PROJECT EXECUTIVE SUMMARY

GEF COUNCIL SUBMISSION

AGENCY'S PROJECT ID:
GEFSEC PROJECT ID: 3037
COUNTRY: China, Ecuador, Morocco and Uganda
PROJECT TITLE: Conservation and Use of Crop Genetic Diversity to Control Pests and Diseases in Support of Sustainable Agriculture – Phase I
GEF AGENCY: UNEP
OTHER EXECUTING AGENCY(IES): Yunnan Agricultural University, Kunming, Yunnan, China; Instituto Nacional Autónomo de Investigaciones Agropecuarias (INIAP), Quito, Ecuador; Institut Agronomique et Vétérinaire (IAV) Hassan II, Rabat, Morocco ; National Agricultural Research Organisation, Entebbe, Uganda; International Plant Genetic Resources Institute (IPGRI), Rome, Italy
DURATION: 2 years
GEF FOCAL AREA: Biodiversity
GEF OPERATIONAL PROGRAM: OP 13
GEF STRATEGIC PRIORITY: BD-2, BD-4
Pipeline Entry Date: 13 June 2003
ESTIMATED STARTING DATE: 1 September 2006
IA FEE: 9%

FINANCING PLAN (US$)	
GEF PROJECT/COMPONENT	
Project – **Phase I**	3,411,148
PDF A	N/A
PDF B	350,000
PDF C	N/A
Sub-Total GEF	3,761,148
CO-FINANCING*	
Project - **Phase I**	
Government	2,215,203
IPGRI-Bilateral	772,167
SDC	750,000
Others	536,974
PDF B	
Government	135,000
IPGRI-Bilateral	235,000
Sub-Total Co-financing:	4,644,344
Total Project Financing:	8,405,492
FINANCING FOR ASSOCIATED ACTIVITIES IF ANY: N.A	
LEVERAGED RESOURCES IF ANY: N.A	

*Details provided under the Financial Modality and Cost Effectiveness section

CONTRIBUTION TO KEY INDICATORS OF THE BUSINESS PLAN:

- At least 356,000 ha of land contribute to the conservation and sustainable use of crop genetic diversity in respect to minimizing pest and disease damage.
- 10% of the families from 31 local and indigenous communities show increased and more reliable food supply through the use of crop genetic diversity to minimize crop loss.

RECORD OF ENDORSEMENT ON BEHALF OF THE GOVERNMENT(S):

Mr. Wu Jiankang — Date: 01 September 2005
Director, IFI Division IV, International Department, Ministry of Finance
Beijing, China

Mrs. Ab. Anita Alban Mora — Date: 09 August 2005
Minister of Environment
Quito-Ecuador

Mr. Abdelfattah Sahibi — Date: 16 August 2005
Chef de la Division de la Planification au Secrétariat d'Etat chargé de l'Environnement, Ministère de l'Aménagement du Territoire, de l'Eau et de l'Environnement
Rabat, Morocco

Mr. Keith Mukakanizi — Date: 05 August 2005
Date of Endorsement:
Ministry of Finance, Planning and Economic Development
Kampala, Uganda

Approved on behalf of the United Nations Environmental Program. This proposal has been prepared in accordance with GEF policies and procedures and meets the standards of the GEF Project Review Criteria for work programme inclusion

IA Coordinator
Olivier Deleuze
Officer-in-Charge
Division of Global Environment Facility Coordination
United Nations Environment Programme
PO Box 30552 - 00100
Nairobi, Kenya

Date: 2 May 2006

Project Contact Person:
Marieta Sakalian
Project Management Officer/Biodiversity
United Nations Environment Program
Division of GEF Coordination
PO Box 30552
Nairobi, Kenya
Tel. and email: (254 20) 762 4352

Marieta.Sakalian@unep.org

1. PROJECT SUMMARY

a) Project rational, objectives, outcomes, and activities

The potential negative consequences of planting large areas to single crop cultivars with uniform resistance to pests or diseases were recognized as early as the 1930s. The resulting economic and food resources costs from this loss are a major consequence of the continuing evolution of pests and pathogens able to overcome resistant genes introduced by modern breeding. Breeding programmes are in place to develop new varieties and to replace varieties that have lost their resistance, however, the maintenance cost of the current system is estimated to be very high and is leading erosion of the traditional crop diversity. Small-scale farmers in developing countries continue to depend on genetic diversity to maintain sustainable production and meet their livelihood needs. Loss of genetic choices, reflected as loss of local crops cultivars, therefore, diminishes farmers' capacities to cope with changes in pest and disease infection, and leads to yield instability and loss. Local cultivars are a primary source for the new resistant germplasm.

Pesticides consumption is in increasing all over the world, leading to serious harmful impact on human and environmental health, including the associated crop biodiversity. Integrated pest management (IPM) strategies, which have focused on using agronomic management techniques to reduce pesticide use, but concentrate on modifying the environment around predominantly modern cultivars, and have tended to exclude the potential of using within-crop diversity, for example, through genetic mixtures (crop variety mixtures) or the planned deployment of different varieties in the same production environment. A diverse genetic basis of resistance (e.g., crop variety mixtures) is beneficial for the farmer because it allows a more stable management of pest and disease pressure, than a monoculture allows. This is because when resistance in a monoculture breaks down the whole population succumbs, while in a genetically diverse field it is much less likely that different types of resistance will all break down in the same place for comparable pest or disease damage.

The six project target crops, rice (*Oryza sativa*), maize (*Zea mays*), barley (*Hordeum vulgare*), common bean (*Phaseolus vulgaris*), faba bean (*Vicia faba*), banana and plantain (*Musa* spp.), are major nutritional staples for large segments of the developing world and their yield stabilities are important factors in food security. The crops represent different breeding systems (cross-pollinated, partially outcrossing, self-pollinated, clonal), as differences between varieties would be expected to be less prominent in cross-pollinated crops than in self-pollinated ones. Banana and plantain, as a result of their sterility, have followed a clonal crop improvement strategy, with farmers doing most of the selection breeding. In addition, the life cycles of major pest and disease that affect these crops are well studied. Criteria for crop, pest and pathogen selection is listed in Annex H.

Each of the four countries, China, Ecuador, Morocco and Uganda, which developed this initiative and jointly selected these target crops, contain areas of important crop genetic diversity for the selected crops, including different types of resistance to major pests and pathogens in the countries' local crop cultivars maintained in traditional farming systems. Rice is an important food staple for China, high diversity of rice continues to exist in China and current host resistance from modern varieties remains effective in China for only a few seasons. Maize is important for food security in Ecuador and the south western highlands of China, both countries contain centres of diversity of the crop. Barley is the fifth largest cultivated cereal crop in the world with centres of diversity in both Morocco and China. Common bean, has its primary centre of diversity in the Andean Highlands (Ecuador) and is also the most important protein source for the people in

Uganda, where it is a secondary centre of diversity. Faba bean has a postulated centre of origin in Morocco, and secondary centres of diversity in Ecuador and China. *Musa* (bananas and plantains) is one of the most important food crop in the third world and Uganda is the leading consumer of bananas in the world, where the crop occupies 30-40% of all land under crops. Plantains are also an important stable of coastal Ecuador, where diversity in respect to pest and disease pressures exists. Detailed descriptions by country of target crop coverage, crop genetic diversity, and pest and diseases incidence, are found in Annex I.

As people move around the globe with genetic resources, so does resistant and virulent germplasm. Resistance genes evolve in response to new pathogens and pest, as well as there being remnants of resistance from old diseases in other regions. This phenomenon has resulted in the occurrence of resistance outside the primary centre of diversity, such as the development of resistance to chocolate spot in faba bean (*Vicia faba*) in the South American Andes although the crops primary centre of diversity is the Fertile Crescent. Each of the four countries has at least two of their target crops in common with one of the other countries, linking diversity of primary centres of diversity to secondary centres of diversity.

The *development objective* of this project is to conserve crop genetic diversity in ways that increase food security and improve ecosystem health. The *immediate objective* of the project is to enhanced conservation and use of crop genetic diversity by farmers, farmer communities, and local and national institutions to minimize pest and disease damage on-farm. The project has three anticipated outcomes: *Outcome 1:* Rural populations in the project sites benefit from reduced crop vulnerability to pest and disease attacks; *Outcome 2:* Increased genetic diversity of target crops in respect to pest and disease management; *Outcome 3*: Increased capacity and leadership abilities of farmers, local communities, and other stakeholders to make diversity rich decisions in respect to pest and disease management.

To achieve these outcomes, the project will produce four key outputs. All four outputs will contribute to each of the three outcomes[1]:

Output 1: Criteria and tools to determine when and where intra-specific genetic diversity can provide an effective management approach for limiting damage caused by pests and disease. While it is known that crop genetic diversity can be used to reduce pest and disease pressures, it is also known that this approach is not appropriate in all circumstances. Criteria will be developed to determine when and where diversity can play or is playing a key role in managing pest and disease pressures. These criteria will form the basis for tools and decision-making procedures for farmers and development workers to enable the appropriate adoption of "diversity rich strategies" to manage pests and diseases.

Output 2: *Practices and procedures that determine how to optimally use crop genetic diversity to reduce pest and disease pressures.* Scientists and farmers will together test and implement approaches to use within-crop diversity in different production situations to reduce pest and disease pressures. Practices and procedures for effectively and efficiently using crop genetic diversity as a response to pest and disease pressures will then be developed. Determining the effectiveness of the different diversity deployment strategies for the different crop/pathogen

[1] All four project outputs contribute to the achievement of each of the three project outcomes and are therefore listed together after the project outcomes in the project logical framework (Annex B).

interactions will allow the general criteria to be identified on the prerequisites for adopting a diversity-based approach.

Output 3: *Enhanced capacity of farmers and other stakeholders to use local crop genetic diversity to manage pest and pathogen pressures.* The project is driven by a clear appreciation by all project partners of the central role of the farmer in managing crop genetic diversity. Capacity building includes enhancing farmer's leadership ability to take decisions concerning the management of pest and diseases and ensuring equitable benefits from the project outputs by actively supporting women's participation in technical and university training programmes and decision making fora. The capacity of local institutions to sustain project activities will be enhanced through training and inputs to local extension, NGOs, middle and technical schools and local colleges and national research and education institutes.

Output 4: Actions that support adoption of genetic diversity rich methods for limiting damage caused by pests and diseases. Sustainable application of benefits derived from the project will require integration of the knowledge gained into all levels of agricultural and environmental practices and development. Mainstreaming will move the project beyond site-specific successes to strategies for diffusing beneficial techniques into practices and policies from community to global levels. A clear approach to benefit sharing is central to this project. The project will be developing benefit sharing means such that the goods and services from crop diversity benefit the stakeholders responsible for their production and management.

A complete list of project activities is presented in Annex B – Logical Framework and Work Plan.

(b) Key indicators, assumptions and risks (from Logframe)

The following eleven impact indicators have been identified during the PDF B phase of the project by national partners from the four countries:

- 10% of the families from 31 local and indigenous communities show increased and more reliable food supply;
- diversity rich practices replace pesticide use in 31 local and indigenous communities;
- at least 356,000 ha of land contribute to the conservation and sustainable use of crop diversity;
- at least 2 departments of agriculture and environment in each country have incorporated crop genetic diversity rich practices;
- food insecurity is reduced for 10% of the families in 31 local and indigenous communities;
- crop yields are increased by 10% from reduced crop losses from disease and pest damage for at least 20% of the farms (equivalent to 52,600 ha) in project site;
- diversity rich practices replace pesticide use to minimize crop damage for 15% of project site regions (equivalent to 106,900 ha);
- diversity for resistance is increased by 10% on 30% of farmer fields in the project sites (equivalent to 78,900 ha);
- use of crop genetic diversity to manage pest and disease pressures occurs on 20% of the farms (equivalent to 142,600 ha) in the project sites in four countries;
- at least 20% of the farmers of the project site (equivalent to 6,200 families) implement diversity rich methods developed in the project to increase use of crop genetic diversity to manage pest and disease pressures on-farm;

- at least two male and female farmer representatives in each site have participated in national committees or decision making fora for planning and evaluation of diversity rich methods to manage pest and diseases.

Economic impact will also be measured using methods and tools tested and made available by year four of the project to estimate the value of crop genetic diversity in reducing yield losses, and in mitigating product quality losses from pest and diseases (see Annex B, Output 1, Objectively Verifiable Indicator 1.3).

Specific Activities for Phase I, together with Milestones, and Objectively Verifiable Indicators for Phase I are listed in Annex B1: Phase I: Objectively Verifiable Indicators and Milestones.

The project carries with it a number of assumptions and associated risks. These assumptions can be classified into five areas: (i) that host resistance exists or is available within the project countries; (ii) that higher levels of diversity will not create super-races of pathogens (iii) that decision-makers and farmers are cooperative and open to the adoption of diversity rich approaches, (iv) that stable and favourable political environment and policy makers and partners commitments, and (v) that a representative, collaborative and efficient project management structure is operative. The full list of indicators and assumptions against each of the outcomes and outputs has been described in Annex B-Logical Framework and Work plan.

