Evaluation of the CGIAR Research Program on Wheat

Volume 1 – Evaluation Report

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Table of contents

Figures

Tables

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ABBREVIATIONS

A4NH	CRP on Agriculture for Nutrition and Health
AARI	Anatolia Agricultural Research Institute (Turkey)
ACIAR	Australian Centre for International Agricultural Research
ACRCP	Australian Cereal Rust Control Program (
AfDB	African Development Bank
AIP	Agricultural Innovation Programme (Pakistan)
ARI	Agricultural Research Institute
AVRDC	World Vegetable Center, previously known as the Asian Vegetable Research and Development Center
BARI	Bangladesh Agricultural Research Institute
BBSRC	Biotechnology and Biological Sciences Research Council (UK)
BGRI	Borlaug Global Rust Initiative (Global)
BISA	Borlaug Institute for South Asia
BMGF	Bill and Melinda Gates Foundation
BoT	Board of Trustees
BoT-PC	Board of Trustees – Program
CA	Conservation Agriculture
CB	CGIAR Consortium Board
CCAFS	CRP on Climate Change, Agriculture and Food Security
CCER	Center Commissioned External Reviews
CD	Capacity development
CIMMYT	International Maize and Wheat Improvement Center (Mexico/Global)
CIP	International Potato Center
CO	CGIAR Consortium Office
CPG	Competitive partner grants (WHEAT)
CRIFC	Central Field Research Institute for Field Crops (Turkey)
CRP	CGIAR Research Program
CSIRO	Commonwealth Scientific and Industrial Research Organisation (Australia)
CSISA	Cereal Systems Initiative for South Asia
CWANA	Central and West Asia and North Africa
DDG-CS	Deputy Director General for Corporate Services (CIMMYT)
DRRW	Durable Rust Resistance in Wheat (Cornel University global project)
EIAC	Evaluation and Impact Assessment Committee (CGIAR)
EPMR	External Program and Management Review (CGIAR)
FACASI	Farm Mechanization and Conservation Agriculture for Sustainable Intensification
FC	Fund Council
FP	Flagship Project
FWCI	Field-weighted citation impact
GIZ	German Federal Enterprise for International Cooperation
GRDC	Grains Research and Development Corporation
GRISP	Global Rice Science Partnership (CRP)
GXE	genotype X environment
HR	Human Resources
HRM	Human Resources Management
HQ	Headquarters
ICAR	Indian Council of Agricultural Research
ICARDA	International Center for Agricultural Research in the Dry Areas

ICT	Information and Communications Technology
IDO	Intermediate Development Outcome
IITA	International Institute of Tropical Agriculture
IEA	Independent Evaluation Arrangement (Rome)
IFPRI	International Food Policy Research Institute (IFPRI)
ILRI	International Livestock Research Institute
IP	Intellectual Property
IPG	International public good
IRRI	International Rice Research Institute (
ISC	Independent Steering Committee (WHEAT)
ISPC	Independent Science and Partnership Council (CGIAR)
IWIN	International Wheat Improvement Network
IWWIP	International Winter Wheat Improvement Program
MAIZE	CGIAR Research Program on Maize
MasAgro	Sustainable Modernization of Traditional Agriculture project (CIMMYT)
MC	Management Committee (WHEAT at CIMMYT)
M&E	Monitoring and evaluation
ME	Mega Environment
NARS	National agricultural research systems
NGO	Non-governmental organization (general)
PARC	Pakistan Agricultural Research Council
PIA	Program Implementation Agreement
PIM	CRP on Policies, Institutions and Markets
PMU	Program Management Unit (WHEAT at CIMMYT)
POWB	Program of Work and Budget
PPA	Program Participant Agreement
R&D	Research and development
R4D	Research for development
RCT	Randomised control trials
RMS	Research Management System
SAGARPA	Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food (Mexico)
SARD-SC	Development of Strategic Crops Africa
SC	Stakeholder Committee (WHEAT
SI	Sustainable intensification
SI	Strategic Initiative (WHEAT)
SLO	System-Level Outcome (CGIAR)
SR	Systematic Review
SRF	Strategy and Results Framework (CGIAR)
SSA	Sub-Saharan Africa
ToC	Theory of Change
ToR	Terms of Reference
QofS	Quality of Science
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USD	US Dollars
USDA	United States Department of Agriculture
W1	Window 1 funding type (CGIAR)
W2	Window 2 funding type (CGIAR)
W3	Window 3 funding type (CGIAR

EXECUTIVE SUMMARY

Background and context

The CGIAR Research Program on Wheat (WHEAT) supports biological, social and economic, research and technology development to provide public goods in scientific knowledge and germplasm for enabling sustainable growth in wheat production in developing countries. It responds to rising demand for wheat as a primary food staple for much of the global population including many fast growing populations in the developing world. WHEAT research contributes to all CGIAR's System Level Outcomes. It is aimed at reducing rural poverty and improving food and nutrition security in developing regions and enhancing sustainable management of natural resources. WHEAT is led by CIMMYT and includes ICARDA as a main CGIAR partner. It involves over 200 partners globally, including NARS, advanced institutions and private enterprises.

In recent decades, global wheat annual productivity gain has been in decline and is now about 1 %. While wheat yields are still growing, global wheat production is barely keeping pace with the demand. The growth in wheat production is increasingly more dependent on rain-fed regions resulting in greater regional yield variability, mainly due to periods of drought, and subsequently in more frequent shortages and greater price fluctuations.

WHEAT is currently organized around five inter-connected Flagship Projects for implementing two main research strategies, the genetic interventions strategy and the sustainable intensifications of wheat systems strategy. These Flagship Projects target Intermediate Development Outcomes related to productivity, food security, income and gender empowerment.

Purpose, scope and objectives of the evaluation

The primary purpose of the evaluation of WHEAT is to enhance the contribution that WHEAT is likely to have towards reaching the CGIAR goals, enhancing the productivity and sustainability of wheat-based farming systems and improving the livelihoods of poor producers and consumers of wheat in developing countries.

The principal audiences for the evaluation are the CGIAR Fund Council and Consortium, the Boards of Trustees of CIMMYT and ICARDA and the centers' management, WHEAT Management Committee and Independent Steering Committee, and researchers in WHEAT and its partner organizations.

This Evaluation includes both summative and formative aspects. Summative components include assessments of WHEAT outputs and the extent to which they have enabled outcomes from continuing activities initiated during 2005-11. The formative components focus on current research and WHEAT evolution over the past three years regarding program design and governance and management arrangements. Evaluation of WHEAT research looked at relevance, including coherence and congruence of program objectives and activities with CGIAR goals. It considered plausibility (logic and validity) of the theories of change underpinning WHEAT strategies and impact pathways to deliver outcomes, including inherent constraints; quality of science as reflected in WHEAT scientist resources, processes and outputs; and the likely effectiveness of the program in contributing to priority outcomes.

Evaluation of WHEAT governance and management arrangements and their evolution since 2012 included legitimacy, efficiency, accountability, independence and transparency, and the following aspects of program management: financial management, resource mobilization, monitoring and reporting, collaboration, risk management, and management of intellectual property. The evaluation also explored the effects of CGIAR reform on the efficiency of program implementation, and recent changes to WHEAT governance and management.

The evaluation addressed WHEAT approaches and progress in the cross-cutting issues: leveraging partners and collaborators for skills, operational synergies, and strategic advantage; improving capacity and skills developments; and implementing a gender strategy.

The evaluation addressed five overarching questions relating to the CGIAR reform principles and WHEAT in the new CGIAR structure:

- Does CRP WHEAT operate as an integrated program (programmatic-level thinking, strategy and management)?
- Has the implementation of WHEAT elevated the program's comparative advantage and improved its prospects to achieve its objectives and contribute more efficiently towards the program's intended IDOs and the CGIAR System-level Outcomes?
- Have CGIAR reforms assisted WHEAT deliver its objectives, achieve program IDOs and contribute to System-level Outcomes?
- Have W1/W2 funding mechanisms sufficiently helped WHEAT achieve its Impact-oriented objectives?
- On its own account, WHEAT has experienced disappointingly low levels of Window 1 & 2 funding, high transactional costs, and heavy management burden associated with the CRP program reforms (and associated reporting dialogues) in comparison to other bilaterally-funded initiatives: If true, how can these aberrations be managed or resolved?

Approach and methodology

The evaluation has based its findings, conclusions and recommendations on the following data collection and analysis, and process of triangulation of evidence collected from different sources:

- desk review of background documentation on CGIAR reform, key program documents, including original program proposal and extension proposal and their reviews related to the approval process, annual planning and reporting documents and project reports;
- 191 interviews, which included members of WHEAT management and governance bodies, staff of CIMMYT and ICARDA, and members of their Boards of Trustees, external collaborators, donors and beneficiaries;
- portfolio analysis among about 140 WHEAT projects active during the review, including comprehensive assessment of 34 projects, including the 10 largest and a random sample of 24 other projects across Flagship Projects;
- site visits to collect information on WHEAT and its key projects, assess facilities and interview CGIAR staff and external partners, visit NARS facilities that host and support WHEAT projects, and review examples of dissemination and scaling out where grower associations, cooperatives and enterprises are involved. Visits included sites in seven countries representing most of the priority mega-environments addressed by WHEAT;

- surveys of CIMMYT and ICARDA research staff to capture their perceptions of a range of issues including relevance and prioritization, management for enhancing science quality and effectiveness, conditions of research, partnerships, gender and capacity development, and perceptions of the value added by the CRP;
- bibliometric analysis of WHEAT publications, including H-index analysis for 49 program, FP and project leaders at CIMMYT and ICARDA;
- peer review analyses of a sample of 36 WHEAT publications for aspects of quality of science, including novelty, methodological rigor, coherence of purpose, approach, data analyses, and narrative, and of publications venues targeted; and
- review and assessment of WHEAT impact narratives and the supporting evidence of impact for addressing impact and sustainability issues.

Main findings and conclusions

Overall, the evaluation concludes that WHEAT is contributing sufficient value from CGIAR's research investments to generate results to warrant continuation during the extension-phase (2015-16) and beyond.

WHEAT has made considerable efforts to comply with and contribute to advancement of the six reform principles: Global development challenges clearly drive WHEAT's R4D strategies while funding opportunities drive the FPs' scientific project activities.

WHEAT is affected by the System-level governance; transparency in communications and reporting for accountability which need further work in order to eliminate misunderstandings, improve clarity about decision-making and streamline reporting. The funding mechanisms that are linked to the CGIAR System's agenda and priorities require greater transparency.

Over time, partnerships with NARS, private sector and civil society have increased but further improvements are required for resolving constraints along the impact pathways and for extending opportunities for WHEAT program-wide arrangements to accelerate output diffusion and associated outcomes.

Resources (staff, facilities and funding) have grown considerably since WHEAT was launched, largely as a result of increased bilateral funding that has been outcome-oriented, but also region-specific, which has been challenging for WHEAT in terms of its ability to maintain and enhance program coherence.

Collaboration between CIMMYT and ICARDA continues to strengthen at the research level and through recent formal agreements.

Over the past year the management and Boards of Trustees of CIMMYT and ICARDA have committed to greater cooperation in program oversight and improved WHEAT management, which included updating the roles of WHEAT's Management Committee and Independent Stakeholder Committee and its advisory functions. This should help WHEAT refine its strategies and priorities, and enhance integration of WHEAT.

One of the main conclusions from this evaluation is that programmatic orientation and management focus on results that enable IDOs and impact should be enhanced in WHEAT. This involves reorientation of resource mobilization to be better aligned with priorities, WHEAT oversight,

strategy development and refinement, and management, including monitoring and evaluation, on WHEAT's purpose, and to the extent possible, aligning partners' and collaborators' contributions towards the same purpose.

Program focus, relevance, quality of science and likely effectiveness

The Evaluation Team concludes WHEAT to be relevant in terms of broad coherence, comparative advantage and program design. However, coherence and congruency with WHEAT and CGIAR objectives would improve through refinement of program strategies and better alignment, prioritization and sequencing of outputs, giving considerations to the theories of change, particularly the underpinning assumptions and constraints along the impact pathways. More active management for results is required and the evaluation team concludes that the changes in program management and oversight can help achieve this.

WHEAT strategies and goals are consistent with the broad goals of the CGIAR. There is good rationale for and coherence among the FPs as presented in the 2015-2016 Extension Proposal, and the Program design has been considerably improved from the original 2012 proposal. WHEAT exploits its comparative advantage, which is unique in terms of access to and knowledge of wheat germplasm, experienced researchers, and long standing relationships with the relevant and highly committed NARS and ARIs.

