

CHALLENGE PROGRAM: WATER FOR FOOD
NILE RIVER BASIN (NRB)
FULL PROPOSAL

PROJECT TITLE

Improving Water Productivity of Cereals and Food Legumes in the Atbara River Basin of Eritrea

BRIEF TITLE

Water Productivity Improvement in Eritrea

KEY WORDS

Drought, Gender-sensitive participatory research, Plant breeding, Seed multiplication, Agricultural system reform, Institutional change, Capacity building.

EXECUTIVE SUMMARY

Eritrea is among the 10 poorest countries in the world. In 1997 two thirds of the population (2.2 million people) were undernourished, and 40% of children under the age of five were suffering from malnutrition. The war with Ethiopia and the droughts and famines that affected the country in the 1970s, 1980s, and more recently in 2002 resulted in major disruption and population movement, especially in rural areas. The agricultural support network is in a state of disrepair, food production has dropped to about 40% over the last decade, and the technology base has changed little over the last 30 years. Agriculture is affected by recurrent droughts. A sixth of Eritrea population, or more than 0.6 million people, live within the Mereb-Gash and Tekeze-Setit basins.

There is considerable potential to develop the agricultural sector by increasing the water productivity of crops in Eritrea. A multi-disciplinary team will be assembled involving the International Center for Agricultural Research in the Dry Areas (ICARDA), the CGIAR Systemwide Program on Participatory Research and Gender Analysis (PRGA Program) at the International Center for Tropical Agriculture (CIAT), the Department of Agricultural Research and Human Resource Development (DARHRD) and other departments of the Ministry of Agriculture, the College of Agriculture of Asmara University, and other non-profit development agencies.

The project will contribute to enhancing food security and alleviating poverty for those who need it the most in the Atbara basin by strengthening agricultural research, seed and extension systems in the use of gender-sensitive participatory approaches to increasing crop water productivity, using low-cost inputs, while minimizing risk and ensuring sustainability of production.

The research will be conducted utilizing the available indigenous knowledge. Farmers will be partners in technology development with extension and research, with full decision-making power in planning, implementation, monitoring, and evaluation. The technologies and management practices identified will be disseminated to non-participating farming communities. Community-based seed multiplication schemes will be promoted by establishing local enterprises and developing locally manufactured seed processing facilities.

The project will produce new varieties of cereals and food legumes, with associated management practices, in partnership with farmers, and which have proven farmer acceptability; establish seed systems which supply farmers with quality seed in a sustainable manner; enhance farmers' skills

in participatory research and in community based seed production; strengthen the capacity of National Institutions to carry out participatory research and technology transfer, and to monitor and assess the impact of their research; strengthen linkages between research, seed, and extension departments by working together in cooperation with farmers and farmers' communities.

The main beneficiaries of the material developed by the project will be the people living in the Atbara river basin in Eritrea. They will benefit from the new technologies. The research and extension staff will acquire increased capacity to conduct participatory research for crop improvement. The decision-makers will use the results and the methodology of the project to extend it to other crops. Other IARC and NARES will be able to use the methodologies and the knowledge generated by project.

INSTITUTIONS PARTICIPATING

International Center for Agricultural Research in the Dry Areas (ICARDA)

Postal address: P.O. Box 5466, Aleppo, Syria

Email: icarda@cgiar.org

Type of institution: CGIAR Centre

Ministry of Agriculture, Department of Agricultural Research and Human Resource Development (DARHRD)

Postal address: P.O. Box 4627, Asmara, Eritrea

Email: research@tse.com.er

Type of institution: NARES

Asmara University, College of Agriculture

Postal address: P.O. Box 1220, Asmara, Eritrea

Email: waraia@asmara.uoa.edu.er

Type of institution: NARES

CGIAR Systemwide Program for Participatory Research and Gender Analysis (PRGA Program), convened at the International Centre for Tropical Agriculture (CIAT)

Postal address: A.A. 6713, Cali, Colombia

Email: ciat@cgiar.org

Type of institution: CGIAR Systemwide Program

PROJECT LEADER

Name: Stefania Grando

Professional discipline: Breeding and Genetics

Institution: ICARDA

Title: Barley breeder

PRINCIPAL INVESTIGATORS

Name: Antonius van Gastel

Professional discipline: Seed technology

Institution: ICARDA

Title: Head of Seed Unit

Name: Amor H. Yahyaoui

Professional discipline: Plant Pathology

Institution: ICARDA
Title: Cereal pathologist

Name: Salvatore Ceccarelli
Professional discipline: Breeding and Genetics
Institution: ICARDA
Title: Participatory crop improvement specialist

