GLOBAL
ENVIRONMENT
FACILITY

Ethiopia

A Dynamic Farmer-Based Approach to the Conservation of African Plant Genetic Resources

Project Document
February 1994

undp

GLOBAL
ENVIRONMENT
FACILITY

Ethiopia

A Dynamic Farmer-Based Approach to the Conservation of African Plant Genetic Resources

Project Document
February 1994

undp

GLOBAL ENVIRONMENT FACILITY

Ethiopia

A Dynamic Farmer-Based Approach to the Conservation of African Plant Genetic Resources

Project Document

This Project Document has been edited to facilitate public dissemination.
The original is on file in the GEF Office at UNDP Headquarters in New York.

GLOBAL ENVIRONMENT FACILITY

Ethiopia

A Dynamic Farmer-Based Approach to the Conservation of African Plant Genetic Resources

Project Document

This Project Document has been edited to facilitate public dissemination.
The original is on file in the GEF Office at UNDP Headquarters in New York.

ABBREVIATIONS

AMCEN	African Ministerial Conference on the Environment
AUA	Alemaya University of Agriculture
BIDNET	Biodiversity Network
CBDC	Community Biodiversity Development and Conservation
CCA	Crop Conservation Association
CGB	Community Gene Bank
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
IAR	Institute of Agricultural Research
IPGRI	International Plant Genetic Resource Institute
MNRDEP	Ministry of Natural Resources Development and Environmental Protection
MOA	Ministry of Agriculture
NGO	Non-governmental organization
PAOC	Project Advisory and Overseeing Committee
PGR	Plant Genetic Resources
PGRC/E	Plant Genetic Resources Centre/Ethiopia
RAFI	Rural Advancement Fund International
SOS	Seeds of Survival
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USC/C	Unitarian Services Committee/Canada

ABBREVIATIONS

AMCEN	African Ministerial Conference on the Environment
AUA	Alemaya University of Agriculture
BIDNET	Biodiversity Network
CBDC	Community Biodiversity Development and Conservation
CCA	Crop Conservation Association
CGB	Community Gene Bank
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Facility
IAR	Institute of Agricultural Research
IPGRI	International Plant Genetic Resource Institute
MNRDEP	Ministry of Natural Resources Development and Environmental Protection
MOA	Ministry of Agriculture
NGO	Non-governmental organization
PAOC	Project Advisory and Overseeing Committee
PGR	Plant Genetic Resources
PGRC/E	Plant Genetic Resources Centre/Ethiopia
RAFI	Rural Advancement Fund International
SOS	Seeds of Survival
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USC/C	Unitarian Services Committee/Canada

CONTENTS

CONTENTS

UNITED NATIONS DEVELOPMENT PROGRAMME

GLOBAL ENVIRONMENT FACILITY

Project of the Government of Ethiopia

Title:	A Dynamic Farmer-Based Approach to the Conservation of African Plant Genetic Resources
Number:	ETH/93/G31
Duration:	Three years
Project site:	Ethiopia
UNDP Sector:	Environment
Subsector:	Natural resources
Government Sector and Subsector:	Natural resources
Implementing Agency:	Ministry of Natural Resources Development and Environmental Protection (MNRDEP)
Collaborating Agency:	Plant Genetic Resource Centre/Ethiopia (PGRC/E)
UNDP Approval:	February 1994
Estimated Starting Date:	June 1994
Government Inputs:	1,324,360 Ethiopian birr (US$ 236,493) (in kind)[1]
UNDP/GEF Inputs:	US$ 2,428,000

Brief Description:

This is a biodiversity conservation project which addresses a neglected aspect of plant diversity—indigenous crop varieties maintained by farmers in dynamic agro-ecosystems, such as those found in Ethiopia. Efforts to conserve crop diversity have, to date, focused on maintaining genetic diversity in static *ex situ* gene banks. This procedure has arrested the complex interaction

[1] According to the official exchange rate at the time of signature of this Project Document, US$ 1 = Ethiopian birr (Br) 5.6.

UNITED NATIONS DEVELOPMENT PROGRAMME

GLOBAL ENVIRONMENT FACILITY

Project of the Government of Ethiopia

Title:	A Dynamic Farmer-Based Approach to the Conservation of African Plant Genetic Resources
Number:	ETH/93/G31
Duration:	Three years
Project site:	Ethiopia
UNDP Sector:	Environment
Subsector:	Natural resources
Government Sector and Subsector:	Natural resources
Implementing Agency:	Ministry of Natural Resources Development and Environmental Protection (MNRDEP)
Collaborating Agency:	Plant Genetic Resource Centre/Ethiopia (PGRC/E)
UNDP Approval:	February 1994
Estimated Starting Date:	June 1994
Government Inputs:	1,324,360 Ethiopian birr (US$ 236,493) (in kind)[1]
UNDP/GEF Inputs:	US$ 2,428,000

Brief Description:

This is a biodiversity conservation project which addresses a neglected aspect of plant diversity—indigenous crop varieties maintained by farmers in dynamic agro-ecosystems, such as those found in Ethiopia. Efforts to conserve crop diversity have, to date, focused on maintaining genetic diversity in static *ex situ* gene banks. This procedure has arrested the complex interaction

[1] According to the official exchange rate at the time of signature of this Project Document, US$ 1 = Ethiopian birr (Br) 5.6.

of genetically diverse traditional cultivated varieties (landraces) with their associated pests, predators and pathogens. *Ex situ* conservation also fails to retain traditional farmer knowledge associated with landraces, which can be instrumental in the utilization and development of new crop varieties from farmers' original landraces. Through a novel method of establishing Community Gene Banks (CGBs), this project will link farm communities and their landraces with existing genetic resource conservation efforts of the Plant Genetic Resources Centre/Ethiopia (PGRC/E). Strengthening Ethiopian capacity for research and extension will support conservation and allow a sustainable expansion of this programme to other regions of the country. This project will minimize the conflict between the need to introduce new agricultural technology (seeds and fertilizer), and the need to conserve traditional crops, since modern and traditional crops are grown in different segments of Ethiopian farming systems. As a pilot project, this programme can be applied, with modifications, to other areas of the world facing loss of traditional crop genetic resources and associated farmer knowledge.

A. CONTEXT

1. Description of subsector

Ethiopia is one of several areas of the world where crop plants were domesticated from wild species. The continued interaction of cultivated crop types with their wild relatives under diverse ecological, social, and economic conditions have made Ethiopia one of the most heterogenous areas of the world in terms of genetic diversity of landraces. Even crops which were originally domesticated outside of the East African Highlands exhibit extreme secondary diversification in Ethiopia.

Landraces are genetically diverse forms of cultivated plants. They are a subset of biodiversity at the interface between wild plant species, and domesticated biota which are manipulated by humans. Through selection, adaptation, and exchange of genes with wild species, landraces represent repositories of traits which have evolved in local environments over long periods of time. Landraces have provided resources from which modern, and often higher yielding, crop varieties have been developed. The genetic diversity found in Ethiopian landraces has been used worldwide by plant breeders as a resource in developing new crop varieties. Introduction of these new varieties has subsequently lead to a decrease, and in some cases loss of, genetic diversity in traditional landraces.

The conservation of local landraces is, therefore, of critical importance worldwide, not only to scientific crop improvement, but also to subsistence agriculture of small farmers in Africa and other regions. Landraces are managed in low-input agro-ecosystems. They can serve as important resources from which to develop new varieties for low-input agriculture, and contribute to more environmentally friendly, and thus more sustainable, farming.

The importance of landraces as sources of a multitude of varied desirable traits, and the rate at which they are being replaced by more recently developed varieties with narrow genetic bases, has spurred international action to conserve this diminishing resource base. This genetic erosion has been addressed by global efforts to conserve plant genetic resources both as seeds and as living plants in off-farm or *ex situ* gene banks. The existing PGRC/E *ex situ* collection is an excellent example

of genetically diverse traditional cultivated varieties (landraces) with their associated pests, predators and pathogens. *Ex situ* conservation also fails to retain traditional farmer knowledge associated with landraces, which can be instrumental in the utilization and development of new crop varieties from farmers' original landraces. Through a novel method of establishing Community Gene Banks (CGBs), this project will link farm communities and their landraces with existing genetic resource conservation efforts of the Plant Genetic Resources Centre/Ethiopia (PGRC/E). Strengthening Ethiopian capacity for research and extension will support conservation and allow a sustainable expansion of this programme to other regions of the country. This project will minimize the conflict between the need to introduce new agricultural technology (seeds and fertilizer), and the need to conserve traditional crops, since modern and traditional crops are grown in different segments of Ethiopian farming systems. As a pilot project, this programme can be applied, with modifications, to other areas of the world facing loss of traditional crop genetic resources and associated farmer knowledge.

A. CONTEXT

1. Description of subsector

Ethiopia is one of several areas of the world where crop plants were domesticated from wild species. The continued interaction of cultivated crop types with their wild relatives under diverse ecological, social, and economic conditions have made Ethiopia one of the most heterogenous areas of the world in terms of genetic diversity of landraces. Even crops which were originally domesticated outside of the East African Highlands exhibit extreme secondary diversification in Ethiopia.

Landraces are genetically diverse forms of cultivated plants. They are a subset of biodiversity at the interface between wild plant species, and domesticated biota which are manipulated by humans. Through selection, adaptation, and exchange of genes with wild species, landraces represent repositories of traits which have evolved in local environments over long periods of time. Landraces have provided resources from which modern, and often higher yielding, crop varieties have been developed. The genetic diversity found in Ethiopian landraces has been used worldwide by plant breeders as a resource in developing new crop varieties. Introduction of these new varieties has subsequently lead to a decrease, and in some cases loss of, genetic diversity in traditional landraces.

The conservation of local landraces is, therefore, of critical importance worldwide, not only to scientific crop improvement, but also to subsistence agriculture of small farmers in Africa and other regions. Landraces are managed in low-input agro-ecosystems. They can serve as important resources from which to develop new varieties for low-input agriculture, and contribute to more environmentally friendly, and thus more sustainable, farming.

The importance of landraces as sources of a multitude of varied desirable traits, and the rate at which they are being replaced by more recently developed varieties with narrow genetic bases, has spurred international action to conserve this diminishing resource base. This genetic erosion has been addressed by global efforts to conserve plant genetic resources both as seeds and as living plants in off-farm or *ex situ* gene banks. The existing PGRC/E *ex situ* collection is an excellent example

of this effort. To date, nearly all such efforts have been focused on conserving crop genetic resources in germplasm repositories which are part of a "formal" international network. While providing one important means of preserving genetic resources, *ex situ* conservation also has the effect of disassociating the material kept in gene banks from communities and farmers, the "informal" sector of genetic resource conservation, and primary users of the material. *Ex situ* conservation also separates farmer knowledge from farmer varieties in that existing *ex situ* data management does not adequately conserve traditional knowledge.

Countless useful genetic variations of global significance have originated at the local farm and rural community level. Among numerous examples are the yellow dwarf virus resistance gene found in Ethiopian barley, on which California's US$ 160 million annual barley crop depends, as well as the high-lysine gene in sorghum, also of Ethiopian origin.

The *ex situ* conservation of genetic resources has proved its worth by saving genes that would have otherwise been lost. But it should be remembered that in nature genes exist, mutate, and continue to increase or decrease, or even disappear, in response to a dynamic interaction with soil and climatic factors, diseases, pests and competitors. This dynamic interaction extends over the whole agricultural history of that crop, and over the whole area where that crop grows, and even where its wild relatives grow. In *ex situ* conservation, time is frozen at sampling, and space is squeezed to that of the fields used for regeneration. Occasional regeneration only accentuates the impact of these unnatural conditions since a diminutive time and a diminutive space are substituted for the dynamic forces which evolved on a much larger scale. This situation explains why regeneration, though necessary, inevitably causes genetic erosion. When seeds from a gene bank are planted out, even this narrowed genetic base which survives the wasting effects of storage and regeneration risks being unequal to the genetic base of the disease, pest, and weed organisms which have continued to evolve. Likewise, the edaphic and climatic conditions have continued to change. A complementary approach to *ex situ* conservation is, therefore, required.

Ex situ conservation needs to be complemented in a way that maximizes the retention and continued evolution of the adaptive qualities of landraces, and avoids the loss of variation that occurs in sampling and maintenance. This situation requires that conservation of landraces by farmers *in situ* be part of the existing cropping system. Conservation at the farm level allows for continuing farmer selection, interaction with the environment, and gene exchange with wild species so that evolution of landraces may continue. Because indigenous crop landraces are genetically diverse and well adapted to local agro-ecological and sociocultural conditions, they are of primary importance for the majority of the world's farmers working in low-input, subsistence agriculture. In many African countries and other regions, small farmers play a central role in the conservation of germplasm because they hold the bulk of the existing crop genetic resources in those countries. Ethiopia is among the richest regions of crop plant diversity in the world; its genetic resources are of critical value both within and outside Africa. Through support from the Global Environment Facility (GEF), this project is designed to help conserve and utilize landraces which form the basis of crop genetic resources in Ethiopia. Landraces of globally and locally significant crops such as wheat, barley, sorghum, teff, finger millet, lentil, chick pea, linseed, and safflower will be conserved through this project.

of this effort. To date, nearly all such efforts have been focused on conserving crop genetic resources in germplasm repositories which are part of a "formal" international network. While providing one important means of preserving genetic resources, *ex situ* conservation also has the effect of disassociating the material kept in gene banks from communities and farmers, the "informal" sector of genetic resource conservation, and primary users of the material. *Ex situ* conservation also separates farmer knowledge from farmer varieties in that existing *ex situ* data management does not adequately conserve traditional knowledge.

Countless useful genetic variations of global significance have originated at the local farm and rural community level. Among numerous examples are the yellow dwarf virus resistance gene found in Ethiopian barley, on which California's US$ 160 million annual barley crop depends, as well as the high-lysine gene in sorghum, also of Ethiopian origin.

The *ex situ* conservation of genetic resources has proved its worth by saving genes that would have otherwise been lost. But it should be remembered that in nature genes exist, mutate, and continue to increase or decrease, or even disappear, in response to a dynamic interaction with soil and climatic factors, diseases, pests and competitors. This dynamic interaction extends over the whole agricultural history of that crop, and over the whole area where that crop grows, and even where its wild relatives grow. In *ex situ* conservation, time is frozen at sampling, and space is squeezed to that of the fields used for regeneration. Occasional regeneration only accentuates the impact of these unnatural conditions since a diminutive time and a diminutive space are substituted for the dynamic forces which evolved on a much larger scale. This situation explains why regeneration, though necessary, inevitably causes genetic erosion. When seeds from a gene bank are planted out, even this narrowed genetic base which survives the wasting effects of storage and regeneration risks being unequal to the genetic base of the disease, pest, and weed organisms which have continued to evolve. Likewise, the edaphic and climatic conditions have continued to change. A complementary approach to *ex situ* conservation is, therefore, required.

Ex situ conservation needs to be complemented in a way that maximizes the retention and continued evolution of the adaptive qualities of landraces, and avoids the loss of variation that occurs in sampling and maintenance. This situation requires that conservation of landraces by farmers *in situ* be part of the existing cropping system. Conservation at the farm level allows for continuing farmer selection, interaction with the environment, and gene exchange with wild species so that evolution of landraces may continue. Because indigenous crop landraces are genetically diverse and well adapted to local agro-ecological and sociocultural conditions, they are of primary importance for the majority of the world's farmers working in low-input, subsistence agriculture. In many African countries and other regions, small farmers play a central role in the conservation of germplasm because they hold the bulk of the existing crop genetic resources in those countries. Ethiopia is among the richest regions of crop plant diversity in the world; its genetic resources are of critical value both within and outside Africa. Through support from the Global Environment Facility (GEF), this project is designed to help conserve and utilize landraces which form the basis of crop genetic resources in Ethiopia. Landraces of globally and locally significant crops such as wheat, barley, sorghum, teff, finger millet, lentil, chick pea, linseed, and safflower will be conserved through this project.

The project brings together farmers and the international plant genetic resource conservation community by recognizing, rewarding, and strengthening the continuing role of farmers in the conservation and use of plant genetic resources. Traditional farmers and landraces can be viewed as co-dependent on one another, since low-input farms have less impact on the various components of an agro-ecosystem than modern high-input farms. By incorporating and supporting the informal sector, an overall, integrated strategy for genetic resource conservation will ensure the reciprocal exchange of information, materials, and benefits between these two sectors that have remained, until now, largely divorced from one another.

Three broad categories of activities will be supported under this project: institutional strengthening, community-based conservation activities, and identifying incentives for *in situ* landrace conservation. Institutional strengthening will focus on PGRC/E, through supporting research and training that will be essential to long-term monitoring and planning of conservation. Institutional strengthening will also include the training of extension agents who work in target areas of the project, as well as training of farmers at the local level in improved seed selection and maintenance. Community-based conservation will build on farmer training and lead to the construction of CGBs in six target districts. These community facilities will focus increased extension contact and local participation in landrace conservation. Identifying incentives for landrace conservation by farmers will include examining market and non-market incentives and disincentives that affect the choice of what type of seed to plant. One goal of this last activity is to identify products that are based on landraces for national and international markets. Another goal is to develop educational material that explains the importance of Ethiopian crop resources to the nation and the world.

The GEF is uniquely positioned to bring all relevant sectors together—farmers, non-governmental organizations (NGOs), the scientific community, and governments—and provide a forum in which they can effectively transmit lessons among themselves, and to other countries and regions.

GEF support for this innovative pilot project is required as no other sources exist. This project complements the GEF-sponsored project in Turkey which focuses on *in situ* conservation of wild relatives of domesticated species in natural areas.

2. Host country strategy

Ethiopia has a well established programme of conserving crop genetic resources. The PGRC/E was established in 1976 to promote the collection, evaluation, documentation, and scientific study of crop germplasm in Ethiopia, East Africa, and adjacent regions. The PGRC/E has been active in all of the above areas and has had a leadership role internationally in seeking to establish on-farm conservation mechanisms to complement off-farm (gene bank) conservation.

Nevertheless, the efforts since 1976 to conserve crop genetic resources have shown the need for further intensification of activities and new initiatives. The Transitional Government of Ethiopia is aware of this situation, and of the other environmental problems of Ethiopia. One of its first institutional initiatives was to create a Ministry of Natural Resources Development and Environmental Protection (MNRDEP), and one of its first international activities was the signing of the Convention on Biological Diversity. These actions were followed by two policy initiatives. A

The project brings together farmers and the international plant genetic resource conservation community by recognizing, rewarding, and strengthening the continuing role of farmers in the conservation and use of plant genetic resources. Traditional farmers and landraces can be viewed as co-dependent on one another, since low-input farms have less impact on the various components of an agro-ecosystem than modern high-input farms. By incorporating and supporting the informal sector, an overall, integrated strategy for genetic resource conservation will ensure the reciprocal exchange of information, materials, and benefits between these two sectors that have remained, until now, largely divorced from one another.

Three broad categories of activities will be supported under this project: institutional strengthening, community-based conservation activities, and identifying incentives for *in situ* landrace conservation. Institutional strengthening will focus on PGRC/E, through supporting research and training that will be essential to long-term monitoring and planning of conservation. Institutional strengthening will also include the training of extension agents who work in target areas of the project, as well as training of farmers at the local level in improved seed selection and maintenance. Community-based conservation will build on farmer training and lead to the construction of CGBs in six target districts. These community facilities will focus increased extension contact and local participation in landrace conservation. Identifying incentives for landrace conservation by farmers will include examining market and non-market incentives and disincentives that affect the choice of what type of seed to plant. One goal of this last activity is to identify products that are based on landraces for national and international markets. Another goal is to develop educational material that explains the importance of Ethiopian crop resources to the nation and the world.

The GEF is uniquely positioned to bring all relevant sectors together—farmers, non-governmental organizations (NGOs), the scientific community, and governments—and provide a forum in which they can effectively transmit lessons among themselves, and to other countries and regions.

GEF support for this innovative pilot project is required as no other sources exist. This project complements the GEF-sponsored project in Turkey which focuses on *in situ* conservation of wild relatives of domesticated species in natural areas.

2. Host country strategy

Ethiopia has a well established programme of conserving crop genetic resources. The PGRC/E was established in 1976 to promote the collection, evaluation, documentation, and scientific study of crop germplasm in Ethiopia, East Africa, and adjacent regions. The PGRC/E has been active in all of the above areas and has had a leadership role internationally in seeking to establish on-farm conservation mechanisms to complement off-farm (gene bank) conservation.

Nevertheless, the efforts since 1976 to conserve crop genetic resources have shown the need for further intensification of activities and new initiatives. The Transitional Government of Ethiopia is aware of this situation, and of the other environmental problems of Ethiopia. One of its first institutional initiatives was to create a Ministry of Natural Resources Development and Environmental Protection (MNRDEP), and one of its first international activities was the signing of the Convention on Biological Diversity. These actions were followed by two policy initiatives. A

task force is preparing a draft policy on plant genetic resources (both wild and domesticated) to be completed shortly. It is expected that this policy will clear the way for a strategy on the conservation and sustainable use of plant genetic resources in Ethiopia.

The second initiative is a national seed policy that is already under implementation. This policy supports landrace genetic conservation and utilization. Referring primarily to *ex situ* conservation, one of the policy objectives is:

> *"To ensure that the genetic resources which are or could be of economic benefit to present and future generations are collected, curated, evaluated and utilized through national research and development programmes."*

Referring to on-farm and community conservation and utilization of crop genetic resources, one of the objectives states:

> *"In order to ensure that farmers share the economic benefits accruing from the plant genetic resources which they have managed for generations, foster their participation in the conservation of germplasm and in the production and distribution of seed."*

One of the policy statements stipulates that a balance will be maintained in the development of genetic conservation on the one hand, and seed production and distribution on the other. Another seed policy item provides for strict control and monitoring of genetically modified organisms that are likely to erode plant genetic diversity.

The national policy for the production and distribution of seed to farmers stipulates that, as much as possible, national crop improvement programmes shall be based on the germplasm and agricultural systems which are prevalent in the country. In particular, the traditional system of mixed farming involving cereals, pulses, and animals will be strengthened through modern science and technology.

Though it is clear that Ethiopia is tackling the policy issues of the conservation and enhanced utilization of landraces, it should be pointed out that its scientific and technological capability is low. These capabilities should, therefore, be supplemented with human resources and infrastructure development.

3. Prior and ongoing assistance

For the past seventeen years, the Ethiopian government has been receiving financial and technical support from various external sources to develop its plant genetic resources programme, which started with the establishment in 1976 of the PGRC/E. A grant from the Federal Republic of Germany of some DM 12 million (US$ 7,741,936),[2] administered through German Development Cooperation (GTZ) during the period 1976–85, enabled the Centre to build its office/laboratory

[2] According to the official exchange rate used for conversions throughout this document, US$ 1 = DM 1.55.

task force is preparing a draft policy on plant genetic resources (both wild and domesticated) to be completed shortly. It is expected that this policy will clear the way for a strategy on the conservation and sustainable use of plant genetic resources in Ethiopia.

The second initiative is a national seed policy that is already under implementation. This policy supports landrace genetic conservation and utilization. Referring primarily to *ex situ* conservation, one of the policy objectives is:

> *"To ensure that the genetic resources which are or could be of economic benefit to present and future generations are collected, curated, evaluated and utilized through national research and development programmes."*

Referring to on-farm and community conservation and utilization of crop genetic resources, one of the objectives states:

> *"In order to ensure that farmers share the economic benefits accruing from the plant genetic resources which they have managed for generations, foster their participation in the conservation of germplasm and in the production and distribution of seed."*

One of the policy statements stipulates that a balance will be maintained in the development of genetic conservation on the one hand, and seed production and distribution on the other. Another seed policy item provides for strict control and monitoring of genetically modified organisms that are likely to erode plant genetic diversity.

The national policy for the production and distribution of seed to farmers stipulates that, as much as possible, national crop improvement programmes shall be based on the germplasm and agricultural systems which are prevalent in the country. In particular, the traditional system of mixed farming involving cereals, pulses, and animals will be strengthened through modern science and technology.

Though it is clear that Ethiopia is tackling the policy issues of the conservation and enhanced utilization of landraces, it should be pointed out that its scientific and technological capability is low. These capabilities should, therefore, be supplemented with human resources and infrastructure development.