Funding through Windows 1 and 2 was considerably less than originally proposed by WHEAT and has been declining as a percentage of total funding. As bilateral funding remains critical to sustaining WHEAT, the evaluation concluded that WHEAT should use its recently improved program management and ISC functions, and refined regional and global strategies, as tools to mobilize bilateral support for highest priority activities within its strategies while also being selective to keep its portfolio focused.

Quality of Science in WHEAT was assessed to be on par with advanced agricultural research institutions, particularly considering that WHEAT produces both scientific outputs and enhanced germplasm. The evidence available to the team indicates high quality thinking in research project design and use of state of the art methodologies in project execution. Program approaches build on latest scientific thinking and latest research results, and in some of its exploratory projects on novel approaches, but more generally use either most appropriate or most cost efficient methodologies. This notwithstanding, Flagship Projects 2 and 3 need to stay abreast of rapidly evolving genomic and genetic sciences and development of new tools. Regarding research on sustainable intensification, the Team sees need for greater lateral learning that spans across CRPs and crops and greater use of synthesis reviews and meta-analysis to enhance the international public gods nature of the knowledge generated. Data management investments and data infrastructure are both a science quality and a monitoring issue, and both need attention.

Likely effectiveness for impact from WHEAT outputs enabling outcomes is good in the near term with some excellent advances in both disease resistance and heat tolerance of germplasm. Improvements in rice/wheat rotations, mechanization for no-till planting in South Asia and an inexpensive nitrogen management tool may help developing region farmers improve productivity. The evaluation team notes that the impact pathways for the two main research strategies meet at the farm gate and collectively farmer decisions determine the degree of adoption, progress towards

the intermediate development outcomes and ultimate impact. Slow farmer adoption of WHEAT outputs reflects constraints in WHEAT impact pathways, which need to be addressed, some in the program and others though WHEAT partners. Mas Agro "take it to the farmer" and CSISA hubs in South Asia are focusing on some of these constraints. They can also be addressed by giving more attention to analyses of the constraints and a clearer impact assessment strategy contributing not only to accountability but also to learning and feed-back for program priorities, design and management.

Gender, partnerships and skills development to improve impact

Gender is a relatively new area of activity within WHEAT. During the past three years, WHEAT initiated a number of steps for raising awareness about gender perspectives in wheat research and to integrate gender and social equity in wheat research process. The evaluation team concluded that WHEAT should engage further assistance to implement its gender strategy to address gender in the Program, Flagship Project and project impact pathways towards gender equitable outcomes, sensitize staff and partners to the need for gender disaggregated data where possible, and promote equitable access to capacity development initiatives.

WHEAT is collaborating with more than 200 partners that include NARS, Universities, regional and international organizations, ARIs and private sector organizations, NGO/CBOs and governments in 20 countries hosting CGIAR operations. WHEAT also collaborates with other CRPs (including CCAFS, R4NH and Dryland systems) on 45 Innovation Platforms and other CGIAR Centers in projects such as CSISA in South Asia and Agricultural Innovation Programme in Pakistan. NARS expressed high appreciation of the role of CIMMYT and ICARDA in provision of characterized gene bank accessions, elite germplasm and advanced lines, and emphasized the importance of the role WHEAT plays in managing rust research and breeding efforts.

The evaluation team concluded that WHEAT should develop a partnership strategy that should address partners engagement in program strategy development and priorities and in impact pathway development and adjustments following constraint analysis.

There is an increasing demand for long duration training for wheat researchers to develop and enhance capacities in emerging areas such as molecular breeding and marker assisted selection, conservation agriculture and crop physiology. There is also demand for more collaborative research projects involving WHEAT partners.

Governance and Management

Since the evaluation commenced in May 2014, there have been changes to the governance and management arrangements of WHEAT. These include updating the role and responsibilities of the WHEAT Independent Stakeholder Committee and establishing greater authority in the Management Committee now chaired by the recently establish position of WHEAT director. These changes are necessary, relevant and appropriate for WHEAT.

The evaluation team concludes that the revised governance structure and processes of WHEAT are suitable for effectively implementing WHEAT and facilitating increased programmatic collaboration between CIMMYT, ICARDA and other partners of WHEAT. These changes will help promote greater

authority and capacity of the CRP director to manage for results; and ensure that the CRP governance is free of conflicts of interest, thereby addressing issues of legitimacy and independence.

Value added by WHEAT

While WHEAT is making considerable efforts to comply with, and contribute to the advancement of the CGIAR's reform principles progress is at an early stage.

Global development challenges clearly drive WHEAT's R4D strategies while funding opportunities drive FPs scientific project activities. These are not necessarily at odds, but high dependency on bilateral funding, and particularly on a few major donors for that funding, adds some level of risk to the long-term sustainability of this type of research which has very long impact pathways and where the delivery pipeline is dependent on investment on innovation at the upstream.

Collaboration between WHEAT partners (CIMMYT and ICARDA) at the research level continues to strengthen. Management and governance relationships have also improved, particularly over the past 12-months, as reflected in commitments of both partners' Boards of Trustees to assist in WHEAT strategy refinements and management for results; clarification of make-up, roles and authority of WHEAT ISC; and in the WHEAT MC, which is still defining its role but appears to be fostering greater collaboration, cooperation and trust.

Recent evidence indicates that adjustments in governance, management functions and ISC functions are improving cooperation and synergies in WHEAT research activities. This level of cooperation and integration probably could not have been achieved prior to the formation of WHEAT. Based on this evidence, the evaluation team concludes that some of the goals of the CGIAR reform are being achieved by WHEAT and there are good prospect that more will be realized in the near term.

WHEAT is not yet a fully integrated program even though it has enhanced collaborations among scientists involved in WHEAT and progress has been made both in program design and organization. Adjustments in the WHEAT management and oversight will permit improved programmatic thinking, strategy refinements and prioritization, and better targeting and management of outcome oriented activities. Currently three quarters of total research funding comes from bilateral sources and much of research influenced by the large donors with interests in specific regions. While this is not necessarily at odds with WHEAT's primary purpose, the program needs better defined, coherent and congruent strategies, and greater commitment and accountability in the delivery of results contributing to the intermediate development outcomes that WHEAT targets. WHEAT needs to harness such strategies to align donor interests and support to permit a more efficient and coherent approaches to enabling outcomes.

Going forward

Going forward, the sustainability of WHEAT being able to continuously provide solutions that the intermediate and ultimate beneficiaries need will require strong leadership, strong management and staff focused towards outcome-oriented program objectives and more coordinated efforts to integrate and optimize all prerequisites for effective breeding and sustainable intensification among the broader research and development partnerships.

WHEAT outputs when adopted and properly managed by farmers benefit both the farmers' financial wellbeing and that of the targeted consumers whose food security (availability and costs) depends

on farm productivity. Improved learning by WHEAT is essential for defining current and anticipating future needs of both farmers and consumers. Farm level adoption remains the key determinant of progress toward WHEAT IDOs. Understanding the drivers of farm-level decisions is necessary to design, define and prioritize appropriate WHEAT outputs. Understanding constraints in wheat impact pathways and guiding good on-farm decisions are key determinants of WHEAT's contribution to CGIAR outcomes. WHEAT's ability to interact effectively among its ARI partners, CRP and NARs partners, and manage its internal research activities will ultimately define WHEAT's success as a provider of public goods for resource poor wheat farmers and consumers in much of the developing world.

Recommendations

The evaluation team makes a total of eleven recommendations presented below by the main evaluation criteria, and the last recommendation addressing the added value from WHEAT.

Relevance

1. WHEAT should improve the refinement of its strategies, and better alignment and management of projects (activities) that enable priority WHEAT IDOs and SLOs objectives within its strategies. Each proposed FP project should define its intended output(s), its impact pathway, details of its ToC with critical assumptions, and checkpoints (points in time when assumptions can and should be validated). WHEAT should determine priority of projects based on their costs and risk-adjusted contribution to the Program priority IDOs. The FP projects should be integrated at the level of WHEAT research strategies. Validation of assumptions and progress along the impact pathway should be used by WHEAT management for learning and adjusting plans, and re-prioritizing projects when assumptions prove wrong or better options arise.

2. Bilateral funding remains critical to WHEAT's sustainability and therefore building donor confidence through improved management, strategy and portfolio focus is important. WHEAT should use its recently improved program management and ISC functions, and refined regional and global strategies, as tools to mobilize bilateral support for highest priority activities within its strategies while also being selective to keep its portfolio focused.

Quality of Science

3. In order to accelerate synthesis and programmatic progress, WHEAT, particularly in the Sustainable intensification strategy, should enhance lateral learning to accelerate the rate of knowledge gain. The mechanisms should include information exchange feeding into new project design rather than occurring at the close of projects, synthesis of studies to span space and time dimensions, engagement with other CRPs and other crops, and better integration among disciplines within WHEAT.

4. WHEAT should improve its data management and infrastructure, as part of enhancing the utility of the Research Management System for researchers and Program-level management. Institutionalizing comprehensive data management starting from project inception is a prerequisite for high quality science in data-intensive research domains, such as those of

WHEAT. This upgrading should involve development of repositories, workflows, standards, preservation and data curation mechanisms, as well as policies to make data searchable, retrievable, reusable, and inter-operable.

5. WHEAT should establish internal mentoring within the CRP for safe-guarding the quality of science in the face of rapid programmatic growth and institutional integration. This is needed especially to strengthen the Program during transitions that involve management, staff increases, de-centralization of ICARDA and restructuring wheat programs into WHEAT. Mentoring is also an important reciprocal mechanism for team progress and delivers benefits also for mentors from mentees who are often source of untapped, innovative thinking.

Likely Effectiveness

6. WHEAT should establish an inter-FP special traits team to accelerate delivery of multiple genes for multiple traits into multiple high performance lines. Given the complexity of these processes, special skills and prioritization are required for enhancing time and cost efficiency. Such a team is needed for accelerating progress towards targets on high priority FP2 trait improvement and for magnifying the potential for impact.

7. To improve wheat genetic yield progress in future, WHEAT should, over the next two years, review the current approaches in FP3, and those used by partners in order to (i) efficiently and systematically explore advanced wheat germplasm sources that can contribute to productivity; (ii) optimize the balance of population number and population size based on the divergence among advanced (elite) parents to improve utilization of both additive, and additive X additive interactions among wheat's genomes; and (iii) more efficiently advance populations to homozygosity for subsequently application of selection, while permitting greater learning about yield relevant germplasm and the gene actions and interactions that make them elite.

8. In order to help narrow the gap between potential and realized wheat productivity WHEAT in FP4 should re-establish its priorities (regions and focus) in the context of the evolving CGIAR research agenda and other CRPs contributing to it. SI should continue to refine how farmers can best manage nutrient, genetic, water, mechanization, and crop protection resources, deal with climatic constraints, and better cropping systems to enhance both farm returns and regional food security. WHEAT should understand the drivers of farm decisions (economic, environmental and cultural), and through its linkages with partners and other CRPs, more effectively guide and support those decisions. Both technical refinements and effective decision support are necessary to narrow the yield gap across WHEAT target regions.

Impact and likely sustainability

9. WHEAT should develop a clear impact assessment strategy for learning and accountability. The strategy should be based on the needs and priorities of the key audiences for these assessments to assure that the studies and evaluations are both useful and utilized. The impact assessment strategy should ensure that all claims made about diffusion of WHEAT knowledge and outputs, adoption and impact are supported by credible evidence, and that

this evidence and lessons are used in refining strategies and priorities, and for addressing impact pathway constraints through partnerships and capacity development when necessary for outcomes.

Gender

10. WHEAT should strengthen the development and implementation of the gender strategy by acquiring the necessary expertise either internally or by engaging specialists outside of WHEAT. This should include explicitly addressing gender in the Program, FP and project impact pathways towards WHEAT gender equitable outcomes, sensitizing staff and partners to the need for gender disaggregated data where possible, and promoting equitable access to capacity development initiatives.

Partnerships

11. WHEAT should develop a partnership strategy that should address the following purposes and partners: program strategy development and priorities; impact pathway development and adjustments following constraint analysis (e.g. from program planning, lessons from impact analyses) including closing the knowledge diffusion gaps between scientists and those farmers, whose adoption decisions determine wheat outcomes.

Adding value from WHEAT

12. Programmatic orientation and management focus on results that enable IDOs and impact should be enhanced in WHEAT. This involves reorientation of resource mobilization aligned with priorities, WHEAT oversight, strategy development and refinement, and management, including M&E, on WHEAT's purpose, and to the extent possible, aligning partners' and collaborators' contributions towards the same purpose.

