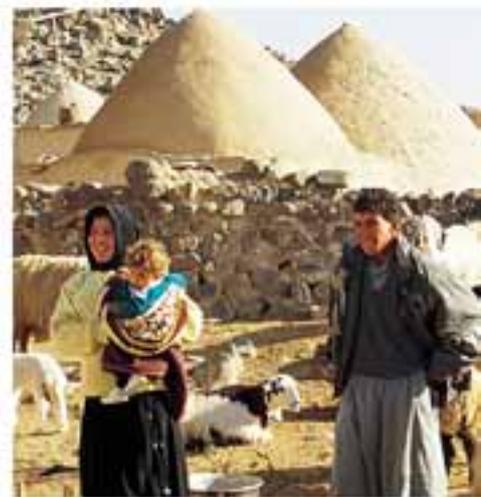


Dryland Cereals

A global alliance for improving food security, nutrition and economic growth for the world's most vulnerable poor



RESEARCH
PROGRAM ON
Dryland Cereals



More than a billion of the Earth's poorest inhabitants live in harsh dryland environments. Dryland cereals are often the only possible crops. About 70-80% of the grain produced in the world is consumed by the poor as food, with the remainder used for feed and other non-food uses. Nearly all smallholder farmers use dryland cereals as fodder in integrated crop-livestock systems.

Led by:



In partnership with:



and public and private institutes and organizations, governments, and farmers worldwide

Vision

The vision of success of the CGIAR Research Program on Dryland Cereals (Dryland Cereals) is to achieve an increase in farm-level crop productivity and total crop production of at least 16% over ten years. In the target geographies of harsh dryland conditions, total grain production will rise by a total of 11 million metric tons to reach a total value of USD 20 billion, along with increases in animal feed and fodder with a value of about USD 10 billion. These food, feed and financial benefits will flow to about 5.8 million smallholder farms and around 34 million total beneficiaries by way of improved food quantity, quality and security, and through cash income generated by off-farm sales into emerging markets for feed, fodder and specialty processed foods driven by the increased urbanized population.



Feeding the forgotten poor

Dryland Cereals focuses on improving the productivity of key cereal crops namely barley, finger millet, pearl millet and sorghum targeted primarily to Low-Income, Food-Deficit Countries (LIFDC) in sub-Saharan Africa and South Asia – but with significant spillover potential to other dryland cereal production ecologies globally.

The targeted regions are home to the ‘poorest of the poor’ living in rural and marginal, often harsh environments characterized by high temperatures, low unreliable rainfall, poor soil fertility and limited market opportunities. Smallholder agricultural systems are based mainly on dryland cereals highly linked to livestock enterprises where almost the

entire crop production is consumed for subsistence as family food and animal feed/fodder.

According to the International Food Policy Research Institute (IFPRI) models, demand for cereals in the target regions is forecast to increase by about 40% by 2020 (over the 2000 baseline), driven mainly by population growth, but also by regional dynamics such as the growing demand for livestock feed/fodder, adverse effects of climate change, and trends toward urbanization of the population.

This overall context presents a prime case for the establishment of a research program to bring together a critical mass of international resources and expertise focused on geography by crop portfolio that would otherwise continue to suffer from neglect and inadequacy of existing in-country resources, and from the inefficiency of uncoordinated, fragmented efforts of individual external agencies. The characterization of the ‘neglected crops in the poorest regions’ presents an exemplary model for the establishment of a Program to:

- Achieve a critical mass of expertise and resources focused on otherwise neglected crops and areas, and to provide a unified channel for individually inadequate and fragmented efforts;
- Utilize the comparative advantage of CGIAR Centers, and other partner agencies, particularly in areas of genomics, phenomics and bioinformatics applied via modern breeding methods; and
- Use the presence and prestige of an explicit international program to lift the in-country profile of inadequately resourced *poor people's* crops – supporting internal infrastructure and human capacity development that will be necessary for lasting implementation.



Focus regions and crops

For reasons of resource allocation efficiency, Dryland Cereals will initially tightly focus its primary efforts in key areas of Africa and Asia using existing CGIAR Center and partner research facilities. However, it is reasonably expected that the mid- to long-term research outcomes, particularly from modern breeding methods, will have wider spillover application in surrounding regions.

The target areas have a population of over 1.5 billion of whom about half are subsisting on less than USD 1.25 per day. Proposed crop improvement products and associated technologies are expected to apply to over 11.8 million hectares in Africa and Asia directly benefiting 5.8 million smallholder households with a total of 34 million beneficiaries (including value chain operators) – via improved food security and nutrition, but also importantly through opportunities to increase cash income by way of off-farm sale of food, feed and fodder to meet the demands of the increasing urbanized population.