3. Prior and ongoing assistance

For the past seventeen years, the Ethiopian government has been receiving financial and technical support from various external sources to develop its plant genetic resources programme, which started with the establishment in 1976 of the PGRC/E. A grant from the Federal Republic of Germany of some DM 12 million (US$ 7,741,936),[2] administered through German Development Cooperation (GTZ) during the period 1976–85, enabled the Centre to build its office/laboratory

---

[2] According to the official exchange rate used for conversions throughout this document, US$ 1 = DM 1.55.

building, assemble various field and laboratory equipment, and train some of its staff. The Unitarian Service Committee/Canada (USC/C), through its Seeds of Survival Programme for Africa (SOS/A), provided some Can $ 1.2 million (US$ 886,459)[3] to support the farmer-based landrace conservation and utilization programme begun by PGRC/E in 1989. Through this programme, farmers also select elite landraces for multiplication for low-input crop production on marginal land.

The United Nations Environment Programme (UNEP) has provided US$ 100,000 for an initial two-year period to support PGRC/E in coordinating the African Biodiversity Network (BIDNET) which was established in 1991 by the African Ministerial Conference on the Environment (AMCEN).

The World Bank is currently developing several agricultural projects in cooperation with the Ethiopian government. Two projects, one on seed production and another on increased inputs of fertilizer, are only marginally related to the proposed GEF project. As a biodiversity conservation and monitoring project, the current effort will complement the pending World Bank programmes by allowing scientists to track technological impacts and providing local seed to farmers who might want to recover it.

4. Institutional framework for subsector

Plant Genetic Resources Centre/Ethiopia (PGRC/E)

The PGRC/E was established in 1976 as a bilateral technical and economic development programme between the Ethiopian government and the Government of the Federal Republic of Germany. The major activities of the Centre are to:

- Promote the collection, evaluation, documentation, and scientific study of crop germplasm in Ethiopia, East Africa and adjacent regions
- Conserve and preserve germplasm using both *ex situ* and *in situ* strategies
- Provide germplasm for breeding programmes aimed at the development of such characteristics as higher yield, better quality, and disease and pest resistance
- Provide Ethiopia with new crop germplasm through exchange with other institutions.

Over the years the Centre has developed a highly competent scientific, technical, and supporting staff. There are 105 employees, out of which 45 percent represent technical personnel comprised of four PhD, ten MS, seventeen Diploma, and eighteen Certificate holders. Areas of specialization of the senior technical staff include plant/seed physiology, biochemistry, biosystematics, genetics, molecular biology, and genetic resource conservation.

---

[3] According to the official exchange rate used for conversions throughout this document, US$ 1 = Can $ 1.3537.

building, assemble various field and laboratory equipment, and train some of its staff. The Unitarian Service Committee/Canada (USC/C), through its Seeds of Survival Programme for Africa (SOS/A), provided some Can $ 1.2 million (US$ 886,459)[3] to support the farmer-based landrace conservation and utilization programme begun by PGRC/E in 1989. Through this programme, farmers also select elite landraces for multiplication for low-input crop production on marginal land.

The United Nations Environment Programme (UNEP) has provided US$ 100,000 for an initial two-year period to support PGRC/E in coordinating the African Biodiversity Network (BIDNET) which was established in 1991 by the African Ministerial Conference on the Environment (AMCEN).

The World Bank is currently developing several agricultural projects in cooperation with the Ethiopian government. Two projects, one on seed production and another on increased inputs of fertilizer, are only marginally related to the proposed GEF project. As a biodiversity conservation and monitoring project, the current effort will complement the pending World Bank programmes by allowing scientists to track technological impacts and providing local seed to farmers who might want to recover it.

4. Institutional framework for subsector

Plant Genetic Resources Centre/Ethiopia (PGRC/E)

The PGRC/E was established in 1976 as a bilateral technical and economic development programme between the Ethiopian government and the Government of the Federal Republic of Germany. The major activities of the Centre are to:

- Promote the collection, evaluation, documentation, and scientific study of crop germplasm in Ethiopia, East Africa and adjacent regions
- Conserve and preserve germplasm using both *ex situ* and *in situ* strategies
- Provide germplasm for breeding programmes aimed at the development of such characteristics as higher yield, better quality, and disease and pest resistance
- Provide Ethiopia with new crop germplasm through exchange with other institutions.

Over the years the Centre has developed a highly competent scientific, technical, and supporting staff. There are 105 employees, out of which 45 percent represent technical personnel comprised of four PhD, ten MS, seventeen Diploma, and eighteen Certificate holders. Areas of specialization of the senior technical staff include plant/seed physiology, biochemistry, biosystematics, genetics, molecular biology, and genetic resource conservation.

---

[3] According to the official exchange rate used for conversions throughout this document, US$ 1 = Can $ 1.3537.

As an institution mandated to carry out conservation in Ethiopia, PGRC/E plays a central role in the overall coordination and monitoring of the activities of the project: conservation, evaluation and selection, scientific studies, documentation, distribution, and introduction and exchange of germplasm and information. More specifically, the Centre provides technical assistance to farmers (training for seed maintenance and selection). In close consultation with all relevant agencies (policy-makers, extension agents, farm communities, crop scientists, and others), it monitors aspects of management, production, use and transfer of material. Another major task of the national gene bank is to create appropriate links that facilitate cooperation at the local, national, and international levels. It serves as a central repository of germplasm collections and pertinent information. PRGC/E is the agency that will supervise and control exchange, distribution, and expansion of material to farms in the various regions. The Centre is also in a strategic position to coordinate landrace conservation in Africa, as part of its current role in coordinating the biodiversity conservation activities of AMCEN, and the Community Biodiversity Development and Conservation (CBDC) Programme in Africa.

Extension agents

The Ministry of Agriculture (MOA) has a cadre of extension workers involved in agricultural and social activities within the wide network of the country's agricultural development programme. Their main task is to coordinate the activities among farm communities, local governments, and researchers, and to assist with the transfer and flow of material (for example, seeds, chemicals and tools), information, and technology to communities. Extension agents also play a direct role in the training of farmers, demonstrations, and in organizing relevant seminars and workshops among farm communities, rural youth and schools.

Research and teaching institutions

The Addis Ababa University is the oldest and largest institution of higher education in the country. It has the best developed research capacity, though the disruptions associated with the post-1974 diaspora and the civil war that continued until 1991, have not allowed its development to keep up with changing times.

The Ethiopian National Herbarium, in the Department of Biology in Addis Ababa University, has a good base to develop further. It is currently executing the Ethiopian Flora Project and a number of smaller projects on ecology and ecophysiology. It has a good desktop publishing unit which is producing the *Flora of Ethiopia*. It would be a logical extension of its present activities to develop a section on crop landraces, of which it already has a small set. The Herbarium could also expand its efforts in ethnobotany in a more comprehensive manner in connection with the writing of the *Flora of Ethiopia*. The Addis Ababa University also has a Faculty of Social Sciences whose staff collaborates with the PGRC/E in research and consultancy studies.

The Awassa College of Agriculture in Addis Ababa University has developed research programmes and linkages with communities in Southern Ethiopia. The wealth of information and experience it has acquired should support the project through strengthened linkages with the PGRC/E.

As an institution mandated to carry out conservation in Ethiopia, PGRC/E plays a central role in the overall coordination and monitoring of the activities of the project: conservation, evaluation and selection, scientific studies, documentation, distribution, and introduction and exchange of germplasm and information. More specifically, the Centre provides technical assistance to farmers (training for seed maintenance and selection). In close consultation with all relevant agencies (policy-makers, extension agents, farm communities, crop scientists, and others), it monitors aspects of management, production, use and transfer of material. Another major task of the national gene bank is to create appropriate links that facilitate cooperation at the local, national, and international levels. It serves as a central repository of germplasm collections and pertinent information. PRGC/E is the agency that will supervise and control exchange, distribution, and expansion of material to farms in the various regions. The Centre is also in a strategic position to coordinate landrace conservation in Africa, as part of its current role in coordinating the biodiversity conservation activities of AMCEN, and the Community Biodiversity Development and Conservation (CBDC) Programme in Africa.

Extension agents

The Ministry of Agriculture (MOA) has a cadre of extension workers involved in agricultural and social activities within the wide network of the country's agricultural development programme. Their main task is to coordinate the activities among farm communities, local governments, and researchers, and to assist with the transfer and flow of material (for example, seeds, chemicals and tools), information, and technology to communities. Extension agents also play a direct role in the training of farmers, demonstrations, and in organizing relevant seminars and workshops among farm communities, rural youth and schools.

Research and teaching institutions

The Addis Ababa University is the oldest and largest institution of higher education in the country. It has the best developed research capacity, though the disruptions associated with the post-1974 diaspora and the civil war that continued until 1991, have not allowed its development to keep up with changing times.

The Ethiopian National Herbarium, in the Department of Biology in Addis Ababa University, has a good base to develop further. It is currently executing the Ethiopian Flora Project and a number of smaller projects on ecology and ecophysiology. It has a good desktop publishing unit which is producing the *Flora of Ethiopia*. It would be a logical extension of its present activities to develop a section on crop landraces, of which it already has a small set. The Herbarium could also expand its efforts in ethnobotany in a more comprehensive manner in connection with the writing of the *Flora of Ethiopia*. The Addis Ababa University also has a Faculty of Social Sciences whose staff collaborates with the PGRC/E in research and consultancy studies.

The Awassa College of Agriculture in Addis Ababa University has developed research programmes and linkages with communities in Southern Ethiopia. The wealth of information and experience it has acquired should support the project through strengthened linkages with the PGRC/E.

The Alemaya University of Agriculture (AUA) started as one of the earliest constituent colleges of the Addis Ababa University. It is the oldest and best developed higher educational institution in agriculture, and includes the oldest agricultural research site in the country, the Debre Zeit Agricultural Research Station. This station is currently working very closely with PGRC/E in the selection and multiplication in farmers' fields of elite lines of landraces of durum wheat, and in extension work on their diffusion. With the development of this project, this working relationship is expected to grow as the staff of both AUA and PGRC/E undertake more joint research activities.

The Junior Colleges of Agriculture in Jimma and Ambo train agricultural technicians to staff the extension system of the MOA. Since the inclusion of the extension system is central to this project, collaboration with these junior colleges will be essential both for positively influencing the training of the extension staff, and for benefitting from the experience of the teaching staff.

The extension staff who work on running nurseries and on reforestation are trained at the Wondo Gennet Junior College of Forestry. The field experience of the teaching staff will become useful for getting information on the conservation and ethnobotany of wild plants, especially tree species. Interacting with the college will also positively influence the training provided in the college for the long-term benefit of ethnobotany.

The three junior colleges have strong links with the communities in which they are found, but their research capability is very low owing to a hitherto virtual absence of research funding. Some of their academic staff members are keen to be involved in research, however, and they could make good junior counterparts to the researchers from PGRC/E and Addis Ababa University.

The Institute of Agricultural Research (IAR) is a national institution mandated to carry out agricultural research. It is also mandated to coordinate agricultural research activities of other institutions, including the universities, in a coherent national system. A sound system of exchange of information and planting material, as well as collaborative research, has evolved in the country. Each crop or group of crops (for example, teff, sorghum, barley, wheat, highland pulses, lowland pulses, and oil crops) and each discipline (soil fertility, pest control, pathology) has a national coordinator. Any researcher involved in any of these areas thus cooperates with the appropriate national coordinator, and is involved in the planning and execution of a national programme. Since the national agricultural system is going to continue being one of the main users of landraces, and since there is much information on landraces already available from the researchers of IAR, the continuation of a close working relationship of PGRC/E with IAR is inevitable.

A College of Arid Zone Agriculture is scheduled to start in Meqhele, Tigray, in the 1993–94 academic year to continue programmes that had been developed in the Asmara University and are now temporarily housed in the AUA. Since the college caters to semi-arid marginal areas, a direct focus on landraces has been envisaged in the design of its teaching and research programmes. It is expected that fruitful interactive involvements in the research in, and use of, landraces will evolve between PGRC/E and the College of Arid Zone Agriculture.

Regional networks

The BIDNET/AMCEN is one of eight specialized regional networks designed to strengthen cooperation between African countries in promoting environmental protection and development. Its prime objective is to assist the African continent to integrate conservation with environmentally sound

The Alemaya University of Agriculture (AUA) started as one of the earliest constituent colleges of the Addis Ababa University. It is the oldest and best developed higher educational institution in agriculture, and includes the oldest agricultural research site in the country, the Debre Zeit Agricultural Research Station. This station is currently working very closely with PGRC/E in the selection and multiplication in farmers' fields of elite lines of landraces of durum wheat, and in extension work on their diffusion. With the development of this project, this working relationship is expected to grow as the staff of both AUA and PGRC/E undertake more joint research activities.

The Junior Colleges of Agriculture in Jimma and Ambo train agricultural technicians to staff the extension system of the MOA. Since the inclusion of the extension system is central to this project, collaboration with these junior colleges will be essential both for positively influencing the training of the extension staff, and for benefitting from the experience of the teaching staff.

The extension staff who work on running nurseries and on reforestation are trained at the Wondo Gennet Junior College of Forestry. The field experience of the teaching staff will become useful for getting information on the conservation and ethnobotany of wild plants, especially tree species. Interacting with the college will also positively influence the training provided in the college for the long-term benefit of ethnobotany.

The three junior colleges have strong links with the communities in which they are found, but their research capability is very low owing to a hitherto virtual absence of research funding. Some of their academic staff members are keen to be involved in research, however, and they could make good junior counterparts to the researchers from PGRC/E and Addis Ababa University.

The Institute of Agricultural Research (IAR) is a national institution mandated to carry out agricultural research. It is also mandated to coordinate agricultural research activities of other institutions, including the universities, in a coherent national system. A sound system of exchange of information and planting material, as well as collaborative research, has evolved in the country. Each crop or group of crops (for example, teff, sorghum, barley, wheat, highland pulses, lowland pulses, and oil crops) and each discipline (soil fertility, pest control, pathology) has a national coordinator. Any researcher involved in any of these areas thus cooperates with the appropriate national coordinator, and is involved in the planning and execution of a national programme. Since the national agricultural system is going to continue being one of the main users of landraces, and since there is much information on landraces already available from the researchers of IAR, the continuation of a close working relationship of PGRC/E with IAR is inevitable.

A College of Arid Zone Agriculture is scheduled to start in Meqhele, Tigray, in the 1993–94 academic year to continue programmes that had been developed in the Asmara University and are now temporarily housed in the AUA. Since the college caters to semi-arid marginal areas, a direct focus on landraces has been envisaged in the design of its teaching and research programmes. It is expected that fruitful interactive involvements in the research in, and use of, landraces will evolve between PGRC/E and the College of Arid Zone Agriculture.

Regional networks

The BIDNET/AMCEN is one of eight specialized regional networks designed to strengthen cooperation between African countries in promoting environmental protection and development. Its prime objective is to assist the African continent to integrate conservation with environmentally sound

management and sustainable resources utilization, with a view to conserving its plant, animal, and microbial genetic resources. Through its coordinating unit (PGRC/E), the network will facilitate the establishment of landrace conservation programmes in the African region, and the coordination of activities related to landrace conservation and utilization, drawing upon the experience gained through this GEF project. Similarly, the CBDC project, which is coordinated in Africa by PGRC/E, will provide technical and financial support for on-farm selection, enhancement, and evaluation of landraces for utilization by small scale farmers, and will complement the conservation activities undertaken through this GEF project.

International Plant Genetic Resource Institute (IPGRI)

The IPGRI is a member of the BIDNET/AMCEN and maintains a Regional Office for Africa in Kenya. The current work programme of IPGRI emphasizes the importance of landrace conservation, the need to integrate socioeconomic and cultural factors into conservation, and the importance of complementary strategies involving both *in situ* and *ex situ* approaches. IPGRI will act as a source of information and technical knowledge, and provide a means of contact with the world plant genetic resources community. PGRC/E and IPGRI expect to develop close collaboration of their work in this area.

B. PROJECT JUSTIFICATION

Ethiopia is a major world centre of genetic diversity for many regionally and globally important domesticated plant species, such as sorghum, teff, barley, chickpeas and coffee. Genetic variations emanating from local farm and rural community levels continue to have great global significance. The conservation of local landraces is therefore of critical importance, not only to subsistence farmers in Ethiopia, but also to regional and global agriculture. The project will use an extremely innovative approach, since it will be the first major national or regional programme to integrate the informal sector of genetic resource conservation (farmers) with the formal sector (genetic research institutions), thus linking the "holders" of genetic diversity with the international conservation network.

Over the course of several millennia human and natural selection pressures, together with the exchange of genes between cultivated and wild plants, has resulted in the evolution of a diverse assemblage of cultivated types of plants or landraces. Representing repositories of genes which have evolved in local environments where they are best adapted, landraces have provided, and continue to provide, breeding materials from which modern crop varieties have been developed. Indigenous crop landraces are genetically diverse and well adapted to local agro-ecological and sociocultural conditions, characteristics that are of primary importance for the majority of the world's farmers working in low-input subsistence agriculture. Indigenous landraces are indispensable for modern crop improvement efforts because of their tremendous value as sources of resistance to disease, pest, drought and other stress conditions.

Certain areas of the world are particularly rich in the wild species which have given rise to cultivated crop landraces. These centres of origin include Southwest Asia, Southeast Asia, Mexico, the Central Andes, and Ethiopia. Indigenous landraces in Africa are being replaced by introduced genetically uniform crops, as African countries try to combat periodic food shortages. The yields

management and sustainable resources utilization, with a view to conserving its plant, animal, and microbial genetic resources. Through its coordinating unit (PGRC/E), the network will facilitate the establishment of landrace conservation programmes in the African region, and the coordination of activities related to landrace conservation and utilization, drawing upon the experience gained through this GEF project. Similarly, the CBDC project, which is coordinated in Africa by PGRC/E, will provide technical and financial support for on-farm selection, enhancement, and evaluation of landraces for utilization by small scale farmers, and will complement the conservation activities undertaken through this GEF project.

International Plant Genetic Resource Institute (IPGRI)

The IPGRI is a member of the BIDNET/AMCEN and maintains a Regional Office for Africa in Kenya. The current work programme of IPGRI emphasizes the importance of landrace conservation, the need to integrate socioeconomic and cultural factors into conservation, and the importance of complementary strategies involving both *in situ* and *ex situ* approaches. IPGRI will act as a source of information and technical knowledge, and provide a means of contact with the world plant genetic resources community. PGRC/E and IPGRI expect to develop close collaboration of their work in this area.

B. PROJECT JUSTIFICATION

Ethiopia is a major world centre of genetic diversity for many regionally and globally important domesticated plant species, such as sorghum, teff, barley, chickpeas and coffee. Genetic variations emanating from local farm and rural community levels continue to have great global significance. The conservation of local landraces is therefore of critical importance, not only to subsistence farmers in Ethiopia, but also to regional and global agriculture. The project will use an extremely innovative approach, since it will be the first major national or regional programme to integrate the informal sector of genetic resource conservation (farmers) with the formal sector (genetic research institutions), thus linking the "holders" of genetic diversity with the international conservation network.

Over the course of several millennia human and natural selection pressures, together with the exchange of genes between cultivated and wild plants, has resulted in the evolution of a diverse assemblage of cultivated types of plants or landraces. Representing repositories of genes which have evolved in local environments where they are best adapted, landraces have provided, and continue to provide, breeding materials from which modern crop varieties have been developed. Indigenous crop landraces are genetically diverse and well adapted to local agro-ecological and sociocultural conditions, characteristics that are of primary importance for the majority of the world's farmers working in low-input subsistence agriculture. Indigenous landraces are indispensable for modern crop improvement efforts because of their tremendous value as sources of resistance to disease, pest, drought and other stress conditions.

Certain areas of the world are particularly rich in the wild species which have given rise to cultivated crop landraces. These centres of origin include Southwest Asia, Southeast Asia, Mexico, the Central Andes, and Ethiopia. Indigenous landraces in Africa are being replaced by introduced genetically uniform crops, as African countries try to combat periodic food shortages. The yields

of these varieties, while superior when grown under optimum conditions, can be unstable and unreliable under less-than-ideal conditions. If agriculture on marginal lands is to be environmentally friendly, the role of landraces in modernizing crop production will become decisive. The development of a more environmentally-friendly sustainable system of agriculture was described in *Agenda 21* as a key environmental issue.

To date, nearly all conservation efforts have been focused on storing crop genetic resources in germplasm repositories as part of a formal global gene-bank network. Though well preserved within this international system, the genetic material becomes disassociated from communities and farmers, the informal sector of genetic resource conservation. A complementary approach involving farmer-based activities and off-farm gene bank conservation could prove extremely beneficial in preserving genetic diversity and satisfying the needs of farmers.

Following a long-standing tradition, peasant farmers in many African countries retain a diverse seed stock unless disruptive circumstances prevent them from doing so. Typically, a farmer's stock includes seeds of numerous crops, as well as many varieties of each crop. By maintaining such diversity, farmers reduce the vulnerability of any one crop to potentially devastating disease, insect epidemics, and unpredictable environmental changes. At the same time, the need for yield reliability, nutrition, taste, cooking quality, and useful by-products can be satisfied.

Farmers play a key role in the generation and maintenance of crop genetic diversity through traditional activities such as:

- Promoting the inter-crossing of cultivated crops with wild or weedy relatives, which results in new character combinations in the hybrid plants
- Inter-cropping or growing mixtures of crops, which results in rapid diversification due to introgression from accidental crosses
- Detecting and propagating new varieties which occur in their fields as a result of spontaneous mutation, fortuitous crossing between wild and/or cultivated taxa, or varieties obtained through exchange with other peasant farmers
- Maintaining local seed exchange networks that diffuse both crop varieties and knowledge
- Maintaining local varieties of coffee and other crops by growing them alongside the uniform, government-released cultivars
- Making available their knowledge and skills in identifying, collecting, and using plants which they have helped develop and maintained for generations.

Farm/community conservation of crop diversity has special significance in maintaining and enhancing agricultural productivity in Africa where farms are characterized by highly varied micro-environments differing in soil, moisture, temperature and other characteristics. The availability of such indigenous local diversity allows farmers to exploit the range of such environments.

of these varieties, while superior when grown under optimum conditions, can be unstable and unreliable under less-than-ideal conditions. If agriculture on marginal lands is to be environmentally friendly, the role of landraces in modernizing crop production will become decisive. The development of a more environmentally-friendly sustainable system of agriculture was described in *Agenda 21* as a key environmental issue.

To date, nearly all conservation efforts have been focused on storing crop genetic resources in germplasm repositories as part of a formal global gene-bank network. Though well preserved within this international system, the genetic material becomes disassociated from communities and farmers, the informal sector of genetic resource conservation. A complementary approach involving farmer-based activities and off-farm gene bank conservation could prove extremely beneficial in preserving genetic diversity and satisfying the needs of farmers.

Following a long-standing tradition, peasant farmers in many African countries retain a diverse seed stock unless disruptive circumstances prevent them from doing so. Typically, a farmer's stock includes seeds of numerous crops, as well as many varieties of each crop. By maintaining such diversity, farmers reduce the vulnerability of any one crop to potentially devastating disease, insect epidemics, and unpredictable environmental changes. At the same time, the need for yield reliability, nutrition, taste, cooking quality, and useful by-products can be satisfied.

Farmers play a key role in the generation and maintenance of crop genetic diversity through traditional activities such as:

- Promoting the inter-crossing of cultivated crops with wild or weedy relatives, which results in new character combinations in the hybrid plants
- Inter-cropping or growing mixtures of crops, which results in rapid diversification due to introgression from accidental crosses
- Detecting and propagating new varieties which occur in their fields as a result of spontaneous mutation, fortuitous crossing between wild and/or cultivated taxa, or varieties obtained through exchange with other peasant farmers
- Maintaining local seed exchange networks that diffuse both crop varieties and knowledge
- Maintaining local varieties of coffee and other crops by growing them alongside the uniform, government-released cultivars
- Making available their knowledge and skills in identifying, collecting, and using plants which they have helped develop and maintained for generations.

