



RESEARCH
PROGRAM ON
Dryland Cereals

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

CRP Commissioned External Evaluation of the CGIAR Research Program on Dryland Cereals



Evaluation Report

Volume 1

January 2016

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List of Abbreviations

A4NH	Agriculture for Nutrition and Health (CRP)
Africa RISING	Africa research in sustainable intensification for the next generation
AIP	Agribusiness Innovation Platform
AREEO	Agricultural Research, Education and Extension Organization, Iran
ARI	Advanced Research Institute
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
BMS	Breeding Management System
CA	Cluster of Activities (Formerly Product lines)
CERASS	Centre d'Etude Régional pour l'Amélioration de l'Adaptation à la Sécheresse Senegal.
CCAFS	Climate Change Agriculture and Food Security (CRP)
CCEE	CGIAR Research Programme Commissioned External Evaluation
CGIAR	Consultative Group for International Agricultural Research
CORAF/WeCARD	The West and Central African Council for Agricultural Research and Development
CRP	CGIAR Research Programme
CWANA	Central and west Asia and North Africa
DCLAS	Dryland Cereals and Legumes Agrifood Systems
DH	Double haploid
DIIVA	Diffusion and Impact of Improved varieties in Africa Project
Dryland Cereals	CGIAR Research Programme on Dryland Cereals
EC	European Commission
ESA	East and Southern Africa
FP	Flagship
FWCI	Field-weighted citation impact
GCP	Generation Challenge Program
GDP	Gross Domestic Product
HOPE	Harnessing Opportunities for Productivity Enhancements Project
HPRC	Hybrid Parent Research Consortium
HQ	Headquarters
IAC	Independent Advisory Committee
IBP	Integrated Breeding Platform
ICAR	Indian Council of Agricultural Research
ICARDA	International Center for Agricultural Research in Dry Areas
ICRISAT-	International Crop Research Institute for the Semi-Arid Tropics
IDO	Intermediate Development Outcome
IEA	Independent Evaluation Arrangement
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IPG	International public goods

IPM	Integrated Pest Management
IPR	Intellectual Property Rights
ISPC	Independent Science and Partnership Council
MAS	Marker Assisted Selection
M&E	Monitoring and Evaluation
NARIs	National Agricultural Research Institutions
NARS	National Agricultural Research Systems
NASARRI	National Semi-Arid Resources Research Institute, Uganda
NRI	Natural Resources Institute, University of Greenwich, UK
OPV	Open Pollinated Variety
PIM	Policies, Institutions and Markets CRP
QDS	Quality Declared Seed
R4D	Research for Development
SA	South Asia
SLO	System Level Outcome
SMU	Sorghum for Multiple Uses Project
SNPs	Single nucleotide polymorphisms.
SPIA	Standing Panel on Impact Assessment (sub group of the ISPC)
SRF	Strategy and Results Framework (CGIAR)
SSA	Sub Saharan Africa.
USAID	United States Agency for International Development
USD	United States Dollar
WCA	West and Central Africa

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EXECUTIVE SUMMARY

Background

This external evaluation of the **CGIAR Research Programme on Dryland Cereals** (hereafter referred to as **Dryland Cereals**) was conducted with quality assurance support and advice from the Independent Evaluation Arrangement (IEA). It is intended to provide accountability for the progress of the CRP and to generate lessons and recommendations to enhance management decision making and program improvement, and to contribute to the design for the second phase of the program. The main stakeholders and audiences of the evaluation are the management and governing bodies of Dryland Cereals, the CGIAR Fund Council and Consortium Board, the Independent Evaluation Arrangement, the Lead and Partner Centers and Dryland Cereals' research and development partners.

The Dryland Cereals started in July 2012. It is a global partnership between the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) which is the lead center, and the International Center for Agricultural Research in Dry Areas (ICARDA), together with other public and private institutes and organizations, governments and farmer organizations.

The Dryland Cereals vision is for improved food security, nutrition, income and resilience of smallholder agriculture in the dryland regions of Africa and Asia, through the collaborative development and deployment of solutions for four dryland cereal crops - barley, finger millet, pearl millet and sorghum. The initial structure of the CRP was based on seven product lines, defined by crop and region, and five strategic components. For the extension phase (January 2015 to December 2016), the strategic components were renamed as five flagship projects, with an integrating function across the crop/region axis. These flagships or thematic research areas constitute a delivery pipeline from improved varieties and hybrids to crop management, seed systems and post-harvest value addition, underpinned by priority setting and adoption. The flagships were linked with the intermediate development outcomes. Dryland Cereals is the smallest of the 15 CRPs in terms of funding. Windows 1 and 2 as a proportion of the total budget for the extension phase was 39%¹. Beyond the extension phase, there is likely to be a major reconfiguration of the Dryland Cereals CRP for phase 2, involving elements of combination with other CRPs, such as Dryland Cereals and Grain Legumes.

Scope and design

The evaluation assesses the extent to which the planned outputs and outcomes of Dryland Cereals have been achieved since its establishment. The evaluation is primarily formative, but also takes into account evidence of the results of research prior to the establishment of Dryland Cereals. Five broad evaluation criteria are used - relevance, quality of science, effectiveness, efficiency, and impact and sustainability. Three cross-cutting issues, gender, capacity strengthening and partnerships are considered across the Dryland Cereals flagships. A framework was developed to guide the evaluation, with detailed sub questions, data sources and methods for each criterion. The main tools used were review of Dryland Cereals documentation, interviews and meetings with flagship and crop cluster

¹ With recent budget cuts of around 32% the proportion of Windows 1 and 2 has had a further significant reduction.

leaders, research teams and partners, on-line surveys of scientists and partners and discussions with development partners, private sector actors and farmers.

The evaluation covers the four crops of the Dryland Cereals across different countries and regions. Countries selected for field visits covered the range of crop research and research leadership. For barley, these were India, Morocco, and Ethiopia. ICRISAT's East and Southern Africa Regional center in Nairobi was chosen as a convening point for researchers from Uganda and Tanzania while researchers from Mali and Niger were met in Senegal.

Relevance of Dryland Cereals

Dryland Cereals objectives and design are strategically coherent and consistent with the main goals and strategic level outcomes presented in the CGIAR's Strategy and Results Framework SRF (2016-30). Dryland Cereals research is important for increasing choice and resilience in farming systems in the face of climate variability; it is developing new crop varieties and better management practices for improving productivity and profitability, to address poverty and offer significant nutritional advantages, especially for vulnerable groups. Participatory approaches in technology development help to tailor technologies to different needs. Effective seed systems can provide access to new varieties, while post-harvest knowledge systems and value chains provide the market incentives that ensure adoption, develop safe and nutritious products and contribute to improved nutrition and health. Research on priority setting and adoption provides understanding of the changing regional contexts for Dryland Cereal crops and tracks outcomes and impacts. Gender is a cross-cutting issue across all research areas.

A relatively high proportion of Dryland Cereals resources (37% of 2014 budget) is allocated to Crop Improvement research. However, different regions vary in their capacities to implement the research. India has a strong national agricultural research system with well-equipped national research stations and an expanding private sector seed system which is not dependent on international public finance. Africa, and particularly West Africa, has weaker national research systems in terms of staff, facilities and resources, and a much less developed private sector. There are also challenges to recruitment of staff. Budgets are allocated under each Flagship so it is difficult to assess the proportion of the total which is allocated and transferred to different regional operations. The potential for Dryland Cereals research conducted in India to benefit Africa has been somewhat constrained by obstacles to germplasm transfer from India to other countries. However, recently a solution to this blockage has been reached. For all crop clusters, but particularly sorghum and pearl millet in West Africa and India, a clear strategy and mechanisms are needed for reaching beyond the existing focal countries.

The Dryland Cereals CRP has provided a focus for collaboration with the private sector, producing and giving access to hybrid parental material with demonstrable yield advantages over open pollinated varieties and through new product and market opportunities and seed systems. However, further information on the performance of hybrids for African smallholders across different resource endowments, including in the most marginal areas, would provide the rationale for deciding on the proportion of resources devoted to hybrid technology development for Africa. This includes the benefits, costs and risks of investment in hybrids for low input small producers in marginal areas.

The rationale behind the development and targeting of crop management/NRM research, including work on mechanization and conservation farming, could be further elaborated showing the extent to

which the level of technology is appropriate for the socio-economic status and access to resources of the target communities. The production objectives of different farmer categories are important in influencing acceptability; for more market-oriented farmers, efficiency and cost effectiveness are important, which reinforces the need for economic analysis of input packages.

The Flagship Projects follow a logical pipeline which constitute an impact pathway, however, the flagships 'downstream' from crop improvement depend upon the effective operations of national agricultural research systems and development partners. National institutions, their capacity and partnership with Dryland Cereals CRP are strong for India but less so for Africa. Bilateral projects target downstream activity and therefore fit well with the Dryland Cereals strategy. Improving information flows and learning across the flagships is needed, both within and across regions. This will assist in priority setting as well as efficiency.

The combination of the four crops included in Dryland Cereals makes a coherent program. They are all 'resilient' crops, providing food, and feed and fodder for livestock. The research tools are largely the same and they share much of the research agenda under crop management, seed systems and post-harvest. Barley and sorghum are important for their multiple uses, including as raw materials in the growing commercial brewing industries. Barley research under Dryland Cereals has been mainly towards feed, food and forage, while malting research has been supported by bilateral projects mapped to the CRP, involving a private-public partnership in efforts to popularize malt barley. It is important that relative balance of barley and sorghum research among food, feed/fodder and malt needs is kept under review to ensure primary benefits accrue to smallholders and where public /private initiatives are involved, a clear justification is made for support in their initial stages.

The Centers participating in Dryland Cereals were already doing high quality research for crop improvement prior to the CRP, but the CRP has reinforced a focus on outcomes and encouraged further collaboration with other initiatives, the private sector and national research and development agencies. It has added value to previous dryland cereals research by convening new partnerships and activities across regions and crops to address integrated value chains.

1. **In view of disparities in regional research capacity, Dryland Cereals' relevance to Africa could be boosted by reviewing priority setting and actual resource allocation** for regional research activity clusters and flagships. It is suggested that this review be conducted by Dryland Cereals management and flagship leaders with advice from the steering committee. It could consider increasing support for development of facilities and staff in areas which have the potential to deliver benefits to large numbers of poor farmers in the driest areas, for example, the pearl millet and sorghum work in West Africa.
2. **In planning research to be conducted under the flagships, it is recommended that the CRP management and flagship leaders consolidate evidence linking the level of technology to be developed and promoted, to the resource level of target communities.** This might include:
 - Generating further information on the performance of hybrids (costs, benefits and risks) for African smallholders across different resource endowments in order to develop a rationale for the proportion of resources devoted to hybrid technology development for Africa and more precise targeting.
 - Developing complementary strategies which match technologies to producer and consumer requirements and resource levels e.g. multiple uses for food and livestock feed

or varieties for a specific market requirement; suitability of conservation farming for areas with different human and natural resource endowments.

Quality of Science

Since its inception, Dryland Cereals has built on the well-established breeding programs of ICRISAT and ICARDA. Research and breeding have been productive in developing adapted germplasm for the four crops, introgressing useful traits such as performance under low input and stressed environments for millets and feed quality for barley. Significant advances have been made in developing good parental material for hybrid pearl millet and sorghum breeding by public and private agencies. There has been significant documented progress in research on physiology and development of resistance to major abiotic and biotic stresses affecting the four crops, including resistance to Striga. Molecular techniques have been used with a view to developing marker assisted selection (MAS) systems for some principal stresses, and also for characterizing germplasm. With respect to crop and natural resource management, good quality, appropriate research is being done, for example, on fertilizer micro-dosing, which is also a 'poverty-friendly' technology.

The evaluation team found that research and breeding design and approaches are generally appropriate, but not always sufficiently methodologically up-to-date, particularly with respect to data collection and analysis. The application of modern breeding methods, including molecular techniques, differs according to crop and region. A serious constraint to modernization of the breeding programs is that computerized field-books and electronic data capture, although used in some areas, have not become standard, particularly in sub-Saharan Africa.

Regional differences were observed in facilities and staff available for Dryland Cereals work, linked to differences in the resources and capacities of the constituent NARS. This affects the science done and the potential to write high quality publications. Science quality could be enhanced by CRP management further promoting regular scientific exchange and networking within and across regions. Regional testing of germplasm and technologies could be usefully expanded to ensure that breeding efforts do not become too narrowly focused on local problems and constraints.

Increasing the emphasis on research and production of hybrid parental material is justified given the demonstrated yield advantages over open pollinated varieties at many sites, but the limitations need to be clearly understood. It is important that positive and negative results on use of pearl millet and sorghum hybrids in comparison with local varieties in specific locations are clearly presented, to provide guidance and feedback to breeders. It is important that both 'positive' and 'negative' findings with respect to technology performance, together with economic analysis, are published.

Regarding publications, the evaluation team drew on two recent analyses by Elsevier of published outputs from CGIAR centers and CRPs as evidence of the publication track record and CRP research performance. The publication performance of ICRISAT and ICARDA prior to the CRP (2003-2012) was average compared with other CGIAR centers for agricultural and biological science outputs. Both were above world average. Despite its later start, Dryland Cereals CRP performed well in terms of the volume of publications (146 publications from 46 researchers for 2012-2013) and was above the world average as gauged by field weighted citation index. Dryland Cereals researchers published in recognized international journals, but also in journals and fora that arguably lack adequate peer

review. Over two thirds of Dryland Cereals publications listed for 2014 are on crop improvement, while social science related topics and crop management each accounted for about a fifth.

The evaluation team noted a difference in the number of publications coming from different regions. Further collaboration and co-publishing with external partners and researcher exchange with partner organizations, including universities, especially in ESA would help Dryland Cereals' scientists to gain international recognition. Overall, the publications record could be strengthened in terms of more publications in high impact journals, more balanced representation from the different regions and increased numbers of social science publications.

In its field visits the evaluation team observed the high level of competence and dedication of Dryland Cereals breeders and scientists. However, relatively little disciplinary integration of CRP activities was observed. There is a shortage of staff working in the CRP with a background in agronomy and it is hoped that the forthcoming Phase II restructured CRP will help to facilitate this. A stronger research and policy contribution of social scientists across all regions, particularly linked with the breeding research and research on end-use would help to ensure that efforts are better directed to the needs of dryland farmers and markets for dryland cereal products, including those for grain, seed, feed and forage.

Most scientists working in Dryland Cereals CRP consider it to be effective in ensuring the quality of research. Important incentives for high quality scientific work lie in recognition by peers, management and the public. The evaluation team encourages the CRP scientists to make increased use of the expertise of members of the Dryland Cereals CRP advisory committee.

3. **The application of modern breeding methods, including molecular techniques, has untapped potential.** Modernization is needed in terms of data collection and sharing, storage and accessibility, using computerized field-books and electronic data capture.
4. **Further effort in regional collaboration, exchange and data sharing** is recommended in order to leverage research outcomes within national agricultural research systems, particularly on hybrid sorghum and pearl millet, encouraging private sector collaboration where possible. Increased researcher exchange with partner organizations, including universities and better cross-regional collaboration would help to improve the quality of science and encourage production of publications, (including social science and crop management publications) particularly from underrepresented regions.
5. **Strengthening of disciplinary integration of CRP research activities** could add greater value to the research and its products and make the most of potential synergies. Closer integration of social science and policy research and agronomic skills in all regional teams would better direct efforts to the needs of dryland farmers and diverse markets.

Effectiveness

Dryland Cereals CRP is delivering useful outputs from both new and past research. Most of the targeted outputs in the original logframe have been delivered, although there are some gaps, particularly for seed systems and for post-harvest work. Nevertheless there have been some innovative approaches in developing local seed systems in West Africa and working with the private sector seed system in India. Dryland Cereals has enhanced its potential for development impact

through designing the program to link to bilateral projects which have compatible objectives. At this early stage of the Dryland Cereals CRP it is difficult to assess the overall extent to which outputs are delivering the planned outcomes, however there are many positive indications.

On priority setting and adoption, strengths were in designing and conducting socio-economic research and tracking adoption, while weaknesses were the near-absence of an effective M&E system and limited country researchers' involvement in strategy and planning processes. Country level engagement in planning research with multiple stakeholders could facilitate country level conceptualization of the theory of change and harmonize the work of the CRP with on-going and planned efforts of existing and new national partners. Baseline studies were conducted for different crop-country combinations to identify gaps and facilitate priority setting. Some clearly influenced planning and gender focus; funding constraints delayed others which were then too late to feed into the program planning cycles. The different study designs made comparison and consolidation difficult. Participatory approaches and long-term partnerships with farmer organizations developed over the past years have contributed significantly to priority setting, especially in West Africa. The contribution of social scientists based in East Africa has been considerable, but a stronger contribution is needed in other regions.

The planned outputs on improved varieties and hybrids have been largely achieved. Improved germplasm of the four cereals has been produced targeted at different uses (food, feed, fodder, malt etc.). Crop management research has produced results on fertilizer micro dosing which has enabled a yield response, and on weed and pest and disease management. The restructuring of Dryland Cereals in Phase 2 and a possible combination with Grain Legumes and Dryland Systems could provide the opportunity to encourage a stronger systems orientation to crop management.

Seed systems and input services development has progressed well, especially where it has been implemented through existing partner and stakeholder networks. Most planned outputs were completed for seed production and dissemination, but with limited resources, less work was done on seed regulation and policy. Access to new varieties has been stimulated through sales of seed in small packs. Post-harvest value and output markets research had ambitious targets considering the limited previous focus and skills in this area, but collaboration with partners has produced research results on dryland cereals nutritional qualities, shelf life of millet flour, processing equipment and product development in all regions. New barley products and enterprises have been developed and research on malting quality conducted in collaboration with the private sector.

Currently, the work programs in Africa are hampered by poor linkages with the research in Asia, particularly regarding germplasm exchange, information exchange and data sharing, and difficulties in getting germplasm out of some countries, including India. West Africa is disadvantaged by its distance from the Dryland Cereals management. They would benefit from more support and resources, although they are doing effective work. The lack of a culture of sharing information and data from the center to the periphery is perceived by ICRISAT scientists as having frustrated regional work and 'created artificial boundaries'. Plans for extending research results and technologies beyond the CRP focal countries to other outreach or 'spillover' countries were not always clear, particularly for sorghum and pearl millet.

With a few exceptions, the level of collaboration between Dryland Cereals and other CRPs is low, although there has been some work with A4NH on nutritional content, with PIM on value chains, with

Livestock and Fish on fodder quality and collaboration initiated with Dryland Systems at their action sites. Partnerships with national and international agencies (who are often the same as for other CRP's especially Dryland Systems and Grain Legumes) represent a key feature of Dryland Cereals and further exchanges among researchers focusing on the same crops could increase the efficiency of the breeding programs.

6. Effective implementation of the delivery pathway would be enhanced by a greater emphasis on country-level engagement in planning and implementation of research consistent with national policies, and in innovation and adoption, involving scientists, research and development partners, agricultural service providers, farmer organizations and private sector actors to produce integrated plans across all flagships.

7. Greater emphasis on scaling up and scaling out research results to policy makers and to a broader target group of outreach/spillover countries (beyond existing focal countries) would extend the results of Dryland Cereals research. The evaluation team suggests that:

- Dryland Cereals management and flagship leaders develop a **clear strategy for engagement with other countries** through relevant partner organizations
- Greater **efforts in information sharing, interaction and influence at the policy level** would help to create conducive conditions for dryland cereals, for example, on seed policy and incentives for seed companies, on expanded farmer seed production and semi-formal seed systems such as Quality Declared Seed.

Efficiency

The parallel management structures of Dryland Cereals CRP and the management of the ICRISAT Center Dryland Cereals research program have created confusion and inefficiency. The respective management roles, responsibilities and lines of authority are not clear. This results in duplication of efforts, confused reporting lines and information flow and uncertainty over budget allocations. The CRP Director has responsibility for vision and intellectual leadership of the CRP, but does not have authority to manage resources for implementation, nor a role in performance assessment of output delivery. ICRISAT as the lead Center is accountable to the Consortium for the use of the W1/2. These management issues could be addressed if there were clearly defined and agreed roles and reporting lines for those involved in CRP management. The overlap in nomenclature should disappear with a newly-named Phase II combined CRP.

At the start of the CRP, Centers were under the impression that there would be less need to look for bilateral funding. Currently around 80% of CRP funds are used to cover salaries and maintain basic research and breeding efforts, while most other operational money depends on bilateral projects. Researchers highlighted the unpredictability and uncertainty of W1/W2 funding which affects their working conditions and motivation. Budgets allocated to partners are in most cases, small which affects NARS partners' ability to engage in research and value chain development. Funding allocation on an annual basis and often not at the right time to implement field activities discourages engagement in the longer term development of impact pathways.

Facilities and services are efficiently used by Dryland Cereals and some are used by the NARIs. Facilities in NARIs differ according to region. It is important that the weaker areas be prioritized to try and bring all facilities up to a minimum required standard, particularly those in West Africa.

The issues concerning monitoring and evaluation (M&E) are well recognized by Dryland Cereals Program management. Dryland Cereals is lacking a coherent M&E system that facilitates monitoring of progress against output targets. At present, non-performance can remain hidden in aggregated data and significant examples of progress and lessons may be missed. CRP phase-2 brings the opportunity to develop a more coherent M&E framework and also incorporate robust design of impact research. This framework could link with CRP research plans at country level and inform the design of baseline studies, data collection analysis and reporting. The development of a M&E data base system would facilitate tracking the delivery of research outputs and reporting. An important dimension is sharing expertise and learning on best practice in monitoring and evaluation across the program. There is limited synergy from cross-fertilization of ideas and sharing of research methods and results across crops/regions and partner Centers. Improved efficiency will result from sharing of knowledge and resources among researchers and partners contributing to this CRP. ICRISAT has several platforms that Dryland Cereals can leverage to benefit smallholders in other regions, e.g. the Hybrid Parent Research Consortium and the Agribusiness Innovation Platform in India. It is important that during the merged CRP second phase, these initiatives are tested and replicated more widely.

Dryland Cereals has done good work in knowledge dissemination on varieties and crop management solutions through innovative communication, such as using video in Mali, but would benefit by building on its distinct identity as a consortium of partners delivering an integrated program. There is a need to clearly establish the respective communication roles and responsibilities of Dryland Cereals and the lead Center which produces the excellent ‘Happenings’ series, which incorporates stories related to Dryland Cereals, but not across the consortium.

8. **A clear definition of the roles and responsibilities** of the CRP Director vis a vis program managers in the Lead and partner Centers would help to improve efficiency and effectiveness. An important element to consider is the empowerment of the CRP Director with an increased role in the management of the planning, delivery and quality of CRP outputs and outcomes. Duplication of effort could be avoided by streamlining and standardizing reporting formats.

9. **The CRP is strongly recommended to develop its M&E system.** Elements of this include;

- **The development of an overall M&E framework** within which existing data can be synthesized to guide country strategies and gaps identified which require further data collection.
- **Conceptualisation of CRP program, region and country level theories of change and impact pathways**, as part of the broader framework. Baseline studies by crop and country will draw on these designs, while using common templates for analysis, data consolidation and reporting.
- **A monitoring and evaluation data base system** to facilitate the work of the CRP, in tracking delivery and reporting. An M&E specialist will be needed to support CRP management and deal with M&E and impact requirements in CRP phase 2.
- **A monitoring Community of Practice** to develop standards, reporting guidelines and quality assurance mechanisms for tracking performance of the CRP across Centers.

10. **The CRP is encouraged to develop an effective communication strategy** that:

- Promotes synergy between Centers and CRPs, communicating work across flagships and locations with effective mechanisms for sharing methods, tools and experience across crops and regions.

- Identifies and tailors communication products from across Dryland Cereals partners for different stakeholders.

Gender

A Dryland Cereals Gender Strategy was developed with strategic and crop cluster- specific objectives. Efforts have been made to identify the roles of women and men, their needs and preferences. Practical progress has been made in involving women in different stages of technology testing, evaluation and utilization, especially in breeding, seed production, machinery testing and new product development and enterprise development. At the strategic level, Dryland Cereals is participating in a CGIAR wide study on agricultural innovation, agency and gender norms (Gennovate) with case studies conducted in West Africa, East Africa and India. Compared to gender, the specific circumstances and needs of youth – male and female- in relation to Dryland Cereals are not so well articulated in planning and reporting across all the Dryland Cereals crops and regions. There is scope for increasing the impact of the gender strategy by ensuring greater visibility of the findings from gender studies and their incorporation into all relevant research planning and activities.

The limited gender capacity within NARS is a constraint, although there has been gender related training for extension and research partners in East Africa under bilateral projects. Scientists in the CRP are well aware of the Gender strategy and just over half of the researcher survey respondents reported receiving some level of gender training. The Dryland Cereals gender strategy is clear on the importance of gender in staffing and recruitment, but there remains a low proportion of women scientists involved in Dryland Cereals research, and Dryland Cereals’ governance roles are highly gender imbalanced. There have been efforts to raise awareness of gender and diversity in the work place, but it is not clear to what extent these sessions have been held across all Dryland Cereals locations, involving both Centers and partner organization staff. Efforts have been made to include women scientists in training courses and the policy to encourage women and early career researchers is specified in the terms of reference for the Scholarship program. Six of the eleven scholarships awarded in East and West Africa are for women scientists.

11. The value of gender studies and social analysis could be maximized by Dryland Cereals management together with Center gender experts developing mechanisms for sharing findings and data from gender and social analysis (including of youth and other social groups), from the gender case studies and from Village Studies in India, highlighting implications for research activities, through a reinvigorated gender forum, or on- line seminars for scientists In Dryland Cereals.

12. In consultation with the cross CRP gender network, it is recommended that Dryland Cereals management and gender experts develop plans for gender capacity development:

- In **gender and social analysis** for social scientist researchers in partner country NARS, particularly for West and North Africa.
- In **gender issues in the work place**, especially for senior managers and staff drafting job descriptions or participating in recruitment, promotion and grant awarding panels. Ensure a more flexible working environment in terms of staff location, recognizing challenging conditions in some Dryland Cereals countries.

Partnerships

The CGIAR reform process emphasized a new vision of partnerships which reaches beyond traditional research partnerships. Dryland Cereals has added value to previous dryland cereals research by convening new partnerships and activities across regions and crops to address integrated value chains. Partnerships are strongly emphasized in the CRP as vital for products from crop improvement research to move along the impact pathway, but partnership development still needs more attention with respect to full involvement at all stages of this pathway.

Partnerships within the Dryland Cereals consortium are beginning to show benefits of collaboration. For barley there are joint activities in the Dryland systems action sites and some facilities at ICRISAT are shared, for example, in the physiological and molecular marker, and biotechnology research. The level of collaboration of Dryland Cereals with other CRPs is presently limited, although some individual researchers are working with A4NH and others. Dryland Cereals has built good linkages with advanced research institutions.

National Agricultural Research Institutions (NARIs) are the traditional partners of the CG Centers. They benefit from germplasm and capacity building from the Centers, while managing in country testing and adaptation, including locations for on-station and on-farm trials and demonstrations. The roles are appropriate and necessary, but there is some risk that further downstream development will be slowed, unless further partnerships beyond research are developed. The importance of partnerships lies in their ability to contribute to the impact pathway. Local extension, development organizations, farmers' organizations and value chain actors provide the essential farmer and market interface and play a critical role ensuring Dryland Cereals impact.

The amount of money going to the NARIs and other partners as a proportion of Dryland **Cereals** expenditure remains small (around 15%) and is a constraint to extending impact. There is scope for a wider group of National partners to have an important role in planning and reporting on outputs from the collaborative work. However, this will create further demands on the shrinking CRP budget. There is a need for partners to work together to seek out alternative approaches to fund the NARS.

13. It is recommended that Dryland Cereals CRP **develop a Partnership Strategy to guide future initiatives related to collaboration at different levels/with different stakeholders**. This would include:

- **Identification of the need for further partnerships** based on an analysis of the critical linkages in the impact pathway in each country and crop and the types of partner and functions that are most appropriate to secure those linkages.
- The evaluation team advises the development of **stronger partnerships for effective development and delivery in post-harvest and value addition** with a range of different organizations including research institutes with post-harvest expertise and with local small and medium enterprises.
- **Enhancing the role of national partners of different categories** in planning, implementation and reporting of country activities and engaging in collaborative efforts to identify additional funding to support in country activities under Dryland Cereals.

Capacity strengthening

Most researchers considered that the Drylands Cereals is supportive of capacity development, but it was widely perceived that funds for this were insufficient, particularly for their own capacity development. Dryland Cereals supports competitive grants, however a number of researchers expressed concern that national program researchers are losing out on these as they are disproportionately won by scientists from the CGIAR centers and advanced research institutions. Experience from other competitive grants programs have showed similar trends and required a capacity building process to be associated with proposal preparation. From February 2015, another vehicle for capacity building was introduced; the Dryland Cereals Scholarships Program supports PhD and MSc degree training, research internships and fellowships on dryland cereal crops.

14. Measures are needed to enhance non CGIAR /ARI partners' role in competitive grants, and improve their success rate. Options might include:

- Design a pre- proposal stage of capacity strengthening for non CGIAR partners.
- Include a requirement for capacity building for national partners in all proposals
- Designate a ring fenced percentage of the grant fund for NARS partners as PI with CGIAR or ARIs as Co- PIs.

Impact and sustainability

There is good evidence of research outputs reaching a range of users with positive results for both men and women across of a range of agro-ecologies. Factors influencing impact and sustainability include strategies for scaling out and up, the continuity of funding, the future integration and coordination of the CRP, staff retention, effective management and monitoring and security of country operations - much of the work of the Dryland Cereals is in areas that are currently in political turmoil.

Scaling out of new varieties depends on sustainable schemes for seed production and distribution. Reliance on seed companies and market access for new varieties will be a challenge for communities far from input and output markets and which grow cereals primarily for household use. Approaches using seed mini packs and small local agro-dealers and/or farmer group based seed production have potential for wider use. Crop management technologies can also be distributed in packs such as the Striga management packs distributed in Mali. Considerable effort on training has been made under the bilaterally funded projects. Nevertheless, there is scope to hold more events across all regions. Scaling up seed systems efforts in some countries will require interaction with policy makers to influence policies on seed acquisition, seed production, distribution and pricing. The barley case in Morocco is an example of such efforts, where policies have been modified to encourage certified seed production and utilization.

The sustainability of finance and long term stability of research partnerships in Dryland Cereals have been undermined by short-term funding and budget cuts. Sustained donor interest in plant breeding and research for the drylands will largely determine whether Dryland Cereals work can be sustained at the current scale and this will be influenced by the CRP's ability to demonstrate success. The dilemma is that success in terms of impact will itself depend on having funds to support downstream aspects. An additional threat to sustainability comes from staff turnover, either from resignations, retirement or budget cuts, within the lead and partner Centers of Dryland Cereals.

Sustainability also relies on vision and learning by both management and scientists. The governance and management structures should ideally support the programs of research and their application. If they are not efficient and effective, progress is impeded, outcomes affected and sustainability of effort threatened.

Stability of program structure and funding is important for sustained delivery of research results. If grain legumes and dryland systems are included with dryland cereals in the next phase of the CRP, this is likely to promote sustainability, provided there is practical integration in terms of research locations and farming systems which would allow better appreciation of production and market constraints. Such a new configuration of the CRP should be able to stimulate greater multidisciplinary, and through a systems approach would be better able to understand and research the pathways to impact in the context of entire agro-ecologies and food and market systems.

Given the budget cuts in the CRPs, a possible reduction in the number of crops and/or locations covered by the new phase of the combined CRP is implied. It is important to maintain the focus and quality of crop improvement for dryland cereal and legume crops, situating this within specific dryland agricultural systems and institutional and policy environments. This especially relevant given the contribution this CRP makes toward climate resilient agriculture.

15. It is recommended that **the new CRP phase is based around specific *dryland* cereals and legume crop and livestock systems, regions and countries and shared partnerships**, rather than diversified to non dryland crops in different ecologies.

1. INTRODUCTION TO THE EVALUATION

1.1 Background to the evaluation

This external evaluation of the **CGIAR Research Programme on Dryland Cereals** (hereafter referred to as **Dryland Cereals**) was conducted with quality assurance support and advice from the Independent Evaluation Arrangement (IEA).

As part of the long term evolution of the CGIAR, a major reform took place in 2009 which was designed to unify the system, improve efficiency and increase the potential for development impact. 15 CGIAR Research Programs (CRPs) were established, each bringing together the work of different centers in a consortium arrangement to address a specific theme in agricultural research for development. Research in the CGIAR is guided by the Strategy and Results Framework (SRF), approved in 2011, which sets out the System's common goals in terms of development impact (articulated as four System-Level Outcomes [SLOs])². In early 2015 a consultation process was implemented and revised Strategy and Results Framework for 2016-2030 was produced³. The revised framework identifies three main goals: reduce poverty; improve food and nutrition security for health; and improve natural resource systems and ecosystem services. The CGIAR's specific niche is characterized by: providing research leadership and international public goods; safeguarding and utilizing genetic resources; strengthening research capacity; partnering for impact; informing global debates and managing open data and sharing knowledge. The CRP programs are funded through a pooled funding mechanism that provides funding to CRPs through three "Windows"; Window 1 allocated across CRPs as per Consortium decision; Window 2 to donor-specified CRPs; and Window 3, to donor-specified centers. In addition, financial resources for specific projects or activities are received directly from donors as bilateral funding⁴.

In November 2013, the CGIAR Fund Council and Consortium Board decided that all CRPs should go through *some form of external evaluation* in order to generate lessons to feed into the final proposals for the second phase of the program. The first phase of the CRPs was extended in 2015 for a further year, during which proposals for phase 2 would be developed. The CRP evaluations are to inform that process. The CGIAR's Independent Evaluation Arrangement (IEA) which is responsible for system-level evaluations⁵ has commissioned full evaluations of ten CRPs and are supporting five other CRPs to commission their own evaluations⁶.

1.2 Structure of the evaluation report

The report is divided into nine chapters. This chapter provides the background to the evaluation, its purpose and intended audience, the evaluation objectives, the scope of the study and a brief overview of the Dryland Cereals CRP. Chapter two outlines the evaluation approach and methodology,

² Reducing rural poverty; Improving food security; Improving nutrition and health; Sustainable management of natural resources, A Strategy and Results Framework for the CGIAR, CGIAR, 2011.

³ CGIAR Strategy and results framework 2016 -2030. 18 May 2015.

⁴ <http://www.cgiar.org/who-we-are/cgiar-fund/>

⁵ <http://iea.cgiar.org/>

⁶ Background, Roles and Responsibilities for CRP Commissioned External evaluations (CCEE) for the following CRPs: A4NH, Grain Legumes, Humid tropics, Dryland Systems, Dryland Cereals. CGIAR, IEA. Further details on background were given in the Dryland Cereals Evaluation Inception Report.

presenting the evaluation criteria and evaluation questions and the methods of enquiry and analysis. The following chapters (three to eight) present the findings of the evaluation organized under the broad evaluation criteria of relevance, effectiveness, quality of science, efficiency, impact and sustainability, and the cross cutting issues of gender, partnership and capacity strengthening. Finally, the conclusions and recommendations are presented.

1.3 Evaluation purpose and Clients

The primary purpose of the CRP Commissioned External Evaluation (CCEE) is to provide input towards continued enhancement of the Dryland Cereals CRP, specifically to meet funders' needs for accountability and to provide recommendations to enhance decision-making by program management with respect to the second phase of the CRP; and secondly, to consolidate learning to enable continuous improvement in the CRP's capacity to deliver efficiently and effectively on its Intermediate Development Outcomes and contribute to the CGIAR System Level Outcomes.

The evaluation will examine the extent to which Dryland Cereals is responding within its mandate to the vision and focus of the reformed CGIAR; whether it has a delivery orientation, clear accountability mechanisms and facilitates synergy through building efficient partnerships. It will assess the relevance and validity of the CRP, its planned impact pathways and the likelihood of achieving results. It will review progress towards achievements on the major research areas since its approval in 2012 and the adequacy of the systems in place for good organizational performance.

The main stakeholders and audiences of the evaluation are the management of Dryland Cereals, as part of accountability for performance, learning for improvement and increasing the likelihood of future financial support; the Dryland Cereals Steering and Advisory committee, the CGIAR fund council and the Consortium Board, the Independent Evaluation Arrangement (IEA), donors, the lead center, ICRISAT and its board, the partner center, ICARDA and the CRP's research and development partners.