1. COUNTRY OWNERSHIP

a) COUNTRY ELIGIBILITY

Countries participating in this project ratified the Convention on Biological Diversity on the following dates: China, 05 January 1993; Ecuador, 23 February 1993; Morocco, 21 August 1995; and Uganda, 08 September 1993.

b) COUNTRY DRIVENNESS

The partner countries have adopted a number of conservation and development plans related to PGR, agriculture, sustainable use of plant diversity, Farmers' rights and benefit sharing mechanisms, pesticides reduction, and Material Transfer Agreement. Preliminary analysis and implication of these laws, were carried out during PDF B phase and are summarized in Annex F-Analysis of existing Legislation and Policy. All four countries ratified the Convention on Biological Diversity and all the countries also have developed their respective National Biodiversity Strategy and Action Plan (NBSAP), the Convention on International Trade in Endangered of Wild Fauna and Flora (CITES). All countries, except China, have signed and ratified International Treaty on Plant Genetic Resources for Food and Agriculture. Ecuador and Morocco are signatories to Global Crop Diversity Trust. In addition to international treaties and policy guidelines, each country has developed several domestic policies and laws which includes: National Policies on Agricultural Biodiversity and Food Security; Access and Benefit-Sharing, Equity and Biodiversity; Integrated Pest Management (IPM); Safe movement of germplasm and the Cartagena Protocol on Biosefety; Pesticide control and environmental and human health; and Environmental Law programme.

2. PROGRAM AND POLICY CONFORMITY

a) FIT TO GEF OPERATIONAL PROGRAM AND STRATEGIC PRIORITY

The proposed project is consistent with the priorities of the GEF OP#13 "Conservation and sustainable use of biological diversity important to agriculture". The project directly supports all four objectives of the Convention on Biological Diversity (CBD) programme of work on agricultural biodiversity, adopted through decision V/5 at the fifth meeting of the Conference of the Parties of the CBD. More specifically, it relates directly to each of the four objectives of the CBD programme of work for agricultural biodiversity.

The project, consistent with Strategic Priorities Two and Four in Biodiversity for GEF Phase III and will: a) develop globally applicable and relevant criteria and tools to determine when and where intra-specific genetic diversity can provide an effective management approach for limiting crop damage caused by pests and diseases in agroecosystems; b) demonstrate replicable best practices that determine how to optimally use crop genetic diversity to reduce pest and disease pressures; and; c) support the mainstreaming of agrobiodiversity conservation and sustainable use strategies beyond site-specific successes by effectively disseminating project tools, methodologies, practices and policies to stakeholders (farmers, community organisations, Universities, government ministries) that are involved in sustainable use and conservation of agrobiodiversity. For policy makers and government officials, the results will support implementation of National policy, which supports the reduction of pesticide use and biodiversity conservation.

b) SUSTAINABILITY (INCLUDING FINANCIAL SUSTAINABILITY)

During the PDF-B phase, project components were tested, assumptions analyzed, and stakeholder groups identified. The resulting analyses and strategies have guided the strategy to implement the project intervention, which comprises four components: (1) Criteria and Tools; (2) Practices and Procedures; (3) Capacity and Leadership; and (4) Mainstreaming and Replication. The project is driven by a clear appreciation by all project partners of the central role of the farmer in managing crop genetic diversity and of the importance of adopting working practices that are fully participatory and start from a desire to reflect farmers' needs and concerns in diversity management. Working relationships will be developed through training in participatory approaches and team building among farmers, farmers' organisations, NGOs, local and national research and educational institutes, government ministries, and international institutes, and will lead to the sustainability of the project.

The financial sustainability is linked through community biodiversity management approaches used in this project, which will facilitate the development of strong ownership of the conservation and development activities by local communities and by local and national researchers, development workers, and policy makers. This will result in nationally supported initiatives, where communities will be prepared to develop their own work plan and generate their own resources and information systems to guide the activities. Economics methodology will also be developed to estimate the effects of diversity rich practices of crop genetic diversity management on expected yield losses, yield variability, and downside risk, or the probability of crop failure. These effects, when valued by relevant prices, will constitute the insurance value of crop genetic diversity use and three types of benefits will result, viz., (i) farmers save cash outlays in terms of input costs; (ii) the deleterious effects of unsafe pesticide use on the human health are avoided; and (iii) environmental externalities, such as the risk of losses to other species and aquatic diversity, are reduced. Policies briefs and extension manuals will be developed demonstrating economic value of use of crop diversity, curricula for local schools, modified extension packages on the use of diversity, and benefit sharing mechanism, all will promote the public awareness for sustainable use of crop diversity on farm and policy support to national programme and donor concern for sustainability of the project over space and time.

c) REPLICABILITY

Protocols and practices developed within the project can be applied to other sites within the participating countries or to other countries to determine when and where local crop genetic diversity can be used to manage pests and diseases on-farm. Documentation of successful experiences and comparisons of diversity rich options to others options (e.g., agronomic practices, chemical use) will ease replication of these options to other sites within and among countries. Farm field visits for policy makers and the press, and cross site visits for farmers will enhance the interest and confidence of stakeholders to replicate good practices. Through the regional networks, as describe under Programme Context of Project Brief, the project will see that the outcomes are shared with the respective national, regional and global network member countries through active participation and linking project activities. The project will also support regional meetings, where the respective network member countries will be supported for their participation.

d) STAKEHOLDER INVOLVEMENT

Stakeholders were identified through consultation and are based on multi-institutional and multi-disciplinary approach at national and local project site level. The main stakeholders involved are: farmers, farmer organizations, women motivators within the farming communities, CBOs, NGOs, agricultural extension workers, natural and social science researchers from universities and agricultural research institutes, and government ministries of agriculture and the environment. The project management and implement structure identified is based on each country national policies and organizational set up. These implementation and execution arrangements are designed for effective coordination of project activities at national as well as at project sites. More details on public involvement plans at national and global levels and the project management structure is described in Annex E-Public Involvement Plans.

e) MONITORING AND EVALUATION

The M&E Plan follows UNEP guidelines and incorporates UNEP monitoring and evaluation activities. The full Monitoring, Progress Reporting, and Evaluation Plan and Tracking Tools for GEF Biodiversity Focal Area Strategic Priority Two are found in Annex P and Q, respectively. There are four entities with roles to play in the M&E process: (i) UNEP will receive from the Global Project Management Unit (PMU) biannual progress and quarterly financial reports, UNEP will also serve as a member of the International Steering Committee and will make field visits to assess progress and problems and organize independent evaluators for mid-term and final evaluations; (ii) PMU will develop a reporting structure for all project partners and ensure that reporting is timely and complete. It will develop all reports for UNEP, and carry out regular site visits with particular attention to sites experiencing difficulties or delays; (iii) The International Steering Committee (ISC) will review all reports, advise the PMU on resolving difficulties and increasing efficiency, and monitor progress on the capacity-building component; (iv) The National Steering Committees (NSCs) will review all national reports and offer policy guidance where needed. Project monitoring will be carried out at two levels. The first is the execution performance and the second is monitoring of project outputs and milestones.

Stakeholder participation in the M&E process is also essential to ensure their continued ownership in the project activities. Farmers and other stakeholders will therefore be included on the evaluation team and will be involved in internal project evaluation and annual reviews of project performance. Mid-term and final evaluation will be conducted by independent evaluators contracted by UNEP. The roles, responsibilities and reporting deadlines for UNEP, global and national project management/implementation units, international and national steering committees, and various other national coordination committees are clearly articulated in the Monitoring, Progress Reporting, and Evaluation Plan (Annex P).
Annual Financial audits will be carried out by IPGRI, the project Executing Agency.

3. FINANCIAL MODALITY AND COST EFFECTIVENESS

The total estimated cost of the project Phase I and Phase II is US$15,340,162, which does not include the cost of the PDF B. Of the estimated project cost, the government contribution from the four countries, both cash and in-kind, is US$4,600,004. Co-financing from other international donors and partners is also ensured both for in-kind and cash contribution for US$2,876,624 and under negotiation for US$995,000. The remaining amount of US$6,868,534 is being requested from GEF.

The total estimated cost of the Phase I is US$7,685,493 which does not include the cost of the PDF B. Of the estimated cost of Phase I , the government contribution from the four countries, both cash and in-kind, is US$2,215,203. Co-financing from other international donors and partners is also ensured both for in-kind and cash contribution for US$2,059,141. The remaining amount of US$3,411,148 is being requested from GEF.

Name of Co-financier (source)	Classification	Type	Amount (US$) Phase I and Phase II	Phase I	Status
IPGRI	Global Executive Agency	In-kind Cash	1,080,000 200,000	576,000 196,167	Financial statement
Swiss Agency for Development and Cooperation (SDC)	Government Agency for Development	Cash	750,000	750,000	Financial Statement
Governments	National Executive Agency	In-kind Cash	3,374,922 1,225,082	1,594,102 621,101	Financial statements
FAO	International Partner	In-kind	150,000	90,000	Financial statement
US University Consortium lead by WSU[1]	International Partners	In-kind	309,124	173,474	Financial statement
University of Kassel	International Partner	In-kind	52,500	28,000	Financial statement
CSIRO	International Partner	In-kind	40,000	24,000	Financial statement
UPWARD	International Partner	In-kind	100,000	60,000	Financial statement
IFPRI	International Partner	In-kind	150,000	90,000	Financial statement
IRRI	International Partner	In-kind	45,000	27,000	Financial statement
Ford Foundation	International Partner	Cash	44,500	44,500	Financial statement
Others (Ford Foundation, EU[2])		Cash	950,500	0	Under negotiation
Sub-Total Co-financing			**8,471,628**	**4,274,344**	

4. INSTITUTIONAL COORDINATION AND SUPPORT

a) CORE COMMITMENTS AND LINKAGES

The proposed project is consistent with the following areas of UNEP's mandate in the GEF, as identified in the UNEP Action Plan on Complementarity, approved by the May 1999 GEF council meeting:

- UNEP contributes to the ability of the GEF and of countries to make informed strategic and operational decisions on scientific and technical issues in programs and project design, implementation and evaluation, through scientific and technical analyses. These will include

[1] The consortium is lead by Washington State University (WSU), and includes Oregon State University (OSU) and Cornell University. In kind commitments have been made and cash commitments are under discussion based on a project proposal submitted to the US government SANREM-CRSP program.

[2] EU-China-FAO Programme on Enhancing Farmers' Awareness and Protection of Agro-biodiversity (EFAPA) in South/West China (Yunnan, Sichuan, Xinjiang and Inner Mongolia)

assessments, targeted research, methodology development and testing and structured programme learning projects.

- UNEP's projects promote regional and multi-country cooperation to achieve global environmental benefits, focusing on diagnostic analyses and cooperative mechanisms, and associated institutional strengthening.
- UNEP implements projects to promote specific technologies and demonstrate methodologies and policy tools that could be replicated on a larger scale by other partners.

In addition to the international treaties and policy guidelines, each country has also developed several domestic and regional policies and laws addressing the need for agrobiodiversity conservation, access and benefit sharing, agricultural biodiversity and food security, integrated pest management, biosafety and environmental protection, and includes: National policies on agricultural biodiversity and food security; Integrated pest management (IPM); Safe movement of germplasm and the Cartagena Protocol on Biosefety; Pesticide control and environmental and human health; Environmental Law programme.

All the four countries are member of their respective initiatives and PGR networks and includes:

- China: Regional Network for Conservation and Utilization of Plant Genetic Resources in East Asia; Asian Rice Biotechnology Network; International Network for Genetic Evaluation of Rice; and Tropical Asian Maize Network.
- Ecuador: Andean Plant Genetic Resources Network; Amazonian Network on Plant Genetic Resources; Central American Network on Plant Genetic Resources; Andean Community of Nations (CAN); Declaration of Cancun and Declaration of Cusco.
- Morocco: West Asia and North Africa Network on Plant Genetic Resources; Faba Bean Research Network for the Maghreb; Mediterranean Network on Nitrogen Fixation; Protection of the Mediterranean against pollution and the protection of biological diversity; and Natural Resource and Nature Conservation and Plant Health of Africa.
- Uganda: Eastern Africa Plant Genetic Resources Network (EAPGREN); Banana Research Network for East and Southern Africa (BARNESA).

At the national level, the four countries have made appropriate linkages to existing projects and planned projects of country components of project within their countries: Chinese partners have made links with the UNDP/GEF project on “Conservation and Sustainable Utilization of Wild Relatives of Crops” and UNDP/GEF project on “Multi-agency and Local Participatory Cooperation in Biodiversity Conservation in Yunnan's Upland Ecosystem. Ecuador partners have developed close links with the Proyecto de Resistencia Duradera para la Zona Andina, and with the “ECOSALUD” (ecological health) project to quantify the negative effects and assist farmers in the reduction of pesticide use through implementing of IPM programs. Ecuador is a participant of the UNEP/GEF project on “Conservation of the Biodiversity of the Paramo in the Northern and Central Andes. Morocco is linked to the UNDP-GEF supported project to promote the maintenance and better use of the data palm diversity present in North Africa. Project partners in Morocco are also providing information in the development of the UNDP/GEF project “Conservation and Sustainable Management of Globally Important Ingenious Agricultural Heritage Systems (GIAHS)”. In Uganda linkages are made with the UNEP-GEF project on “Conservation and sustainable management of below ground biodiversity,” and Uganda is a member country of the UNEP/GEF project “Promoting Best Practices for Conservation and Sustainable Use of Biodiversity of Global Significance in Arid and Semi-arid Zones” and the UNEP/GEF project on “Community-based Management of On-farm Plant Genetic Resources in

Arid and Semi-arid Areas of Sub-Saharan Africa." The project builds on the experiences and capacity developed by the UNEP GEF supported UNU-led People Land management and Environmental Change (PLEC) programme.

b) CONSULTATION, COORDINATION AND COLLABORATION BETWEEN IAS, AND IAS AND EXAS, IF APPROPRIATE.