Name: Rajinder S. Malhotra
Professional discipline: Breeding and Genetics
Institution: ICARDA
Title: Legume breeder

Name: Tesfaslassie G/Mariam
Professional discipline: Breeding and Agronomy
Institution: DARHRD, MoA
Title: Head of Agronomy Department

Name: Yoel Tewelde
Professional discipline: Breeding
Institution: DARHRD, MoA
Title: Legume breeder

Name: Dawit Solomon
Professional discipline: Plant protection
Institution: DARHRD, MoA
Title: Pathologist

Name: Omar Jaber
Professional discipline: Soil science
Institution: DARHRD, MoA
Title: Soil scientist

Name: Woldeamlak Araya
Professional discipline: Agronomy, Cropping systems/Crop Ecology
Institution: College of Agriculture, Asmara University
Title: Assistant Professor/Agronomist (Crop ecology)

Name: Nina Lilja
Professional discipline: Agricultural economics
Institution: CGIAR Systemwide Program for Participatory Research and Gender Analysis at CIAT
Title: Senior Scientist

BUDGET REQUESTED FROM CP (in US\$):	US\$ 1,284,252
BUDGET OFFERED AS MATCHING FUNDS (in US\$):	US\$ 763,165
TOTAL BUDGET (in US\$):	US\$ 2,047,417
DURATION OF PROJECT:	5 years (2004 to 2008)

COVERAGE OF BASINS

The project will be located in the Atbara River Basin of Eritrea, which is part of the Nile River Basin, and is populated by about 0.6 million people, 80% of whom rely on agriculture for their livelihood.

COVERAGE OF THEMES

Crop Water Productivity Improvement (Theme 1)	85%
Multiple Use of Upper Catchments (Theme 2)	5%
Aquatic Ecosystems and Fisheries (Theme 3)	-
Integrated Basin Water Management Systems (Theme 4)	5%
Global and National Food and Water System (Theme 5)	5%

BACKGROUND AND JUSTIFICATION

The extent of poverty in Eritrea. Since independence from Ethiopia in May 1993, Eritrea has faced the economic problems of a small, poor country, developing its economy while recovering from a protracted war, and from drought and famine. Eritrea is among the 10 poorest countries in the world, with a GDP per capita at US\$ 160, and a low GDP growth rate of 9.2% (<http://www.worldbank.org/data/>). Two thirds of the population in 1997 (2.2 million people) were estimated to be undernourished, and 40% of children under the age of five were estimated to suffer from malnutrition.

The people and the land. Like many African nations, Eritrea's economy is largely based on subsistence agriculture. Eritrea's population in 2000 was estimated at 3.7 million (FAOSTAT Database, <http://www.fao.org>) with an annual growth rate of 3.8%, and the population is expected to increase by over 30% to 5.1 million by the year 2010. Eritrea covers a total land area of 122,000 km², of which around 61% is classified as agricultural land, but this is mainly under permanent pasture, with only 4% of the total area, or some 500,000 ha, classified by FAO as arable land or under permanent crops. The economy is largely based on subsistence agriculture, with over 80% of the population living in rural areas depending on farming and livestock production for their livelihoods.

The consequences of the war. The protracted war with Ethiopia and the droughts and famines that affected the entire region in the 1970s and 1980s, and more recently in 2002, resulted in major disruption and population movement, especially in rural areas. At the time of independence, approximately 20% of the population within Eritrea was displaced, and substantial numbers were living as refugees in Sudan. The productive base and infrastructure of the agricultural sector have been devastated. The agricultural support network is in a state of disrepair, export crop production is practically nil, food production has dropped to about 40% over the last decade, and the technology base has changed little over the last 30 years.

Crop production. Eritrea lies in the Sahelian rainfall zone of Africa. Rainfed crop production is carried out using traditional methods of cultivation, and constitutes 95% of national crop production. Agriculture is vulnerable to recurrent droughts. Eritrea has three main drainage systems, of which the Mereb-Gash and Tekeze-Setit basins (Atbara basin in the Sudan), belong to the Nile river basin. A sixth of Eritrea's population, or more than 0.6 million people, live within the Atbara River basin (<http://worldbank.org/afr/nilebasin/countries.htm>).

Cereals are the dominant component in the diet throughout the country. Barley accounts for 16% of the total food crop production. Barley and wheat are produced mainly in the highlands

for the local market for staple food consumption. Cool-season food legumes, namely chickpea, lentil, faba bean, cowpea, and grasspea (*Lathyrus sativus*) because of their high protein content (23-26%), provide a major portion of the daily protein requirements. They can be a source of income to farmers since they are valued on the local market, and they can improve the soil fertility through their nitrogen fixing ability.