1.4 Evaluation Scope and Objectives

The evaluation assesses progress under the Dryland Cereals since its establishment in July 2012, taking into account its evolution over this period. It looks at the extent to which the planned outputs and outcomes of the program have been achieved, across all funding sources (windows 1, 2 and bilateral). The evaluation covers the four crops of the Dryland Cereals across different countries and regions. The scope of the evaluation also takes into account evidence of the results of research prior to the establishment of the Dryland Cereals. The evaluation criteria are relevance, including issues of program design and prioritization; quality of science; effectiveness in delivering outputs and intermediate development outcomes and the validity of the impact pathways; efficiency, which includes management aspects and resource allocation; and impact and sustainability including prospects for scaling out and scaling up. Three topics, namely gender, capacity strengthening and partnerships are considered across the Dryland Cereals flagships.

1.5 The Dryland Cereals - background

The Dryland Cereals is a global partnership between the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT) which is the lead center, and the International Center for Agricultural

Research in Dry Areas (ICARDA), together with other public and private institutes and organizations⁷, governments and farmer organizations.

The Dryland Cereals was developed and approved in 2012, with a start date of 1 July 2012. It therefore benefited from the guidance given in the Strategy and Results Framework (2011), in particular, the linking of program design to the delivery of the strategic level outcomes. The **Dryland Cereals vision** is for improved food security, nutrition, income and resilience of smallholder agriculture in the dryland regions of Africa and Asia, through the collaborative development and deployment of solutions for crop improvement, crop management, seed systems, post-harvest technologies and market access to dryland cereal crops - barley, finger millet, pearl millet and sorghum.

The program rationale for the focus on dryland cereals cites the importance of these crops to large numbers of people (650 million people with 155 million in target countries), the levels of poverty, hunger and malnutrition, the area under production and the agro ecologies in which there are few, if any, alternative staple food crops. The importance of these crops in supplying nutritious food, feed and fodder for livestock, and income to support livelihoods is highlighted. The program justification also cites the relative neglect, inadequate resources and inefficient fragmentation of research on these crops as a reason for bringing together a critical mass of international resources and expertise focused on a geography by crop portfolio which has similar breeding and development approaches and common researchable issues and concerns (e.g. role of women, production risks and climate change, genetic tolerance for drought, high temperature and soil salinity and resistance to pests and diseases, seed delivery systems) and capacity development. These issues are encapsulated in Dryland Cereals five Intermediate Development Outcomes (IDOs):

1. Improved productivity of dryland cereals in smallholder farming systems in Africa and Asia
2. Increased and stable access to dryland cereal food, feed and fodder by the poor, especially rural women and children
3. Increased consumption of nutritious dryland cereals by the poor, especially among nutritionally vulnerable women and children
4. Increased and more equitable income from marketing dryland cereal grain, fodder and products by low income value chain actors, especially smallholder women farmers
5. Increased capacity to adapt to environmental variability and longer terms changes in low income communities in Africa and Asia

In the Dryland Cereals proposal, the development and delivery of the program's research was articulated under seven 'product lines', later termed 'Clusters of activities' (CA), defined according to geographical regions, crop, beneficiary type and market orientation (Figure 1). They were based on analysis of the major constraints for the different dryland cereal crops in five target regions and differentiation of the needs of subsistence oriented and market oriented farmers. Five strategic components were identified, describing the key actions and approaches to which the seven product lines would relate.

⁷ Advanced Public and Private Research Institutes, e.g. CIRAD, the University of Queensland, EMBRAPA, Cornell University, the University of Georgia and the University of Hohenheim, the University of California, Davis. Also USDA-ARS, North Dakota on barley genomics research, brewing industry companies and USAID on the development of malt barley. Dryland Cereals Proposal for Extension, 2015-16 p 12.

DRYLAND CEREALS Structure (Phase I)

Seven Product Lines (PL) centered on 4 crops and 5 regions.
PLs undertook activities under five Strategic Components (SC).

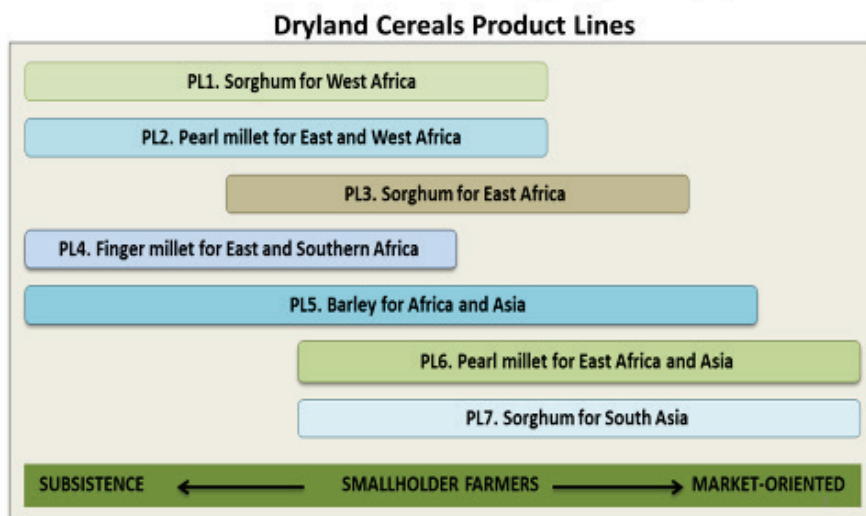


Figure 1: Dryland Cereals Product lines on subsistence to market continuum. (Source: CGIAR Research Program on Dryland Cereals, August 2012.)

The first phase of Dryland Cereals was intended to run until 30 June 2015, but as part of the Consortium effort to synchronize all CRPs to start Phase II in January 2017, Dryland Cereals Phase 1 ended in December 2014 and an extension phase was designed to run from 1 January 2015 until the end of December 2016. The design of the extension phase modified the phase 1 structure by designating the strategic components as **flagship projects**, emphasizing their integrating function across the crop/region axis and the need to move beyond crop improvement (Table 1). The flagships would be a focus for consolidating Dryland Cereals achievements.

Table 1 Dryland Cereals Flagships, Clusters of Activities, regions and countries

Cluster of Activities	Flagship 1 Priority Setting & Adoption	Flagship 2 Improved Varieties & Hybrids	Flagship 3 Integrated Crop Management	Flagship 4 Seed Systems & Input Services	Flagship 5 Postharvest Value & Output Markets
CA1	SORGHUM for West & Central Africa: Burkina Faso, Mali, Niger and Nigeria				
CA2	PEARL MILLET for Africa: East & West Africa: Burkina Faso, Mali, Niger, Nigeria, Senegal, Sudan				
CA3	SORGHUM for East Africa : Ethiopia, Sudan, Tanzania, Mozambique, (Kenya)				
CA4	FINGER MILLET for East and Southern Africa: Ethiopia, Kenya, Tanzania, Uganda				
CA5	BARLEY for Africa and Asia: Central and West Asia & North Africa, and South Asia: Ethiopia, India, Iran, Kazakhstan, Morocco and Turkey				
CA6	PEARL MILLET hybrids for East Africa & South Asia: India				
CA7	POST RAINY SEASON SORGHUM for South Asia: India				

For the extension phase, increased emphasis was placed on understanding the nature of demand and adoption constraints, crop management, seed systems and input services and post-harvest processing

technologies and output markets. It was anticipated that these areas would open up broader opportunities for collaboration with other CRPs.

The Drylands Cereals Proposal 2012, did not present a theory of change, but did include a diagram of how outputs would lead to research and development outcomes and impacts and separate impact pathway diagrams for subsistence farmers and market oriented farmers. A more developed theory of change was included in the extension proposal (discussed in chapter 3).

1.6 The Dryland Cereals - Funding

Dryland Cereals is the smallest of the 15 CRPs in terms of funding. Figure 2 shows the budget allocation for 2012 to 2016 Windows 1 and 2 as a proportion of the total is 39% overall, ranging from 48% in 2013 to 32% in 2015⁸.

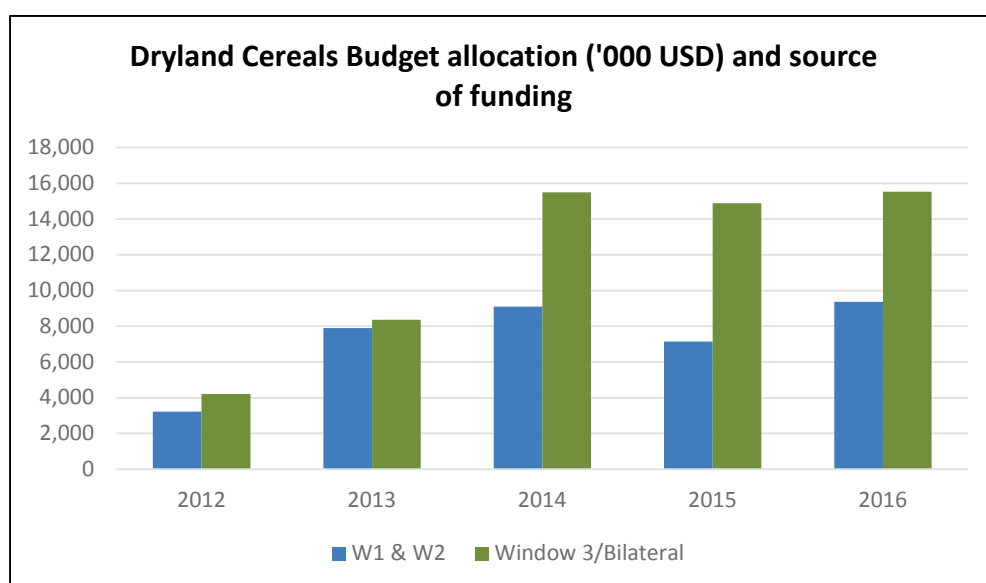


Figure 2 Dryland Cereals Budget Allocation 2012-2016

Source: Dryland Cereals Extension proposal, 2014

Actual expenditure for the Dryland Cereals from 2012 to December 2014 is shown in Figure 3. Windows 1 and 2 constituted 44.6% overall, window 3, 15.6% and bilateral funding, 40.7%.

The number of donors contributing to bilateral/window 3 funds increased from 29 in 2012 to 37 in 2014. The top four donors contributed over 68% of these funds from 2012-2014. One donor, funding a specific project, 'HOPE: Harnessing Opportunities for Productivity Enhancements', accounted for 49% of bilateral and window 3 funding in 2012 and 2013. The relative proportion reduced to 33% in 2014 as the next ranking donors increased their contributions.

⁸ It is now substantially less. The 2015 and 2016 W1/W2 budget was reduced by around 32% in October 2015 – the reduction is not reflected in this figure which shows the requested funding for 2015 and 2016 at the time of the extension proposal.

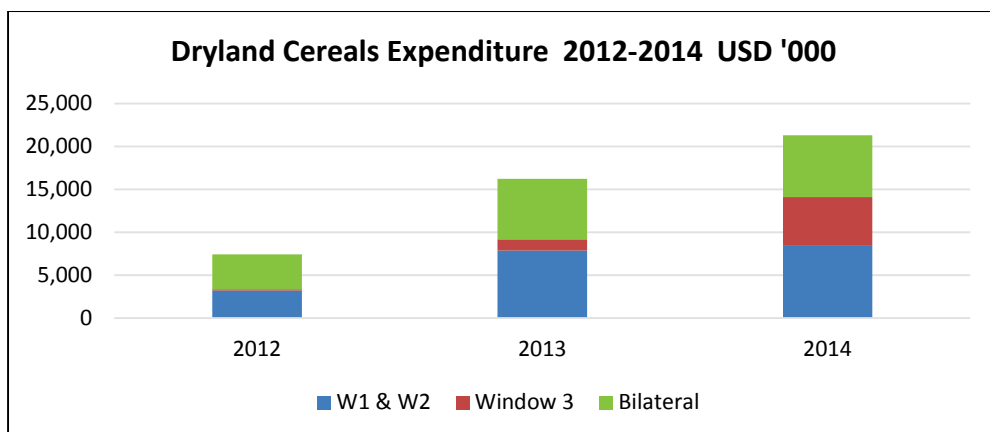


Figure 3 Dryland Cereals Actual Expenditure 2012-2014

Source: Dryland Cereals Annual Reports 2012- 2014.

The budget allocation by flagship project for 2014-2016, assigns the largest amount to FP 2 Improved varieties and hybrids, followed by FP3 Integrated crop management, FP1 Priority setting and adoption, FP4 Seed systems and input services and FP 5 Post-harvest value and output markets (Figure 4). The dominance of crop improvement reflects the inherited historical pre CRP allocations and the skills and comparative advantage of existing ICRISAT and ICARDA staff.

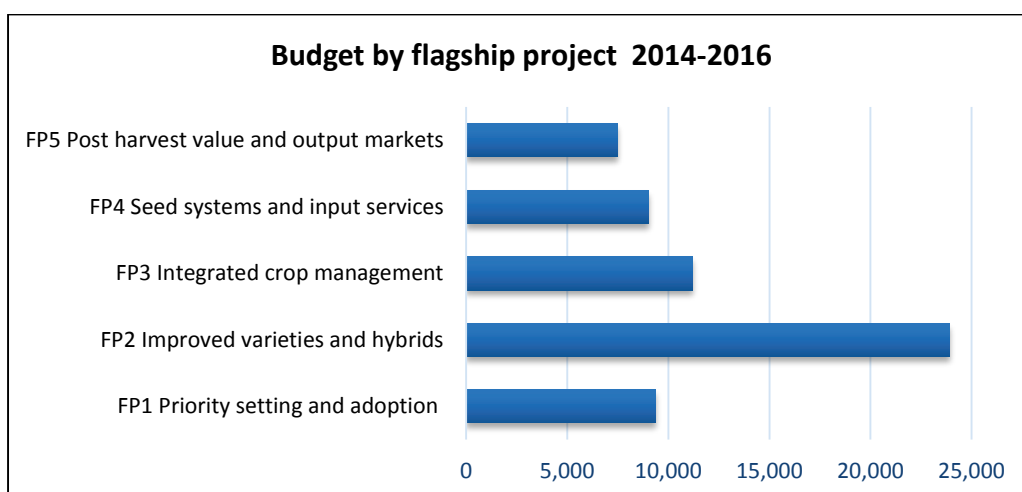


Figure 4: Budget for 2014- 2016 by Flagship project '000 USD (source: Programme data)

Budget allocation by Intermediate Development outcome is related to the flagship distribution; 29% is associated with IDO 1, improved productivity of dryland cereals and 23% with IDO2, Increased and stable access to dryland cereal food, feed and fodder and 23% with IDO 4, Increased and more equitable income (Figure 5). The proportions for increased consumption and capacity to adapt to environmental variability and change are lower, at 14% and 11% respectively.

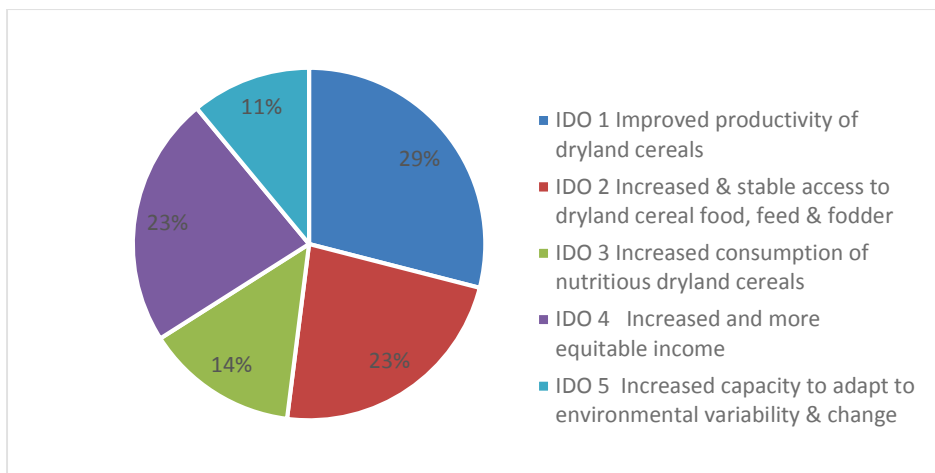
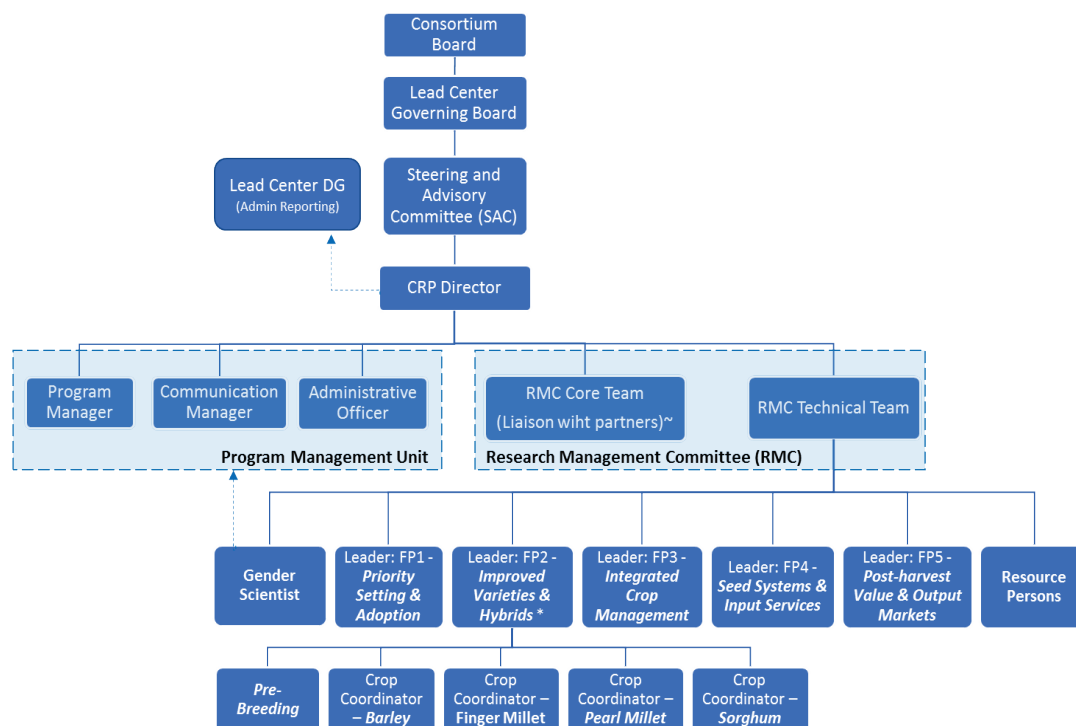


Figure 5 Proportion of the budget by IDO 2014-2016 (Dryland Cereals Extension proposal 2014)

1.7 Dryland Cereals Governance Structure

The current governance structure of Dryland Cereals is shown in Figure 6. Following efforts to streamline the structures, the Independent Advisory Committee and the Steering Committee were combined. The CRP Director reports through this committee to the lead center governing board, while reporting administratively to the lead center Director. The Program management unit and research management committee are separately identified. The flagship project leaders are responsible for managing and reporting on the research areas, consolidating information from the cluster activities coordinators.



* to be filled

~ Liaison with Bayer Crop Science, CERAAS, CIRAD, ICARDA, ICRISAT, NASARRI, SFSA, SMIL, UQ and ZEF, UoB

Figure 6: Governance & Management Structure (Extension phase)

2. EVALUATION APPROACH AND METHODOLOGY

2.1 Development of the evaluation questions

The evaluation team began work in early May 2015 with a meeting to discuss the terms of reference, assign roles and responsibilities and plan field visits. The development of the evaluation questions and methodology followed, based on a review of program documentation and discussions with the Dryland Cereals Director and the evaluation manager during the inception phase (details are given in the Dryland Cereals Evaluation Inception report).

A number of overarching questions were formulated to explore the extent of added value generated by the Dryland Cereals.

1. Does the Dryland Cereals provide an effective **framework and procedures for prioritizing research**? Is research becoming strategically better focused on development outcomes as well as delivering the long-term high quality scientific research achievements which underpin these?
2. Is the Dryland Cereals **generating synergy among centers** and improving integration among disciplines and teams? Is knowledge being shared, technologies exchanged and capacity being built across countries and partners?
3. Is Dryland Cereals research becoming better **aligned to the needs of smallholder farmers, consumers and other beneficiaries**? Are gender and diversity issues being integrated into research planning and implementation and in the articulation of uptake pathways?
4. Is the Dryland Cereals developing a **broader range of partnerships** which contribute to research outputs and realization of outcomes? Is this adding value and likely to enhance the global benefits from Dryland Cereals research for poor producers and consumers?
5. How has Dryland Cereals managed resources to **realize the new vision of the CRP**; how have the multiple sources, levels and allocation of funding influenced incentives for bringing about change?
6. Are the **governance and management structures**, practices and reporting lines of the CRP efficient and effective? Is there clarity and a common understanding of the roles and operational procedures of different components of CRP management within the lead and partner institutions?

Using the **six evaluation** criteria - relevance, quality of science, effectiveness, efficiency, impact and sustainability, a number of specific sub questions were developed under each. For relevance, the evaluation questions explore the coherence of the program with the CGIAR SRF, the comparative advantage of the program to deliver its objectives, and the program design. The quality of science questions examine how far the research reflects cutting edge science and the research outputs are of high quality. Under the effectiveness criteria, the questions concern the extent to which the planned outputs and outcomes have been achieved or are likely to be achieved and how far the theory of change is being realized. They explore whether research outputs are reaching their target groups and knowledge is being shared. For efficiency, a number of dimensions are discussed – management structures and processes, program governance, resource use, collaboration and coordination, monitoring and evaluation, management of risk and communication and cross learning. The section on impact and sustainability examines the evidence for the contribution the research outputs and outcomes have made to productivity, food security, consumption and nutrition and livelihoods. It

considers the sustainability of results and the potential for scaling up and scaling out. Three important cross cutting areas are examined separately; capacity strengthening, gender and partnerships.

The full set of evaluation questions, together with the methodologies and data analysis plans for each are listed in annex 1 of volume 2 of this report. This evaluation framework was applied both for considering the work under the five thematic flagships and for the specific activities, outputs and outcomes of each crop cluster.

2.2 Evaluation approach and country coverage

The rationale for country selection for field visits for direct interaction with Dryland Cereals scientists and partners was based on ensuring sufficient coverage of the four dryland cereal crops across different regions. The seven clusters of activity based on crop and region, together with the flagship themes provided the matrix for selection of focus countries for the evaluation (see Table 1). Countries with activities relating to more than one dryland cereal crop were prioritized for the visits. Other considerations for country selection included the location of flagship project leaders and leaders of Clusters of Activity /product lines and the locations of the major partners of the program. Three countries were chosen where barley is a focus crop - Morocco, India and Ethiopia. For pearl millet, India, Niger, Kenya (Tanzania) were selected. For sorghum, the countries were India (post rainy season sorghum), Ethiopia, Kenya (Tanzania) and Mali, and for finger millet, Ethiopia and Kenya (Uganda, Tanzania). The East and Southern Africa Regional center in Nairobi was chosen as a convening point for researchers from Kenya, Uganda and Tanzania. Security concerns prevented the evaluation team from travelling to Mali and Niger (and ruled out northern Nigeria), but researchers from those countries were invited to convene in Senegal. The countries visited for the evaluation are shown in Table 2.

Table 2: Dryland Cereals countries visited by the CCEE team

Region	West & Central Africa:	South Asia	East and Southern Africa:		Central, West Asia, North Africa
Countries visited	Senegal (Mali/Niger)	India	Kenya (Uganda/Tanzania)	Ethiopia	Morocco
Cluster of activities/product line	Pearl millet (CA2)	Pearl millet (CA6)	Pearl millet (CA2 & CA6)		
		Barley (CA5)		Barley (CA5)	Barley (CA5)
	Sorghum (CA1)	Post rainy season sorghum (CA7)	Sorghum (CA3)	Sorghum (CA3)	
			Finger millet (CA4)	Finger millet (CA4)	

2.2 Evaluation methods and tools

The **evaluation matrix** in annex 1 prepared during the inception period, identifies the main data sources, methods and tools that were used for answering the evaluation questions. The underlying principle was to access information from multiple sources, for example, reports and publications, surveys, interviews and group discussions, and to allocate sufficient time for interaction with scientists

and managers in the different regions in order to capture the diverse range of perspectives and values of partners and stakeholders. The main sources of information are outlined below.

1. **Documentation analysis:** Dryland Cereals management made available on line a wide range of useful documents including the original proposal and extension proposal, annual reports which also contain financial reports on budgeted and actual expenditure, technical reports and information on grants and scholarships. Minutes of Steering committee and Research committee meetings were also available. There were also spread sheets of work plans and outputs used by Dryland Cereals management, publicity and news items and lists of scientific publications. In the course of the country field visits, reports and reviews from bilateral funded projects (e.g. HOPE, Sorghum Multiple Use etc.) were made available as well as further working papers and discussion papers.
2. **Interviews and meetings with management, scientists and research partners:** interviews and meetings were held with Dryland Cereals managers and scientists during the country visits to India, Morocco, Ethiopia, Kenya and Senegal. Meetings were held with research teams, including national research partners. Powerpoint presentations given at these meetings were a useful source of information and stimulus for discussion. Other stakeholders, including those with a governance/oversight role were interviewed via Skype or contacted by email. A full list of participants in interviews and discussions and their locations is given in Annex 2.
3. **Online surveys:** two on-line surveys using survey monkey were designed (see annexes 5 and 6) covering the main areas under the evaluation criteria. The researcher survey targeted ICRISAT and ICARDA scientists working with Dryland Cereals, while the partner survey targeted individuals from institutions that collaborate with the Dryland Cereals CRP. The researcher survey was sent to 90 scientists, 36 or 40% of whom responded and around three quarters of them completed the survey in full. 77.7% of those responding were from ICRISAT and 22.2% were ICARDA scientists. The partner survey was sent to 86 partners of whom 27 responded - a rate of 31%.
4. **Discussions with farmers and development partners:** The evaluation team emphasized the need to meet, where possible, with some of the end users of Dryland Cereals research - men and women farmers, processors, farmers' organizations, farmer seed producers, seed companies and manufacturers of food products containing the target crops. This was achieved to some extent in all countries visited, despite the limited time and complex logistics.

The Dryland Cereals CCEE Inception report sets out how the information generated by these methods would be used to analyze the evaluation questions under each of the evaluation criteria. For the most part these were followed.

For *relevance*, the questions on coherence, comparative advantage and program design are addressed drawing on the analysis of Dryland Cereals proposals, budgets, reports and information from interviews with managers, scientists and advisers and from the scientists' survey. The theory of change and impact pathway diagrams are used to examine the relevance and logic of linkages between activities, outputs and research and development outcomes. Discussion related to Flagship 1 provides insights into how far priority setting was based on clear evidence of demand.

For *effectiveness*, evidence from reports, presentations and discussions is used to analyze how far Dryland Cereals is delivering on its planned outputs and outcomes. The in-country interviews were

important in providing insight into how research outputs are being utilized and what may constrain their use and hence how this may be better supported in future. The survey provided useful information on perceptions of communication and sharing of knowledge across Dryland Cereals.

For the *quality of science analysis*, resources allocated for the evaluation did not allow time for in-depth analysis of publications but the team was able to draw on secondary sources and interviews for a qualitative assessment. The emphasis was primarily on management for quality research rather than a detailed assessment of science quality itself. Evidence for the findings was mainly based on reports and interviews with scientists and managers and the on-line surveys. Scientists' views on institutional incentives to enhance the quality of science and their assessment of how effectively quality of science has been ensured were analyzed from the scientists' survey.

Assessment of *efficiency* in terms of management issues and organizational performance draws primarily on interviews with managers, scientists and partners, the scientists' and partners' on-line surveys and minutes of management committee meetings. Financial analysis is based on the financial reports contained within annual reports, including resource allocation to researchers and partners and crop cluster and flagship over time. Data collection and information management for monitoring is addressed and the overall efficiency of Dryland Cereals communications and public outreach discussed.

For *impact and sustainability*, it was expected that evidence would be scarcer, given the relatively short time frame of the project. This summative dimension of the evaluation related mainly to research pre-dating the start of Dryland Cereals. Interviews with scientists and partners were the main source of insights into the areas considered to have made the most contribution and those with most potential for scaling out.

The three *cross-cutting* areas of Capacity Strengthening, Gender and diversity and Partnerships have been assessed through interviews, group discussions with researchers and partners and through the scientists and partners' surveys. Additionally, for capacity strengthening, the commissioned and competitive grants processes and the scholarships fund have been reviewed. Gender and diversity was explored using the framework in the Dryland Cereals gender strategy and included interviews with gender specialists working in the CRP. Information for the qualitative assessment of partnerships was obtained through partners' interviews and the partners and scientists' on line surveys which explores satisfaction with collaboration, partnerships and coordination.

2.3 Acknowledgement of changes

There have been no major changes departing from the initial terms of reference or the inception report. The depth of some the analysis proposed has been modified to some extent, due to time constraints. For example, the qualitative analysis of perceptions of management and governance have been compiled from interview notes in relation to the evaluation questions, but not systematically tabulated and coded under thematic categories as was originally planned. As noted above, the light touch analysis of the quality of science drew mainly on evidence from secondary sources and from interaction with scientists. Questions on financial planning, resource allocation and decisions on research staffing were also not addressed in depth as these issues were more the responsibility of the lead Center rather than the Drylands Cereals management team.

2.4 Quality assurance

Quality assurance for the evaluation was provided by the evaluation Oversight Group, a nine member Oversight Group chaired by the Chair of ICRISAT Governing Board with three members drawn from the steering/advisory committee, one member representing the IEA, two members from the research management committee and two members from the Dryland Cereals program management. The list of members is given in Annex 4. They were responsible for reviewing the Inception report, preliminary headline findings and the draft and final evaluation report. The evaluation team presented the conclusions and recommendations of the draft report to the oversight group/ Steering committee via video conference in early December 2015 and responded to comments and suggestions received. The evaluation manager (the Senior Program Manager of Dryland Cereals and Grain Legumes CRPs) managed the overall evaluation process and provided the feedback to the CCEE team. The role of the IEA and external reviewers was to provide input and feedback to the evaluation processes and the draft final report. Following the finalization of the report, an independent quality validation review panel will provide a summary report on the quality of the evaluation processes and final evaluation report.

2.5 Organization and timing of the evaluation

The evaluation team was led by Adrienne Martin from the Natural Resources institute (NRI), University of Greenwich UK, and advised by NRI Emeritus Professor George Rothschild. The team members are NRI staff Ravinder Kumar and Rory Hillocks, together with two highly experienced consultants, Jonathan Robinson and Paul Thangata. Each team member had primary responsibility for one or more strategic components of the Dryland Cereals (flagships or major issues). However, the evaluation was conducted as a team, sharing information and contributing to each other's areas. Profiles of the team and team responsibilities are in Annex 3.

The timeline of the evaluation started with a preparatory phase in March and early April 2015, including the preparation of a technical and financial proposal setting out the proposed approach and preliminary methodology. This was followed by the Inception phase starting at the beginning of May. Field visits, initially planned to start in May, took place in June and July, starting with the team visit to the lead Center ICRISAT in India. The full itinerary of country visits, locations and people met, including team members involved, is given in Annex 2. The inception report and a summary of preliminary findings and recommendations were submitted at the end of July 2015. Comments on the inception report were received and addressed in August. Further interviews and the preparation of the on-line survey took place in August and September, followed by analysis, synthesis and production of the draft evaluation report by the end of October 2015.

The timeline proposed in the Inception report was modified due to a number of circumstances. Delays in travel to India created a concentration in the schedule of field visits, delaying the completion of the inception report until after the visits had taken place. This was not considered to be detrimental - comments received on the Inception report were helpful in enhancing clarity of the report and encouraging the team to put more emphasis on forward looking recommendations, but would not have changed the planning or conduct of field visits. The time required to compile a comprehensive lists of scientists and partners for the on-line surveys and to follow up, was greater than anticipated. This created a slippage of approximately three weeks on the original schedule for the evaluation report.

2.6 Research ethics

The evaluation has been conducted in line with the core principles for the conduct of evaluations⁹. These are the basis of the University of Greenwich Research Ethics Policy and NRI's Code of Practice on Research with People. We have signed the ICRISAT agreement on Ownership and Use of Confidential Information. The purpose of meetings and surveys was explained to participants and it was made clear that engagement in interviews, discussions was voluntary. Response to the scientists and partners surveys was clearly stated to be optional, thereby allowing recipients not to respond if they preferred. Confidentiality was assured to all respondents; views expressed during the evaluation will remain confidential and will not be attributed to individuals or used in such a way that the individual source is identifiable. Efforts were made throughout the country visits to discuss observations and potential recommendations with participants. Direct feedback was sought through an initial presentation of findings to the CRP management in August 2015 and in early December 2015, the findings and recommendations were presented to the Steering/advisory committee.

2.7 Main limitations and constraints of the evaluation

The main limitations of the evaluation relate to availability of time and resources to pursue in detail the outputs and outcomes of the different Crop activity clusters and flagships. The lack of a Dryland Cereals M&E data base which could have provided the framework for further analysis meant that a lot of time was invested in attempting to track performance reported in annual and technical reports, against the frameworks included in the original Dryland Cereals proposal and Extension proposal. An updated version of the Dryland Cereals consolidated outputs spreadsheet and current status was made available in August 2015, and this was complemented by the information from scientists' presentations and discussions. However, there remains the risk of incompleteness. Gaps in the spreadsheet were not explained – whether due to lack of reporting, or because activities had not been carried out because of budget cuts or lack of personnel.

The analysis of quality of science was light touch, involving discussions and observations with scientists and managers in the countries visited, covering the ways in which research is designed, managed and performance assessed and the staffing and facilities supporting the research. For analysis of publications it drew on other bibliographic analyses. It was not possible given the resources available, to do a systematic analysis of a sample of publications.

The rates of response to the Scientists and Partners surveys were lower than expected, nevertheless our reported response rates are in line with those for on line surveys¹⁰. Additionally, the response rates are similar to those by other IEA evaluations¹¹. The scientists' survey with a response rate of 40% was reasonably representative of the composition of the population, covering scientists at different

⁹ CGIAR 2015. CGIAR Standards for Independent External Evaluation, Standard 7.3. Core principles are independence, impartiality, conflict of interest, honesty and integrity, competence, accountability, obligations to participants, confidentiality, avoidance of harm, accuracy, completeness and reliability, transparency, omissions and wrongdoing.

¹⁰ Duncan D. Nulty 2008. The adequacy of response rates to online and paper surveys: what can be done? *Assessment & Evaluation in Higher Education* Vol. 33, No. 3, June 2008, 301–314

¹¹ Forests, Trees and Agroforestry (FTA) scientists 32%, FTA partners 40%, Roots, Tubers, Bananas 56%, Wheat 38%, Maize scientists 36% and 48% (CIMMYT and IITA)

grades and also managers, although somewhat weighted towards principal scientists and managers (principal scientists and managers constituted 47.2% of the responses compared to 33.3% of the total list). The partners' survey had a response rate of 31%, with a high proportion of the responses from government research partners (82% of the responses compared to 56% of the partners contacted). Universities (17% of those contacted) and private sector partners (10.5% of those contacted) were underrepresented in the responses and this has been taken into account in the analysis. A number of the questions from both surveys were discussed in interviews and meetings with such stakeholders on country visits.

The timing of the evaluation was not ideal in terms of field observation and discussion of crops research, falling after the harvest period for barley in all countries and sorghum and pearl millet in India, and before or at planting time in East and West Africa. However, it was possible to view sorghum, pearl millet and finger millet crops at research stations (in Ethiopia and Kenya), and a seed company's pearl millet field trials (India). Also evaluation of seedling resistance to rust pathotypes in barley under laboratory conditions was reviewed in Shimla, India. Presentations given by researchers and partners in all countries visited were amply substantiated with both field data and photographs.

3. RELEVANCE

The Dryland Cereals is targeted at low income, food deficit countries in sub Saharan Africa and South Asia, with spill over potential to other dryland cereal production ecologies. The program justification¹² cites the relative neglect, inadequate resources and inefficient fragmentation of research on dryland cereal crops as a reason for bringing together a critical mass of international resources and expertise focused on a geography by crop portfolio with important common elements.