Farm/community conservation of crop diversity has special significance in maintaining and enhancing agricultural productivity in Africa where farms are characterized by highly varied micro-environments differing in soil, moisture, temperature and other characteristics. The availability of such indigenous local diversity allows farmers to exploit the range of such environments.

Furthermore, *in situ* conservation sustains the evolutionary processes responsible for generating variability useful in maintaining crop productivity, especially in regions where extremes of environment prevail, and where adaptation to stressful conditions occurs. It also allows ongoing host-parasite co-evolution which is likely to provide material resistant to disease and pests. Similarly, conservation of locally-adapted landraces in community-managed seed banks will ensure sustained provision of useful variability to these farmers, and to various breeding programmes, and will complement the formal network of international gene banks.

The importance of landraces, and the rate at which they are being replaced by more recently developed varieties, has spurred international action to protect this shrinking resource base. In fact, a major outcome of the Keystone International Dialogue Series on Plant Genetic Resources was the recognition of the important role of farming communities in the conservation of genetic resources. The Series noted that there is a marked separation between this sector and gene banks and plant breeding programmes. The Keystone participants stressed the urgent need to provide support for chronically underfunded community-level projects that have specific conservation/utilization objectives. This objective was given international legal status through the Convention on Biological Diversity.

Given the long-standing precedent of informal genetic resource management, a project to formally integrate farmers into the international plant genetic resource conservation community through conservation of landraces on peasant farms, and in community gene banks, represents a valuable opportunity for enhancing biodiversity.

Through GEF support, this project is designed to conserve and effectively utilize landraces by expanding the informal strategies for genetic resource conservation that are currently in effect. By incorporating the informal sector into the international network, an overall, integrated strategy for genetic resource conservation can emerge, involving farmers, farming communities, scientists, and extension workers. This process will provide for a reciprocal exchange of information, materials, and benefits between these two sectors that have, to date, remained largely divorced from one another.

1. Problem to be addressed and the present situation

The project addresses the general problem of the loss of significant crop genetic resources and their associated traditional knowledge. The loss of these resources is caused by many factors, including population growth, market development, and cultural and technological change. A key factor is the spread of high-yielding crop varieties or new crops that replace local ones. Conserving genetic resources of landraces and associated traditional knowledge requires an enhanced research capacity at PGRC/E. The project will strengthen capacity in ethnobotany, social sciences, and population biology, enabling scientists to determine the extent of genetic variation within landraces under traditional agricultural practices, distribution of landraces, and population size/sampling techniques for optimal *ex situ* storage.

Local farmers have extensive knowledge concerning local landrace distribution, attributes, and use. Through the establishment of local CGBs, farmers will be enlisted to record this information in formats accessible to PGRC/E. A community gene bank will provide a seed storage

Furthermore, *in situ* conservation sustains the evolutionary processes responsible for generating variability useful in maintaining crop productivity, especially in regions where extremes of environment prevail, and where adaptation to stressful conditions occurs. It also allows ongoing host-parasite co-evolution which is likely to provide material resistant to disease and pests. Similarly, conservation of locally-adapted landraces in community-managed seed banks will ensure sustained provision of useful variability to these farmers, and to various breeding programmes, and will complement the formal network of international gene banks.

The importance of landraces, and the rate at which they are being replaced by more recently developed varieties, has spurred international action to protect this shrinking resource base. In fact, a major outcome of the Keystone International Dialogue Series on Plant Genetic Resources was the recognition of the important role of farming communities in the conservation of genetic resources. The Series noted that there is a marked separation between this sector and gene banks and plant breeding programmes. The Keystone participants stressed the urgent need to provide support for chronically underfunded community-level projects that have specific conservation/utilization objectives. This objective was given international legal status through the Convention on Biological Diversity.

Given the long-standing precedent of informal genetic resource management, a project to formally integrate farmers into the international plant genetic resource conservation community through conservation of landraces on peasant farms, and in community gene banks, represents a valuable opportunity for enhancing biodiversity.

Through GEF support, this project is designed to conserve and effectively utilize landraces by expanding the informal strategies for genetic resource conservation that are currently in effect. By incorporating the informal sector into the international network, an overall, integrated strategy for genetic resource conservation can emerge, involving farmers, farming communities, scientists, and extension workers. This process will provide for a reciprocal exchange of information, materials, and benefits between these two sectors that have, to date, remained largely divorced from one another.

1. Problem to be addressed and the present situation

The project addresses the general problem of the loss of significant crop genetic resources and their associated traditional knowledge. The loss of these resources is caused by many factors, including population growth, market development, and cultural and technological change. A key factor is the spread of high-yielding crop varieties or new crops that replace local ones. Conserving genetic resources of landraces and associated traditional knowledge requires an enhanced research capacity at PGRC/E. The project will strengthen capacity in ethnobotany, social sciences, and population biology, enabling scientists to determine the extent of genetic variation within landraces under traditional agricultural practices, distribution of landraces, and population size/sampling techniques for optimal *ex situ* storage.

Local farmers have extensive knowledge concerning local landrace distribution, attributes, and use. Through the establishment of local CGBs, farmers will be enlisted to record this information in formats accessible to PGRC/E. A community gene bank will provide a seed storage

facility for local farmers, and a place for farmer conservators to store samples of community landraces. PGRC/E will periodically visit (two to four times per year) the CGB to gather subsamples.

The identification and training of locally-based farmer conservators will be a unique aspect of the project. Farmers have intimate knowledge acquired through generations of crop experimentation. By incorporating this knowledge, the project seeks to capture information and crop landraces which are not readily apparent to genetic resource curators or users.

The interaction between *ex situ* germplasm collections and farmers has in general been limited. The strengthening of the relationship between PGRC/E and farmers will enhance existing efforts at landrace conservation. PGRC/E is well positioned to provide training to farmer conservators, and benefit from farm-based *in situ* conservation.

Sustainability of farm-based landrace conservation may ultimately depend upon external market and non-market incentives for continuing their cultivation. Through special investigations, the project will seek to identify landrace-based products which can be marketed as value added products to support farmer cultivation of landraces. Existing products, such as the marketing of *Triticum polonicum*, which is essentially an Ethiopian wheat landrace, have been economically viable in the specialty health-food cereal market. Other market niches for landraces likely exist and warrant special initiatives.

In situ conservation of landraces presents many challenges. A number of different approaches have been suggested but, to date, practical experience in this area is lacking. The project will create the framework, conditions and expertise that will allow different local initiatives for *in situ* conservation to be undertaken. It will create the conditions whereby *in situ* conservation is enhanced, and provide the knowledge base and organization that will ensure long-term success.

2. Expected end-of-project situation

At the end of this project, four situations can be expected.

- The PGRC/E will be strengthened in its conservation efforts by the addition of scientific staff and CGBs to its community-based conservation division.
- The capacity of PGRC/E for undertaking research on landraces will be strengthened in the fields of population biology, conservation biology, ethnobotany, and related social sciences. The Ethiopian National Herbarium will likewise be strengthened in ethnobotany and population biology.
- Target communities and regions will have established sustainable on-farm conservation of crop genetic resources to complement existing PGRC/E off-farm conservation.
- Long-term prospects for conservation of globally important crop genetic resources will be enhanced by the collaborative efforts of PGRC/E and Ethiopian farmers.

facility for local farmers, and a place for farmer conservators to store samples of community landraces. PGRC/E will periodically visit (two to four times per year) the CGB to gather subsamples.

The identification and training of locally-based farmer conservators will be a unique aspect of the project. Farmers have intimate knowledge acquired through generations of crop experimentation. By incorporating this knowledge, the project seeks to capture information and crop landraces which are not readily apparent to genetic resource curators or users.

The interaction between *ex situ* germplasm collections and farmers has in general been limited. The strengthening of the relationship between PGRC/E and farmers will enhance existing efforts at landrace conservation. PGRC/E is well positioned to provide training to farmer conservators, and benefit from farm-based *in situ* conservation.

Sustainability of farm-based landrace conservation may ultimately depend upon external market and non-market incentives for continuing their cultivation. Through special investigations, the project will seek to identify landrace-based products which can be marketed as value added products to support farmer cultivation of landraces. Existing products, such as the marketing of *Triticum polonicum*, which is essentially an Ethiopian wheat landrace, have been economically viable in the specialty health-food cereal market. Other market niches for landraces likely exist and warrant special initiatives.

In situ conservation of landraces presents many challenges. A number of different approaches have been suggested but, to date, practical experience in this area is lacking. The project will create the framework, conditions and expertise that will allow different local initiatives for *in situ* conservation to be undertaken. It will create the conditions whereby *in situ* conservation is enhanced, and provide the knowledge base and organization that will ensure long-term success.

2. Expected end-of-project situation

At the end of this project, four situations can be expected.

- The PGRC/E will be strengthened in its conservation efforts by the addition of scientific staff and CGBs to its community-based conservation division.

- The capacity of PGRC/E for undertaking research on landraces will be strengthened in the fields of population biology, conservation biology, ethnobotany, and related social sciences. The Ethiopian National Herbarium will likewise be strengthened in ethnobotany and population biology.

- Target communities and regions will have established sustainable on-farm conservation of crop genetic resources to complement existing PGRC/E off-farm conservation.

- Long-term prospects for conservation of globally important crop genetic resources will be enhanced by the collaborative efforts of PGRC/E and Ethiopian farmers.

The objective of the project is to establish a programme linking *ex situ* and *in situ* conservation, ideally one which is self-sustaining. As with *ex situ* conservation, minimal inputs may be required for long-term system viability. Activities which might require additional support include:

- Continued monitoring activities by PGRC/E of farmer conservation efforts to assess genetic erosion and crop diversity
- Extending the GEF project to new areas and crops
- Disseminating the Ethiopian model to other African countries and to other regions of crop genetic diversity.

3. Target beneficiaries

Different users or beneficiaries of the project can be identified, including:

- The PGRC/E, which will have a continued source of genetic material produced by a dynamic evolutionary system
- The PGRC/E and the Ethiopian National Herbarium, whose capacity will be strengthened to undertake ethnobotanical and population biology research associated with landraces
- Farmers in the target regions and elsewhere who will have a more secure source of local seeds that otherwise might be eliminated by genetic erosion
- Farmers in target regions and elsewhere who will have improved knowledge of seed selection and management procedures through increased contact with the extension service and the PGRC/E
- National and international breeders of new crop varieties who will have a greater range of genetic material from Ethiopia
- National and international crop scientists who will have a unique living laboratory to understand the biology and ecology of crop genetic resources.

4. Project strategy and institutional arrangements

Three strategies are planned to achieve the objectives of this project: institutional strengthening, a community-based conservation programme, and the identification of incentives for landrace conservation. Each of these strategies is composed of several elements.

Institutional strengthening

A primary strategy of this project is to strengthen the capacity of Ethiopian institutions, especially the PGRC/E, to rationally plan and implement *in situ* conservation programmes. This

The objective of the project is to establish a programme linking *ex situ* and *in situ* conservation, ideally one which is self-sustaining. As with *ex situ* conservation, minimal inputs may be required for long-term system viability. Activities which might require additional support include:

- Continued monitoring activities by PGRC/E of farmer conservation efforts to assess genetic erosion and crop diversity
- Extending the GEF project to new areas and crops
- Disseminating the Ethiopian model to other African countries and to other regions of crop genetic diversity.

3. Target beneficiaries

Different users or beneficiaries of the project can be identified, including:

- The PGRC/E, which will have a continued source of genetic material produced by a dynamic evolutionary system
- The PGRC/E and the Ethiopian National Herbarium, whose capacity will be strengthened to undertake ethnobotanical and population biology research associated with landraces
- Farmers in the target regions and elsewhere who will have a more secure source of local seeds that otherwise might be eliminated by genetic erosion
- Farmers in target regions and elsewhere who will have improved knowledge of seed selection and management procedures through increased contact with the extension service and the PGRC/E
- National and international breeders of new crop varieties who will have a greater range of genetic material from Ethiopia
- National and international crop scientists who will have a unique living laboratory to understand the biology and ecology of crop genetic resources.

4. Project strategy and institutional arrangements

Three strategies are planned to achieve the objectives of this project: institutional strengthening, a community-based conservation programme, and the identification of incentives for landrace conservation. Each of these strategies is composed of several elements.

Institutional strengthening

A primary strategy of this project is to strengthen the capacity of Ethiopian institutions, especially the PGRC/E, to rationally plan and implement *in situ* conservation programmes. This

strategy is based on the premise that no single master plan for *in situ* conservation is possible. Rather, a resilient and flexible approach is needed to plan strategies for different crops and regions, and for farming conditions that may change in the future. A major means of building a flexible and resilient national effort for *in situ* conservation is to develop a community of scientists, extension agents, and farmers who are well trained, equipped, and motivated to pursue *in situ* conservation objectives. This project intends to develop this community of scientists, extension agents, and farmers through research, training, and communication through workshops.

Research

Understanding the processes of genetic erosion and conservation requires a base of expertise across the fields of genetics, botany, agronomy, ecology, anthropology, sociology and economics. One challenge is to understand long-term social and biological processes with limited temporal data. Another challenge is to combine the methodologies of different areas of science which are concerned with genetic resources. Meeting these two challenges will enable a group of scientists to assess the current threat to genetic resources, and monitor the success and future needs of conservation programmes.

Two types of research will be supported by this GEF project. The first is ethnobotanical research to understand and analyze patterns of farmer knowledge, selection, utilization, and maintenance of Ethiopian crop genetic resources. Initially, the ethnobotanical research will rely on anthropological methods to describe the base of farmer knowledge regarding local crops. Subsequently, social, cultural and economic factors will be quantitatively measured and used to analyze the patterns of conservation and loss of genetic diversity on different farms and in different communities. Questions that will be addressed will be the influence of farm size, commercialization of production, and use of external inputs. By understanding these factors, this research will enable Ethiopian scientists to determine how changes such as increased population or improved markets will affect the selection and maintenance of local crop varieties.

The second type of research is the population and conservation biology of local crops. This research seeks to understand the structure and dynamics of genetic diversity in landraces of Ethiopian crops. It will involve studies on the distribution and extent of genetic diversity in the target crops and areas, and provide a base for continuing studies of change in diversity over time. This research will enable Ethiopian scientists to determine the distribution of genetic resources among different farms and regions, the risk of genetic erosion, and optimal sampling and collection strategies, both for *in situ* and *ex situ* conservation. It will provide invaluable baseline information by which to gauge and monitor future change in genetic resources. A significant feature of the work will be the linkages developed between ethnobotanical, and population and conservation biology aspects. This process will yield integrated conclusions on conservation strategies which account for both social and biological factors.

This research experience will equip the PGRC/E and other Ethiopian institutions to continue this activity after the life of the project. The continued ability to carry on research in these areas will be a lasting contribution to the national ability to monitor the status of crop genetic resources, and to plan new phases of conservation activities.

strategy is based on the premise that no single master plan for *in situ* conservation is possible. Rather, a resilient and flexible approach is needed to plan strategies for different crops and regions, and for farming conditions that may change in the future. A major means of building a flexible and resilient national effort for *in situ* conservation is to develop a community of scientists, extension agents, and farmers who are well trained, equipped, and motivated to pursue *in situ* conservation objectives. This project intends to develop this community of scientists, extension agents, and farmers through research, training, and communication through workshops.

Research

Understanding the processes of genetic erosion and conservation requires a base of expertise across the fields of genetics, botany, agronomy, ecology, anthropology, sociology and economics. One challenge is to understand long-term social and biological processes with limited temporal data. Another challenge is to combine the methodologies of different areas of science which are concerned with genetic resources. Meeting these two challenges will enable a group of scientists to assess the current threat to genetic resources, and monitor the success and future needs of conservation programmes.

Two types of research will be supported by this GEF project. The first is ethnobotanical research to understand and analyze patterns of farmer knowledge, selection, utilization, and maintenance of Ethiopian crop genetic resources. Initially, the ethnobotanical research will rely on anthropological methods to describe the base of farmer knowledge regarding local crops. Subsequently, social, cultural and economic factors will be quantitatively measured and used to analyze the patterns of conservation and loss of genetic diversity on different farms and in different communities. Questions that will be addressed will be the influence of farm size, commercialization of production, and use of external inputs. By understanding these factors, this research will enable Ethiopian scientists to determine how changes such as increased population or improved markets will affect the selection and maintenance of local crop varieties.

The second type of research is the population and conservation biology of local crops. This research seeks to understand the structure and dynamics of genetic diversity in landraces of Ethiopian crops. It will involve studies on the distribution and extent of genetic diversity in the target crops and areas, and provide a base for continuing studies of change in diversity over time. This research will enable Ethiopian scientists to determine the distribution of genetic resources among different farms and regions, the risk of genetic erosion, and optimal sampling and collection strategies, both for *in situ* and *ex situ* conservation. It will provide invaluable baseline information by which to gauge and monitor future change in genetic resources. A significant feature of the work will be the linkages developed between ethnobotanical, and population and conservation biology aspects. This process will yield integrated conclusions on conservation strategies which account for both social and biological factors.

This research experience will equip the PGRC/E and other Ethiopian institutions to continue this activity after the life of the project. The continued ability to carry on research in these areas will be a lasting contribution to the national ability to monitor the status of crop genetic resources, and to plan new phases of conservation activities.

Training

The second component of institutional strengthening is training aimed at four different groups: scientists, technical support staff, extension agents, and farmers. The objective is to build a broad base of expertise in crop conservation.

At the scientific level, the project will support advanced degree work at both the MS and PhD levels in population biology, ecology and social science. The strategy is to train a group of scientists who will focus specifically on crop resources, and assume leadership positions at PGRC/E and other Ethiopian institutions.

Technical support staff will complement the work of scientists in such areas as data management, geographic information systems (GIS), and biochemical analysis (isozyme) for population research. This technical staff is an essential element in the long-term ability to monitor genetic resources. Their training will be carried out in-service.

Extension agents working in the crop conservation sites comprise the third group for training. The object is to add crop identification, selection, and seed maintenance skills critical in helping farmers to improve local crop selection and maintain unique crop varieties on their farms. Extension agents will receive training at PGRC/E facilities. It is expected that their interest and involvement in the project will stimulate farmers to improve selection and *in situ* conservation. Extension agents will also provide an important bridge between PGRC/E staff and the farmers, as well as the Ministry of Agriculture (MOA).

Farmers are the fourth group to be trained under this project. Training will emphasize enhancing the identification, selection, utilization and maintenance of local crops. Training will take place both in the communities selected for the *in situ* project activities and at PGRC/E. The initial emphasis in farmer training will be to choose farmer conservators and assistants from each community to serve as resource persons for the entire community.

Communication and networking

Forming a cooperative link between PGRC/E, extension agents, and farmers is an important ingredient for success on all levels. PGRC/E depends on the flow of information from the farm level to succeed in its research and conservation mission. Extension agents depend on information from both research centres and farmers, who in turn are eager to receive technical information and assistance. The research and training elements discussed above will provide numerous opportunities for these three groups to communicate and share knowledge. Moreover, this project will formalize this communication by holding yearly workshops at the national levels. Finally, a major seminar in year three will bring outside experts into the project. Crop conservation specialists from other countries in Africa, Asia, and Latin America with genetic resources and leading international scientists will participate. Besides reviewing the progress of the project, these seminars will help alert the agricultural development community to this unique effort.

Training

The second component of institutional strengthening is training aimed at four different groups: scientists, technical support staff, extension agents, and farmers. The objective is to build a broad base of expertise in crop conservation.

At the scientific level, the project will support advanced degree work at both the MS and PhD levels in population biology, ecology and social science. The strategy is to train a group of scientists who will focus specifically on crop resources, and assume leadership positions at PGRC/E and other Ethiopian institutions.

Technical support staff will complement the work of scientists in such areas as data management, geographic information systems (GIS), and biochemical analysis (isozyme) for population research. This technical staff is an essential element in the long-term ability to monitor genetic resources. Their training will be carried out in-service.

Extension agents working in the crop conservation sites comprise the third group for training. The object is to add crop identification, selection, and seed maintenance skills critical in helping farmers to improve local crop selection and maintain unique crop varieties on their farms. Extension agents will receive training at PGRC/E facilities. It is expected that their interest and involvement in the project will stimulate farmers to improve selection and *in situ* conservation. Extension agents will also provide an important bridge between PGRC/E staff and the farmers, as well as the Ministry of Agriculture (MOA).

Farmers are the fourth group to be trained under this project. Training will emphasize enhancing the identification, selection, utilization and maintenance of local crops. Training will take place both in the communities selected for the *in situ* project activities and at PGRC/E. The initial emphasis in farmer training will be to choose farmer conservators and assistants from each community to serve as resource persons for the entire community.

Communication and networking

Forming a cooperative link between PGRC/E, extension agents, and farmers is an important ingredient for success on all levels. PGRC/E depends on the flow of information from the farm level to succeed in its research and conservation mission. Extension agents depend on information from both research centres and farmers, who in turn are eager to receive technical information and assistance. The research and training elements discussed above will provide numerous opportunities for these three groups to communicate and share knowledge. Moreover, this project will formalize this communication by holding yearly workshops at the national levels. Finally, a major seminar in year three will bring outside experts into the project. Crop conservation specialists from other countries in Africa, Asia, and Latin America with genetic resources and leading international scientists will participate. Besides reviewing the progress of the project, these seminars will help alert the agricultural development community to this unique effort.

Community-based conservation programme

The second broad strategy to achieve the objective of establishing an *in situ* crop conservation effort in Ethiopia will be to create a network of CGBs in six districts in different agro-ecological regions of Ethiopia. The sites for these banks will be determined according to ecological and genetic erosion criteria. This initial network can be expanded at relatively minor cost after project completion since PGRC/E and other institutions will have improved capabilities, and will also have developed a working model.

The CGB is planned as a means to organize local support for conservation, train farmers in conservation activities, build a low-cost and low-maintenance storage facility, and link farmers, extension agents and PGRC/E staff. The first step will be to contact local leaders and farmers in selected districts and communities to organize a local association, the Crop Conservation Association (CCA), to work with the extension agents and PGRC/E in initiating the work of the CGB. The CCA, the district extension agents, and the PGRC/E will join in building the facility for the CGB. This facility will have rooms for seed storage, seed selection, documentation/administration, and community meetings and training sessions. It will also include a garden area for local plants that cannot be stored as seed. The CGB will be equipped for documentation (desk, file cabinet, adding machine) and seed storage (scale and shelves).

The next step in establishing a community-based conservation programme will be to select a local farmer conservator and two assistants through a meeting/workshop involving the CCA, community leaders, extension agents, and local farmers, including women. The farmer conservator and his/her assistants will be the primary local contact for the project, and will be responsible for managing the CGB. The farmer conservator will be trained by PGRC/E, in conjunction with extension agents, to select, document and store genetic resources in the CGB.

The farmer conservator, along with the CCA, trained extension agents, and PGRC/E, will then initiate a programme of community-seed storage at the CGB. Community storage is already practiced in Ethiopia as a method to provide seed in times of stress, and the CGB builds on this tradition. Farmers will store a portion of their seed in the CGB, and this seed will be available for retrieval at any time. A small, but representative, population sample of seed will be taken from selected stocks for storage as a genetic resource at the CGB, with a duplicate sent to PGRC/E.

Major incentives to the farmer in the operations of the CGB will be the increased training and presence of extension agents, and the training received by the farmer conservator and assistants. These experts will not only be available to select and store local seed and genetic resources, but also to work with farmers in improving crop production. A flexible strategy to accommodate both improved crop production techniques and conservation of local crop varieties is anticipated here. Both the extension agents and the farmer conservator will be able to advise farmers on the advantages of different crop varieties (local and introduced) and where these might do well. These experts will be able to help farmers increase production by improved crop management techniques such as fertilizer application, soil erosion control, and pest control.

Community-based conservation programme

The second broad strategy to achieve the objective of establishing an *in situ* crop conservation effort in Ethiopia will be to create a network of CGBs in six districts in different agro-ecological regions of Ethiopia. The sites for these banks will be determined according to ecological and genetic erosion criteria. This initial network can be expanded at relatively minor cost after project completion since PGRC/E and other institutions will have improved capabilities, and will also have developed a working model.