Technical production constraints. Major technical constraints to crop production include highly variable and erratic rainfall, with recurrent droughts; damage caused by insect pests and diseases; genetic erosion of indigenous landraces; land degradation due to erosion and declining soil fertility; minimal inputs and lack of improved cultural practices and cultivars adapted to local conditions; lack of post-harvest storage facilities; lack of good quality seed; inefficient water distribution systems in irrigated schemes; and insufficient draft animals and cultivation equipment.

Farmer practices. All rainfed crops in the highlands are local varieties established by farmers over generations and adapted to the short growing season. Farmers mitigate the effects of the highly variable and erratic rainfall by using sequential planting, i.e., planting early crops that will take advantage of early rains, and when rains do not arrive early crops like barley are planted at the end of June as well as legumes such as chickpea and grass pea in September. Dry planting is practiced so that the crops can utilize all rainfall. Farmers practice mixed cropping as a risk management strategy against abiotic and biotic stress. Traditional cultural practices contribute considerably to the low agricultural productivity. Seed of local landraces is harvested and saved for next year's planting. The seed is broadcast by hand and is not chemically treated. Weeding is also done by hand. Chemical fertilizers and farmyard manure are not used; the first is too costly and the second is used for fuel.

Institutional production constraints. Institutions that support agricultural technology development and dissemination were greatly affected by the war, as well as by the subsequent low levels of investment in these institutions. The capability of the national system is limited by the lack of human resources, capacity, and qualified technical staff to conduct agricultural research and transfer technologies to the farmers. In addition the linkages between research, extension, and teaching is very poor.

Opportunities for strengthening the agricultural system. There is considerable potential for developing the agricultural sector to address the needs of the farmers and to increase the productivity of water in Eritrea, provided that low-cost farming practices and sustainable production systems are adopted. Participatory approaches are the only viable alternatives to develop these technologies. Eritrea has natural conditions suitable for the production of a wide range of agricultural crops and farmers are keen to improve their technology in partnership with national scientists.

Following the experience developed by ICARDA in farmer participatory research and particularly in farmer participatory breeding approaches (Ceccarelli et al., 1999; Ceccarelli and Grando, 2002), the Department of Agricultural Research and Human Resource Development (DARHRD) has already adopted a participatory breeding approach in Eritrea for barley improvement (Tekle et al., 2000). The response in the farming communities to participatory barley breeding has been enthusiastic, and the first barley lines selected by farmers are under multiplication, which indicates that scaling up the participatory research to include other regions, other crops and management practices has a high probability of success.

In marginal areas, simply “getting the technology right” is not sufficient if the aim is to have lasting impact on people’s livelihoods. Specific attention needs to be paid to ensuring that the technologies will reach the intended users. To effectively exploit the benefit of participatory plant breeding, linkages with decentralized seed production and supply programs are needed from the onset of the project. Therefore, special efforts are essential to scale-up seed multiplication through alternative or additional seed supply systems. The development of alternative seed schemes managed by local enterprises/communities will help to: (i) provide appropriate training in technical seed production; (ii) use selected enterprises to multiply local varieties, selected according to local needs; (iii) link seed demand with seed production at the local level; (iv) reduce overhead, transport, marketing and distribution costs; (v) adopt appropriate seed quality standards that can be adapted to farmers’ requirements; (vi) develop low cost seed cleaning/treatment equipment to improve seed quality at farm level; (vii) ensure technology transfer to farmers to improve the quality of on-farm saved seed; and (viii) introduce promotional and marketing skills that could facilitate rapid uptake of quality seed by farming communities.

This project will develop, together with the farming communities in the Mereb-Gash and Tekeze-Setit basins (Atbara basin) a program for technology generation and transfer to other non-participating communities. A multi-disciplinary and multi-institutional team will be assembled involving the International Center for Agricultural Research in the Dry Areas (ICARDA), the CGIAR Systemwide Program on Participatory Research and Gender Analysis (PRGA Program) convened at the International Center for Tropical Agriculture (CIAT), the Department of Agricultural Research and Human Resource Development (DARHRD) and other departments of the Ministry of Agriculture, the College of Agriculture of Asmara University, and other non-profit development agencies.

GOAL

The development goal of the project is to enhance food security and alleviate poverty for those who need it the most in the Mereb-Gash and Tekeze-Setit basins of Eritrea by strengthening and building the capacity of the agricultural research, seed and extension systems in the use of gender-sensitive participatory approaches to increasing crop water productivity, using low-cost inputs, while minimizing risk and ensuring sustainability of production.