IPGRI has a long experience in coordinating and managing projects relating to conservation and use of crop diversity at regional and global levels. IPGRI has linkages with several of the international organizations. Cooperation among UNEP and Executing Agencies (national partners and IPGRI), and engagement of stakeholders before and during the PDF-B phase has helped to ensure that the project is in line with existing needs of national partners, and that the project is driven by a clear appreciation of the central role of the farmer in managing crop genetic diversity. The International Steering Committee, which met two times during PDF B phase, and Technical Advisors, identified at national and international level (the details are provided in Annex K - National and International Roster of Experts), has provided information for linkages and advice for ensuring consistency in approach from country to country. Several International Institutes have already made in-kind commitments to participate as technical advisors and includes: CSIRO, Australia; Washington State University, USA; Oregon State University, USA; Cornel University, USA; the University of Kassel, Germany; International Rice Research Institute; International Food Policy Research Institute; CIP-UPWARD; and Food and Agricultural Organization. The detailed contributions of these international organizations are listed in Annex E.

C) PROJECT IMPLEMENTATION ARRANGEMENT

A detailed national project management and implementation structure and its linkage with the global coordination was discussed for each country during PDF B phase and are described in Annex E. A common agreement was reached among partners for the Project Management Unit across all the four countries. The Project management Unit will have a National Project Director (contribution from the national executing agency), a National Project Manager (to be hired by the project) a national Programme Assistant (to be hired by the project), and Technical Advisors. The country partners discussed the need for various committees at national and site levels for better coordination of project activities and the various committees proposed are: a National Steering Committee, a Site Coordination Committee, National Teams of Technical Experts, and Site Teams. The constitutions and responsibilities of these committees is described in Annex E. A team of Technical Advisors will be established at international and national levels. Members of the team will support technical aspects of the project.

IPGRI will serve as the executive agency at the global level. It will oversee the Global Project Management Unit (PMU), located at its headquarters in Rome. The Global PMU will be placed within the IPGRI's Agricultural Biodiversity and Ecosystem Project. The PMU will include a Project Director (whose time is contributed by IPGRI), a Global Project Manager (to be hired by the project) and a Programme Assistant (to be hired by the project), and Technical Advisors.

An International Steering Committee (ISC) will be established. Membership will include representation from each of the Project Management Units at national level (National Project Director), IPGRI (executing agency, Global Project Director), representatives from international partners (SDC, FAO; University of Kassel, Germany; Washington State University) and a UNEP/GEF representative. ISC responsibilities includes: review quarterly progress and financial reports, annual summary progress reports, provide policy guidance to the project, assist PMU in developing linkages with other related projects, and overall guidance for the project implementation. ISC will be meeting once a year.

Annex A – Incremental Cost

Broad Development Goals

Host resistance breeding and pesticide use are the most common strategies to protect crops against pest and disease pressures. In most cases, however, these responses provide only temporary solutions. Most breeding programs use single genes to provide resistance across many types of environment. The large areas in which popular resistant cultivars are then planted facilitate rapid pathogen evolution and migration to overcome resistance. This has led to the so-called "Boom and Bust" phenomenon in agriculture. One consequence of the development and spread of new resistant cultivars can be the loss of local cultivars with different resistance properties and mechanisms, and, ultimately, loss of genetic diversity in production systems.

This proposed intervention aims to integrate and applying existing knowledge to provide a framework of tested management practices that can support use of genetic diversity to mitigate the effects of pests and pathogens. It will bring together farmer knowledge and experience with information from agricultural research work. On the basis of selected model studies on crop-pathogen systems throughout the world, it will develop the tools and capacities needed to determine what diversity-based approaches are desirable and how they should be deployed. It will identify techniques and approaches that can be replicated to areas and crops outside those selected for the project. It will help build the frameworks for sustainable partnerships between farmers, extension workers, national research institutes, government ministries and others, frameworks that will serve as models for other parts of the world. The intervention complements and extends IPM strategies by using and managing local crop cultivars themselves as a key resource, making use of the intra-specific diversity among the cultivars maintained by farmers. The approach will provide environmental health workers with an alternative to unsafe pesticide use. Crop breeding programmes will be more effective by increased use of local resistant materials and new methods to reduce crop vulnerability.

Global benefits of the project are:

1. Conservation of globally significant crop genetic diversity in respect to resistance to pests and diseases
2. Conservation of associated biodiversity due to decreased pesticide use, and
3. Development of practices that use local crop genetic diversity to manage pest and diseases that can be applied both within and outside the four project countries

Domestic Benefits of the project are:

1. Increased availability and use of "diversity rich" low cost solutions to manage pest and disease pressures for small and marginal farmers,
2. Enhanced capacity to make decisions by farmers and other stakeholders on when and where local crop genetic diversity will be useful to minimize pest and disease pressures,
3. Increased and more reliable food supply for local and indigenous communities through the use of crop genetic diversity to minimize crop loss,
4. Increased land area contributing to the sustainable use of crop genetic resources,
5. Alternatives to unsafe pesticide use for environmental health workers.
6. More effective crop breeding programmes through increased use of local resistant materials and new methods to reduce crop vulnerability
7. Benefit sharing protocols with farming communities.

BASELINE

Each country contains areas of important crop genetic diversity significant for the management of disease pressures, traditional farming communities that maintain the diversity, a national-level commitment to conserve crop resources and existing multi-stakeholder efforts upon which the project can build. Earlier projects have developed protocols, which work with farmers, using participatory methods, to estimate the number of, and area covered by, different crop cultivars. These protocols, however, have not been applied to quantifying amounts of diversity in respect to resistance found on-farm. The host-pest/pathogen systems selected are those which have well characterized cycles in the literature. All host-pest/pathogen systems selected will serve as important models for ease of replication and diffusion of project methodologies to areas outside the project's geographic scope. The four countries bring different expertise in developing practices and procedures to optimally use crop genetic diversity to minimize pest and disease damage. An agreed set of criteria among the countries has guided site selection. These criteria include environmental diversity, social cultural diversity of farming communities, intra-specific diversity of target crops, distribution of pest and pathogens, willingness of communities and local institutions to participate, local institutional capacity, and logistics for site access.

These countries have good infrastructure and faculty for providing training in agricultural research and development. However, they lack trained manpower and training materials for specialised training courses in the field of plant genetic resources conservation and use and are not linked to community-based organizations working with farmers.

Each country also has its own national coordination mechanism for undertaking various activities relating to plant genetic resources conservation, both *ex situ* and *in situ*. These national programmes have well established national coordination mechanisms for plant genetic resources related activities and also participate in regional sub-regional PGR networks, to share and gain from each others experience in the region. The partner countries have adopted a number of conservation and development plans related to plant genetic resources, agriculture, sustainable use of plant diversity, farmers' rights and benefit sharing mechanisms, pesticides reduction, Material Transfer Agreement. Each country has also developed several domestic policies and laws addressing the need for agrobiodiversity conservation, access and benefit sharing, agricultural biodiversity and food security, integrated pest management, biosafety and environmental protection.

The project components were designed to address the overall project baseline assumptions:

1. Lack of criteria and tools to determine when and where intra-specific crop genetic diversity can be used to minimize pest and disease pressures on-farm.
2. Lack of tested and available practices to use within-crop diversity in different production systems to minimize pest and disease pressures.
3. Insufficient capacity and leadership abilities at local, regional and national levels to optimally use crop genetic diversity to minimize pest and disease pressures.
4. Insufficient awareness of the benefits of using local crop diversity and lack of national benefit sharing protocols with local communities.

Criteria and Tools

Evidence of high levels of intra-specific diversity in target crops has been documented in each of the four countries through genebank collections and earlier on farm projects. Maize and bean landraces cover 90 percent of the Ecuador highlands. Landraces still cover a significant percentage of land area in remote indigenous areas in the southwestern provinces of China. Evidence of high levels of barley diversity come from on-farm surveys in Morocco, and accessions collected in southwestern China. On-farm studies in Uganda have shown that over 80 locally evolved highland banana cultivars continue to exist on-farm, and that commonly up to 22 cultivars can be found on any given farm.

Substantial theoretical advances exist in the biological and epidemiological knowledge of the function of intra-specific genetic diversity. Still, the understanding of long-term host-pathogen interactions is inadequate. The role of the farmer in these interactions is even less known. The few studies that are available provide only localized insight. Most problematic is the lack of a standardized methodology to enable easy comparisons between diagnostic information on farmers' perceptions and practices and technical assessment through field and laboratory experiments. A further constraint has been that the understanding of farmer management of genetic diversity for pest and disease management is limited to a few cropping systems.

Participatory tools exist to aid in on-farm research and development, but these tools are not adapted for understanding farmers' perception on the pest and disease problem, nor are they linked to standard technical methods of assessing the availability of host (crop variety) resistance available in the existing farming system. Little is known of farmers' understanding regarding virulence and aggressiveness of pathogen diversity, and the movement and transmission mechanisms of diseases, nor have these on-farm systems been well studied in the field or in laboratories. Protocols that provide guidance for the production of host-pest/pathogen systems on-farm are inadequate. Moreover, protocols do not exist that can provide decision making tools for farmers and other stakeholders based on assessments of farmers' beliefs and practices combined with laboratory and field measured data.

The baseline cost for this project component is estimated to be $ 1,180,575. These costs comprise the related on going work in each of the four countries such as: developing participatory tools for better understanding of farmers knowledge; collecting, screening and evaluation of national and international germplasm collections against different pest and diseases reactions, both by curators of genebank and plant breeders for the respective crops and their conservation cost; scientific and field studies in progress to understand host-pest interaction and existing diversity for virulence and aggressiveness of pathogens and biotypes for pests. The estimated cost cover the real cash spent by the national government and by other donors; the in-kind contribution of national partners in terms of staff time salary and other facilities made available for these project activities, including any publication costs for developing extension packages and scientific publications.

Practices and Procedures

The four countries bring different expertise in developing practices and procedures to optimally use crop genetic diversity to minimize pest and disease damage. Partners from China have a wide experience in the use of varietal mixtures based on a comprehensive analysis of the resistance background, agronomic character, economic value, local cultivation conditions and the planting habits of farmers. Results from the Yunnan Agricultural University work in using diversity to manage pests and disease by mixed planting of rice varieties to control blast and improve yield has convinced the Chinese Ministry of Agriculture and provincial agricultural departments to evaluate this technique in ten other provinces in China for possible large scale implementation. Partners from Morocco bring to the project the expertise in screening local crop germplasm, Ugandan partners have worked closely with farmer mixtures and percentages or ratios of different banana varieties in farmers' mixtures, and Ecuadorian partners have a long history of linking formal sector breeding practices with farmer breeding practices.

Actions that support technology transfer and farmers' education are available in each of the four countries. Farmer field schools for farmer-to-farmer training in integrated pest management (IPM) exist. However, these schools have concentrated on understanding the agronomic practices that farmers use to manage pest and disease and have made limited use of local crop genetic diversity in the schools. Little knowledge is available on how farmers make genetic choices to manage pest and disease pressures, e.g., how farmers manage diverse genes in plant populations in order to control single constraints or complexes of pests and diseases to minimize crop loss.

The baseline cost for this project component is estimated to be $ 1,507,715. These estimates are based on on-going project related activities which include: national crop improvement programmes with focus on resistance breeding; understanding genetic of resistance mechanisms for the target crops; on-going scientific research to use crop genetic diversity to control pest and disease problems; economic aspects of comparing different approaches for pest and disease management at national level; physiological crop modeling and pest and pathogen infestation; Early warning system for spread of pests and diseases over space and time; and scientific research for integrated pest management. The cost includes the cash by national governments and other donors within country for staff time salaries, cost of equipment and chemicals and also for field and lab experimentation.

Capacity and Leadership

The project is driven by a clear appreciation by all project partners of the central role of the farmer in managing crop genetic diversity and of the importance of adopting working practices that are fully participatory and start from a desire to reflect farmers' needs and concerns in diversity management. Experience of working on the management of agricultural biodiversity has demonstrated that not only do participants need the capacity to employ those activities relevant to their specific work or role, but also they must be able to rely on strong working relationships with other stakeholder groups. These working relationships need to be developed and enhanced among the four countries through training in participatory approaches and team building among farmers, farmers' organisations, NGOs, local and national research and educational institutes, government ministries, and international institutes.

Across the four countries there are 41 universities and institutions, both at national and local level, including technical schools, which can provide training to their respective partners at national level in the field of: agronomy, crop protection, crop physiology, crop breeding and biotechnology, environmental sciences, extension techniques, documentation and communication, social sciences and economics. This information is based on preliminary surveys conducted during the national stakeholders meetings organised during the PDF B phase of this project. These countries have good infrastructure and faculty for providing training in agricultural research and development. However, they lack trained manpower and training materials for specialised training courses in the field of plant genetic resources conservation and use and are not linked to community based organizations working with farmers.