The CGB is planned as a means to organize local support for conservation, train farmers in conservation activities, build a low-cost and low-maintenance storage facility, and link farmers, extension agents and PGRC/E staff. The first step will be to contact local leaders and farmers in selected districts and communities to organize a local association, the Crop Conservation Association (CCA), to work with the extension agents and PGRC/E in initiating the work of the CGB. The CCA, the district extension agents, and the PGRC/E will join in building the facility for the CGB. This facility will have rooms for seed storage, seed selection, documentation/administration, and community meetings and training sessions. It will also include a garden area for local plants that cannot be stored as seed. The CGB will be equipped for documentation (desk, file cabinet, adding machine) and seed storage (scale and shelves).

The next step in establishing a community-based conservation programme will be to select a local farmer conservator and two assistants through a meeting/workshop involving the CCA, community leaders, extension agents, and local farmers, including women. The farmer conservator and his/her assistants will be the primary local contact for the project, and will be responsible for managing the CGB. The farmer conservator will be trained by PGRC/E, in conjunction with extension agents, to select, document and store genetic resources in the CGB.

The farmer conservator, along with the CCA, trained extension agents, and PGRC/E, will then initiate a programme of community-seed storage at the CGB. Community storage is already practiced in Ethiopia as a method to provide seed in times of stress, and the CGB builds on this tradition. Farmers will store a portion of their seed in the CGB, and this seed will be available for retrieval at any time. A small, but representative, population sample of seed will be taken from selected stocks for storage as a genetic resource at the CGB, with a duplicate sent to PGRC/E.

Major incentives to the farmer in the operations of the CGB will be the increased training and presence of extension agents, and the training received by the farmer conservator and assistants. These experts will not only be available to select and store local seed and genetic resources, but also to work with farmers in improving crop production. A flexible strategy to accommodate both improved crop production techniques and conservation of local crop varieties is anticipated here. Both the extension agents and the farmer conservator will be able to advise farmers on the advantages of different crop varieties (local and introduced) and where these might do well. These experts will be able to help farmers increase production by improved crop management techniques such as fertilizer application, soil erosion control, and pest control.

Incentives to farmers

Farmers themselves must perceive an advantage in continuing to grow traditional crops, and their participation in the conservation of landraces must be self-sustaining. This last condition requires a minimum of centralized support or subsidy to specific farmers or farm groups. In other words, continuing *in situ* conservation cannot rely on direct production subsidies to farmers. However, landrace production and utilization is important for Ethiopian farming communities and will continue to make a substantial contribution to Ethiopian agriculture. In this context, it will be important to identify where agricultural production and pricing policies are likely to act as disincentives to continuing the use of landraces. The infrastructural framework and research objectives pursued in the agricultural and related sectors may also have an impact on the conservation and use of landraces, and their effects will also need to be investigated and identified.

The third broad strategy of the farmer-based conservation programme is to identify non-market and market incentives for growing landraces. Among the significant non-market issues to be addressed will be the availability of seed, and the current status and level of informal seed exchange. At a wider level, the institutional strengthening and community activities mentioned above will greatly elevate the awareness of landraces and their value. This project will also develop educational material and programmes at regional agricultural fairs to illustrate the wealth and importance of crop genetic diversity in Ethiopia. The keys to a market incentive programme are to identify the specific constraints that would limit continuing landrace utilization by farming communities, and their capacity to market landrace products at the local, national, and international levels. A key component would be the identification of special consumer products that utilize landraces, including botanical coffee varieties, snack foods, flour, and breakfast cereals.

The extent to which existing local and national marketing opportunities could be developed and the major constraints (for example, transport, communication, and market opportunities) which currently exist need to be identified. On the national and international level, the potential for green marketing deserves special attention. Green marketing is a strategy that recognizes the potential of special urban markets to support local conservation programmes in rural areas where low income and other marginal economic conditions make conservation too costly for farmers. Green marketing for traditional crop products is supported by the fact that urban consumers in both developed and developing countries are often willing to pay higher prices for traditional crop products. There is a potentially large international market for products that have social values such as conservation and the support of disadvantaged farmers. In the United States, for instance, there are good markets for "organic" tropical products such as bananas and coffee that are produced by farmer cooperatives. Green marketing has proved itself as a viable strategy in specialized tropical products for condiments (for example, Ben and Jerry's Ice Cream), and the personal hygiene industry (for example, the Body Shop).

The PGRC/E will contract a consultant to identify landrace products with national and international potential. This consultant will report on the economic feasibility and possible negative social impacts of marketing Ethiopian landrace products. The consultant will also identify the procedure to implement mechanisms to develop and market products.

Incentives to farmers

Farmers themselves must perceive an advantage in continuing to grow traditional crops, and their participation in the conservation of landraces must be self-sustaining. This last condition requires a minimum of centralized support or subsidy to specific farmers or farm groups. In other words, continuing *in situ* conservation cannot rely on direct production subsidies to farmers. However, landrace production and utilization is important for Ethiopian farming communities and will continue to make a substantial contribution to Ethiopian agriculture. In this context, it will be important to identify where agricultural production and pricing policies are likely to act as disincentives to continuing the use of landraces. The infrastructural framework and research objectives pursued in the agricultural and related sectors may also have an impact on the conservation and use of landraces, and their effects will also need to be investigated and identified.

The third broad strategy of the farmer-based conservation programme is to identify non-market and market incentives for growing landraces. Among the significant non-market issues to be addressed will be the availability of seed, and the current status and level of informal seed exchange. At a wider level, the institutional strengthening and community activities mentioned above will greatly elevate the awareness of landraces and their value. This project will also develop educational material and programmes at regional agricultural fairs to illustrate the wealth and importance of crop genetic diversity in Ethiopia. The keys to a market incentive programme are to identify the specific constraints that would limit continuing landrace utilization by farming communities, and their capacity to market landrace products at the local, national, and international levels. A key component would be the identification of special consumer products that utilize landraces, including botanical coffee varieties, snack foods, flour, and breakfast cereals.

The extent to which existing local and national marketing opportunities could be developed and the major constraints (for example, transport, communication, and market opportunities) which currently exist need to be identified. On the national and international level, the potential for green marketing deserves special attention. Green marketing is a strategy that recognizes the potential of special urban markets to support local conservation programmes in rural areas where low income and other marginal economic conditions make conservation too costly for farmers. Green marketing for traditional crop products is supported by the fact that urban consumers in both developed and developing countries are often willing to pay higher prices for traditional crop products. There is a potentially large international market for products that have social values such as conservation and the support of disadvantaged farmers. In the United States, for instance, there are good markets for "organic" tropical products such as bananas and coffee that are produced by farmer cooperatives. Green marketing has proved itself as a viable strategy in specialized tropical products for condiments (for example, Ben and Jerry's Ice Cream), and the personal hygiene industry (for example, the Body Shop).

The PGRC/E will contract a consultant to identify landrace products with national and international potential. This consultant will report on the economic feasibility and possible negative social impacts of marketing Ethiopian landrace products. The consultant will also identify the procedure to implement mechanisms to develop and market products.

Finally, this project will help PGRC/E to identify national policies and trends that may adversely affect on-farm conservation in the future. This will be accomplished by commissioning a consultant report on relevant policies and trends. This report will help PGRC/E to plan new conservation steps, such as special collection programmes, at times and places where genetic erosion is more imminent.

5. Reasons for GEF assistance

Ethiopia has demonstrated both the capacity to carry out conventional gene bank conservation, and the commitment to begin an innovative programme of farmer-based conservation to complement this capacity. National and international support for PGRC/E is now provided on a maintenance basis, but these funds are insufficient to undertake this new initiative. GEF support for this innovative pilot project is required as no other sources exist. This project complements the GEF-sponsored project in Turkey which focuses on *in situ* conservation of wild relatives of domesticated species in natural areas.

For many crops in Africa and elsewhere, the genetically-diverse local landraces grown on peasant farms will continue to be the main genetic resource base for modern plant-breeding programmes. This is particularly true in Ethiopia, an important gene centre for many of the major food and feed crops grown in Africa and the rest of the world. Furthermore, Ethiopian farmers also depend largely on locally-adapted landraces to sustain crop production, especially under the prevailing low-input conditions, and in marginal lands. The conservation of local landraces is therefore of critical importance, not only to scientific crop improvement, but also to small farmers' agriculture, and to the country as a whole, since 98 percent of its agricultural production is on small farms.

Genetic variations which originated at the local farm and rural community level have had great global significance. Among numerous examples are the yellow dwarf virus resistance gene found in Ethiopian barley, on which California's US$ 160 million annual barley crop depends, as well as the high-lysine gene in sorghum, also of Ethiopian origin.

The GEF is uniquely positioned to bring all relevant sectors together (for example, farmers, NGOs, the scientific community, and governments), and to provide a forum in which the involved parties can effectively transmit lessons among themselves, and to other countries and regions.

6. Special considerations

Food and Agriculture Organization (FAO)

FAO, both through its main programme and through the activities of the Commission on Plant Genetic Resources, has expressed a significant interest in farmer-based conservation, and in particular the fuller recognition of the role of farmers in maintaining genetic resources. The project will also substantially contribute to the current information-collection activities of the FAO (such as the State Report on Plant Genetic Resources), and to the Fourth Conference on Plant Genetic Resources planned for 1995.

Finally, this project will help PGRC/E to identify national policies and trends that may adversely affect on-farm conservation in the future. This will be accomplished by commissioning a consultant report on relevant policies and trends. This report will help PGRC/E to plan new conservation steps, such as special collection programmes, at times and places where genetic erosion is more imminent.

5. Reasons for GEF assistance

Ethiopia has demonstrated both the capacity to carry out conventional gene bank conservation, and the commitment to begin an innovative programme of farmer-based conservation to complement this capacity. National and international support for PGRC/E is now provided on a maintenance basis, but these funds are insufficient to undertake this new initiative. GEF support for this innovative pilot project is required as no other sources exist. This project complements the GEF-sponsored project in Turkey which focuses on *in situ* conservation of wild relatives of domesticated species in natural areas.

For many crops in Africa and elsewhere, the genetically-diverse local landraces grown on peasant farms will continue to be the main genetic resource base for modern plant-breeding programmes. This is particularly true in Ethiopia, an important gene centre for many of the major food and feed crops grown in Africa and the rest of the world. Furthermore, Ethiopian farmers also depend largely on locally-adapted landraces to sustain crop production, especially under the prevailing low-input conditions, and in marginal lands. The conservation of local landraces is therefore of critical importance, not only to scientific crop improvement, but also to small farmers' agriculture, and to the country as a whole, since 98 percent of its agricultural production is on small farms.

Genetic variations which originated at the local farm and rural community level have had great global significance. Among numerous examples are the yellow dwarf virus resistance gene found in Ethiopian barley, on which California's US$ 160 million annual barley crop depends, as well as the high-lysine gene in sorghum, also of Ethiopian origin.

The GEF is uniquely positioned to bring all relevant sectors together (for example, farmers, NGOs, the scientific community, and governments), and to provide a forum in which the involved parties can effectively transmit lessons among themselves, and to other countries and regions.

6. Special considerations

Food and Agriculture Organization (FAO)

FAO, both through its main programme and through the activities of the Commission on Plant Genetic Resources, has expressed a significant interest in farmer-based conservation, and in particular the fuller recognition of the role of farmers in maintaining genetic resources. The project will also substantially contribute to the current information-collection activities of the FAO (such as the State Report on Plant Genetic Resources), and to the Fourth Conference on Plant Genetic Resources planned for 1995.

In an effort to alert the world conservation community to urgent conservation needs, the FAO has initiated an Early Warning System for crop genetic erosion. The series of CGBs established in different agro-ecological regions of Ethiopia will provide an excellent farm-based means to assess the displacement of landraces by new varieties.

International agricultural research

National and international breeders and other scientists (for example, agronomists, pathologists, and taxonomists) will assist with training farmers in simple procedures of crop improvement, and participate directly in germplasm enhancement activities (for example, crossing within and among species, evaluation, and selection). They will also assist in formulating selection criteria, sampling strategies, and various scientific studies to support conservation and crop improvement. Breeders will also serve as contact persons with international breeding programmes through their collaborative links, especially in the transfer of information and technology.

The IPGRI has a global mandate for conservation of plant genetic resources, including landrace conservation. This initiative can serve as a model for other projects, such as those undertaken by IPGRI, and improved links between PGRC/E and IPGRI landrace conservation work are expected to develop. Collaboration with other international efforts will benefit landrace conservation in Ethiopia and other areas with abundant crop genetic resources. Other centres of the Consultative Group for International Agricultural Research (CGIAR) are targeting conservation and use of landraces as part of new innovative crop improvement programmes (for example, International Centre for Tropical Agriculture (CIAT), International Potato Centre (CIP), and International Centre for Agricultural Research in Dry Areas (ICARDA)). These projects will benefit from the PGRC/E initiative in both knowledge and experience.

Women

Women are key elements in the PGRC/E strategy for farmer-based conservation. It is traditionally the women who select seeds at harvest time. Their crop selection criteria are often based on food preparation traits which are not easily addressed by traditional plant breeders. The knowledge of women will be a focus for ethnobotanical research which will seek links between landrace genetic diversity and food usage patterns. Participation of women will, therefore, be critical in executing the plan to store seed in community seed banks.

NGOs

A number of international networks and NGOs have also expressed interest in landrace conservation and management for traditional farmers. As the most extensive project to date, the PGRC/E initiative will complement and enhance NGO efforts in other areas of Africa and the rest of the world. A growing number of NGOs are involved in community approaches to plant genetic resource conservation as part of the rural development programmes they are supporting in Africa. NGOs such as the Seeds of Survival Programme for Africa (SOS/A), involving USC/C and Rural Advancement Fund International (RAFI) among other Partnership Canada/Africa members, have played a key role in the PGRC/E strategy for farmer-based conservation. Their activities are specifically geared to assist farmers in maintaining their crop diversity while improving yield through

In an effort to alert the world conservation community to urgent conservation needs, the FAO has initiated an Early Warning System for crop genetic erosion. The series of CGBs established in different agro-ecological regions of Ethiopia will provide an excellent farm-based means to assess the displacement of landraces by new varieties.

International agricultural research

National and international breeders and other scientists (for example, agronomists, pathologists, and taxonomists) will assist with training farmers in simple procedures of crop improvement, and participate directly in germplasm enhancement activities (for example, crossing within and among species, evaluation, and selection). They will also assist in formulating selection criteria, sampling strategies, and various scientific studies to support conservation and crop improvement. Breeders will also serve as contact persons with international breeding programmes through their collaborative links, especially in the transfer of information and technology.

The IPGRI has a global mandate for conservation of plant genetic resources, including landrace conservation. This initiative can serve as a model for other projects, such as those undertaken by IPGRI, and improved links between PGRC/E and IPGRI landrace conservation work are expected to develop. Collaboration with other international efforts will benefit landrace conservation in Ethiopia and other areas with abundant crop genetic resources. Other centres of the Consultative Group for International Agricultural Research (CGIAR) are targeting conservation and use of landraces as part of new innovative crop improvement programmes (for example, International Centre for Tropical Agriculture (CIAT), International Potato Centre (CIP), and International Centre for Agricultural Research in Dry Areas (ICARDA)). These projects will benefit from the PGRC/E initiative in both knowledge and experience.

Women

Women are key elements in the PGRC/E strategy for farmer-based conservation. It is traditionally the women who select seeds at harvest time. Their crop selection criteria are often based on food preparation traits which are not easily addressed by traditional plant breeders. The knowledge of women will be a focus for ethnobotanical research which will seek links between landrace genetic diversity and food usage patterns. Participation of women will, therefore, be critical in executing the plan to store seed in community seed banks.

NGOs

A number of international networks and NGOs have also expressed interest in landrace conservation and management for traditional farmers. As the most extensive project to date, the PGRC/E initiative will complement and enhance NGO efforts in other areas of Africa and the rest of the world. A growing number of NGOs are involved in community approaches to plant genetic resource conservation as part of the rural development programmes they are supporting in Africa. NGOs such as the Seeds of Survival Programme for Africa (SOS/A), involving USC/C and Rural Advancement Fund International (RAFI) among other Partnership Canada/Africa members, have played a key role in the PGRC/E strategy for farmer-based conservation. Their activities are specifically geared to assist farmers in maintaining their crop diversity while improving yield through

selection, multiplication, and distribution of locally-adopted plant material. USC/C is a valuable partner of PGRC/E in landrace conservation activities, with particular emphasis on small-scale farm utilization of landrace materials, complementing the GEF project focusing on conservation. GEF will support activities that USC/C has not supported in the past, such as advanced training, research, and community gene bank construction. RAFI, which has played a key role in supporting the exchange of information through relevant workshops and newsletters, could assist with creating awareness among African countries, particularly scientists and policy-makers, of the importance of conserving their genetic resources, as well as with the networking of NGO activities in this field.

BIDNET/AMCEN

BIDNET is emerging as an important African initiative to establish and strengthen activities related to plant genetic resources (PGR) in the African region. The network is composed of national institutions with access to one or more of the nature reserves, biosphere reserves, germplasm banks, or biological reference collections. It has a Regional Coordination Unit (PGRC/E) and national level coordination institutions, some of which will serve as focal points for the subregional coordination of the network's activities. The network may assist with the promotion of the landrace programme initiated in Ethiopia, especially by fostering collaborative activities among its twenty-six member countries as part of this regional responsibility. The various focal points to be established at the subregional and regional levels will be involved in implementing such a programme in Africa, based on the experience gained in Ethiopia.

Community Biodiversity Development and Conservation (CBDC)

CBDC is a global initiative established by the joint actions of governments and some NGOs of the South and the North for conservation and sustainable use of biological diversity. It includes regional programmes for Africa, Asia and Latin America. The African regional programme is coordinated by PGRC/E, and complements this GEF project and the programmes of SOS/Ethiopia.

Intellectual property rights

All collections will be the sovereign property of the Ethiopian people in accordance with the newly adopted Seed Policy (see Section A, subsection 2), and the Convention on Biological Diversity. Germplasm accessions will be available through PGRC/E subject to standard exchange protocols.

Environmental impacts

No detrimental environmental impacts are envisioned by the project. On the contrary, through the conservation of biodiversity and support for traditional low-input agriculture, this project will likely produce only positive environmental impacts. Long-term impacts will certainly be beneficial through the continued conservation of unique, genetically diverse, locally adapted crop landraces. Guidelines for an Environmental Overview Programme and Management Strategy (EOPMS) will be developed following standard procedures of the United Nations Development Programme (UNDP).

selection, multiplication, and distribution of locally-adopted plant material. USC/C is a valuable partner of PGRC/E in landrace conservation activities, with particular emphasis on small-scale farm utilization of landrace materials, complementing the GEF project focusing on conservation. GEF will support activities that USC/C has not supported in the past, such as advanced training, research, and community gene bank construction. RAFI, which has played a key role in supporting the exchange of information through relevant workshops and newsletters, could assist with creating awareness among African countries, particularly scientists and policy-makers, of the importance of conserving their genetic resources, as well as with the networking of NGO activities in this field.

BIDNET/AMCEN

BIDNET is emerging as an important African initiative to establish and strengthen activities related to plant genetic resources (PGR) in the African region. The network is composed of national institutions with access to one or more of the nature reserves, biosphere reserves, germplasm banks, or biological reference collections. It has a Regional Coordination Unit (PGRC/E) and national level coordination institutions, some of which will serve as focal points for the subregional coordination of the network's activities. The network may assist with the promotion of the landrace programme initiated in Ethiopia, especially by fostering collaborative activities among its twenty-six member countries as part of this regional responsibility. The various focal points to be established at the subregional and regional levels will be involved in implementing such a programme in Africa, based on the experience gained in Ethiopia.

Community Biodiversity Development and Conservation (CBDC)

CBDC is a global initiative established by the joint actions of governments and some NGOs of the South and the North for conservation and sustainable use of biological diversity. It includes regional programmes for Africa, Asia and Latin America. The African regional programme is coordinated by PGRC/E, and complements this GEF project and the programmes of SOS/Ethiopia.

Intellectual property rights

All collections will be the sovereign property of the Ethiopian people in accordance with the newly adopted Seed Policy (see Section A, subsection 2), and the Convention on Biological Diversity. Germplasm accessions will be available through PGRC/E subject to standard exchange protocols.

Environmental impacts

No detrimental environmental impacts are envisioned by the project. On the contrary, through the conservation of biodiversity and support for traditional low-input agriculture, this project will likely produce only positive environmental impacts. Long-term impacts will certainly be beneficial through the continued conservation of unique, genetically diverse, locally adapted crop landraces. Guidelines for an Environmental Overview Programme and Management Strategy (EOPMS) will be developed following standard procedures of the United Nations Development Programme (UNDP).

7. Coordination arrangements

The proposed farmer-based landrace conservation project will be implemented by the PGRC/E. The Ministry of Natural Resources Development and Environmental Protection (MNRDEP), as chair of the PGRC/E Council, will monitor project activities. The project will be headed by the Director of PGRC/E, who will designate the division that is responsible for the Centre's Community Genetic Resources programme to coordinate and monitor the farmer-based genetic resources conservation activities. It will be assisted by a Project Coordinating Committee comprised of extension agents, a farmer representative, University/IAR researchers, and local government agents. Organizational charts have been created to illustrate the management and coordination of the various activities of the project.

The other relevant divisions of PGRC/E—conservation, documentation, plant exploration/collection, seed health, plant introduction and distribution—will participate in the on-farm programme and provide technical support to the CGBs.

The CBDC project, which is coordinated in Africa by PGRC/E, will provide technical and financial support for on-farm selection, enhancement, and evaluation of landraces for utilization of such material by small-scale farmers, and will complement the conservation activities undertaken through the GEF project.

The project will also establish a Project Advisory and Overseeing Committee (PAOC) made up of prominent national and international experts and scientists in relevant fields such as socioeconomics, genetic resource conservation, population genetics, ecology and ethnobotany. The members should include four national and three international scientists/experts with active experience in these fields. The committee will oversee the project and will monitor, evaluate, and provide guidance throughout the life of the project; it will refer to the Natural Resources Development Department of MNRDEP and the Ministry of Agriculture (MOA).

The PGRC/E will also coordinate the activities of the project with other donor programmes which are actively providing support in similar or related areas, with a view to complementing the GEF project. These projects include the USC/C landrace conservation, enhancement, and utilization programme which primarily emphasizes small-scale farm utilization of locally adapted seed to support low-input crop production by peasant farmers in Ethiopia.

The PGRC/E is institutionally linked to relevant national and international bases, and to NGOs working in this area. At the national level, the PGRC/E is currently directed by the PGRC/E Council, which includes representatives from the Ethiopian Science and Technology Commission, the Institute of Agricultural Research (IAR), the University of Addis Ababa, the Alemaya University of Agriculture (AUA), and the ministries of Agriculture, Coffee and Tea Development, Industry, and Health.

Internationally, the PGRC/E participates in the FAO Commission on Plant Genetic Resources. It also coordinates the BIDNET/AMCEN, supported by UNEP. The PGRC/E has a long history of collaboration with international scientists and crop breeders, for instance, from Norway and Germany. The Centre has also been providing short-term training courses for genetic

7. Coordination arrangements

The proposed farmer-based landrace conservation project will be implemented by the PGRC/E. The Ministry of Natural Resources Development and Environmental Protection (MNRDEP), as chair of the PGRC/E Council, will monitor project activities. The project will be headed by the Director of PGRC/E, who will designate the division that is responsible for the Centre's Community Genetic Resources programme to coordinate and monitor the farmer-based genetic resources conservation activities. It will be assisted by a Project Coordinating Committee comprised of extension agents, a farmer representative, University/IAR researchers, and local government agents. Organizational charts have been created to illustrate the management and coordination of the various activities of the project.

The other relevant divisions of PGRC/E—conservation, documentation, plant exploration/collection, seed health, plant introduction and distribution—will participate in the on-farm programme and provide technical support to the CGBs.

The CBDC project, which is coordinated in Africa by PGRC/E, will provide technical and financial support for on-farm selection, enhancement, and evaluation of landraces for utilization of such material by small-scale farmers, and will complement the conservation activities undertaken through the GEF project.

