGRFA utilization, the number of scientists from NAFRI involved in plant breeding activities almost doubled in the last decade. Their educational level also showed a significant improvement (Table 1). However, this overall capacity appears insufficient for a country with diverse agro-ecological conditions, high indigenous crop genetic diversity and an agricultural sector so important for the economy and livelihoods. There is an urgent need to invest in capacity building, to increase the number of scientists involved in plant breeding activities and to improve their educational level.

Table 1. Number of scientists involved in plant breeding activities at NAFRI during 1995-2007.

	1995	2000	2007
BSc	3	4	4
MSc	5	7	9
PhD	-	1	2
Total	8	12	15

Since 1995, mostly rice benefited from some genetic improvement activities although the amount of resources devoted to plant breeding has been in general too limited. Investments in other highly important crops such as vegetables have been insufficient. Consequently, farmers' demand for

improved varieties has not been adequately met and the most widespread cultivars remain the traditional ones.

Two biotechnology laboratories on tissue culture were established in 1998 and 1999 at ARC and the Sciences Technology and Environment Agency (STEA), respectively. They mainly produce disease-free bananas, potatoes, and orchids.

Part of the success of the agriculture in the country is due to the contribution of the plant breeding programmes of ARC and their partnership with regional/international endeavours. The supply of varieties has been expanded with the release of new varieties. However, the number of improved varieties is still very limited and they are not available for all crops important for our agricultural economy. There is an increasing demand for new varieties for different crops which has to be urgently met.

PRIORITIES AND RECOMMENDATIONS

The Government has expressed through different policy documents that conservation and utilization of plant genetic diversity is highly important to improve food security, alleviate poverty, and promote rural development. Based on the results and discussions under this Project the following priorities and recommendations have been agreed.

- Existing regulations for protecting plant diversity have to be applied and enforced properly. This may require neighbouring countries' collaboration when resources are taken from protected areas close to national borders. An awareness raising campaign on the need to preserve plant genetic resources and the benefits derived from their sustainable management could also be conducted among farmers' communities living within or near forest areas.
- Surveying and inventorying of crop intra-specific diversity and wild species of vegetables, fruits, forages and medicinal plants need to be systematically and comprehensively carried out to better cover existing diversity of PGRFA and fill in gaps in ex situ collections.
- Ex situ conservation is a central element of the national conservation and utilization strategy. Existing facilities should be upgraded to provide for long term conservation of plant genetic resources' collections. Regeneration protocols should be applied following international standards.
- Documentation and information management are liaison elements between conservation and utilization activities. Information systems currently in use do not meet the requirements for efficient PGRFA management. Strengthening of the established National Information Sharing Mechanism on PGRFA and the adoption of a crop-independent, accession-level genebank information management system would help to improve ex situ conservation and facilitate genetic improvement efforts.



Photo: R. Grossman

- To meet the growing food demand in the coming years, the agricultural sector will have to significantly evolve towards an intensification and diversification of existing cropping systems. The introduction and development of improved varieties and the availability of quality planting materials will be essential for pursuing these objectives. Therefore, adequate provisions of resources for breeding, evaluation and multiplication programmes will have to be ensured.
- Overall the National PGRFA Programme suffers from an acute shortage of trained staff in PGRFA conservation and use. This shortage extends from taxonomists to breeders, and from information technologists to socio economists. Although there are staff engaged in postgraduate programmes overseas, their number still appears too limited to meet the country's demand for expertise in PGRFA management. There is an urgent need to invest in capacity building, to increase the number of scientists involved in conservation and utilization activities and to improve their educational level.
- In March 2006, the country became a Party to the International Treaty on PGRFA, a multilateral agreement to promote PGRFA conservation, access and utilization, as well as the equitable sharing of benefits derived from their use. Opportunities disclosed by the implementation of the International Treaty on PGRFA need to be taken promptly. In this regard a task force could be established to guide the implementation of the Treaty in the country and to foster collaboration with national programmes of neighbouring countries, regional and international research centers, as well as participation in PGRFA networks.