The baseline cost for this project component is estimated to be $ 1,694,648. The cost is based on personnel, logistic arrangements for conducting training and development and printing of training materials in each of the four countries. The various training and capacity building programmes considered for these estimates includes: participatory and rural appraisal; crop breeding for resistance; genetics of host-pest interaction; team building; IPM and Farmers Field Schools; agricultural extension training activities. This also includes the amount being spent for teaching and research for degree studies at the national and regional universities as well as the amount spent by the local institutions, including NGOs, for training of farmers and extension workers for related activities.

Mainstreaming and Replication

Successful experiences using agronomic practices, resistant varieties and application of chemicals to minimize pest and diseases on farm are well documented and published in different media by the national partners. However, these experiences lack the component of using intra-specific diversity and information on trade-offs of diversity rich approaches compared to other approaches Seed cleaning techniques other methods of seed quality exist within agricultural extension and NGO development packages but have not included intra-specific diversity as an option.

Education sectors contain curriculum on biodiversity, agronomy and plant breeding, but lack information on the value and use of local crop genetic diversity in support of sustainable management. Methods are available for ensuring that data are of some use to the communities from which they are being elicited and returning these data in a user-friendly format.

Methods for upscaling best practices, such as diversity fairs, site demonstration plots, and the promotion of seed interchanges through local nodal farmers are known but not mainstreamed into national extension and development systems. National breeding strategies include local materials from *ex situ* collections, but farmer's knowledge and local on-farm materials are not mainstreamed.

Economics methodologies exist for calculating income instability due to yield losses, but have not focused on yield variability and downside risk, or the probability of crop failure, nor have these methods included estimates of public good value for the conservation of resistant crop genetic diversity for future use, or the impact on environmental externalities, such as the risk of losses to other species and aquatic diversity. Methods are lacking to estimate the ecosystem support value of crop genetic diversity.

Each country has also developed several domestic policies and laws addressing the need for agricultural biodiversity conservation, access and benefit sharing, agricultural biodiversity and food security, integrated pest management, biosafety and environmental protection. All the four countries are part of their respective regional plant genetic resources networks in addition to participating in other regional strategies and initiatives. A key component of the project will be the recommendation of diversity rich practices to substitute pesticide use. Links have therefore been made not only to the agricultural sector, but also to the environmental sector for measurements of impact the project could have on environmental and human health.

The baseline cost for this project component is estimated to be $ 1,033,731 and these costs are based on spending by each of the four countries on related project activities such as: public appreciation and awareness of the use and conservation of agrobiodiversity; developing legislation and policy guidelines for conservation and use of agrobiodiversity; promotion of scientific research, including the high yielding resistance varieties, to farmers and farming communities; spending on promotion of farmers diversity fair and field demonstration for PPB, PVS and for high yielding resistant varieties. This also includes the cost of printing and distribution of public awareness materials.

GLOBAL ENVIRONMENT OBJECTIVES

This project will conserve and promote the sustainable use of crop genetic diversity with respect to resistance to pest and disease pressures. Conservation of the resource will support resource-poor farmers' production and livelihood strategies and conserve valuable genetic materials globally important to plant breeders, researchers, and local populations who depend on them. The use of crop diversity to manage pest and disease pressures will reduce the need for the application of pesticides that destroy useful and beneficial insects and fungi in the agroecosystem and that also contaminate groundwater. Thus, additional global biodiversity benefits that will accrue through application of this approach will include conservation of insects, fungi, soil microorganisms, and aquatic biodiversity of adjacent ecosystems to the agricultural production system.

The project will increase the use of "diversity rich" solutions to manage pest and disease pressures for small and marginal farmers. They will be used by the farmers, community based organizations, development and extension workers, NGOs, NARS research scientists, breeders, environmental health workers and policy makers. Farmers will use the information and materials when the methods and materials are seen to reduce crop vulnerability to production and income losses. The approach will provide environmental health workers with an alternative to unsafe pesticide use. Crop breeding programmes will be more effective through increased use of local genetic diversity and new methods to reduce crop vulnerability.

Local crop genetic diversity will be maintained as it will contribute to sustainable production and farmers' livelihood. Tools and practices will be provided that can be used to support farmers around the world to conserve local crop diversity through its use to minimize pest and disease damage. Practices will include diversity rich options to substitute pesticide use. IPM strategies will be complemented and extended globally to include the use of local crop cultivar diversity as an important resource. Ultimately, these results will support biodiversity conservation, improve ecosystem health and increase food security.

GEF ALTERNATIVE

At project completion, diversity for resistance to pest and disease will be increased on farm. Local and indigenous communities will show increased and more reliable food security through the use of crop genetic diversity to minimize crop loss, and diversity rich practices will reduce pesticide use. Tools and practices will be available to support farmers around the world to conserve local crop diversity through its use to minimize pest and disease damage. Benefit sharing protocols will ensure that the goods and services from crop diversity benefit the stakeholders responsible for their production and management.

Criteria and Tools

Criteria will be developed to determine when and where diversity can play or is playing a key role in managing pest and disease pressures. These criteria will form the basis for tools and decision-making procedures for farmers and development workers to enable the appropriate adoption of “diversity rich strategies” to manage pests and diseases.

National partners will continue the joint development and testing of diagnostic protocols begun during the PDF-B phase. These protocols will aid farmers and researchers to determine (1) whether pest and diseases are viewed both by farmers and scientists as a significant factor limiting production; (2) whether intra-specific diversity with respect to pest and diseases exists within project sites and if not, whether other sources of intra-specific diversity with respect to pest and diseases exist from earlier collections or from similar agroecosystems within the country; (3) whether diversity with respect to pest and diseases exists but is not accessed or optimally used by the farming communities; (4) whether in the case of diseases there is diversity in virulence and aggressiveness of pathogens or diversity in biotypes for pest; (5) whether and how pest and diseases are moving in and out of the project sites, including the local seed systems; and (6) how farmers make “genetic choices” on using or discarding new and old genotypes, including their selection criteria for hosts that are resistant.

A detailed quarantine strategy will be worked out in each country for each host - pest or pathogen system as part of the research protocols. Particular care will be taken that both field and glasshouse or lab experiments do not introduce alien biotypes or pathotypes. Partners will also be developing econometric methods to test the effects of crop genetic diversity on expected crop yields, yield variability and the probability of crop failure, given levels of pesticides applied.

The incremental cost of this project component is estimated to be US$2,771,010 of which national government will provide co-financing of US$503,412 (in-kind) and US$118,026 (cash) to cover salaries of their staff participation and use of laboratory and operational facilities for undertaking activities as indicated for Output 1 of the project logframe and includes: refinement of protocol for participatory diagnosis of farmers beliefs and practices and field and laboratory assessment; undertaking field surveys and collecting of samples of host and pathogen diversity; and providing all logistic arrangements for undertaking these surveys and laboratory experimentations. Co-financing from others is estimated at US$497,281 in-kind, of which IPGRI will contribute US$180,000, and US$590,000 cash, of which IPGRI will contribute US$50,000, and SDC will contribute US$340,000 to IPGRI to implement this component. GEF funds of US$1,062,291 will be used to assist the development of protocols for participatory diagnosis through conducting focus group discussions, farmer surveys, technical assessment through field and laboratory trials, and for the development and testing of econometric methods to test the effect of these methods using crop diversity to minimize pest and disease pressures.

Practices and Procedures

Farmers and researchers will together test and implement approaches to use within-crop diversity in different production situations to reduce pest and disease pressures. Practices and procedures for effectively and efficiently using crop genetic diversity as a response to pest and disease pressures will then be developed. Determining the effectiveness of the different diversity deployment strategies for the different crop/pathogen interactions will allow the general criteria to be identified on the prerequisites for adopting a diversity-based approach. Generally applicable criteria, guidelines and decision-making tools will be developed. These criteria will be used to identify new systems and sites to reduce genetic vulnerability to pest and disease pressures through the use of genetic diversity management.

Practices and procedures to be tested can be grouped into four categories: (1) identifying and upscaling farmer knowledge and practices in on-going systems where intra-specific diversity is being used to manage pest and disease pressures and promote good practices; (2) conducting experiments using intra-specific diversity that show the effect of diversity on controlling pest and disease incidence; (3) linking national breeding and farmer selection practices to manage pest and disease pressures; and (4) conducting simulation modeling to look at how patterns of intra-specific diversity distribution and population sizes might affect pest and disease incidence over space and time. These practices and procedures will be tested and validated at project sites, in farmers' fields. Quarantine issues are of extreme importance. Protocols will be developed for exchange of resistance plant materials within and among countries. However, alien biotypes or pathotypes will remain within their country of origin.

The incremental cost of this project component is estimated to be US$2,551,559. Countries partners agreed to contribute US$849,889 (in-kind) and US$165,442 (cash) for this component of the project. This will include: contribution for personnel for the staff time; laboratory space and available lab equipments; part of chemicals and glassware uses cost; and to provide all logistic arrangements for undertaking field experimentation. Co-financing by international partners is estimated at US$100,000 in kind, of which IPGRI will provide US$50,000, and US$330,000 in cash, of which IPGRI will contribute US$70,000, and SDC will contribute US$60,000 to IPGRI to provide scientific backstopping, supervising PhD students, monitoring of project progress and publication of scientific articles. The GEF funds of US$1,106,228 will be used for testing different practices and procedures developed.

Capacity-building

Working synergies will be enhanced through training in participatory approaches and team building among farmers, farmers' organizations, NGOs, local and national research and educational institutes, government ministries, and international institutes. Training will include enhancing farmer's leadership ability to take decisions concerning the management of pest and diseases. Capacity building will take into account the different knowledge of women and men, and the importance to ensure equitable benefits from the project. Activities will include actively supporting women's participation in technical and university training programmes and decision making fora. Farmers and farmer groups will be targeted for capacity-building to manage their production systems with diversity rich options to manage pests and diseases, including training in biological sciences, diversity assessment, and seed management for pest and diseases. The seed activities of local farm organizations will be strengthened to integrate pest and disease considerations.

The capacity of local institutions to sustain project activities will be enhanced through training and inputs to local extension, NGOs, middle and technical schools and local colleges. Teachers at primary schools will also be involved in the process through training which could improve understanding at community level. Capacity will be built in research institutes to analyze local crop diversity in respect to pests and pathogens. Capacity will also be built to apply new econometric methods and tools in assessing the value of crop genetic diversity, and manage the information. The project will build capacity to analyze national and international legal and economic policies related to project objectives.

A National Research Center for Agriculture Biodiversity (NRCAB) will be established and operative at the Yunnan Agricultural University (YAU), Kunming, China. This center will focus on three key areas: agriculture biodiversity and pest and disease control; agriculture biodiversity and its conservation and use; and crop modeling, technology development and extension activities to for agriculture biodiversity to enhance sustainable economic development. During PDF B phase, it has been agreed that this center will provide training at global level for use of crop diversity to manage pests and diseases problems in traditional farming systems, using both local and high yielding varieties.

"Sandwich" Ph.D. programmes will be designed between Washington State University, Oregon State University and Cornell with the Institut Agronomique et Vétérinaire Hassan II, Rabat, Morocco, and Makarere University, Kampala Uganda. Washington State University is taking the lead in providing a collaborative arrangement among the three US universities. A sandwich Ph.D. programme is also being designed between University of Kassel, Germany and universities in Ecuador. Students who enter the sandwich programmes will complete their course work in a US or European university and return to their respective countries to complete their research work at the project sites. A feature of the programmes is the student's thesis research, which will focus on major research questions of the project logical framework. Another important dimension of the sandwich programmes will be the appointment of qualified respective national university faculty as adjunct faculty in relevant departments at WSU and the appointment of qualified WSU faculty as adjunct at the respective national universities.

The incremental cost of this project component is estimated to be US$3,692,675. Of this the countries will provide US$880,221 (in-kind) and US$763,110 (cash). National funds include support from the Chinese government for the establishment of National Research Center for Agriculture Biodiversity. Funds also include staff time of national experts for conducting various training courses and to provide training room facilities and logistic arrangements, including subsidized accommodations and catering for the participants, wherever possible. International co-funding will include the support "sandwich" programmes with US and European universities, resource persons, training courses and training materials. Total international co-funding in kind is estimated at US$384,343, of which IPGRI will provide US$50,000, and US$395,000 cash, of which SDC will provide US$100,000 to IPGRI for implementation of this component. GEF funds of US$1,270,001 will be used to cover capacity building for farmers and local communities, local institutions, and national research institutes and for training for use of intra-specific diversity to manage pest and disease problem.

Mainstreaming and Replication

Sustainable application of benefits derived from the project will require integration of the knowledge gained into all levels of agricultural and environmental practices and development. Mainstreaming will move the project beyond site-specific successes to strategies for replicating beneficial techniques into practices and policies from community to global levels. It is this process that ultimately allows replication of project results and adds significant global value to the project investments.