SPECIFIC OBJECTIVES

The specific objectives of the project are to:

1. Identify major stakeholder-defined production constraints in the Mereb-Gash and Tekeze-Setit basins of Eritrea;
2. Develop in partnership with farmers, improved, drought tolerant barley, wheat, chickpea, lentil, faba bean, cowpea, and grass pea varieties and related management practices that will increase the crop water productivity and ensure the sustainability of production systems;
3. Develop in partnership with farmers, sustainable options for an integrated pest management program and for integrated management of natural resources;
4. Develop alternative seed delivery system (linked to participatory crop improvement approaches) to meet the diverse needs of small scale resource poor subsistence farmers and to ensure their access to new improved technologies;
5. Diffuse the improved technologies and management practices to other farmers in the target area;

6. Strengthen human capacity of national program institutions and farmers communities to conduct research;
7. Develop a model, by documenting the project experience and identifying best practices of working with farmers at large scale, for rebuilding post-disaster agricultural research systems.

ACTIVITIES AND METHODOLOGY

The project will be executed through three stages:

- **Participatory research and technology development:** Applied and adaptive research will fill gaps in existing research and utilize the indigenous knowledge available in farmers' communities. This may include new research on specific problems, jointly identified by stakeholders and encountered in the targeted areas or the adaptation of technologies and management practices already developed for similar agroecological conditions. The research will be conducted with the participation of the farming communities both on the research station and in farmers' fields. Farmers will be full partners in technology development with extension and research, with full decision-making power in planning, implementation, monitoring, and evaluation. This implies that farmers', extension agents' and scientists' human capacity and skills need strengthening in order to form a successful partnership. The main objective of the participatory research is to identify and develop new low-cost technologies and management practices that improve productivity and can be readily adopted by smallholders.
- **Participatory on-farm technology testing:** Promising technologies and management practices will be more widely evaluated in farmers' fields under farmers' management in target areas representing a range of agroecological conditions and production systems. The organization, management and supervision of this activity will be discussed between the participating communities, researchers, and extension agents. The primary purpose of these trials is to evaluate packages of technologies and practices under farmers' management and in terms of total system productivity. The trials will be closely monitored to provide data for economic evaluation and feedback for further adaptive research where necessary. They will also serve to demonstrate technological innovations to the wider farming community through the organization of field days during the growing season.
- **Scaling out of the technology options to non-participating farmers:** The technologies and management practices identified in the participatory technology testing in target areas will be disseminated to farming communities who did not participate in the steps 1 and 2, through demonstrations and other media to be further designed and developed with the farmers and extension staff. Farmers' seed fairs will be organized to disseminate new varieties to non-participating farmers. Community-based seed multiplication schemes will be promoted by establishing local enterprises and develop locally manufactured seed processing facilities to assist farmers in the participating villages.

Output 1

Activity 1.1 A partnership meeting will be conducted at the onset of the project to establish the role, responsibilities, and accountability of each partner, and identify additional key partners in the NGO community.

Activity 1.2 Rapid rural appraisals will be undertaken by the full multidisciplinary team in order to characterize the various production systems and identify representative target areas in which

the project activities will be conducted. Four sites will be selected for project implementation to be representative of the target areas.

Activity 1.3 Within each target area, informal and formal (questionnaire) surveys will be conducted to collect qualitative and quantitative data on farm household resources and incomes, their production constraints, production objectives and priorities, and their management practices.

A baseline study of the farming systems is essential in order to:

- a. Identify farmers' resources, skills, production constraints and priorities;
- b. Collect baseline data on productivity, production practices and farm income from the project's target commodities;
- c. Identify external factors, such as markets and policies, which may limit farmers' technology adoption;
- d. Document past experience in technology transfer and farmers uptake of past technologies;
- e. Determine the role of women in the production systems and provide guidelines for addressing gender issues with the project;
- f. Provide the baseline data necessary for evaluating the viability of new and promising technologies and assessing the potential impact of the project on farm households' livelihoods.
- g. Assess current agricultural sector and extension system.

Particular attention will be paid to the role of men and women in agricultural production and post-harvest processing, with a view to identifying potential differential impacts of new technologies to men and women.

Information will be collected on farmers' past experience and perceptions of new technologies, on the role and influence of local institutions (formal and informal) and on national policies with a view to identifying possible constraints to adoption of new technologies.

Production constraints will be prioritized based on the farmers' assessment of their seriousness, and the expected impact on increasing productivity.