Research on all four crops targeted by the Dryland Cereals CRP is highly relevant to the needs of communities in the drier parts of Africa and Asia and will become increasingly so as climate change makes rainfall more unreliable. Sorghum and millet production and consumption is greatest in the drier areas and amongst the poorest households (in Tanzania for instance – see Gierent *et al*, 2014). Maize and rice are preferred and may be the first choice for planting at the start of the rains, but sorghum areas increase if there is a poor start to the rains. There is already a trend towards increased sorghum growing relative to maize where the length of drought periods is increasing (Kangalawe & Lyimo, 2013). A similar scenario exists for barley – for example, areas in Morocco where wheat production is marginal are increasingly being allocated to barley for food, livestock feed and forage. These are crops in which the private sector has until recently been reluctant to invest, with the exception of varieties suitable for malting and hybrid varieties of sorghum and pearl millet in India, and they are poorly supported by seed systems.

Most of the sorghum and millet produced in Africa and India is consumed as food grain or used as animal feed within the producing country, so in countries that are self-sufficient, national production figures reflect the food security demand. The leading sorghum producing countries in sub Saharan Africa (SSA) are countries with arid zones bordering the Sahara, but Cameroon and Tanzania are also among the top ten sorghum producing nations. In all of these countries, agriculture makes a large contribution to the economy with a percentage above the SSA average and much above the global average. With the exception of Nigeria (due to oil revenue), they are among the poorer countries, their Gross Domestic Product per capita being well below the average for SSA (Nigeria has a low score on poverty indicators, despite the high GDP). The leading sorghum and millet producing countries in the Sahel, have a high proportion of their population employed in agriculture. Chad is one of the poorest countries in the world with 80% of the population living below the poverty line. Infant mortality is above 75 per 1000 of population in three of the main sorghum and millet growing countries - Chad, Mali and Nigeria.

The major constraints to adoption of improved varieties were identified as access to seed, low yield and soil fertility, pest and diseases, stover quality and yield. Improving the productivity and production of dryland cereal crops can provide additional food security benefits to the poorest. There is an increase in the non-food uses of dryland cereals, for livestock feed and fodder and for brewing, especially in India, however, 50-75% is still used for food and the crops are characterized by their multiple uses and users. Dryland cereals provide important sources of carbohydrates, energy, protein, fiber, calcium, iron, and certain vitamin B complexes, which are especially relevant for poor households that depend on these crops. Opportunities arise in the new markets emerging especially

¹² CGIAR Research Program on Dryland Cereals. A global alliance for improving food security, nutrition and economic growth for the world's most vulnerable poor. 15 August 2012. ICRISAT and ICARDA. pp 11-21.

for barley and finger millet, associated with the health products industry, such as gluten free, higher beta-glucan and other specialized diets. There is scope for collaborative work on processing, equipment and industrial uses.

Relatively little research and breeding is carried out on pearl millet, finger millet and dryland barley outside this CRP and although sorghum is relatively well researched, that research is not primarily directed at small-scale dryland farming. Low input, post rainy season sorghum that relies on residual moisture for growth has been researched by national partners, with support from ICRISAT through bilateral funding, but not previously addressed at the current scale in Dryland Cereals. Finger millet breeding for Africa represents a relatively new endeavor, but is particularly relevant given, *inter alia*, the crop's nutritional characteristics (high calcium content of the grain, value as a weaning food), possibilities for double cropping, resistance to the common storage pests and diseases and malting merits.

In these respects Dryland Cereals CRP has had no direct competitors, and addresses the needs of dryland farmers that might otherwise not be met other than through national systems of various capacities. The overarching question in this respect is whether Dryland Cereals is exploiting sufficiently the comparative advantage that it undoubtedly has. This should be set against the IFPRI IMPACT model that predicts consistently rising demand for pearl millet and sorghum in WCA up to 2050, contrasting with stable demand in ESA and SA.

The work of flagship 1 is highly relevant to understanding the CRP's contribution towards productivity, nutrition and income (IDOs 1, 3 and 4) since it includes foresight planning and priority setting to contribute to a demand-driven research-for-development focus, collection and management of baseline data and impact analysis. Relevance can be enhanced by the increased involvement of country partners, farmers and end users in strategy development and prioritization. Gender is a cross-cutting activity in this flagship and is integrated into all of its planned outputs. In the phase-2 pre-proposal for the Dryland Cereals and Legumes Agri-Food Systems CRP, Flagship 1 is entitled priority setting and impact *acceleration*.

The breeding programs for the four cereal crops included in Dryland Cereals have been relevant, and remain so, for poor cereal farmers of the dryland areas of SA, ESA and WCA. The scientific research underlying the crop improvement components in flagship 2 is largely relevant, being geared towards major production constraints that might be addressed by, for example, hybrid pearl millet and sorghum production. Disease and pest resistance work is being carried out for all cereals, for example for downy mildew and head miner in pearl millet, midge, anthracnose and stalk borer in sorghum, blast in finger millet, midge, Russian wheat aphid and foliar diseases in barley.

Quality traits, such as malting and flour color, Fe and Zn concentrations, suitability for local food processing, as well traits related to stover digestibility for ruminant nutrition, are also being investigated. For finger millet the discovery of the 'snapping head' trait could make harvesting the crop easier if the trait can be incorporated into adapted germplasm¹³. Molecular tools are being used in the associated research projects, including for determining the possible existence of biotypes of *Striga*, which if they exist will influence the work being done on locating and developing resistance in

¹³ Presentation from Henry Ojulong Dryland Cereals Finger millet breeder, Nairobi, Kenya, August 2015.

sorghum and pearl millet. Molecular tools are also being applied to phenotypic-genotypic characterization of finger millet, pearl millet and sorghum germplasm accessions. In addition, research is being carried out on edaphic factors affecting the physiology and growth of the crops, particularly adaptation to low soil phosphate levels of sorghum and pearl millet.

Dryland Cereals research on seed systems and input services is a vital element which contributes to realizing the advantages of crop improvement through developing systems for seed production, seed quality and seed distribution. It is relevant to the private seed sector, particularly in India, where improved varieties of barley, sorghum and pearl millet are made available to small-scale farmers, and where, in some instances, farmers are able to produce seed of OPVs and hybrids for the seed industry¹⁴. However, in the lower rainfall zones in India and over much of East and West Africa, private seed companies are much less active and systems for multiplication and distribution of quality seeds are at the early stages of development. The Seed systems work has developed relevant strategies for different crops and regions, making significant progress in utilizing informal farmer-based seed systems where the formal seed sector is weak. Farmer production of hybrid sorghum seed for cash has become increasingly relevant in Mali¹⁵. The continuing relevance of Dryland Cereals (albeit within a reconfigured grouping potentially including Dryland Systems and Grain Legumes) will predominantly rest on development of adapted parental material for development of hybrid pearl millets and sorghum for SA, WCA and ESA, recognizing that they are not universally suitable.

Dryland Cereals gives clear recognition to the post-harvest area which is highly relevant to income generation and employment and improved diets. Flagship 5 addresses post-harvest value and output markets including grain processing characteristics, post-harvest loss reduction, bulk sale of grain, storage, processing and nutrition and value chain incubators, noting that this links to the intermediate development outcomes, 'increased and more equitable income from marketing dryland cereal grain, fodder and products by low income value chain actors, especially smallholder women farmers' and 'increased consumption of nutritious dryland cereals'.

In summary, the relevance of the focus on the four dryland cereals is multi-dimensional; they are important for increasing choice and resilience in farming systems in the face of climate variability; they are important in addressing poverty as these crops are produced and consumed by some of Africa's and South Asia's poorest populations; they offer significant nutritional advantages, especially for vulnerable groups; they are a focus for collaborative engagement with the private sector to create opportunities for increased production and wealth creation through new product and market opportunities, and to fill the gap in providing improved seeds and agricultural options for increasing yields and food security in more marginal areas where the private sector does not engage.

3.1 Coherence with the CGIAR goals and strategy and results framework

- *Is Dryland Cereals strategically coherent and consistent with the main goals and SLOs presented in the CGIAR's Strategy and Results Framework?*

¹⁴ Presentations to the evaluation team and discussions with Dryland Cereals Scientists, private sector partners and State agricultural university partners met in India, July 2015.

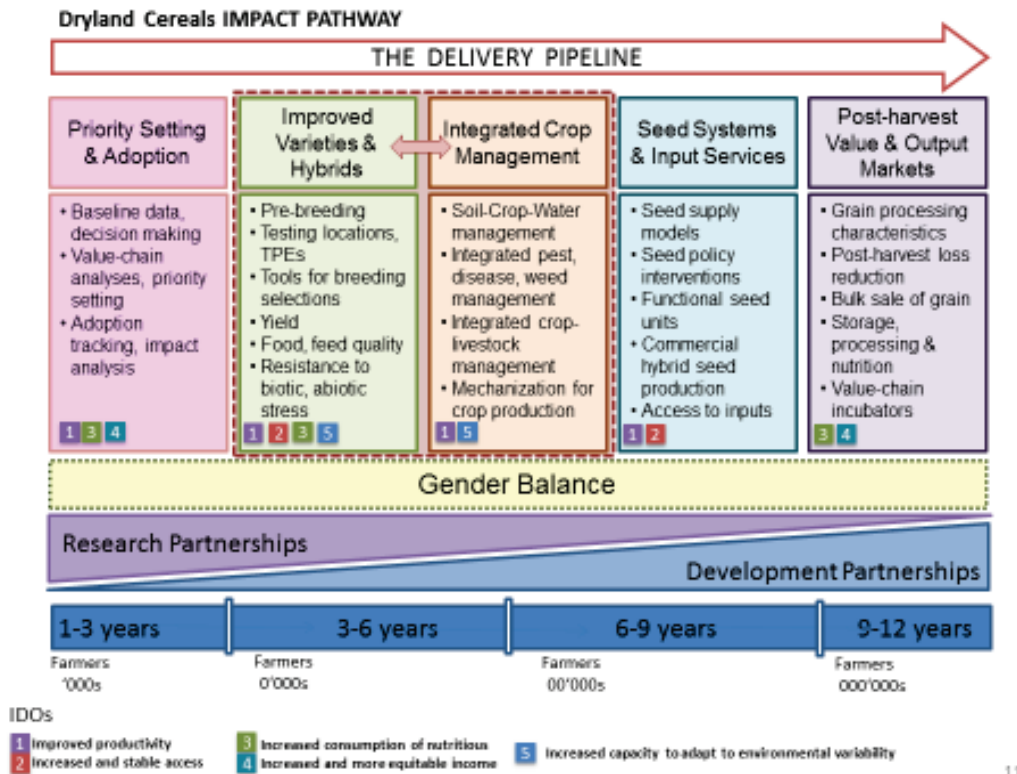
¹⁵ Presentation to the evaluation team by Fred Rattunde; WA Sorghum Research Highlights and issues for future consideration, at the Centre d'Etude Régional pour l'Amélioration de l'Adaptation à la Sécheresse (CERAAS) Theis, Senegal. 13 July 2015.

Research to improve dryland cereal crops (Flagship 2) is consistent with the main goals and SLOs of the CGIAR's Strategy and Results Framework SRF (2016-30) to reduce poverty, to improve food and nutrition security for health, and to improve natural resources systems and ecosystems services. In order for improved varieties of sorghum and millets to contribute to those goals their further promotion together with the appropriate crop management packages (Flagship 3) is advised. This is especially true of the sorghum and pearl millet hybrids which require higher input levels to ensure profitability. Seed systems (Flagship 4) are required to provide access to new varieties, while functioning post-harvest systems and value chains (Flagship 5) provide the market incentives that ensure adoption of the variety/crop management packages and through developing safe and nutritious end products, contribute to improved nutrition and health for consumers. Research on priority setting and adoption (Flagship 1) is important to understand the changing context for Dryland Cereal crops in different regions and to track outcomes and impacts on incomes and poverty, food security and nutrition, employment, market trends and policy. The analysis and presentation of data and lessons can influence policies and investment toward a more enabling environment. Dryland Cereals gender strategy and capacity building arrangements are consistent with the SRF. Elements of the SRF which are recognized in Dryland Cereals, but are not a specific focus, are sustainable management of natural resources and ecosystem services and a production systems perspective which is broader than a single crop commodity value chain approach.

3.2 Coherence of Dryland Cereals crops, regions and flagships

➤ *Is there a clear rationale for, and coherence among the Dryland Cereals flagship projects?*

The Flagship Projects follow a logical pipeline (Figure 3) which if properly implemented constitutes an impact pathway. The challenge is that all the flagships 'downstream' of Flagship 2 depend upon the effective and efficient operations of the NARS and development partners. Here there may be some tensions between a narrower definition of 'research', and the CRP and donor emphasis on realizing impact on the ground and developing capacity of local partners which tend to encourage a more active engagement of CRP researchers in activities that may be defined more as 'development'.



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Figure 7: Flagships represent a pipeline leading to dissemination and adoption of crop improvement products and to impact on livelihoods.

(Source: Dryland Cereals extension proposal, 2014)

- *What is the rationale for inclusion of the four crops in Dryland Cereals-CRP (pearl millet, sorghum, barley and finger millet) and is there added value from this crop combination?*

The combination of all four crops included in Dryland Cereals makes a coherent program covering the main crops that substitute for maize, rice and wheat in the semi-arid and arid tropics and dryland areas. Sorghum and pearl millet occupy similar agro-ecologies although pearl millet can be grown in areas too dry for sorghum. All four crops provide livestock feed that is crucial during dry periods, while sorghum and barley are raw materials in the growing commercial brewing industries. In Uganda finger millet is also used in brewing.

The relevance of barley in Dryland Cereals CRP could be questioned because it is a small-grain cereal in many respects similar to wheat. However, barley has much in common with millets and sorghum when grown in the dryland (marginal) regions of South Asia and Africa – they are all ‘resilient’ crops. Barley is climate change friendly (with the proviso that it does not tolerate flooding and is prone to lodging) and will remain important in marginal areas where livestock have to be fed on-farm. In addition, dryland barley is a winter crop that can complement millet and sorghum summer crops. Barley is becoming increasingly important as a fodder/feed crop and performs better than heat-tolerant wheat, a potential competitor, in conservation agriculture and under extreme water-limited conditions. In North Africa, West Asia and Ethiopia, barley is also used as a food crop, for example for bread making and/or mixed with whole wheat flour for use in some traditional dishes. Hence there is increasing emphasis in breeding for improved nutritional value. The inclusion of malt barley in the research agenda adds value to the crop and creates a new source of income – important in Morocco,

Ethiopia and India. The Indian brewing industry currently guarantees the barley grain price; low prices were previously an obstacle to growing it in preference to wheat.

Were barley to be included in the Wheat CRP, it is possible that it would represent a poor fit in many of the wheat-based farming systems being researched and could be neglected if the attention paid to wheat were to dominate¹⁶. Under dry conditions and in rotation with legumes, for example, barley will have a secure place in the new Dryland Cereals and Legumes Agrifood Systems CRP (DCLAS).

The commonalities among the four Dryland Cereals, for example, their climate resilience, their importance as a staple crop in vulnerable areas, their multi purpose uses, etc. create opportunities for synergy in research and development through a critical mass of research under the Dryland Cereals CRP. While breeding programs for the four crops must be to some extent separate due to differences in their breeding systems (related to genetics, pollination etc.), the research *tools* are largely the same and research challenges are similar; for example, breeding for different grain and biomass requirements, tolerance to drought, low soil fertility and resistance to pests and disease. Much of the research under Flagship 3 is common to all four crops – integrated crop and pest management with common topics such as Striga control, weed control and yield enhancement through fertilizer micro-dosing. Similarly for Flagship 4, where inadequate seed systems are the main constraint to adoption of improved varieties and solutions such as the development of hybrid technology and promotion of small seed packs are common interventions across more than one of the four crops. Much of the post-harvest and value addition agenda, for example on nutritional value, processing and product development and shelf life, is common to the four crops. Research on regional and national socio-economic, market and policy contexts (Flagship 1), gender analysis and institutional analysis is relevant to all crops in a specific agroecology and country. Methods and frameworks for analysis are shared (e.g. baseline studies for the HOPE project, gender case studies, value chain studies etc.). Furthermore, efforts in training and capacity strengthening with country partners can be enhanced as national organisations deal with several of the crops.

The four crops together provide food, feed and income in the dry agro-ecologies covering the Near East, Middle East, North Africa, South Asia and sub-Saharan Africa. There are strong arguments for addressing the research challenges under a common framework such as the Dryland Cereals CRP. The extent to which the potential synergies have been realized to date are discussed in sections 5.2 and 5.3 of this report.

➤ *To what extent has Dryland Cereals used unrestricted programmatic funding (W1, W2) for leveraging complementary bilateral funding and alignment of bilateral projects within the program strategy?*

There is no evidence that Dryland Cereals has leveraged bilateral funding, as the main bilateral project mapped to the CRP is the HOPE project and this project began before the CRP. HOPE has been the principle implementation instrument for Dryland Cereals and there is very close alignment between

¹⁶ Barley scientists met by the evaluation team indicated the critical important of Dryland Cereals funding, noting that while sorghum and millet have large bilateral funds, barley without the CRP would have a problem.

the CRP and HOPE as to a large extent they share target countries and target crops - pearl millet in Africa and Asia, sorghum and finger millet in East Africa¹⁷ and post rainy season sorghum in India¹⁸.

With respect to Flagship 3, HOPE contributes through activities on pest and disease management and the development and promotion of crop management technologies¹⁹. HOPE also implements activities related to improved seed systems that contribute to Flagship 4 of the CRP²⁰. The extension and a new phase of HOPE will be important to continued operationalization of the Dryland Cereals. Another bilateral project, which started in 2011, Sorghum for Multiple Use (SMU), EC-IFAD funded, is contributing to sorghum value chain development work under flagship 5 in Kenya and Tanzania.

Of the four new bilateral projects mentioned in the Extension Proposal, two of these target downstream activity, rather than breeding and therefore fit well with Dryland Cereals strategy, but the evaluation team have no information on donor decision making to know if the Flagship structure of the CRP encouraged them to award these projects to ICRISAT.

- Boosting Sorghum Production, Commercialization and Industrial Utilization through Value Chain Public-Private-Partnerships funded by the Federal Ministry of Agriculture and Rural Development, Government of Nigeria, (USD 2.757 million from 2013 to 2016)
- Africa RISING's large-scale diffusion of technologies for sorghum and millet systems in Mali, supported by USAID, provides a total budget of US\$ 3,565,636 to the Lead Centre and further funding in phase 2.

3.3 Comparative advantage

➤ *Is there a comparative advantage of Dryland Cereals CRP with respect to CGIAR's mandate compared to other international initiatives and research efforts, including the private sector, national research institutions or development agencies?*

Dryland Cereals research at ICRISAT and ICARDA has a comparative advantage in genomics and pre-breeding of the four dryland crops in its mandate and the breeding materials distributed to NARS and other partners constitute International Public Goods relevant to India, Africa and dry areas in other parts of the world. Although crop improvement is the main area of comparative advantage at ICRISAT and of Dryland Cereals, the CRP offers the opportunity to facilitate partnerships for work across the flagships. Most NARIs, just as the CGIAR Centers, have a limited mandate for development activity and therefore must conduct their outreach work mainly through partnerships. Also, the Indian and African NARS have not had the necessary expertise in seed systems. The Dryland Cereals CRP widens the reach of Center focused dryland cereals reach by convening new partnerships and activities across regions and crops to address dryland cereals integrated value chains.

¹⁷ <http://hope.icrisat.org/women-farmers-reaping-benefit-of-improved-finger-millet-cultivation-in-western-kenya/>

¹⁸ <http://hope.icrisat.org/seed-consortium-strengthens-postrainy-sorghum-seed-value-chain-in-maharashtra-india/>

¹⁹ <http://hope.icrisat.org/wp-content/uploads/2013/10/hope-rabi-sorghum-production-tech.jpg>

²⁰ <http://hope.icrisat.org/hope-transforms-farmer-livelihoods-by-improving-access-to-sorghum-seeds-in-tanzania/>

Some concerns remain over the extent to which Dryland Cereals is delivering IPGs for poor farmers with respect to outputs related to dryland cereals. Product Line 7 on Post Rainy Season sorghum focuses entirely on India. This makes sense for India, in that this corresponds to current trends in crop expansion and addresses needs in the seed system, but application to Africa is limited. There is also the challenge of promoting hybrids in more marginal areas which are of limited interest to private seed companies. Improving understanding of the incentives and conditions for private sector seed companies operation in these areas is important in order to plan efficient complementarity between public and private sector efforts.

Similar concerns exist with respect to Product Line 6 [Pearl Millet for East Africa and South Asia] because most of the activity is focused on India. Although high yielding hybrids suitable for East Africa have been identified with a potential for 30-50% yield advantage over OPVs, it is unknown what proportion of African pearl millet growers can benefit from hybrid technology. Furthermore, the Indian government IPR restrictions on transfer of ICRISAT germplasm to Africa (if it contains any background of Indian origin) has until November 2015, prevented transfer of material. ICRISAT management have engaged in finding solutions to this, and a backlog of pearl millet material from ICRISAT has recently moved to Africa.

More needs to be known about the yield stability of hybrids relative to varieties currently grown by most smallholders in Sub Saharan Africa and what is the potential for adoption in the short, medium and long-term. End user requirements and the benefits of crosses with locally preferred varieties have been operationalized by the Dryland Cereals CRP sorghum program in Ethiopia to deliver short season/high biomass varieties.

With respect to the four dryland cereals and with the exception of sorghum and pearl millet hybrids in India, the area where there is greatest private sector engagement is in production of barley and sorghum for malting. This is an area of expanding demand as beer consumption is increasing by 10 - 15% per annum in some developing countries and at 5% per annum on average²¹

It is important that there is continuing reflection on the extent to which public resources are used for activities that could be, and are being done by private sector brewing companies, many of which are multi-nationals. There is potential for private funding from industry, provided policy adjustments can protect industry exclusivity rights and provision for cultivating their registered genotypes. However, use of public resources should not be prematurely abandoned as it is recognized that in the short-term, incentives may be needed to stimulate private sector agri-business companies investment in value chain development which can ultimately benefit crop producers.

The relative balance of barley and sorghum research among food, feed/fodder and malt, needs careful consideration to ensure primary benefits accrue to smallholders. Support to the private sector depends on making a clear case that smallholders will benefit and that public investment is necessary in the early stages of its development.

The role of the CRP is to research these aspects and to ensure that partners have the capacity and resources to address the constraints to effective and efficient product flow along the value chain.

²¹ <http://blogs.blouinnews.com/blouinbeatbusiness/2015/04/02/growing-african-markets-thirsty-for-beer/>

- *In the different areas of research (flagship projects, Product lines/clusters of activities) does Dryland Cereals CRP play an appropriate role as global leader, facilitator or user of research compared to partners and other research suppliers?*

Dryland Cereals is a Global Leader in research with respect to genomics and aspects of molecular plant breeding. Many or most of the improved varieties of all four dryland cereal crops already released are selections from ICRISAT (ICARDA in the case of barley) germplasm or have ICRISAT or ICARDA material in their genetic background. In India the NARS have the capability in variety development and the private sector has much greater ability in variety development of hybrids, although still relying to a great extent on ICRISAT for breeding lines, or ICARDA for diverse improved germplasm of barley. Dryland Cereals CRP plays an important role as facilitator of partner linkages to establish the adoption and impact pathways for research outputs.

The potential realignment or amalgamation of Dryland Cereals CRP with Dryland Systems and Grain Legumes together with closer collaboration with CCAFS, livestock and A4NH would extend global leadership to Flagship 3 and potentially flagships 4 and 5 in dryland areas. Among the Product lines [renamed Clusters of Activities] Dryland Cereals ranks among global leaders for sorghum, pearl millet and finger millet research and for barley research (with ICARDA). The main rivals for global leadership in these crops would be national and advanced research institutes in China, Brazil, Australia and USA for sorghum and in India for sorghum, pearl millet and barley, but in terms of research relevant to dryland cereals and smallholder farmers in Africa, ICRISAT and ICARDA are the global leaders in germplasm collection, exploitation and development and in understanding target agro-ecologies and cropping systems and their future development.

3.4 Dryland Cereals: Research priority setting and targeting

- *Does Dryland Cereals target an appropriate set of Intermediate Development Outcomes (IDOs) and do the activities cover and/or make reasonable assumptions about the results of other actors' work for achievement of program objectives?*

The five IDOs targeted by the Dryland Cereals are appropriate to contribute to the SLOs and to address the major challenges facing dryland cereals development. IDOs 1 and 4 are linked to the SLO *reducing rural poverty* through their focus on improving productivity of dryland cereals and generating equitable income. IDO 2, Increased and stable access to dryland cereal food feed and fodder relates to the SLO, *improving food security*, while IDO 3, increased consumption of nutritious dryland cereals, contributes to the SLO *improving nutrition and health*, particularly through work on increasing the nutritional content of dryland cereals. IDO 5, increased capacity to adapt to environmental variability and change, is contributing to the SLO, *Sustainable management of natural resources*.

However, some challenges remain with respect to achieving those outcomes:

- Assumptions about the capacity of NARS and development partners to improve seed access and strengthen input and output markets are optimistic.
- Baseline data is inadequate for some of the targets to be able to measure progress towards the 10-year targets and to what extent they are eventually realized. There is less consistency in coverage of food security, consumption, nutrition and income from sales.
- Some of the IDO indicators are difficult to quantify such as increase in profitability and decrease in length of hunger period or improvements in nutritional status, particularly as these are to some extent household-specific.

The large number of activities and targeted outputs in the Dryland Cereals CRP proposal appeared over-ambitious even with the original budget. For areas such as crop management and new areas of seed systems and post-harvest and value addition, the assumptions were that funding would be available that could engage appropriate skills and participation from partners. However, NARS and most of the development partners receive funding that is insufficient to make their full contribution to the impact pathway. NARS in India and Ethiopia are well funded by Government, but less so in other countries in Africa. Resources and human capacity among partners remain a constraint to delivery of impact.

- *Have constraints to outcomes and impacts been considered in the program design, for example through assessment of the assumptions and risks in reliance on policies, actions of national institutions, capacity and partnerships?*

Constraints were evaluated in the CRP proposal from the perspective of the farmer, e.g. poor access to seed and to information about improved varieties and the crop management packages. These constraints were known when the CRP proposal was written and have been confirmed in HOPE project baseline studies. However in program design, insufficient attention was given to poor institutional development, policy and to the capacity or incentive for partner engagement. Subsequently, efforts have been made within the constraints of the budget to invest in capacity development through the scholarship program and to support partner engagement through the commissioned and competitive grants program.

National institutions, their capacity and partnership with Dryland Cereals CRP are strong for India but less so for Africa although there is growing capacity in Morocco, Kenya and Ethiopia²². Constraints to delivery of outcomes and impact are less therefore for India than for Africa, and particularly so for breeding [Flagship 2] and seed delivery [Flagship 4] compared to crop management or post-harvest (Flagships 3 and 5).

Poor access to seed and to information about improved varieties is mentioned as the key constraint for almost every product line. The only exceptions are for hybrid seed of sorghum and pearl millet in India and for farmer groups contracted by private agri-business companies, where there are elements of vertical integration through the provision of seed and other inputs or input credit. Strict adherence to the regulations associated with the formal seed system may be constraining dissemination of improved varieties. Where policies have been implemented for Quality Declared Seed [or similar e.g. 'truthfully labeled seed'], in Tanzania for instance, dissemination and adoption levels improve (Granqvist, 2006). However, the informal seed system requires much more research and development.

- *Have the Dryland Cereals research activities been adequately prioritized in line with beneficiary needs, resource availability and partner needs and with respect to climate change?*

In developing the Dryland Cereals extension proposal, there was a further attempt to extend the data on which prioritization was based. This included projections of demand as well as existing areas and populations associated with the crops. Prioritization also has to be informed by national and regional policies and planning processes through participation in collective reflection at various levels, from

²² As evidenced from discussions in meetings with country partners and from reports.

farmers to policy makers. Dryland Cereals is producing regional and international public goods, but actual implementation requires more country level engagement in planning, involving Center scientists, research partners, development partners and farmer organization working together, collecting evidence on which to base country level integrated plans across all flagships. The need for more country level engagement has been recognized in the planning for the next phase of the program, for the development of country level strategies and integration of action sites.

Dryland Cereals has a major contribution to make on issues of Climate change, given that it operates in marginal areas that are particularly sensitive to changes in rainfall patterns. Pearl millet, and in some cases sorghum, represent the only realistic possibility for future crop production in many areas, especially Sahelian environments that lack irrigation potential, if rainfall patterns continue to flout the long-term norms (in the 300–600 mm isohyet of WCA peak rainfall is falling and the rains are finishing earlier). This will include production of grain for human consumption and stover for livestock feed. Pearl millet is also set to make a comeback in the drier areas of East Africa, where it was once grown extensively, if climate change impacts are as predicted and rainfall patterns change. Biotic factors such as maize lethal necrosis disease could also have an effect on cropping systems in Africa.

From a breeding perspective, it appears that hybrid varieties have the potential to outperform OPVs in many environments, although there remain many areas where traditional varieties are grown because hybrids have not been developed to target dry marginal areas and those available require higher levels of inputs which are a risky investment, or do not meet taste criteria. DCLAS, in order to remain relevant, will have to prioritize those crops, varieties and regions most in need of assistance to address the impacts of climate change. These are likely to be in the WCA and ESA regions where national infrastructures are most in need of support in addressing the challenges of climate change. It is suggested that breeding sweet sorghum for biofuel as has been done in India, is less relevant for the program than breeding for grain and stover yield.

Efforts have been made to prioritize Dryland Cereals CRP activities towards the needs of the beneficiaries, drawing on studies on constraints and opportunities in the respective crops, cropping systems and value chains. The Dryland Cereals proposal, 2012 identified two broad target beneficiary groups, subsistence and market oriented farmers. These categories were seen as part of a continuum rather than distinct separate groups, but the distinction led to recognition of their different constraints, production objectives and hence different research needs. For subsistence farmers, the emphasis was put on improved food security, preferred qualities for food consumption, yield stability and risk reduction, with limited additional investment, while for market oriented farmers, the focus was hybrids with traits and quality required by the market, technologies which require additional investment. This distinction appears to have been dropped in subsequent documents without explanation why it was considered no longer relevant. It is important to understand the scope and limitations of different technologies for different target groups and agroecologies.

The Dryland Cereals CRP has provided a focus for collaboration with the private sector, producing and giving access to hybrid parental material with demonstrable yield advantages over open pollinated varieties and through new product and market opportunities and seed systems. However, further information on the performance of hybrids for African smallholders across different resource endowments, including in the most marginal areas, would provide the rationale for deciding on the proportion of resources devoted to hybrid technology development for Africa; in particular, the extent

to which increases in productivity and profitability from use of hybrids can be realized by input constrained and water-scarce African smallholders and challenges of seed access can be overcome. Dryland Cereals is beginning to accumulate important evidence in these two areas, but this needs to be clearly articulated.

With respect to crop and natural resource management, good quality, appropriate research is being done, for example, on fertilizer micro-dosing, which is a 'poverty-friendly' technology. It is not so certain that some of the work on mechanization and conservation farming is equally appropriate. There is little evidence that conservation farming can work for low-input agriculture²³ and the majority of farmers in SSA are a long way from mechanized farming based on fossil fuels, although there is ample scope for wider use of animal draught providing that the support services can be developed. The point is not that the Dryland Cereals should stop supporting work on mechanization and conservation farming but that more could be done to link the level of technology under research to the resource level of target communities.

A relatively high proportion of Dryland Cereals resources (37% of 2014 budget) is allocated to Crop Improvement research. However, different regions vary in their capacities to implement the research. India has a strong national agricultural research system with well-equipped national research stations and an expanding private sector seed system which is not dependent on international public finance. Africa, and particularly West Africa, has weaker national research systems in terms of staff, facilities and resources, and a much less developed private sector. There are also challenges to recruitment of staff. Budgets are allocated under each Flagship so it is difficult to assess the proportion of the total which is allocated and transferred to different regional operations. Steps are being taken to support infrastructure development, for example, for the renovation of an irrigation system for managed drought experiments at the semi-arid agricultural research station in Uganda (NASARRI). The potential for Dryland Cereals research conducted in India to benefit Africa has been constrained by obstacles to germplasm transfer from India to other countries. However, in November 2015 a solution to this blockage was reached. A review of the allocation of the CRP resources would be a useful step towards rectifying some of these imbalances. This applies particularly to the pearl millet and sorghum work in West Africa, where demand for grain is expected to increase by at least 300% by 2050. Careful priority setting will become even more important in the future, if dryland legumes and systems are included in a combined Dryland Cereals and Legumes Agrifood Systems CRP.

It is appreciated that the Dryland Cereals has limited its activities to a specific set of countries in Africa and among those countries emphasis has differed for a variety of reasons. Political instability has impeded work in some important zones. It was previously suggested in the Phase I evaluation of HOPE that project staff needed to be placed in the larger areas of production of target crops and that the project could not succeed without succeeding in Nigeria. Despite the security situation, some activities are being achieved by a sorghum breeder and local research partners in Northern Nigeria. Overall, given the limited resources available to Dryland Cereals, the work carried out to date has been very relevant to those countries in which it has worked.

²³ Baudron, F., Andersson, J. A., Corbeels, M. and Giller, K. E. (2012), 'Failing to yield? Ploughs, conservation agriculture and the problem of agricultural intensification: An example from the Zambezi Valley, Zimbabwe', *Journal of Development Studies*, Vol 48, No 3, pp 393-412.

3.5 Impact pathways and link to IDOs, assumptions and risks

- *Do the impact pathways logically link the principal clusters of activities to the IDOs and are the IDOs linked to the SLOs through plausible theories of change that take into account trade-offs between multiple objectives?*

The Dryland Cereals proposal (2012) gave limited attention to how research outputs would be translated into outcomes and impact and lacked evidence of engagement with development partners or other value chain stakeholders at the end of the research-to-development continuum in developing the Dryland Cereals priorities and agenda. Further development of the intermediate development outcomes, conceptualization of partnerships and a generic impact pathway for Dryland Cereals, were formulated in 2013²⁴. A simplified depiction of the ‘delivery pipeline’ with its interlinked ‘flagships’ (figure 7), was included in the Dryland Cereals extension proposal. However, this depiction did not show the actors or institutions needed to ensure the components are delivered and the connections made between them. The vision of interconnected flagships delivering along the value chain requires more concerted effort to ensure its realization. The intention underlying the current flagship structure was to highlight the profile and importance of these different elements. This is commendable, but has to an extent weakened understanding of the crop/region/ beneficiary categories originally utilized to define the program structure and focus. The original terminology of ‘product line’ was unfortunate in downplaying the interlinked relationships involved in achieving outcomes and impact for each crop/region/beneficiary type.

A theory of change defines the “*expected changes and benefits for the next users of these outputs, and what needs to occur for these outputs to be translated into outcomes among the targeted groups*”²⁵ The theory of change diagram from the Dryland Cereals extension proposal (figure 8) depicts the broad logical pathway from research activities across the flagships linked to different crops and regions, to a series of research outputs and research outcomes, to intermediate development outcomes and finally strategic level outcomes (or impacts). It shows the cross-cutting areas of partnerships and gender informing the research process, the behavioral change and capacity changes at outcome level and the assumptions that link outputs to outcomes. This is a stronger depiction of how the Dryland Cereals is to bring about change and the intended results, but it requires a stronger accompanying narrative explaining the specific linkages and causalities and differentiating the roles of different types of partners and how Dryland Cereals will engage with them.

²⁴ CGIAR Research Program on Dryland Cereals 2013. Concept note on Intermediate Development Outcomes, Phase II. Sept 2013.