Proposed farm-level crop improvement targets will not only address existing requirements for traditional

food quantity and nutritional quality, but also take on a wider range of crop developments to address the emerging opportunities for animal feed and fodder and for diversified new products demanded by the emergent urban population.

In this context the proposed crop focus represents a balanced portfolio encompassing millets which are a mainstay traditional food, but with relatively low technical development; sorghum, also a traditional food and fodder, with moderate technical development; and barley with strong international technical development and potential upside as a cash food, feed and malt crop.

Performance of existing crops in the target regions may be regarded as at least 'hardy' in the harsh conditions – empirically selected over centuries, but possibly within a limited germplasm pool. The resources of the Program will diversify the available germplasm pool and bring to bear the latest breeding methods involving the use of genomics and phenomics, drawing on related international developments already existing from partner programs, particularly in sorghum and barley.

A global partnership

The development and implementation of the Dryland Cereals will be led by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), working in partnership with the International Center for Agricultural Research in the Dry Areas (ICARDA) in a global alliance including key participants in the CGIAR's Generation Challenge Program (GCP) – the Indian Council of Agricultural Research (ICAR); the Iranian Agricultural Research, Education and Extension Organization (AREEO); L'institut de recherché agronomique pour le developpement (IRD) and the Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD) in France; the United States Agency for International Development (USAID)-supported Sorghum and Millet Innovation Lab; and more than 70 other agricultural research and extension programs in Africa and Asia; 15 advanced research institutes (ARIs); 20 non-governmental organizations (NGOs), civil



society organizations (CSOs) and farmer organizations; and 30 private sector companies.

The formation of Dryland Cereals will draw on existing (but currently fragmented) resources and expertise of partners both in basic research and in research for development (for crop/livestock systems, value chain and local macro- and micro-economics); and provide a unified focus and coordinated channel for research and in-region development – importantly gaining efficiencies both in front-end research and in back-end application. The Centers – ICRISAT and ICARDA – will utilize their comparative advantage both in gaining access to diverse but scattered international research, and in providing a unified channel for application where weak in-region infrastructure would otherwise risk being overwhelmed by piecemeal individual programs.



‘Game-changing’ Product Lines

The Dryland Cereals is structured around the development and delivery of seven innovative ‘game-changing’ Product Lines (PLs). Each Product Line has been developed based on a critical analysis of the major constraints in the targeted regions, including the specific needs of subsistence and market-oriented farmers growing the crop. While each Product Line is centered on the strengths of the Program partners in crop improvement, it is recognized that improved cultivars alone cannot overcome limitations on yield and thus, each has been structured to include an entire production package.

- PL1. Supporting farmers’ transition from subsistence to market orientation with productive, nutritious, photoperiod-sensitive sorghum production packages for multiple uses in West Africa
- PL2. Improving food security for subsistence smallholder farmers in East and West Africa with productive and nutritious pearl millet food and fodder production technologies
- PL3. Drought tolerant, highly productive multi-use sorghum varieties for food and processing uses in the dry lowlands of East Africa
- PL4. Improving nutritional security with productive and nutritious finger millet production technologies for East and Southern Africa
- PL5. Multi-purpose barley production technologies to meet food, feed and fodder demands in the driest regions of Africa and Asia
- PL6. Improving food security and incomes with productive and nutritious multi-purpose pearl millet hybrid production technologies for East Africa and South Asia
- PL7. Multi-purpose post-rainy season sorghum hybrid production technologies for improving food and fodder availability in the driest regions of South Asia

These Product Lines represent ‘the what’ that the Dryland Cereals will produce over the ten-year period. Five Strategic Components (SCs) or ‘the how’ will effectively develop and deliver each Product Line, with a priority ranking firstly on the comparative advantage of the Centers and international partners in modern breeding methods to address abiotic and biotic production stresses and output quality traits, followed by a range of systems management options for sustainable crop/livestock production. Integrated across all activities will be a focus on human capacity development of young scientists and local/regional institutions to ensure sustainable implementation.





Strategic Components

- SC1. Assembling and making accessible data and knowledge for better targeting of dryland cereal technologies to enhance their adoption by smallholder farmers for updated and more detailed data collection and analysis to stay abreast of the dynamics of population movements and potential climate change; and to provide a baseline and monitoring capacity for on-going governance of the program.
- SC2. Developing improved dryland cereal varieties and hybrids for increased grain and stover yield, quality and adaptation in smallholder farmers' fields to rapidly improve cereal crop varieties for increased, sustainable yield and for a range of quality traits for food, feed and fodder applications, including emerging opportunities driven by population dynamics.
- SC3. Integrating sustainable crop, pest and disease management options, and enhancing crop-livestock integration, to capture genetic gains from improved varieties and hybrids to capture and deliver genetic gains in farmers' fields
- SC4. Promoting effective seed dissemination for better delivery of improved cultivars to smallholder farmers to enable improved delivery and adoption of new technology packages.
- SC5. Promoting post-harvest value addition and market access to enhance income of smallholder dryland cereal producers to improve smallholder income beyond mere subsistence.