The baseline surveys will be used as a benchmark to study the adoption and impact of the project in later stages of the project.

Output 2

Activity 2.1 Identification of indigenous landraces of cereals and food legumes for different agroecologies and uses. In addition advanced lines, segregating populations, and genetic stocks will be introduced from ICARDA. ICARDA will liaise with other centers and/or institutions to procure germplasm for non-mandated crops. The introduction of advanced lines, segregating populations will be reduced with time; from Year 2 new crosses will be designed in consultation with farmers and executed by researchers at DAHRD.

Activity 2.2 Multilocation testing and selection with participation of farmers under stress conditions. Multilocation testing and selection will be an essential component of the germplasm evaluation to identify genetic material with both specific adaptation and stability of performance. In a country like Eritrea, with a large amount of both spatial and temporal variability, parental material, segregating populations, and breeding lines need to be evaluated for their ability to cope with such variability. Material will be evaluated for yield, yield stability, drought tolerance, early maturity, resistance to diseases and pests, nutritional quality, and other attributes identified by farmers and end-users.

Activity 2.3 Screening for tolerance to major abiotic stresses, with particular emphasis on water stress. The efficiency of screening for abiotic stresses will be greatly increased by making larger

use of direct selection under stress conditions. This can be achieved by exposing material to stressed conditions. Selection for water-use efficiency and drought tolerance will be emphasized. It is proposed an increased utilization of the off-season with supplementary irrigation to expose the plants to known levels of moisture stress at precise stages of crop development.

Activity 2.4 Germplasm will be screened for disease and insect pests of economic significance both under controlled field conditions and under farmers' field conditions with the participation of the farmers. As most disease resistance genes may be race-specific, multilocation testing will be emphasized. Sources of resistance for prevailing races will be identified for utilization in the breeding program for the development of resistant cultivars. Similar research has already been undertaken in research networks operating within ICARDA's Nile Valley and Red Sea regional program, and it is expected that the project can rapidly take advantage of existing information and results.

Activity 2.5 Evaluation of advanced material for nutritional and processing quality. All advanced breeding material will be evaluated for nutritional and processing quality. This will be done through laboratory analysis for nutritional quality and other factors that affect end-use (e.g., baking quality of wheat, malting quality of barley, protein level of legumes, anti-nutritional factors), and testing of the material in the preparation of traditional dishes and beverages by rural households. Women play the greater role in food processing, and therefore their participation in these studies is essential in order to identify preferences.

The focus of the germplasm improvement will be on farmers' selection under their own conditions. In the majority of plant breeding programs, only a small fraction of the breeding process takes place in farmers' fields. One of the main consequences is that a large amount of breeding material is discarded without knowing whether it could have been useful in farmers' field conditions. Ceccarelli (1989) showed that for crops grown in environments poorly represented by the research stations, this often results in discarding useful breeding material. A recent example of this danger is offered by the results of a trial with 100 pure lines extracted from local barley landraces conducted in three villages and one research station in Eritrea (Tekle et al., 2000). The ten lines with the lowest grain yield in the research station included six of the highest yielding lines in two villages.

Output 3

Activity 3.1 Agronomic research, using both local landraces and newly developed cultivars, will be conducted to identify appropriate cultural practices, including integrated weed control measures, that will increase crop water productivity, while maintaining soil fertility and minimizing soil erosion. Mixed cropping and crop rotation studies will be established to evaluate the effect of improved practices and cereal/legume rotations on soil fertility, soil moisture, system productivity, and income per unit of land.

Activity 3.2 Systematic disease monitoring will be conducted in the targeted area to determine the significance and geographical distribution of causal agent of fungal, bacterial, and viral diseases.

Activity 3.3 The control of disease and insect pests through crop management practices and/or the exploitation of predators and parasites will be investigated as part of an integrated control approach. These control measures will be incorporated in the rotation trials to be established under Activity 3.1. The farmers' practice of cultivating *Hanfetse* a wheat-barley mixture will be further investigated. Adequate host plant resistance coupled with adoption of appropriate IPM measures will help sustain crop production system.

Activity 3.4 Systematic surveys of field and storage insect pests and their natural enemies, will be conducted, to develop biological and integrated management of serious insect pests.

Activity 3.5 Seed storage facilities will be improved to control storage insect pests in addition to the continued research on identification of harmless material, e.g., neem extracts, oils and salts.

Output 4

Activity 4.1 The weakness, strengths, and opportunities of the existing seed system will be appraised through participatory assessment with farmers, traders, and government organizations in order to identify opportunities and challenges for establishing and strengthening the national seed system and developing other alternatives for dissemination.