²⁵ Strategy and Results Framework (SRF), 2016-2030. May 2015
<https://library.cgiar.org/bitstream/handle/10947/3865/CGIAR%20Strategy%20and%20Results%20Framework.pdf?sequence=1>

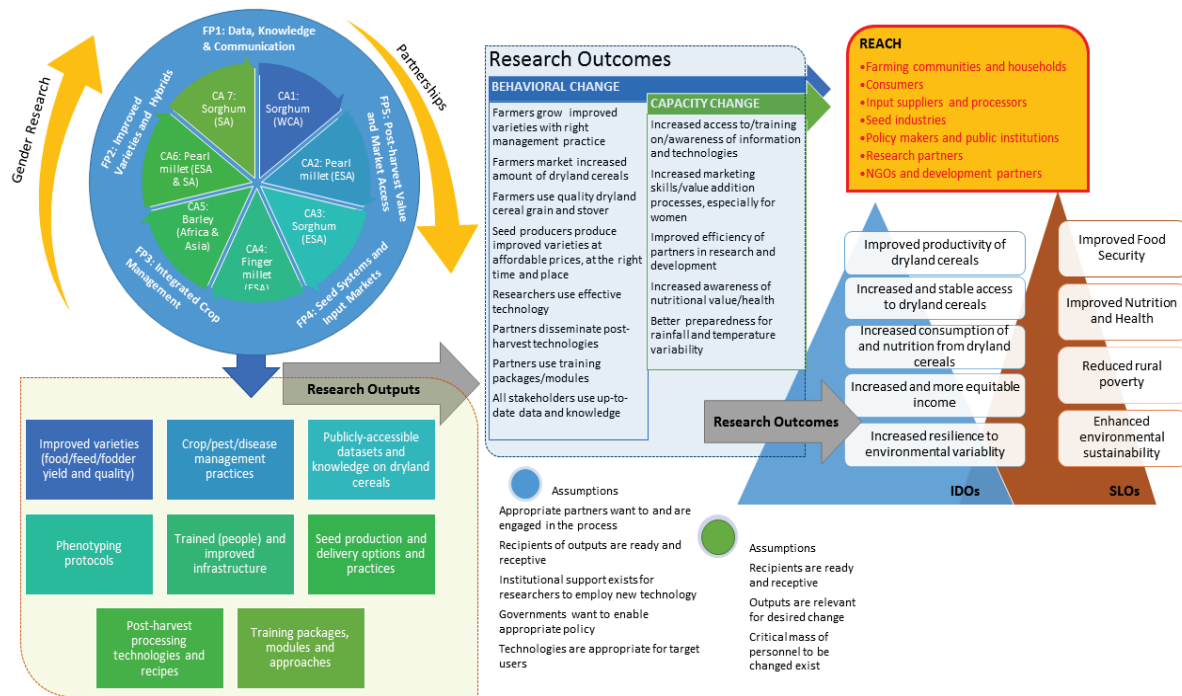


Figure 8: Dryland Cereals CRP Theory of change

Source: Dryland Cereals Extension proposal.

The assumptions are the necessary conditions to be established in order to achieve results at the next stage. For example, ‘Appropriate partners want to and are engaged in the process’ and ‘technologies are appropriate for target users’ – are both areas where Dryland Cereals researchers would be expected to make efforts to identify and engage with appropriate and willing partners and through gender sensitive needs assessment and priority setting, on-farm testing and farmer feedback, have established which technologies are appropriate for target users. The two assumptions ‘Governments want to enable appropriate policy (for dryland cereals)’ and ‘Institutional support exists for researchers to employ new technology,’ do not appear to link with areas of activity and output shown in the theory of change diagram, although policy makers and public institutions are included in the ‘reach’ box and seed policy and institutional capacity are important constraints to uptake. The stakeholders listed that are reached by the project are not linked with particular outcomes and are not well differentiated, including in terms of gender. The two impact pathways for subsistence and market oriented farmers which were highlighted in the original program proposal narrative are not indicated in the diagram.

In terms of its function in Dryland Cereals, the theory of change does not appear to be used as the basis for a monitoring framework or reflection on what is being delivered and what more is needed. It shows the dimensions of the intervention and broad causal pathways leading to impacts, but it does not indicate how specific connections at different stages of the impact pathway will help to deliver these changes, nor does it identify potential trade-offs between different elements. The diagram of the impact pathway/delivery pipeline (figure 7) is more commonly recognized in the program as encapsulating the CRP logic of delivery. This is possibly related to the lack of experience with formulating and using theory of change rather than impact pathway mapping which has been part of CGIAR Centers’ planning processes for some years.

Dissemination and adoption of breeding products depends on the successful implementation of activities and engagement with partners further down the impact pathway. The challenges differ according to country, region, crop and circumstance, but include limited national capacity for participatory adaptation of technologies to local agro climatic conditions and weak linkages to farmers, NARS, policy makers, seed systems, food based enterprises and markets that can make use of research products and knowledge for improved incomes and nutrition. Key to the 'delivery mechanism' to farmers are development partners, extension service providers, farmer organizations and NGOs and the private sector actors, traders, private seed companies, processing industries.

3.6 Recommendations on Relevance

Overall, the Dryland Cereals CRP is considered to be relevant in terms of its crops and locations, poverty focus, integrated value chain perspective, nutritional contribution and potential for enhancing resilience to climate variability. It has helped to increase relevance by convening new partnerships and activities across regions. However, different regions vary in their capacities to implement research. India has a strong national agricultural research system while Africa has weaker national research systems. Program targeting and prioritisation could be refined with respect to different farmer production objectives, access to resources, market requirements and incentives.

1. **In view of disparities in regional research capacity, Dryland Cereals' relevance to Africa could be boosted by reviewing priority setting and actual resource allocation for regional research activity clusters and flagships.** It is suggested that this review be conducted by Dryland Cereals management and flagship leaders with advice from the steering committee. It could consider increasing support for development of facilities and staff in areas which have the potential to deliver benefits to large numbers of poor farmers in the driest areas, for example, the pearl millet and sorghum work in West Africa.
2. **In planning research to be conducted under the flagships, it is recommended that the CRP management and flagship leaders consolidate evidence linking the level of technology to be developed and promoted, to the resource level of target communities.** This might include:
 - Generating further information on the performance of hybrids (costs, benefits and risks) for African smallholders across different resource endowments in order to develop a rationale for the proportion of resources devoted to hybrid technology development for Africa and more precise targeting.
 - Developing complementary strategies which match technologies to producer and consumer requirements and resource levels e.g. multiple uses for food and livestock feed or varieties for a specific market requirement; suitability of conservation farming for areas with different human and natural resource endowments.

4. QUALITY OF SCIENCE

4.1 Quality of research outputs

- *Does the research design, problem setting and choice of approaches reflect high quality and up-to-date scientific thinking, state of the art knowledge and innovative implementation?*

The science that underlies the breeding and research programs in FP2 was well established in the original breeding programs of ICRISAT and ICARDA. Dryland Cereals has built on this during the two and a half years of Phase I.

During field visits and interviews with scientists, the evaluation team observed that the application of modern breeding methods, including molecular techniques, differed according to crop and region. Developing marker assisted selection (MAS) systems for some of the principal stresses and characterizing germplasm are standard for the four mandate crops but expectedly, for example, methods are better developed for barley than for finger millet. Research and breeding design and approaches are generally appropriate, but not always sufficiently methodologically up-to-date, particularly with respect to data collection and analysis. A serious constraint to modernization of the breeding programs is that computerized field-books and electronic data capture have not become standard. This is a limitation particularly in sub-Saharan Africa where application of modern methods is hindered by insufficiency of facilities, including basic field facilities, and restricted availability of even standard equipment such as computers. Introduction of electronic data capture will make breeding more efficient and improve resource use efficiency, especially for time, and the errors inherent in transcription of information collected from the field in outdated notebook form will cease. Dataloggers are being used in the field at ICRISAT headquarters and in WCA, enabling data to be entered directly into a cloud-based M&E system. This system complements that of the GCP developed integrated breeding platform (IBP) with its breeding management system (BMS), which caters for more complex experimental designs and analyses than the Dryland Cereals breeding programs have been able to use so far. The perception of scientists as indicated in interviews, was that the well-established working partnership between GPC and the CRP on IBP genomics has improved the quality of science through increased partnerships in the upstream research area.

Some members of the Dryland Cereals CRP advisory committee felt that the committee has not had sufficient opportunity for meaningful discussions and interactions with the Dryland Cereals participants and hoped that in the future, they would have increased possibilities to spend more time talking with breeders and researchers about research direction, methodological challenges and resource requirements. It is very difficult for the committee to advise on science if it is not sufficiently informed what the breeders and researchers are doing. The evaluation team encourages the CRP scientists to make increased use of this available source of expertise.

The quality of research on crop and natural resource management is good, despite the comparatively fewer publications in this area. Research on fertilizer micro-dosing, which is a 'poverty-friendly' technology, has been productive²⁶ and the HOPE website has examples of microdosing success

²⁶ Ibrahim A, Pasternak D and Fatondji D. 2014. Impact of depth of placement of mineral fertilizer micro-dosing on growth, yield and partial nutrient balance in pearl millet cropping system in the Sahel. *Journal of Agricultural Science*. doi:10.1017/S0021859614001075

stories²⁷. There has been useful research on the benefits of improved germplasm under low fertility conditions²⁸. Fertiliser micro-dosing in combination with improved seed has been an important success story for FP3. Further work could benefit from taking more account of production efficiency and economic benefits, in addition to crop yields.

Regional testing of germplasm and technologies could be usefully expanded to ensure that breeding efforts do not become too narrowly focused on local problems and constraints to production. Data from regional trials should provide details of specific traits so that germplasm suitable for local conditions can be identified. This requires the development of shared and searchable databases. Science quality within Dryland Cereals could be enhanced by CRP management promoting regular scientific exchange and networking within and across regions. There are, for example, opportunities to establish collaboration with the Syngenta Foundation Seeds2B Connect training network.

➤ *Are the research outputs, such as publications and genetic material, of high quality and quantity commensurate with the program investment?*

Research and breeding have been productive in developing adapted germplasm for the four crops, introgressing useful traits such as performance under low input and stressed environments for millets and feed quality for barley. Significant advances have been made in developing good parental material for hybrid pearl millet and sorghum breeding by public and private agencies. Increasing the emphasis on research and production of hybrid parental material is justified given the demonstrated yield advantages over open pollinated varieties (OPVs) at many sites, but the limitations need to be clearly understood: hybrids do not represent a panacea and there remains a demand for OPVs in particular environments in India and Africa. There has generally been significant documented progress in research on physiology and development of resistance to major abiotic and biotic stresses affecting the four crops, including resistance to Striga, which represents a serious constraint to cereal production in many marginal dryland environments. The MAS systems used for breeding for resistance to some of the principal stresses have helped generate elite material, parental lines and varieties with enhanced expression of desired traits. Molecular characterization of germplasm, including establishment of mini-core collections for breeders, is a further example of an FP2 output.

Regarding published outputs, the resources available for this evaluation did not allow the team to conduct a detailed analysis. However, to complement its reading of selected recent publications (see Annex 7 in volume 2) it used two recent CGIAR-wide analyses of published outputs by Elsevier that were commissioned by the Consortium Office. The first CGIAR-wide comparative study for 2003–2012 covered CGIAR centers and was used by the team as evidence of the publication track record of ICRISAT and ICARDA²⁹. This study was followed by a comparative study of research performance for all the CRPs³⁰. Based on Field Weighted Citation Index (FWCI) analysis, ICARDA and ICRISAT's

²⁷ <http://hope.icrisat.org/when-small-bits-make-a-difference-microdosing-fertilizer/>

²⁸ Gemenet, D.C., Hash, C.T., Sy, O., Zangre, R.G., Sanogoe, M.D., Leiser, W.L., Parzies, H.K. and Hausmann, B.I.G. (2014) Pearl Millet Inbred and Testcross Performance under Low Phosphorus in West Africa. *Crop Science*, 54 (6). pp. 2574-2585

²⁹ CGIAR research output and collaboration study. A report prepared by Elsevier for Consultative Group on International Agricultural Research (CGIAR), 2014

³⁰ Research performance of CGIAR research programs. A report prepared by Elsevier for Consultative Group on International Agricultural Research (CGIAR), 2014

performance in the first study was average compared with other CGIAR centers for agricultural and biological science outputs, areas where both centers published more than in the other science areas investigated. Both were above world average. The situation was similar regarding environmental sciences. In social sciences ICARDA published very little. ICRISAT's social science articles were similar in number to those of other commodity-focused centers and the FWCI was slightly above the world average. The study revealed that ICRISAT published extensively in collaboration with national partners. On the basis of these results the evaluation team considers that the publication performance of the centers in the period preceding the CRP was good based on global comparisons.

With respect to the second Elsevier publication, the analysis was based on the number of researchers mapped to each CRP (see 4.2) and publications generated by the CRPs. With respect to publishing volume, Dryland Cereals performed well in terms of the volume of publications (174 included in the Elsevier study for the 1.5 years of operation) and was above the world average as gauged by FWCI. In its assessment, the team took into account the fact that the CRP is relatively small (USD 5 million per annum) and that its cereal crops represent minor crops that are of importance mainly in developing countries, which therefore might be expected to attract less interest in leading journals and fewer citations internationally than maize, wheat and rice for instance. Nearly 40% of the CRP's publications were written in collaboration with scientists from other CRPs, which the evaluation team considers commendable. While the proportion of publications with academic-corporate collaboration was small (1.1%), and there is scope to enhance this form of collaboration, it compared well with other crop-focused CRPs (GRiSp, 1.2%; MAIZE 1.3% and WHEAT 0.7%).

Perusal of the 2014 publication list for the Dryland Cereals CRP indicates that there was little change in the statistics over the previous years. The Dryland Cereals researchers published in recognized journals, such as *Field Crops Research* and *Crop Science*, which are that read globally by other breeders and researchers and which represent the best journals for disseminating plant breeding research results. ICRISAT scientists working on crops outside the Dryland Cereals CRP have published in the highest impact factor journals, but aside from publications in molecular biology it would be unrealistic to imagine that standard plant breeding research would be published in the most high impact journals. The evaluation team noted that CRP research was also published in journals and fora that arguably lack adequate peer review. It is therefore important that research results are written up and communicated for peer-reviewed fora. The evaluation team noted a difference in the number of publications coming from WCA and ESA, more coming from WCA. The reason for this inconsistency was not clear and it would be beneficial for this to be investigated and the issues addressed by program management. In this connection, it was suggested by ESA staff that they would benefit from better international partnerships. For example, there would be opportunities for more international graduate and postgraduate work to be undertaken in ESA, particularly at Kiboko, that would lead to more publications.

Most of the publications and all the high quality peer reviewed publications are on breeding. It has apparently been more difficult to generate high quality publishable results for crop management research and seed systems research, probably because there are very few agronomists employed in the CRP, and seed systems/social science expertise is scarce for this type of Dryland Cereals research. There could be greater emphasis on raising the standard of crop management research to a publishable level: researching adapted germplasm and its management together.

The ongoing research on Striga control, fertilizer micro-dosing and soil fertility maintenance and input use efficiency of hybrids vs. OPVs represent good opportunities for publishing. Nevertheless, four crop management papers were published in quality journals – all of them from West Africa. One or more publications can be expected on seed systems when the analyses are completed under the extension and second phases of the CRP.

The publication list for Dryland Cereals for 2014 comprises 94 items. Although open to some interpretation only 10.6% of these appear to be social science related (on participation, business innovation, partnerships, adoption/impact and crop trends) and a similar number on crop management. This compares with 12.6% that relate to sweet sorghum, the remaining two thirds of the articles being mainly focused on crop improvement. Three papers in the socioeconomics discussion paper series on combined *ex post* / *ex ante* impact analysis are not listed.

There is scope for greater collaboration with staff from external organizations more used to publishing research findings. To improve the quality of science (including production of publications) it would be helpful if there were to be increased researcher exchange with partner organizations, including universities. Researchers' time for writing up research results is constrained by workloads and reporting requirements according to discussions held with the team and researchers. With greater collaboration with staff from external organizations more used to publishing research findings, the situation might improve.

➤ *Are negative as well as positive findings documented and disseminated?*

Neither the reporting system nor the peer-review publication process encourage publication of negative findings, although there are examples of this having been done on occasions (e.g. a paper on selection for mycorrhiza associations in sorghum and results on bi parental mapping population for pearl millet in West Africa). It is important that positive and negative results on use of pearl millet and sorghum hybrids in comparison with local varieties are clearly presented, in order to provide guidance and feedback to breeders.

Difficulties with yield stability under adverse conditions and more intensive management requirements for hybrids are not much publicized. Adoption studies in East Africa (e.g. Kaliba, 2014) and economic analysis of crop management interventions show that local varieties are preferred for taste and cooking quality as well as performance under low input conditions: farmer practice sometimes being the least risky option that can provide the best rate of return (see Dixit, 2012). In contrast, data from Mali³¹ on hybrid sorghum on-farm trials under farmer management, indicated a yield increase of more than 30% relative to the local variety, suggesting a low level of risk for farmers investing in hybrid seed in that situation. Two factors are pertinent – that local germplasm is used as the basis for crop improvement for sorghum in WCA and that progeny selections are made under low phosphorous conditions, which represent the typical on-farm conditions.

Two further observations can be made; firstly the importance of comparing hybrids and improved varieties with local checks under a range of fertility and input conditions. Data from on-farm testing

³¹ *Source:* Presentation by Fred Rattunde; WA Sorghum Research Highlights and issues for future consideration, CERAAS, Theis, Senegal. 13 July 2015.

under on-farm conditions are particularly important and allow scientists and farmers to make recommendations and informed choices on the use of the variety and input levels. The production objectives of different farmer categories are important – for farmers growing primarily for home consumption their assessment of cooking, taste and storage qualities will be important. For more market-oriented farmers, efficiency and cost effectiveness are important, which reinforces the need for economic analysis of input packages. The highest yield does not necessarily represent the most profitable outcome.

4.2 Quality of research staff and research leadership.

- *Is the quality of research staff and research leadership adequate for assuring science quality and synthesis at flagship and program level?*

The evaluation team drew evidence on research staff and leadership both from the cross-CRP report by Elsevier and from interactions and interviews with staff and managers of the CRP. The number of Dryland Cereals researchers, 46, used as the basis of the Elsevier analysis, was confirmed by CRP management as being accurate. The majority of the researchers have a low h-index (0-5), a quarter have an h-index of 6-15 and about 15 % an h-index higher than 15. H-index is linked to seniority but this does not explain the relative proportions, as only about 15% of Dryland Cereals researchers included in the study were junior (5 years or less from their first publications). One explanation could be that the CRP engages heavily in breeding. Collaboration and co-publishing with external partners help the Dryland Cereals' scientists to gain international recognition. The CRP is already engaged in strong partnership with numerous ARIs, for example in the USA, Europe and Australia. However, as concluded above for publications, there is scope to increase the extent of research collaboration.

In its field visits the evaluation team observed the high level of competence and dedication of Dryland Cereals CRP breeders and scientists. The breeders are open to new ideas and responsive to market pull and industry needs. The level of collaboration of breeders with leaders of other programs that are associated with breeding is good. The team saw, however, relatively little disciplinary integration of CRP activities, and this observation was also confirmed through interviews, assessment of projects and review of recent publications. There is need to strengthen disciplinary and project integration for the program to capture potential synergies, add value to its products and orient them better towards user needs.

The contribution of social scientists based in East Africa has been considerable, but there is a need for stronger research and policy contribution of social scientists in other regions, particularly regarding seed systems and post-harvest work. In some countries, national non-CGIAR institutions, including universities, have contributed to this, but more a concerted effort is needed from Dryland Cereals/ICRISAT.

There naturally remains a strong emphasis on crop improvement within ICRISAT and ICARDA and this is where their comparative advantage still lies. However, there is a shortage of staff working for the Dryland Cereals with a background in agronomy and it is hoped that the forthcoming Phase II integrated CRP will help to facilitate this. The recently appointed Leader of Flagship 3 is working with the Dryland Systems CRP and in the future this may improve the integration of variety improvement with the development of crop management packages. However there will continue to be heavy

reliance on the NARS for research and development of crop management packages but it is to be hoped that the Flagship Leader can provide the strategic direction.

4.3 Management of research output and quality.

- *Are the internal processes, conditions and incentives sufficient to ensure high quality research and timely delivery of outputs across the program?*

The parallel and complex management and governance structures of the Dryland Cereals CRP and ICRISAT have created internal processes that can represent a barriers to high quality science. These are discussed in section 6.1. The survey for researchers asked a question about how effective the Dryland Cereals CRP has been in ensuring the quality of research (Figure 9). In particular, researchers appreciated the availability and quality of research support staff. While the survey did not reveal a high level of dissatisfaction with technical facilities and equipment, the team observed a large discrepancy among the regions in this regard, as mentioned above. Learning aspects, innovation and risk taking and performance incentives were regarded as being less effectively ensured.

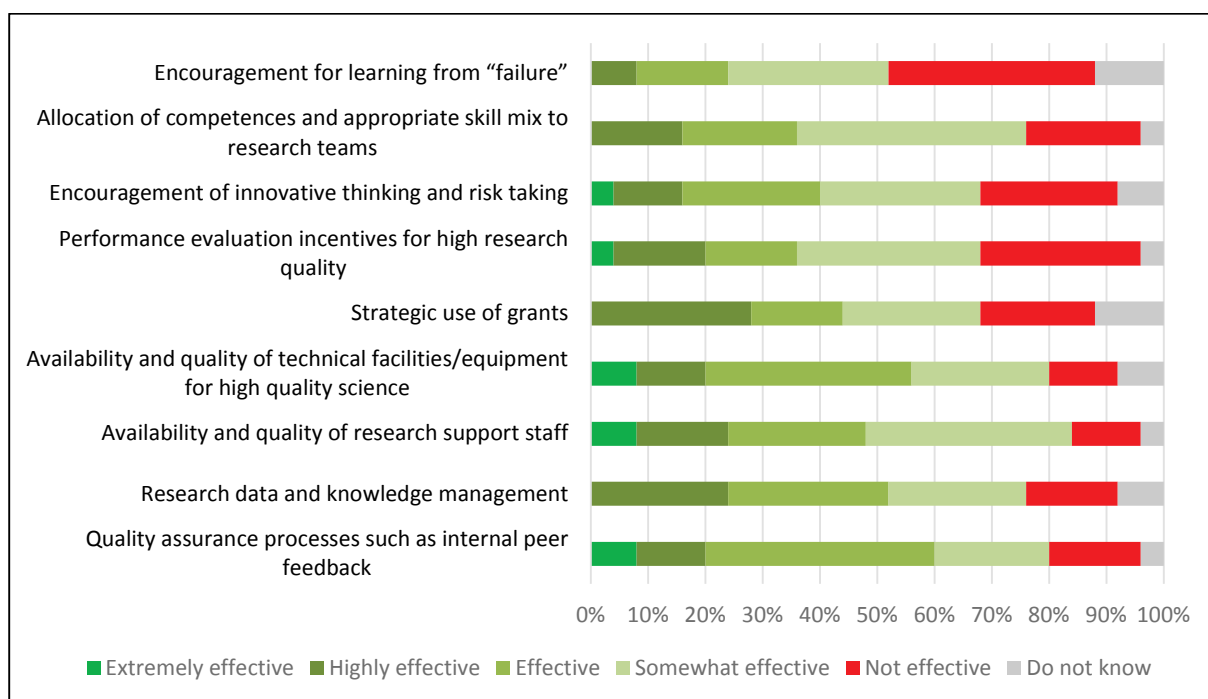


Figure 9: Researchers view of the effectiveness of Dryland Cereals in ensuring research quality
(Source: Researcher Survey, October 2015)

Regarding incentives contributing to the quality and effectiveness of scientists’ research, the following were highlighted by scientists in the survey as being important (table 3). While salaries, equipment and facilities were mentioned, important incentives for high quality scientific work lie in recognition by peers, management and the public.

Table 3. What would you consider as the most important incentive used in your Center to enhance the quality of science?

Incentive	Responses
<i>Annual performance assessment and salary increments</i>	7
<i>Recognition of individual scientists and teams by management, or peers or both, e.g. scientist of the year award</i>	6
<i>High quality scientific publications, public display of papers published</i>	3
<i>Scientific freedom - freedom to work and plan experiments</i>	2
<i>Broad expertise available (science and economics, inclusive market oriented development, impact assessment)</i>	2
<i>Access to operational resources, office, equipment, lab facilities</i>	2
<i>Good coordination, Interaction with Program Director</i>	2
<i>Well funded research</i>	1
<i>Collaboration with advanced institutes such as USDA and universities</i>	1
<i>High expectations of our National partners that ICRISAT deliver useful results</i>	1
<i>None/ no clear incentives</i>	2

One major area in which there could be significant progress in the future is through the inclusion of social science research in the breeding research, and in research on end use in particular. This will ensure that efforts are better directed to the needs of dryland farmers and markets for dryland cereal products, including those for grain, seed, feed and forage. The publications record could be strengthened in terms of more publications in high impact journals, more balanced representation from the different regions and increased numbers of social science publications.

Differences in the Quality of Science among the breeders and researchers in the Dryland Cereals CRP can often be associated with regional differences in facilities and staff available. Such differences are expected, but nonetheless affect the science done and the possibilities to write high quality publications. An important question is whether the Dryland Cereals CRP is taking the right steps to bring the level of ‘regional’ science up to the level of HQ/Indian science. In addition to the discrepancy between regional facilities and ICRISAT HQ facilities, there is often a discrepancy between NARIs facilities and those of ICRISAT: NARS’ resources are scarce for on-farm adaptive research and demonstrations. This has an effect because there is reliance on NARS for the adaptive research that is so important for the adoption of technologies.

4.4 Recommendations on Quality of Science

- 3. The application of modern breeding methods, including molecular techniques, has untapped potential.** Modernization is needed in terms of data collection and sharing, storage and accessibility, using computerized field-books and electronic data capture.
- 4. Further effort in regional collaboration, exchange and data sharing** is recommended in order to leverage research outcomes within national agricultural research systems, particularly on hybrid sorghum and pearl millet, encouraging private sector collaboration where possible. Increased

researcher exchange with partner organizations, including universities and better cross-regional collaboration would help to improve the quality of science and encourage production of publications, (including social science and crop management publications) particularly from underrepresented regions.

5. **Strengthening of disciplinary integration of CRP research activities** could add greater value to the research and its products and make the most of potential synergies. Closer integration of social science and policy research and agronomic skills in all regional teams would better direct efforts to the needs of dryland farmers and diverse markets.

5. EFFECTIVENESS

5.1 Delivery of outputs and outcomes

- *To what extent have the planned **Outputs and Outcomes** been achieved or are likely to be achieved within the planned time frame?*

The program is targeting 20% of the total area of dryland cereals of 60.1 million ha (11.8 million ha) and 5.8 million farm households, affecting a total population of 34 million. The aim over a ten year period is to achieve a sustainable 16% increase in dryland cereal farm level crop productivity and in total crop production. This is estimated to allow an additional 39 million households in the countries of the target regions to meet at least 30% of their energy requirements from dryland cereals³².

A proper monitoring and evaluation (M & E) system associated with the CRP or within ICRISAT would make it easier to assess output delivery and progress towards achieving overall targets and specific intermediate development outcomes. It would help to ensure that activities were directed towards achieving outputs in the proposal logframe. The Annual Report does not report achievements against output targets as numbered in the CRP proposal. However, by going back to the Annual Reports of individual product line/crop cluster Leaders, and cross checking with information from interviews, it can be seen that Dryland Cereals CRP is delivering useful outputs from new research and outcomes from legacy research that impact on improving food security, nutritional status and income. Some outputs have been delivered for most of the targeted outputs in the original logframe. There are some gaps with respect to Flagship 4, but gaps are most evident in flagship 5 (this was explained by funding shortfalls).

Because there is no fully integrated system showing time-bound milestones relating to output targets for the whole duration of the project and the IDO indicators are only those for the end of the CRP after 10 years, it is difficult to know if outputs so far delivered represent reasonable progress towards final targets. Annex 8 summarises available information. Legacy work (e.g. adoption of improved varieties released by the Dryland Cereals Programme before the CRP) and lack of adequate baseline data make it difficult to assess the extent that new research initiated under the CRP will deliver expected outcomes (in terms of IDO targets and indicators) by the end of the 10 year proposed period of the program. The potential is certainly there for most of the outcomes to be achieved.

Flagship 1, Priority Setting, demand analysis and adoption tracking is assessed based on work since the start of Dryland Cereals in value chain analysis, demand assessment and priority setting; baseline data and intervention planning and country level analyses, monitoring and evaluation³³ and communication and learning platforms. Dryland Cereals has carried out baseline studies for different crop-country combinations; many carried out under the HOPE project. They include baseline surveys of sorghum and millet production in Mali, Niger and Northern Nigeria; a baseline for sorghum and finger millet in Ethiopia and Tanzania; for barley in Ethiopia, India and Morocco and for post rainy

³² Dryland Cereals CRP Proposal, August 2012, p14

³³ Further discussion of M&E issues is in section 6.4

sorghum in Western Maharashtra, India. An economic analysis of improved varieties and crop management practices for sorghum and millet was completed in Kenya and Tanzania.

The study designs, tools and templates were not uniform and hence not easy to consolidate at the country, regional or CRP level. Given that the M&E framework of the CRP was not developed, the baseline studies were designed based on information needs as perceived by different research leaders in different countries. They were not designed to provide starting values on various IDOs, sub-IDOs and other programmatic indicators as contained in the CRP design nor did they reflect the theories of change or crop-specific impact pathways visualized in the original conception of the CRP. Most baseline studies results were published around 2012 at the time when the Dryland Cereals CRP design was being developed. It is not evident that the preparation of the original proposal took heed of the baseline study results during 2012. The baseline studies provided useful information on the socio-economic profile of the farmers, varietal uptake of modern varieties and constraints that farmers are facing along the crop value chain. The studies have made a variable contribution towards intervention planning or country level strategy-making. This could be enhanced by greater involvement of scientists together with social scientists into the design of the studies and participate in result sharing sessions for deriving the implications of the findings.

The CRP conducted many consumer studies and value chain analyses aimed at understanding the research gaps at country and regional levels to facilitate research and development priority setting along the value chain. These included inclusive business models for sorghum and millets in Kenya and Uganda; demand for cereal grains and their related flour, weaning food and other processed products in Mali and Niger; studies of sorghum and finger millet flour processors in Kenya, Tanzania and Uganda; sorghum scoping study in Mozambique and dryland cereal and household food security in Tanzania. The barley team made significant achievements in identifying research gaps in partnerships with NARS in all six focal countries. As a result of value chain studies on post rainy season sorghum, value-added products were identified and profiled for business opportunities and industry preferred sorghum traits were identified. Overall, variable progress was witnessed across the regions and countries. Funding constraints have affected the delivery of the studies. More significantly, the value chain studies /demand assessments were not always timed effectively to feed into the program planning cycles. The study findings have generated good insights into farmer needs and uptake of improved varieties, but systematic integration of the results of these studies for improved understanding is lacking in some cases.

Adoption tracking and impact analysis are being done through surveys with partners, bi-lateral project M&E, scientists reporting of numbers based on personal information validated by 'circle of experts' and assessment of uptake of new varieties. It captures numbers in terms of the level of farmers reached, but not necessarily counting those who have adopted a particular technology and benefited from the adoption. Clearly adoption tracking will need a more nuanced understanding of layers of outreach and levels of adoption.

An increased emphasis on conceptualizing Dryland Cereals interventions at country and regional level, and building partnerships and cooperation with a broader range of national and local organizations and stakeholders, would help to create a platform within which issues around varietal selection, crop management, seed systems, post-harvest issues and product development and promotion could be addressed.

Dryland Cereals has designed and implemented actions on flagship -1 reasonably well. The portfolio analysis suggests that the strength of the flagship-1 actions was the socio-economic team and skills residing in ICRISAT and ICARDA for designing and conducting socio-economic research and adoption tracking (the team however could have been provided with better resources) and communication platforms and tools that CRP has developed /used, while the weaknesses were the near-absence of an effective M&E system and country level conceptualization processes which have affected the achievement of flagship-1 intentions.

The **breeding and hybrid development** work of Flagship 2 (FP2) in its seven crop clusters of activities is largely founded on heritage work undertaken over many years by ICRISAT, in the case of pearl millet, sorghum and finger millet, and ICARDA in the case of barley. The objective of the four breeding programs has been to produce advanced breeding material that can be taken up by NARS, and more recently the private sector, who breed for several more generations (or test and release) to produce crop varieties suited to particular agro-ecologies and farming systems. This approach underpins the Dryland Cereals activities.

Planned outputs and outcomes in FP2 have been largely achieved in terms of producing improved germplasm of the four cereals included in the Dryland Cereals, but unreliable funding has had a negative effect on efforts. FP2 represents the largest component of Dryland Cereals CRP in terms of budget allocation (>50%) and the associated outputs are consequently numerous and detailed. Budget shortfalls have meant reprioritization of research and some anticipated outputs have not been produced. Double haploid (DH) research for barley, pearl millet and sorghum, for example, has been initiated, but has not progressed according to plans. This has not negatively impacted the current breeding programs for pearl millet and sorghum because double haploid (DH) application to breeding is more relevant for inbreeders such as barley than outbreeders such as millets and sorghum (outcrossing inbreeder). Sorghum DH could, however, deliver true-breeding recombinant lines for breeders in a single plant generation, halving the time required to produce higher yielding, better adapted single-cross hybrids. Budget permitting, it is important that the development of this tool, which is relevant across the programme, is taken forward in phase 2.

Crop management research under flagship 3, has been targeted at areas where capacity and funding have been available. Part of what is reported under Flagship 3 is linked closely to breeding, for example, for pest and disease resistance, low phosphorous adaptation and striga resistance. FL3 research has resulted in some achievements, such as fertilizer micro-dosing, a technology that cuts across crops and CRPs, weed management, and pest and disease management. For sorghum in West Africa, research on integrated striga and soil fertility management showed an improvement in yields. In West Africa, fertilizer management options (organic and inorganic) in combination with varieties and intercropping have been tested for pearl millet. IPM options including biocontrol of millet head miner and seed treatment have been tested with positive results. In East Africa, varietal testing and participatory variety selection for sorghum were combined with water management, striga management and organic manure options. Three manuals were produced, including one on integrated striga management and micro dosing in sorghum. For finger millet, varieties, row planting, weed control management options, herbicide and micro dose fertilizer were tested and demonstrated. There were reports of improved sorghum earnings enabling farmer investment in improved living conditions. Barley research emphasised IPM, integrated management, conservation agriculture and disease management. Planned outputs were achieved for the pearl millet hybrid and post rainy season

sorghum in India, including wide scale on-farm trials, demonstrations and field days on crop management practices (seed treatment, balanced fertilizer and weed control) alongside improved varieties. Reports on post-rainy season sorghum indicate the total number of farmers reached by improved cultivars and management practices is 42,000, with farmers achieving 39% higher grain yield and 30% stover yield. More emphasis will need to be given to livestock feed and the work in Ethiopia on short season, high biomass sorghum, based on crosses with local land races, is important in that respect.

It is apparent that an exclusive focus on technical solutions will not address the yield gap challenge in Africa³⁴. Integrated crop management packages will need to be more widely adopted and successfully implemented, but only where the institutional and policy environment is conducive and where technologies are promoted to address the whole production to market chain, covering crop management, labour shortage and market access, including transport for the delivery of produce to the processor.

Seed systems and input services development under Dryland Cereals flagship 4 has made good progress where seed system development has been closely allied to crop improvement and has been developed on the basis of existing partner and stakeholder networks, for example, the Indian experience with the Hybrid Parent Research Consortium. Delivery of some targeted outputs have been delayed, mainly where a different disciplinary input is required, e.g. seed system analysis, seed market potential, studies of seed regulatory frameworks, regulations for 'truthfully labelled' or 'quality declared seed', seed policy and policy briefs, including policies on inter regional and country seed exchange, and evaluations of new initiatives such as the use of millet seed mini packs. Some of these are being addressed in the Dryland Cereals extension phase. An example of success in increasing awareness on seed issues is the Moroccan government's decision to introduce a subsidy on certified barley seed production which is expected to have significant impact on seed availability of new barley cultivars. Currently only about 1% of barley planted is from certified seed³⁵. This indicates the importance of policy engagement on the part of the CRP, informing and influencing decision makers on policies (depending on location) to encourage private sector seed production, farmer seed production and semi-formal seed systems such as Quality Declared Seed.

Most of the remaining planned activities were completed. For West Africa these included sorghum hybrid seed production and dissemination (Mali, Burkina Faso, Niger and Nigeria), an impact assessment of seed system support and a manual on hybrid sorghum seed production. The HOPE project has supported community seed production and management for pearl millet and sorghum.