1. INTRODUCTION

1. 1. Purpose and audience

The primary purpose of this evaluation of the WHEAT CRP is to enhance the contribution that WHEAT is likely to have towards reaching the CGIAR goals, enhancing the productivity and sustainability of wheat-based farming systems and improving the livelihoods of poor producers and consumers of wheat in developing countries. The evaluation aims at providing essential evaluative information to WHEAT management, funders and partners for the extension phase 2015-2016 and for decision-making on issues such as expansion and structuring of the program and adjustments to some aspects of the program and its management.

In November 2013, the Fund Council of the CGIAR agreed that all current CRPs should undergo some form of evaluation by the time preparation of the full proposal for the second call of CRPs begins. The WHEAT evaluation is being completed in time to provide information for WHEAT management and staff at CIMMYT and ICARDA for their preparation of the WHEAT pre-proposal and eventually for decisions on program selection. The first round of evaluations, including that of WHEAT will also contribute to the next System-wide evaluation.

The primary audience of the evaluation is the WHEAT program and its core partners, its governing bodies, the Consortium and the Fund Council. The evaluation is also intended to be of interest and use by the broader partnership involved in WHEAT including research partners and those involved in development or delivery.

The evaluation team was formed by the Team Leader and four Team members. ANNEX A provides bio data of the evaluation Team.

1. 2. The evolving CGIAR context

In the course of the CGIAR reform, initiated in 2008, the CGIAR adopted a Strategy and Results Framework (SRF) in 2011. In parallel, the Fund Council approved 15 CRPs, most of which started their operations in 2011-12. In the first three years of the CRP operation, and under the instruction of the Consortium Office (CO), the CRPs have been developing their impact pathways and theories of change (ToC) that link CRP activities and outputs to Intermediate Development Outcomes (IDOs) that are, in turn, linked to the CGIAR's high level goals, the System Level Outcomes (SLOs).[1] The CRPs have begun defining quantitative targets and measurable indicators for progress and for the IDOs. All CRPs have been extended until the end of 2016. A new CRP cycle begins in 2017.

[1] The three SLOs in the February 2015 draft of the SRF are: Reduced poverty; Improved food and nutrition security foe health; and Improved natural resource systems and ecosystems services. CGIAR Strategy and Results Framework for 2016-2025. February 2015. Draft for final consultation.

A new SRF is being developed and is at its final stage of approval. The draft SRF defines a revised set of SLOs and a results framework that incorporates a new level of sub-IDOs that feed into the IDOs (also a revised set) and link to SLOs. The new SRF will be a guiding document for development of CRPs for the 2nd cycle. The instructions concerning the CRP portfolio, development and approval processes are also forthcoming.

At the CGIAR governance level, the Mid-Term Review[2] made several recommendations for mid-term adjustment of the implementation of the reform, including major changes in the governance of the CGIAR, which are being addressed by the Fund Council.

1. 3. Evaluation questions

The Evaluation Team set the evaluation questions at two levels; overarching questions and the key evaluation criteria (relevance, quality of science, effectiveness, impact and sustainability). Programmatic and organizational aspects of WHEAT were considered as distinct areas in defining the criteria-specific evaluation questions.

The overarching questions were:

- Does WHEAT operate as an integrated program (programmatic level thinking, strategy and management)?
- Has the implementation of WHEAT (its strategies, integrated core partners and committed collaborators, capabilities, management and governance processes, and funding mechanisms) elevated the program's comparative advantage and improved its prospects to achieve its objectives and contribute more efficiently towards the intended IDOs and the CGIAR System-level Outcomes?
- Have CGIAR reforms assisted WHEAT deliver its objectives, achieve program IDOs and contribute to System-level Outcomes?
- Have W1/W2 funding mechanisms sufficiently helped WHEAT achieve its Impact-oriented objectives?
- On its own account, WHEAT has experienced disappointingly low levels of Window 1 and 2 funding, high transactional costs, and heavy management burden associated with the CRP program reforms (and associated reporting dialogues) in comparison to other bilaterally-funded initiatives: If true, how can these aberrations be managed or resolved?

Regarding the key evaluation criteria, the program's current research for relevance, quality of science and likely effectiveness was assessed though a set of questions pursuing different dimensions of those criteria:

- relevance: coherence and consistency with the CRP objectives and the CGIAR goals, and the extent to which WHEAT is internally coherence and focuses on priority areas; comparative advantage of WHEAT for delivery of international public goods (IPGs) and the role it plays in

[2] https://library.cgiar.org/bitstream/handle/10947/3390/Final%20Report%20from%20the%20MTR%20Panel%20of%20the%20CGIAR%20Reform,%20October%2028.pdf?sequence=4

research and delivery and in relation to its partners; and program design in terms of targeting appropriate Intermediate Development Outcomes (IODs) and impact pathways;

- quality of Science: quality of program design and research approaches; internal processes and conditions for assuring science quality; and quality of outputs;
- likely effectiveness: being on track in terms of progress towards outputs and along the impact pathway towards impacts; using the monitoring system for tracking, learning and adjusting the program; the extent to which constraint analyses are being done for adjusting the program and enhancing the likelihood of impact; addressing the enabling factors for scaling up; the logic and validity of program theories of change.

In addition the evaluation covered past impact of research that is continuing in the CRP, and the extent to which there was feed-back from impact to on-going research:

- impact and sustainability: the extent to which outcomes and impacts have been achieved and documented including their magnitude and equity of benefits; efforts to document outcome and impact results across the portfolio; the likelihood of sustaining the benefits.

The evaluation covered three cross-cutting issues addressed as part of the programmatic performance; namely gender, capacity development and partnerships. The evaluation questions covered the following:

- gender: adequacy of incorporating gender analysis results into program design in terms of relevance and effects of the program on women; incorporating gender aspect in impact pathways in terms of differential roles of and equity of benefits for men and women; progress in implementation of the CRP gender strategy across the research portfolio;
- capacity development: the extent to which capacity development is needs-based, targets men and women and is incorporated into research implementation; the extent to which capacity issues have been considered among assumptions and risks related to the theories of change regarding impact and long-term sustainability, and integrating capacity development with research and delivery activities.
- partnerships: The relevance and strategic prioritization of partnerships; incentives for partners to contribute to WHEAT; involvement of partners in research decision-making, funding, coordination, and joint ownership of results.

The questions regarding evaluation governance and management (G&M) addressed legitimacy, efficiency, accountability, independence and transparency, and the following aspects of program management: financial management, resource mobilization, monitoring and reporting, collaboration, risk management, and management of intellectual property. The evaluation also explored the effects of CGIAR reform on the efficiency and likely success of program implementation, and lessons from changes to WHEAT G&M.

1. 4. Evaluation methodology

The evaluation methodology is described in detail in the Inception Report[3]. Here the key methodological components are presented.

The evaluation used a combination of qualitative and quantitative methods. The key components are briefly explained below.

Review of program documents. The main program documents included the original program proposal and extension proposal, Annual Reports and reports of Program of Work and Budget and project reports. The team also reviewed material related to the process of approval of WHEAT, including the ISPC reviews and Fund Council decisions. Aside from the main project documents the choice of documents was guided by the criteria and questions. A large part of the documentation related to G&M of WHEAT, and these included the cross-CRP review commissioned by the IEA as a reference document[4]. The team used several documents related to the CGIAR reform as important reference including the 2011 SRF and its management update, working documents related to the development of the IDOs, and material related to the 2nd call of CRPs.

Field visits. The countries visited are shown in the team's itinerary (ANNEX B). The countries were chosen on the basis of major activities and partnerships. In some countries visited, both ICARDA and CIMMYT were operating and opportunities for integration could be observed. The field visits were used for collecting additional information on projects sampled, for collecting perceptions at the higher scales of program operation and specifically for looking at partnerships.

Interviews. Semi-structured interviews were conducted both during the field visits and virtually, and were conducted on the premise that interviewee responses would be integrated into the report without personal attribution (with anonymity). A total of 191 persons were interviewed. The questions were targeted both at the program level and at sample project level when the interviewees were knowledgeable about the project work. The interviews were used mainly for assessing relevance, quality of science, likely effectiveness and the cross-cutting issues. Interviews on G&M covered their own set of issues. Depending on the interviewee, different aspects of program performance were emphasized in the interview. Table 1-1 shows the distribution of interviewees within groups of stakeholders. A list of persons interviewed is given in ANNEX C.

[3] http://www.iea.cgiar.org/sites/default/files/WHEAT-Inception_Report-Final-OCT-2014.pdf
[4] Review of CGIAR Research Programs Governance and Management, 2014.

Table 1-1: Number of interviews per type

Type of interviewee	number
WHEAT staff, management	16
WHEAT staff, researchers	53
WHEAT G&M	7
ICARDA staff, management	5
CIMMYT, corporate	13
Partners	79
CGIAR, others	10
Donors	3
External peers	1
Beneficiaries	4

Sampling of projects. Thirty four projects including both W1/2 and W3/bilaterally funded ones were reviewed by the Team members following a comprehensive assessment template. The assessment focused on relevance, quality of science, likely effectiveness and the cross-cutting issues. Projects in the WHEAT budget of less than USD 50,000 were excluded from the sample. The largest ten projects, in terms of budget, were included purposefully in the sample. Furthermore, within each Flagship Project (FP), the projects were selected at random (list of sampled projects is shown in ANNEX D). A standard project assessment template was used for ensuring consistent assessment by all team members (ANNEX G).

Researcher survey. The survey was targeted at CIMMYT and ICARDA researchers who contribute any of their time to WHEAT. A number of non-CGIAR partners were also included. The total response rate was 61 percent (completed response rate was 39%). The questions addressed relevance, management of quality of science and effectiveness, conditions of research, partnerships, gender and capacity development, and perceptions of the value added by the CRP. Open-ended questions were also included. A large number of CIMMYT researchers work both for WHEAT and MAIZE and they were asked to respond to one of the surveys and highlight variances regarding the other CRP in open sections. The survey results were used as complementary evidence. The survey summary results can be found in ANNEX F.

Bibliometrics. As part of the quality of science assessment, quantitative and descriptive analysis was conducted on scientific journal publications related to WHEAT, published between 2012 and 2014. The parameters included volume, frequency of articles by journals, citation analysis for years 2012 and 2013, listing of articles with highest citations, and affiliations of ICARDA and CIMMYT in publishing. These results were interpreted by the team members, for instance in judging the appropriateness of the journals considering the audiences that WHEAT wants to reach with its knowledge products.

Research publications and analysis. For analysis of research output quality (a dimension of the quality of science assessment), the team members conducted a qualitative assessment of a random sample of research articles. A total of 36 articles were assessed covering all disciplinary areas. The parameters included methodological rigor and coherence of data analysis (that were scored) and narrative observation on comprehensiveness of research narrative, innovativeness and novelty,

quality (and appropriateness) of publication venue, collaboration and alignment with WHEAT objectives. For a full list of the publications assessed and the template used, see ANNEX E and H.

H-index analysis. For assessment of the inputs to quality of science, H-index analysis was conducted, including researchers with team leader or supervisory role. A total of 27 researchers from CIMMYT and 22 from ICARDA were included. In the analysis the team looked at variance, taking however into consideration that a large number of WHEAT researchers focus on plant breeding where publications are not their main output.

Impact narrative. The WHEAT program was asked to prepare a narrative about outcomes and impacts since the most recent EPMRs of the participating Centers. The claims in the narrative were to be supported by documented evidence. The team member responsible for impact reviewed the narrative and evidence for credibility, magnitude of reported impacts and coverage of impact studies across research areas. This analysis contributed directly to addressing questions under the criteria on impact and sustainability.

1. 5. Deviations from the inception report

The evaluation team did not complete individual in-depth case studies sustainable intensification, as outlined in the Inception Report Chapter 5.1 in part due to limitations of both time and information (SI-mechanization). As such, the team re-oriented more of its in-depth focus on the two broader intervention strategies of WHEAT, where more comprehensive information was available.

Furthermore, the assessment of past impacts was not completely based on the impact narrative provided by the program alone, but also relied also on the review of a random sample of impact studies.

1. 6. Limitations to this evaluation

This evaluation took place at a time when WHEAT was in the middle of structural G&M changes as well as within a changing CGIAR context. Therefore, the program was a “moving target” and the team could not easily establish a cut off point for data collection and some analyses.

During the evaluation WHEAT changed its structure from ten Strategic Initiatives into five more integrated FPs and the portfolio was in transition. The CIMMYT project management system was not fully implemented and had limited functionality for program management, which had implications for data gathering at the portfolio level.

Due to the fact that the number of projects was large (approximately 140) and varied greatly in scale and duration, random sampling resulted in the selection of some projects that were not fully representative of the program.