Activity 4.2 Seed multiplication will take place with involvement of formal (public or private) and informal sector (local Non-Governmental Organizations, and farmer associations). DARHD will support this process by making (pre)-basic seed available and technical recommendations for seed production.

Activity 4.3 ICARDA's Seed Unit will provide backstopping in technical and financial management of the national seed system for achieving increased cost efficiency of formal and informal seed delivery systems, and recommendations on the establishment of national seed stocks, seed security reserves, and community based seed initiatives. The potential for strengthening the informal seed sector, through multiplication of seed by farmers, will be actively pursued.

Output 5

Activity 5.1 Farmer-managed trials will be closely monitored to provide the data needed to conduct economic evaluations of proposed technologies and management practices. Analyses will include partial budget analysis, cost-benefit analysis at the cropping system level and risk analysis.

Activity 5.2 Surveys of farmers participating in, or exposed to, on-farm trials will provide information on adoption rates and dissemination of production technologies, as well as feedback on possible constraints to adoption.

Activity 5.3 Ex ante analyses using stakeholder defined indicators of the potential impact on systems productivity and farm household income and well-being will be conducted using the data from the baseline survey data, data from the monitoring and evaluation process, combined with projected productivity gains, the economic evaluation of technologies and the expected adoption profile.

Output 6

Activity 6.1 Farmers' field schools will be implemented, by organizing field days and farmers' workshop, with the participation of all stakeholders to observe and discuss project activities and to evaluate project performance. Farmers' communities from outside the project will participate in these activities.

Activity 6.2 Quality seed production requires higher skills and care than grain production. Farmers or farmer groups engaged in local seed multiplication will be assisted (if needed) to develop additional technical skills in production, processing and storage technology to ensure production of good quality seed.

Activity 6.3 Community based seed production could only be viable and sustainable provided there is demand and market for seed produced by farmer groups, NGOs, etc. Farmers or farmer groups will be assisted to develop the necessary skills in business and financial management as well as development of a marketing system/marketing information system to facilitate sale of quality seed produced within and possibly beyond the target area.

Output 7

Enhancement of the professional capabilities of national scientists and extension workers will be an essential component of the project. The activities will consist of:

Activity 7.1 Short term in-country training on gender and participatory research. In-country or regional training will make use of the expertise already available in the region. On-the-job training, a very effective low cost activity to enhance the professional capabilities of NARES, it will be an important component of the project activities.

Activity 7.2 Extension staff will be trained on communication skills to strengthen their ability to involve farmers as true partners.

Activity 7.3 Post-graduate degree training will take place at national and/or international universities in collaboration with CIAT and ICARDA to develop adequate scientific manpower in the field of specialization currently lacking in national programs. Women will be given priority in training programmes.

Activity 7.4 Visits by national scientists to ICARDA, CIAT, and/or other institutions in the region or outside the region for an exposure to the ongoing research programs on project related activities.

Activity 7.5 Regional linkages and cooperation between Eritrea and other countries within the region will be strengthened through participation in the Nile Valley and Red Sea Regional Program activities coordinated by ICARDA.

Activity 7.6 Farmers-extensionists-researchers travelling workshops to discuss, analyse, and evaluate the ongoing activities.

Activity 7.7 The project research results will be published in the proceedings of the annual reports. Presentation of these results will be encouraged in international and regional conferences. Similarly for publications in local and regional periodicals as well as international journals.

Activity 7.8 Relevant reference books and periodicals will be made available to the national program.

Output 8

The improved production packages (drought tolerant varieties and related management practices that will increase the crop water productivity) will be extended to non-participating farmers through demonstrations, pilot production sites and popularization fields in the major production areas of Eritrea.

Activity 8.1 In addition to the direct contact with the farmers participating in the project activities, farmer-to-farmer contacts will be encouraged to extend technologies to large sections of farming communities to have greater impact. Field days involving researchers, extensionists and farmers will be organized each season in the project area where demonstrations/pilot production fields are established. The extension agents, subject matter specialists and other officials involved in the development projects will be encouraged to make full use of the opportunities that ICARDA's program aims to offer for extension of research findings.

Activity 8.2 Leaflets on improved technologies, field guides for extension workers and educational posters to improve farmers' awareness, will be developed, published and disseminated to extension agents.

Output 9

Activity 9.1 A formation of stakeholder committee which will identify indicators to be monitored to assess project progress, as well create a constant feedback loop for project staff to receive input about possible changes that need to be made to approaches applied and mechanisms used in the project.