In East Africa, the challenges of weak structures for dissemination of high quality affordable seeds have been well recognized. Different channels of seed supply have been identified to improve the situation, for example, supplying breeder and foundation seed to seed companies, linking local seed producers to seed companies and to agrovets³⁶ for better distribution, producing seed to QDS status, and the inclusion of seed provision and credit in contract arrangements with malt companies. Also in

³⁴ R.J.Hillocks (2014) Addressing the yield gap in Sub Saharan Africa. *Outlook on AGRICULTURE Vol 43, No 2, 2014, pp 85–90 doi: 10.5367/oa.2014.0163*

³⁵ Interview at INRA, Dryland Cereals national partners, Settat Morocco. June 2015.

³⁶ Agricultural input enterprises.

East Africa, seed business systems for sorghum hybrid seed production were promoted with seed companies and NARS as part of the Sorghum Value Chains Development Consortium. For finger millet which is of less interest to the private sector, mini seed packs were distributed in Tanzania, Kenya and Uganda and a marketing manual produced in local languages.

A seed systems study was conducted for barley in Ethiopia and farmers' seed production groups, including women's groups, were trained to produce quality declared seed of finger millet and barley (food and malt varieties). One member of a farmers' association, commenting on the change towards seed production as a business said, *“Our primary focus was on food security, but we are now past that stage; we want to produce quality malt and reorganize with legal status as producers of seeds at the national level”*³⁷. Pearl millet hybrid production has been taken up by private seed companies in India and hybrids distributed to farmers for drought prone environments. Community-based seed production systems have been promoted for post rainy season sorghum in Maharashtra State. 5000 women sorghum farmers in self-help groups and Farmers' associations were trained in improved technologies and seed production and seed business training was conducted with 30 rural entrepreneurs.

Different strategies have been appropriate for different crops and regions. In India, close links have been established with the private seed sector for sorghum and pearl millet hybrids through the Hybrid Parent Research Consortium (HPRC). This arrangement allows the consortium members (private sector companies and agricultural universities) to access a selection of hybrid parents for further development. The consortium has successfully promoted the production and distribution of hybrid seed, particularly for the higher rainfall zones and is encouraging seed production on a wider scale. There is increased interest among individual farmers, women's groups and rural entrepreneurs in seed production businesses.

Quality assurance and buy back arrangements with the seed certification agency are part of this model. 500 hectares of sorghum were being multiplied in 2014/15 to supply 100,000 ha. The public sector model, with involvement of Agricultural Universities, is important to address the seed needs of marginal zones, particularly in pearl millet and barley where the private sector is unwilling to engage. Similarly, seed production initiatives based on farmers' groups and associations exist in East, West and North Africa, in some cases existing alongside or interfacing with seed companies in the formal seed system.

Poor seed systems are considered to be the main challenge to wider adoption of improved varieties, but more needs to be done to meet the challenge. Wider use of demonstrations and access to information on improved crop varieties will help to improve adoption rates of improved varieties within the timeframe of the CRP, but there is also need for policy support for seed systems.

The HPRC model can benefit smallholders from other developing regions. It is therefore important that during the merged CRP second phase, the initiative is tested and replicated globally

³⁷ Meeting with farmers at Holetta, Ethiopia, 6 July 2015.

Flagship 5 Post-harvest value and output markets had a slow start. The targets for post-harvest research in Dryland Cereals were ambitious considering the relatively limited previous focus in this area and the lack of specialist skills in post-harvest research. The development of quality products and functioning market chains are important stimuli to the adoption of improved varieties, yet these aspects are highly demanding of resources and skills. The development of strategic collaboration with partners and projects, or initiatives with their own sources of funding (e.g. the HOPE project and the Agri business innovation but), has helped to achieve results. Nevertheless there has been significant postponement of planned outputs into the extension phase or beyond. This is partly attributed to the CRP budget cuts.

In West Africa, plans relating to sorghum marketing, grain handling and storage practices, access to inputs and financing, malting qualities and processing characteristics were all postponed to 2014 -15, although information on nutrition³⁸ and food processing was developed for farmer field schools and papers drafted on iron and zinc content.

For pearl millet, planned outputs included evaluation of appropriate machinery options for dryland cereal postharvest handling and processing and training in equipment maintenance. Other initiatives concerned warehouse receipt systems options and linking livestock owners to milk markets. With the exception of some efforts made to introduce milling machines reported in 2012, all FL5 outputs under pearl millet were postponed.

In East Africa, some outputs concerning sorghum grain marketing and models for facilitating farmers' access to inputs and finances have been postponed. Support was given to the operationalization of the Sorghum Value Chain Development Consortium (SVCDC) in Kenya which is being mentored by ICRISAT's Agri-Business and Innovation Platform (AIP) under the UniBRAIN – FARA project. For finger millet, work on post-harvest technologies included testing and modification of prototypes of small scale threshing equipment with women farmer groups and fabricators in Tanzania and Ethiopia. Women farmers were trained in finger millet post-harvest handling and value addition. Plans to develop linkages with processors and to identify processing characteristics and nutritional profiles for finger millet have been achieved to some extent. Finger millet flour has been taken up by grain millers and producers of composite flours in Uganda. Information on the nutrient quality of finger millet varieties and their milling quality and use characteristics have been shared with breeders, processors and farmers. A trainer's manual on Improving Management of Agribusiness Enterprises and Farmer Organizations was produced for training farmers and rural based SMEs in Kenya, Tanzania and Ethiopia.

For barley, planned outputs were the identification of opportunities to integrate small farmers into added-value schemes and to access market opportunities, and to make new malt barley cultivars available through NARS and private sector collaboration. The development of hydroponic barley in Morocco and Ethiopia is an example of a new market opportunity, as well as meeting demands for dry season livestock feed. Market studies and development of barley products in collaboration with local

³⁸ For work on improving the nutritional qualities of sorghum for human consumption and for fodder and improving the cereal's resistance to drought, diseases and pests, ICRISAT scientists Dr Eva Weltzien and Dr Fred Rattunde received the Justus-von-Liebig Award for World Nutrition 2015. ICRISAT Happenings. 23 October 2015 No. 1698.

partners have also taken place and locally manufactured processing machinery for production of barley flour was investigated. Improvement in malting quality is based on barley breeding work in collaboration with the private sector, followed by demonstration, selection and seed production of appropriate varieties. This is a good example of innovation in partnership with malt factories and breweries, research and extension partners, private companies and farmers organizations.

For pearl millet in South Asia, the planned outputs were processing technologies and packaging options to extend the shelf-life of pearl millet flour. 12 varieties of pearl millet were examined for the keeping quality of their flour under different storage conditions. 200 women farmers in Gujarat and Rajasthan were trained on the use of blanching to increase shelf life of pearl millet flour. Efforts to improve market access of small holder farmers started with mapping of the pearl millet value chain in Gujarat, Haryana and Maharashtra. Pearl millet consumers' behavior and purchase patterns were captured through market research.

Planned outputs for post rainy season sorghum SA have been achieved, including work on storage, development of products and packaging. A study was undertaken on sorghum business and market opportunities, processing, and strengthening farmer linkages. Positive opportunities for sorghum based value added products assisted by increase consumer consciousness of healthy foods. Research on consumption and preference has informed the 'smart food' campaign to promote millet and sorghum based foods. Sorghum (and pearl millet) snack products and Smart Breakfast cereals have been commercialized in the Indian market through SME entrepreneurs. ICRISAT's AIP Platform has been supporting two groups of women entrepreneurs with businesses in sorghum and pearl millet value chains and also ICARDA assisted women barley entrepreneurs to develop business plans and market engagement.

Collaboration with partners has been important in achieving results in this flagship, particularly in view of its limited funding. Further partnerships for development and delivery of post harvest initiatives are to be encouraged.

➤ *Is the theory of change being realized in practice and how valid are the assumptions?*

Dryland Cereals' conceptualization of the impact pathway was based on interconnections between the flagships which address range of priorities (crop improvement, crop management, seed systems and post-harvest value addition) for country-crop combinations. The translation of these priorities in a particular geography (country or specific clusters within a country) has remained a challenge for most product line and flagship leaders. Some of the CRP teams, for example the post-rainy sorghum team in South Asia, have ensured that a work program involving different actions on all flagships happens within a particular geography. There have been accomplishments in last three years through engaging with range of partners (state agriculture universities, private sector seeds companies, public sector seed corporations, academic institutions, non-governmental organizations, farmer organizations and co-operatives) for ensuring work across different flagships. Country level actualization of the connected flagships has happened also in Mali with sorghum, in Ethiopia and India with malt barley and in Tanzania with finger millet and sorghum³⁹.

³⁹ Information from meetings in country with researchers and partners, annual reports and technical reports.

Two important assumptions in the theory of change, ‘Appropriate partners want to and are engaged in the process’ and ‘technologies are appropriate for target users’ have been shown to be valid if interpreted as actions which are necessary for the next stage of the impact pathway to be reached rather than as external risks or assumptions to be monitored. In the examples above, the partner engagement in sorghum in India has been committed and technologies have been tested and assessed with farmers, with next users and in the market. However, there is a risk that with further budget cuts in the CRP, it will be more difficult to engage partners with skills needed to encourage behavioural change and build capacity – this is particularly the case for the post harvest and seed systems flagships. An important new assumption might be that funding to support such engagement is forthcoming from compatible bilateral projects.

The assumptions, ‘Governments want to enable appropriate policy (for dryland cereals)’ and ‘Institutional support exists for researchers to employ new technology’ have been more difficult to influence. Policy obstacles were a challenge for barley in Morocco and institutional support, or rather institutional capacity has been a limiting factor in West Africa.

The realization of the theory of change could be assisted by improvements in the planning system of Dryland Cereals. Plans are driven by the demands placed on the CRP for generating proposals and documentation (three proposals written in three years- the original proposal, extension phase proposal and most recently the 2nd phase pre-proposal). The writing process becomes the planning process, and whoever participates in writing influences the direction and strategies of the CRP. Although partners are represented and inputs from country research teams are given, these have not included wider-stakeholder in-country forums. The CRP typically faces tough timelines which do not allow for suitable country level consultative processes of planning. This has encouraged a perception that the agenda and decisions on participants are drawn up based the experience of CRP managers and scientists situated at the center.

This is changing now for planning of the second phase of HOPE, each country team have been given funds (15,000 USD) to organize stakeholder forums, which will remain constituted during the course of implementation of the project to review what is achieved and to revise what more needs to be done. This approach is likely to achieve more specific plans and priorities responding to needs of the countries where Dryland Cereal and Legumes Agri Food Systems will work. This requires complementary analysis of policy and sectoral trends in each country (or developing the agenda based on policy briefs prepared earlier by socio-economists), which will improve alignment of the envisaged impact pathway with the country requirements⁴⁰.

➤ *How effective are the connections between the 5 flagships along the product line impact pathway and have the flagships enhanced integration across the delivery pipeline?*

Since the implementation of the CRP, variety promotion and the development and promotion of appropriate crop management technologies is becoming more integrated, primarily through the sharing of testing sites with the Dryland Systems CRP and technology transfer through variety and crop management packages. This trend is likely to become more apparent in the extension phase of

⁴⁰ Country level plans should be aligned with needs and priorities articulated through CAADP-led processes and the national medium-term agricultural Investment Plans developed as part of individual CAADP Compacts as agreed in the Dublin Momentum 2012.

the Dryland Cereals CRP and subsequently, the new phase of the CRP, but will require a more explicit focus on the role of livestock with the dryland systems. There is also good integration between flagships 2, 4 and 5. It is difficult to gauge the level of influence of flagship 1 among those deciding on the principal production problems and breeding objectives to pursue. There are few socio-economists working with the breeders and agronomists and there was a time lag before the findings of studies initiated after the start of Dryland Cereals could start to influence decision making. However, there is evidence of baseline studies influencing the other flagships and their gender orientation (see section 8.1) and there are examples from the sorghum work in West Africa of the breeding program taking account of important socio-economic issues.

Historically crop improvement at ICRISAT has meant breeding improved varieties and there has been little work on agronomy and little human capacity in agronomy. This situation has improved with the CRP and its flagships. There is now more recognition that improved varieties need to be promoted as a package, together with appropriate integrated crop management. Although challenges remain for seed delivery where there is little commercial incentive, Flagship 4 has encouraged more thinking about seed systems, as has Flagship 5 with respect to the development of value-added products and associated market chains. A recent farmer field day in Uganda illustrates this integration, where new varieties of finger millet and sorghum were demonstrated along with crop management technologies and food products⁴¹.

Such integration can be taken further through a fully 'value chain approach' whereby traits are selected by market demand and market chains developed to create the demand for those varieties that deliver the required qualities. This is happening with malt barley varieties in India and Ethiopia. Seed supply tends to follow demand for improved varieties and quality seed, responding to the pull from value chains. Intensification with respect to crop management usually requires the incentive of market demand and market access for produce that is surplus to household needs (See Saunders and Ouendeba, 2012).

The proposed merging of Dryland Cereals, Legumes and Dryland Systems currently under discussion would help to encourage a genuine systems approach to crop improvement and the promotion of integrated packages of improved varieties and appropriate crop management technologies.

➤ *Are research outputs reaching their intended target groups?*

At this stage of the Dryland Cereals CRP it is too early to indicate the overall extent to which new outputs are reaching the intended targets, however there are positive examples. In addition, CRP activities are improving the adoption of improved varieties developed before the start of the CRP. The use of participatory variety selection, on-farm trials and demonstrations and farmer field days has brought a large number of farmers and some seed companies and traders into contact with the new technologies. More than 5,000 have attended field days across Africa since the beginning of the CRP, for instance a sorghum and millet promotion at agri-fairs in Kenya⁴². Working with agro-dealers to promote the sale of seed of new varieties in small packs has proved successful in making seed available to more growers, reaching around 8,000 households in east and West Africa e.g. sorghum seed mini

⁴¹ <http://www.icrisat.org/newsroom/latest-news/happenings/happenings1687.htm#2>

⁴² <http://hope.icrisat.org/sorghum-and-finger-millet-varieties-showcased-at-county-agri-fairs-in-kenya/>.

packs in Mali⁴³. Similarly, the promotion of fertilizer micro-dosing has enabled a yield response with much smaller and therefore more affordable amounts of fertilizer than the normal recommendation.

Farmers are also being reached through training days, for instance on hybrid seed production in Mali and Nigeria, with a total of 275 participants. Although the strategic direction may come from ICRISAT, these outreach activities are beyond the direct remit of the CRP and depend upon NARS and other partners for implementation. The Seed Consortium formed in India has provided access to seed of improved sorghum OPVs to 30,000 farmers in 2014 and the target is to reach 100,000 in 2015. If the intended impact of Dryland Cereals is to be achieved, then such activities should be expanded but this will require a source of increased partner funding.

- *To what extent has Dryland Cereals achieved the right balance between research efforts and activities more directly designed to contribute to outcomes? What would assist the Dryland Cereals to enhance the delivery of outcomes? Are the range and type of partnerships secured sufficient for that purpose?*

More emphasis on development outcomes is one way in which the CRP is expected to differ from the previous Center Dryland Cereals Programs, but at this stage of the CRP, most of the resources go to breeding and even for pests and disease control, most of the work is on breeding for resistance. The confounding of CRP and Center program plans of work and budgets (POWB) makes it difficult to change the allocation of resources. Budget cuts impacted particularly on partner funding and analyses of seed systems, although it is recognized that access to seed is a major impediment to the achievement of development outcomes. As long as CG Centers are considered as strictly research organizations, their ability to engage in activity more related to outcomes will be constrained. Dryland Cereals have been able to include important activities to enhance development, primarily through designing the program to link to bilateral projects which have compatible objectives, for example, the HOPE project. It is likely that this model will continue given the funding requirement from W1 and W2 to sustain core breeding activities.

5.2 Knowledge exchange and synergy

- *Is knowledge being shared, technologies exchanged and capacity being built across countries and partners? What outcomes demonstrate positive synergy among various centers and partners and regions in Dryland Cereals CRP? To what extent is Dryland Cereals creating communities of practice?*

The absence of an effective M&E system, including a comprehensive database, is likely to have impacted negatively on the capacity to use results from one season/year, and among breeders, to feed back into the decision-making and priority-setting procedures. It is essential that datasets are broadly available and are archived in a readily accessible database. The work at ICRISAT HQ on the cloud-based M&E system for scientists would help to improve breeding program effectiveness if it is adopted throughout ICRISAT/Dryland Cereals⁴⁴.

The generally complex organizational and management systems of Dryland Cereals, have not enhanced the effectiveness of FP2 activities, particularly regarding reporting. Feedback from scientists indicated that they found reporting systems to be unclear and onerous. Reinforcing the links among

⁴³ <http://hope.icrisat.org/mini-seed-packs-aiding-sorghum-utilization-in-mali/>.

⁴⁴ Abishek Rathore provided a brief introduction to this system.

the component units of Dryland Cereals CRP, and particularly between ICRISAT HQ and the regions, would improve the effectiveness of the CRP. Currently, the work programs in Africa are hampered by poor linkages, particularly regarding germplasm exchange, information exchange and data sharing, and there have been lost opportunities to enhance diversity of the breeding materials and obtain data on multi-location performance by not being able to get germplasm out of some countries, including India. The lack of a culture of sharing information and data from the center to the periphery is perceived as having frustrated regional work and ‘created artificial boundaries’.

Regarding complementarities in Dryland Cereals activities, there appears to be little in the way of duplication of breeding and research activities in FP2, but there is insufficient sharing of information among the various breeders and researchers. Effectiveness could be enhanced however, through improved communication among researchers and particularly between researchers based in India and those in the regions, who often suffer from being on the periphery. One of the major factors militating against the Dryland Cereals CRP being a fully integrated program is the sometimes apparent disconnect among breeding programs, among crop clusters of activities, among regions and between ICRISAT HQ and the regions.

Effectiveness of the Dryland Cereals CRP could be enhanced through cooperation with other bodies, including CRPs. GCP has been a very effective partner, particularly regarding sorghum research and breeding⁴⁵.

Inter-center collaboration is well illustrated by the development and release of the biofortified pearl millet variety Dhanashakti. With A4NH and HarvestPlus, the Dryland Cereals CRP developed Dhanashakti pearl millet (an OPV) in India, which is high in iron and zinc and has an 11% yield advantage over the then current market leader. The variety was developed from germplasm by ICRISAT in partnership with the Indian NARS (All India Pearl Millet Improvement Programme) and disseminated in partnership with A4NH through a private sector seed company (Nirmal Seeds) and an NGO (Mahatma Phule Krishi Vidyapeeth). <http://oar.icrisat.org/8602/>

CCAFS would seem to be a natural partner of a CRP operating in the drylands, where climate change is set to have some of its most serious effects, and yet is not mentioned in the 2013 annual report of Dryland Cereals CRP. If the new phase of Dryland cereals incorporates dryland systems and grain legumes, collaborative work among the CRPs is likely to increase and improve.

Harmonization of variety improvement procedures in East Africa is an example of cross-county collaboration allowing more rapid diffusion of improved varieties once they have been approved and released in one country.

There are some good examples of partner integration to deliver outputs and outcomes, but not involving collaboration between CG Centers

- There is strong synergy between Dryland Cereals and the NARS sorghum breeding program in Ethiopia which is based on 4 agro-ecologies with priority given to dry lowlands, requiring varieties with early maturity (120 – 130 days). The challenge has been to deliver early maturity with both high biomass and acceptable grain yield. The variety ‘Dekeba’ was released in 2014 with ICRISAT

⁴⁵ <http://www.generationcp.org/research/research-initiatives/sorghum>

background. HOPE has released 3 hybrids and the new program focuses on land race crosses. Eighty percent of the breeding material in the NARS sorghum program comes from ICRISAT. Now the CRP and NARS are focusing on introgressing drought and striga resistance into local land races using marker-assisted SNPs⁴⁶ – leaf samples go to LGC Genomics in the UK after DNA extraction at Holleta Research Station under a bilateral project with the University of Queensland. ICRISAT provides technical know-how, training in molecular breeding, some equipment and retains two technicians at Melkassa Research Station, while the NARS provides manpower, facilities field trials and seed multiplication and links to farmer groups.

- In East Africa the demand for sorghum has increased dramatically following the resolution by the East Africa Breweries Limited (EABL) to use sorghum for production of one of its beer brands. According to figures by the Tanzanian Ministry of Agriculture Food Security and Cooperatives (MAFSC), the annual demand for sorghum is 3,360MT metric tonnes while the supply in 2011/12 was 1,084 MT. In an effort to promote farming of sorghum in the region, the HOPE Project developed and is implementing strategies that will enable farmers to have easy access to improved quality seed. To enable this, the project team in Tanzania lobbied for the government of Tanzania to include sorghum certified seed into the government seed subsidy program. The Tanzania Seed Trade Association (TASTA), one of the HOPE Project partners in Tanzania is an association of seed companies in Tanzania and is leading the project's activity to improve markets and inputs access in the country. The association participates in high level agricultural and seed fora in the country and because of that status it played a key role in advocating for sorghum seed subsidy. The roles of ICRISAT were to provide the required technical support (the evidence and rationale) to TASTA, especially with regard to climate change and the need for farmers to diversify more into drought tolerant crops; hence the inclusion of sorghum in the subsidy scheme. In August 2012, the Ministry of Agriculture, Tanzania, announced that 402 tons of several varieties of sorghum had been included in the seed subsidy program, fully funded by the national government. It has also been confirmed that the government of Tanzania has agreed to provide fertilizer subsidy for sorghum for the first time. The subsidized sorghum seed is being distributed in all 24 regions in the country. <http://hope.icrisat.org/hope-improves-access-to-sorghum-seeds-in-tanzania/>

- *Have sufficient efforts been made to document outcomes and impact from past research and with what coverage over research areas? How have results been shared with different audiences at local, regional and international levels, including policy makers?*

There is very little documented evidence of past research and those that exist are not technically accessible to a wide range of audiences, including policy makers. Three ex ante/ex poste impact assessments have been published by ICRISAT with a strong focus on economic rates of return and less on other areas of impact. The CRP has been able to engage with a wide range of audiences through field days and research strategy meetings.

Communication with 'policy makers' is generally weak although this is as much a failing of the NARS as of Dryland Cereals. Three big policy successes however, have been firstly, to get sorghum included

⁴⁶ Single nucleotide polymorphisms

in the seed subsidy in Tanzania; secondly, the adoption by the Government of Maharashtra of the Hope project five point crop management package for sorghum⁴⁷ and thirdly, the incorporation of barley into the Moroccan government's Green Morocco Plan, with a target to increase the production of certified seed from the current 1%, of all seed types produced, to 22% by 2020. The two main areas of need with respect to policy research are seed system analysis and constraints to market chain development, both of which feature strongly in the extension proposal. There is also scope to link with other seed policy initiatives, e.g. SFSA Seeds2B seeds policy work on regional harmonization. However, conducting policy relevant research is insufficient – a process of communication of findings and interaction with policy makers is important if influence and ultimately changes are to occur.

5.3 Value added

- *Is Dryland Cereals CRP more than the sum of its parts? Has there been value added to research brought about by the CRP collaboration of the two Centers compared to the previous programs?*

The inclusion of the four dryland cereal crops in a single CRP did not result in substantial changes in breeding and research approaches for the four crops. However, Dryland Cereals faced a particular challenge not faced by those centers where mandate crops had been researched and bred collaboratively by several centers, as was the case for wheat, maize and rice, for example. In those cases, lines of communication and cooperation were already well established when the CRPs were set up, or at least the opportunities for synergy and efficiency gains were more apparent when dealing with a single crop. The inclusion of barley in the Dryland Cereals with three ICRISAT mandate cereals required careful management to make the CRP a truly integrated program. A recent CGIAR report did however say that the Dryland Cereals was one of several CRPs that had 'not yet really demonstrated the value of working in an integrated manner'⁴⁸. This observation is based on the general and continuing need to link better all the breeding efforts together into a single program that operates collaboratively across regions and with other disciplines. The 2013 annual report⁴⁹ of the Dryland Cereals CRP is entitled 'Towards an integrated value chain for dryland cereals': Dryland Cereals has been moving in this direction, but has still some considerable way to go. However, it should be borne in mind that the Dryland Cereals is the smallest CRP in terms of budget and was one of the last CRPs to be initiated – it has only been operating for a little over two years. Therefore, it would be premature to expect too much of it too soon.

Allowing for the early stage of Dryland Cereals CRP when this evaluation was conducted and that collaborative arrangements are still under development, the level of collaboration between Dryland Cereals and other CRPs is moderate to low. The researchers' survey indicated that they were contributing to Dryland Systems (50% of responses), Grain legumes (42%) and Policies, Institutions and Markets and Agriculture for Nutrition and Health (both 27%) (see Annex 5.2, volume 2. Question 22). However, there was some dissatisfaction with the quality of the collaboration. In some areas of research, funding for important topics was provided by other CRPs but not in a planned or coordinated fashion. There has been some work with A4NH on nutritional content, with PIM on value chains, with Livestock and Fish on fodder quality and collaboration initiated with Dryland Systems at their action

⁴⁷ <http://hope.icrisat.org/icrisat-hopes-five-point-program-transforms-lives-of-poor-sorghum-farmers-in-maharashtra-india/>

⁴⁸ CGIAR Research Program Portfolio Report For Year 2013

⁴⁹ CGIAR research program on Dryland cereals, performance monitoring report for calendar year 2013

sites. It was suggested that Dryland Cereals and Dryland Systems could develop further plans to share experimental sites to promote cooperation. The only other direct links are with A4NH with respect to work on biofortification and dissemination of the variety Dhanashakti. Although collaboration between Dryland Cereals and other CRPs is minimal to date, this is an evolving process and will improve in Phase 2, particularly with the amalgamation of Dryland Cereals and Grain Legumes. The recently appointed Leader for Flagship 3, Crop Management, an ICRISAT staff member, is participating in and funded by the ICARDA led Dryland Systems Programme. As cross-CRP collaboration was one of the main aims of the CGIAR reform, this aspect requires close monitoring in future.

Partnerships with national and international agencies represent a key feature of Dryland Cereals CRP. However, with respect to FP2 activities these could be expanded to include greater researcher exchange in the regional hubs. It was suggested that the efficiency of the breeding programs in ESA, for instance, might be improved by increased researcher exchange with countries researching the same crops, such as Australia and the USA for sorghum. An added benefit would be that visiting scientists doing work for postgraduate studies would likely want to publish the results of their work and thereby raise the profile of the research being done there.

Molecular biology tools and techniques have been applied across the crops and regions, in the interests of making breeding generally more efficient. Research carried out within GCP on sorghum genetics stands to benefit sorghum breeding. Similarly the pearl millet consortium work in ICRISAT will add knowledge that ultimately will enable more efficient breeding of the crop⁵⁰. Much of the work will result in MAS procedures for traits of interest, including quality traits and resistances to biotic and abiotic stresses. Concurrent molecular biology work on the pests and diseases, and in the case of *Striga* confirmation of the existence (or not) of biotypes, will usefully feed into the breeding programs. For finger millet in East Africa, molecular biology will allow accurate characterization of germplasm accessions and location and characterization of the 'snapping-head gene(s)', and for barley will complement the traditional work such as that being done on race-specific-resistances to rusts being carried out in Shimla⁵¹, which is done *pro bono*.

FIGS, or 'Focused Identification of Germplasm Strategy' is a technique for searching agricultural genebanks which has been developed over the past seven years by ICARDA and partner institutions. It helps crop breeders to identify more quickly potential sources of resistance by using algorithms to link accessions to their agro-ecological source. This allows a smaller subset of accessions (hundreds rather than thousands) to be assembled and screened. This was reportedly an effective and efficient alternative to current methodology for screening, yet there appeared to be little awareness of the technique in other parts of the Dryland Cereals.

A key question is whether costs are commensurate with outputs: does the Dryland Cereals CRP represent value for money? FP2 activities receive the largest share of the CRP budget and outputs in terms of adapted germplasm and research goals have largely been according to plan. The value of the physical outputs and information generated through FP2 is very difficult to gauge, but the results from numerous studies indicate that plant breeding costs are outweighed by the benefits that accrue from plant breeding. There is no reason to suppose that in the case of Dryland Cereals CRP that this does

⁵⁰ <http://www.ceg.icrisat.org/ipgsc.html>

⁵¹ Indian Institute of Wheat and Barley Research

not hold, although the benefits derive largely from the work done in programs that predated the CRP. ICRISAT has, for example, delivered 268 sorghum varieties grown in 49 countries during 40 years. Perhaps the more important question to ask is whether FP2 has received sufficient funding to meet its objectives in relation to the funds used for other activities, including administration⁵².

One very apparent means of increasing the efficiency and effectiveness of the various breeding programs would be to assess germplasm over two seasons within a year where possible. This could involve shuttle breeding, which has been used to great effect by wheat breeders, or inclusion of an irrigated crop at the same site where double cropping is not possible due to insufficient rainfall, e.g. in West Africa's drylands, or where irrigation would interfere with trait selection. This would increase costs, but would likely result in accelerated breeding progress.

Germplasm exchange with ICRISAT India has been problematic, due to national policy restrictions, even where the germplasm originates from Africa. This has represented a serious impediment to breeding progress but a recent agreement has been reached and germplasm sharing from India to Africa has resumed. There are some good examples of 'spillover', e.g. the release of the pearl millet cultivar "Hashaki 1", in Uzbekistan in 2013 in collaboration with the International Center for Biosaline Agriculture. However some parts of the program, particularly sorghum and millet in Africa, could be more explicit in defining their strategies and mechanisms to reach further countries.

5.4 Recommendations on Effectiveness

Important recommendations on effectiveness concern scaling up and scaling out research results – both scaling up to policy makers and scaling out to reach other countries. At the other end of the spectrum, more effective intervention at country level could be enhanced by country based planning processes.

6. **Effective implementation of the delivery pathway would be enhanced by a greater emphasis on country-level engagement in planning and implementation of research** consistent with national policies, and in innovation and adoption, involving research and development partners, agricultural service providers, farmer organizations and private sector actors to produce integrated plans across all flagships.
7. **Greater emphasis on scaling up and scaling out research results to policy makers and to a broader target group of outreach/spillover countries** (beyond existing focal countries) would extend the results of Dryland Cereals research. The evaluation team suggests that:
 - Dryland Cereals management and flagship leaders develop a **clear strategy for engagement with other countries** through relevant partner organizations
 - Greater **efforts in information sharing, interaction and influence at the policy level** would help to create conducive conditions for dryland cereals, for example, on seed policy and incentives for seed companies, on expanded farmer seed production and semi-formal seed systems such as Quality Declared Seed.

⁵² It was suggested by one interviewee that transaction costs (e.g. for reporting, evaluating, meeting etc.) were disproportionately large and time devoted to research was diminishing.

6. EFFICIENCY

6.1 CRP management roles, structures and governance

- *Are the institutional arrangements and governance and management mechanisms of the Dryland Cereals efficient? Do they achieve greater organizational performance and efficiency compared to previously?*

The findings in this section are from document reviews, interviews with Dryland Cereals' staff, management and advisers and researcher and partner survey findings.

Like other CRPs, Dryland Cereals is governed according to a set of formal agreements, whereby ICRISAT as the Center is accountable to the Consortium for the use of the W1/2 funds that are transferred to the Lead Center. ICRISAT has a Program Implementation Agreement with ICARDA on how to manage W1/2 funds. The ICRISAT Board of Trustees has the fiduciary and legal responsibility for the use of funds it receives from the Consortium, Fund donors and bilateral funders. The Research Management Committee (RMC) composed of a core team and a technical team leads research planning, while the Steering and Advisory Committee provides oversight⁵³. The Steering and Advisory Committee provides advice to the ICRISAT Governing Board on the quality and relevance of the CRP research portfolio, priority setting and allocation of resources. The committee meets once a year in person, with other meetings conducted virtually as required. The simplification of the structure has helped to reduce the transaction costs of multiple committees.

When scientists were asked if the Dryland Cereals Governance Structure works well for the CRP, 52% said yes, while 28% said no, and 20% were non-committal. Comments from researchers, although reflecting the wish to simplify governance structures, were more concerned about the relationship with the Consortium Office and issues around communication of what the CRPs were meant to achieve. Comments from researchers on the governance structure include the following:

BOX 1: Does the Dryland Cereal Governance Structure work well for the CRP?

- *We need to reduce transaction costs in governance and management*
- *For future, we need a simple management committee from Institutes and NARS.*
- *Donors wanted change but were not clear what it was they wanted to fix. It seems like top management in the CGIAR were in another world from CG centers.*
- *Consortium office started without processes in place.*
- *The Consortium is demanding too much, yet it provides less than 50% funding*
- *Earlier we were told there would be less reporting - simple window reporting. This has been enhanced to different levels - reporting in CRPs to product lines and flagships. How much time to do research?*
- *Most of the scientists and national partners do not know how the CRP works after 2.5 years.*
- *The roles and responsibilities of CRP Director are not clear.*
- *The CRP director has no inputs into the performance management process.*

Source: Scientist survey (see volume 2, annex 5)

⁵³ The Independent Advisory Committee and the Steering Committee were originally separate, but were combined in 2014 for enhanced efficiency. See Figure 6 in section 1.6 for the overall structure.

The Steering Committee meeting of 08 September 2014 discussed the Governance and Management structure that was to be followed by CRPs (Figure 10). It shows a relatively simple structure of roles accountability, but the challenge lies in the CRP management box, with ‘authority to manage for results’. This is an issue of contention between the respective management roles of the CRP and Center programs.

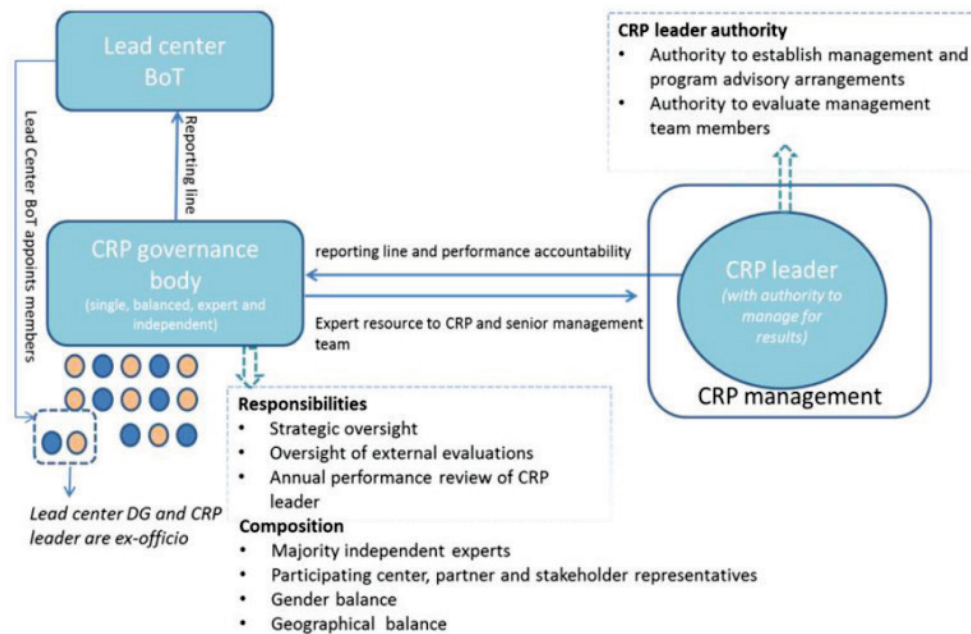


Figure 10: CRP Governance and Management structure guide- from IEA report on CRP Governance and Management structure, discussed at the SC meeting. (Source: SC Meeting, September 2014)

During field visits, the evaluation team learnt from headquarters, regional and country staff that the parallel structures and management of Dryland Cereals and the Dryland Cereals Program of the lead center (ICRISAT) have created confusion and inefficiency, particularly around their respective management roles and responsibilities. The ICRISAT programs are similar or identical in name to the CRPs; they have a programmatic content as well as being disciplinary or thematic based resource centers and are the locus for staff management and for allocation and control of financial and staff resources, including staff performance appraisal. In contrast, the CRP Director is responsible for the strategic leadership and delivery of results of the CRP, but without the authority to manage the resources for implementation. This results in duplication of efforts, confused and multiple reporting lines and uncertainty over budget allocations. These issues were often referred to in terms of ‘transaction costs’

While window 3 and bilateral projects are notionally ‘mapped’ to the CRP, these are managed from within the ICRISAT research programs. When Dryland Cereals was being developed, there was an intentional overlap of target countries. The ICRISAT Dryland Cereals Program Director was the leader of the HOPE project which accounts for 70-80% of the work in Africa. Scientists working with HOPE report to the ICRISAT Dryland Cereals Program. The ICRISAT Dryland Cereals Program Director coordinates work with program breeders, seed specialists, planning and follow-ups, supervising research and liaising with Regional Directors (who report to the Center DG). This has further

complicated the situation concerning the respective roles and responsibilities of the Directors of ICRISAT program and the Dryland Cereals CRP.