Regional in-country human capacity development will be integrated across all Product Lines and Strategic Components including provision for degree and non-degree level training, workshops and conferences, and the development of distance learning products. Special efforts will be made to strengthen and empower extension staff and NGOs at the grassroots level. Training programs will reflect a back-to-basics approach to offset current deficits in skilled personnel for conventional breeding, agronomy, crop protection and farming systems. All capacity development activities will have due regard to gender equality, recognizing the key role of women along all levels of the crop value chain.

Working within a unified CGIAR system

Internally within the CGIAR, Dryland Cereals will have clearly distinguished specific crop objectives but very strong development and implementation linkages with several other CGIAR Research Programs – notably with the CGIAR Research Program on Dryland Systems (Dryland Systems) to better combine the optimum genetic and management options; and with the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) to ensure the development and availability of climate change-ready crop options.

Implementation will also include linkages with other programs including the CGIAR Research Program on Policies, Institutions and Markets to address deficiencies in marketing systems; on Wheat (WHEAT), Maize (MAIZE) and Rice (GRiSP) to exchange information on genetics and breeding methodologies; on Grain Legumes to optimize cereal-legume systems; on Livestock and Fish to develop more suitable feed and fodder crop varieties; on Agriculture for Nutrition and Health (A4NH) to improve nutritional traits of cereals; and on Water, Land and Ecosystems (WLE) to improve sustainable water use.

The major innovation of the Program will be to access and apply recent advances in genomic and phenomic technologies and modern breeding methods in otherwise neglected areas. Overall the objectives and

activities of the Dryland Cereals may be regarded as falling into a hierarchy of:

- Utilizing the comparative advantage of the Centers, and international partners, for access to and implementation of modern breeding methods for crop improvement, including heterosis;
- Partnerships with in-country agencies and linkages with other CGIAR Research Programs to integrate genetic gain within farm-level implementation of optimum farming systems; and
- Linkages with other Programs and other agencies to address wider issues of in-country infrastructure relating to communications, extension, and seed distribution – leading to improved farmer adoption and market access.

The success of Dryland Cereals will contribute primarily to three CGIAR System Level Outcomes (SLOs): SLO 1, reduced rural poverty; SLO 2, improved food security; and SLO 3, improved nutrition and health. In addition, since dryland cereals are already efficient users of soil water and nutrients, the expansion of cereals alone, more particularly in cereal/legume systems, is expected to optimize crop production without undue reliance on artificial nitrogen fertilizer inputs. It will also lead to a balance of increased production while minimizing the risks of environmental degradation to achieve sustainable management of natural resources (SLO 4), especially in view of the projected effects of climate change.

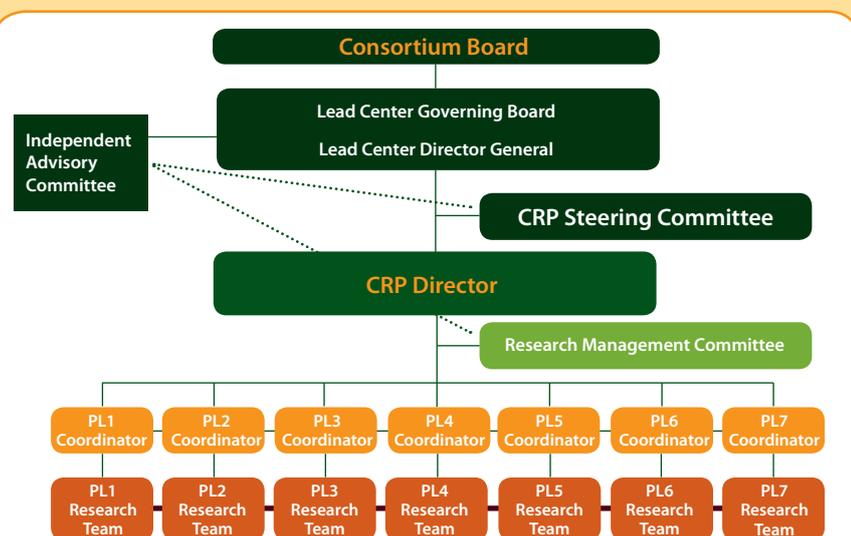
Structure, management and governance

Administratively the designated lead Center for the Dryland Cereals will be ICRISAT, working with ICARDA and a wide range of partner organizations. ICRISAT have signed a Program Implementation Agreement with the CGIAR Consortium and, through its Director General, will have overall responsibility for fiduciary and legal matters and performance accountability for the program.