Activity 9.2 Systematic and consistent assessment and evaluation of project experience with an objective to analyze the lessons learned and to identify best practices for rebuilding the post-disaster agricultural research system. This evaluation and documentation is done by project staff and stakeholder committee according to details described in the monitoring and evaluation section of this proposal.

Activity 9.3 External evaluation of project conducted at the end of year 2 and at the end of year 5, in order to get an unbiased assessment of the best practices and lessons learned, in addition to impact on project intended beneficiaries.

ROLES OF PROJECT RESEARCHERS AND INSTITUTIONS

The project will utilize the experience of ICARDA and the PRGA Program at CIAT in farmer participatory research and particularly in farmer participatory breeding approaches which have already been adopted for barley improvement by DARHRD. One of the key lessons learned through participatory research is that involving stakeholders in the early stages of technology development leads to better targeting, greater sense of ownership, and higher impact. Participation by farming communities will be facilitated by working with the community council, and other local institutions. The project will seek the collaboration of NGOs already working in Eritrea (such as Catholic Relieves Services) to promote Farmers' seed fairs.

ICARDA works through a network of partnerships with national, regional and international institutions, universities, non-governmental organizations and ministries in the developing world; and with advanced research institutes in industrialized countries. ICARDA serves the entire developing world for barley, lentil, and faba bean improvement; and the dry-areas of developing countries for on-farm water management, improvement of nutrition and productivity of small ruminants, and rangeland rehabilitation and management. ICARDA has implemented participatory plant breeding projects in several countries including Eritrea.

ICARDA will be the lead institution of the project, and will provide administrative, logistic, and research support in cereal and food legume improvement, participatory plant breeding, plant protection, agronomy, and seed production and diffusion.

The project leader will follow-up on the implementation of the workplan and activities, play a liaison role between institutions to ensure effective collaboration, be responsible for the finance, administration, and reporting of the project.

The technical input of ICARDA's staff includes the following:

- Contribution to project planning
- Provision of research support in all aspects of the project including design, implementation and analysis of participatory trials; joint evaluation and selection of breeding materials; identification of pests and diseases, and design of disease and pest management strategies;
- Support for formal and informal seed system development activities;
- Provision of germplasm including improved genetic stocks and advanced breeding lines of cereals and food legumes;

- Training at ICARDA and contribution to in-country training;
- Assistance in information dissemination and publication of scientific articles.

The PRGA program at CIAT develops and promotes methods and organizational approaches for gender-sensitive participatory research in plant breeding and on the management of crops and natural resources. Its contribution will focus on several aspects of socio-economic research, with specific contribution to baseline survey, to setting objectives with stakeholders, technology evaluation, and participatory monitoring and evaluation. A strong emphasis will be on local capacity building, through the joint supervision of students, contribution to on-the-job training, in-country courses, and project workshops, and through the joint writing and publication of project results.

The Department of Agricultural Research and Human Resource (DARHRD) will rely on the effort of national scientists to implement the program activities according to the agreed workplan and budget, providing research team, technologies, and available research equipment and facilities. Junior support staff will also contribute to the project. The extension department of the Ministry of Agriculture will contribute to the technology transfer activities.

The College of Agriculture of Asmara University will provide expertise on the development of appropriate crop management practices, including integrated pest and disease management, in particular will lead the research on the *Hanfetse*, wheat-barley mixture. The College of Agriculture will also contribute as a source of trained personnel.

OUTPUTS

The outputs of the project are:

1. Documentation of farm resources, current practices and production constraints that will (i) provide the basis for selection of target sites for field activities and (ii) guide the development of appropriate problem-solving technologies and production practices.
2. Improved drought tolerant varieties of barley, wheat, chickpea, lentil, faba bean, cowpea, and grasspea with higher and stable yields, resistant to the major biotic stresses, and with higher nutritional quality, selected and tested in partnership with farmers, and which have proven farmer acceptability.
3. Appropriate crop management practices, including integrated pest and disease management, developed and tested within cropping systems in partnership with farmers.
4. Appropriate seed systems established which supply farmers with quality seed of adapted varieties in a cost effective and sustainable manner.
5. Socio-economic evaluation of new and promising technologies, adoption studies and ex ante impact analyses.
6. Farmers' skills build up, as related to participatory research and to community based seed production.
7. Strengthened capacity of National Institutions to carry out participatory research and technology transfer, and to monitor and assess the impact of their research.

8. Strengthened linkages between research, seed, and extension departments by working together in cooperation with farmers and farmers' communities.
9. A model which identifies best practices of working with farmers at large scale to rebuild post-disaster agricultural research system.