The team’s ability to assess past results at outcome and impact level was limited to the availability of documented evidence of such results. Although the team could gather perceptions of past effectiveness and impacts the validity of such evidence is more limited than with rigorous studies.

Furthermore, the response rate of the researcher staff survey was relatively low, reducing its strength as a source of evidence.

2. WHEAT BACKGROUND

2. 1. Context of wheat research

Wheat is vital to the wellbeing of 2.5 billion poor wheat-consuming men, women and children and approximately 30 million poor wheat producers (<US$ 2 a day)[5] and their families. Dramatic price spikes in wheat, and the fact that annual global consumption has been exceeding production over the past decade, indicate very possible scenarios that increasing demand and falling supply of wheat may result in more than doubling of (real) wheat prices by 2050; and renewed occurrences of regional famine are possible. Rising demand and slowing wheat productivity gains pose challenges in several regions and frame the context in which WHEAT will operate. Wheat is a major crop and primary food grain in many developing regions where annual consumption (food, industrial and seed) of wheat ranges from 60-300 kg/capita and production is split between irrigated and rain-fed production systems. The private sector is not engaged in wheat breeding for developing countries to a major extent due to lack of profit prospects[6]. Its involvement in the regions that WHEAT primarily targets is limited to providing some traditional cereal crop protection chemicals and nutrients. It provides almost no genetic products and only very limited agronomic support beyond the products it sells.

Over 60 % of wheat is currently produced in the developing world, primarily in WHEAT's mandate regions. If wheat is to be affordable for the poor, yields need to increase globally by 1.6% per annum to ensure that wheat production can meet demand based on current demographic trends. These yield increases will not only need to be realized in an environmentally sustainable manner, but also in the face of new and growing biotic and abiotic stresses.

2. 2. The WHEAT program

2.2.1 WHEAT objectives, structure and activities

WHEAT is led by CIMMYT. It brings together the previously separate mandates of CIMMYT and ICARDA building on their long-term wheat research, and as a CRP was designed for at least ten years duration. It encompasses wheat related breeding, resource management and social science research at CIMMYT, and ICARDA's wheat breeding. WHEAT was formally launched in the beginning of 2012. It is currently in its fourth year of implementation, having had its 2015-2016 extension proposal approved by the CGIAR Fund Council in November 2014.

[5] in line with World Bank definition.
[6] Exceptions are Sensako which develops varieties in South Africa and Mahyco in India, which focuses only on hybrid wheat.

The WHEAT Strategy outlined in the original proposal[7] aims to ensure that "publicly-funded international agricultural research helps most effectively to dramatically boost farm-level wheat productivity and stabilize wheat prices, while renewing and fortifying the crop's resistance to globally important diseases and pests, enhancing its adaptation to warmer climates, and reducing its water, fertilizer, labor and fuel requirements".

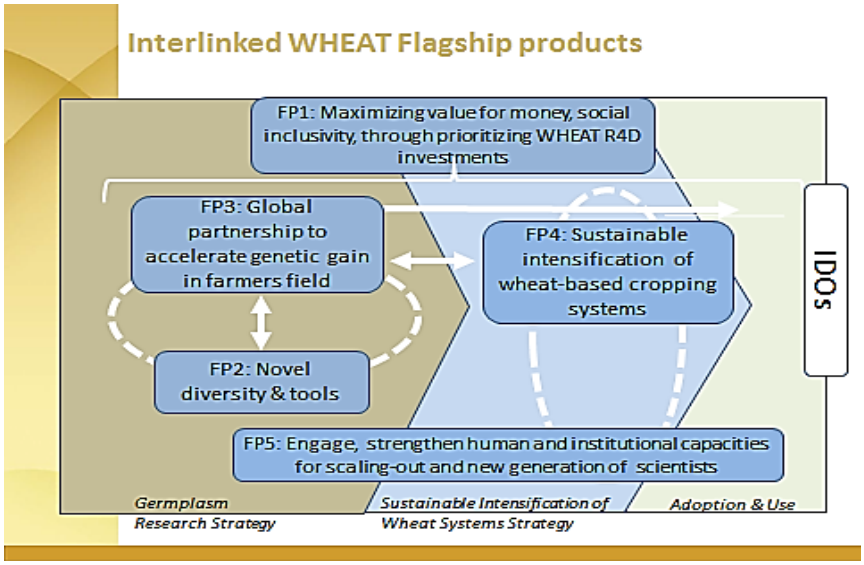
WHEAT is addressing the increasing demand for wheat-based foods primarily through two broad and interconnected research for development (R4D) strategies:

- Creating better wheat seed lines, combining greater yield potential with better resistance to pests, resilience to climatic shifts ,and more efficient utilization of nutrient and water resources, for farmers in target regions (Genetic interventions); and

- Better wheat crop management practices and wheat-based farming systems in target regions that increase wheat production and farm revenues, preserve scarce resources, and protect local environments (Sustainable Intensification of wheat systems Interventions).

WHEAT was initially structured into ten Strategic Initiatives that represented thematic areas. For the Program of Work and Budget 2014 and 2015-2016 Extension Proposal these were re-structured into five inter-connected FPs (in line with Consortium Office requirements) shown in Figure 2-1.

Figure 2-1: WHEAT Interlinked Flagship Projects



Source: WHEAT Extentsion Proposal 2015-2016.

[7] WHEAT - Global Alliance for Improving Food Security and the Livelihoods of the Resource-poor in the Developing World. Proposal submitted by CIMMYT and ICARDA to the CGIAR Consortium Board. August 2011

The Intermediate Development Outcomes (IDOs)[8] that WHEAT targets relate to productivity, food security, income and gender empowerment. WHEAT's ToC is based on the two distinct research strategies. The Genetic interventions strategy aims at accelerating the wheat breeding cycle and achieving higher genetic gains through activities in FP 2 and FP3. The strategy of Sustainable intensifications of wheat systems aims at developing comprehensive, climate smart germplasm x environment x management solutions through FP 4. These strategies merge in FP 5 that focuses on seed systems innovations and enhanced partner capacity for adaptive research and scaling out at country level. The strategies are informed by FP1 on targeting and prioritization.

2.2.2 WHEAT funding and expenditures

The full funding scenario presented in the WHEAT proposal (2011) was USD 228 million for three years, including a steep increase in funding by the third year to an annual budget of USD 93.4 million. However, the proposal was approved at a lower funding level (a scenario of 50% of the "full funding") of a total of USD 113.885 million with the remaining amount added as "expanded funding component".[9]

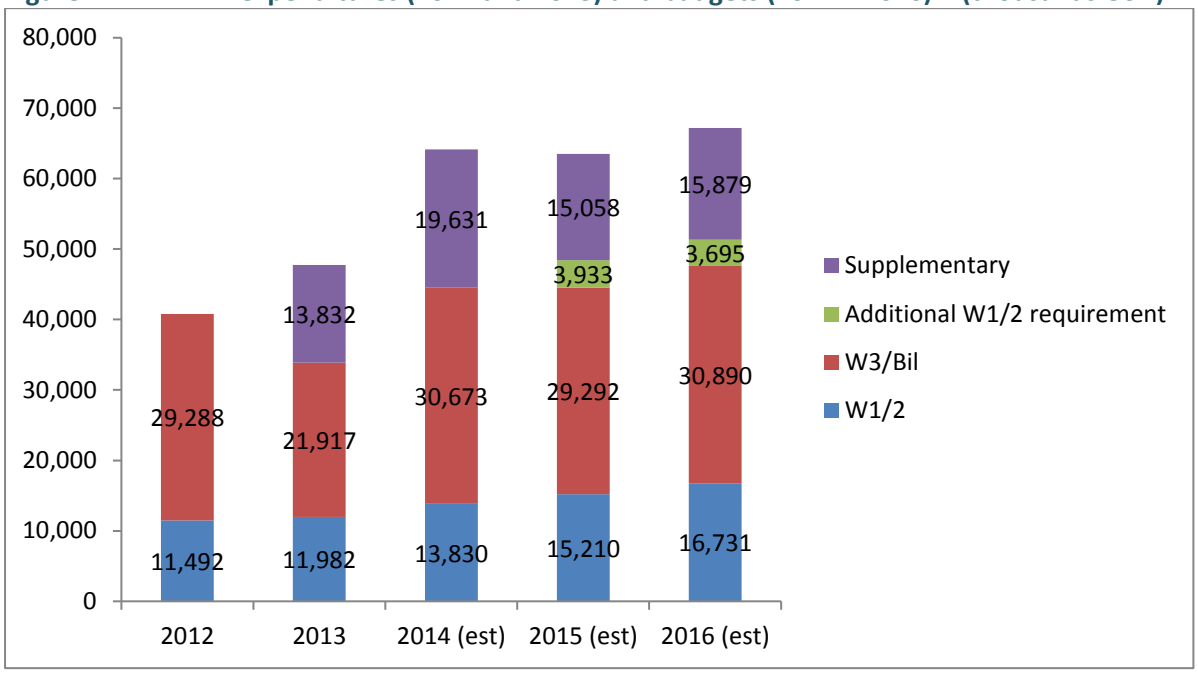
Across the first two years of implementation (2012 and 2013) and including the 2014 approved budget[10], WHEAT will have spent USD 37.304 million of W1/2 funding. WHEAT has had the third lowest level of W1/2 funding among the CRPs. Fifty eight percent has been spent for research at CIMMYT, 17% for research at ICARDA, 17% for research by partners and 8% for CRP management. Of the total, WHEAT expenses in 2012 and 2013 (USD 74.678 million) 31% was from W1/2 and 69% from W3/Bilateral. Figure 2-2 shows actual expenditures for 2012 to 2013 and budget estimates for 2014 (from POWB) and 2015-2016 (from Extension Proposal) by funding source. The additional W1/2 requirement refers to W1/2 funding request exceeding the CGIAR Financial Plan for 2015-2016.

[8] The Intermediate Development Outcomes of the CGIAR are being revised in early 2015

[9] See the Program Implementation Agreement between the Consortium and CIMMYT dated February 2012: Year 1: USD 36.1 million, Year USD 2: 37.9 million, Year 3: USD 39.8 million.

[10] Sources: Financial Reports for 2012 and 2013; WHEAT-MC minutes.

Figure 2-2: WHEAT expenditures (2012 and 2013) and budgets (2014[11]-2016)[12] (thousands USD)



Source: Financial reports 2012 and 2013, POWB 2014, Extension Proposal 2015-2016

In 2013, WHEAT started to report part of its bilaterally funded projects outside the CRP partly in response to the CO request to Lead Centers to identify non-CRP research and partly because WHEAT expenditures exceeded the W3/bilateral amount approved by the Fund Council, as per the Program Implementation Agreement (USD 113.9 million for the first three years). The funding declared as "supplementary to" the CRP was for activities not envisioned in the original proposal, including mostly scaling-up and other development type activities. CIMMYT considers that these activities are aligned with the impact pathway for WHEAT and the request for and funding for these activities come from WHEAT donors.

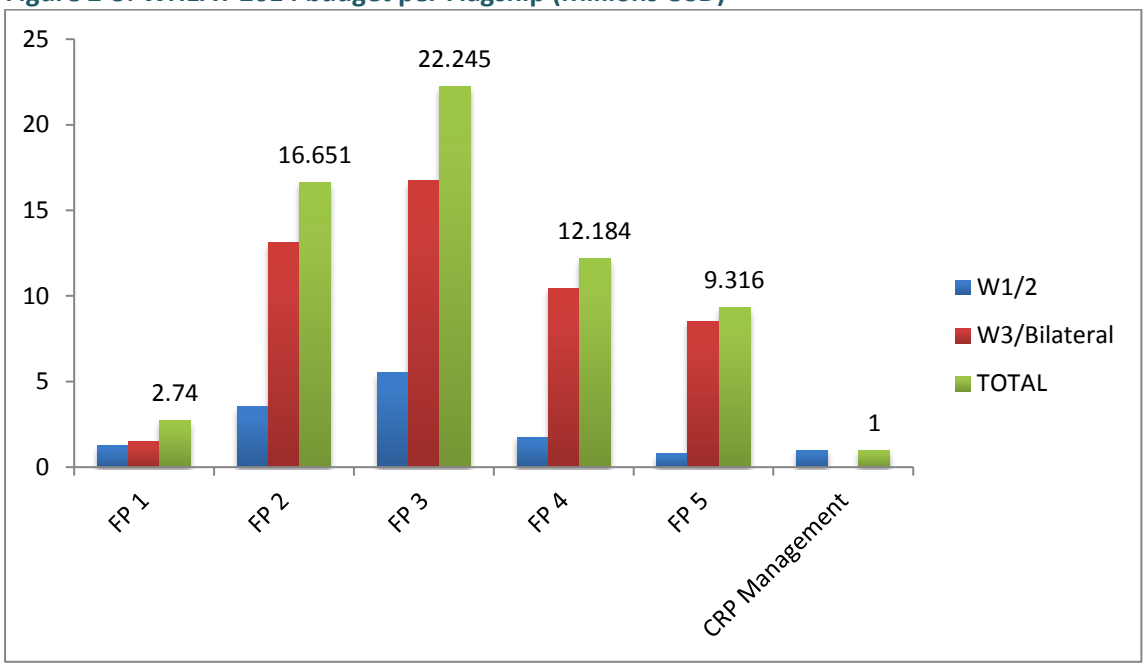
W1/2 funds are assigned to CRP management, research activities, partners, as well as gender-related activities. In 2014 around 10% of the budget was dedicated to gender related activities.