Monitoring and feedback mechanisms for the Program will conform to the principles and standards now being developed by the CGIAR Consortium. *Ex ante* assessments will be conducted during the project development stage, followed by periodic monitoring studies during implementation. Feedback loops from these studies, and from on-going relationships with partners, will be used for continuous program improvement. Formal

reports will be available to the program management and governance structures.

Direct management will be via appointment of a newly recruited Dryland Cereals Director (dedicated position, reporting to the Director General of ICRISAT), who will lead Product Line research teams headed by Product Line Coordinators. An Administrative Officer and a Communications and Information Manager will support the Dryland Cereals Director.



The Dryland Cereals Director and Product Line Coordinators will form a Research Management Committee (RMC), together with senior designates from each key partner organization, altogether selected to ensure effective regional representation. The RMC will be the key entity responsible for establishment, implementation, monitoring and communicating of the research portfolio, strategy, work plans, annual budgets and reports.

At a governance level an 'Independent Advisory Committee' will be formed to provide periodic input and advice to the ICRISAT Governing Board on the direction and quality of the research portfolio, priority setting and resource allocations. The Independent Advisory Committee will be composed of five to six independent R4D experts with relevant experience and expertise in the field, including representatives from key sub-regional fora and NARS in Dryland Cereals.

The **budget** for the first three years of Dryland Cereals has been developed following guidelines from the CGIAR Consortium for Window 1 and 2 funding and with existing bilateral funding for ICRISAT, ICARDA and GCP. The budget for actual research activities represents 95% of total expenses, built up from projected research costs for each Product Line.

Costs for management and administrative overheads for the Dryland Cereals have been kept to 5% of total expenses – including salaries, travel and operations for the Dryland Cereals Director, seven part-time Product

Line Coordinators, the Program Management Unit, and meeting and honoraria costs for the Independent Advisory Committee functions.

Gender strategy: Dryland Cereals recognizes the importance of gender in target geographies where women frequently have key roles in crop and livestock production. Crop activities such as harvesting, storage (including the commodity and its seed portion), processing and use (including marketing), and livestock such as feeding, milking, birthing and animal health care are activities where women often have a decisive role. Each Product Line and Strategic Component will include gender-differentiated activities and outcomes specifically targeted to address equitable inclusion of women along the entire value chain, and will investigate the full integration of women in enterprising in seed, other agricultural market services, and value added uses of the raw commodity products, especially when the use of the commodity is for food.

Prior lessons: Adoption of improved dryland cereal technologies has previously been limited by poor farmer access to seed and to management information. The Dryland Cereals, with partners, will give particular attention to distribution of seed in smaller affordable packages, and to strengthening of extension services.

Dryland cereal farmers' crop adoption decisions take account of multiple end-uses, strong consumer food preferences and the evolving market dynamics for feed and fodder – presenting a complex of multiple crop traits beyond a simplistic objective of 'higher yield' that is yet to be well understood by researchers.

Hybrids are proving viable and economically attractive to farmers and seed producers in certain areas (notably India) and application of heterosis offers wider potential in Africa as well.

Genomic and phenomic technologies and related modern breeding methodologies have advanced rapidly in recent years. Accessing new germplasm and leveraging existing international expertise offers potential to rapidly transfer technology for accelerated gains.

IP management: The Dryland Cereals IP management will be driven by CGIAR Consortium principles. As the Program will work with a wide range of external partners, particular agreements will have to be developed to merge each party's interests, without compromising CGIAR principles.

Essentially, IP arising from the Program will be made available globally and publicly. Germplasm will be exchanged under the Standard Material Transfer Agreement (SMTA).





Knowledge management and communications:

Knowledge management encompasses a variety of strategies and practices to create, identify, represent, distribute and enable adoption of new results, insights and experiences. Effective KM systems do not just happen; they require expert development and implementation.

The Dryland Cereals will have a dedicated Communications and Information Manager who will help develop policies and practices, with its partners, to ensure effective dissemination of new information – with the guiding principle of furthering the objectives of the Program.

Risk management: The Dryland Cereals will engage with a range of partners across a broad sweep of geography and will face risks from several externalities beyond its immediate control – such as, drought, famine, political upheaval and civil unrest – which will be avoided or dealt with when they occur.

Internal risks of scientific or administrative competence will be safeguarded against in the first instance by the proposed structures of the Research Management Committee (for science management) and the Independent Advisory Committee (for oversight governance) reporting to the ICRISAT management and Governing Board.

A potential new risk arises from the size and complexity of the wide-ranging partnership arrangement, where ICRISAT (as Lead Center) will develop and nurture the goodwill of all parties but will not have direct management 'control' of partner priorities or activities. ICRISAT and the Dryland Cereals Director will allocate significant resources to 'internal' communications and to on-going promotion of 'team spirit' with ownership and accountability for agreed objectives and activities. Doing so may have an increased transaction cost but will mitigate against backsliding. ■



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www.drylandcereals.cgiar.org

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