These issues of CRP Governance and Management were recognized fairly early in the life of the CRP. They were discussed at the First Meeting of the Dryland Cereals Independent Advisory Committee (IAC) and reported to ICRISAT's Board of Trustees (February 15, 2014). Some of the comments included:

- **Accountability:** If the CRP Director is to be held accountable for delivery of the CRP outcomes on budget and within the agreed timeframes, then the Director will need greater involvement in decision-making processes associated with the CRP.
- **Freedom to manage:** The IAC recommends the Dryland Cereals Director be actively involved in all high level budget discussions involving activities and key staff working with Dryland Cereals. Furthermore, the IAC recommends that the Director receive a monthly summary of Dryland Cereal CRP allocations and expenditures versus budgets, by line item.
- **Performance Reviews:** The IAC recommends that the Director of the Dryland Cereals CRP provide formal input into the annual performance evaluation of all senior staff that are committing 30% or more of their professional research time to designated Dryland Cereal CRP activities, and that s(he) be actively involved in setting CRP-related annual performance goals for these same staff.

Management issues were widely reported by research staff across all regions. When asked if the CRP Management structure works well for the CRP, 44% of researcher respondents said yes, while 32% said no, and 24% were non-committal. The following comments were given as additional information:

BOX 2: Does the Dryland Cereals management structure work well for the CRP?

- *There may be a need to streamline and clarify roles by the CRP Director and the Centre's Program Director*
- *Coordination within the region/countries across disciplines and partners is weak, and really only happens between people who work on the same special donor funded projects.*
- *Much of our efforts would more effectively be organized on a regional basis than on a flagship basis, in order to simplify planning and reporting for the scientists involved in implementation of the research and development activities of this CRP*
- *I still don't know in detail how decision making and process management is shared between Program Director and CRP Director*

These issues may have been avoided had a change management plan been instituted with, or in advance of the CRP. However, at the initial stages there does not appear to have been any guidance provided as to how the new CRPs were to interact with existing center management structures, nor were processes for change management proposed.

A number of different options and modalities were raised and discussed with Dryland Cereals participants and others interviewed:

- a. The CRP Director to be responsible for program administration and reporting rather than strategic direction and decision-making. The evaluation team considered that this might

- reduce conflict, but would be unlikely to support the delivery of the vision of the CRPs.
- b. CRP Director to be located outside the lead Center. This would support the CRP distinctiveness, but would not necessarily improve the situation particularly with respect to budgeting and communication.
 - c. Some researchers perceived that the CRPs appeared to some extent like a Challenge Program where researchers work together for enhanced synergy in science and NARS help delivery. However, an important difference was that the Challenge programs were *additional* to the Center core funding (like bilateral projects), while the Windows 1 and 2 funding for CRPs replaced core funding.
 - d. For the CRP Director to be responsible for strategic program direction, cross program and partner communications, monitoring deliverables and reporting while the Center program director is responsible for managing human resources, scientific quality, work plans of staff and staff performance assessment. This would require joint decisions on allocation of the budget between the CRP Director, the Center Director, and participating Centers and a role for the CRP director in assessing the quality of the research outputs delivered by scientists and in managing resources.

Regarding the performance evaluation of contributing scientists by the CRP Director, this was mentioned by the Center to the Consortium Office in the response to the comments on the Extension Proposal. ICRISAT noted the need to involve the CRP Director in future performance evaluation of the contributing scientists and responded: *“At present, this does not create an overly serious issue, but going into the future, the performance of the CRP will need to be further elevated both with regard to quality of science, as well as the comprehensiveness of and approach to research and development partnerships. Participation of the CRP director in performance assessment of all scientific staff contributing to CRP goals will therefore become very essential as the CRP moves into the extension phase, so that the delivery of outputs and outcomes meet expectations”.*

It is the view of the evaluation team that most governance issues could be addressed if there were very clearly defined and mutually agreed roles for all those involved in CRP governance and management, on the lines of paragraphs (d) above. ICRISAT has new leadership for the DG and DDG positions and during the field visits, researchers expressed the view that there is scope for change under the new DG and DDG-R and the CRP could run smoothly with their full support. The overlap in nomenclature and confusion should reduce as a newly named reconfigured CRP program develops.

As a way forward in the second phase, the management/administration structure of the CRP and Center needs to be clarified and streamlined to improve efficiency and effectiveness and reduce apparent duplication of activities. It would also improve the effectiveness and application of science. A solution to this problem will require considerable effort and willingness to collaborate among the managers. Assistance from a Human Resources specialist could help to accurately define the job description in terms of duties and responsibilities and reporting lines, to reduce ambiguity and clearly specify the expectations of the post.

- *Is there clarity and a common understanding of the roles, operational procedures and reporting lines of different components of CRP management structure within the lead and partner institutions?*

Staff performance assessment and reporting lines have also been topics of some confusion with the introduction of the CRP.

Discussions during the field visits corroborated the initial finding that the Dryland Cereals Director is not involved in evaluating staff performance and guiding their research. All researchers have a supervisor within the program management structure of the center. The researchers' survey revealed that 88% consider they have a formal system for regular staff performance assessment, 8% responded no, while only 4% (1) didn't know. When asked if they are involved in the performance assessment of their research activities, most people (64%) indicated they are involved, while 21% were not and 12% didn't know. Some commented on the lack of feedback on performance assessment forms filled and logistical difficulties of arranging a performance review with their manager.

In the researcher survey the response to the question, to whom are you accountable for the quality of your research outputs under Dryland Cereals, most of them (72%) indicated the Center Dryland Cereals Program Director (Figure 11).

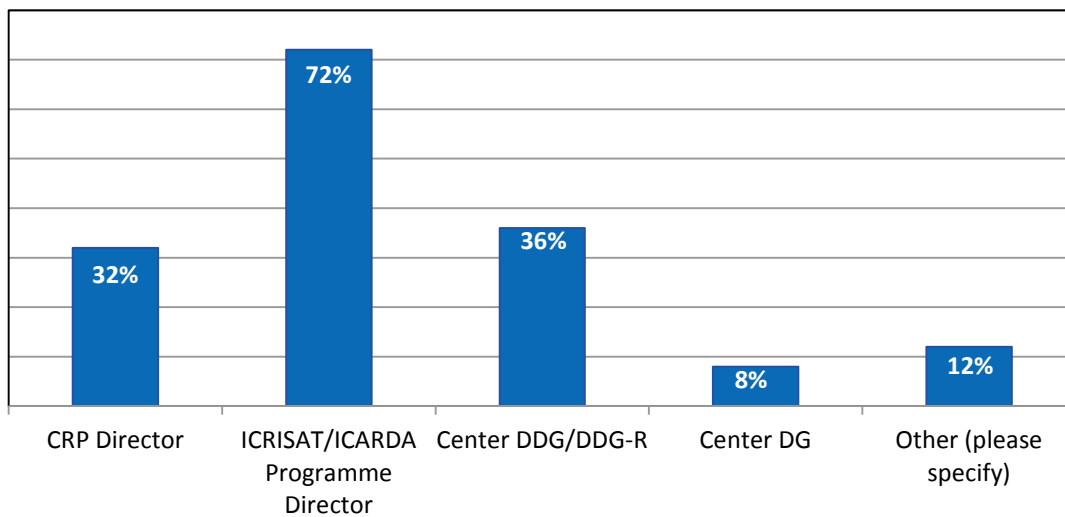


Figure 11: To whom are researchers accountable for the quality of their research outputs under the CRP? (Source: Research survey, 2015)

A number of different reporting routes were identified, which have different reporting formats requiring double reporting, which add to the burden on scientists. Scientists send reports to their crop cluster coordinator who sends relevant sections to a Flagship Leader, who in turn sends their consolidated report to the CRP Director, with a copy to ICRISAT Dryland Cereals Center Research Director. However, other scientists said that they had to report on their research directly to the ICRISAT program director. Staff working on bilateral projects (like HOPE) report to the ICRISAT Dryland Cereals Program Director, who extracts and sends reports to the CRP Director. The reporting flow is not working well between the Center program and the CRP, and creates risks that the CRP director will not receive reports or only get a copy when specifically requested.

These reporting requirements were seen as an 'obstacle to research', leading to multiple and frequent reports, which are overly long and complex. There is need to streamline the reporting and to standardize formats to follow current CRP reporting nomenclature. The suggestion from scientists was

to adopt reporting templates from the Consortium Office that require reporting on contributions to the IDOs.

The reporting from ICARDA (the other main participating center) is working relatively well with ICARDA barley cluster leader reporting directly to the CRP. The ICARDA team compiles reports from national partners and circulates among scientists with copies to the ICARDA program Director. Once the reports are cleared in house they are sent to Dryland Cereals. While previously the product line report went to the director, now the relevant sections have to be sent to the Flagship Leaders. However, there was a perception that the report is heavily edited in the flagship report, thereby tending to make barley appear less visible.

While the use of flagships as the organizing structure for the program helps to ensure that the different segments of the value chain receive attention, their use as the organizing structure for the annual reports tends to fragment and decontextualize the story for each crop/region/agroecology into segments of the value chain.

➤ *To what extent have the reformed CGIAR organizational structures and processes increased (or decreased) efficiency and successful program implementation?*

The analysis above, relating to management and reporting indicates that the CRP is not seen as promoting efficiency in use of time or in feedback of useful information to CRP management. There remains a lack of information and understanding among researchers about the purpose and function of higher level CGIAR structures and processes.

The following are a selection of issues mentioned in the researcher survey as main areas that need to improve in the CRP (see annex 5.2 question 36 for full details):

BOX 3:: Overall, in your opinion, what are the three main areas for improvement for Dryland Cereals:

- *Adequate allocation of resources and reporting*
- *Better funding for all flagships from W1/W2 and timely budget allocation*
- *Budget stability and program continuity*
- *Reduce overhead costs to have enough money for doing research*
- *Realistic levels of support for national program partners*
- *Priority based operational fund allotment for research within CRP commensurate with targets*
- *Need to increase global visibility of CRP-DC to attract funding*
- *Efficient use of scientist and managers' time*
- *Priority setting for DC research*
- *Need for a fair balance between barley research and other crops*
- *Involve scientists in research planning*
- *Balance biophysical and socioeconomic research*
- *Cross integration and learning across FPs, crops and regions*
- *Focus on value addition and creation of demand for dryland cereals*
- *Need a platform to strengthen processing side of our crops*
- *Better M&E system, Data management and knowledge sharing*
- *Improve quality of research and feedback systems*
- *Strategic partnership with advanced institutes*
- *Timely and transparent communication with stakeholders*
- *Capacity building and valuing young scientists*

6.2 Management of resources

- *Are the facilities and services used efficiently and are there areas where efficiency could be improved, for instance through outsourcing?*

Generally facilities and services are efficiently used at ICRISAT and some are used by the NARIs as well – such as analysis of micronutrient content of cereals. During the decentralization process of ICARDA some analyses were carried out at ICRISAT facilities; *“synergies and partnerships have emerged particularly because of ICARDA’s special situation; we made use of cooperation”*⁵⁴. There is some scope for improved efficiency with respect to research on seed systems and on fertilizer micro-dosing and small seed packs which are interventions that are not commodity-specific.

Facilities for carrying out FP2 activities in Dryland Cereals CRP differ according to region. While they are excellent at ICRISAT HQ and in Indian partner organizations, they are not of the same standard in ESA and WCA. The weaker areas should be prioritized to try and bring all facilities up to a minimum required standard, particularly those in WCA where replacing a broken computer, for instance, seems to be unnecessarily problematic and restricts pearl millet breeding operations severely. Furthermore, although molecular biology applications to plant breeding are of great benefit, and are being employed in SA and ESA, in WCA it appears not yet possible to be able to store DNA, and stop it from denaturing, prior to it being sent to a laboratory for analysis. At the other end of the technology spectrum there are equipment limitations in WCA, including absence of appropriate threshers and grinders. A further serious limitation to breeding in WCA is the absence of suitable precision fields where accurate selection (minimizing the environment effect) can take place. Issues such as these affect the Quality of Science carried out.

- *Is there transparent allocation of resources to researchers and partners for specific activities and outputs and are the resources adequate for their expected role?*

To respond to the question of resource allocation, the Evaluation Team reviewed budget information and financial statements as well as discussing resource access in interviews.

Unreliable and arguably inadequate W1 and W2 CRP funding (40%) has encouraged researchers to look for W3/bilateral funding to realize their research objectives. While W1/2 funding has maintained various research/breeding efforts, large percentages of the funds are used for salaries and overheads, with about 20% remaining for undertaking the actual work. Combined with less than adequate facilities, particularly in regional hubs and NARIS, Dryland Cereals efficiency is suboptimal. Moreover, the numbers of potential NARS/ARI partners are reduced because they often apply for the same competitive grants as the CRP⁵⁵

The partner Center, ICARDA, is allocated their share of the Dryland Cereals CRP budget to manage according to their plan of work and budget. For ICRISAT it appeared that funds are allocated based on the need to cover individual scientists’ salaries and costs which are not covered by funds from bilateral sources.

⁵⁴ Meeting with barley team at ICARDA, Rabat, Morocco, 1st July 2015

⁵⁵ Personal communication

For example, one researcher mentioned that during the 2015 planning meeting in Addis Ababa, Ethiopia, out of US\$5 million, US\$4 million went to salaries and recurrent costs, and the rest for competitive grants and training. For the competitive grants, ICRISAT scientists got 20% of the research. The questions scientists have are how they are going to reach farmers, or do molecular studies.

During the evaluation team's visits, scientists reported that they are reducing the number of activities, since no budget was yet approved for 2015. Funding allocation on an annual basis discourages a longer term view of the impact pathway.

At the start of the CRP era, Center scientists were under the impression that centers would not need to look for bilateral funding, but concentrate on CRP research and successes. They now feel they were better off before the CRP. The risk they face is that they invest their time in research, yet they are not sure if funding will be available. Scientist feel they have no option but to still go for big bilateral projects, which are restricted in nature and therefore less flexible.

The Dryland Cereals crop cluster leaders and flagship leaders were allocated 50% of salary (reduced to 25% in the extension phase reflecting availability of time to commit to coordination and management) and some limited travel funds, but no research funds.

On financial control, the Evaluation Team observed that ICRISAT as a center has not delegated significant budgetary control to the CRP Director. The Evaluation Team was told this is because it is the board of the lead Centre, ICRISAT, which is financially liable in legal terms of program closure, staff redundancies, etc. in the case the CRP fails. However, this is not sufficient reason to isolate the CRP Director from managing the CRPs finances, especially as the Director is an ICRISAT employee. Rather, it emphasizes the need for a proper dialogue and harmonized approach to managing center and CRP budgets and a very clear definition of the respective responsibilities of both lead center and CRP staff. Since the CRP Director is not involved in decision making over allocation of the CRP funds, plans and budgets are collated at the ICRISAT program level.

Flagship 2, Improved Varieties and Hybrids, gets the largest share of the funding from the CRP (Figure 12). Nevertheless, even for FP2 adequate resources to carry out planned activities have frequently not been available, or not been available at the necessary time, and plans have consequently had to be adjusted according to circumstance. As yet, flagship leaders do not have budgetary control over the allocation to their flagship.

In its response to the review by the Independent Science and Partnership Council (ISPC) and the Consortium Office on the Extension Proposal, ICRISAT as the lead Center recognized that budget and functional emphasis of the CRP is still skewed towards Flagship 2. ICRISAT is working towards rebalancing the emphasis during the implementation of the extension phase, setting the stage for Phase II.

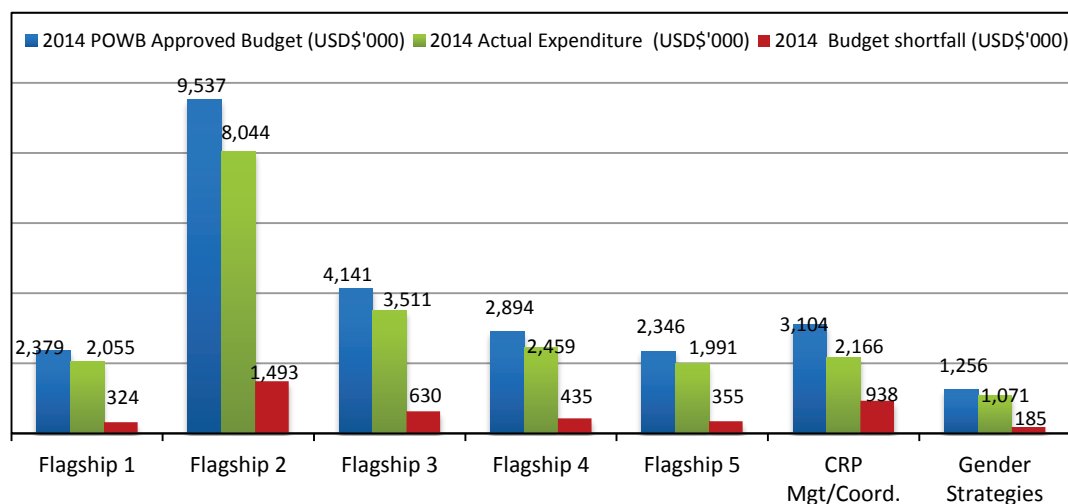


Figure 12: Financial Summary by Flagship Project, January – December 2014. (Source: Dryland Cereals Financial Report 2014)⁵⁶

The Dryland Cereals Annual Reports have a table showing the funding allocated to each partner but in most cases the budgets are small. NARS partners will require increased funding for their development role, including non-research partners in value chain development.

➤ *Is the program able to adapt flexibly in response to changes in circumstances?*

The unpredictability and uncertainty of W1/W2 funding affects researchers' working conditions and motivation. ICRISAT is therefore working on developing a resource mobilization strategy as a key to targeting W3 and bilateral funding that give stability to research.

6.3 Collaboration and coordination

➤ *Is the level of collaboration and coordination with other CRPs and partners appropriate and efficient for reaching maximum synergies and enhancing partner capacity? What are partners' contributions to research and management processes?*

The level of coordination with other CRPs appears rather limited (see section 5.3), but this may be due to their having started at different times. More opportunities for coordination are anticipated in phase 2. There is not much evidence of coordination on the important topic partner capacity building. Many of the NARS partners would like to be more involved in the planning process. There are some good examples from the HOPE project of involving partners in research planning such as the June 2014 meeting in Ethiopia on how to improve impact and partner participation⁵⁷ and the 2013 planning meeting for pearl millet research in South Asia⁵⁸. Information on participation in Dryland Cereals planning processes is less available – there was a two-day planning meeting with partners in February 2014 for planning the extension phase, and one in March 2015 for the initial planning meeting for the

⁵⁶ Management and coordination funds only for ICRISAT

⁵⁷ <http://hope.icrisat.org/new-ways-of-doing-business-identified-and-put-high-on-the-priority-for-the-future-of-work-in-africa/>

⁵⁸ <http://hope.icrisat.org/hope-planning-meeting-for-pearl-millet-in-south-asia/>

second phase, but the evaluation team has not seen the reports. However, of the CRP partners who responded to the partners' survey, 81% said they participated in research prioritization, and 77% participated in planning of projects.

➤ *Are the respective roles of the CRP and national programs clearly understood and appropriate?*

The NARS are the traditional partners of the CG Centers and in some countries, for example Ethiopia (ICRISAT) and Morocco (ICARDA), the Centers are almost embedded within the NARS. While the NARS rely on the CG for access to germplasm and capacity building, both human and physical, the advanced NARS need the CG less than the CG needs them. ICRISAT and ICARDA depend heavily on the NARS for on-station trial sites and for the access they provide to farming communities for on-farm trials and demonstrations. So the roles are appropriate and necessary, but there is some risk of duplication in breeding and neglect of development activity due to both being research organizations. Where the national extension service is left to do the outreach, the development outcomes and impact are restricted by low manpower, low morale and inadequate human and physical capacity.

6.4 M&E systems

➤ *Is the M&E system adequate and efficient for recording, tracking and enhancing Dryland Cereals' processes, progress, and achievements?*

Dryland Cereals is lacking a coherent M & E system that facilitates monitoring of progress against output targets or can provide early warning that outputs are likely to be delayed, based on failure to meet time-bound activity milestones. Outcomes are quantified at the level of IDOs and only to end-of-project targets, so it is difficult after only 3 years to estimate how far the CRP has gone towards those targets.

M&E provisions in the original proposal were weak, and although the importance of M&E has been recognized, there has been no real practical development so far. The Dryland Cereals Director keeps track of activities and outputs via spreadsheets based on the annual work plan and budget, but there is no M&E database providing real time information. Information on the allocated budget and actual spend is available in summary form from accounts. However, there is no system which shows the allocation of funds and time for individuals linked to the delivery of an expected output and allows tracking of outputs and outcomes over specific time frames. There are no baseline values associated with the outputs and output targets. Baseline studies have been funded and conducted mainly under bilateral projects, so are not comprehensive in coverage and not all reports are available. This makes it difficult to assess progress in a meaningful way on all fronts.

The allocation of budgets according to historical proportions is problematic when it comes to assessing impact and accountability. Dryland Cereals allocation of funds to research could be more transparently allocated against a well-defined work plan, where funds are clearly tied to research activities and associated outputs/deliverables.

The issues concerning M&E are well recognized by Dryland Cereals Program management. They have begun defining quantitative targets and measurable indicators for progress and for the IDOs. ICRISAT management has also discussed the need for a comprehensive M&E system.

The Dryland Cereals M&E system is not efficient due to both governance issues and an ineffective planning and tracking model. Under the present system, non-performance across a range of cluster of

activities remains hidden in aggregated data suggesting overall progress has been made across the countries. As reporting is at a broader level, the activities, outputs and progress based on country, crop/product line and flagship do not get the attention of the CRP management and /or of consortium office. The 'global' nature of the M&E system discounts and discourages disaggregation. The M&E and communication systems are capturing the large items (success stories) for external communication and missing many significant stories of progress and under-achievements for internal communication and for programmatic understanding and improvement.

ISPC –SPIA -IFPRI are currently engaged in the DIIVA project (Diffusion and Impact of Improved varieties in Africa) that has collected and collated data on diffusion of modern varieties in SSA. It has produced three databases on adoption, varietal release and scientific strength of breeding programs, organized as a set of 152 crop-country observations (across 20 crops and 30 countries). The analysis mostly covers the period up to 2009-10 and can form an excellent baseline for Dryland Cereals. Using similar data sources (expert assessments and surveys, along with literature, seed production and trade), the CRP can update the diffusion results every five years or so for the Dryland Cereals crops. Currently the CRP uses seed production and trade based assumptions on diffusion of improved varieties. However the efforts in this direction have been limited. Through the HPRC initiative, such information can be easily accessed by the lead center.

The theory of change (envisaged in original and extension proposal) does not appear to have been used as the basis for designing the monitoring framework or reflecting on what is being delivered, or on what more is needed to activate more effective progress towards outcomes. There is an opportunity for developing a theory of change for Phase 2 which can guide the M&E design and provide a 'road map' to guide and prompt reflection on the process of implementation.

The M&E design is tied in with tracking the theory of change. Progress is expected to be tracked through socio-economic studies in different phases of the project. In terms of resources allocated to M&E, HOPE 2 has created an example with 10 percent of the total budgets dedicated to M&E. Understanding of constraints to adoption may be much better in HOPE 2. CRP phase-2 provides the opportunity to improve its M&E framework which among other things could highlight the robust design of impact research, using various statistically valid, experimental or quasi experimental research methodologies.

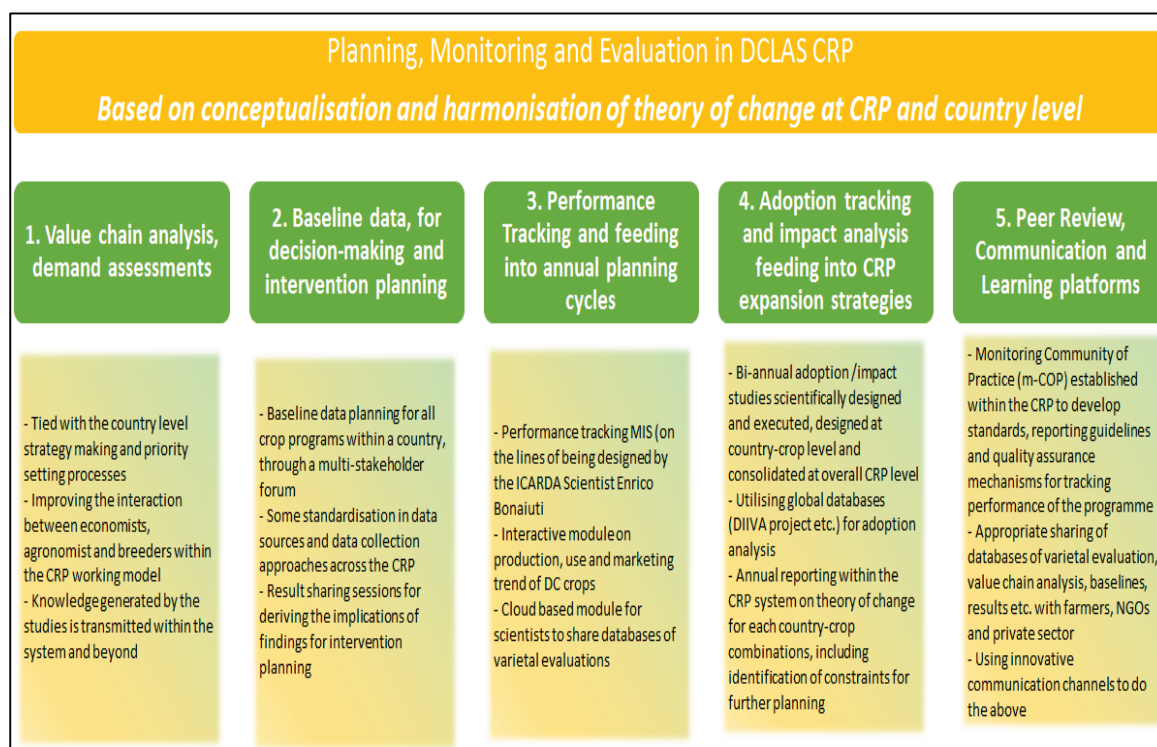
The M&E framework is being developed by the ICARDA Scientist Enrico Bonaiuti. The framework based system (under development and testing) was reviewed by the evaluation team and found to be very appropriate for the CRP needs for the following reasons:

- The M&E framework is based on specific country approach to programming (theory of change) and reporting, while thematically aligned with the overall CRP, which addressed the information needs of CRP management and development donors (who wants to see location specific, issue specific progress)
- The M&E framework leads to development of impact pathways at cluster of activities level and hence more clarity and commitment among the scientists in terms of leading and executing their work. It brings in customized indicators (adapted by each scientist during their planning cycle, later on the scientist start reporting on those) for each IDOs and sub-IDOs.

- The M&E framework is futuristic in terms of outcome based monitoring driven by outcome based plans and budgets
- It considers scientists as a primary unit of reporting, which then is able to reduce reporting burden and harmonizes efforts in consolidation
- The M&E framework allows testing the validity of theory of change and validity of assumptions every year

While crucial for accountability purpose, the monitoring and evaluation function contributes to planning, learning and performance management in a programme. The M&E framework aspires to develop a community of practice within the CRPs on monitoring (which is different to the Evaluation Community of Practice, ECOP facilitated by IEA). In this community of practice, program managers, M&E specialists of CRPs along with M&E experts can be involved.

A newly configured phase 2 CRP could consider enhancing the status, functionality and use of M&E through designing it as Planning, Monitoring and Evaluation flagship. This could potentially be a substitute or sub-set of current ‘priority setting and impact acceleration’ flagship. A second innovation could be to include the development and operationalisation of country level Planning, Monitoring and Evaluation (PME) frameworks linking to the overall M&E framework. This would not only strengthen country level conceptualisation of theory of change (drawing on CRP theory of change and the CGIAR IDOs and SLOs) but also priority setting, targeting and intervention planning. This can potentially improve harmonisation of the work of the CRP with the on-going and planned efforts of the existing and new national partners. The efficiencies and return on investment from such an arrangement would be greater as the CRP would be able to co-ordinate and integrate efforts of many agencies at country, regional and global levels on the dryland cereal crops. An indicative framework for planning, monitoring and evaluation in Dryland Cereals is as given below:



The evaluation function within the CG system has been streamlined with the creation of IEA which has led to developing common evaluation frameworks, standards, guidelines, reporting templates and quality assurance mechanisms, a similar effort is needed for the monitoring function. Different components within a particular CRP can use different approaches to measuring outreach achieved, research uptake, benefit realization and cost-benefit calculations. These can be effectively streamlined through common definitions and templates.

Hiring of relevant expertise for the purpose would benefit the program in this regard. In phase 2, consideration should be given to hiring a specialist to be located with the CRP management, or relocating the M&E specialist from Bulawayo to handle the expected increase in M&E and impact requirements in the new merged CRP. The CRP should also consider the potential to increase allocations to M&E to at least 5 percent of the total program budgets.

This is the most important handicap that the CRP is facing in implementing the coordination and management needs of the program, including the M&E. The Project Management Unit (PMU) of Dryland Cereals is minimal, and does not have the necessary expertise for M&E, or financial management and budget tracking⁵⁹. In the second phase merged scenario, the M&E system from Dryland Systems CRP and the expertise behind it will be readily accessible.

6.5 Communications and cross learning

Two aspects of communications in Dryland Cereals are considered here – internal CRP communications for management and reporting purposes, and communication of the CRP’s research results and achievements.

- *How efficient is interaction and communication between CRP-DC management and researchers, and cross regionally among researchers and partners?*

Views on internal communication within the CRP were variable among researchers. The majority were highly appreciative of the efforts of the CRP director to communicate information concerning CRP matters. Communication channels were more complicated for ICRISAT scientists because of their reporting lines to their program manager rather than the CRP director. ICARDA scientists communicate directly with the Dryland Cereals Director on CRP matters.

The CRP philosophy was to bring Centers together. However, the extent to which there is synergy through cross fertilization of ideas and sharing of research methods and results across crops/regions and across partner Centers is limited. The flagships have not yet constituted fora to develop a community of practice around their topics (although this is working well for crop improvement).

Institutional boundaries and different funding sources add to the complexity. Integrating the work of different Centers within common flagships and locations of operation⁶⁰ will present a challenge. Dryland Cereals needs a greater emphasis on coordination and communication of work across

⁵⁹ PMU has 1 Administrative Assistant, 0.5 Communication Manager and at present, 0.5 Program manager, the latter only until the end of 2015).

⁶⁰ While in India, the evaluation team visited Jaipur, Rajasthan to discuss pearl millet research. They were informed only on their subsequent visit to Karnal to discuss barley, that there was a research team on barley in Rajasthan which could have been included.

flagships and locations as well as effective mechanisms for sharing methods, tools and experience across crops and regions in order to improve synergy. Improved efficiency will result from sharing of knowledge and resources among researchers and partners contributing to this CRP.

- *Has Dryland Cereals a clear identity and platform for sharing and promoting the program outputs and achievements?*

ICRISAT has several platforms that Dryland Cereals can leverage to benefit smallholders from other developing regions. These include the Agribusiness Innovation Platform, the Hybrid Parent Research Consortium model, the South to South Initiative, and the ICRISAT Development Center for UpScaling.

At present these learning platforms are not sufficiently leveraged for cross-learning, CRP branding, resource mobilization and harmonization of efforts. It is therefore important that during the merged CRP second phase, these initiatives are tested and replicated globally. An exception is the Agribusiness Innovation Platform (AIP) of ICRISAT in India. Dryland Cereals is supporting the replication of the AIP model in Africa. The AIP works closely with FARA in Africa, specifically with its UniBRAIN unit, and has already established a Sorghum Value Chain Development Consortium (SVCDC) in Kenya (<http://www.fara-africa.org/apps/news/item/309/>). Dryland Cereals is working closely with the Hybrid Parent Research Consortium (HPRC) and Seed Dissemination in India⁶¹. This is a platform where basic research on germplasm diversification and enhancement, and a diverse hybrid parent selection is shared with partners, including seed companies and public sector institutions, for them to make selections of suitable parental lines. The new hybrids are subsequently tested in their target markets and locations and then released and made available to farmers. The Evaluation Team talked with representatives of companies and visited field trials run by the companies. Under the HPRC agreement, each company contributes fees annually to become a member of consortia. The number of contributing companies increased from 9 in 2000 to 50 in 2008. The impact of the HPRC has been impressive. So far, 60% of 110 pearl millet hybrids sold in India are based on ICRISAT-bred lines, and 50 more are in the pipeline. Also 56% of 55 sorghum hybrids sold in India are based on ICRISAT-bred lines, and 8 more are in the pipeline.

Other platforms and mechanisms for sharing Dryland Cereals outputs are the ICRISAT South-South Initiative, supporting value-chain based agribusiness incubators in Africa; the India-Africa Forum Summit supporting food processing business Incubators in Africa and the ICRISAT Development Center for UpScaling which is promoting 'BhooChetana' or land rejuvenation with farmers through water management, soil fertility enhancement and diversification. These platforms are a good integration point for partnerships and coordination across commodities and for upscaling commodity-system CRP interventions.

Dryland Cereals needs to promote its achievements more effectively to a wider and international audience. Dryland Cereals needs a good communications strategy identifying different stakeholders and audiences and the communication topics and channels of interest to them. This is part of a larger framework to provide critical knowledge inputs to the variety of actors associated with influencing

⁶¹ Research for Development on Dryland Cereals in Africa & Asia: Recent Successes and Lessons Learned; ASA, CSSA, SSSA, Annual Meeting, 4 Nov 2014

policy, especially in developing countries. It is recognized that this is a challenge given the competing demands on the Communications manager's time.

Dryland Cereals can build positively on its distinct identity as a consortium of CGIAR and non-CGIAR partners dedicated to delivering an integrated program. There is a need to clearly establish the respective communication roles and responsibilities of Dryland Cereals and the lead Center. ICRISAT as the lead center has a major role to play and there will be collaboration in developing the communications content and use of resources. The Dryland Cereals web site could do much more to communicate research achievements (including publications) and the outcomes experienced in different regions. At present it is hard to access through search engines – only accessible via the CGIAR or ICRISAT web sites. Use of different ICTs could be considered e.g. blogs, discussion groups, newsletters etc.

Dryland Cereals has undertaken extensive efforts for knowledge dissemination on varieties and crop management solutions through innovative communication channels (use of pre-sowing radio campaign, videos and marketing plots). However these have been mostly done in Mali and to some extent in Burkina Faso for product line 1, in Tanzania and Kenya for product line 3 and in India for product line 6 and 7. The communication systems are capturing the large items (success stories) for external communication and missing many significant stories of progress or constraints faced, for internal communication and for programmatic understanding and improvement.

6.6 Recommendations on efficiency

The three main recommendations concerning efficiency address the management relationship between the Dryland Cereals CRP and the Center Program managers, the requirement for a functioning M&E system spanning different levels of the program, and a more targeted communication strategy focusing on communication across crops, flagships, partners and locations.

8. **A clear definition of the roles and responsibilities** of the CRP Director vis a vis program managers in the Lead and partner Centers would help to improve efficiency and effectiveness. An important element to consider is the empowerment of the CRP Director with an increased role in the management of the planning, delivery and quality of CRP outputs and outcomes. Duplication of effort could be avoided by streamlining and standardizing reporting formats.
9. **The CRP is strongly recommended to develop its M&E system.** Elements of this include;
 - **The development of an overall M&E framework** within which existing data can be synthesized to guide country strategies and gaps identified which require further data collection.
 - **Conceptualisation of CRP program, region and country level theories of change and impact pathways**, as part of the broader framework. Baseline studies by crop and country will draw on these designs, while using common templates for analysis, data consolidation and reporting.
 - **A monitoring and evaluation data base system** to facilitate the work of the CRP, in tracking delivery and reporting. An M&E specialist will be needed to support CRP management and deal with M&E and impact requirements in CRP phase 2.
 - **A monitoring Community of Practice** to develop standards, reporting guidelines and quality assurance mechanisms for tracking performance of the CRP across Centers.