W1/2 funding is also spent on competitive partner grants (CPGs). Eighteen CPG projects started 2012, and despite of a cut in W1/2 funding in 2013 were supported for a 2nd year [13]. In 2014 WHEAT funded six additional CPGs, among them a global impact study on improved wheat variety adoption.

[11] Actual expenditures for 2014 were not available at the time when the report was drafted.
[12] After the report was drafted the CGIAR Consortium announced budget cuts and W1&2 budget for 2015 has been reduced to USD 13.5 million.
[13] In June 2013, the CO established a new rule that did not allow to carry-over funds committed and held on behalf of partners from 2012 to 2013. Faced with a severe W1/2 budget cut mid-year and income insecurities (only 90% of the 2013 budget were guaranteed), the WHEAT Management Committee decided to put priority on funding CGIAR Centers' ongoing research and competitive grant partners' R4D in 2013.

Regarding the relative share of budget per Flagship, FP 3 is by far the largest, making up around a third of the total programme, followed by FP 2. FP 1 has the smallest share but the largest relative contribution from W1/2 funding. This is shown in Figure 2-3.

Figure 2-3: WHEAT 2014 budget per Flagship (Millions USD)



Source: WHEAT POWB 2014.

2.2.3 Donors

The major donors that have been funding activities mapped to WHEAT are SAGARPA, which funds the MasAgro project (shared with MAIZE), USAID and USDA and the Bill and Melinda Gates Foundation (BMGF) that fund CSISA (Table 2-1). The BMGF funding of the Durable Rust Resistance in Wheat (DRRW) project is passed over to Cornell University. This illustrates that research contributing to WHEAT is funded and reported outside the CRP. Furthermore, WHEAT introduced the concept of "supplementary" projects in 2013 which are reported outside of the CRP and therefore the funding for these projects is not reflected in the 2013 figures in the table below.

Table 2-1: Largest donors to WHEAT (in USD 000')

DONOR	2012	2013	Comments (main activities)
BMGF (Window 3)	822	2,122	CSISA (FP32, FP 3 and FP4)
European Commission	1,031	672	Enhanced small-holder wheat-legume cropping systems to improve food security under changing climate, EC IFAD NARS Operations (both ICARDA) (FP4)
Cornell	5,291	3,645	Durable Rust Resistance in Wheat - Phase II (FP3)
GIZ	996	1,143	Utilization of wild relatives of wheat in developing salinity tolerant winter wheat with improved quality for Central Asia
GRDC	1,445	400	Enhancement of CIMMYT wheat breeding strategy for drought tolerance and genotypes of relevance to rain-fed areas of Australia, ACRCP- CIMMYT delivery of resistant germplasm and surveillance for resistance in Australian cultivars (FP2)

SAGARPA	11,016	5,954	MasAgro (FP2 and FP4)
USAID (Window 3)	1,244	2,115	Agricultural Innovation Program (Pakistan), parts of CSISA, Rapid Deployment of High Yielding and Rust Resistant Wheat Varieties for Achieving Food Security in Ethiopia (multiple FPs)
USDA	5,296	409	Pakistan Wheat Production Enhancement Program (FP5)
AfDB through IITA		990	Development of Strategic Crops for Africa (ICARDA)

Source: Annual Funding Summary 2012 and 2013 (L106 of Financial Reports)

2.2.4 WHEAT project portfolio

The WHEAT project portfolio (as of July 2014) includes a total of 155 projects/activities of which 76 are bilateral projects, 22 are W3 projects and the remainder are W1/2 activities. It includes 27 ICARDA projects currently mapped to the CRP.[14] While W1/2 funds are allocation annually, the bilateral grants have variable multi-year duration. Because both CIMMYT and ICARDA contribute also to CRPs other than WHEAT, some projects are only partially mapped to WHEAT.

The biggest projects in terms of 2013 expenditures were CSISA II (~ USD 3 million), MasAgro – Take it to the Farmer (~ USD 6 million), USAID's Pakistan Innovation Program (~ USD 1.6 million), and the USDA Pakistan wheat production enhancement program (USD 1.4 million).[15]

WHEAT is a global program and almost half of the portfolio is of global relevance. The most important region for CMMYT is Asia, which includes several bilateral projects with large budgets: CSISA in India and Bangladesh, the USDA-Pakistan wheat production enhancement program, Agricultural Innovation Program in Pakistan and ACIAR-Wheat & Maize Production in Afghanistan. ICARDA's WHEAT activities are divided among global, CWANA, Asia and Africa. ICARDA has a lot of regional breeding projects that target the Arab world and CWANA, and the large Turkey/CIMMYT/ICARDA International Winter Wheat Improvement Program (IWWIP) (jointly executed with Turkish NARS). The African Development Bank funded project "Development of Strategic Crops Africa" and the "Rapid Deployment of High Yielding and Rust Resistant Wheat Varieties for Achieving Food Security in Ethiopia", funded by USAID, are two large activities in Africa.

[14] Several of the ICARDA projects reported very low expenditures, starting from as little as USD 776.
[15] Financial information is based on the financial reports for 2013. The reports for 2014 are only expected to be finalised by April 2015 and could therefore not be considered in this evaluation.

3. RELEVANCE

3.1. Introduction

The purpose of this section is to respond to the evaluation questions on relevance regarding coherence of the CRP and its components, comparative advantage and program design. It will also address the key question: "Has the implementation of WHEAT (its strategies, integrated partners/collaborators capabilities, management and governance processes, and funding mechanisms) elevated the program's comparative advantage and improved its prospects to achieve its objectives and contribute more efficiently towards the program's intended IDOs and the CGIAR System-level Outcomes?". In this assessment, relevance encompasses three aspects given below; the aspect of value added of WHEAT is addressed in Chapter 9:

- **supply-side relevance and design:** The extent to which WHEAT's objectives, strategies, and Impact Pathways are coherent and consistent with the Program's Intermediate DOs and the CGIAR's system-level outcomes;
- **Demand-side relevance:** The extent to which WHEAT's objectives, strategies, and impact pathways are consistent with the needs and priorities of intermediary users and ultimate beneficiaries of WHEAT's activities;
- **Comparative advantage:** The extent to which WHEAT is exploiting its comparative advantages in the global wheat research system and research is prioritized.

While recognizing aspects of these three dimensions of relevance overlap, each aspect is assessed in turn.

The primary information sources used to assess the components of relevance include the 2011 WHEAT Proposal, WHEAT Extension Proposal 2015-2016[16], the 2014 WHEAT Partner Survey done by the CRP[17], analysis of 34 randomly selected WHEAT projects, and numerous interviews of key stakeholders.

3.2. Supply-side relevance and program design

Each of the two WHEAT strategies, Genetic interventions through improved seeds, and Sustainable Intensification interventions, through improved crop management and sustainable wheat-based farming systems, have unique impact pathways. However, these impact pathways both involve adoption by farmers as a critical step for achievement of a range of IDOs and ultimately contribution to SLOs. Thus the impact pathways are inter-linked.

[16] CGIAR Research Program on Wheat: Extension Period Proposal for 2015-16. April 2014.
[17] M. Audley, V. Kommerell, N. Jakobi, C. Velasco and J. Crossa. 2014. Partner survey for the CGIAR Research Program WHEAT: National and international priorities and engagement. Mexico, D.F.: CGIAR Research Program on Wheat.

WHEAT, as for other CRPs, is expected to adhere to three core principles: demonstrate a strategic approach to achieving impact on one or more of the SLOs; integrate research across CGIAR core competencies and Centers; and engage with stakeholders and develop effective partnerships throughout the R&D process. In 2013, all CRPs were instructed to develop their impact pathways to connect research outputs and outcomes to one or more IDOs, formulate targets and indicators for measuring progress and develop ToCs that specify assumptions related to the impact pathways.

Given the importance of wheat for food security, the evaluation team considers the overall strategic objective of WHEAT as being consistent with the CGIAR's current vision, "A world free of hunger, poverty and environmental degradation".[18] The IDOs as formulated in the WHEAT Extension Proposal for 2015-2016 are aligned, through a plausible theory, to the three SLOs that are the high level goals of the CGIAR. The WHEAT strategy implies that impacts are targeted through improved farm-level productivity of wheat, but it is also explicit about targeting poor consumers through stable prices.

The five FPs are interlinked. In combination, they directly target, in theory at least, an appropriate set of IDOs related to productivity, food security, income, gender empowerment, and environment (under revision for the 2015 SRF). Further, WHEAT targets six other IDOs through its collaboration with other CRPs (particularly the Dryland Systems CRPs, CCAFS, GRiSP and MAIZE). Qualitative and quantitative indicators of progress have been proposed for each of the main IDOs have also been articulated for the two R4D strategies[19] although without details of how to implement such monitoring in M&E.

The extent to which impact pathways have been defined varies across FPs. As mentioned above, the FPs are interlinked and their impact pathways therefore need to illustrate these linkages.

Impact pathways for the genetic interventions (FP 2, FP3 and FP 5) are tied to the joint WHEAT and NARS line selection and evaluation processes of the International Wheat Improvement Network (IWIN; discussed further in Chapter 5). In the Discovery and tool development projects (FP 2) outputs support the Genetics strategy by identifying sources of genes to improve variety attributes (yield, heat and drought resilience, etc.) and genomic markers and phenotyping platforms that assist in selecting and assimilating the best genes for attributes needed to improve varieties (in FP 3). As such, FP2 outputs are inputs to FP3 and share common ToC and impact pathways. FP 5 activities include variety seed scale-out between FP 3 and NARS and have a capacity development component. NARS are an essential contributor to the impact pathway between FP3 and wheat farmers.

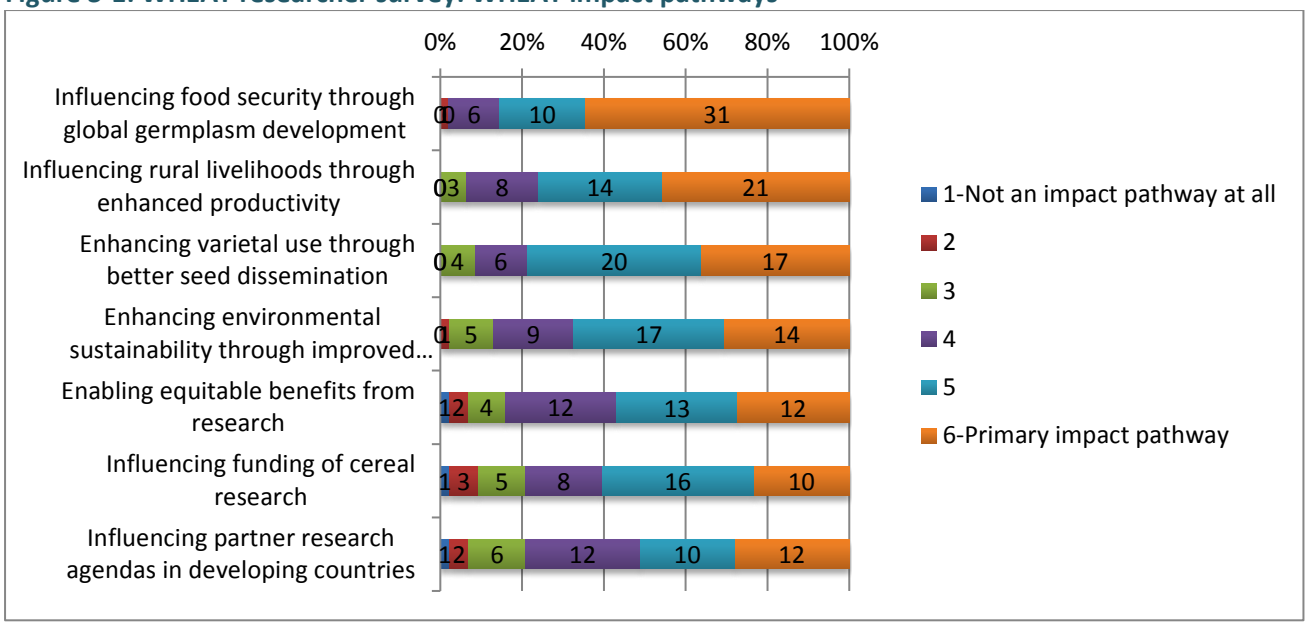
The only fully defined impact pathway exists for the Sustainable intensification strategy, for FP4. A list of assumptions accompanies the Impact Pathway representing a ToC for FP4. Impact Pathways and ToCs for the two strategies and their assumptions need to be explicitly defined. The ToCs need to articulate causal links between clear and measureable outputs, outcomes and impacts and identify the role of the key stakeholders, the assumptions about what has to happen for the

[18] CGIAR Strategy and Results Framework 2016-2025, February 2015. Draft for final consultation.
[19] CGIAR Research Program on Wheat: Extension Period Proposal for 2015-16.

intervention to work, the perceived risks to the intervention working, other external factors influencing the expected outcomes and impacts, and they need to consider unintended effects and rival explanations. In its comments on the initial WHEAT proposal, the ISPC requested greater clarity on outcomes and transparency of program-level impact projections.[20] The assumptions in ToC often relate to partnerships and capacity. While partnerships and capacity development are not mentioned in the WHEAT strategic objectives, two FPs - FP3 and FP5 – include them in the FP objectives. FP5 has primary role in WHEAT for capacity development including scale-out and next generation of WHEAT researchers. All FPs use both upstream and downstream partners to achieve objectives and fill gaps in current skills, technologies and along the impact pathway (from research to IDO beneficiaries).