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Photo: FAO/P. Bannungrach



Photo: FAO/J. Vandame

ENVIRONMENTAL IMPACT ASSESSMENT: INTEGRATING AGRICULTURAL BIODIVERSITY

Environmental Impact Assessment (EIA) is a widely used tool to evaluate the potential impact of any given activity on the environment. In particular, this refers to the impact of development projects or programmes, including investment projects. The potential environmental impacts of projects/programmes can be numerous and affect different aspects of the environment, such as soil erosion or water quality – but also biodiversity that is important for food and agriculture.

In Lao PDR, the conservation and sustainable use of agricultural biodiversity in the short and long term, for national socio-economic development as well as for food security, nutrition and livelihoods, is important – hence, protecting agricultural biodiversity from the potential impact of development projects/programmes is a priority for Lao PDR. Integrating agricultural biodiversity considerations into EIA is a specific activity in the Lao PDR National Agricultural Biodiversity Programme.

The Ministry of Agriculture and Forestry (MAF) identified the need to develop technical guidelines which specifically address agricultural biodiversity – a process which fits with a request from the Science, Technology and Environment Agency to line ministries to develop technical guidelines, as part of the national process to develop a

Decree on Environmental Impact Assessment for Lao PDR.

Agriculture, fishery, forestry, irrigation and livestock are the most relevant project types of MAF that address components of biological diversity of relevance to food and agriculture. These components are sources of basic needs, food and income for the Lao rural poor, and therefore, their conservation and sustainable use (including for improvement), are very important. When considering the potential impacts of development projects/programmes on the environment, agricultural biodiversity considerations are crucial as they represent not only biodiversity that provide food security to populations, but also provide essential ecosystem services that contribute to regulating ecosystem functions as well as providing ecosystem resilience. Sector-specific and step-by-step technical guidelines were developed to allow project proponents to include, in their targeted environmental assessments, the agricultural biodiversity aspect of the entire environment.

To further assist the development of projects in Lao PDR while ensuring that environmental requirements are incorporated into development projects, it is necessary to conduct an Initial Environmental Examination (IEE) or Environmental Impact Assessment (EIA) with its Environmental Management Plan (EMP), which will take into account the impacts of development projects on the environment as well as mitigation measures to contrast potential negative effects on the environment. Other tools are Technical Guidelines, which serve to advise project owners on reporting on the status of their projects, as well as to lead project owners to conduct additional studies, if there is such a requirement from the approving agency prior to certifying the projects. These technical guidelines also assist in monitoring and evaluating projects.



Photo: NAFRI/V. Vongkhamso

The technical guidelines prepared by NAFRI serve the Ministry of Agriculture and Forestry two purposes:

1. To undertake EIA for projects of MAF sectors of competence
2. To provide technical advice to all other sectors/proponents on how to integrate agricultural biodiversity considerations into their EIA

When undertaking any environmental assessment, some basic questions need to be asked first, to ensure that agricultural biodiversity considerations are addressed at the genetic, species and ecosystem levels. These questions address the level of diversity, and the questions of both the conservation and the sustainable use of agricultural biodiversity. Indicative sector-specific questions were developed for: crop and crop-associated biodiversity, livestock development and management, sustainable use and conservation of aquatic biodiversity, and non-timber forest products and other terrestrial biodiversity.

With regards to Environmental Management Plans, although specific mitigation measures would need to be developed for each project, based on the project specificities, some “general” mitigation measures which apply to all components of agricultural biodiversity (crops, crop wild relatives, crop-associated biodiversity, livestock, aquatic biodiversity and NWFP and other terrestrial biodiversity) could include:

- Use, to the best extent possible, indigenous species
- Conserve genetic resources ex-situ
- Avoid deforestation in slope landscapes
- Consider issues related to downstream impact (such as pollution, siltation, erosion, lowered water tables, and so forth)
- Use sustainable agricultural practices
- Use integrated pest management (IPM) to deal with pest problems (this is especially relevant for crop production and fish-rice based farming systems)



Photo: FAO/J. Vandame



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