10. The CRP is encouraged to develop an effective communication strategy that:

- Promotes synergy between Centers and CRPs, communicating work across flagships and locations with effective mechanisms for sharing methods, tools and experience across crops and regions.
- Identifies and tailors communication products from across Dryland Cereals partners for different stakeholders.

7. CROSS CUTTING ISSUES

7.1 Gender

The CGIAR Strategic Results Framework (SRF) identified research on gender as a cross-cutting theme of relevance to all CGIAR Research Programs. An important achievement of Dryland Cereals in 2013 was the completion of its Gender Strategy⁶² which is intended to promote the integration of gender across the Dryland Cereals as an essential element of its overall agenda and its research and training activities.

The overall goal of the gender strategy is to reduce gender inequality in the production, processing and marketing of dryland cereals to drive an increase in whole family benefits in income, nutrition and food security. The document highlights the need to address gaps in information on gender roles and gender disparities across the different regions and countries, in order to inform priority setting and to adapt and target technologies more appropriately.

Strategic gender objectives and crop cluster-specific objectives are articulated, together with process, output, outcome and impact (or system level) indicators, guiding research questions and proposed impact pathways. These were further elaborated in the Dryland Cereals extension proposal in relation to the Flagship projects. Other aspects addressed were gender staffing and recruitment and the designation of 10% of flagships budgets for gender relevant R4D interventions, as well as an overarching budget for strategic gender research. The strategy includes support for gender-related capacity building for Dryland Cereals participants.

Strategic gender studies were completed in 2013 in South Asia, ESA, WCA and North Africa covering the four crops. The studies investigated the specific contributions of women and men in dryland-cereal value chains, the typologies of farmers involved and the gender relations. Findings were summarised in the annual report, but individual reports were not seen by the evaluation team, nor is it clear whether they have played a role in guiding targets and indicators and research priorities.

Dryland Cereals is participating in a cross-CRP study on agricultural innovation, agency and gender norms, undertaking case studies with a common framework and methodology to facilitate consolidation and joint learning. Studies have been conducted in West Africa, East Africa, and are planned for India.

➤ *Have the respective roles and needs of men, women and youth been adequately identified through gender analysis and have these informed the setting of research objectives and priorities?*

The key roles of women in crop and livestock production, processing and use are recognized in the Dryland Cereals proposal and women farmers are indicated as a primary focus of the work, particularly with respect to 'identifying appropriate quality traits, suitable agronomic practices and profitable post-harvest processing and market access options'. The importance of equitable inclusion of women along the value chain was highlighted. Overall, Dryland Cereals has taken seriously the need to identify the roles of women and men. However, it is less visible in some cases, how the different needs and

⁶² Gender strategy. Feeding the forgotten Poor. Research program on Dryland Cereals.

<https://onedrive.live.com/view.aspx?resid=42697C9EAEF5F373!269&ithint=file%2c.pdf&app=WordPdf&authkey=!AFH2fE7fS1LYpWM>

preferences of women and men have actually influenced the planning of research and development activities. Some positive examples are given, drawing on baseline data, annual reports and researchers' presentations:

- Baseline studies for barley in Haryana and Rajasthan states, India assessed the roles of women in crop production and their responsibilities in the post-harvest sphere, e.g. storage, fodder management and processing of food products⁶³. The study revealed women's limited role in decision making on agricultural production and led to a strategy of support for women's self-help groups. Market surveys of food barley products in Morocco and Ethiopia have led to proposals for value addition and market access activities mainly involving women.
- For pearl millet and pearl millet hybrids in South Asia and East Africa, gender needs identified were for labor saving crop management technologies, improved post-harvest and processing and value addition technologies and improved marketing, which encouraged work on processing equipment and shelf life.
- In East Africa, the baseline study for the Sorghum for multiple use project⁶⁴ found that compared to men, women had significantly smaller cultivated areas, were less likely to purchase seed or use improved sorghum varieties, relied on other farmers rather than extension services for information and sold smaller quantities at lower prices. This reinforced the strategy to increase women's involvement in seed production and marketing.
- The nutritional needs of women and children are important priorities for Dryland Cereals, which focus on the nutritional improvement of the crop (high zinc and iron, and beta glucan for barley). In east Africa emphasis is on increasing women's knowledge on quality control, seed production and marketing. In West Africa an earlier study estimated that 50% of sorghum produced by women is used for children's food (van den Brook, 2010). Activities include promoting consumption of the whole grain through nutrition field schools in Mali and Niger⁶⁵.
- A commissioned grant for a study of weeding practices and the role of "*shibras*"⁶⁶ in community-level food security in Mali and Niger is giving particular attention to gender and equity aspects. It is exploring options for reducing the potential negative impact upon food-insecure households of adoption of "*shibra-free*" improved pearl millet cultivars.

The specific circumstances and needs of youth – male and female- in relation to Dryland Cereals are not prominently articulated in planning and reporting across all the Dryland Cereals crops and regions. Analysis of the position of youth in agriculture the focus regions of a reconfigured CRP will be important for developing a longer term strategy to sustain cereal production in dryland areas.

➤ *Have research processes involved women's participation in technology testing, evaluation and selection?*

⁶³ Presentation by researchers and discussions at the Institute of Wheat and Barley Research, (ICAR, Indian Council of Agricultural Research) Karnal, India, June 2015.

⁶⁴ D Marangu, P Audi, M Mgonja, N Mburu (2014) Characterization of sorghum production and marketing systems in Eastern Province Kenya. Sorghum for multi-use (SMU Baseline Survey report).

⁶⁵ Skype interviews with Sorghum breeder and Gender specialist, West Africa, July 2015.

⁶⁶ a wild form of pearl millet which can provide some grain. Source: Presentation by TM Hash at CERASS, Theis, Senegal August 2015.

Clear efforts have been made to involve women in different stages of technology testing, evaluation and utilization; *“in general in all activities implemented we make sure the population is represented by various groups, women and youth”*⁶⁷. The HOPE project, with a clear target for women’s participation, appears to have done much to highlight and encourage women’s involvement in technology testing for sorghum, pearl millet and finger millet, through on- farm trials and variety assessment and seed production. New product development has been particularly targeted toward women⁶⁸. Scientists across Dryland Cereals emphasized that their breeding strategies should involve end users, both men and women, so as not to miss critical criteria for acceptability. Examples were given of instances where crop trait preferences of men and women were different. In Kenya, systematic voting during participatory hybrid selection on station is done separately for men and women and the best are taken into on-farm trials⁶⁹.

An important area of success has been the involvement of women in seed production initiatives in India, West Africa and East Africa. In Ethiopia, 532 women farmers belonging to research and extension groups at two locations were trained in seed production and management by NARS and members of farmer groups. Members of the evaluation team met a woman farmer who produces finger millet seed for sale to the Ministry of Agriculture, locally and to seed dealers from other areas. She expanded her area of seed production from .25ha to >6 ha. Similar approaches based on women’s groups who produce Quality Declared Seed have been followed in Western Kenya and Tanzania. In West Africa, the HOPE project has supported community seed production and management for pearl millet and sorghum and women are actively involved.

The post-harvest research area has been recognized as an important route for benefits to women and households. In east Africa, women were trained in finger millet post-harvest handling and value addition for household use and local markets. Women are involved in testing prototypes for finger millet threshing and weeding. The use of small mobile threshing machines transported by motor bike is being explored as a way to reduce labor demands on women and provide an occupation for youth. In Morocco, pilot activities were initiated in 2014 with two women’s associations in semi-arid barley production zones on production of hydroponic barley for quality dry season feed for livestock. In India, around 200 women farmers in Gujarat and Rajasthan were trained on the use of blanching to increase the shelf life of pearl millet flour. ICRISAT’s Agri-Business and Innovation Platform has been working with the Association of Lady Entrepreneurs of Andhra Pradesh providing training on business opportunities and have supported women entrepreneurs to develop business plans and engagement⁷⁰.

In some countries the inclusion of women in the research process, from identification of needs and preferences to involvement in varietal assessment and selection and seed multiplication, is dependent on research and extension staff being able to engage with women in culturally acceptable ways. For example, in Morocco, inclusion of women in baseline studies presented a challenge as there was no female researcher available to join the team⁷¹. However in this case, previous studies and six years of

⁶⁷ Meeting with ICRISAT Country coordinator, Ethiopia, July 2015.

⁶⁸ Group discussion with ICRISAT researchers and regional partners, Nairobi, July 2015.

⁶⁹ Meeting with ICRISAT staff working on Dryland Cereals, based at Kiboko Research Station Kenya, July 2015.

⁷⁰ Interview with the Director of the Agri Business and Innovation Platform, ICRISAT, India, June 2015.

⁷¹ Interview with national research partner, INRA Settat, Morocco. June 2015.

participatory trials on barley in Morocco provided good insight into women's roles and interest in multi-purpose barley. In West Africa there is a lack of local female technical staff to maintain interaction with women in farmers' associations, although there are women facilitators and male technicians are able to interact with both men and women.

- *Have the intended users of research outputs and different categories of beneficiaries of research - men and women farmers, consumers, agro enterprises, researchers (national and international), policy makers etc. been clearly identified along the impact pathway?*

Dryland cereals have identified categories of users including men and women farmers (see section 3.5), researchers, consumers and agro enterprises, making efforts to link with these groups through partnerships or by engaging directly. Research has identified areas of policy relevance, for example, the seed system in Morocco, implications of policies on pricing and subsidy for wheat and maize in relation to barley, sorghum and millet and promotion of mechanization versus demand for labor. However, the capacity to consolidate information into policy relevant formats and to engage at policy level appears to be limited.

- *Has research resulted in benefits for men and women, enhancing the livelihoods and nutrition of women and children and increasing income from market sales?*

From reviews of reports and discussions with researchers, the Evaluation Team found benefits of the research to date for men and women. These include enhanced income from sales of seed for members of women's seed production groups. A woman finger millet seed producer in Ethiopia said, *"the success is very big. I constructed a modern house, I sent my children to school, improved our feeding, sold seed in other parts of the country. I have a small shop, and three wheeler [vehicle], and I help my relatives"*⁷². Similar reports were given by women members of barley seed producer groups, including the acquisition of additional livestock⁷³. There are reports of reduced drudgery and the saving of time for women in East Africa and Western India through the introduction of mechanical innovations such as fertilizer-cum-seed drills, weeders, threshers, and other crop-improvement/management technologies, through the HOPE project. An unanticipated change associated with the introduction of row planters for finger millet, is the increase in cropped area as it becomes easier to weed and a greater involvement of men in weeding. Other benefits in terms of productivity and food security arise from initiatives such as seed mini-packs that are affordable for resource-constrained women and men farmers, fertilizer micro-dosing and farmer-to-farmer videos on Striga management. A study⁷⁴ of the effectiveness of the videos shown to farmers' groups and communities on control of striga and improving soil fertility in West Africa, identified a number of changes in social organization and technical practices. These included stronger women's groups and group cooperation for hand pulling of striga, and changes in practice such as making compost, micro dosing fertilizer, intercropping with legumes. These innovations were reported to have helped in managing striga.

On a wider scale, Dryland Cereals' interaction with formal and informal seed systems in India shows the potential for reaching and benefiting large numbers, for example the production of sorghum seed

⁷² Meeting with farmers in Melkassa Research Center, Ethiopia, July 2015.

⁷³ Meeting with farmers in Holetta Research Center, Ethiopia, July 2015.

⁷⁴ Bentley, Jeff, Paul Van Mele, Gérard Zoundji, Samuel Guindo (2014). Social innovations triggered by videos: Evidence from Mali. Agro-Insight

in Maharashtra State to supply 100,000 farmers by 2015 and training provided for 5,000 women farmers⁷⁵.

Some of these examples are currently only found within the detailed technical reports of Dryland Cereals or were presented in meetings with researchers and not fully consolidated.

- *Have capacity-building needs for men and women been adequately identified and their differential needs taken into account in targeting and designing capacity building activities? Has information on capacity building opportunities incorporated specific encouragement for women applicants? With what outcomes?*

Capacity building across Dryland Cereals has taken place at different levels – from farm level, to local extension service providers to national researchers. Working with local partners, researchers have contributed to training workshops and events for men and women farmers, including training of trainers. In India, workshops on barley for farm women were held in Haryana and Rajasthan and women were specifically invited to field days through village heads. Around 20% of participants were women. Dryland Cereals is seeking to increase the involvement of women in initiatives with private companies on malt barley for the brewing industry. Farmer training has been a particular focus in the HOPE project (on crop management, seed production, post-harvest handling, food products and value addition, marketing of grain and products, and nutrition). In HOPE Maharashtra, 50% of selected trainees were women. The effectiveness of field days⁷⁶ as communication channels for finger millet technology dissemination was evaluated in Western Kenya. More than 80% of the farmers who took part successfully applied the knowledge on their farms. Women applied the seed selection technologies learnt in training, however, a smaller proportion tried out technologies on fertilizer and manure use, compared to men.

There is gender capability within Dryland Cereals, but the major constraint relates to the limited gender capacity within NARS. This is closely related to the wider problem of lack of social science expertise in national systems where responsibility for gender is often delegated to women scientists with no social science training. There has been gender related training for extension and research partners in East Africa linked with the HOPE project among other initiatives, but further capacity development in gender is needed.

- *Are scientists and partners throughout the Dryland Cereals aware of the gender strategy and have they incorporated gender awareness in their research design and practice (including collection of gender disaggregated data) and technology uptake?*

Efforts were made to sensitize scientists to gender in the CRP, build awareness and encourage the asking of questions. Gender is integrated to some extent into the product line/cluster activities, but there is still some way to go. Project documents and survey tools are gender screened and gender specialists provide help with proposals and reports. Guidelines have been produced to assist with this. The gender specialists also make suggestions when scientists give presentations, explaining how gender related information can contribute.

⁷⁵ Presentation from Dr A. Ashok Kumar, Sorghum cluster leader, ICRISAT HQ, June 2015.

⁷⁶ ICRISAT HAPPENINGS 5 December 2014 1652

The researcher survey indicated that most researchers (77%) were conversant with the Gender Strategy, with 20% indicating strong agreement (figure 13). About 50% or more of the researchers rated positively all other factors related to gender, in particular, the collection of gender disaggregated data and the influence of the strategy on the way they plan and conduct their work (77% agreeing to both to some degree). Just over half of respondents agreed that they had received some level of gender training⁷⁷. 73% thought that the Dryland Cereals CRP gender strategy has been well communicated to teams and researchers

In the questions on researcher satisfaction, 75% of respondents said they were satisfied, or somewhat satisfied with gender research.

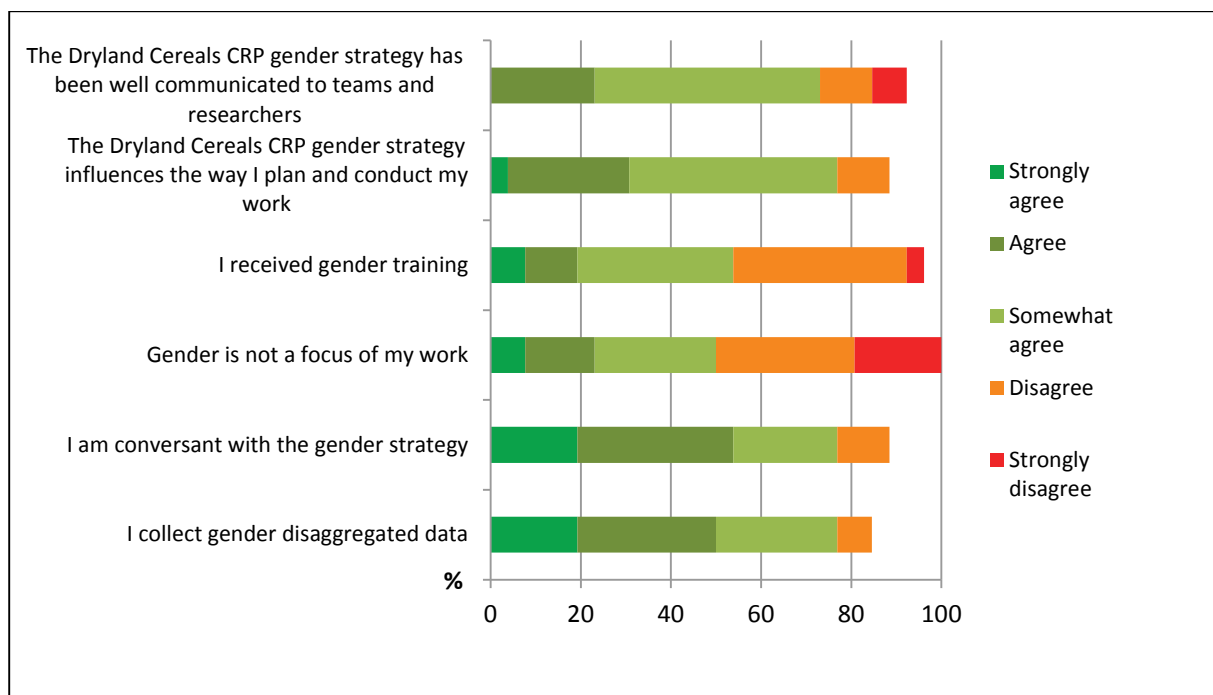


Figure 13: Researcher satisfaction on gender factors (source: Researcher survey Sept 2015)⁷⁸

Feedback from scientists in East Africa indicated that they were influenced by the interaction on the gender strategy, especially when there were tangible outcomes from the gender focus or positive gender impacts from the interventions. Finger millet crop management trials in Kenya have tested row planting using simple machinery and found that men were more ready to participate in weeding when the crop was planted in rows rather than broadcast⁷⁹.

The Evaluation Team found that good progress has been made regarding awareness of gender issues. However, the next step is to increase the practical impact of the Gender Strategy by integrating the findings of the gender studies and gender disaggregated data collection into all relevant R4D planning and activities associated with the Flagship Projects and Clusters of Activities. The case studies

⁷⁷ A workshop on Gender Integrated Planning was held India in December, 2013, to train staff and partners on the integration of gender in the two ICRISAT-led CRPs.

⁷⁸ The remaining percentage is 'don't know'

⁷⁹ Millet breeding programme in ESA. Presentation from Heny Ojulong, E. Manyasa, P. Sheunda, J. Kibuka, D. Otwani, Partners. ICRISAT Nairobi, 9 July 2015.

commissioned under the agricultural innovation, gender norms and agency cross CRP study are not yet available, but in preparation. Greater awareness of these studies among Dryland Cereals Scientists could be promoted.

The Village Dynamics in South Asia <http://vdsa.icrisat.ac.in/> is a very valuable data set which can situate gender analysis alongside social and economic analysis. The experience of this program in using tools and approaches for efficient and accurate data collection are potentially extremely valuable to Dryland Cereals gender specialists, social scientists and flagship leaders.

There is still some way to go before the concern with gender and social equity in research prioritization, implementation and outcomes is really embedded in the institutional culture of partner NARS in Dryland Cereals. It appears to have been successfully integrated and reported on in the HOPE project which started earlier than the CRP, and it is expected that with further efforts a similar focus will develop across the whole portfolio of projects.

➤ *What are the respective proportions of men and women scientists in the Dryland Cereals as researchers, managers and in governance roles?*

The Dryland Cereals gender strategy is clear on the importance of gender in staffing and recruitment. The evaluation team did not get details of numbers of men and women staff employed at ICRISAT and ICARDA who are working on Dryland Cereals. However, the list of scientists and partners compiled for the scientists' and partners surveys provides a good indication. On the scientists list, 16.7% were women and on the partners list, 14.7% while 14% of scientists' survey respondents were women. The proportion of women involved in Dryland Cereals at all grades is likely to be higher, if laboratory staff and technicians are included. However, these figures indicate the limited number of women scientists contributing to the CRP.

Dryland Cereals CRP has a female Director, recruited in 2013 who is one of the three women directors among the 15 original CRPs. The governance roles in Dryland Cereals are highly gender imbalanced. The steering /advisory committee, composed of 13 members (not including the CRP Director) has only one woman member, and the research management committee (core plus technical team) has 24 members of which only four are women.

There have been efforts to raise awareness of gender and diversity at the work place, for example a workshop in Mali in 2012. However, it is not clear to what extent these sessions have been held across other Dryland Cereals locations, involving both ICRISAT, ICARDA and partner organization staff.

Efforts have been made to include women scientists in training courses – e.g training on sequencing and biometrics in West Africa. The general guidelines or terms of reference for the Scholarship program (see section 8.3) specify one of the objectives ' Encourage and develop excellence in fundamental and practical research capabilities in women and early-career scientists in developing nations to address the global challenges in agriculture, with a focus on dryland cereals'. Six of the eleven scholarships awarded through RUFORUM and WACCI are for women scientists.

The senior gender specialist appointed in February 2014 and based in Bamako, was responsible for coordination of the gender work across Dryland Cereals. However, she resigned from the post in July 2015. The three gender specialists contributing to Dryland Cereals are at ICRISAT HQ Patancheru, ICRISAT Nairobi and ICARDA, Amman. This is an efficient arrangement as the gender specialists work

across CRPs, crops and flagships. The ICRISAT gender scientists cover Dryland Cereals and Grain Legumes, while the ICARDA gender scientist covers Dryland Systems in addition to work (mainly in barley producing areas) for Dryland Cereals. The recruitment of an additional post-doctoral gender researcher is planned, with a focus on trait prioritization.

7.2 Partnerships

The CGIAR reform process emphasized a new vision of partnerships which reaches beyond traditional research partnerships to establish broader associations with other actors so that they fully participate in the design of the research and their scaling up, and develop the appropriate supporting institutional and policy environments. (SRF, 2011).

In addition to ICRISAT and ICARDA as partners in the Dryland Cereals CRP, other important national and international partners collaborate in the program. Those indicated as partners on the program web site are the Generation Challenge Programme (now ended), ICAR (India), AREEO (Iran) and IRD and CIRAD (France). Other stakeholders mentioned are USAID, NARS, ARIs, NGOs, civil society organization/farmer organizations and private sector companies.

Linkages between Dryland Cereals and a number of other CRPs were indicated in the program documentation, although relatively few examples were identified from interviews and reports. At the first meeting of the Independent Advisory Committee (IAC) for Dryland Cereals (15 February, 2014), suggestions were provided on linking with other CRPs for CRP-CRP synergy activities, commissioned grants proposed by the CRP, strengthening of NARS capacities. Both the Dryland Cereals researcher survey and particularly the partners' survey (figure 14) indicate that researchers collaborate with other CRPs, but this is not necessarily indicative of cross-program collaboration.

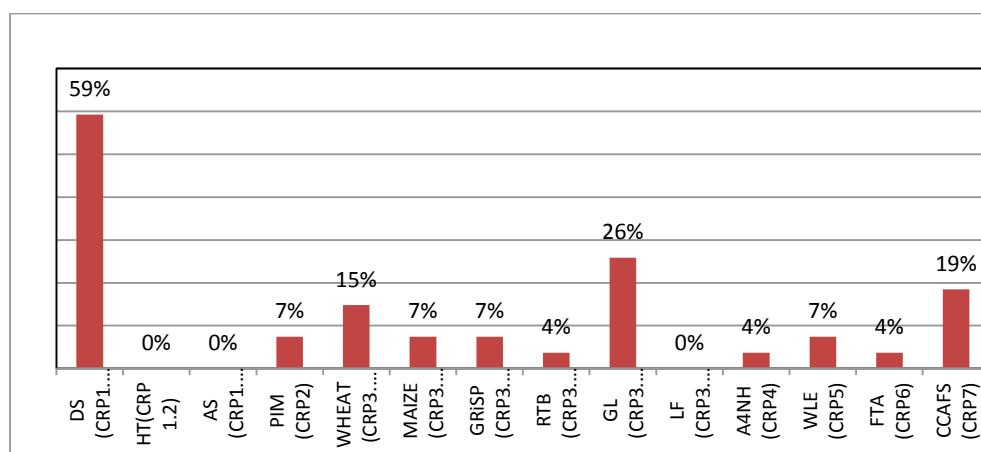


Figure 14: Partners collaborating with CRPs other than Dryland Cereals (Source: Partner Survey, October 2015, see annex 6) ⁸⁰

- *Are the range of partners required to achieve the program objectives present?*

⁸⁰ Dryland Systems (CRP1.1), Humid Tropics (CRP1.2), Aquatic Agricultural Systems-AAS (CRP1.3), Policies, Institutions, and Markets PIM (CRP2), WHEAT (CRP3.1), MAIZE (CRP3.2), Global Rice Science Partnership-GRiSP (CRP3.3), Roots, Tubers and Bananas-RTB (CRP3.4), Grain Legumes (CRP3.5), Livestock and Fish (CRP3.7), Agriculture for Nutrition and Health-A4NH (CRP4), Water, Land and EcosystemsWLE (CRP5), Forests, Trees and Agroforestry FTA (CRP6), Climate Change, Agriculture and Food Security CCAFS (CRP7)

Linkages with advanced research institutions are seen as facilitating access to modern breeding methods for crop improvement, while NARIs, NGOs and civil society partners are important in terms of farm level integration and adaptation, communication, extension and seed distribution. Dryland Cereals has built good linkages with advanced research institutions and National Agricultural Research Institutions (NARIs). The first are important for collaboration at the cutting edge of science, while the NARIs are the most important research partner for Dryland Cereals in helping to deliver impact on the ground. They provide human capacity and land for screening of breeding material as well as multiplication of foundation seed. Some have a strict research mandate that limits their ability to act as effective development partners, but nevertheless they are able to organize and supervise on-farm trials and participatory variety selection for which the CG Centers do not have the manpower. Where the national researchers are limited to a research role, their relationship with the agricultural service providers – both government and non-government/private sector is important for any outreach activity. The relationship between the NARIs and Dryland Cereals was particularly strong in Ethiopia, Morocco and Kenya, with regular coordination of activity and resource-sharing.

The initial approach to partnerships in the CRPs tended to emphasize involvement of partners who were able to contribute funding to the program; this meant that many national and local research and development organizations, especially in Africa, were not included. This has changed over the period of Dryland Cereals implementation. However, the amount of money going to the NARIs and other partners as a proportion of Dryland Cereals expenditure remains small and is a constraint to extending impact. In 2014 about 15% of expenditure went to research and development partners. Governments in India, Ethiopia and to some extent Morocco, are committed to funding agricultural research and development, however allocations for operational costs are limited.

It is difficult to assess whether or not the range of partners associated with the CRP is adequate because it is not always apparent the extent of their involvement, particularly those that do not receive funding, which includes most private sector actors – seed companies, agro-dealers, processors etc. The extent of partnership with the private sector is more advanced in India than in the other regions. In response to feedback on the Extension proposal, Dryland Cereals agreed to look for new non-traditional partners. Dryland Cereals has initiated discussions with potential partners that will allow the CRP to focus on developing crucial regional and strategic collaborations for the effective functioning of the impact pathway across all target regions⁸¹. In addition to the strategic collaborations, the Dryland Cereals is advised to place more emphasis on extending the range of national partners as they provide the essential farmer and market interface. However, this will create further demands on the shrinking CRP budget. There is a need for partners to work together to seek out alternative approaches to fund the NARS.

➤ *To what extent are the Dryland Cereals partnerships relevant and target critical roles and linkages in the impact pathways?*

The relevance of the partnerships depends on their ability to contribute to the impact pathway. During the time available for field visits, in addition to researchers from NARIs, the evaluation team were able to meet some development partners and private companies (see list in annex 2). These included

⁸¹ Response to Review Comments on Dryland Cereals Extension Proposal, 24 August 2014.

organizations collaborating in the larger bilaterally funded projects (HOPE, SMU), farmer seed producing associations, private seed companies and a malt factory. Outside India, partnership with private sector seed companies is in the early stages, as the market for hybrids begins to expand. Private sector processors are often risk averse and reluctant to invest in smallholder supply chains because of poor contract enforcement, low produce quality and unreliable delivery. More effort is required to meet these challenges, beginning at the policy level. There is scope for further work with fertilizer companies on small packs of fertilizers, seed companies on small seed packs and distributors and small rural agro-dealers – bringing these actors together where possible, to foster coordination. The researchable question for investigation is whether and under what circumstances these initiatives are economically worthwhile and sustainable for seed companies and agro-dealers.

- *Are partnerships managed so as to maximize efficiency for results? Are the respective roles of the CRP and national programs clearly understood and appropriate?*

Partnerships within Dryland Cereals are beginning to show benefits of collaboration. The partnership in barley has changed compared to when the CRP started in 2012. When ICARDA moved from Syria, scientists started thinking in a decentralized mode. At the beginning there was no clear vision on how to work together, but from the second year, there was an effort to develop joint activities and use screening sites in the Dryland systems action sites and experiment together. Due to the decentralization, ICARDA has seen the value of cooperation through Dryland Cereals. They share facilities with ICRISAT, for example, in the physiological and molecular marker, and biotechnology research.

The extent to which partnerships and networks function, thereby influencing aspects of efficiency, particularly regarding shared responsibilities, differ according to crop and region. There are strong, well-resourced organizations in India that are able to partner with ICRISAT/Dryland Cereals and improve the efficiency of the breeding and allied research programs. In Africa there appear to be fewer such organizations, especially in West Africa. Work done out of Kenya is done in partnership with KALRO, and responsibilities are split with Dryland Cereals whereby KALRO manages on-farm aspects and the CRP on-station aspects of sorghum breeding and selection. This issue is linked with resource allocation according to capacity, and how this might make breeding more efficient. It was apparent that in India that the national capacity for crop breeding in the public and private spheres was substantial, whereas strong national capacity in Africa was less evident and arguably more deserving of financial and material support.

With the exception of the NARS that are the traditional partners of the CG Centers, it is difficult to determine whether partnerships are being managed effectively as their outputs are incorporated into the general Dryland Cereals reporting and there do not appear to be separate grantee reports required.

- *Is the level of collaboration and coordination with other CRPs and partners appropriate and efficient for reaching maximum synergies and enhancing partner capacity? What are partners' contributions to research and management processes?*

There were 27 respondents to the partners' survey, out of a total of 86. This was a low response (31%) despite a number of polite reminders. 78% indicated they are involved in Dryland Cereals research, fairly evenly spread across the four crops and five flagships. The highest percentage of partners work

on flagship 2 (67%) then flagship 3 (48%). Flagships 1 and 4 were similar (33%). The partners also work on capacity Building (63%), partnerships and foresight Planning (52%), gender (26%), and other (19%).

The partner survey results show that 33% of the responding CRP partners received a competitive grant. The grants were across all the flagships, with Flagship 2 being the most frequent (71%) (Figure 15).

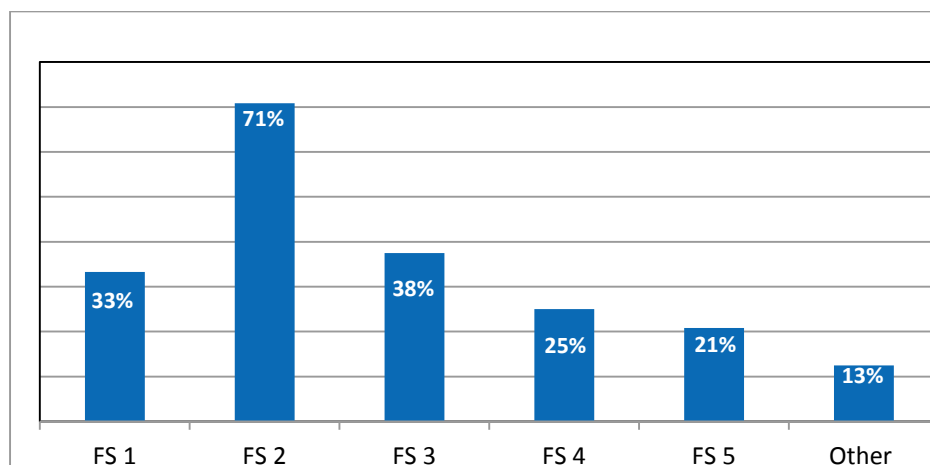


Figure 15: Grants supporting Flagship⁸² activities (Source: Partner Survey, October, 2015)

Most partners effectively participated in a range of project related activities. Areas of collaboration include: (i) Dissemination/Feedback from clients (72%), (ii) Research prioritization (81%), (iii) Planning of projects (77%), (iv) Research publications (70%), and (v) Research mentoring (50%) (Figure 16).

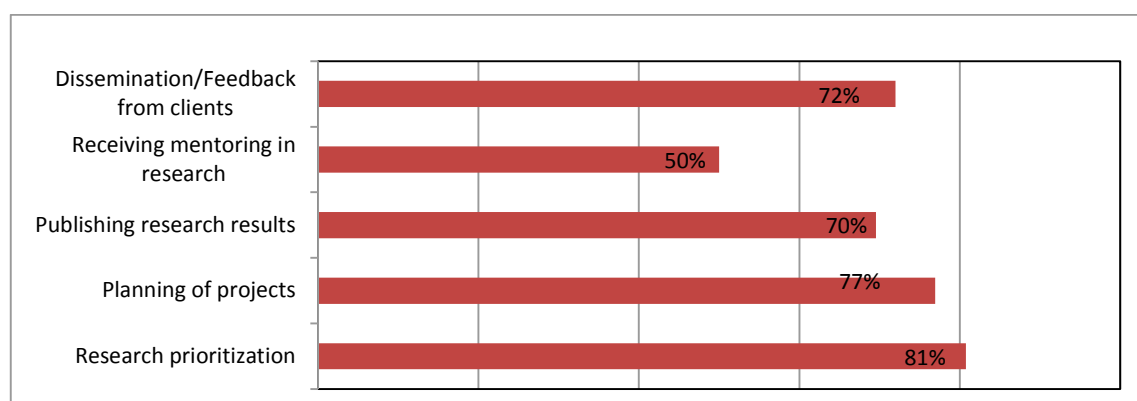


Figure 16: Partnership activities (Source: Partner Survey, October, 2015)

Our findings indicate that most partners reported their research results to the relevant product Line/crop cluster leader (58%) and/or to the CRP Director (23%), and the Center DG (4%). However 42% indicated ‘other’, which might indicate multiple channels or a possible lack of clarity in terms of reporting channels to be followed by the partners.

⁸² FS 1 Priority setting and adoption; FS 2: Improved Varieties & Hybrids; FS 3: Integrated Crop Management; FS 4: Seed Systems & Input Markets; FS 5: Post-harvest Value & Output Markets

During discussions with scientists, the Evaluation Team was briefed that ICARDA allocated funding to partners in 2013 from the ICARDA Dryland Cereals budget allocation. For the 2014 partnership grants, Dryland Cereals received 74 submissions.

Some NARIs partners indicated that they faced difficulties with funding uncertainty. Funds are allocated through annual budgeting in June, which is too late for the growing season. Several seemed to be uncertain of the funding status for 2015.

Overall, while the CRP has embraced partnerships as a mode of delivery of CRP initiatives geared towards impact, there is still work to be done. The further development of a partnership strategy based on an analysis of the critical linkages in the impact pathway in each country and the types of partner that are most appropriate to secure those linkages, could help to strengthen partners and their roles in dissemination, particularly in Africa.

This is likely to increase the proportion of the CRP budget allocated to partners, but is necessary to achieving research outcomes leading to development outcomes /IDOs. Without funding to stimulate the participation of the critical innovation actors, the CRP achievements may remain sub-optimal, confined to research outputs that various scientists produced in the system. NARIs are likely to continue to get the biggest chunk of partners funding portfolio, but an appropriate proportion could be worked out for other categories of partners (NGOs, research /academic and private sector organizations).

7.3 Capacity strengthening

- *To what extent is capacity development is needs based and integrated into research and delivery; to what extent are capacity issues taken into account in impact pathways; are the demonstrable outputs of capacity building? (summarised)*

Dryland Cereals has conducted a total of 17 training courses in 2013 under the special capacity building fund approved by ICRISAT management. The courses were attended by a total of 325 participants representing various partners from Asia (Bangladesh, India, Lao PDR, Nepal and Sri Lanka, China, Malaysia, Myanmar, Philippines, Vietnam and Turkey), Africa (Bamako, Benin, Burkina Faso, Democratic Republic of the Congo, Egypt, Eritrea, Ethiopia, Ghana, Kenya, Malawi, Mali, Mozambique, Niger, Nigeria, Senegal, Sierra Leone, Sudan, Tanzania, Uganda, Zambia and Zimbabwe) and other regions (Brazil and England). Of the 325 participants, only 24% were female.