In the researcher survey, WHEAT researchers ranked the impact pathways related to food security, rural livelihoods and seed dissemination as the most relevant. The results are presented in Figure 3-1 in order of perceived importance of the impact pathway.

Figure 3-1: WHEAT researcher survey: WHEAT impact pathways[21]



Source: WHEAT researcher survey.

WHEAT researcher interviews and the researcher survey were also used by the evaluation team to determine the extent to which relevance and coherence as outlined at the CRP research strategy and FP levels translates at the research project level. WHEAT researchers perceive that their research projects are relevant in terms of contributing to development outcomes, primarily to productivity, food security and income. This was supported by the fact that a number of interviewees were able to articulate logical Impact Pathways for their research along with some

[20] ISPC commentary on the revised proposal for CRP 3.1. September 2011.

[21] Question 18: In your view, what are important pathways through which research in WHEAT aims to have impact?

quantitative information on outputs, outcomes and impact, and time estimated for impact to be observed.

With regard to the difference that WHEAT has made in terms of enhanced relevance for reaching development outcomes, opinions were mixed. While some interviewed researchers felt that WHEAT as a CRP had made their research more relevant, other believe that it hadn't made a difference ('It is the research per se and not the fact that it is now undertaken within a CRP that contributes to the development outcomes'). Moreover, when asked if WHEAT prioritizes the most relevant research areas, most interviewees felt that their area of research was underfunded and that research priorities were still largely donor-driven. Donor dependency in priority-setting was also seen as posing risks. For example, a concern was raised that the intensive build-up of pathogen surveillance under DRRW had a risk of collapsing if funding dependent on a single donor came to an end. Another view was that the global breeding platform could suffer if all funding went to discovering trait genes and genomic markers.

Relevance and coherence were also evaluated by the Evaluation Team through the analysis of 34 randomly selected projects. In terms of supply-side relevance and design, alignment of projects with WHEAT's objectives was assessed. While a number of the projects were not explicitly presented as part of WHEAT, only three of the projects were assessed as being poorly aligned[22], eight were moderately aligned and 22 were very well aligned. This is a very positive result given a significant number of the projects begun prior to the formation of the CRP on WHEAT, suggesting that the anomalies around alignment were driven more by bilateral funding than the intended WHEAT strategy.

WHEAT has used W-1/2 funding for leveraging bilateral funding and aligned bilateral projects within the program strategies. According to WHEAT management, W1/2 aims to make the program more coherent and to enable WHEAT to pursue an overall strategy. W1/2 is relatively more important in some FPs than in others.

3.3. Demand-side relevance

While many groups across the globe could potentially benefit from WHEAT activities and outputs (and do so, for instance in Australia), WHEAT focuses principally on five mega-environments (**Table 3-1**). The four spring wheat mega-environments ME1, ME2, ME4, and ME5 account for 67% of the total wheat area and 84% of wheat-dependent poor. An additional high priority area, ME12, is a low rainfall region producing winter wheat (see Table 3-1). NARS and extension services (e.g., government extension agencies, NGO, farmer groups, policy makers, private sector etc.) in these MEs are the primary intermediary users targeted by WHEAT, and the resource poor farmers and poor wheat consumers are the primary ultimate beneficiaries targeted.

[22] Joint ICARDA-ARC Wheat Improvement Program, Enhanced Delivery of CIMMYT Germplasm to Australia, Development of Cereal Germplasm and the Screening for Disease Resistance and End-Use Quality: CIMMYT - Triticale Improvement Component

Table 3-1: Mega-Environments (ME) that are priority target areas for WHEAT*

ME	Description	Wheat area (million ha)	People earning less than USD 2/d (millions)	Representative regions
1	Favorable, irrigated, low rainfall production	32.0	556	Afghanistan, Egypt, India, Iran, Mexico, Pakistan
2	High rainfall, low edaphic constraints	7.0	107	Andes, Ethiopia, Kenya, Mediterranean and Caspian coasts, Mexico
4	Low rainfall	21.6	75	India, Iran, North Africa, Syria, Turkey
5	Warm, humid/dry	7.1	238	Bangladesh, India, Nepal, Nigeria, Sudan
12	Low rainfall	7.9	14	China, Turkey, West and Central Asia

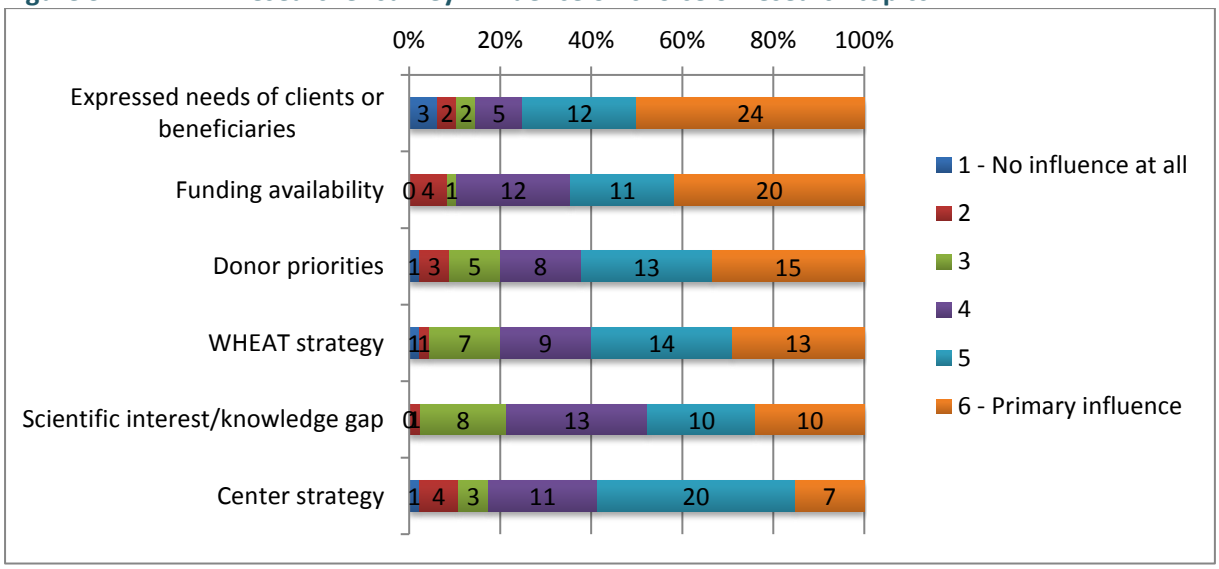
**A more complete overview of the 12 Mega-Environments and their characterizations, modified from Braun et al. 2010, is available in table 2 in the 2011 WHEAT proposal.*

At the FP level, the WHEAT partner survey on national and international priorities and engagement provides some useful information. The results from 92 respondents show that across most regions, partners prioritize investment in FP3 for both institutional and international agricultural research for development, with investment in research to combat wheat stem rust as major priority in all regions. The respondents also want enhanced access to training, information, decision-making tools (FP5) and breeding material (FP2). Regarding "WHEAT measures of success," food security and expanding the capacity of agricultural research through greater engagement with all stakeholders topped the list. Overall, it appears that the FP objectives and activities are aligned with the needs and strategies of partner institutions.

Information from the collaborator interviews and the sample project analysis also confirm that WHEAT's activities and outputs at the project level are generally consistent with the needs and priorities of intermediary users.

WHEAT's attention to demand-side relevance is also perceived to be good by the WHEAT researcher survey, in which most researchers (more than 75%) stated that the needs of clients and beneficiaries are influencing research and half of the respondents felt that this was the primary influence.

Figure 3-2: WHEAT researcher survey: Influence on choice of research topics[23]



Source: WHEAT researcher survey.

Interviews with ARI representatives revealed that the critical and very relevant role played by WHEAT partners and collaborators is recognized. An example is the DRRW and its two aspects: delivery of resistant materials to farmers, particularly for new stem rust races, and surveillance and early warning on emerging threats.

In general, the collaborator interviewees believe that WHEAT projects meet the needs and priorities of NARS intermediaries by enhancing their capacity to undertake nationally relevant wheat research and/or technology diffusion for wheat farmers. For example, officials in agriculture ministries in the Middle-East sites visited recognized the importance of WHEAT to food security for their farmers and populations (e.g. Turkey, Ethiopia and Morocco). In India and Bangladesh, feedback from NARS researchers indicated that WHEAT outputs are very important (varieties and production technology) and in addition WHEAT breeding material, staff training and agronomic support are essential. Indian partners in R&D also responded positively on relevance, but some expressed concerns that they are sometimes treated like workers more than scientists that ought to be engaged in strategy and priority setting. WHEAT's support of the Ethiopian agricultural research system through germplasm and rust resistant research is another example where the WHEAT contribution is highly valued and seen to fit the needs and priorities of the relevant research centers and there intended beneficiaries. Over all, interviews with supply-side researchers and research leaders in NARS and ARIs confirmed recognition of the relevance of WHEAT capabilities and outputs. Some down-stream NARS partners (e.g. in India) thought they could help delivery if they were more integrated into program/project implementation. In general, there was agreement that WHEAT activities are in line with the capacities and interests of the interviewees' organisations. Training provided by WHEAT is greatly appreciated and needed in the regions and comments were made about the infrequent availability

[23] Question 14. What is your perception of the factors influencing the choice of research topics in the WHEAT Flagship you mostly contribute to?

(see Chapter 5 for analysis of constraints along the Impact Pathways and Chapter 7 for capacity development).

Discussions with three major bilateral donors to WHEAT also revealed that the relevance of WHEAT is recognized, as is the need for greater leadership and accountability to drive outputs for outcomes and impact. However, based on the interviews, donor perception of relevance, and subsequently support, seems to be related also to WHEAT's willingness to accept greater responsibility for timely delivery of outputs. Restructuring of several discipline components into FP5 in the 2015-16 Extension Proposal may reflect WHEAT acknowledgment and adjustment to address some of these concerns.

The team assessed demand-side relevance also through its sample project review. Detailed information on the target groups was provided only for a few projects. A small number of cases had no information on the intended beneficiaries. In general the main target beneficiaries are identified only as 'poor farmers' or 'poor wheat growers' in the region or country of interest. Moreover, while poor wheat consumers are also intended beneficiaries of WHEAT activities, wheat consumers as targeted beneficiaries were mentioned in only one of the 34 projects analyzed. In addition, the needs and priorities of the target beneficiaries were often implicit at best. Recognizing that the simplified description 'poor wheat farmers', and the lack of explicit information on their needs and priorities, is in part due to the proposal writing and project reporting requirements given by bilateral donors, this information is too generalized or limited to be useful for project design. While some of the projects reviewed are clearly designed to increase the capacity of the intermediary users to develop and/or promote the project outputs, care is needed to ensure their real needs and priorities are met – at least to the extent WHEAT is able to do so. Even more importantly, outputs have to meet the needs of farmers on whose decisions to adopt WHEAT outputs the subsequent outcomes depend.