The four national executing institutions are primary institutions in their respective countries for mainstreaming project results. The Yunnan Agricultural University has expanded the mixed planting of rice varieties to manage pest and diseases to ten other provinces in China. The Instituto Nacional Autónomo de Investigaciones Agropecuarias (INIAP), Ecuador has more than 40 years of research and extension activities in the country. The Institut Agronomique et Vétérinaire (IAV) Hassan II, Rabat, Morocco was awarded the 2004 National FAO World Food Award from the Ministries of Agriculture and the Environment for its work in improving food security through the use of crop genetic resource in Morocco. The National Agricultural Research Organisation, Uganda is the overall government institution in charge of all agricultural research.

Successful experiences and comparisons of diversity rich options to others (e.g., agronomic practices, chemical use) will be documented and published in different media forms, farm field visits will be organised for policy makers and the press, and cross site visits will be organised for farmers. Field visits will illustrate the benefit of specific technologies and operations on demonstration plots, such as seed cleaning and treatment effects on seed quality, production practices, and results of participatory selection. Workshops will be organised at the province and county levels of each site designed to feedback results generated to a multi-stakeholder group. Workshops will be attended by highest level representatives of all the provincial and local authorities under different ministries (interior affairs, agriculture, environment, economy and finance, education), NGO's, farmers directly involved in the project and farmers from all over the Province, representatives of staff from provincial schools and universities, and newspapers and radio commandeers. Meetings will be organized in local languages and include presentations and discussion of messages related to the conservation strategy based on generated data, exhibitions of variety samples and related technologies developed by the project, farmers' and professional (NGOs, development) view of the proposed strategy.

Analyses will be carried out of legal and economic policies related to project objectives, including an analysis of potential barriers to adoption of the best practice demonstrated in the project and the development of benefit sharing protocols for the use of local resistant materials identified. The aim is to build recognition amongst institutions and in policy fora that the project methodologies provide an effective and efficient approach to managing pest and disease pressures. Through the regional networks described under the Programme Context Section of the

Project Brief, the project will ensure that the outcomes are shared with the respective network member countries through active participation and linking project activities. The project will also support regional meetings, where the respective network member countries will be supported for their participation.

The incremental cost for this project component is estimated to be US$2,683,966. The contribution for the national governments is estimated at US$680,343 in-kind and US$125,072 cash for providing support for the promotion of project outcomes at both policy and grass roots levels. The national contribution will also be used for providing support for field demonstration and local media facilities for broadcasting and modifying the existing extension packages and for the development of school curriculum of local institutions. International co-funding is estimated at US$235,000 in kind, of which IPGRI will contribute US$90,000, and US$480,000 cash, of which IPGRI will contribute US$30,000, and SDC will contribute US$250,000 to IPGRI to this component to provide backstopping for revising national policies and laws, publishing project outcomes into publications and newsletters and making available information to its web site for wider circulation. The GEF contribution of US$1,163,551 will be used for documentation of successful experiences from the project and their publication; developing and disseminating public awareness materials for conservation of crop diversity and protection of environment, translation of publication, developing cost effective design of policies for pest and disease management.

Project Management

The incremental cost of project management component is estimated to be US$3,640,952. The funds requested from GEF of $2,266,463 for project management of which US$1,060,000 will meet costs of full time global project manager, full time global program assistant, direct administration charges, global coordinator's travel, International Steering Committee's work, support of technical advisors to participate in global planning meetings, internal monitoring, including field visits. IPGRI will contribute US$710,000 in-kind and US$50,000 cash to support staff time of the Global Project Director and scientific and administrative staff based at its headquarters and regional offices for scientific and administrative backstopping, office space and supplies. The remaining US$1,206,463 requested from GEF will cover costs for National Project Management Units, which include a full time National Project Manager for each country, full time national admin/finance assistants, direct administration charges, national coordinator's travels, National Steering Committee's work, National Site Committees and Site Teams meetings, cost for Site Coordinators and office equipment. Costs of National Project Directors are covered by national in-kind and cash contributions. Country contributions also include funds to cover cost for the office maintenance of PMUs. Total contribution of the countries for this component is US$461,057 in kind, and US$53,432 in cash.

COSTS

The incremental costs and benefits of the proposed project are summarized in the following incremental cost matrix. Baseline expenditures amount to US$5,416,669, while the alternative has been estimated at US$20,756,831. The incremental cost of the project, US$15,340,162, is required to achieve the project's global environmental objectives of which the amount US$6,868,534 is requested from GEF. This amounts to 33.1% of the total costs of the alternative.

The remaining amount US$8,471,628, 55.2% of the "Full Project" total incremental cost, will come from the national and international partners and other donors. The figure includes in-kind and cash contributions.

TABLE 1: COSTS AND INCREMENTAL ANALYSIS

	Baseline (B)	Alternative (A)	Increment (A-B)
Global Benefits	• No systematic efforts to conserve crop genetic diversity through its use in production system for pest and disease management. • Lack of knowledge to exploit the natural resistance that resulted from the co-evolution of pest and host-species. • Pesticides used to control pest and diseases are polluting groundwater, affect human health, and decreasing beneficial insects and fungi diversity • 30% of the world annual harvest is lost to pest and disease, with developing countries experiencing the great devastation Baseline $ 5,416,699	• Conservation of globally significant crop genetic diversity in respect to resistance to pest and diseases • Conservation of associated biodiversity due to decreased pesticide use • Development of practices that use local crop genetic diversity to minimize pest and disease pressures that are replicable within and outside the four project countries. • Increased availability of "diversity rich" solutions to manage pest and disease pressures for small and marginal farmers, Alternative $ 20,756,831	Increment $ 15,340,162
Domestic Benefits	• Knowledge on the use of existing varieties to manage disease and pest incomplete and lacks information on the farmer's central role; • Host resistance breeding and pesticide use are the most common strategies to protect crops against pest and disease pressures proving only temporary solutions. • Most breeding programs use single genes to provide resistance across many types of environment. • Large areas in which popular resistant cultivars are planted facilitate rapid pathogen evolution and migration to overcome resistance.	• Farmers provided with low-cost options for pest and disease management. • Increased and more reliable food supply for local and indigenous communities through the use of crop genetic diversity to minimize crop loss • Capacity to make decisions by the farmers, development and extension workers, NGOs, NARS research scientists, and policy makers on when and where local crop genetic diversity will be useful to minimize pest and disease pressures • Crop breeding programmes more effective by increased use of local resistant materials and new methods to reduce crop vulnerability • Environmental health workers provided with an alternative to unsafe pesticide used • Benefit sharing protocols developed with farming communities	

Component 1: Criteria and tools to determine when and where intra-specific genetic diversity can provide an effective management approach for limiting crop damage caused by pests and diseases	• Knowledge of how pest and disease systems function • Limited characterization of local crop diversity of target crops • Lack of information to characterize hosts, pests, pathogens and surrounding abiotic environment in the production system • Lack of decision making procedures for farmers and development workers for use of local crop diversity for disease and pest management • Lack of information on local crop cultivar resistance to pest and pathogen pressure	• Criteria, guidelines and decision making tools for use of local crop diversity to pest and disease management developed • Genetic basis of resistance in local crop cultivars better understood and identified • Distribution patterns of the pathogen and of variation in pathogen virulence for the target crops better understood • Farmers concerns and appreciation of pest and diseases understood and used in decision making • Protocols for participatory assessment combined with laboratory and field analysis to determine when and where genetic diversity can be recommended to minimize pest and disease pressures on-farm • A set of tools to estimate the economic value of crop genetic diversity in reducing yield and quality losses, and yield variability	China: 982,224 Ecuador: 637,775 Morocco: 557,593 Uganda: 593,418 Total: 2,771,010 Co-finance: 1,708,719 Cost to GEF: 1,062,291
	China: 445,000 Ecuador: 183,000 Morocco: 258,375 Uganda: 294,200 Total: 1,180,575	China: 1,427,224 Ecuador: 820,775 Morocco: 815,968 Uganda: 887,618 Total: 3,951,585	
Component 2: Practices and procedures that determine how to optimally use crop genetic diversity to reduce pest and disease pressure	• No systematic information available to implement different ways of using within crop diversity in different production situations to reduce pest and disease pressures • Lack of tested diversity rich methods to manage pest and diseases	• Synthesis of farmers experiences on using crop genetic diversity to minimize pest and diease pressures • Increased number of different landraces with different resistance available to farmers • Desirable characters bred into resistant varieties • Increased number of varieties which are now more resistance through breeding or mixture planting • Diversity rich methods to manage pest and disease pressures tested and made available for different spatial scales	China: 1,068,312 Ecuador: 439,980 Morocco: 622,878 Uganda: 420,389 Total: 2,551,559 Co-finance: 1,445,331 Cost to GEF: 1,106,228

	China: 620,000 Ecuador: 297,400 Morocco: 383,315 Uganda: 207,000 Total: 1,507,715	China: 1,688,312 Ecuador: 737,380 Morocco: 1,006,193 Uganda: 627,389 Total: 4,059,274	
Component 3: Enhanced capacity of farmers and others to use local crop genetic diversity to manage pest and pathogen pressures	• Training to assess distribution and diversity for resistance, collecting and conservation techniques, data documentation, socio-economic issues and other areas related to conservation, and sustainable management of agrobiodiversity not available • Training for farmers, local communities, and policy makers not available	• Farmer associations established to support the use of local crop genetic diversity to minimize pest and disease damage • Male and female farmers have increased leadership capacity and participate in national decision making fora • International training center established and operative; • Stakeholders trained in areas of expertise needed for their role in project implementation; • Participatory research programmes established or enhanced to supporting agrobiodiversity conservation.	China: 1,772,373 Ecuador: 577,030 Morocco: 623,704 Uganda: 719,568 Total: 3,692,675 Co-finance: 2,422,674 Cost to GEF: 1,270,001
	China: 863,069 Ecuador: 381,200 Morocco: 255,479 Uganda: 194,900 Total: 1,694,648	China: 2,635,442 Ecuador: 958,230 Morocco: 879,183 Uganda: 914,468 Total: 5,387,323	

Component 4: Action that support adoption of genetic diversity rich methods for limiting damage caused by pests and diseases	• Extension and development systems and packages exist in countries but with minimal use of local crop genetic diversity and farmer knowledge • Seed cleaning techniques exist but not applied to local materials • Education sectors contain curriculum on biodiversity but lack inclusion of information on the value of agricultural biodiversity • International and domestic policies and laws exist related to biodiversity conservation and pesticide use • Partner countries are part of regional networks and strategies	• Agricultural extension packages include diversity rich options to manage pest and disease pressures • Policy briefs and extension manuals developed that demonstrate the economic value of using these options in practical terms, for policymakers and farmers in year five • Breeding, pathology, and entomology programmes in the country include the use of intraspecific diversity to manage pest and diseases in year four • Information exchange and mainstreaming of practices through national, regional and local conferences and workshops on diversity and pest and disease management • National education sectors have available materials on the use of diversity rich methods to manage pest and diseases for inclusion in curriculum • Recommendations on the establishment or improvement of benefit sharing protocols are submitted to policy makers by year five • Agreements for benefit sharing mechanisms among farmer communities and national programmes developed and adopted in each country by year five	China: 908,750 Ecuador: 608,395 Morocco: 686,550 Uganda: 480,271 Total: 2,683,966 Co-finance: 1,520,415 Cost to GEF: 1,163,551
	China: 520,000 Ecuador: 173,800 Morocco: 202,831 Uganda: 137,100 Total: 1,033,731	China: 1,428,750 Ecuador: 782,195 Morocco: 889,381 Uganda: 617,371 Total: 3,717,697	
Project Management		Effective national and global collaboration to produce project outputs with required standards of monitoring, evaluation and active participation of	China: 610,386 Ecuador: 372,000 Morocco: 469,291

		stakeholders in project activities at national and global levels. China: 610,386 Ecuador: 372,000 Morocco: 469,291 Uganda: 369,275 Global: 1,820,000 Total: 3,640,952	Uganda: 369,275 Global: 1,820,000 Total: 3,640,952 Co-finance: 1,374,489 Cost to GEF: 2,266,463

ANNEX B: PROJECT LOGICAL FRAMEWORK

Project Planning Matrix (PPM)	**Project title: "Conservation and Use of Crop Genetic Diversity to Control Pests and Disease in Support of Sustainable Agriculture"**	**Phase I:** **Date:**	**ANNEX B**

Objectives and Outcomes[1]	**Objectively Verifiable Indicators**	**Means of Verification**	**Important Assumptions**
Development Objective: Conserve crop diversity in ways that increase food security and improve ecosystem health	• 10% of the families from 31 local and indigenous communities show increased and more reliable food supply through the use of crop genetic diversity to minimize crop loss. • Diversity rich practices replace pesticide use in 31 local and indigenous communities.	• Project and survey reports that include quantification of reduced crop loss and cost savings from reduced pesticide use.	• Stable and favourable political environment • Policy makers' and partners' commitments
Immediate objective: Enhanced use of crop genetic diversity by farmers, farmer communities, and local and national institutions to minimize pest and disease damage on-farm	• At least 356,000 ha of land contribute to the conservation and sustainable use of crop genetic diversity in respect to minimizing pest and disease damage. • At least 2 departments of agriculture and the environment in each country have incorporated crop genetic diversity rich practices to minimize pest and disease pressures into their extension plans.	• Extension packages including instructions with diversity rich options. • Project publications, reports and agricultural census data • Participant lists of workshops and meetings, project reports	• Host resistance exists or available in project countries • Financial support is available • Decision makers are open to the adoption of diversity rich approaches
Outcome 1: Rural populations in the project sites benefit from reduced crop vulnerability to pest and disease attacks	• Food insecurity is reduced for 10% of the families in 31 local and indigenous communities. • Crop yields are increased by 10% from reduced crop losses from disease and pest damage for at least 20% (equivalent to 52,600 ha) of the farms in project sites. • Diversity rich practices replace pesticide use to minimize crop damage for 15% of project site regions (equivalent to 106,900 ha).	• Project reports including analysis of farmer interviews	• Host resistance exists or available in project countries • Farmers are open to the adoption of diversity rich approaches
Outcome 2: Increased genetic diversity on farm in respect to pest and disease management	• Diversity for resistance is increased by 10% on 30% of farmer fields in the project sites (equivalent to 78,900 ha). • Use of crop genetic diversity to manage pest and disease pressures occurs on 20% of the farms (equivalent to 142,600 ha) in the project sites in four countries.	• Survey reports on number of different landraces with different resistance, breeding desirable characters into resistant varieties; and number of varieties which are now more resistant through breeding or mixture planting.	• Host resistance exists or available in project countries

[1] All four project outputs contribute to the achievement of each of the three project outcomes and are therefore listed together after the project outcomes.