The project will also establish a Project Advisory and Overseeing Committee (PAOC) made up of prominent national and international experts and scientists in relevant fields such as socioeconomics, genetic resource conservation, population genetics, ecology and ethnobotany. The members should include four national and three international scientists/experts with active experience in these fields. The committee will oversee the project and will monitor, evaluate, and provide guidance throughout the life of the project; it will refer to the Natural Resources Development Department of MNRDEP and the Ministry of Agriculture (MOA).

The PGRC/E will also coordinate the activities of the project with other donor programmes which are actively providing support in similar or related areas, with a view to complementing the GEF project. These projects include the USC/C landrace conservation, enhancement, and utilization programme which primarily emphasizes small-scale farm utilization of locally adapted seed to support low-input crop production by peasant farmers in Ethiopia.

The PGRC/E is institutionally linked to relevant national and international bases, and to NGOs working in this area. At the national level, the PGRC/E is currently directed by the PGRC/E Council, which includes representatives from the Ethiopian Science and Technology Commission, the Institute of Agricultural Research (IAR), the University of Addis Ababa, the Alemaya University of Agriculture (AUA), and the ministries of Agriculture, Coffee and Tea Development, Industry, and Health.

Internationally, the PGRC/E participates in the FAO Commission on Plant Genetic Resources. It also coordinates the BIDNET/AMCEN, supported by UNEP. The PGRC/E has a long history of collaboration with international scientists and crop breeders, for instance, from Norway and Germany. The Centre has also been providing short-term training courses for genetic

resource scientists and others active in community genetic resources work in Africa and Southeast Asia for the last five years.

8. Counterpart support capacity

The initiative to start the PGRC/E was taken by the pre-1974 Imperial Government of Ethiopia, though the institution was established only in 1976 during the military regime. It is one of the very few institutions that was given sufficient support even during the difficult years that followed, and it grew to be one of the leading institutions in germplasm conservation in the world. The Transitional Government of Ethiopia has increased its support to PGRC/E by integrating plant genetic resources conservation with other related environmental issues. The MNRDEP will honor PGRC/E requests for increased staffing levels to carry on *in situ* conservation, and to enhance its research capacity in conservation and population biology.

The PGRC/E has been supported by successive governments in Ethiopia. Ethiopia is, however, a poor country grappling with the huge problem of rehabilitating its basic infrastructure which has been devastated by a long civil war, and support will be required in human resources and infrastructure development. The GEF project will depend on a self-sustaining market mechanism for future maintenance costs its conservation activities by farmers. The international community, in the spirit of the Convention on Biological Diversity, can help ensure the continuity of these invaluable genetic resources for the world's food base.

C. DEVELOPMENT OBJECTIVES

The primary objective of this project is the development of a sustained capacity within Ethiopia to conserve biodiversity of crop landraces *in situ*, together with their associated farmer knowledge. This project will address a neglected aspect of biodiversity—indigenous crop varieties maintained by farmers in dynamic agro-ecosystems found in Ethiopia. Efforts to conserve crop diversity to date have focused on maintaining genetic diversity in static off-farm gene banks. By being based at the community level, with linkages to *ex situ* storage at PGRC/E, the project will benefit local farmers as well as the global community involved in the conservation of plant genetic resources.

D. IMMEDIATE OBJECTIVES, OUTPUTS AND ACTIVITIES

IMMEDIATE OBJECTIVE 1

Strengthen the institutional capacity for planning and implementing *in situ* conservation.

Output 1.1

An enhanced research capacity at PGRC/E and collaborating institutions for surveying crop biodiversity and site identification (short-term, wide-scale research).

resource scientists and others active in community genetic resources work in Africa and Southeast Asia for the last five years.

8. Counterpart support capacity

The initiative to start the PGRC/E was taken by the pre-1974 Imperial Government of Ethiopia, though the institution was established only in 1976 during the military regime. It is one of the very few institutions that was given sufficient support even during the difficult years that followed, and it grew to be one of the leading institutions in germplasm conservation in the world. The Transitional Government of Ethiopia has increased its support to PGRC/E by integrating plant genetic resources conservation with other related environmental issues. The MNRDEP will honor PGRC/E requests for increased staffing levels to carry on *in situ* conservation, and to enhance its research capacity in conservation and population biology.

The PGRC/E has been supported by successive governments in Ethiopia. Ethiopia is, however, a poor country grappling with the huge problem of rehabilitating its basic infrastructure which has been devastated by a long civil war, and support will be required in human resources and infrastructure development. The GEF project will depend on a self-sustaining market mechanism for future maintenance costs its conservation activities by farmers. The international community, in the spirit of the Convention on Biological Diversity, can help ensure the continuity of these invaluable genetic resources for the world's food base.

C. DEVELOPMENT OBJECTIVES

The primary objective of this project is the development of a sustained capacity within Ethiopia to conserve biodiversity of crop landraces *in situ*, together with their associated farmer knowledge. This project will address a neglected aspect of biodiversity—indigenous crop varieties maintained by farmers in dynamic agro-ecosystems found in Ethiopia. Efforts to conserve crop diversity to date have focused on maintaining genetic diversity in static off-farm gene banks. By being based at the community level, with linkages to *ex situ* storage at PGRC/E, the project will benefit local farmers as well as the global community involved in the conservation of plant genetic resources.

D. IMMEDIATE OBJECTIVES, OUTPUTS AND ACTIVITIES

IMMEDIATE OBJECTIVE 1

Strengthen the institutional capacity for planning and implementing *in situ* conservation.

Output 1.1

An enhanced research capacity at PGRC/E and collaborating institutions for surveying crop biodiversity and site identification (short-term, wide-scale research).

Activities for Output 1.1

1.1.1 Review current state-of-the-art knowledge and Ethiopian experience, and capacity for ecogeographic surveying of cultivated plants in centres of diversity.

1.1.2 Workshop of Ethiopian scientists to plan ecogeographic surveys.

1.1.3 Conduct rapid agro-ecological assessment surveys in six districts (see Output 2.1). Surveys in agro-ecological regions will take into account the following: altitude, cropping cycle, rainfall and aridity patterns, major crop assemblages, and status of genetic erosion.

Output 1.2

An enhanced ethnobotanical and social research capacity at PGRC/E to support *in situ* conservation (mid-term, mid-scale research).

Activities for Output 1.2

1.2.1 Develop cooperation with the social and life sciences personnel and students in the country through workshops, exchange of information, and research collaboration.

1.2.2 Train PGRC/E and affiliated personnel in ethnobotanical and social science research methods. Train one PhD candidate and three MS abroad in agro-ecological, social and conservation sciences.

1.2.3 Conduct intensive research on farmer knowledge and behavior regarding crop genetic resources. Research will involve: ethnographic and quantitative survey methods on selection, cultivation and use of different crops and varieties; the knowledge and roles of women; and seed exchange and movement (to be conducted by two teams of two scientists and their support personnel, focusing on cultivated species).

1.2.4 Hold a project seminar on ethnobotanical and social science research, coordinated with population biology seminar (see Activity 1.3.6), at the beginning of year three of the project with invited international participants.

Output 1.3

An enhanced population and conservation biology research capacity at PGRC/E (small-scale, long-term).

Activities for Output 1.3

1.3.1 Strengthen data acquisition, documentation, management and utilization capacity at PGRC/E and the Ethiopian National Herbarium. Recruit full-time project data/report coordinator.

Activities for Output 1.1

1.1.1 Review current state-of-the-art knowledge and Ethiopian experience, and capacity for ecogeographic surveying of cultivated plants in centres of diversity.

1.1.2 Workshop of Ethiopian scientists to plan ecogeographic surveys.

1.1.3 Conduct rapid agro-ecological assessment surveys in six districts (see Output 2.1). Surveys in agro-ecological regions will take into account the following: altitude, cropping cycle, rainfall and aridity patterns, major crop assemblages, and status of genetic erosion.

Output 1.2

An enhanced ethnobotanical and social research capacity at PGRC/E to support *in situ* conservation (mid-term, mid-scale research).

Activities for Output 1.2

1.2.1 Develop cooperation with the social and life sciences personnel and students in the country through workshops, exchange of information, and research collaboration.

1.2.2 Train PGRC/E and affiliated personnel in ethnobotanical and social science research methods. Train one PhD candidate and three MS abroad in agro-ecological, social and conservation sciences.

1.2.3 Conduct intensive research on farmer knowledge and behavior regarding crop genetic resources. Research will involve: ethnographic and quantitative survey methods on selection, cultivation and use of different crops and varieties; the knowledge and roles of women; and seed exchange and movement (to be conducted by two teams of two scientists and their support personnel, focusing on cultivated species).

1.2.4 Hold a project seminar on ethnobotanical and social science research, coordinated with population biology seminar (see Activity 1.3.6), at the beginning of year three of the project with invited international participants.

Output 1.3

An enhanced population and conservation biology research capacity at PGRC/E (small-scale, long-term).

Activities for Output 1.3

1.3.1 Strengthen data acquisition, documentation, management and utilization capacity at PGRC/E and the Ethiopian National Herbarium. Recruit full-time project data/report coordinator.

1.3.2 Develop PGRC/E collaboration in programmes with biology faculty and students at affiliated institutions.

1.3.3 Train two PhD and three MS candidates abroad in population and conservation biology. Provide technical training for four support staff (six months or less) in foreign laboratories.

1.3.4 Survey three sites chosen for intensive ethnobotany to select locations for intensive population biology research.

1.3.5 Conduct intensive research on population biology (two sites) of landraces of wheat/barley and chickpea, or other pulse crops as appropriate. This research will complement ethnobotanical research, and describe the population structure and dynamics of local and regional crop populations. Agronomic, plant morphological, and biochemical means will be employed.

1.3.6 Hold project seminars on population and conservation biology research progress in year three of the project. Coordinated with social science research seminar (see Activity 1.2.4).

Output 1.4

An enhanced capacity of PGRC/E to collect, characterize, document, and store on a long-term basis crop germplasm materials originating from *in situ* conservation activities.

Activities for Output 1.4

1.4.1 Acquire vehicles and field equipment for field collecting from *in situ* conservation sites by PGRC/E staff.

1.4.2 Acquire laboratory equipment for isozyme analysis and DNA sequencing.

1.4.3 Establish cold storage facility at PGRC/E for long-term storage of up to 160,000 crop germplasm samples.

1.4.4 Acquire computer and related equipment to establish a database.

1.4.5 Train six support technicians in isozyme analysis and data management for up to six months each in foreign laboratories.

Output 1.5

An enhanced capacity of the national herbarium to collect, type, and store crop specimens from *in situ* conservation sites.

1.3.2 Develop PGRC/E collaboration in programmes with biology faculty and students at affiliated institutions.

1.3.3 Train two PhD and three MS candidates abroad in population and conservation biology. Provide technical training for four support staff (six months or less) in foreign laboratories.

1.3.4 Survey three sites chosen for intensive ethnobotany to select locations for intensive population biology research.

1.3.5 Conduct intensive research on population biology (two sites) of landraces of wheat/barley and chickpea, or other pulse crops as appropriate. This research will complement ethnobotanical research, and describe the population structure and dynamics of local and regional crop populations. Agronomic, plant morphological, and biochemical means will be employed.

1.3.6 Hold project seminars on population and conservation biology research progress in year three of the project. Coordinated with social science research seminar (see Activity 1.2.4).

Output 1.4

An enhanced capacity of PGRC/E to collect, characterize, document, and store on a long-term basis crop germplasm materials originating from *in situ* conservation activities.

Activities for Output 1.4

1.4.1 Acquire vehicles and field equipment for field collecting from *in situ* conservation sites by PGRC/E staff.

1.4.2 Acquire laboratory equipment for isozyme analysis and DNA sequencing.

1.4.3 Establish cold storage facility at PGRC/E for long-term storage of up to 160,000 crop germplasm samples.

1.4.4 Acquire computer and related equipment to establish a database.

1.4.5 Train six support technicians in isozyme analysis and data management for up to six months each in foreign laboratories.

Output 1.5

An enhanced capacity of the national herbarium to collect, type, and store crop specimens from *in situ* conservation sites.

Activities for Output 1.5

1.5.1 Acquire vehicle and field equipment for field collection.

1.5.2 Acquire herbarium cabinets, computer, and accessories for specimen and data storage.

IMMEDIATE OBJECTIVE 2

Establish community support for *in situ* conservation in eight districts, and establish CGBs in six of those districts.

Output 2.1

The establishment of *in situ* conservation activities in the following six districts: Tigray; Tegulet in Northern Shewa; Kalu, Wello; Ginir, Bali; Bonga area, Kefa; and Ada, Eastern Shewa.

Activities for Output 2.1

2.1.1 Initial visits by PGRC/E, agricultural extension agents and others to discuss programme with local officials and farmers to identify possible sites.

2.1.2 Conduct public meeting in each district to inform local farmers and others of programme for *in situ* conservation.

2.1.3 Identify farmers and establish *in situ* conservation activities, including supplying farm tools and equipment, and initial landrace seed materials.

Output 2.2

The identification of sites in six districts for siting CGBs, with community support (see Output 2.1).

Activities for Output 2.2

2.2.1 Analyze results of ecogeographic surveys (Activity 1.1.3).

2.2.2 Select specific localities for CGBs on the basis of location and agro-ecological conditions.

2.2.3 Conduct initial visits by PGRC/E and agricultural extension agent teams to discuss programme with local officials and populations.

2.2.4 Hold a public meeting at the chosen locality in each district to inform local farmers and others of the programme for CGBs, and to identify possible sites for the CGBs.

Activities for Output 1.5

1.5.1 Acquire vehicle and field equipment for field collection.

1.5.2 Acquire herbarium cabinets, computer, and accessories for specimen and data storage.

IMMEDIATE OBJECTIVE 2

Establish community support for *in situ* conservation in eight districts, and establish CGBs in six of those districts.

Output 2.1

The establishment of *in situ* conservation activities in the following six districts: Tigray; Tegulet in Northern Shewa; Kalu, Wello; Ginir, Bali; Bonga area, Kefa; and Ada, Eastern Shewa.

Activities for Output 2.1

2.1.1 Initial visits by PGRC/E, agricultural extension agents and others to discuss programme with local officials and farmers to identify possible sites.

2.1.2 Conduct public meeting in each district to inform local farmers and others of programme for *in situ* conservation.

2.1.3 Identify farmers and establish *in situ* conservation activities, including supplying farm tools and equipment, and initial landrace seed materials.

Output 2.2

The identification of sites in six districts for siting CGBs, with community support (see Output 2.1).

Activities for Output 2.2

2.2.1 Analyze results of ecogeographic surveys (Activity 1.1.3).

2.2.2 Select specific localities for CGBs on the basis of location and agro-ecological conditions.

2.2.3 Conduct initial visits by PGRC/E and agricultural extension agent teams to discuss programme with local officials and populations.

2.2.4 Hold a public meeting at the chosen locality in each district to inform local farmers and others of the programme for CGBs, and to identify possible sites for the CGBs.

2.2.5 Organize local Crop Conservation Association (CCA) to serve as support and liaison for the project.

Output 2.3

Construction of six CGB facilities.

Activities for Output 2.3

2.3.1 Design a low-cost, low-technology, low-maintenance CGB facility appropriate for local conditions.

2.3.2 Select building site, assemble materials, and recruit local labor for building.

2.3.3 Build CGB facility, including botanical gardens for collections kept as whole plants, such as coffee.

IMMEDIATE OBJECTIVE 3

Select and train farmer conservators to curate and manage the CGBs.

Output 3.1

The identification of farmer conservator at each CGB site.

Activities for Output 3.1

3.1.1 Convene a meeting of the CCA, community leaders, extension agents, and local farmers (including women) to elicit nominations of farmer conservator.

3.1.2 Elect farmer conservator.

Output 3.2

Development of the capacity of farmer conservators to support *in situ* conservation programmes.

Activities for Output 3.2

3.2.1 Conduct a national training course for farmer conservators, extension agents, and staff involved in the project in year one.

3.2.2 Equip farmer conservators with appropriate field equipment (bicycle, motorbike or mule, and documentation materials).

3.2.3 Conduct yearly national workshops for farmer conservators and extension agents.

2.2.5 Organize local Crop Conservation Association (CCA) to serve as support and liaison for the project.

Output 2.3

Construction of six CGB facilities.

Activities for Output 2.3

2.3.1 Design a low-cost, low-technology, low-maintenance CGB facility appropriate for local conditions.

2.3.2 Select building site, assemble materials, and recruit local labor for building.

2.3.3 Build CGB facility, including botanical gardens for collections kept as whole plants, such as coffee.

IMMEDIATE OBJECTIVE 3

Select and train farmer conservators to curate and manage the CGBs.

Output 3.1

The identification of farmer conservator at each CGB site.

Activities for Output 3.1

3.1.1 Convene a meeting of the CCA, community leaders, extension agents, and local farmers (including women) to elicit nominations of farmer conservator.

3.1.2 Elect farmer conservator.

Output 3.2

Development of the capacity of farmer conservators to support *in situ* conservation programmes.

Activities for Output 3.2

3.2.1 Conduct a national training course for farmer conservators, extension agents, and staff involved in the project in year one.

3.2.2 Equip farmer conservators with appropriate field equipment (bicycle, motorbike or mule, and documentation materials).

3.2.3 Conduct yearly national workshops for farmer conservators and extension agents.

IMMEDIATE OBJECTIVE 4

Strengthen PGRC/E and farmer interaction.

Output 4.1

Improved extension agent training in districts with CGBs.

Activities for Output 4.1

4.1.1 Conduct diploma course at PGRC/E for extension agents involved in the maintenance of biodiversity, crop conservation, ethnobotany, and crop evaluation.

4.1.2 Organize yearly visits of extension agents to PGRC/E headquarters for feedback and the exchange of experience.

4.1.3 Conduct district level ecogeographical survey using farmer conservators, extension agents, and PGRC/E personnel.

4.1.4 Conduct community-based farmer training workshops in biodiversity, crop conservation, ethnobotany, and crop evaluation.

Output 4.2

Extension agents able to work more closely with districts, communities, and CGBs.

Activities for Output 4.2

4.2.1 Equip extension agents with improved transportation means (motorbikes, bicycles, or mules where appropriate).

4.2.2 Organize regular visits by extension agents to advise and complement farmer conservators.

Output 4.3

Increased PGRC/E presence in districts and communities with CGBs.

Activities for Output 4.3

4.3.1 Four yearly visits by PGRC/E staff to each CGB to monitor its activities.

4.3.2 Incorporate PGRC/E plant genetic resource issues into extension agent visits in areas served by a CGB.

IMMEDIATE OBJECTIVE 4

Strengthen PGRC/E and farmer interaction.

Output 4.1

Improved extension agent training in districts with CGBs.

Activities for Output 4.1

4.1.1 Conduct diploma course at PGRC/E for extension agents involved in the maintenance of biodiversity, crop conservation, ethnobotany, and crop evaluation.

4.1.2 Organize yearly visits of extension agents to PGRC/E headquarters for feedback and the exchange of experience.

4.1.3 Conduct district level ecogeographical survey using farmer conservators, extension agents, and PGRC/E personnel.

4.1.4 Conduct community-based farmer training workshops in biodiversity, crop conservation, ethnobotany, and crop evaluation.

Output 4.2

Extension agents able to work more closely with districts, communities, and CGBs.

Activities for Output 4.2

4.2.1 Equip extension agents with improved transportation means (motorbikes, bicycles, or mules where appropriate).

4.2.2 Organize regular visits by extension agents to advise and complement farmer conservators.

Output 4.3

Increased PGRC/E presence in districts and communities with CGBs.

Activities for Output 4.3

4.3.1 Four yearly visits by PGRC/E staff to each CGB to monitor its activities.

4.3.2 Incorporate PGRC/E plant genetic resource issues into extension agent visits in areas served by a CGB.

IMMEDIATE OBJECTIVE 5

Develop community and market incentives for *in situ* conservation.

Output 5.1

Identification by PGRC/E and consultants/NGOs of market products that utilize landraces and their market potential.

Activities for Output 5.1

5.1.1 PGRC/E with consultants/NGOs conduct product identification and market survey of possible products.

5.1.2 Conduct socioeconomic feasibility study to determine impacts and viability of marketing of landrace products.

5.1.3 Identify bottlenecks and problems for marketing landrace products (for example, transportation, manufacturing potential, and licensing).

5.1.4 Conduct environmental impact assessment on biodiversity of target crops included in marketing strategy.

5.1.5 PGRC/E, assisted by consultants/NGOs, to coordinate social, economic, and biological diversity assessments of landrace marketing strategy.

Output 5.2

Create non-market community incentives for *in situ* conservation.

Activities for Output 5.2

5.2.1 Contract consultants/NGOs to organize regional agricultural fairs every year in areas with CGBs to highlight local crops and promote pride in the Ethiopian agricultural heritage.

5.2.2 Contract consultants/NGOs to prepare educational material about agricultural biodiversity in Ethiopia.

5.2.3 Distribute educational material to schools throughout Ethiopia.

Output 5.3

National policy analysis of policies affecting crop biodiversity in Ethiopia.

IMMEDIATE OBJECTIVE 5

Develop community and market incentives for *in situ* conservation.

Output 5.1

Identification by PGRC/E and consultants/NGOs of market products that utilize landraces and their market potential.

Activities for Output 5.1

5.1.1 PGRC/E with consultants/NGOs conduct product identification and market survey of possible products.

5.1.2 Conduct socioeconomic feasibility study to determine impacts and viability of marketing of landrace products.

5.1.3 Identify bottlenecks and problems for marketing landrace products (for example, transportation, manufacturing potential, and licensing).

5.1.4 Conduct environmental impact assessment on biodiversity of target crops included in marketing strategy.

5.1.5 PGRC/E, assisted by consultants/NGOs, to coordinate social, economic, and biological diversity assessments of landrace marketing strategy.

Output 5.2

Create non-market community incentives for *in situ* conservation.

Activities for Output 5.2

5.2.1 Contract consultants/NGOs to organize regional agricultural fairs every year in areas with CGBs to highlight local crops and promote pride in the Ethiopian agricultural heritage.

5.2.2 Contract consultants/NGOs to prepare educational material about agricultural biodiversity in Ethiopia.

5.2.3 Distribute educational material to schools throughout Ethiopia.

Output 5.3

National policy analysis of policies affecting crop biodiversity in Ethiopia.

Activities for Output 5.3

5.3.1 Contract policy analysis consultant to evaluate government policies that might adversely affect landrace cultivation in Ethiopia (for example, national seed policy, and national credit programmes for agricultural inputs).

5.3.2 Contract policy analysis firm to assist PGRC/E in establishing an in-house monitoring system to track government policy affecting biodiversity (see Activity 5.3.1).

5.3.3 Designate PGRC/E staff personnel to track national policies affecting crop biodiversity.

E. INPUTS

1. Government of Ethiopia

Personnel

No.	*Position*	*mm*	*Qualification*	*E. birr*	*US$*
4	Scient. Staff (PGRC/E)				
	2 Social Scientists	87	PhD	185,310	33,091
	2 Population Biologists	87	PhD	185,310	33,091
1	Data Manager (PGRC/E)	36	MS	35,200	6,286
4	Technical Support Staff (PGRC/E)	36	MS	86,400	15,429
6	Field Asst. (PGRC/E)	87	Diploma	120,060	21,439
2	Drivers (PGRC/E)	29	G. IV. Lis.	13,340	2,382
2	Drivers (Herbarium)	15	G.III. Lis.	3,750	670
2	Scient. Staff (Herbarium)	29	PhD; MS	36,250	6,473
2	Technical Support Staff (Herbarium)	15	BS	11,250	2,009
2	Technical Assistants (Herbarium)	25	Diploma	6,300	1,125
1	Secretary (Herbarium)	29	Diploma	21,750	3,884
12	Extension Agents	144	Certif.	397,440	70,971
1	Senior Accountant (PGRC/E)	36	BS	21,600	3,857
2	Secretaries (PGRC/E)	72	Diploma	72,000	12,857
	Subtotal			1,195,960	213,564

Activities for Output 5.3

5.3.1 Contract policy analysis consultant to evaluate government policies that might adversely affect landrace cultivation in Ethiopia (for example, national seed policy, and national credit programmes for agricultural inputs).