3.4. Comparative advantage

There are a number of reasons why WHEAT is in a strong position to exploit its comparative advantages in the global wheat research system. CIMMYT and ICARDA hold in trust globally unique genetic wheat resources and have a global mandate for international wheat research producing IPGs. As such WHEAT has access to approximately 80,000 wheat lines and collections of wild relatives which are used in breeding programs to identify and develop high yielding wheat varieties that are resistant to biotic and abiotic stresses and/or have other desirable traits. Another comparative advantage that CIMMYT and ICARDA have and which is exploited by WHEAT are the legal arrangements with national governments that facilitate germplasm exchange through international nurseries, and for shuttle breeding (for decades within Mexico and more recently among several countries in Africa).24 Further, these legal arrangements give WHEAT the advantage

[24] In the situation of ICARDA needing to evacuate its HQ from Syria, the decentralization has been much assisted through arrangement with several partner countries including Lebanon, Ethiopia, Egypt, Morocco, Turkey and Jordan.

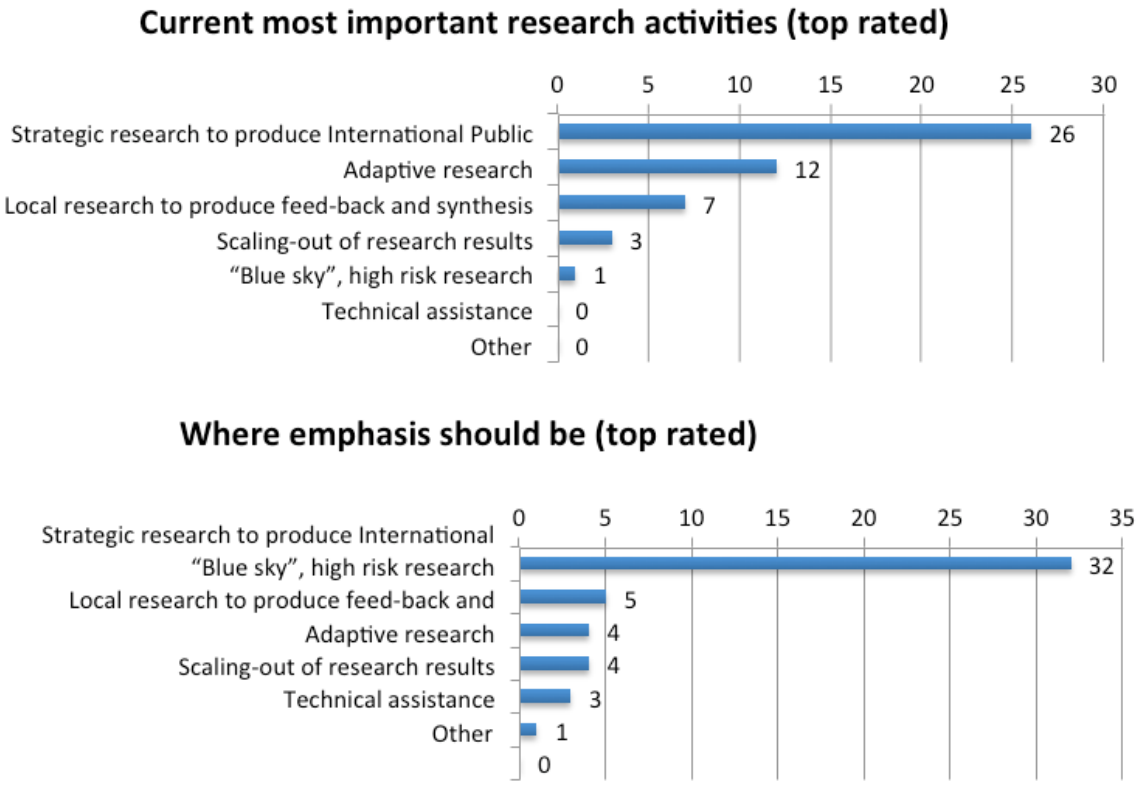
of being able to respond quickly to potentially disastrous situations, such as an outbreak of UG99 stem rust in sub-Saharan Africa (SSA) or opportunities for rapid selection or evaluation of heat tolerant or drought tolerant lines from internal discovery efforts and those of upstream partners.

While the private sector has become an important supplier of new varieties for many crops also in the developing countries, particularly where there are markets for hybrid seed, it does not have the incentives to engage much in wheat breeding. Wheat combines multiple genomes and as such is a complex crop to breed. Although there are small efforts on wheat hybrid breeding (WHEAT is actually funded by the private sector to engage in hybrid wheat breeding, an activity with an uncertain impact pathway), the overall complexity and lack of prospects for hybrid production any time soon have left the responsibility for wheat breeding to the public sector, where CIMMYT and ICARDA, and consequently WHEAT, remain core players.

WHEAT has also been able to exploit its role as a convener of partners by bringing together world-class expertise to accelerate innovation and develop research outputs, while simultaneously using its knowledge and skills to enhance the capacity of NARS in the developing world to undertake wheat research. Furthermore, in addition to collecting and distributing germplasm, WHEAT is the only organization that collects and freely shares wheat-based data on a global basis.

The results of the WHEAT researcher survey show that while the respondents generally feel that the three most important research activities within WHEAT are largely where the emphasis should be, several respondents believe there should still be a shift away from 'local research to produce feedback and synthesis for global research' towards 'strategic research to produce international public goods'.

Figure 3-3: WHEAT researcher survey: Most important research activities and suggested emphasis [25]



Source: WHEAT researcher survey

While the analysis above provides very positive examples of where WHEAT is clearly exploiting its comparative advantage in global wheat research, there are some areas where the WHEAT Evaluation Team feels that WHEAT does not necessarily have a comparative advantage. Both WHEAT research strategies require research (operational activities) at selected or representative locations to select or evaluate methods or lines among representative environments of targeted regions. Adaptive research can and should be done within NARs partners to the extent that partners' capacities permit. Methodological components of WHEAT research need to be adapted to local economic, environmental, farming system and cultural realities. WHEAT strategies and research objectives need to be informed by local circumstances because the farmers who are essential for adoption and ultimately for impact from WHEAT investments are always confined by local circumstances. For example, while there is no doubt about the necessity for further investment in standard agronomic research (such as comparative tillage practices or dates of planting trials), at the national level it should be part of the NARS research agenda, rather than being funded and implemented by WHEAT. The comparative advantage of WHEAT leading the Agricultural Innovation Programme (AIP) in

[25] Question 15. According to you, which are currently the three most important research activities within WHEAT and where you think the emphasis should be?

Pakistan is also questioned as this role could be taken by the Pakistan Agricultural Research Council (PARC). It is also the view of the WHEAT Evaluation Team that hybrid wheat research is another area where WHEAT has questionable comparative leadership advantage.

WHEAT is making strides to potentially increase its presence in SSA where yearly production grew by over three percent during the last 50 years[26] and demand is rapidly growing. The efforts have involved some exploratory investigation by CIMMYT on opportunities and socio-economic and environmental conditions to justify efforts on wheat improvement and research, and involvement of ICARDA in the African Development Bank funded project "Development of Strategic Crops Africa". The Evaluation Team considers that major new investments in SSA would require careful consideration by WHEAT of the drivers, rationale and success prospects of this research before expanding.

3.5. Conclusions and recommendations

Overall, the Evaluation Team concludes WHEAT to be relevant in terms of coherence, comparative advantage, and program design.

WHEAT strategies and goals are consistent with the broad goals of the CGIAR as defined in the 2011 SRF and its 2015 revision. There is rationale for and coherence among the FPs as presented in the 2015-2016 Extension Proposal, and the Program design has been considerably improved from the original 2012 proposal. WHEAT has used W1/2 funding for leveraging bilateral funding and aligning bilateral projects better within the program strategies.

WHEAT exploits its comparative advantage, which is unique in terms of access to and knowledge of wheat germplasm, experienced researchers, and long standing relationships with the relevant and highly committed NARS and ARIs, to deliver its outputs as public goods to appropriate NARS partners who use these in local efforts to enhance production of wheat for producer and consumer benefits. In FPs 2-4, WHEAT provides a leadership role in gene and marker discovery and accelerated pre-breeding and the interphase of crop physiology and production agronomy in the context of resource utilization efficiencies. It plays a coordination role in the IWIN and a support role in capacity/skills development among its NARs partners. FP1 provides socio-economic support for prioritization and targeting of outputs and impact assessments as outputs move along the impact pathways while FP 5 provides scale-out support for NARS and a coordinating role in capacity and skills development for those it depends upon to deliver outcomes from WHEAT outputs. In areas where national programs are well equipped to do nationally relevant research, WHEAT has less of a comparative advantage.

Program design has improved and now most FPs have internal logical links and as a set are aligned with the Program's intended outcomes at the intermediate level (IDOs). There are still some

[26] Negassa, A., B. Shiferaw, Jawoo Koo, K. Sonder, M. Smale, H.J. Braun, S. Gbegbelegbe, Zhe Guo, D. Hodson, S. Wood, T. Payne, and B. Abeyo. 2013. The Potential for Wheat Production in Africa: Analysis of Biophysical Suitability and Economic Profitability. Mexico, D.F.: CIMMYT

weaknesses in definition, validation and schedules for delivering outputs among FPs (and in some case between FPs and collaborators), which undermine active management for program level outcomes.

Recommendation 1: WHEAT should improve the refinement of its strategies, and better alignment and management of projects (activities) that enable priority WHEAT IDOs and SLOs objectives within its strategies. Each proposed FP project should define its intended output(s), its impact pathway, details of its ToC with critical assumptions, and checkpoints (points in time when assumptions can and should be validated). WHEAT should determine priority of projects based on their costs and risk-adjusted contribution to the Program priority IDOs. The FP projects should be integrated at the level of WHEAT research strategies. Validation of assumptions and progress along the impact pathway should be used by WHEAT management for learning and adjusting plans, and re-prioritizing projects when assumptions prove wrong or better options arise.

Recommendation 2: Bilateral funding remains critical to WHEAT's sustainability and therefore building donor confidence through improved management, strategy and portfolio focus is important. WHEAT should use its recently improved program management and ISC functions, and refined regional and global strategies, as tools to mobilize bilateral support for highest priority activities within its strategies while also being selective to keep its portfolio focused.

4. QUALITY OF SCIENCE

4.1. Introduction

The evaluation of the Quality of Science (QofS) is inclusive of people (leadership and research staff), processes and enabling mechanisms pertinent to conducting high quality research, and science outputs, primarily publications and genetic materials. The issues and questions that were the focus of this evaluation emphasize key attributes influencing the extent to which WHEAT science achieves the designation of "state-of-the-art". Attributes considered by the Evaluation Team ranged from choice of approach and scientific infrastructure to track records of team leaders. QofS assessment was done on the basis of the following:

- bibliometric analysis of all publications 2012 – 2014 citation rates (for 2013 and 2014), journal impact factors (IF); list dated 14/1/2015). A supplemental analysis of review articles (identified as "review" in the 14/1/2015 updated list 2012 – 2014 publications) was conducted to gauge the quantity and quality of program-wide research synthesis as an indicator of programmatic learning;
- review of sample publications – a review of a randomly selected subset of 38 of 2012 - 2014 publications;
- review of publications as outputs of WHEAT was supplemented with review of relevant, ancillary documents. The review of 35 sample projects active between 2012 and 2014 provided additional, albeit limited, insights into QofS at the project and programmatic level;
- assessment of researcher track record as reflected by H-index for Principle Investigators/ Team Leaders;
- field visits to selected projects in geographies with major activity and interviews of representatives of research leadership, staff, and stakeholders provided contextualizing insights to inform the evaluation of WHEAT documents and perceptions of QofS;
- a survey of WHEAT researchers gave key, additional insights into mechanism influencing the science process within WHEAT including mentoring, management and incentivizing for high quality research.

In publications and researcher analysis we note that ICARDA researchers working on NRM and social science are not mapped to WHEAT and thus ICARDA's contribution is mainly in genetics and breeding. Below we provide a general analysis of eminence of WHEAT's scientific staff, the quality of their outputs and some comments on process to supplement the analysis in Chapter 8. This is followed by the Evaluations Team's key observations regarding opportunities to enhance QofS at project and FP levels and to better leverage projects and FPs into effective programming.