Outcome 3: Increased capacity and leadership abilities of farmers and local communities to make diversity rich decisions in respect to pest and disease management	• At least 20% of the farmers of the project site regions (equivalent to 6,200) implement diversity rich methods developed in the project to increase use of crop genetic diversity to manage pest and disease pressures on-farm. • At least two male and female farmer representatives in each site have participated in national committees or decision making fora for planning and evaluation of diversity rich methods to manage pest and diseases.	• Participant lists of national meetings	• Decision makers and farmers are open to the adoption of diversity rich approaches • A favourable political environment exist that supports farmers participation in national forum

Project Planning Matrix (PPM)	Project title: "Conservation and Use of Crop Genetic Diversity to Control Pests and Disease in Support of Sustainable Agriculture"	Phase I: Date:	ANNEX B

Outputs	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Outputs: *1. Criteria and tools to determine when and where intra-specific genetic diversity can provide an effective management approach for limiting crop damage caused by pests and diseases*	• Guidelines for Farmers Group Discussion to understand farmers' knowledge, practices, problems and needs for using diversity to control pests and diseases developed, published and used by year two. • Protocols for participatory assessment combined with laboratory and field analysis to determine when and where genetic diversity of the four target crops can be recommended to manage pest and diseases published and made available to concerned stakeholders by year three. • A set of methods and tools to estimate the value of crop genetic diversity in reducing yield losses, yield variability, and in mitigating product quality losses from pests and diseases tested and made available by year four in each country.	• Guidelines and protocols • Scientific publications • Training materials for farmers, extension workers and research groups • Periodic project progress reports • Donors reports	*In order to achieve output 1* • Farmers on-site are cooperative • Farmers have understanding and awareness about use of crop diversity
2. Practices and procedures that determine how to optimally use crop genetic diversity to reduce pest and disease pressure	• At least one diversity rich practice or option developed for each of the four target crops, which synthesizes project experiences and provides guidance to farmers on using diversity rich options to manage pest and disease by year four. • A set of recommendations that provide guidance about substituting diversity rich practices for pesticide use produced in each country and submitted to agricultural and environmental development sectors by year five.	• Technical reports of field trials of diversity rich options • Published manual • Report and papers from concerned partners • Community feedback and project documents	*In order to achieve output 2* • Decision makers are open to adoption of *in situ* conservation approaches to manage pest and disease damage
3. Enhanced capacity of farmers and other stakeholders to use local crop genetic diversity to manage pest and pathogen pressures	• At least one farmer associations is established or enhanced per site in each country to support the use of crop genetic diversity to manage pest and disease pressures by year four. • At least two male and female farmer representatives in each site have participated in national committees/ decision making fora for planning and evaluation of diversity rich methods to manage pest and diseases by year five. • At least four researchers with Partner teams have in-house expertise on all disciplines to enable project outputs in the country by year four of the project. • Site Coordination Committees are established in each county and operating to coordinating and link intra-site, thematic and multidisciplinary activities within each country by the end of year one.	• Progress reports • National reports and publications • Training course evaluation and reports • Training database • Training manuals, lecture notes and presentations • Increase farmers' knowledge about pests and disease management (site visits and interview with farmers) • Increase use of crop diversity on-	*To achieve output 3* • Commitment of the project partners is ensured • Farmers are receptive

	• At least two researches in each country with expertise on participatory approaches in respect to pest and disease management available in each country by year two. • At least one participatory research training programme developed at the provincial level in each country by year three. • An International Agrobiodiversity Training Centre is operative in China which includes a training curriculum on agrobiodiversity management for pest and disease pressures by year three. • At least two International Ph.D. sandwich programmes are set up with universities from the partner countries by year four.	farm (Site visits and community biodiversity registers)	
4. Actions that support the adoption of genetic diversity rich methods for limiting damage caused by pests and diseases.	• Agricultural extension packages include diversity rich options to manage pest and disease pressures in year five in each country. • Policy briefs and extension manuals developed that demonstrate the economic value of using these options in practical terms, for policymakers and farmers in year five. • Breeding, pathology, and entomology programmes in the country include the use of intraspecific diversity to manage pest and diseases in year four. • Four national and three regional conferences on diversity and pest and disease management organized by year five. • National education sectors have available materials on the use of diversity rich methods to manage pest and diseases for inclusion in curriculum in each country in year five. • At least two recommendations on the establishment or improvement of benefit sharing protocols are submitted to policy makers by year five. • At least two agreements for benefit sharing mechanisms among farmer communities and national programmes developed and adopted in each country by year five.	• National curricula • Course outlines • Diversity rich options used in farmers' field • Extension service packages • Policy guidelines	*To achieve output 4* • Decision makers are open to adoption of *in situ* conservation approach through use for pest and disease management

ACTIVITIES
1.1 Develop participatory criteria and tools to determine whether pest and or disease are a key limiting factor to production in farmers' systems: 1.1.1 Global and national workshops on participatory diagnostic approaches and data analysis 1.1.2 Global and national workshops to standardize assessment methods for pest, pathogen and environmental interactions 1.1.3 Determine farmers' concerns and appreciation of pest and diseases in their crops 1.1.4 Determine farmers' perceptions on the controllability of the pest or disease under different environmental conditions 1.1.5 Determine site characteristics (environmental, social, economic, levels of poverty) which influence the effect of pest and disease pressures **1.2 Determine whether intraspecific diversity with respect to resistance exists within the site:** 1.2.1 Assess the amount and distribution of crop genetic diversity (landraces) in target sites 1.2.2 Collect and analyze farmers' knowledge/descriptions of host diversity with respect to pest and diseases at different degrees, stages and environmental conditions 1.2.3 Conduct experiments for identification of resistance response in landraces - including intra-populations reactions to different pest and diseases 1.2.4 Develop criteria and tools to determine whether the pest and/or disease problem is related to lack of crop diversity with respect to resistance on-farm or to other factors **1.3 Identify other sources of intraspecific diversity with respect to resistance from earlier collections from the site or from similar agroecological environments (*ex situ* collections, other sites with similar environments):** 1.3.1 Look for *ex situ* characterization data and farmer knowledge on disease and pest response from earlier collections of landraces from the sites of similar environments to project sites 1.3.2 Conduct experiments for identification of resistance response in landraces **1.4 Develop criteria and tools to determine whether diversity, with respect to pest and/or disease control, exist but is not accessed and/or not optimally used:** 1.4.1 Determine whether farmers are using available intra-specific diversity to manage pest and diseases 1.4.2 Determine how farmers access intra-specific materials, and information on the materials, to manage pest and disease pressures 1.4.3 Identify constraints to optimal access and use of intra-specific diversity to manage pest and diseases (e.g., farmers are not aware that host resistance exists, mixtures not used that would reduce pest and disease pressures, problems in access to existent material) **1.5 Develop criteria and tools to determine whether there is diversity in virulence and aggressiveness of pathogens and biotype diversity for pests:** 1.5.1 Determine farmers' knowledge and perceptions on pathogen variation and pest population dynamics 1.5.2 Determine pathogen variation (e.g. collection, screening, and conservation of samples of isolates against a range of host genotypes) 1.5.3 Standardize methods for resistance and virulence screening for specific host-pest/pathogen systems 1.5.4 Standardize methods for determining population dynamics of pest for specific host pest systems **1.6. Determine the movement and transmission mechanisms of pest and diseases within and among the sites:** 1.6.1 Determine farmers' knowledge and perceptions on movement/transmission mechanisms of pest and pathogens and their management to reduce transmission (including seed systems and access to resistance hosts) 1.6.2 Identify key persons responsible and pathways for the movement of seeds/genetic planting material inside and outside the village and their knowledge of disease and pests 1.6.3 Quantify the transmission of the disease and pest through the movement of the material and through other mechanisms (including host range)

2.1 Identify and compile farmer knowledge and practices in on-going systems where intra-specific diversity is being used to manage pest and disease pressures and promote good practices
2.2 Conduct experiments using intra-specific diversity that show the effect of diversity on controlling pest and disease incidence
2.3 Evaluate past and present use of crop diversity by national breeding programmes to manage pest and disease pressures
2.4 Conduct simulation modeling to look at how patterns of intra-specific diversity distribution and population sizes might affect pest and disease incidence over space and time
2.5 Compare the range of diversity rich practices and options to determine appropriate spatial and temporal scales to manage pest and diseases pressures
2.6 Provide sets of options for farmers, farmer organizations, NGOs and extension works of diversity rich solutions to pest and disease management in project sites:

2.6.1 Provide different mixtures of local germplasm from project site materials and earlier collected materials (*ex situ* collections) from project sites and similar agroecosystems
2.6.2 Promote interchange resistance materials between farming communities from the same sites as well as between sites

3.1 Team building of farmers, field technicians, researcher, policymakers at regional and local level and education institutions (strengthen the ability to work in a group in a participatory manner):

3.1.1 Training in participatory approaches and team building for all the stakeholders mentioned above
3.1.2 Promote information interchange among different stakeholders through local networks

3.2 Provide opportunities to increase gender equity in project management and participation project activities and training opportunities

3.3 Identify key farmers (male and female) and farmer groups who use intra-specific crop diversity to manage their production systems and support these farmers with diversity rich options to manage pests and diseases:

3.3.1 Facilitate the definition of criteria to identify key farmers
3.3.2 Organize training programmes for identified key farmers and facilitate farmers to train other farmers
3.3.3 Organize cross site visits

3.4 Reinforce the local farmer organizations in seed activities related to pest and disease management

3.4.1 Seed cleaning, management and marketing
3.4.2 Support local seed system networks

3.5 Empower male and female farmers and other stakeholders to determine when diversity rich choices are appropriate for their circumstances:

3.5.1 Enhance farmers' knowledge to strength their decision-making on use of diversity choices to manage pest and disease pressure
3.5.2 Enhance the leadership ability of farmers to take decisions concerned with the management of pest and diseases (including participatory approaches for confidence building)

3.6 Identify and promote local methods for farmers to efficiently use crop diversity information:

3.6.1 Link with on-going national and/or informal (NGO) literacy promotion programmes to enhance farmer's ability to manage crop diversity information

3.7 Build local institutional capacities to sustain project activities through training and inputs to local extension, NGOs, CBOs, local research stations, middle and technical schools and local colleges:

3.7.1 Formulate and implement appropriate training programmes for each partner
3.7.2 Support and complement local educational initiatives already in operation (e.g. school curriculum) to include diversity rich solutions to manage pest and diseases

3.8 Enhance capacity of research institutes to analyze local crop diversity with respect to pest and disease resistance through training and facilities:

3.8.1 Support national needs to implement project activities through for short, medium and long term training plans in phytopathology, entomology, plant population

genetics, ethnobotany, economics and participatory approaches
- 3.8.2 Interchange of experts visits among country partners
- 3.8.3 Organization of thematic network meetings by crop and by discipline
- 3.8.4 Design "sandwich" programmes and courses among universities

3.9 Develop the understanding of national and international legal and economic policies related to use of local crop diversity to manage pest and disease pressures:
- 3.9.1 Develop strategy for information and germplasm exchange and testing based on national and international treaty and agreements

3.10 Set up an international network of persons from national, regional and global levels to compile and feed back information on using intraspecific diversity to manage pest and disease pressures

---

4.1 Document successful experiences from the project output of interdisciplinary work and of farmers' participatory research on use of diversity to manage pest and disease and recognition of such team efforts (prizes, awards, etc.):
- 4.1.1 Publish and disseminate information from the project case studies in different media forms (journals, newspapers, videos, radio, web pages, etc.) showing the benefits/gains from using of local crop diversity to manage pest and disease pressures
- 4.1.1 Organize and participate in national, regional and global scientific exchange meetings (including participation in other appropriate regional and international meetings in agrobiodiversity management, phytopathology and entomology not organized by the project)