5.3.2 Contract policy analysis firm to assist PGRC/E in establishing an in-house monitoring system to track government policy affecting biodiversity (see Activity 5.3.1).

5.3.3 Designate PGRC/E staff personnel to track national policies affecting crop biodiversity.

E. INPUTS

1. Government of Ethiopia

Personnel

No.	*Position*	*mm*	*Qualification*	*E. birr*	*US$*
4	Scient. Staff (PGRC/E) 2 Social Scientists	87	PhD	185,310	33,091
	2 Population Biologists	87	PhD	185,310	33,091
1	Data Manager (PGRC/E)	36	MS	35,200	6,286
4	Technical Support Staff (PGRC/E)	36	MS	86,400	15,429
6	Field Asst. (PGRC/E)	87	Diploma	120,060	21,439
2	Drivers (PGRC/E)	29	G. IV. Lis.	13,340	2,382
2	Drivers (Herbarium)	15	G.III. Lis.	3,750	670
2	Scient. Staff (Herbarium)	29	PhD; MS	36,250	6,473
2	Technical Support Staff (Herbarium)	15	BS	11,250	2,009
2	Technical Assistants (Herbarium)	25	Diploma	6,300	1,125
1	Secretary (Herbarium)	29	Diploma	21,750	3,884
12	Extension Agents	144	Certif.	397,440	70,971
1	Senior Accountant (PGRC/E)	36	BS	21,600	3,857
2	Secretaries (PGRC/E)	72	Diploma	72,000	12,857
	Subtotal			1,195,960	213,564

Other services at PGRC/E and Addis Ababa University

	E. birr	*US$*
Office Rent	19,800	3,536
Office Furniture	30,000	5,357
Office Stationery	47,400	8,464
Electricity and Water	31,200	5,571
Subtotal	128,400	22,929
Total	1,324,360	236,493

2. Global Environment Facility

Personnel — US$ 266,150

- Technicians for the agro-ecological survey, technicians in ethnobotany, population biology, a herbarium assistant, together with other support staff
- Professional personnel including ethnobotanists, population biologists, a data manager, training specialist and project manager
- National and international consultants
- Travel costs
- Support for the PAOC.

Subcontracts — US$ 54,000

- Studies of the market potential of landrace-based products
- Design of the CGBs.

Training — US$ 692,200

- Training for six MS and three PhD students in ethnobotany and population biology
- National workshops for the farmer conservators and extension agents
- In-service training for six technicians in isozyme analysis and data management, and diploma training for twelve extension agents
- Workshops and review seminars for farmers, farmer conservators, extension agents, and others involved in the project, together with technical resource materials.

Equipment — US$ 1,292,650

- Expendable equipment and materials for project operation
- Vehicles and camping and field equipment for the teams from the PGRC/E and the National Herbarium
- Computers, printers, software, and associated office equipment for data storage and analysis
- CGBs and motorcycles for the farmer conservators and extension agents.

Other services at PGRC/E and Addis Ababa University

	E. birr	*US$*
Office Rent	19,800	3,536
Office Furniture	30,000	5,357
Office Stationery	47,400	8,464
Electricity and Water	31,200	5,571
Subtotal	128,400	22,929
Total	1,324,360	236,493

2. Global Environment Facility

Personnel — US$ 266,150

- Technicians for the agro-ecological survey, technicians in ethnobotany, population biology, a herbarium assistant, together with other support staff
- Professional personnel including ethnobotanists, population biologists, a data manager, training specialist and project manager
- National and international consultants
- Travel costs
- Support for the PAOC.

Subcontracts — US$ 54,000

- Studies of the market potential of landrace-based products
- Design of the CGBs.

Training — US$ 692,200

- Training for six MS and three PhD students in ethnobotany and population biology
- National workshops for the farmer conservators and extension agents
- In-service training for six technicians in isozyme analysis and data management, and diploma training for twelve extension agents
- Workshops and review seminars for farmers, farmer conservators, extension agents, and others involved in the project, together with technical resource materials.

Equipment — US$ 1,292,650

- Expendable equipment and materials for project operation
- Vehicles and camping and field equipment for the teams from the PGRC/E and the National Herbarium
- Computers, printers, software, and associated office equipment for data storage and analysis
- CGBs and motorcycles for the farmer conservators and extension agents.

Operating costs — US$ 123,000

- Miscellaneous operating and reporting costs.

Total — US$ 2,428,000

F. RISKS

There are potential risks to project success, but none is perceived to be of such high probability as to endanger project implementation or continuation. Risks have been anticipated throughout project development (including risks whose probability is minimal), and measures have been taken to reduce their impact.

Political upheaval

Ethiopia has a recent history of political upheaval including armed conflicts and widespread food shortages. Currently there is political stability in the country and all indications are that this situation will continue throughout the five-year duration of this project. Should political upheaval occur, there could conceivably be a disruption of linkages between the PGRC/E and the CGBs. Regular visits by the PGRC/E to the CGBs to acquire small subsamples of germplasm accessions will assure that duplicate samples are maintained in the unlikely event that CGB collections are destroyed. Should upheaval cause a disruption of local conditions, the CGB could serve a useful role for the reintroduction of landraces back into communities where they are lost.

Acceleration of genetic erosion

Through increased attention to selection of superior landraces, farmers could conceivably emphasize a smaller number of varieties than they would otherwise normally grow. This scenario is unlikely, but even if it does occur, there are adequate measures taken throughout the project specifically to conserve genetic diversity. If after project completion the CGB system is viewed as a vehicle for the introduction of new varieties, there will already have been sufficient documentation of farmer knowledge, population biology of landraces, and the conservation of germplasm, to assure that the erosion of gene supplies and knowledge will be insignificant.

Maintenance costs after the project

External inputs will be required in order for PGRC/E and community-based landrace conservation to continue beyond the life of the project. These inputs are projected to be minimal, involving increased staffing of no more than two personnel based at PGRC/E, and associated travel costs for the CGBs. Taken as a whole, *in situ* conservation and monitoring may actually be more cost-effective than *ex situ* conservation, which involves the maintenance of samples under cold storage conditions, and periodic regeneration. The conservation of genetic diversity which is not immediately being used requires inputs regardless of its occurring on-farm or off-farm.

Operating costs — US$ 123,000

- Miscellaneous operating and reporting costs.

Total — US$ 2,428,000

F. RISKS

There are potential risks to project success, but none is perceived to be of such high probability as to endanger project implementation or continuation. Risks have been anticipated throughout project development (including risks whose probability is minimal), and measures have been taken to reduce their impact.

Political upheaval

Ethiopia has a recent history of political upheaval including armed conflicts and widespread food shortages. Currently there is political stability in the country and all indications are that this situation will continue throughout the five-year duration of this project. Should political upheaval occur, there could conceivably be a disruption of linkages between the PGRC/E and the CGBs. Regular visits by the PGRC/E to the CGBs to acquire small subsamples of germplasm accessions will assure that duplicate samples are maintained in the unlikely event that CGB collections are destroyed. Should upheaval cause a disruption of local conditions, the CGB could serve a useful role for the reintroduction of landraces back into communities where they are lost.

Acceleration of genetic erosion

Through increased attention to selection of superior landraces, farmers could conceivably emphasize a smaller number of varieties than they would otherwise normally grow. This scenario is unlikely, but even if it does occur, there are adequate measures taken throughout the project specifically to conserve genetic diversity. If after project completion the CGB system is viewed as a vehicle for the introduction of new varieties, there will already have been sufficient documentation of farmer knowledge, population biology of landraces, and the conservation of germplasm, to assure that the erosion of gene supplies and knowledge will be insignificant.

Maintenance costs after the project

External inputs will be required in order for PGRC/E and community-based landrace conservation to continue beyond the life of the project. These inputs are projected to be minimal, involving increased staffing of no more than two personnel based at PGRC/E, and associated travel costs for the CGBs. Taken as a whole, *in situ* conservation and monitoring may actually be more cost-effective than *ex situ* conservation, which involves the maintenance of samples under cold storage conditions, and periodic regeneration. The conservation of genetic diversity which is not immediately being used requires inputs regardless of its occurring on-farm or off-farm.

Lack of perceived benefits for farmer cooperation

Misunderstanding or lack of perceived benefits by farmers is a possible risk. Participation of farmer conservators is therefore essential for project success. Considerable incentives such as training, motorbikes, and the CGB itself should increase the likelihood of active farmer participation. Local farmers will be treated with due respect as experts in landrace knowledge, thereby increasing the prestige of their community. Local pride in "heritage" landraces, and the establishment of agricultural fairs will also increase farmer incentives for participation.

Failure to achieve intermediate objectives

The successful completion of early phases of the project is a prerequisite to the continuation of project activities. The designation of a project manager specifically devoted to the GEF project will aid implementation throughout the project cycle. The review schedule anticipates the need for two meetings of the PAOC in the first year which will help get the project underway. An external review is also scheduled for mid-point (year three) to assure that all conditional requirements have been met in sufficient detail to justify continuation. A draft workplan has been prepared; it incorporates means whereby project success can be measured.

G. PRIOR OBLIGATIONS AND PREREQUISITES

Staff allocation

The Government of Ethiopia will ensure the timely recruitment and posting, on a full-time basis, of all the required national staff as outlined in Section E, subsection 1. The PGRC/E will arrange for a formal agreement with the Addis Ababa University for ensuring the participation in the project of the Ethiopian National Herbarium. It will make a similar arrangement with the Alemaya University of Agriculture (AUA) for the participation of the Debre Zeit Agricultural Research Station.

The Project Document will be signed by UNDP, and UNDP assistance to the project will be provided, subject to UNDP receiving satisfaction that the prerequisites listed above have been fulfilled or are likely to be fulfilled. When anticipated fulfillment of one or more prerequisites fails to materialize, UNDP may, at its discretion, either suspend or terminate its assistance.

H. PROJECT REVIEW, REPORTING AND EVALUATION

The project will be subject to annual tripartite review (TPR), a joint review by representatives of the government, UNDP, and the executing agency. TPRs will be held at least once every twelve months, with the first such meeting being within twelve months of the start of full implementation. The National Project Coordinator shall prepare and submit to each TPR meeting a Project Performance Evaluation Report (PPER). Additional PPERs may be requested, if necessary, during the project.

A project terminal report will be prepared for consideration at the terminal TPR meeting. It shall be prepared in draft sufficiently in advance to allow review and technical clearance by the executing agency at least four months prior to the terminal TPR.

Lack of perceived benefits for farmer cooperation

Misunderstanding or lack of perceived benefits by farmers is a possible risk. Participation of farmer conservators is therefore essential for project success. Considerable incentives such as training, motorbikes, and the CGB itself should increase the likelihood of active farmer participation. Local farmers will be treated with due respect as experts in landrace knowledge, thereby increasing the prestige of their community. Local pride in "heritage" landraces, and the establishment of agricultural fairs will also increase farmer incentives for participation.

Failure to achieve intermediate objectives

The successful completion of early phases of the project is a prerequisite to the continuation of project activities. The designation of a project manager specifically devoted to the GEF project will aid implementation throughout the project cycle. The review schedule anticipates the need for two meetings of the PAOC in the first year which will help get the project underway. An external review is also scheduled for mid-point (year three) to assure that all conditional requirements have been met in sufficient detail to justify continuation. A draft workplan has been prepared; it incorporates means whereby project success can be measured.

G. PRIOR OBLIGATIONS AND PREREQUISITES

Staff allocation

The Government of Ethiopia will ensure the timely recruitment and posting, on a full-time basis, of all the required national staff as outlined in Section E, subsection 1. The PGRC/E will arrange for a formal agreement with the Addis Ababa University for ensuring the participation in the project of the Ethiopian National Herbarium. It will make a similar arrangement with the Alemaya University of Agriculture (AUA) for the participation of the Debre Zeit Agricultural Research Station.

The Project Document will be signed by UNDP, and UNDP assistance to the project will be provided, subject to UNDP receiving satisfaction that the prerequisites listed above have been fulfilled or are likely to be fulfilled. When anticipated fulfillment of one or more prerequisites fails to materialize, UNDP may, at its discretion, either suspend or terminate its assistance.

H. PROJECT REVIEW, REPORTING AND EVALUATION

The project will be subject to annual tripartite review (TPR), a joint review by representatives of the government, UNDP, and the executing agency. TPRs will be held at least once every twelve months, with the first such meeting being within twelve months of the start of full implementation. The National Project Coordinator shall prepare and submit to each TPR meeting a Project Performance Evaluation Report (PPER). Additional PPERs may be requested, if necessary, during the project.

A project terminal report will be prepared for consideration at the terminal TPR meeting. It shall be prepared in draft sufficiently in advance to allow review and technical clearance by the executing agency at least four months prior to the terminal TPR.

The project shall be subject to evaluation within twelve months following termination. The organization, terms of reference, and timing will be decided after consultation between the parties to the Project Document, plus any associated United Nations agency.

I. LEGAL CONTEXT

This Project Document shall be the instrument referred to as such in Article I of the Standard Basic Assistance Agreement (SBAA) between the Government of Ethiopia and the UNDP, signed by the parties on 26 February, 1981, and effective from 5 November, 1985. The government implementing agency shall, for the purpose of the SBAA, refer to the government cooperating agency described in this agreement.

The following types of revisions may be made to the original Project Document with the signature of the UNDP Resident Representative only, provided he or she is assured that the other signatories of the document have no objections to the proposed changes:

- Revisions which do not involve significant changes in the immediate objectives, outputs or activities of the project, but are caused by the rearrangement of inputs already agreed to, or by cost increases due to inflation

- Mandatory annual revisions which rephase the delivery of agreed project inputs, or reflect increased costs due to inflation, or take into account agency expenditure flexibility.

J. BUDGET

The project budget covering the GEF/UNDP contribution is attached.

The project shall be subject to evaluation within twelve months following termination. The organization, terms of reference, and timing will be decided after consultation between the parties to the Project Document, plus any associated United Nations agency.

I. LEGAL CONTEXT

This Project Document shall be the instrument referred to as such in Article I of the Standard Basic Assistance Agreement (SBAA) between the Government of Ethiopia and the UNDP, signed by the parties on 26 February, 1981, and effective from 5 November, 1985. The government implementing agency shall, for the purpose of the SBAA, refer to the government cooperating agency described in this agreement.

The following types of revisions may be made to the original Project Document with the signature of the UNDP Resident Representative only, provided he or she is assured that the other signatories of the document have no objections to the proposed changes:

- Revisions which do not involve significant changes in the immediate objectives, outputs or activities of the project, but are caused by the rearrangement of inputs already agreed to, or by cost increases due to inflation

- Mandatory annual revisions which rephase the delivery of agreed project inputs, or reflect increased costs due to inflation, or take into account agency expenditure flexibility.

J. BUDGET

The project budget covering the GEF/UNDP contribution is attached.

PROJECT BUDGET COVERING UNDP CONTRIBUTION

Project Title: A Dynamic Farmer-Based Approach to the Conservation of African Plant Genetic Resources

Project Number: ETH/93/G31

B/L	Description	Total	1994	1995	1996
10.00	**PROJECT PERSONNEL**				
11.01	International Consultant	28,000		14,000	14,000
11.02	National Consultant	69,000	15,000	15,000	39,000
11.99	**Sub-total Consultants**	**97,000**	**15,000**	**29,000**	**53,000**
13.01	4x5 Technicns for agro-ecol survey 1.5 m	4,500	4,500		
13.02	4 Ethnobotany Technicians 12m @ 150/m	7,200	2,400	2,400	2,400
13.03	4 Technicians population biology 12m @ 1	7,200	2,400	2,400	2,400
13.04	1 Technical Assistant Herbarium 36m @ 1!	5,400	1,800	1,800	1,800
13.05	Miscellaneous Support Staff	17,730	1,730	8,000	8,000
13.99	**Sub-Total Support Personnel**	**42,030**	**12,830**	**14,600**	**14,600**
15.00	**Local Travel**	**6,000**	**2,000**	**2,000**	**2,000**
16.01	HQ Monitoring Mission	20,000		10,000	10,000
16.02	Terminal Evaluation	20,000			20,000
16.03	Project Advisory & Oversight Committee	48,000	16,000	16,000	16,000
16.99	**Sub-Total Mission Costs**	**88,000**	**16,000**	**26,000**	**46,000**
17.01	2 Ethnobotanists 8m @ 150/m	3,600	600	1,500	1,500
17.02	1 Data Manager 36m @ 150/m	5,400	1,800	1,800	1,800
17.03	2 Population Biologists 12m @ 150/m	3,600	0	1,800	1,800
17.04	Training Specialist	5,400	1,800	1,800	1,800
17.06	Project Manager 36 m @ 420/m	15,120	5,040	5,040	5,040
17.99	**Sub-total National Project Personell**	**33,120**	**9,240**	**11,940**	**11,940**
19.00	**Personnel Component Total**	**266,150**	**55,070**	**83,540**	**127,540**
20.00	**SUBCONTRACTS**				
21.00	Study Contract/NGO	50,000		25,000	25,000
22.00	CGB Design	4,000	4,000		
29.00	**Subcontract Component Total**	**54,000**	**4,000**	**25,000**	**25,000**
30.00	**TRAINING**				
31.00	**Fellowships**				
31.01	6 MSc Ethnobotany/Popn Biol	152,000	76,000	76,000	
31.02	3 PhD Ethnobotany/Popn Biol	231,000	76,000	76,000	79,000
31.99	**Fellowships Total**	**383,000**	**152,000**	**152,000**	**79,000**
32.00	**Group Training**				
32.01	National wkshops Conservators & Ext	20,000		10,000	10,000

PROJECT BUDGET COVERING UNDP CONTRIBUTION

Project Title: A Dynamic Farmer-Based Approach to the Conservation of African Plant Genetic Resources

Project Number: ETH/93/G31

B/L	Description	Total	1994	1995	1996
10.00	**PROJECT PERSONNEL**				
11.01	International Consultant	28,000		14,000	14,000
11.02	National Consultant	69,000	15,000	15,000	39,000
11.99	**Sub-total Consultants**	**97,000**	**15,000**	**29,000**	**53,000**
13.01	4x5 Technicns for agro-ecol survey 1.5 m	4,500	4,500		
13.02	4 Ethnobotany Technicians 12m @ 150/m	7,200	2,400	2,400	2,400
13.03	4 Technicians population biology 12m @ 1	7,200	2,400	2,400	2,400
13.04	1 Technical Assistant Herbarium 36m @ 1!	5,400	1,800	1,800	1,800
13.05	Miscellaneous Support Staff	17,730	1,730	8,000	8,000
13.99	**Sub-Total Support Personnel**	**42,030**	**12,830**	**14,600**	**14,600**
15.00	**Local Travel**	**6,000**	**2,000**	**2,000**	**2,000**
16.01	HQ Monitoring Mission	20,000		10,000	10,000
16.02	Terminal Evaluation	20,000			20,000
16.03	Project Advisory & Oversight Committee	48,000	16,000	16,000	16,000
16.99	**Sub-Total Mission Costs**	**88,000**	**16,000**	**26,000**	**46,000**
17.01	2 Ethnobotanists 8m @ 150/m	3,600	600	1,500	1,500
17.02	1 Data Manager 36m @ 150/m	5,400	1,800	1,800	1,800
17.03	2 Population Biologists 12m @ 150/m	3,600	0	1,800	1,800
17.04	Training Specialist	5,400	1,800	1,800	1,800
17.06	Project Manager 36 m @ 420/m	15,120	5,040	5,040	5,040
17.99	**Sub-total National Project Personell**	**33,120**	**9,240**	**11,940**	**11,940**
19.00	**Personnel Component Total**	**266,150**	**55,070**	**83,540**	**127,540**
20.00	**SUBCONTRACTS**				
21.00	Study Contract/NGO	50,000		25,000	25,000
22.00	CGB Design	4,000	4,000		
29.00	**Subcontract Component Total**	**54,000**	**4,000**	**25,000**	**25,000**
30.00	**TRAINING**				
31.00	**Fellowships**				
31.01	6 MSc Ethnobotany/Popn Biol	152,000	76,000	76,000	
31.02	3 PhD Ethnobotany/Popn Biol	231,000	76,000	76,000	79,000
31.99	**Fellowships Total**	**383,000**	**152,000**	**152,000**	**79,000**
32.00	**Group Training**				
32.01	National wkshops Conservators & Ext	20,000		10,000	10,000

PROJECT BUDGET COVERING UNDP CONTRIBUTION
(continued)

32.99 Group Training Total	**20,000**		**10,000**	**10,000**
33.00 **In-Service Training**				
33.01 6 Technicians in isozyme & data mngmt	58,200	29,100	29,100	
33.02 12 Extension agents diploma training	30,000	6,000	12,000	12,000
33.99 In-Service Training Total	**88,200**	**35,100**	**41,100**	**12,000**
34.00 **Seminar & Comm. Based Training**				
34.01 Survey Workshop	22,000	22,000		
34.02 Project Seminar	65,000			65,000
34.03 Technical Literature	12,000	4,000	4,000	4,000
34.04 Initial Farmer Conservator (6) support	6,000	6,000		
34.05 Initial National Trng Conservators & Extens	15,000	15,000		
34.06 Community Based Farmer Trng Workshop	81,000	10,000	56,000	15,000
34.99 Seminar & Comm. Based Trng Total	**201,000**	**57,000**	**60,000**	**84,000**
39.00 Training Component Total	**692,200**	**244,100**	**263,100**	**185,000**
40.00 **EQUIPMENT**				
41.00 Expendable Equipment	**70,230**	**28,750**	**20,820**	**20,660**
42.00 Non-expendable Equipment				
42.01 **Sub-total PGRC/E Equipment**	1,133,920	517,720	616,200	0
42.02 **Sub-total National Herbarium**	88,500	78,500	10,000	0
42.99 Non-Expendable Equipment Total	**1,222,420**	**596,220**	**626,200**	**0**
49.00 Equipment Component Total	**1,292,650**	**624,970**	**647,020**	**20,660**
50.00 **MISCELLANEOUS**				
51.00 Operation & Maintenance	105,000	35,000	35,000	35,000
52.00 Reporting Cost	12,000	4,000	4,000	4,000
53.00 Sundries	6,000	2,000	2,000	2,000
59.00 Miscellaneous Component Total	**123,000**	**41,000**	**41,000**	**41,000**
90.00 Project Total	**2,428,000**	**969,140**	**1,059,660**	**399,200**
99.00 GRAND TOTAL	**2,428,000**	**969,140**	**1,059,660**	**399,200**

PROJECT BUDGET COVERING UNDP CONTRIBUTION
(continued)

32.99	**Group Training Total**	**20,000**		**10,000**	**10,000**
33.00	**In-Service Training**				
33.01	6 Technicians in isozyme & data mngmt	58,200	29,100	29,100	
33.02	12 Extension agents diploma training	30,000	6,000	12,000	12,000
33.99	**In-Service Training Total**	**88,200**	**35,100**	**41,100**	**12,000**
34.00	**Seminar & Comm. Based Training**				
34.01	Survey Workshop	22,000	22,000		
34.02	Project Seminar	65,000			65,000
34.03	Technical Literature	12,000	4,000	4,000	4,000
34.04	Initial Farmer Conservator (6) support	6,000	6,000		
34.05	Initial National Trng Conservators & Extens	15,000	15,000		
34.06	Community Based Farmer Trng Workshop	81,000	10,000	56,000	15,000
34.99	**Seminar & Comm. Based Trng Total**	**201,000**	**57,000**	**60,000**	**84,000**
39.00	**Training Component Total**	**692,200**	**244,100**	**263,100**	**185,000**
40.00	**EQUIPMENT**				
41.00	**Expendable Equipment**	**70,230**	**28,750**	**20,820**	**20,660**
42.00	**Non-expendable Equipment**				
42.01	**Sub-total PGRC/E Equipment**	1,133,920	517,720	616,200	0
42.02	**Sub-total National Herbarium**	88,500	78,500	10,000	0
42.99	**Non-Expendable Equipment Total**	**1,222,420**	**596,220**	**626,200**	**0**
49.00	**Equipment Component Total**	**1,292,650**	**624,970**	**647,020**	**20,660**
50.00	**MISCELLANEOUS**				
51.00	Operation & Maintenance	105,000	35,000	35,000	35,000
52.00	Reporting Cost	12,000	4,000	4,000	4,000
53.00	Sundries	6,000	2,000	2,000	2,000
59.00	**Miscellaneous Component Total**	**123,000**	**41,000**	**41,000**	**41,000**
90.00	**Project Total**	**2,428,000**	**969,140**	**1,059,660**	**399,200**
99.00	**GRAND TOTAL**	**2,428,000**	**969,140**	**1,059,660**	**399,200**