Most researchers felt the Drylands Cereals CRP supports capacity development needs in developing countries (88%) and for men and women. However, only 27% agreed that the CRP has sufficient capacity building funds for staff (Figure 17).

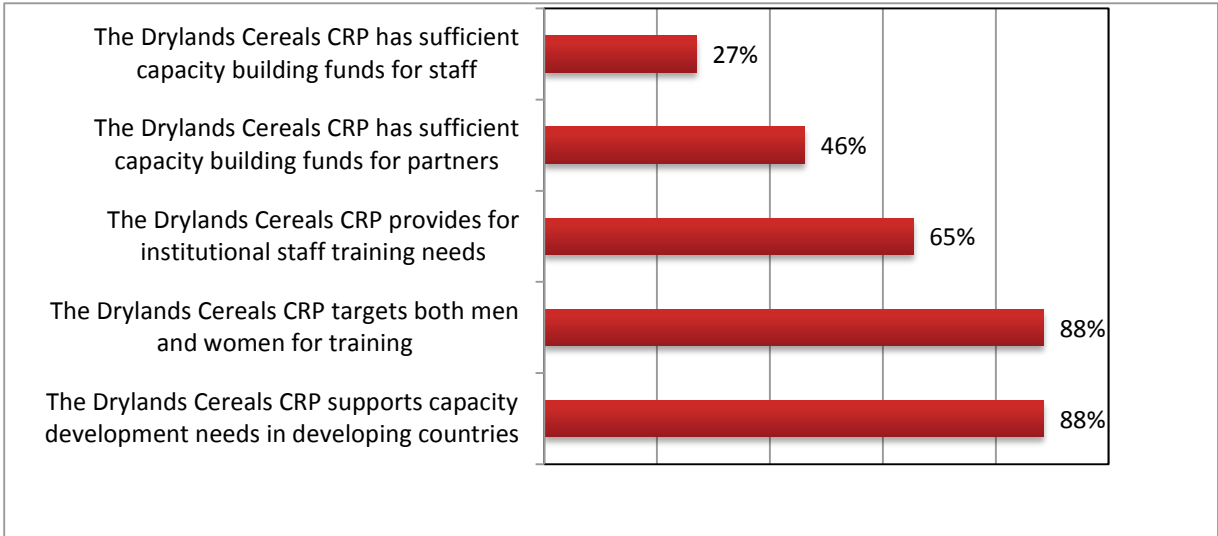


Figure 17: Capacity Development Funding (Source: researcher survey, October 2015)⁸³

The researchers were least satisfied with the budget for internal capacity development out of a range of other factors (Figure 18).

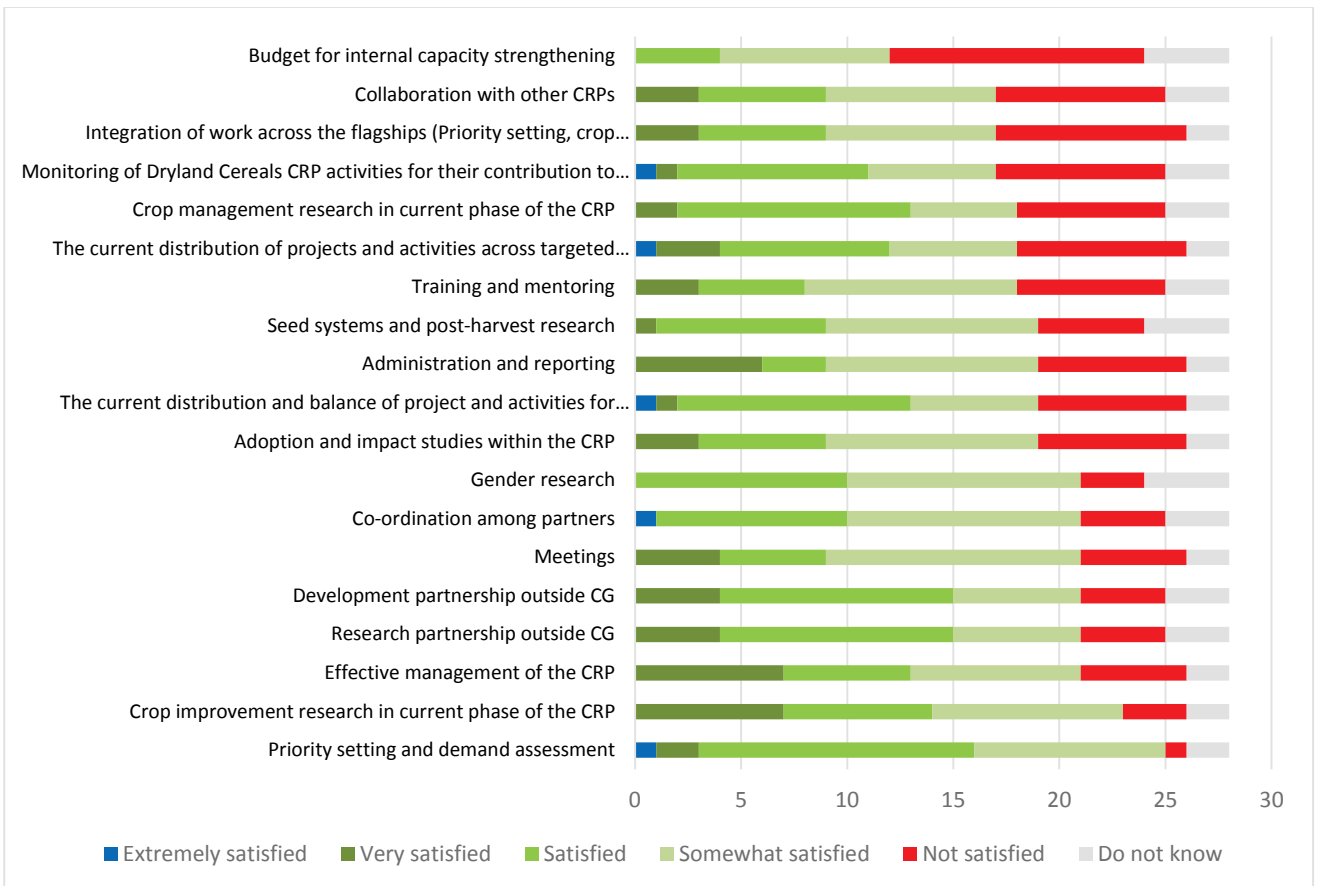


Figure 18: Researcher satisfaction (Source: researcher survey, October 2015)

⁸³ This is a total score combining (i) strongly agree, (2) agree, and (3) somewhat agree

Dryland Cereals also supports competitive/commissioned grants. Guidelines for partner funding through competitive and commissioned grants have been drafted and reviewed internally within the Lead Center by the Research Management Committee and the Steering Committee. Due to the time constraints in 2014, it was decided to proceed with Commissioned Grants in 2014, and a call was made in May 2014 for mini proposals that contribute to the overall goals of the program. A total of 52 proposals were received and reviewed by the Research Management Committee. About 35% were identified for funding. It was expected that the grants would be offered in 2015

However, there was some concern that National programs are losing out on the competitive grants which are disproportionately won by scientists from the CGIAR centers and advanced research institutions. Experience from other competitive grants programs have showed similar trends and required a capacity building process to be associated with proposal preparation.

Another vehicle for capacity building is the Scholarships Program. About USD\$ 250,000 has been earmarked annually towards the Dryland Cereals Scholarship Program during the period from 2014 to 2016. The aims of the scholarship are: (i) create a pool of world class talents in R4D and modern science, for improvement of lives in the dryland areas of Africa and Asia by creating new opportunities through Dryland Cereals focus crops (barley, finger millet, pearl millet and sorghum); (ii) Strengthen and enhance the human resource capacities of NARS partners in Africa and Asia, and motivate young minds to focus on R4D for creating a sustainable environment in dryland areas; (iii) Encourage and build capacities of women in science and development of dryland cereals; and (iv) Utilize skill sets and services of talented and qualified young graduates in NARS. Dryland Cereals had planned to disburse to 3 to 4 scholars for the academic year starting September 2014.

7.4 Recommendations on cross cutting issues:

The three cross-cutting areas of gender, partnerships and capacity strengthening play a vital role in the delivery and sustainability of Dryland Cereals research. The following are the suggested recommendations.

7.4.1 Gender

11. The value of gender studies and social analysis could be maximized by Dryland Cereals management together with Center gender experts developing mechanisms for sharing findings and data from gender and social analysis (including of youth and other social groups), from the gender case studies and from Village Studies in India, highlighting implications for research activities, through a reinvigorated gender forum, or on- line seminars for scientists In Dryland Cereals.

12. In consultation with the cross CRP gender network, it is recommended that Dryland Cereals management and gender experts develop plans for gender capacity development:

- In **gender and social analysis** for social scientist researchers in partner country NARS, particularly for West and North Africa.
- In **gender issues in the work place**, especially for senior managers and staff drafting job descriptions or participating in recruitment, promotion and grant awarding panels. Ensure a more flexible working environment in terms of staff location, recognizing challenging conditions in some Dryland Cereals countries.

7.4.2 Partnerships

13. It is recommended that Dryland Cereals CRP **develop a Partnership Strategy to guide future initiatives related to collaboration at different levels/with different stakeholders**. This would include:

- **Identification of the need for further partnerships** based on an analysis of the critical linkages in the impact pathway in each country and crop and the types of partner and functions that are most appropriate to secure those linkages.
- The evaluation team advises the development of **stronger partnerships for effective development and delivery in post-harvest and value addition** with a range of different organizations including research institutes with post-harvest expertise and with local small and medium enterprises.
- **Enhancing the role of national partners of different categories** in planning, implementation and reporting of country activities and engaging in collaborative efforts to identify additional funding to support in country activities under Dryland Cereals.

7.4.3 Capacity Strengthening

14. **Measures are needed to enhance non CGIAR /ARI partners' role in competitive grants**, and improve their success rate. Options might include:

- Design a pre- proposal stage of capacity strengthening for non CGIAR partners.
- Include a requirement for capacity building for national partners in all proposals
- Designate a ring fenced percentage of the grant fund for NARS partners as PI with CGIAR or ARIs as Co- PIs.

8. IMPACT AND SUSTAINABILITY

8.1 Assessment of impact

- *What evidence is there on the magnitude of impact in different geographical regions in terms of increased dryland cereal production and consumption; more resilient farming systems in the face of climate change; improved livelihoods and nutrition of vulnerable women and children and enhanced income?*

There are some previous impact assessments of research on dryland cereals and three have been conducted by the HOPE project and published by ICRISAT during the period covered by Dryland Cereals (Table 4).

Table 4 Impact assessment reports on dryland cereals research

Impact assessment report	Study conducted by	Report date
A combined ex post/ex-ante impact assessment for improved sorghum varieties in Ethiopia http://oar.icrisat.org/8329/1/A_Gierend_et_al_ISEDPS_22.pdf	ICRISAT	2014
A combined ex post/ex-ante impact assessment for improved sorghum and finger millet varieties in Uganda http://oar.icrisat.org/8271/1/ISEDPS_19.pdf	ICRISAT	2014
An Overview and Economic Assessment of Sorghum Improvement in Mali http://fsg.afre.msu.edu/gisaia/Mali/idwp137_revised%20for_Table5.pdf	Michigan State University	2014
A Combined Ex-post/Ex-ante Impact Analysis for Improved Sorghum Varieties in Tanzania http://oar.icrisat.org/8272/1/ISEDPS_20.pdf	ICRISAT	2013
Economic Impact Assessment of Sorghum Millet and Other Grains CRSP: Sorghum and Millet Germplasm Development Research http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1019&context=int_sormilpubs	INTSORMIL	2013
Impact of Potential Technologies for Post Rainy Season Sorghum (in Maharashtra) and Pearl Millet (in Gujarat, Haryana, and Rajasthan) in India. http://hope.icrisat.org/report-impact-of-potential-technologies-for-post-rainy-season-sorghum-and-pearl-millet-in-india-2/	ICRISAT	2011
Pearl millet and sorghum improvement in India http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/26964	IFPRI	2009
Impacts of Sorghum and Millet Research in West and Central Africa (WCA): A Synthesis and Lessons Learnt http://ejournal.icrisat.org/mpii/v2i1/v2i1impactsofsorghum.pdf	ICRISAT	2006
Partnerships for Progress: The SADC/ICRISAT Sorghum and Millet Improvement Program http://www.fao.org/docs/eims/upload/206572/1_3_4_cases.PDF	Unknown	2004

The three ex-ante/ex-post impact assessments conducted under HOPE for Ethiopia, Tanzania and Mali, are excellent work but focus on rates of return on research. While they show the relevance of

sorghum and millet research to improved food security and income among the poor in dry areas, 90% of the benefit of improved varieties in Tanzania for instance, will come in the future. Also, there is insufficient link between impact assessment and the indicators used to verify progress towards the IDOs. These studies show positive indicators for national public good, but the fundamental questions remain unanswered about changes in food security, income and nutrition at household level and changes in the profitability of processing and industrial enterprises based on access to improved dryland cereals. However, one piece of evidence, a nutritional study conducted with funding from HarvestPlus showed improvements in iron deficiency in children consuming iron-fortified pearl millet (Finkelstein et al., 2015 <http://jn.nutrition.org/content/145/7/1576.long>).

Evidence for more resilient farming systems as a result of Dryland Cereals research is harder to judge as the criteria that the program hopes to influence are not clearly defined. These require development linked to crop management research and broader issues of land and water conservation and climate change adaptation. Adoption of drought tolerant crops is widely reported as increasing farmers' resilience in the face of climate change, however, there is little reported on how Dryland Cereals technologies interact with farming systems and the environment. The Drylands Systems CRP currently has a bilateral project funded by the Arab Fund for Economic and Social Development to conduct an Impact Assessment of Agricultural Research in Dryland Systems which could contribute important insights.

Governments have an important role in creating an environment that can support research and extension services, improve efficiency of improved seed delivery system, minimize transaction costs between agro-dealers and farmers, and provide incentives to agro-processors to stimulate demand for improved /modern varieties. Dryland Cereals' work with country policies and government stakeholders has been rather limited since the dominant CRP partners tend to be agricultural universities and NARS institutes rather than policy experts, think tanks and civil society organizations.

➤ *How inclusive and equitable have research outcomes been in terms of benefits for different end users (men, women, youth, low income communities)?*

There is good evidence of research outputs reaching a range of users – both men and women, and across of a range of agroecologies and resource endowments (see sections on Delivery of outputs and outcomes, 5.1 and Gender 7.1). However, as noted in the gender section, the emphasis on youth, although referred to, has not been clearly evident in reporting of activities and outputs.

➤ *Have adequate constraint analyses and lessons from ex post studies informed program design for enhancing the likelihood of impact?*

An assessment of the SADC/ICRISAT Sorghum and Millet Improvement program published in 2005, concluded that future research should focus on crop productivity and farm incomes. Priority areas were soil fertility and soil water management, and identifying and exploiting opportunities for commercialization. These priorities have been followed by Dryland Cereals. The lessons learned from the assessment were:

- Translating successful research into tangible benefits requires strong partnerships among appropriate stakeholders.
- Developing partnerships requires time and resources. However, this effort is vital if the benefits of research are ever to become available to the targeted beneficiaries.

- For partnerships to be effective, all partners must participate in both project planning and implementation, and must be accountable to the larger group, in terms of fulfilling their commitments.
- Regional collaboration among researchers can lead to substantial pay-off by reducing the cost and the time required for technology development and adoption.

The lessons on partnerships are reflected in Dryland Cereals understanding that partnerships are vital for products from crop improvement research to move along the impact pathway, but partnership development could be further strengthened with respect to full involvement at all stages of this pathway, including planning, capacity building, monitoring and more explicit activity to foster regional collaboration between NARS and development partners. The great majority of partnerships are with national research institutions (see section 7.2 above), with limited engagement from non state actors, particularly in Africa.

8.2 Sustainability

- *What evidence is there on the sustainability of past benefits and the extent to which positive outcomes demonstrated at pilot or small-scale level are likely to be sustained and out-scalable?*

One of the most comprehensive and most recent adoption studies for sorghum and millet improved varieties is that of Kaliba (2014) who found that in their study area of Central Tanzania during the 2012/13 season, 61% of farm households had adopted one or more improved sorghum varieties. The variety Macia derived from ICRISAT germplasm was adopted by 55% of households, followed by Tegemeo at 19%. Early maturity appeared to be the dominant preferred trait, provided that in comparison with the local variety, yield was better and drought and pest and disease resistance at least as good. Studies of this type show a snapshot in time and give no idea of the rate of adoption. Macia was released in 1998. Where a new variety was attractive to farmers, but not adopted, seed availability was the main factor.

Adoption of new varieties when seed is available free through projects, NGOs and Government schemes may not be regarded as sustainable. Where communities are used to purchasing seed and/or there is ready input and output market access, adoption of new varieties is more sustainable. In India seed companies produce hybrid seed for sorghum and pearl millet and this greatly facilitates variety adoption in the higher rainfall zones. For sorghum in East Africa and barley in Morocco, India and Ethiopia used for malting, brewing companies are beginning to provide input support to contracted farmers. In West Africa, farmers seed production initiatives supported by farmers' organizations and functioning extension systems are marketing seed profitably. Sustainability with respect to variety adoption in the absence of these facilitating circumstances remains a challenge, especially for communities far from input and output markets and which grow cereals primarily for household use.

- *Are the capacity building efforts and incentives among partners adequate for enhancing the long-term sustainability of program effects?*

ICRISAT conducts a large number of capacity-building events at Patancheru and it is difficult to see how the number could be increased. Considerable effort on training has been made under the bilaterally funded projects. Nevertheless, there may be scope to hold more events within the regions

rather than in India and more on crop management and scaling up of variety dissemination and associated technologies. The training of trainers approach has been used effectively in East Africa. Extension Departments appear to be largely excluded from participation in capacity-building events whereas their involvement could create useful opportunities for extending the reach of technologies. HOPE held one training in Niger (pearl millet production) and one in Mali (striga and soil fertility management) aimed at Government and NGO-based Extension Service Providers⁸⁴

- *How effectively is the Dryland Cereals work being scaled up? Is it achieving the right balance between farmer level impact and policy level influence arising from its work?*

It is early in the Dryland Cereals to see much evidence of scaling-up with new breeding products but scaling-up efforts have focused on field days and demonstrations to show case new varieties and technologies such as the Gadam x IS8193 sorghum hybrid in Kenya⁸⁵ and working with seed companies to enhance access to quality seed such as the Seed Consortium in India⁸⁶. With respect to varieties released earlier one example of successful scaling up is the seed multiplication and distribution of Dhanashakti biofortified pearl millet to 100,000 farmers in India under A4NH⁸⁷

Another approach to scaling up used by HOPE is work with Tanzanian policy makers to get sorghum seed included in the Government seed subsidy and seed distribution scheme. The CRP together with NARS in East Africa and India have increased access to seed to new varieties by using small seed packs and engaging small local agro-dealers to stock them. In addition to seed packs crop management technologies can also be distributed in packs such as the 400 striga management packs consisting of improved pearl millet seed, cowpea seed for intercropping and fertilizer for micro-dosing that HOPE distributed in Mali⁸⁸

- *What are the prospects for sustaining financing, for example, for long-term research programs and key partnerships?*

The sustainability of finance and long term stability of research partnerships in Dryland Cereals have been undermined by short-term funding and budget cuts. Partner funding has suffered cuts when there is a budget shortfall as in 2014, or delay in disbursement, although efforts have been made to retain the 2014 level of budget for partner funding through the competitive/commissioned grants in 2015.

Operational funding has relied heavily on bilateral projects. Donors' willingness to invest through the Fund Council appears to be declining and far from reliance on the CRP, CG Centers now recognize the necessity to expand their income stream from bilateral sources. However, most bilateral funding does not cover the salary component. Sustainability of donor interests in plant breeding and research for

⁸⁴ <http://hope.icrisat.org/hope-trains-field-agents-in-niger/> <http://hope.icrisat.org/hope-trains-field-agents-in-mali/>

⁸⁵ <http://hope.icrisat.org/sorghum-and-finger-millet-varieties-showcased-at-county-agri-fairs-in-kenya/>

⁸⁶ <http://hope.icrisat.org/seed-consortium-strengthens-postrainy-sorghum-seed-value-chain-in-maharashtra-india/>

⁸⁷ <http://www.thehindubusinessline.com/industry-and-economy/agri-biz/cultivation-of-ironrich-pearl-millet-gains-traction-as-farmers-turn-health-conscious/article5052909.ece>

⁸⁸ <http://hope.icrisat.org/from-variety-tests-and-farmer-field-schools-to-the-sale-of-seed-packs-and-integrated-striga-control-packs/>

the drylands will largely determine whether Dryland Cereals work can be sustained. Given that the millets and sorghum are invariably associated with the poorest farmers from the most marginal areas, and that dryland barley fits into this grouping, it is unlikely that donor interest would wane appreciably. The dilemma is that success in terms of impact will itself depend on having funds to support downstream aspects. However, a complicating factor for the sustainability of long-term research and breeding is that they do not thrive if they rely heavily on competitive grants that are of 3–4 years duration. W1 and W2 funding is largely used for salaries and W3 funds are necessary for the breeding and research work to be carried out. Sustainability could be further threatened by donor expectations for rapid results from inherently slow research and breeding programs.

➤ *How should the future sustainability of the combined Dryland Cereals and Legumes Agrifood Systems CRP be addressed?*

Dryland Cereals will in the future most probably be part of a CRP combining elements of Dryland Cereals, Grain Legumes and Dryland Systems. However, the breeding and research elements associated with the four Dryland Cereals crops will continue into the future, with progress accruing from long-term breeding programs initiated in ICRISAT and ICARDA decades previously. However, although the breeding programs and breeders/researchers might remain over long periods of time, if the program structure and funding keep changing, sustained delivery of research results is unlikely to be promoted.

Given the budget cuts in the CRPs, a possible reduction in the number of crops and/or locations covered by the new phase of the combined CRP is implied. The view of the evaluation team is that effectiveness and sustainability will be enhanced if the CRP maintains the focus and quality of crop improvement for dryland cereal and legume crops, situating this within specific dryland agricultural systems and institutional and policy environments. This especially relevant given the contribution this CRP makes toward climate resilient agriculture.

Inclusion of dryland legumes and dryland systems with dryland cereals in the new phase of the CRP is likely to promote sustainability, provided there is practical integration in terms of research locations and farming systems which should allow better appreciation of production and market constraints than when the three elements were addressed in individual CRPs. The new CRP would also be able to stimulate greater multidisciplinary, and through a systems approach be better able to understand and research crop improvement and the pathways to impact in the context of entire agro-ecologies, including crop /livestock interactions and food and market systems.

An additional threat to sustainability comes from staff turnover within the lead and partner Centers of Dryland Cereals. Recently there have been staff resignations and some staff members have been let go following reductions in budget allocations within the CGIAR. Moreover, much of the work of the Dryland Cereals is in areas that are currently in political turmoil where it is either not possible or not attractive to work. Among staff in West Africa, the senior gender specialist appointed in 2014 recently resigned and the experienced sorghum breeders are soon to retire, while the pearl millet breeder has only three years left to retirement. Staffing issues such as these do not bode well for sustainability of the Dryland Cereals breeding programs, which rely on continuity.

Sustainability also relies on vision and learning by both management and scientists. Governance and management across the CRPs have been assessed recently and the issues identified are highly relevant

to Dryland Cereals⁸⁹, particularly the findings on roles and relationship of Centers and the CRP structures. The lessons arising from this have not been fully applied and there has been absence of consensus over CRP management during the past two and a half years that has undermined sustainability. The governance and management structures should exist to support the programs of research and its application. If they are not efficient and effective, progress is impeded, outcomes affected and sustainability of effort threatened.

8.3 Recommendation on Impact and sustainability

15. It is recommended that **the new CRP phase is based around specific *dryland* cereals and legume crop and livestock systems, regions and countries and shared partnerships**, rather than diversified to non dryland crops in different ecologies.

⁸⁹ IEA, 2014 Review of CGIAR Research Programs Governance and Management.

9. CONCLUSIONS AND RECOMMENDATIONS

9.1 Overarching conclusions

This section briefly addresses the overarching evaluation questions

- *Does the Dryland Cereals provide an effective framework and procedures for prioritizing research? Is research becoming strategically better focused on development outcomes as well as delivering the long-term high quality scientific research achievements which underpin these?*

The Dryland Cereals structure of interconnected flagships has encouraged a more integrated understanding of how development outcomes will be achieved, building on farmer participatory approaches to include private sector engagement, work with farmer organizations, enterprise and product development, and gender integration. There is scope for examination of prioritization among the regions, particularly in view of imbalances of national capacities and resources. The CRP has maintained science quality despite the transition to a new structure and reporting requirements and the management issues it has raised.

However, with successive budget cuts there is likely to be a trade-off between high quality/cutting edge research and the drive for development outcomes. There is close collaboration with NARIs, but they have the same research-oriented mandate as the CGIAR. Development partners require supporting, having limited coverage, human resources and finance. Supporting downstream development competes for resources with crop improvement/breeding unless bilateral funding for the more developmentally oriented projects can compensate.

- *Is the Dryland Cereals generating synergy among centers and improving integration among disciplines and teams? Is knowledge being shared, technologies exchanged and capacity being built across countries and partners?*

Some practical collaboration between the two Centers is occurring, but there is much more to achieve in terms of sharing of information and technologies across the entire CRP. Thinking in terms of Center, crop and regional affiliations will take time to transform. How to foster greater synergy between centers and CRPs is an area that would benefit from detailed consideration in the planning of the next phase of the CRP. There are good examples of integration of regional teams closely linked with a range of national partners, but as yet limited examples of cross regional exchange. In some cases, such as transfer of hybrids from India to Africa, this has been inhibited by policy.

It is important that the Dryland Cereals implements coordinated efforts to integrate different priorities with a stronger delivery orientation. If it remains fragmented it may contribute to incremental change in a narrow sub sector, but may not deliver any major change in productivity of dryland crops or the extent to which farmers and other value chain operators are benefiting.

- *Is Dryland Cereals research becoming better aligned to the needs of smallholder farmers, consumers and other beneficiaries? Are gender and diversity issues being integrated into research planning and implementation and in the articulation of uptake pathways?*

Integration of gender considerations in research planning and implementation has made visible progress particularly in bilateral projects which reinforce the CRPs requirement for gender reporting. The needs of other social groups such as youth are less well articulated and with respect to some technologies, for example hybrids, there needs to be more developed awareness of the boundaries of

suitability in terms of agro ecology and resource access. The categorization of subsistence and market oriented farmers in the original drylands proposal was perhaps over simplistic, but it signaled the need to differentiate farmer groups in terms of their agro ecology, economic and social situations and priorities. Significant progress has been made in researching consumer demand and how dryland cereals can meet nutritional needs.

However, Dryland Cereals needs to go further in focusing on research activities and outputs that lead to outcomes directly associated with improved livelihoods of agricultural communities in less advantaged countries. A high proportion of resources is focused in India which has a strong national agricultural research system and an expanding private sector seed system (at least in the more favorable agro-ecological zones) which is not dependent on international public finance. West Africa has weaker national research systems and private sector development. It is not clear to what extent Dryland Cereals research in India, for example on pearl millet, can benefit Africa, particularly in view of obstacles to germplasm transfer from India to other countries.

- *Is the Dryland Cereals developing a broader range of partnerships which contribute to research outputs and realization of outcomes? Is this adding value and likely to enhance the global benefits from Dryland Cereals research for poor producers and consumers?*

A broader range of partnerships is being achieved with advanced research institutes, which have contributed to outputs in breeding and genomics. New partnerships with private sector companies have helped to realize research outputs particularly for flagships 4 and 5, although these initiatives are still at an early stage in Africa. Where the private sector is weaker, there have been initiatives based on farmer associations and women's groups. The most successful examples are where different partners have been linked, for example, seed producing or grain producing groups in Ethiopia and Kenya with private seed companies and malt factories.

- *How has Dryland Cereals managed resources to realize the new vision of the CRP; how have the multiple sources, levels and allocation of funding influenced incentives for bringing about change?*

The CRP began with a high level of expectation on the part of scientists that the funding would support research agenda set out in the CRP, but there has been continued and now expanding reliance on bilateral project funding. There has been a positive effort to align bilateral projects and CRP outputs so it is difficult to attribute which has the greater influence. Achieving this alignment might pose more of a challenge in the future if the donor influenced focus of bilateral projects does not address the main research areas of Dryland Cereals.

- *Are the governance and management structures, practices and reporting lines of the CRP efficient and effective? Is there clarity and a common understanding of the roles and operational procedures of different components of CRP management within the lead and partner institutions?*

This has been a problematic area as discussed in sections 6.1 and 6.2. There has been a reduction in the complexity of the CRP governance structures through combining the CRP's Independent Science committee with the Steering Committee into a single advisory group. However, with regard to management, Crop cluster leaders and flagship leaders in Dryland Cereals have had to negotiate their way through the confused management structure, especially regarding lines of responsibility and reporting. The evaluation team considers this can be improved through greater clarity on roles and responsibilities and reporting communicated to all participants in Dryland Cereals and an agreed modality for the participation of the CRP Director in managing for results and financial management.

9.2 Recommendations

The recommendations set out below represent the distillation of learning of the review team through interaction and discussion with the management, researchers, partners and advisors working in, or associated with Dryland Cereals CRP, as well as drawing on CRP and CGIAR documentation. Issues which are important for the planning of the new phase of the CRP are those associated with targeting of resources, country level planning and engagement including a greater emphasis on partnerships, and the development of the M&E framework and system.

It is recommended that the new CRP phase is based around specific *dryland* cereals and legume crop and livestock systems, regions and countries and shared partnerships, rather than diversified to non dryland crops in different ecologies.

More immediate action could address the need for modernisation of methods and fostering collaboration to enhance the quality of science, scaling up and out to policy makers and other countries, the sharing of data and the strengthening of capacity among national partners. The findings of the evaluation team on governance and management reflect those of the recent CRP-wide review, in particular the clarification of respective roles and responsibilities of the CRP and Center is an urgent requirement going forward.

Relevance

- 1. In view of disparities in regional research capacity, Dryland Cereals' relevance to Africa could be boosted by reviewing priority setting and actual resource allocation for regional research activity clusters and flagships.** It is suggested that this review be conducted by Dryland Cereals management and flagship leaders with advice from the steering committee. It could consider increasing support for development of facilities and staff in areas which have the potential to deliver benefits to large numbers of poor farmers in the driest areas, for example, the pearl millet and sorghum work in West Africa.
- 2. In planning research to be conducted under the flagships, it is recommended that the CRP management and flagship leaders consolidate evidence linking the level of technology to be developed and promoted, to the resource level of target communities.** This might include:
 - Generating further information on the performance of hybrids (costs, benefits and risks) for African smallholders across different resource endowments in order to develop a rationale for the proportion of resources devoted to hybrid technology development for Africa and more precise targeting.
 - Developing complementary strategies which match technologies to producer and consumer requirements and resource levels e.g. multiple uses for food and livestock feed or varieties for a specific market requirement; suitability of conservation farming for areas with different human and natural resource endowments.

Quality of Science

- 3. The application of modern breeding methods, including molecular techniques, has untapped potential.** Modernization is needed in terms of data collection and sharing, storage and accessibility, using computerized field-books and electronic data capture.

4. **Further effort in regional collaboration, exchange and data sharing** is recommended in order to leverage research outcomes within national agricultural research systems, particularly on hybrid sorghum and pearl millet, encouraging private sector collaboration where possible. Increased researcher exchange with partner organizations, including universities and better cross-regional collaboration would help to improve the quality of science and encourage production of publications, (including social science and crop management publications) particularly from underrepresented regions.
5. **Strengthening of disciplinary integration of CRP research activities** could add greater value to the research and its products and make the most of potential synergies. Closer integration of social science and policy research and agronomic skills in all regional teams would better direct efforts to the needs of dryland farmers and diverse markets.

Effectiveness

6. **Effective implementation of the delivery pathway would be enhanced by a greater emphasis on country-level engagement in planning and implementation of research** consistent with national policies, and in innovation and adoption, involving scientists, research and development partners, agricultural service providers, farmer organizations and private sector actors to produce integrated plans across all flagships.
7. **Greater emphasis on scaling up and scaling out research results to policy makers and to a broader target group of outreach/spillover countries** (beyond existing focal countries) would extend the results of Dryland Cereals research. The evaluation team suggests that:
 - Dryland Cereals management and flagship leaders develop **a clear strategy for engagement with other countries** through relevant partner organizations
 - Greater **efforts in information sharing, interaction and influence at the policy level** would help to create conducive conditions for dryland cereals, for example, on seed policy and incentives for seed companies, on expanded farmer seed production and semi-formal seed systems such as Quality Declared Seed.

Efficiency

8. **A clear definition of the roles and responsibilities** of the CRP Director vis a vis program managers in the Lead and partner Centers would help to improve efficiency and effectiveness. An important element to consider is the empowerment of the CRP Director with an increased role in the management of the planning, delivery and quality of CRP outputs and outcomes. Duplication of effort could be avoided by streamlining and standardizing reporting formats.
9. **The CRP is strongly recommended to develop its M&E system.** Elements of this include;
 - **The development of an overall M&E framework** within which existing data can be synthesized to guide country strategies and gaps identified which require further data collection.
 - **Conceptualisation of CRP program, region and country level theories of change and impact pathways**, as part of the broader framework. Baseline studies by crop and country will draw on these designs, while using common templates for analysis, data consolidation and reporting.

- **A monitoring and evaluation data base system** to facilitate the work of the CRP, in tracking delivery and reporting. An M&E specialist will be needed to support CRP management and deal with M&E and impact requirements in CRP phase 2.
- **A monitoring Community of Practice** to develop standards, reporting guidelines and quality assurance mechanisms for tracking performance of the CRP across Centers.

10. **The CRP is encouraged to develop an effective communication strategy that:**

- Promotes synergy between Centers and CRPs, communicating work across flagships and locations with effective mechanisms for sharing methods, tools and experience across crops and regions.
- Identifies and tailors communication products from across Dryland Cereals partners for different stakeholders.

Cross Cutting Issues

Gender

11. **The value of gender studies and social analysis could be maximized by Dryland Cereals management together with Center gender experts developing mechanisms for sharing findings and data from gender and social analysis (including of youth and other social groups),** from the gender case studies and from Village Studies in India, highlighting implications for research activities, through a reinvigorated gender forum, or on- line seminars for scientists In Dryland Cereals.

12. **In consultation with the cross CRP gender network, it is recommended that Dryland Cereals management and gender experts develop plans for gender capacity development:**

- In **gender and social analysis** for social scientist researchers in partner country NARS, particularly for West and North Africa.
- In **gender issues in the work place**, especially for senior managers and staff drafting job descriptions or participating in recruitment, promotion and grant awarding panels. Ensure a more flexible working environment in terms of staff location, recognizing challenging conditions in some Dryland Cereals countries.

Partnerships

13. It is recommended that Dryland Cereals CRP **develop a Partnership Strategy to guide future initiatives related to collaboration at different levels/with different stakeholders.** This would include:

- **Identification of the need for further partnerships** based on an analysis of the critical linkages in the impact pathway in each country and crop and the types of partner and functions that are most appropriate to secure those linkages.
- The evaluation team advises the development of **stronger partnerships for effective development and delivery in post-harvest and value addition** with a range of different organizations including research institutes with post-harvest expertise and with local small and medium enterprises.
- **Enhancing the role of national partners of different categories** in planning, implementation and reporting of country activities and engaging in collaborative efforts to identify additional funding to support in country activities under Dryland Cereals.

Capacity strengthening

14. **Measures are needed to enhance non CGIAR /ARI partners' role in competitive grants**, and improve their success rate. Options might include:
- Design a pre- proposal stage of capacity strengthening for non CGIAR partners.
 - Include a requirement for capacity building for national partners in all proposals
 - Designate a ring fenced percentage of the grant fund for NARS partners as PI with CGIAR or ARIs as Co- PIs.

Impact and sustainability

15. It is recommended that **the new CRP phase is based around specific *dryland* cereals and legume crop and livestock systems, regions and countries and shared partnerships**, rather than diversified to non dryland crops in different ecologies.

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