4.2 Promote public appreciation and awareness of the use of agrobiodiversity to minimize pest and disease pressures for farmers, extension and education programs, and policy makers:
- 4.2.1 Organize field visits for policy makers and the press
- 4.2.2 Organize cross site visits for farmers

4.3 Develop mechanisms to disseminate information and materials to farmers and communities on previously collected (*ex situ*) and/or characterized/evaluated germplasm from farmers' sites and similar agroecosystems

4.4 Compare diversity rich approaches to other options (e.g., agronomic practices, chemical use):
- 4.4.1 Examine cost effectiveness of approaches and estimate economic benefits of using diversity rich approaches

4.5 Promote collaboration with agricultural extension services and local NGOs to increase access of locally adapted farmer seeds across villages and regions with similar agroecosystems:
- 4.5.1 Promote seed interchange through diversity fairs
- 4.5.2 Promote seed interchange through on site demonstration plots of selected *ex situ* collections
- 4.5.3 Promote seed interchange through local nodal farmer(s) on site – informal seed exchange system

4.6 Mainstream the inclusion of local crop diversity and techniques on seed cleaning of local crop cultivars and other methods of seed quality improvement into agricultural extension and NGO development packages

4.7 Adapt the national breeding strategy to include farmers' knowledge with local materials in breeding programmes:
- 4.7.1 Compare conventional breeding strategies with the farmers' strategies to minimize pest and disease pressures
- 4.7.2 Adopt the use of local resistant material together with farmers' knowledge in national breeding programmes
- 4.7.3 Develop or expand participatory selection and participatory breeding (PPB, PVS) to include the use of local resistant materials and farmers' knowledge

4.8 Work with education sectors to supply materials on the use of local crop diversity to manage pest and disease pressures to integrate into the national curriculum:
- 4.8.1 Review existing materials, identify areas where materials could be included, and supply information for inclusion of materials

4.9 Provide information for cost effective design of policies to support the maintenance of diversity on farm

4.10 Develop protocols for benefit sharing of genetic material and new methods of diversity management
5.3 Arrangements for overall project administration and implementation infrastructure: 5.1.1 Hire global project manager and assistant 5.1.2 Hire project personnel in partner countries 5.1.3 Establish and equip national project offices 5.1.4 Establish the Site Coordination Committees in each partner country 5.1.5 Establish and equip site committees at each site **5.2 Establish and operate project reporting and accounting system** **5.3 Prepare work plans for project personnel in partner countries** **5.4 International Steering Committee Meetings** **5.5 National Steering Committee Meetings** **5.6 Site Committee Meetings** **5.7 Site Coordination Committee meetings:** 5.7.1 Annual work plan workshops 5.7.2 Annual project implementation review meetings **5.8 Project monitoring and evaluation**

ANNEX B1: PHASE I - OBJECTIVELY VERIFIABLE INDICATORS AND MILESTONES (YEARS 1, 2 AND 3 OF PROJECT IMPLEMENTATION)

Components and Cost to GEF for Phase I	Objectively Verifiable Indicators (from Annex B: Logical Framework and Work Plan)	Percent Completion in Phase I	Logframe Activity Numbers	Phase I Milestones (from Annex P: Monitoring, Progress Reporting, and Evaluation Plan)
Component 1: *Criteria and tools to determine when and where intra-specific genetic diversity can provide an effective management approach for limiting crop damage caused by pests and diseases*	• Guidelines for Farmers Group Discussion to understand farmers' knowledge, practices, problems and needs for using diversity to control pests and diseases developed, published and used by year two.	**100% completed**	1.1.1-1.1.5 1.2.1-1.2.3 1.3.1-1.3.2 1.4.1-1.4.3 1.5.1-1.5.4 1.6.1-1.6.2	**M** Global workshop on participatory diagnostic approach and data analysis for developing Farmers Group Discussion (FGD) and participatory assessment combined with laboratory and field assessment organized by *Month 6 Year 1* **M** National workshops in each of the four countries to refine and finalize the FGD and participatory assessment, based on target crops and local situations, by *Month 10 Year 1* **M** Field survey for gathering site specific baseline information relating to amount of crop diversity, use of pesticides, site environment, social and economic aspects of the farmers and farming communities, undertaken by *Month 10 Year 1* **M** Survey information compiled and analyses to understand farmers belief regarding the concept of crop diversity and using the diversity to manage pest and diseases problem in their farming system by *Month 12 Year 1* **M** Survey information compiled and analyzed to determine whether intraspecific diversity with respect to resistance exists within the site and to identify other sources of diversity to be used by *Month 4 Year 2* **M** Guidelines information for Farmers Group Discussion to understand farmers' knowledge, practices, problems and needs for using diversity to control pests and diseases gathered and compiled from each of the four countries for publication by *Month 10 Year 2* **M** Experimentation conducted and data analyses to understand the pattern of diversity in resistance mechanism in host and pests and their interaction by *Month 6 Year 3* **M** Feedback on the usability and modification of the participatory protocol, based on its testing at each of the project sites from all the four countries compiled and the protocol finalised for its publication by *Month 6 Year 3*
	• Protocols for participatory assessment combined with laboratory and field analysis to determine when and where genetic diversity of the four target crops can be recommended to manage pest and diseases published and made available to concerned stakeholders by year three.	**100% completed**		
	• A set of methods and tools to estimate the value of crop genetic diversity in reducing yield losses, yield variability, and in mitigating product quality losses from pests and diseases tested and made available by year four in each country.	60% completed		
Component 2: *Practices and procedures that determine how to*	• At least one diversity rich practice or option developed for each of the four target crops, which synthesizes project experiences and provides guidance to farmers on using diversity rich options to manage pest and disease by year four.	20% completed	2.1 2.2 2.3	**M** Status of national crop improvement system for developing resistant varieties, its extension and associated problem and challenges fully understood and documented in each of the four countries by *Month 8 Year 2* **M** Full support provided to the establishment of International Agrobiodiversity Training Centre in China and made operative

optimally use crop genetic diversity to reduce pest and disease pressure	• A set of recommendations that provide guidance about substituting diversity rich practices for pesticide use produced in each country and submitted to agricultural and environmental development sectors by year five.	20% completed	2.6.1-2.6.2	for training of project partners by *Month 6 Year 3*
Component 3: *Enhanced capacity of farmers and other stakeholders to use local crop genetic diversity to manage pest and pathogen pressures*	• At least one farmer associations is established or enhanced per site in each country to support the use of crop genetic diversity to manage and pest and disease pressures by year four.	30% completed	3.1.1-3.1.2 3.3.1-3.3.3 3.5.1-3.5.2 3.6 3.7.1-3.7.2 3.8.1-3.8.3 3.10	**M** Team building and participatory training workshops in each of the four countries organised by *Month 8 Year 2* **M** Key farmers, both male and female, identified and were trained at each site in each of the four country for their active participation in the project by *Month 10 Year 1* **M** Necessary training facilities at national and site level provided to all four countries by *Month 5 Year 2* ***M*** Full support provided to the establishment of International Agrobiodiversity Training Centre in China and made operative for training of project partners by *Month 6 Year 3*
	• At least two male and female farmer representatives in each site have participated in national committees/ decision making fora for planning and evaluation of diversity rich methods to manage pest and diseases by year five.	0%		
	• At least four researchers with Partner teams have in-house expertise on all disciplines to enable project outputs in the country by year four of the project.	30% completed		
	• Site Coordination Committees are established in each county and operating to coordinating and link intra-site, thematic and multidisciplinary activities within each country by the end of year one.	**100% completed**		
	• At least two researches in each country with expertise on participatory approaches in respect to pest and disease management available in each country by year two.	**100% completed**		
	• At least one participatory research training programme developed at the provincial level in each country by year three.	30% completed		
	• An International Agrobiodiversity Training Centre is operative in China which includes a training curriculum on agrobiodiversity management for pest and disease pressures by year three.	**100% completed**		

Component 4: *Actions that support the adoption of genetic diversity rich methods for limiting damage caused by pests and diseases.*	Agricultural extension packages include diversity rich options to manage pest and disease pressures in year five in each country.	10%	4.1.1 4.2.2 4.3 4.5.2 4.7.1	**M** Global and National project web sites established, both in English and local languages for information sharing and e-discussion by *Month 4 Year 2*
	• Policy briefs and extension manuals developed that demonstrate the economic value of using these options in practical terms, for policymakers and farmers in year five.	10%		
	• Breeding, pathology, and entomology programmes in the country include the use of intraspecific diversity to manage pest and diseases in year four.	10%		
	• Four national and three regional conferences on diversity and pest and disease management organized by year five.	10%		
	• National education sectors have available materials on the use of diversity rich methods to manage pest and diseases for inclusion in curriculum in each country in year five.	0%		
	• At least two recommendations on the establishment or improvement of benefit sharing protocols are submitted to policy makers by year five.	10%		
	• At least two agreements for benefit sharing mechanisms among farmer communities and national programmes developed and adopted in each country by year five.	10%		
Component 5: *Project Management*	• Project management	50%	5.1-5.8	Years 1-3 of project management

ANNEX C: STAP ROSTER TECHNICAL REVIEW

"CONSERVATION AND USE OF CROP GENETIC DIVERSITY TO CONTROL PESTS AND DISEASES IN SUPPORT OF SUSTAINABLE AGRICULTURE"

Norman C. Ellstrand
Professor of Genetics
University of California at Riverside

Key issues

♦ ***Scientific and technical soundness of the project***

Overall, the project has a high level of scientific and technical soundness. The keystone to the project is the general observation that very low genetic diversity in crops is highly correlated with vulnerability to epidemics of pests – both disease organisms and other organisms such as insects that devastate yields. The same observation has been made for wild populations that have low genetic diversity. Those observations have been largely backed up with experimental and theoretical work that has demonstrated that genetic mixtures generally have higher mean yields (or fitness, in the case of wild populations) than genetically uniform stands. The authors of the proposal, however, correctly note that not all genetic diversity should necessarily lead to sustainability of crop yields, but rather genetic diversity for resistance to pests. They note that a general feature of traditional agriculture is that farmers frequently manage the genetic diversity of their crops in such a way that genetic diversity with regard to resistance is frequently maintained or augmented, resulting in sustainable yields.

The goal of the proposal is to study how genetic diversity for resistance is managed and maintained such that the best practices can be identified and introduced to resource-poor rural populations to increase yields and sustainability. With this information, farmers should be able to grow crops more sustainability without resorting to pesticides, thereby having economic and environmental benefits as well.

The crops and countries have been well chosen. In particular, the six crops represent globally important species that provide food in multiple continents. Therefore, their general biology, agricultural biology, and pest biology have been extremely well-studied. At the same time, the six are a diverse assemblage representing three different plant families – two grains, two pulses, and a fleshy fruit – and the three types of plant reproductive systems – selfing, outcrossing, and clonal reproduction. The crop pests under study represent microorganisms, pest insects, and nematodes. The four target countries represent three different continents and four different biogeographical zones. And while they are all developing nations, the central locus for research at each is a significant research institution.

The research has two important components: ethnobotanical and ecological/genetic. The ethnobotanical component involves measuring farmers' beliefs and practices. The ecological/genetic component involves measuring biological and abiotic parameters at the field sites.

Nonetheless, I have a set of questions regarding the research. The details of how genetic diversity will be measured and described are not clear. Furthermore, it is not clear how either set of data will be statistically analyzed. Both straightforward comparisons of controls to experiments will be necessary; some multivariate analysis is probably necessary as well. Also, I note that there is an explicit plan for monitoring, but it is not clear to me that the project has an internal adaptive protocol if unanticipated data or other problems appear that require a re-evaluation of the project's planned pathway. Finally, given year-to-year environmental variation that impacts yields, is a single year of data collection sufficient to create a baseline for future comparison? Regarding these questions, it is disconcerting to read on pages G-42 and G-43 that protocols for technical assessment of the crops have not yet been developed.

- ***Global environmental benefits and/or drawbacks of the project***

If it is shown that genetic diversity for resistance of crop pests can be manipulated to significantly reduce food insecurity – and that it is general over sites, crops, countries, and pests, application of the information gleaned in this project has tremendous potential for global environmental benefits because genetic manipulation would serve as an alternative to pesticides. The adoption of this methodology by farmers, large and small, would reduce pesticide use and pesticide exposure to farmers and non-pest organisms in the surrounding environment. Secondary environmental benefits would include (1) reduced need to transport pesticides, reducing burning of fossil fuels, and (2) reduced exposure to residual pesticides by the human and animal consumers of the crops. If the methodology is indeed general, the substitution of genetic manipulation for pesticide use could be applied anywhere globally with the above benefits.

One potential drawback is that the principal of managing crops for an *<u>optimal</u> level of genetic diversity with respect to pest resistance* might easily be misunderstood as managing crops for a *<u>maximum</u> amount of general genetic diversity*. Conservation geneticists who work on wild populations have already come to realize that introducing genetic diversity to populations for its own sake may have disastrous consequences. I am confident that the authors of this proposal recognize that but should be on guard that their results are not misunderstood.