Annex 1

WORKPLAN

	ACTIVITY	Year 1.				Year 2.				Year 3.			
1.	**Strengthen the Institutional Capacity for Planning and Implementating *in-situ* conservation.**												
1.1	**Enhanced crop biodiversity research and site idnetification capacity at PGRC/E**												
1.1.1	Review of current knowledge, experience and capacity.												
1.1.2	Workshop to plan ecogeographic surveys												
1.1.3	Rapid Agro-ecological assessments												
1.2	**Enhanced ethnobotanical and social research capacity at PGRC/E**												
1.2.1	Develop cooperation and information exchange												
1.2.2	Training of Phd and MSc candidates												
1.2.3	Research on farmer knowledge & behaviour												
1.2.4	Project Seminar												
1.3	**Enhanced population and conservation biology research capacity at PGRC/E**												
1.3.1	Recruit data coord. & strengthen data mngmt.												
1.3.2	Develop PGRC/E collaborn with other institts.												
1.3.3	Train PhD & MSc candidates												
1.3.4	Survey 3 sites for ethnobotany research												
1.3.5	Research on popn. biology of land races												
1.3.6	Project Seminar												
1.4	**Enhanced germ plasm handling at PGRC/E**												
1.4.1	Acquire vehicles & equipment												
1.4.2	Acquire laboratory equipment												
1.4.3	Establish cold storage facility												
1.4.4	Acquire computer & other data storage eqpt.												
1.4.5	Train technicians in isozyme analysis												
1.5	**Enhanced capacity of National Herbarium to handle crop specimens**												
1.5.1	Acquire vehicle & equipment												
1.5.2	Acquire herbarium cabinets, computers, etc.												
2.	**Establish community support and community gene banks**												
2.1	**Establish in-situ conservation activities in 6 districts**												
2.1.1	Initial visits by PGRC/E & others												
2.1.2	Public Meetings												
2.1.3	Identify farmers & establish activities												
2.2	**Identify sites for Community Gene Banks**												
2.2.1	Analyze results of agro-ecological survey												
2.2.2	Select localities												
2.2.3	Visits by PGRC/E to discuss with officials												
2.2.4	Public Meetings at each locality												
2.2.5	Organise Crop Conservation Associations												

Annex 1

WORKPLAN

	ACTIVITY	Year 1.				Year 2.				Year 3.			
1.	**Strengthen the Institutional Capacity for Planning and Implementating *in-situ* conservation.**												
1.1	**Enhanced crop biodiversity research and site identification capacity at PGRC/E**												
1.1.1	Review of current knowledge, experience and capacity.												
1.1.2	Workshop to plan ecogeographic surveys												
1.1.3	Rapid Agro-ecological assessments												
1.2	**Enhanced ethnobotanical and social research capacity at PGRC/E**												
1.2.1	Develop cooperation and information exchange												
1.2.2	Training of Phd and MSc candidates												
1.2.3	Research on farmer knowledge & behaviour												
1.2.4	Project Seminar												
1.3	**Enhanced population and conservation biology research capacity at PGRC/E**												
1.3.1	Recruit data coord. & strengthen data mngmt.												
1.3.2	Develop PGRC/E collaborn with other instits.												
1.3.3	Train PhD & MSc candidates												
1.3.4	Survey 3 sites for ethnobotany research												
1.3.5	Research on popn. biology of land races												
1.3.6	Project Seminar												
1.4	**Enhanced germ plasm handling at PGRC/E**												
1.4.1	Acquire vehicles & equipment												
1.4.2	Acquire laboratory equipment												
1.4.3	Establish cold storage facility												
1.4.4	Acquire computer & other data storage eqpt.												
1.4.5	Train technicians in isozyme analysis												
1.5	**Enhanced capacity of National Herbarium to handle crop specimens**												
1.5.1	Acquire vehicle & equipment												
1.5.2	Acquire herbarium cabinets, computers, etc.												
2.	**Establish community support and community gene banks**												
2.1	**Establish in-situ conservation activities in 6 districts**												
2.1.1	Initial visits by PGRC/E & others												
2.1.2	Public Meetings												
2.1.3	Identify farmers & establish activities												
2.2	**Identify sites for Community Gene Banks**												
2.2.1	Analyze results of agro-ecological survey												
2.2.2	Select localities												
2.2.3	Visits by PGRC/E to discuss with officials												
2.2.4	Public Meetings at each locality												
2.2.5	Organise Crop Conservation Associations												

2.3	**Construct 6 Community Gene Banks**
2.3.1	Design Gene Banks
2.3.2	Select sites, assemble materials & labour
2.3.3	Construct facilities & botanical gardens
3.	**Select & Train Farmer Conservators**
3.1	**Identify Farmer Conservators**
3.1.1	Meet with Crop Conservation Associations
3.1.2	Elect Farmer Conservators
3.2	**Develop Farmer Conservator Capacity**
3.2.1	Conduct national training course
3.2.2	Equip farmer conservators
3.2.3	Conduct annual training courses
4.	**Strengthen PGRC/E - Farmer Interactions**
4.1	**Improved Extension Agent Training in Districts with Community Gene Banks**
4.1.1	Diploma course for Extension Agents
4.1.2	Annual visits for Extension Agents to PGRC/E
4.1.3	District level eco-geographical surveys
4.1.4	Community based farmer training
4.2	**Extension agents enabled to work with districts, communities & gene banks**
4.2.1	Equip Extension Agents
4.2.2	Visits to farmer conservators by Ext agents
4.3	**Increased PGRC/E Presence in Districts with Gene Banks**
4.3.1	Quarterly visits by PGRC/E to each gene bank
4.3.2	Incorporate PGRC/E issues into Ext. agents wk
5.	**Develop community and market incentives**
5.1	**Identification of market potential**
5.1.1	Product identification and market survey
5.1.2	Socio-economic feasibility study
5.1.3	Identify bottlenecks & problems
5.1.4	Conduct EIA
5.1.5	Assess marketing strategy
5.2	**Create non-market community incentives**
5.2.1	Annual regional agricultural fairs
5.2.2	Prepare educational materials
5.2.3	Distribute educational materials
5.3	**Analysis of policies affecting crop biodiversity**
5.3.1	Evaluate government policies
5.3.2	Establish monitoring system for policies
5.3.3	Designate staff to track policies

2.3	**Construct 6 Community Gene Banks**
2.3.1	Design Gene Banks
2.3.2	Select sites, assemble materials & labour
2.3.3	Construct facilities & botanical gardens
3.	**Select & Train Farmer Conservators**
3.1	**Identify Farmer Conservators**
3.1.1	Meet with Crop Conservation Associations
3.1.2	Elect Farmer Conservators
3.2	**Develop Farmer Conservator Capacity**
3.2.1	Conduct national training course
3.2.2	Equip farmer conservators
3.2.3	Conduct annual training courses
4.	**Strengthen PGRC/E - Farmer Interactions**
4.1	**Improved Extension Agent Training in Districts with Community Gene Banks**
4.1.1	Diploma course for Extension Agents
4.1.2	Annual visits for Extension Agents to PGRC/E
4.1.3	District level eco-geographical surveys
4.1.4	Community based farmer training
4.2	**Extension agents enabled to work with districts, communities & gene banks**
4.2.1	Equip Extension Agents
4.2.2	Visits to farmer conservators by Ext agents
4.3	**Increased PGRC/E Presence in Districts with Gene Banks**
4.3.1	Quarterly visits by PGRC/E to each gene bank
4.3.2	Incorporate PGRC/E issues into Ext. agents wk
5.	**Develop community and market incentives**
5.1	**Identification of market potential**
5.1.1	Product identification and market survey
5.1.2	Socio-economic feasibility study
5.1.3	Identify bottlenecks & problems
5.1.4	Conduct EIA
5.1.5	Assess marketing strategy
5.2	**Create non-market community incentives**
5.2.1	Annual regional agricultural fairs
5.2.2	Prepare educational materials
5.2.3	Distribute educational materials
5.3	**Analysis of policies affecting crop biodiversity**
5.3.1	Evaluate government policies
5.3.2	Establish monitoring system for policies
5.3.3	Designate staff to track policies

Annex 2

SCHEDULE OF PROJECT REVIEWS, REPORTING AND EVALUATION

Project Performance Evaluation Report (PPER)	Submitted biannually.
Tripartite Review (TPR)	Annually—two months after receipt of PPER numbers two, four, and six.
Technical Reports	To be issued as appropriate.
Seminar Report	Seminar to be conducted early in year three of the project, and the report published at least six months prior to the end of the project.
Terminal Evaluation	To be conducted four months prior to the end of the project.

Annex 2

SCHEDULE OF PROJECT REVIEWS, REPORTING AND EVALUATION

Project Performance Evaluation Report (PPER)	Submitted biannually.
Tripartite Review (TPR)	Annually—two months after receipt of PPER numbers two, four, and six.
Technical Reports	To be issued as appropriate.
Seminar Report	Seminar to be conducted early in year three of the project, and the report published at least six months prior to the end of the project.
Terminal Evaluation	To be conducted four months prior to the end of the project.

Annex 3

LINKING GENETIC RESOURCE CONSERVATION TO FARMERS IN ETHIOPIA

Melaku Worede and Hailu Mekbib

Abstract

Farmers in Ethiopia have a wide knowledge of crop varieties and have developed strategies to preserve diversity in crops and genetic material. This expertise enables crops to be adapted to specific environments, and to conditions of stress. Given the weakness of modern varieties in performing under conditions of stress and in adapting to specific environments, farming communities can play an important role in genetic resource conservation and development. PGRC/E programmes in which farmers play an important role are described. Improved landrace conservation will enable farmers to exercise greater choice in adopting planting material and in rejecting poorly adapted exotic varieties.

The knowledge of farmers is an important resource for the development of sustainable agriculture and the conservation of genetic material. Farmers have developed landraces on the basis of utilizing locally accessible resources for the management of farming systems. The indigenous landraces of various crop species and their wild and weedy relatives form the basis of Ethiopia's plant genetic resources. These landraces are highly prized for their potential value as sources of material for crop improvement programmes. Genetic resource development forms an important activity in Ethiopia, and major national programmes have been undertaken over the last decade. Crop scientists are presented with the challenge of developing new approaches to the rich and diverse biological resources of the country. There is a unique opportunity to salvage and effectively utilize landraces and indigenous knowledge which farming communities in Ethiopia have developed and maintained through the centuries.

This contribution reviews and describes the importance of local knowledge in traditional agricultural systems, and discusses the role peasant farmers play in the conservation of landraces and in the programmes of the PGRC/E. It is important that the dynamics of traditional cropping systems be understood before they are replaced with modern agriculture, and that peasant farmers be supported with resources to become partners in the development of genetic resources.

Crop diversity in farming systems

Farmers frequently grow mixtures of different crops which are adapted to different localities. This practice reduces the risk of economic loss caused by undesirable environmental conditions or from pest attack. The small farmers are more concerned with gaining maximum security from their cropping systems than maximizing yield, in order to assure that the basic food requirements of their families are met.

In northern Ethiopia, particularly in the drought-prone areas, wheat and barley are grown in particular mixtures. In favourable years farmers will get yields of both crops, and in poor years they

Annex 3

LINKING GENETIC RESOURCE CONSERVATION TO FARMERS IN ETHIOPIA

Melaku Worede and Hailu Mekbib

Abstract

Farmers in Ethiopia have a wide knowledge of crop varieties and have developed strategies to preserve diversity in crops and genetic material. This expertise enables crops to be adapted to specific environments, and to conditions of stress. Given the weakness of modern varieties in performing under conditions of stress and in adapting to specific environments, farming communities can play an important role in genetic resource conservation and development. PGRC/E programmes in which farmers play an important role are described. Improved landrace conservation will enable farmers to exercise greater choice in adopting planting material and in rejecting poorly adapted exotic varieties.

The knowledge of farmers is an important resource for the development of sustainable agriculture and the conservation of genetic material. Farmers have developed landraces on the basis of utilizing locally accessible resources for the management of farming systems. The indigenous landraces of various crop species and their wild and weedy relatives form the basis of Ethiopia's plant genetic resources. These landraces are highly prized for their potential value as sources of material for crop improvement programmes. Genetic resource development forms an important activity in Ethiopia, and major national programmes have been undertaken over the last decade. Crop scientists are presented with the challenge of developing new approaches to the rich and diverse biological resources of the country. There is a unique opportunity to salvage and effectively utilize landraces and indigenous knowledge which farming communities in Ethiopia have developed and maintained through the centuries.

This contribution reviews and describes the importance of local knowledge in traditional agricultural systems, and discusses the role peasant farmers play in the conservation of landraces and in the programmes of the PGRC/E. It is important that the dynamics of traditional cropping systems be understood before they are replaced with modern agriculture, and that peasant farmers be supported with resources to become partners in the development of genetic resources.

Crop diversity in farming systems

Farmers frequently grow mixtures of different crops which are adapted to different localities. This practice reduces the risk of economic loss caused by undesirable environmental conditions or from pest attack. The small farmers are more concerned with gaining maximum security from their cropping systems than maximizing yield, in order to assure that the basic food requirements of their families are met.

In northern Ethiopia, particularly in the drought-prone areas, wheat and barley are grown in particular mixtures. In favourable years farmers will get yields of both crops, and in poor years they

will mainly reap barley. The mixture of landrace populations consists of genetic lines, which complement each other. They are all adapted to the region in which they have evolved, but differ in the mechanisms through which they express traits such as drought or pest resistance. The mixtures of both crops are kept together for the coming planting season, but during consumption, the two crops are used separately for different food preparations.

In the Gonder area of northwestern Ethiopia, farmers plant more than six crops together in their backyards, including maize, faba bean, sweet sorghum (used for chewing the stalk like sugar cane and for chicken feed), cabbage, tomato, potato, pumpkin, and bottle gourd. Most of these backyard activities are the responsibility of women. In the southern and central part of the country, the farmers focus more on perennial crops. A highly diversified range of crops and trees used for fencing materials are planted (Figure 1). These crops mature at different periods making maximum use of scarce land and labour resources, minimizing weed problems, and maintaining soil fertility.

Exchange of seeds and planting material

Farmers have developed networks and systems of ensuring a sustained supply of seeds. Seeds are exchanged in local markets, where an assortment of varieties adapted to different environmental adaptations are available. Inter-regional exchange is also important, and farmers know where to locate new supplies of seeds when traditional landraces become degraded.

In northern Ethiopia, in areas where lands are flat, wind and water can easily carry pollen from one field to another. Under these conditions farmers find it difficult to maintain traditional landraces, and visit other areas every few years to acquire seeds of recognized landraces. Edwards (1989) reports that farmers in Kanesham in Eritrea are able to maintain distinct landraces of barley on small and isolated plots. Areas in Gonder and Tigray also specialize in the maintenance of elite landraces of other crops. It is important that other such areas are identified and studied, and that the knowledge of farmers sustaining the processes which produce elite landraces are recognized. These practices enable farmers to have a wide choice of planting material suited to particular agro-climatic conditions.

In some of the more developed areas of Ethiopia, such as the Central Highlands, the traditional seed conservation activities of farmers are becoming eroded as new improved seeds are spread by extension systems. But in most of the drought prone areas, particularly in northern Shewa and Welo, farmers depend on traditional methods of seed dissemination and production to ensure a supply of adaptable planting material.

Mechanisms have also been developed for the storage of seeds. Individual farmers often store seeds in clay pots and rock-hewn mortars, which are sealed, buried, or stored in other secure places. Community grain pits are also made in which different crop seeds are stored. The grain pits are carefully prepared and fumigated with smoked, dried cow-dung, or with wood from selected tree species.

Farmer selection and maintenance of seeds

Farmers expert in traditional seed selection have great knowledge of varieties. The traditional criteria for selection of landraces include induced adaptability, high yield, reliable and stable yield,

will mainly reap barley. The mixture of landrace populations consists of genetic lines, which complement each other. They are all adapted to the region in which they have evolved, but differ in the mechanisms through which they express traits such as drought or pest resistance. The mixtures of both crops are kept together for the coming planting season, but during consumption, the two crops are used separately for different food preparations.

In the Gonder area of northwestern Ethiopia, farmers plant more than six crops together in their backyards, including maize, faba bean, sweet sorghum (used for chewing the stalk like sugar cane and for chicken feed), cabbage, tomato, potato, pumpkin, and bottle gourd. Most of these backyard activities are the responsibility of women. In the southern and central part of the country, the farmers focus more on perennial crops. A highly diversified range of crops and trees used for fencing materials are planted (Figure 1). These crops mature at different periods making maximum use of scarce land and labour resources, minimizing weed problems, and maintaining soil fertility.

Exchange of seeds and planting material

Farmers have developed networks and systems of ensuring a sustained supply of seeds. Seeds are exchanged in local markets, where an assortment of varieties adapted to different environmental adaptations are available. Inter-regional exchange is also important, and farmers know where to locate new supplies of seeds when traditional landraces become degraded.

In northern Ethiopia, in areas where lands are flat, wind and water can easily carry pollen from one field to another. Under these conditions farmers find it difficult to maintain traditional landraces, and visit other areas every few years to acquire seeds of recognized landraces. Edwards (1989) reports that farmers in Kanesham in Eritrea are able to maintain distinct landraces of barley on small and isolated plots. Areas in Gonder and Tigray also specialize in the maintenance of elite landraces of other crops. It is important that other such areas are identified and studied, and that the knowledge of farmers sustaining the processes which produce elite landraces are recognized. These practices enable farmers to have a wide choice of planting material suited to particular agro-climatic conditions.

In some of the more developed areas of Ethiopia, such as the Central Highlands, the traditional seed conservation activities of farmers are becoming eroded as new improved seeds are spread by extension systems. But in most of the drought prone areas, particularly in northern Shewa and Welo, farmers depend on traditional methods of seed dissemination and production to ensure a supply of adaptable planting material.

Mechanisms have also been developed for the storage of seeds. Individual farmers often store seeds in clay pots and rock-hewn mortars, which are sealed, buried, or stored in other secure places. Community grain pits are also made in which different crop seeds are stored. The grain pits are carefully prepared and fumigated with smoked, dried cow-dung, or with wood from selected tree species.

Farmer selection and maintenance of seeds

Farmers expert in traditional seed selection have great knowledge of varieties. The traditional criteria for selection of landraces include induced adaptability, high yield, reliable and stable yield,

nutritional quality, colour, grain size, and texture. Crops are also adapted for specialized uses. In the case of wheat varieties, *Triticum aestivum* is used for making common bread, while *T. turgidum* conv. *durum* and *aetiopicum* are used for macaroni, spaghetti and pastries, local breads, whole and crushed grain foods, drinks and porridge. *T. turgidum* conv. *dicoccum* is used to prepare a soup which is consumed by women during pregnancy and weaning. Various alcoholic drinks are brewed and distilled from a variety of wheats.

Figure 1 Crops in southern and central Ethiopia

Name	*Scientific name*
Enset	*Ensete ventricosum*
Rhamnus	*Rhamnus prinoides*
Sacred basil	*Ocimum basilicum*
Chili	*Capsicum annum*
Potato	*Solanum tuberosum*
Lime	*Citrus aurantium*
Maize	*Zea mays*
Sweet potato	*Ipomoea batatas*
Garlic	*Allium sativum*
Rue	*Ruta chalepensis*
Dama kese	*Ocimum lamifolium*
Ariti	*Artemisia afra*
Tej sar	*Cymbopogon citratus*
Pumpkin	*Cucurbita maxima*
Nacha	*Hibiscus canabinus*
Sugar cane	*Saccharum officinarum*
Astenagir	*Datura stramonium*
Shallot	*Allium cepa*

All of these recipes are prepared by women. Thus the role of women in seed selection and vegetative propagation is crucial to both agricultural production and the conservation and enhancement of genetic resources. Women have traditionally played a silent but central role in the sustainable use of biological resources and life support systems (Shiva and Dankelman 1992).

nutritional quality, colour, grain size, and texture. Crops are also adapted for specialized uses. In the case of wheat varieties, *Triticum aestivum* is used for making common bread, while *T. turgidum* conv. *durum* and *aetiopicum* are used for macaroni, spaghetti and pastries, local breads, whole and crushed grain foods, drinks and porridge. *T. turgidum* conv. *dicoccum* is used to prepare a soup which is consumed by women during pregnancy and weaning. Various alcoholic drinks are brewed and distilled from a variety of wheats.

Figure 1 Crops in southern and central Ethiopia

Name	*Scientific name*
Enset	*Ensete ventricosum*
Rhamnus	*Rhamnus prinoides*
Sacred basil	*Ocimum basilicum*
Chili	*Capsicum annum*
Potato	*Solanum tuberosum*
Lime	*Citrus aurantium*
Maize	*Zea mays*
Sweet potato	*Ipomoea batatas*
Garlic	*Allium sativum*
Rue	*Ruta chalepensis*
Dama kese	*Ocimum lamifolium*
Ariti	*Artemisia afra*
Tej sar	*Cymbopogon citratus*
Pumpkin	*Cucurbita maxima*
Nacha	*Hibiscus canabinus*
Sugar cane	*Saccharum officinarum*
Astenagir	*Datura stramonium*
Shallot	*Allium cepa*

All of these recipes are prepared by women. Thus the role of women in seed selection and vegetative propagation is crucial to both agricultural production and the conservation and enhancement of genetic resources. Women have traditionally played a silent but central role in the sustainable use of biological resources and life support systems (Shiva and Dankelman 1992).

The maintenance of species and genetic diversity in fields is an effective strategy to create a stable system of conservation by farmers practising low-input agriculture. Cultivated crops often intercross with their wild or weedy relatives growing in the field or in nearby fields, resulting in new characteristics. This has been observed for enset (*Ensete ventricosum*) in central and southern Ethiopia (Shengeta 1990). Farmers have taken advantage of this system of interbreeding to adapt materials to changing agro-ecological realities. Strategies of intercropping and cropping with varietal mixtures may result in accidental crosses between the varieties promoting introgression. Bayush (1991) reports that farming communities in southern Ethiopia actively manage germplasm through artificial selection. It is believed that the different characteristics of plants within the brassicas, such as *Brassica carinata* (Ethiopian mustard) and *Brassica nigra* (black mustard), arose on farms in which mixtures of these two species were planted. These practices may also account for the relatively high inter-population diversity which has been observed in PGRC/E collections (Worede 1986a). Coffee growers often preserve a diversity of local varieties in small areas (alongside the more uniform coffee blight disease (CBD) resistant line) which are distributed by the coffee improvement projects in Ethiopia.

The PGRC/E has benefitted from the knowledge and skills of farming families collaborating in genetic resource activities, especially in collecting and rescuing germplasm, and the identification of useful planting material. This has already contributed to available information on Ethiopia's crop germplasm resources which farmers have developed and maintained for many generations.

The role of farmers in genetic resource conservation

Given the knowledge and skills within the traditional system, the conservation of landraces on peasant farms provides a valuable option for conserving crop diversity. It increases the range of strategies for genetic resource conservation efforts (Worede 1986b), and provides a mechanism through which the evolutionary systems which are responsible for the generation of variability are sustained. In relation to pests and disease, conservation of landraces will allow continued host-parasite co-evolution. Within stressful environments, access to a wide range of local landraces may provide the best available planting strategies. The ability of landraces to survive under such stress is conditioned by an inherent broadly-adaptive genetic base. This is often not the case with the more uniform improved varieties which, despite their high-yield potential, are less stable and hardy under adverse growing conditions.

Under these conditions, the establishment of field gene banks of species adapted to extreme conditions may provide a seed reserve for post-drought planting in places where traditional crops have failed. Germplasm materials maintained in such fields could be distributed to rural farming communities, scientific institutions, and other organizations for further investigation on their potential use as food resources, and for utilization in plant breeding programmes.