BENEFICIARIES AND IMPACT

The main beneficiaries of the project outputs will be the 0.6 million farmers and their families who live in extreme poverty and suffer from related malnutrition in the Atbara river basin in Eritrea. They will benefit from the new varieties and management practices.

Farmers, researchers, and extension staff will acquire increased skills to use participatory methodologies for crop improvement. The decision-makers, who will use the results and the methodology of the project to extend it to other crops will benefit in terms of improvement in long-term sustainability of the agricultural research system to address the needs of the farmers they serve.

Other IARC and NARES will use both the methodologies and the knowledge generated by project, especially in terms of best practices and lessons learned for rebuilding the post-disaster agricultural research systems.

ASSUMPTIONS AND RISKS

1. Any participatory project faces risks that some of the events beyond the control of the participants will have adverse effects. The interest of farmers, local communities, and national institutions is assumed. DARHRD has already adopted a participatory barley breeding approach in Eritrea and the response of the farming communities has been enthusiastic in the farming communities. However, the risk of the project failing to meet its objectives due to the non-cooperation or opposition of potentially disadvantaged key stakeholders will be minimised by the use of stakeholder analysis in the preliminary stages.
2. The project requires close cooperation between the participating institutions and between different departments within institutions even if not directly involved in the project. Every effort will be made to ensure that such cooperation will take place, and management structures will be put in place to facilitate this. The project leader will keep close contact with participating institutions to ensure continuous interest in the project.
3. Unexpected weather conditions, such as extended drought or abnormal wet season can disrupt the planned activities. The project will adjust the activities and methodologies to minimize such risks.
4. A risk to consider, even though with a very low probability, is the resuming of the border conflict with Ethiopia. In this rare event the project implementation and completion could be at threat.
5. Human, capital, and financial resources will be available. If the project is funded, the support of the Challenge Program is sustainable.

MONITORING AND EVALUATION PLAN

The monitoring and evaluation plan of this project has the following components:

The project leader is responsible for an evaluation of the progress made towards achieving the set milestones every 6 months of the project. The purpose of this evaluation is to assure accountability of the project and assessment of necessary changes that may need to be considered in implementation of the project.

Financial control will be maintained by ICARDA Finance Department, with experience of managing major projects over many years. They will ensure that contractual obligations are adhered to and auditing requirements met.

In addition, participatory monitoring and evaluation is a basic building block in this project for eventual impact assessment of the project because impact, defined as significant and lasting change in people's lives cannot be deemed to have been a success if the perceptions of those who the intervention aim to benefit diverge from those of external evaluator. The main challenge is how to incorporate these opinions into monitoring and evaluation systems. Therefore, in the onset of the project, a stakeholder monitoring and evaluation committee is formed which will define the indicators to be monitored and the conducts of the monitoring of the progress towards ultimate impact of the project. This stakeholder committee includes farmers, seed traders, researchers and extension staff and it is envisioned they will meet every 6 months to conduct the stakeholder evaluation. National program scientists who will be backstopped by the impact assessment economist from the PRGA program will coordinate the participatory impact monitoring.

The reports of the evaluation committee will form part of the Annual Reporting process of the project, and edited versions will be made publicly available on the project website.

An external evaluation panel will be appointed. Two external evaluations are planned: the first external evaluation is proposed 2 years after the beginning of the project, the second one at the end of the project.

DISSEMINATION STRATEGY

The technologies and management practices identified by the project will be disseminated to non-participating farming communities. The dissemination mechanism will be developed with farmers and extension staff, and one possible option is to organize farmers' seed fairs. Community-based seed multiplication schemes will be promoted by establishing local enterprises and develop locally manufactured seed processing facilities to assist farmers in the participating villages.

The results and conclusions of the project will be disseminated by the production of annual progress reports and a comprehensive final report. Information will be made available to potential end users (especially breeders), the scientific community and the public in general by means of scientific publications and presentations at meetings. The research institutes involved in the project have very close contacts with breeding activities and as a result also close relationships with breeders in private companies and public search institutes. This fact will facilitate a broad spreading of the results through these other channels

To facilitate the communication of objectives to interested parties at a general level a poster and handouts will be prepared describing the project in general terms. Poster and handouts will be distributed among the partners, for publicity purposes. A web page with the same purpose will also be set and placed in the Internet site of all participating institutions. This material will be prepared and distributed during the first six months of the project. The nature of ICARDA and PRGA Program at CIAT, with extensive and closed links with agricultural organizations, will facilitate the dissemination of work throughout developing countries.