- ***Global environmental benefits for the biodiversity important to agriculture***

If the methodology is indeed general, genetic manipulation of crops for diversity with regard to pest resistance has immediate benefits for the biodiversity important to agriculture. First and foremost, it is recognized that genetic diversity itself is an important component of the biodiversity important to agriculture. *Ex situ* conservation of genetic diversity has been critical for crop improvement in the last century, including improvement in areas other than pest resistance. Efforts towards *in situ* conservation of genetic diversity have been uneven at best. The management of genetic diversity at the farm level has the immediate benefit of tremendously augmenting the diversity held in *ex situ* collections (it should be noted, however, that *in situ* conservation <u>does not replace</u> *ex situ* collections). That *in situ* diversity is likely a valuable resource for future crop improvement for crop resistance in other regions of the world and for other purposes as well. Maintenance of such a large base of germplasm serves as a *global* resource of food security via the opportunity for enhanced germplasm exchange among countries because of the greater pool of genotypes available.

Secondly, reduced pesticide use stops the pesticide-based deaths of non-target beneficial organisms. For example, these include soil species that interfere with populations of soil-borne pest species as well as insects that effect pollination or prey upon insect pests. Therefore, application of the new methodology is expected to increase beneficial species diversity in agroecosystems wherever applied.

♦ ***How the project fits within the context of the goals of GEF, as well as its operational strategies, Operational Programme 13 on Conservation and Sustainable Use of Biological Diversity Important to Agriculture, Strategic Objectives for Biodiversity focal area, GEF Council guidance and the provisions of the relevant conventions, particularly the Convention on Biological Diversity (CBD) and approved by Conference of Parties (COP) work programme for Agrobiodiversity.***

As a plan to increase, manage, and sustainably maintain biodiversity, the project fits the goals and operational strategies of the GEF very well. It matches the priorities of GEF OP 13 in that it directly addresses the objective "… to promote the positive and mitigate the negative impacts of agriculture systems and practices on biological diversity in agro-ecosystems and their interface with other ecosystems; the conservation and sustainable use of genetic resources of actual and potential value for food and agriculture … ". Likewise, the project directly addresses the four objectives of the Convention on Biological Diversity program of work on agricultural biodiversity in that it (1) assesses biological diversity – both in terms of measuring genetic diversity and assesses farmer knowledge; (2) builds an adaptive management scheme from case studies (a) by studying the goal of genetic diversity in providing resilience, reducing susceptibility to pests, and enhancing adaptability through the *in situ* management of local germplasm and (b) by studying pest and disease control mechanisms, (3) builds capacity by the cycle of knowledge and information among farmers, extension workers, and scientists as the same time directly linking them to a framework of national and international programs for agricultural biodiversity, and (4) creates a mainstreaming effect driven by the immediate benefits of the research. In the same way, the project supports the goals of the other programs listed above.

♦ ***Rationale for the project's global approach***

As noted above, the rationale for the project's global approach is clear. The four partner countries represent as diverse a set of environmental sites as possible, a key for testing for global generality. Likewise, if global generality is demonstrated by the project, then because of the immediate and diverse benefits of crop genetic diversity management as an alternative to pesticides (listed above and below), it is likely that the diversity-promoting methodology developed will be globally adopted, with adaptation to local crops, pests, and conditions.

♦ ***Replicability of the project (added value for the global environment beyond the project itself)***

If the methodologies developed by the project are found to be generally successful for the crops, pests, sites, and countries involved, then the project is inherently replicable because it should "sell itself", mainstreaming into other regions motivated by the anticipated benefits accrued that have been described above.

♦ ***Sustainbility of the project in terms of environmental, socio-economic and financial sustainability***

Currently, the global trend has been to increased local genetic uniformity of crops. It is well-accepted that the temporary gains in yields are accompanied by occasional disastrous outbreaks of pests. While pesticides can offer relief from pests, pests eventually evolve resistance, leading to even worse outbreaks. Clearly, the current trend is not sustainable.

If management of genetic diversity for optimization of food security proves to be globally general, the project should be inherently environmental, socio-economic, and financial sustainable. It will be environmentally stable because the higher levels of biodiversity that will be generated (both intra-specific and inter-specific) are already known to be correlated with community and ecosystem stability and resilience. The use of fewer pesticides will also contribute to environmental sustainability. Socio-economic sustainability should also be enhanced as the iterative cycle of exchange of information between farmers, scientists, and other project participants increases and stabilizes crop yields for the farmers who adopt the refined methodology that emerges. As the project becomes increasingly successful, its own financial sustainability should be assured as other regions seek to adopt the new methodology.

Secondary issues

- ***Linkages between biodiversity and other focal areas.***

The project involves direct and straightforward linkage of genetic biodiversity to a number of other GEF focal areas. In particular, the reduced use of pesticides accrued as a benefit of increasing and maintaining crop genetic diversity related to pest resistance will result in reduced runoff of pollutants into international waters, reduced land degradation by pesticide accumulation, and the overall reduced use and accumulation of persistent organic pollutants.

- ***Linkages to other programmes and action plans at regional or sub-regional levels.***

The four partner countries have strong multiple links to other relevant programs. All are participants in regional plant genetic resources networks and other programs for the improvement of agriculture, and the development of rural communities (including a number of existing UNEP-GEF projects). These are extensively detailed in the proposal brief and the Annexes of the proposal.

- ***Other beneficial or damaging environmental effects***

None that I can think of.

- ***Degree of involvement of stakeholders in the project***

The proposed project has an impressive array of appropriate stakeholders. At the local level, the direct stakeholders, the farmers, are directly involved in conveying data. Local scientists are directly interacting with the farmers. All of the appropriate stakeholders at a series of higher levels appear to be listed for each of the countries involved – academic, NGO, governmental and other public institutions – representing all aspects of agriculture, agricultural science, environmental science, and the communities of people directly involved. I could not identify any group of obvious stakeholders that were overlooked.

♦ ***Capacity-building aspects***

As designed, the project inherently builds capacity because its execution depends on training of the participants and by the requisite establishment of collaborative frameworks from the local through the national to the international levels. In particular, farmers and farmer groups will receive substantial training because they represent the sites of the management of genetic diversity for pest control. At the same time, it is farmers' knowledge and skills that will be accumulated by the scientists involved in the project so that the farmers will be training local scientists as much as the scientists are training the farmers. This iterative cycle of training provides an opportunity to break down barriers and build lasting partnerships. Also, I note that the major academic institutions involved in the project will serve as sites for "sandwich" Ph.D. programs.

♦ ***Innovativeness***

The proposed project is exceptionally innovative. While germplasm scientists have cried for decades for the need for farmers to be involved in *in situ* conservation, they have often felt that farmers would accrue no benefit from doing that. On the other hand, crop ecological geneticists have recognized the benefit of genetic diversity in raising and sustaining wild plant fitness and crop yields, but with little opportunity to use that information. The proposed project seeks to merge the first goal with the recognized benefits posited by the second goal. When reading this proposal, it seems like a "no-brainer" but it is clearly not obvious because the need for *in situ* conservation and the benefits of genetic mixtures have been well-known for at least thirty years. This is a bold and innovative application of plant population genetics.

ANNEX C1 - RESPONSE TO STAP REVIEW

We would like to thank the Reviewer for his comments noting the high level of scientific and technical soundness of the proposal, the impressive array of stakeholders, and the inherent capacity building component based on the project's collaborative partnerships. We also appreciate the Reviewer's agreement on the appropriateness of the crops, pest and disease systems, countries, and lead institutions selected for the proposal, and his statement that "the proposed project is exceptionally innovative." We have listed responses below to the reviewer's set of questions regarding the project.

- ***Scientific and technical soundness of the project***

***Reviewer comment**:*
1. The details of how genetic diversity will be measured and described are not clear.

Response:
We agree with the reviewer on the need to have a sound strategy for the measurement of genetic diversity on-farm. These methodologies were not specifically stated in the project brief, as extensive in-house experience and documentation is available at IPGRI and its national and international partners on the assessment of the amount and distribution of diversity in farmers' fields *(e.g., Jarvis, DI, L Myer, H Kelmick, L Guarino, M Smale, AHD Brown, M Sadiki, B Sthapit, and T Hodgkin. 2000. "A Training Guide to In Situ Conservation On-farm. Version I." International Plant Genetic Resources Institute, Rome, Italy*). This expertise is mentioned in Paragraph 29 of the Project Brief where we discuss the fact that protocols have been developed to determine how consistent are the names and traits that farmers use to distinguish their varieties, with genetically identifiable units.

In this project, diversity will be measured at agromorphological, biochemical and molecular levels using international standards and protocols developed through earlier projects in Nepal, Morocco, Uganda and Mexico. CSIRO (one of the international partners) has been working with IPGRI and its national partners over the last nine years to develop capacity in national programmes in the assessment of the amount of distribution of diversity maintained over time on farmers fields. The three US universities (Washington State University, Oregon State University and Cornell) also have extensive expertise on traditional diversity assessment methods. This capacity and inputs of the project national and international partners are listed in the Annex E: The Public Involvement Plans.

***Reviewer comment**:*
2. There is an explicit plan for monitoring, but it is not clear to me that the project has an internal adaptive protocol if unanticipated data or other problems appear that require a re-evaluation of the project's planned pathway.

Response:
An internal adaptive protocol is part of the project implementation plan. As the project progresses, protocols for data collection will be re-evaluated and refined. This is part of the protocol development procedure mentioned in Annex G, and shown on page G-22 for the participatory diagnostic component, but will also be applied to the other components of the project.

Reviewer comment*:*
3. Given year-to-year environmental variation that impacts yields, is a single year of data collection sufficient to create a baseline for future comparison?

Response:
Although a single year of data constitutes the primary baseline, data exist from previous years in related sites in all four countries, and within specific project sites in Morocco and Uganda through earlier projects. Previous year data will provide some measure of year-to-year variation. Certainly, the project plans to have yearly sampling, which will provide additional information on year-to-year variation. The amount of yearly data collected will be based on an analysis of the baseline information collected during the first year of the project. This will be more clearly spelled out when the national work plans are developed.

Reviewer comment*:*
4. Regarding these questions, it is disconcerting to read on pages G-42 and G-43 that protocols for technical assessment of the crops have not yet been developed.

Response:
We realize from reading this comment of the reviewer that the statements on pages G-42 and G-43 are misleading, and the word "development" should not have been used. In fact, technical assessment methods of host-pest/pathogen systems do exist for all systems proposed in the project. As noted in paragraph 31 of the Project Brief, the crop-host/pathogen systems are well characterized. Descriptions of host-pest/pathogen systems are described in Annex L. What is currently lacking is a finalized standardization by crops across the countries on the experimental design, minimum sampling sizes and precise procedures appropriate for specific sites. A working meeting (as noted in Activity 1.1.2) is planned in the first six months of the project, to standaradize technical assessment protocols across the countries, so as to meet comparative objectives of producing globally applicable protocols.

- ***Global environmental benefits and/or drawbacks of the project***

Reviewer comment*:*
5. One potential drawback is that the principal of managing crops for an <u>*optimal*</u> *level of genetic diversity with respect to pest resistance might easily be misunderstood as managing crops for a* <u>*maximum*</u> *amount of general genetic diversity.*

Response:
We are glad that the reviewer has drawn attention to this point. We are also concerned that the project is not misinterpreted as promoting maximum amounts of diversity, which could be detrimental to farmers' livelihoods. The project does not assume that maximum diversity is the best solution, but will identify when and where diversity, and the optimal levels of this diversity, could be used to minimize pest and disease pressures. For this reason, as stated in the Project Brief Summary, and within the title of Output 1 of the Project Brief, the project proposes to develop tools to determine when and where intra-specific crop diversity <u>can</u> provide and effective management approach. Output 2 also notes that the project seeks to develop and promote: "Practices and Procedures that determine how to <u>optimally</u> use crop genetic diversity."

- ***Global environmental benefits for the biodiversity important to agriculture:***

Reviewer comment:
6. The management of genetic diversity at the farm level has the immediate benefit of tremendously augmenting the diversity held in ex situ collections (it should be noted, however, that in situ conservation <u>does not replace</u> ex situ collections).

Response:
We are in agreement with the reviewer's comment that *in situ* conservation does not replace *ex situ* collections. Identification of other sources of intraspecific diversity from earlier *ex situ* collections from project sites or similar agroecological environments is a part of Activity 1.3 (Annex B). Activity 4.3 is designed to develop mechanisms to disseminate information and materials to farmers and communities on previously collected (*ex situ*) materials. In addition, the project is also concerned with developing protocols for the conservation of sample isolates as mentioned in Activity 1.5.2.

Reviewer comment:
7. Reduced pesticide use stops the pesticide-based deaths of non-target beneficial organisms. For example, these include soil species that interfere with populations of soil-borne pest species as well as insects that effect pollination or prey upon insect pests.

Response:
We thank the reviewer for pointing out the importance of this project in not only conserving crop genetic diversity on-farm, but also on the potential global benefit it will have on the conservation of associated biodiversity.

♦ ***Rationale for the project's global approach***

Reviewer comment:
9. The rationale for the project's global approach is clear. The four partner countries represent as diverse a set of environmental sites as possible, a key for testing for global generality.

Response:
As noted by the reviewer, and also in paragraphs 11, 12, and 13 of the Project Brief, the global approach proposed in this project will allow the promotion of methodologies that can be globally adopted with adaptation to local crops, pests, and conditions.