Landrace evaluation and enhancement programmes will stimulate the utilization of germplasm resources which are already adapted to the conditions of stressful environments in these regions. Local landraces will provide suitable materials for institutional crop improvement programmes, but need to be maintained within the dynamic conditions which have characterized their evolution and selection, within farm- or community-based conservation programmes.

The maintenance of species and genetic diversity in fields is an effective strategy to create a stable system of conservation by farmers practising low-input agriculture. Cultivated crops often intercross with their wild or weedy relatives growing in the field or in nearby fields, resulting in new characteristics. This has been observed for enset (*Ensete ventricosum*) in central and southern Ethiopia (Shengeta 1990). Farmers have taken advantage of this system of interbreeding to adapt materials to changing agro-ecological realities. Strategies of intercropping and cropping with varietal mixtures may result in accidental crosses between the varieties promoting introgression. Bayush (1991) reports that farming communities in southern Ethiopia actively manage germplasm through artificial selection. It is believed that the different characteristics of plants within the brassicas, such as *Brassica carinata* (Ethiopian mustard) and *Brassica nigra* (black mustard), arose on farms in which mixtures of these two species were planted. These practices may also account for the relatively high inter-population diversity which has been observed in PGRC/E collections (Worede 1986a). Coffee growers often preserve a diversity of local varieties in small areas (alongside the more uniform coffee blight disease (CBD) resistant line) which are distributed by the coffee improvement projects in Ethiopia.

The PGRC/E has benefitted from the knowledge and skills of farming families collaborating in genetic resource activities, especially in collecting and rescuing germplasm, and the identification of useful planting material. This has already contributed to available information on Ethiopia's crop germplasm resources which farmers have developed and maintained for many generations.

The role of farmers in genetic resource conservation

Given the knowledge and skills within the traditional system, the conservation of landraces on peasant farms provides a valuable option for conserving crop diversity. It increases the range of strategies for genetic resource conservation efforts (Worede 1986b), and provides a mechanism through which the evolutionary systems which are responsible for the generation of variability are sustained. In relation to pests and disease, conservation of landraces will allow continued host-parasite co-evolution. Within stressful environments, access to a wide range of local landraces may provide the best available planting strategies. The ability of landraces to survive under such stress is conditioned by an inherent broadly-adaptive genetic base. This is often not the case with the more uniform improved varieties which, despite their high-yield potential, are less stable and hardy under adverse growing conditions.

Under these conditions, the establishment of field gene banks of species adapted to extreme conditions may provide a seed reserve for post-drought planting in places where traditional crops have failed. Germplasm materials maintained in such fields could be distributed to rural farming communities, scientific institutions, and other organizations for further investigation on their potential use as food resources, and for utilization in plant breeding programmes.

Landrace evaluation and enhancement programmes will stimulate the utilization of germplasm resources which are already adapted to the conditions of stressful environments in these regions. Local landraces will provide suitable materials for institutional crop improvement programmes, but need to be maintained within the dynamic conditions which have characterized their evolution and selection, within farm- or community-based conservation programmes.

PGRC/E farm-based conservation activities

Work has recently begun in Ethiopia to develop farm-based conservation activities which build upon the skills and traditions of farmers. The PGRC/E is presently involved in developing three programmes with farmers.

On-farm landrace conservation and enhancement

Since 1988 farmers, scientists, and extension workers have been involved in a programme of genetic resource conservation in northeastern Shewa and southeastern Welo, with support from the Unitarian Services Committee/Canada (USC/C). The project aims to help farmers maintain crop diversity by protecting cultivars from disappearing, and improve their genetic performance. Material previously collected from surrounding areas and regions are given to farmers to plant and to carry out simple forms of mass selection to improve their characteristics. They are assisted by breeders, and other scientists have access to the farmers' fields for carrying out research. Most of the farmers are women and were selected through farmer cooperatives.

Farmer seed selection is usually carried out at the time when crops have formed heads, and the various plant types become discernible. Plant types and subraces of cultivars are selected for such characteristics as disease or pest resistance, size of kernel or head, maturity period, and other characteristics of local importance. The long-established skills of farmers are complemented by PGRC/E scientists, who establish standard descriptor lists (such as ear length, ear width, number of tillers, disease and pest resistance, and lodging resistance), which they train farmers to follow, thus enhancing their selection skills. Occasionally farmers also rogue out suspect varieties at an early stage for such diseases as smut in sorghum. A small number of plants are identified for each cultivar and harvested; the seeds of the selected stock are bulked to form a new slightly improved population, which the farmers multiply in order to continue the process in the following season.

Special experimental plots are planted in which farmers evaluate their seeds by comparing performance and yields with samples of the original seed stock. These plots are also used for on-site maintenance of landraces, sampling, and other relevant scientific experiments. The traditional cultural and cropping practices under which the plants have acquired their distinctive properties are maintained to optimize conservation. The multiplication and selection of elite materials for further selection is carried out on separate plots. After three to five years of selection, an appreciable improvement in crop yield can be expected.

There is also a possibility of transferring genes which control particular positive characteristics (for example, disease and pest resistance, high lysine in sorghum, or drought tolerance) from external sources, or from already existing selections, to enhance the elite populations of the future. Certain types of cultivars which despite positive attributes may have been abandoned by farmers for various reasons, such as risk of crop failure or marketing problems, could also be rescued. Currently, a great deal of germplasm which has already disappeared in the surrounding area due to adverse growing conditions, insecurity and war, has been maintained on these landrace conservation farms.

PGRC/E farm-based conservation activities

Work has recently begun in Ethiopia to develop farm-based conservation activities which build upon the skills and traditions of farmers. The PGRC/E is presently involved in developing three programmes with farmers.

On-farm landrace conservation and enhancement

Since 1988 farmers, scientists, and extension workers have been involved in a programme of genetic resource conservation in northeastern Shewa and southeastern Welo, with support from the Unitarian Services Committee/Canada (USC/C). The project aims to help farmers maintain crop diversity by protecting cultivars from disappearing, and improve their genetic performance. Material previously collected from surrounding areas and regions are given to farmers to plant and to carry out simple forms of mass selection to improve their characteristics. They are assisted by breeders, and other scientists have access to the farmers' fields for carrying out research. Most of the farmers are women and were selected through farmer cooperatives.

Farmer seed selection is usually carried out at the time when crops have formed heads, and the various plant types become discernible. Plant types and subraces of cultivars are selected for such characteristics as disease or pest resistance, size of kernel or head, maturity period, and other characteristics of local importance. The long-established skills of farmers are complemented by PGRC/E scientists, who establish standard descriptor lists (such as ear length, ear width, number of tillers, disease and pest resistance, and lodging resistance), which they train farmers to follow, thus enhancing their selection skills. Occasionally farmers also rogue out suspect varieties at an early stage for such diseases as smut in sorghum. A small number of plants are identified for each cultivar and harvested; the seeds of the selected stock are bulked to form a new slightly improved population, which the farmers multiply in order to continue the process in the following season.

Special experimental plots are planted in which farmers evaluate their seeds by comparing performance and yields with samples of the original seed stock. These plots are also used for on-site maintenance of landraces, sampling, and other relevant scientific experiments. The traditional cultural and cropping practices under which the plants have acquired their distinctive properties are maintained to optimize conservation. The multiplication and selection of elite materials for further selection is carried out on separate plots. After three to five years of selection, an appreciable improvement in crop yield can be expected.

There is also a possibility of transferring genes which control particular positive characteristics (for example, disease and pest resistance, high lysine in sorghum, or drought tolerance) from external sources, or from already existing selections, to enhance the elite populations of the future. Certain types of cultivars which despite positive attributes may have been abandoned by farmers for various reasons, such as risk of crop failure or marketing problems, could also be rescued. Currently, a great deal of germplasm which has already disappeared in the surrounding area due to adverse growing conditions, insecurity and war, has been maintained on these landrace conservation farms.

Maintaining elite indigenous landrace selection on peasant farms

The PGRC/E, in conjunction with Debre Zeit Research Centre of the Alemaya University of Agriculture (AUA), is developing a programme to maintain elite indigenous material of tetraploid wheat. The project involves farmers in multiplying and using elite seed stock provided by breeders which is best suited to their conditions.

The programme utilizes wheat germplasm collected by PGRC/E over the last seven years. The approach is based on a modification of conventional mass selection. Different genetic lines are selected for their adaptation to specific environmental conditions, such as stress. After yield testing, two or more superior lines are bulked for further multiplication and distribution to farmers (Tessema 1986). The farmers multiply and use the stock best suited to their conditions. PGRC/E maintains representative samples for long-term storage at their gene bank. This practice enables farmers to experiment with the elite landrace lines without the threat of losing the old indigenous populations which are accessible from within the gene bank. They are being encouraged to experiment so as to critically evaluate the present available planting materials which are represented by new poorly-propagated varieties distributed to farmers in the region, and to continue to use the elite landraces.

Preliminary yield trials indicate that the selected elite landraces have in many ways surpassed officially released wheat varieties. There is a potential for breeders to develop programmes which select or segregate superior landrace varieties to provide suitable breeding material for specific environments (Tessema 1986). There is also a possibility of utilizing the various selections for continual hybridization, possibly by employing chemical male gametocide, allowing new, unusual genetic combinations to surface, which would be unlikely to occur under controlled manual hybridization programmes (Worede 1974).

At the national level, varieties adapted from local lands can be released to ensure that farmers have a long-term choice of seeds, and can fall back on improved versions of adapted local varieties when high risk seeds fail. This is particularly relevant for areas with marginal growing conditions or extremes of environment, where improved varieties fail to meet the requirements of farmers.

Field gene banks for drought prone areas

Climatic change within Ethiopia is likely to have a serious impact on crop production. A few areas have already been abandoned due to persistent drought and constant crop failure. In other areas, there is a significant shift to more drought-resistant crops. In this situation, research into species adapted to extreme environments is important, as is the creation of field gene banks which will provide a source of drought-resistant seeds. Germplasm material maintained in these gene banks could be distributed to farmers and scientists for further investigation of their potential use as food resources and for utilization in breeding programmes.

There are several wild plants which have the potential of surviving droughts where conventional crops perish. These are commonly known as famine crops, since they provide humans with food in times of drought. Some research has been carried out by PGRC/E with ye-eb (*Cordeauxia edulis*), a perennial bush which grows wild in the Ogaden region with seeds which are used by nomads as a highly nutritious source of food. Its leaves are an important fodder crop and cosmetic dye. The plant thrives on marginal soils in semi-arid conditions of less than 200

Maintaining elite indigenous landrace selection on peasant farms

The PGRC/E, in conjunction with Debre Zeit Research Centre of the Alemaya University of Agriculture (AUA), is developing a programme to maintain elite indigenous material of tetraploid wheat. The project involves farmers in multiplying and using elite seed stock provided by breeders which is best suited to their conditions.

The programme utilizes wheat germplasm collected by PGRC/E over the last seven years. The approach is based on a modification of conventional mass selection. Different genetic lines are selected for their adaptation to specific environmental conditions, such as stress. After yield testing, two or more superior lines are bulked for further multiplication and distribution to farmers (Tessema 1986). The farmers multiply and use the stock best suited to their conditions. PGRC/E maintains representative samples for long-term storage at their gene bank. This practice enables farmers to experiment with the elite landrace lines without the threat of losing the old indigenous populations which are accessible from within the gene bank. They are being encouraged to experiment so as to critically evaluate the present available planting materials which are represented by new poorly-propagated varieties distributed to farmers in the region, and to continue to use the elite landraces.

Preliminary yield trials indicate that the selected elite landraces have in many ways surpassed officially released wheat varieties. There is a potential for breeders to develop programmes which select or segregate superior landrace varieties to provide suitable breeding material for specific environments (Tessema 1986). There is also a possibility of utilizing the various selections for continual hybridization, possibly by employing chemical male gametocide, allowing new, unusual genetic combinations to surface, which would be unlikely to occur under controlled manual hybridization programmes (Worede 1974).

At the national level, varieties adapted from local lands can be released to ensure that farmers have a long-term choice of seeds, and can fall back on improved versions of adapted local varieties when high risk seeds fail. This is particularly relevant for areas with marginal growing conditions or extremes of environment, where improved varieties fail to meet the requirements of farmers.

Field gene banks for drought prone areas

Climatic change within Ethiopia is likely to have a serious impact on crop production. A few areas have already been abandoned due to persistent drought and constant crop failure. In other areas, there is a significant shift to more drought-resistant crops. In this situation, research into species adapted to extreme environments is important, as is the creation of field gene banks which will provide a source of drought-resistant seeds. Germplasm material maintained in these gene banks could be distributed to farmers and scientists for further investigation of their potential use as food resources and for utilization in breeding programmes.

There are several wild plants which have the potential of surviving droughts where conventional crops perish. These are commonly known as famine crops, since they provide humans with food in times of drought. Some research has been carried out by PGRC/E with ye-eb (*Cordeauxia edulis*), a perennial bush which grows wild in the Ogaden region with seeds which are used by nomads as a highly nutritious source of food. Its leaves are an important fodder crop and cosmetic dye. The plant thrives on marginal soils in semi-arid conditions of less than 200

millimetres annual rainfall. A field gene bank is being developed in collaboration with AUA at Dire Dawa in eastern Ethiopia, which will test famine crops and involve farming communities in maintaining and evaluating seed.

Linking landrace conservation and enhancement to utilization

Landraces are stable dependable sources of planting material which are adapted to local growing conditions. In environments where modern varieties fail to meet the requirements of farmers, the conservation and enhancement of landraces on farms is an important objective. It makes little sense to conserve landraces unless systems are developed for the multiplication and distribution of seeds. Community seed production, marketing, and distribution forms a rational solution to this problem since these can be built onto the pre-existing traditional networks of seed selection. This approach enables farmers to exercise control over the availability of seeds and gives them ready access to locally-adapted planting material. It also enables them to critically evaluate the relative performance of a wide range of varieties. These factors will act as checks on the undue expansion of costly and poorly-adapted modern varieties.

millimetres annual rainfall. A field gene bank is being developed in collaboration with AUA at Dire Dawa in eastern Ethiopia, which will test famine crops and involve farming communities in maintaining and evaluating seed.

Linking landrace conservation and enhancement to utilization

Landraces are stable dependable sources of planting material which are adapted to local growing conditions. In environments where modern varieties fail to meet the requirements of farmers, the conservation and enhancement of landraces on farms is an important objective. It makes little sense to conserve landraces unless systems are developed for the multiplication and distribution of seeds. Community seed production, marketing, and distribution forms a rational solution to this problem since these can be built onto the pre-existing traditional networks of seed selection. This approach enables farmers to exercise control over the availability of seeds and gives them ready access to locally-adapted planting material. It also enables them to critically evaluate the relative performance of a wide range of varieties. These factors will act as checks on the undue expansion of costly and poorly-adapted modern varieties.

REFERENCES

Bayush, T. (1991). "Community Management of Crop Genetic Resources in the Enset Complex Farming Systems of Southern Ethiopia: A Case Study from Sidamo Region." MSc. thesis, NORAGRIC, Agricultural University of Norway.

Gebrekidan, B. (1982). "Utilization of Germplasm in Sorghum Improvement," in *Sorghum in the Eighties*, Proceedings of the International Symposium on Sorghum, held at ICRISAT, Patancheru, 2-7 November, 1981, pp 335-345.

Mekbib, H. and Habte Mariam, G. (1990). "Evaluation and Utilization of Ethiopian Wheat Germplasm," in *Wheat Genetic Resources: Meeting Diverse Needs*, edited by J.P. Srivastava and A.B. Damania, pp 179-186.

Monaco, L.C. (1968). "Considerations on the Genetic Variability of Coffee Arabica Populations in Ethiopia," in *FAO Coffee Mission to Ethiopia*, 1964-65, FAO, Rome, pp 49-70.

Mooney, P.R. (1985). "Ethiopia, Diversity and Drought: Long-Term Seed Security," in *RAFI-IGRP Survey of National Resources Strategy*, Ethiopia (ethhect/178), draft manuscript.

Edwards, S. (1989). "Herbaceous Crops with Important Genetic Resources in Ethiopia," in *National Resources Degradation: A Challenge to Ethiopia*, Proceedings from the First Natural Resource Conservation Conference.

Kebede, Y. and Botorou, O. (1991). "Niche and Role of Sorghum and Millet in African Agricultural Systems." Paper presented at the International Sorghum and Millet Collaborative Research Support Programme (CRSP) Conference, Corpus Christi, 8-12 July, 1991.

Tessema, T. (1986). "Improvement of Indigenous Durum Wheat Landrace in Ethiopia," in *Proceedings of the International Symposium on the Conservation and Utilization of Ethiopian Germplasm*, edited by J.M.M. Engels, PGRC/E, Addis Ababa, pp 232-238.

Shiva, V. and Dankelman, I. (1992). "Women and Biological Diversity: Lessons from the Indian Himalayas," in *Growing Diversity: Genetic Resources and Local Food Security*, edited by D. Cooper, R. Vellve and H. Hobbelink, London, IT, pp 44-52.

Worede, M. (1974). "Genetic Improvement of Quality and Agronomic Characteristics of Durum Wheat for Ethiopia," PhD dissertation, University of Nebraska.

Worede, M. (1986a). *Conservation and Utilization of Annual Oilseed Genetic Resources in Ethiopia*, Proceedings of Third Oil Crop Network Workshop (IAR/IDRC), Addis Ababa, 6-10 October, 1986.

Worede, M. (1986b). *An Ethiopian Perspective on the Conservation and Utilization of Crop Genetic Resources*, Proceedings of First International Symposium on Conservation and Utilization of Ethiopian Germplasm, Addis Ababa, 13-16 October, 1986.

Worede, M. (1992). "Ethiopia: A Gene Bank Working with Farmers," in *Growing Diversity: Genetic Resources and Local Food Security*, edited by D. Cooper, R. Vellve and H. Hobbelink, London, IT, pp. 78-96.

REFERENCES

Bayush, T. (1991). "Community Management of Crop Genetic Resources in the Enset Complex Farming Systems of Southern Ethiopia: A Case Study from Sidamo Region." MSc. thesis, NORAGRIC, Agricultural University of Norway.

Gebrekidan, B. (1982). "Utilization of Germplasm in Sorghum Improvement," in *Sorghum in the Eighties*, Proceedings of the International Symposium on Sorghum, held at ICRISAT, Patancheru, 2-7 November, 1981, pp 335-345.

Mekbib, H. and Habte Mariam, G. (1990). "Evaluation and Utilization of Ethiopian Wheat Germplasm," in *Wheat Genetic Resources: Meeting Diverse Needs*, edited by J.P. Srivastava and A.B. Damania, pp 179-186.

Monaco, L.C. (1968). "Considerations on the Genetic Variability of Coffee Arabica Populations in Ethiopia," in *FAO Coffee Mission to Ethiopia*, 1964-65, FAO, Rome, pp 49-70.

Mooney, P.R. (1985). "Ethiopia, Diversity and Drought: Long-Term Seed Security," in *RAFI-IGRP Survey of National Resources Strategy*, Ethiopia (ethhect/178), draft manuscript.

Edwards, S. (1989). "Herbaceous Crops with Important Genetic Resources in Ethiopia," in *National Resources Degradation: A Challenge to Ethiopia*, Proceedings from the First Natural Resource Conservation Conference.

Kebede, Y. and Botorou, O. (1991). "Niche and Role of Sorghum and Millet in African Agricultural Systems." Paper presented at the International Sorghum and Millet Collaborative Research Support Programme (CRSP) Conference, Corpus Christi, 8-12 July, 1991.

Tessema, T. (1986). "Improvement of Indigenous Durum Wheat Landrace in Ethiopia," in *Proceedings of the International Symposium on the Conservation and Utilization of Ethiopian Germplasm*, edited by J.M.M. Engels, PGRC/E, Addis Ababa, pp 232-238.

Shiva, V. and Dankelman, I. (1992). "Women and Biological Diversity: Lessons from the Indian Himalayas," in *Growing Diversity: Genetic Resources and Local Food Security*, edited by D. Cooper, R. Vellve and H. Hobbelink, London, IT, pp 44-52.

Worede, M. (1974). "Genetic Improvement of Quality and Agronomic Characteristics of Durum Wheat for Ethiopia," PhD dissertation, University of Nebraska.

Worede, M. (1986a). *Conservation and Utilization of Annual Oilseed Genetic Resources in Ethiopia*, Proceedings of Third Oil Crop Network Workshop (IAR/IDRC), Addis Ababa, 6-10 October, 1986.

Worede, M. (1986b). *An Ethiopian Perspective on the Conservation and Utilization of Crop Genetic Resources*, Proceedings of First International Symposium on Conservation and Utilization of Ethiopian Germplasm, Addis Ababa, 13-16 October, 1986.

Worede, M. (1992). "Ethiopia: A Gene Bank Working with Farmers," in *Growing Diversity: Genetic Resources and Local Food Security*, edited by D. Cooper, R. Vellve and H. Hobbelink, London, IT, pp. 78-96.

GLOSSARY

Agro-ecological	The spatial distribution of crops according to ecological and climatic zones.
Biodiversity	Biological diversity—the variability among living organisms from all sources including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part. This includes diversity within species, between species and of ecosystems.
Clone (clonal)	Group of genetically identical plants produced by vegetatively propagating a single plant over one or more vegetative generations. Clones may become widely dispersed through human dispersal and propagation.
Ecogeographic	Involving both the entire ecological and geographic range of a species.
Ex situ	The off-site management of plants outside their natural range; the conservation of plant seeds or propagating parts in genetic resource collections.
Gene bank	A centre or institution that manages genetic resources, in particular, maintaining *ex situ* or *in situ* collections.
Gene pool	The total of all species or populations, wild or cultivated, that can potentially exchange genes with a cultivated species.
Genetic resources	Genetic resources of actual or potential value to humanity.
Germplasm	Living reproductive material including seeds, pollen and plants or their parts.
Germplasm collection	A collection of many different individuals, populations, varieties, subspecies or species representing a diverse collection of genetic material.
In situ	The management of organisms in their natural state or within their natural range. (For domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.)
Inventory	A detailed assessment of what plant species occur at the site, their abundance, distribution, and suggested management needs.
Landraces	A cultivated (domesticated) population that is genetically heterogenous and has, over generations, become adapted to the local environment and cultural conditions under which it is grown.
Off-farm	See *ex situ*.
On-farm	See *in situ*.
Survey	Surveys are broader in scope and not as detailed as an inventory. A survey consists of a field inventory of the site (not collection-oriented) to determine habitat distribution, and includes notes on the presence or absence of priority target species (crops).

GLOSSARY

Agro-ecological	The spatial distribution of crops according to ecological and climatic zones.
Biodiversity	Biological diversity—the variability among living organisms from all sources including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are a part. This includes diversity within species, between species and of ecosystems.
Clone (clonal)	Group of genetically identical plants produced by vegetatively propagating a single plant over one or more vegetative generations. Clones may become widely dispersed through human dispersal and propagation.
Ecogeographic	Involving both the entire ecological and geographic range of a species.
Ex situ	The off-site management of plants outside their natural range; the conservation of plant seeds or propagating parts in genetic resource collections.
Gene bank	A centre or institution that manages genetic resources, in particular, maintaining *ex situ* or *in situ* collections.
Gene pool	The total of all species or populations, wild or cultivated, that can potentially exchange genes with a cultivated species.
Genetic resources	Genetic resources of actual or potential value to humanity.
Germplasm	Living reproductive material including seeds, pollen and plants or their parts.
Germplasm collection	A collection of many different individuals, populations, varieties, subspecies or species representing a diverse collection of genetic material.
In situ	The management of organisms in their natural state or within their natural range. (For domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.)
Inventory	A detailed assessment of what plant species occur at the site, their abundance, distribution, and suggested management needs.
Landraces	A cultivated (domesticated) population that is genetically heterogenous and has, over generations, become adapted to the local environment and cultural conditions under which it is grown.
Off-farm	See *ex situ*.
On-farm	See *in situ*.
Survey	Surveys are broader in scope and not as detailed as an inventory. A survey consists of a field inventory of the site (not collection-oriented) to determine habitat distribution, and includes notes on the presence or absence of priority target species (crops).