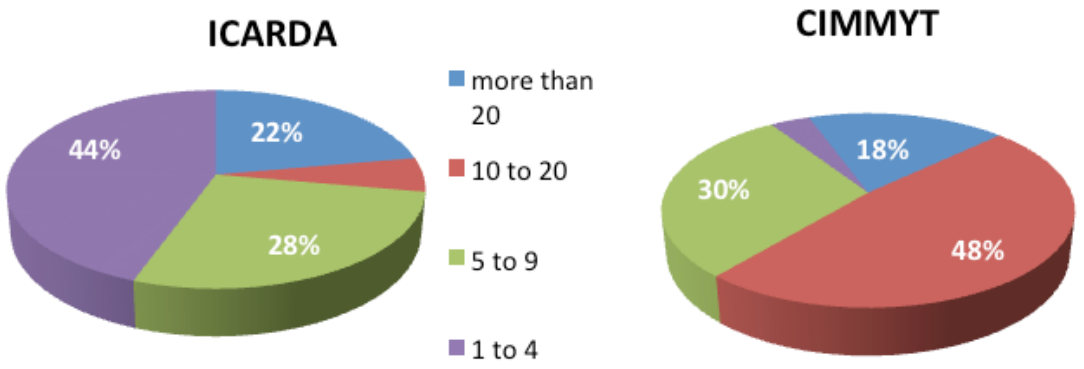
4.2. Scientific eminence of WHEAT researchers

The Team's analysis has taken into account the duality of outcomes and quality parameters in scientific research (biological and social sciences) and practical breeding. Through interviews with approximately 100 scientists and more than a dozen strategy and project leaders and coordinators,

the Evaluation Team found a diverse array of backgrounds, skills and experience levels and concluded that WHEAT has many high-quality research and development staff and, through its vast array of partnerships, access to and successful collaborative experience with a global network of high-quality scientists. Key elements, metrics, or analysis contributing to the by-and-large favorable impressions of the Team are detailed below.

The bibliometric analysis indicates that the eminence of WHEAT scientists[27] is on par with that of advanced agricultural research institutions in general. Results of the H-index[28] analysis (excluding auto-citation) of 45 senior personnel at CIMMYT (27) and ICARDA (18) are shown in Figure 4-1.

Figure 4-1: Distribution of H-index among 27 CIMMYT and 18 ICARDA researchers with team leader responsibilities



Source: Bibliometric Analysis.

The H-index analysis reveals an adequate percentage of researchers at ICARDA and CIMMYT (22 and 18 %, respectively) with high prominence in their respective fields (H-index > 20). Furthermore, nearly 50 % of CIMMYT research leaders have an H-index of 10-20, which, depending on the field, is considered good to excellent for a mid-career scientist on track for a distinguished scientific career. The analyses also point to differences between CIMMYT and ICARDA in both publication patterns and frequencies of citation. This may in part reflect the mismatch in sampling (ICARDA NRM and socio-economics research map to other CRPs particularly Dryland Systems, while the CIMMYT sampling includes all three research areas) but also may reflect differences in focus between the WHEAT partners. CIMMYT is oriented globally and toward R4D (two commodities) while ICARDA is oriented regionally towards both Research and Development (several crops and farming systems). As such, differences in publication and citation profiles may also reflect these WHEAT partners' complementarity of orientation. The wide spread of H-indices very likely reflects the fact that many researchers in both Centers focus on plant breeding where genetic materials are the primary output

[27] Many of the CIMMYT scientists contributing to WHEAT also work for MAIZE.
[28] The H-index is designed to measure the cumulative impact of a researcher's publication record and is an integrated measure of number of publications and the frequency of their citation (http://libguides.utdallas.edu/content.php?pid=77218&sid=572086; verified 2/10/2015)

of their work. Nevertheless, in international research organizations, also breeder scientists should pay attention to publishing and visibility among peers, particularly if they mentor young scientists.

The Evaluation Team's relatively cursory analysis of researcher prominence based on the H-index metric is supported by an independent study by Elsevier of CRP performance, commissioned by the CO, [29] which matched 82 WHEAT researchers to Scopus author profiles to extract bibliometric performance data. These data need to be interpreted with care, as the matching was done with varying success across all CRPs and the results are thus not representative for many CRPs. The Elsevier analysis found an average H-index for WHEAT researchers of 8.85, which was among the highest although significant differences could not be established. Given that H-index is correlated with seniority, the Elsevier study presented results for different age groups where WHEAT's senior researchers (>15 years since 1st publication) had an average H-index of 14. This corresponds with the average H-index of 11.4 in this evaluation that looked at researchers in supervisory positions.

Interviews, field visits, the survey of WHEAT researchers, and prior professional knowledge of the Evaluation Team supports a general assessment of high quality and eminence of program and project leaders, principal investigators and also other research staff.

4.3. Quality of WHEAT publications

Assessment of the quality of WHEAT personnel is clearly interdependent with an assessment of the quality of outputs as the metrics are often inter-related. Here we supplement the discussion presented above on caliber of personnel with an analysis of the publishing record of the two WHEAT partner centers and the prominence of publication venues (as judged by the evaluation team and indicated by the journal IF and results from the Sample Publication Analysis that rated a random selection of 38 publications for rigor, coherence and comprehensiveness, novelty, and quality and appropriateness of the journal.

Publications are a key measure, and are typically aggregated by center. In the independent Elsevier study that assessed research publication output by CGIAR Centers from 2003 to 2012,[30] CIMMYT was ranked first (a total of 1124 publications) and ICARDA was ranked seventh (a total of 580) in the number of publications in Agricultural and Biological Sciences. While CIMMYT was also in the top group for Field-weighted Citation Impact (FWCI; at 1.73), ICARDA was only a little above world average of 1 (with 1.08). For Environmental Sciences, CIMMYT was in the middle group regarding FWCI and ICARDA in the lower group. In social science, CIMMYT together with CIAT had the highest FWCI (although producing relatively few publications) while ICARDA was below the CGIAR Center average. One conclusion of the Elsevier study was for the CGIAR to call for more attention to the quality and impact of publications overall. Results from the Elsevier study for CIMMYT and ICARDA are shown in Table 4-1.

[29] Elsevier (2014): CGIAR Research Output and Collaboration Study 2014.

[30] Elsevier (2014): CGIAR Research Output and Collaboration Study 2014. Part I.

Table 4-1: Research publication output and impact

	CIMMYT	ICARDA
Agricultural and Biological Sciences		
Number of publications	1124	580
FWCI	1.73	1.08
Environmental Science		
Number of publications	112	93
FWCI	1.6658	0.968
Social Science		
Number of publications	70	31
FWCI	2.36	0.88

Source: Elsevier report.

Of the 333 publications identified as WHEAT publication output for 2012 – 2104, most (291) were journal articles or reviews published in journals indicating that the vast majority of WHEAT's written output receives peer-review. Analyses of publication venues most frequently targeted (Table 4-2) clearly indicate that WHEAT's preferred publication venues are prominent in the fields of plant sciences, agronomy and genetics in particular, and optimized for wide dissemination of WHEAT's knowledge contributions. In 2012-2014 WHEAT scientists also published one article in each of the following highly prestigious journals: Nature Climate Change and the multidisciplinary journals Nature, Science, and Proceedings of the National Academy of Science.

Table 4-2: WHEAT publication venues

Journal	***No. of articles published in 2012-14***	***JCR Impact Factor 2013***
Theoretical and Applied Genetics	27	3.658
Crop Science	21	1.513
Euphytica	17	1.643
Field Crops Research	16	2.474
Molecular Breeding	12	3.251
Journal of Cereal Science	8	2.088
Genetic Resources and Crop Evolution	6	1.593
Journal of Agricultural Science	5	2.878
European Journal of Plant Pathology	5	1.61
Journal of Experimental Botany	5	5.242
Heredity	5	4.11
Plant Disease	5	2.455
Cereal Research Communications	5	0.549
Crop and Pasture Science	4	1.133
Canadian Journal of Plant Science	4	0.716
Journal of Plant Registrations	4	0.496
Revista Fitotecnia Mexicana	4	0.264
Functional Plant Biology	4	2.471

Source: Bibliometric Analysis

A small percentage of journal articles (13%) were published in journals that do not have an impact factor and subsequently may not have undergone sufficient peer review. The team noticed near-absence of social science journals among the venues. However, Sample Project Analysis by the Evaluation Team identified approximately 17 articles on socio-economics, which it considered to be of good quality. WHEAT socio-economics research is published, for instance, in high quality peer reviewed agricultural journals such as Agricultural Systems, Journal of Sustainable Agriculture and Ecosystems and Environment.

In its qualitative analysis of a sample of publications, the team classified the majority of the publications as good or very good with respect both to methodological rigor and coherence of the data analysis and to the comprehensiveness of the research narrative. The random sample included seven general agronomy articles, 23 articles addressing genetics, breeding or germplasm screening/evaluation objectives, and seven articles broadly classified as socio-economics. Within these categories, the review team found similar levels of rigor, coherence and comprehensiveness. The Evaluation Team ranked the majority of agronomic papers as innovative in methodology but, in general, found papers on breeding and socio-economic research to be rather standard in methodology, which likely results from documented precision being more meaningful than methodological novelty. In keeping with the bibliometric analysis of all 2012-2014 publications, the Evaluation Team rated 84% of the subsample articles as placed in high quality journals for the research area and considered manuscript placement as highly appropriate for effective communication of WHEAT's results. Overall, the Evaluation Team found the quality of publications to be consistent with advanced agricultural institutions. This finding corresponds with the Center-specific findings or the Elsevier study referred to above.

The citation rate of WHEAT 2012 / 2013 publications also provides evidence about the quality of WHEAT research and the scientists' global eminence (discussed above). The data in Table 4-3 indicate that WHEAT journal articles move rather quickly to be assimilated in subsequent research.

Table 4-3: Citation rate of WHEAT 2012 / 2013 publications

	No. of articles by year (%)	
Number of citations (GS)	2012	2013
0	5 (5.7)	17 (18.3)
1 to 10	45 (51.7)	66 (71.0)
11 to 20	18 (20.7)	7 (7.5)
21 to 30	13 (14.9)	1 (1.1)
31 to 40	2 (2.3)	0
41 to 50	3 (3.4)	0
over 80	1 (1.1)	2 (2.2)

Source: Bibliometric Analysis

Of the ten most heavily cited publications (30 to 117 citations), CIMMYT has primary authorship on three and secondary authorship on seven. Six of the highly cited publications are co-authored by large teams (8 to 47 authors) indicating WHEAT is functioning as an important collaborator in multi-entity, large-scale and prominent efforts to advance science. In the Sample Publication Analysis, the Evaluation Team found strong evidence of some broad collaboration as authorship was often from teams representing multiple partners and disciplines. Analysis of Center affiliations in journal publishing (for 2009-2014) showed that while CIMMYT and ICARDA do not seem to have been publishing jointly, there was a burst of co-authored publications in 2013 (11); less in 2014 (3).

Finally, the Evaluation Team characterized WHEAT's publication volume to be appropriate considering the size of the program. Although the window for evaluation is too small for conclusive statements regarding trends in publication rates, the rate of publication by WHEAT does appear to be increasing (92, 95, and 144 publications in 2012, 2013, and 2014, respectively). Further, the Elsevier analysis of CRP performance suggests a positive correlation between researcher productivity and the launch of the CRPs. The Evaluation Team observed that publication volume varied markedly across FPs and attributed the variation to a host of factors, such as staffing levels, financial resources, and the role of collaborators in driving project topics, activities and orientation (upstream vs. downstream).

In general, the Evaluation Team rated WHEAT's publication record to be very good with good selection and success in publishing in high impact journals that ensure visibility of WHEAT's work within the relevant discipline.

4.4. Quality non-published outputs from breeding

Improved WHEAT varieties for farmers are the primary IDO oriented output of FP 2-3 and 5 activities. WHEAT advanced line releases through the IWIN are the primary reason for funds being invested in FP 2 and 3, but are generally not the subject of frequent peer-reviewed scientific publications. These novel lines (collectively about 200,000 per year for all types of wheat) are primary outputs of WHEAT created through the WHEAT internal genetics and breeding processes (FP2 and FP3). The best performing among these lines are released through the IWIN as public goods, and are subjected to further regional selection and evaluations by collaborating breeders. Some may be selected for registration, scale-out and release as national varieties. Others may be used as parental germplasm for further cycles of local breeding efforts by NARS and local institutions. Assessment of the quality of this activity covers both the process and the level of advancement.

Wheat breeding (as a process) includes systematic and overlapping breeding cycles [crossing parents (wheat germplasm) to permit recombination of genes, inbreeding, selection, and evaluations] to assimilate the best available genes and combinations of genes (e.g. for productivity, resilience and disease resistance, etc.) into novel lines from which a small percentage may become varieties for wheat farmers.

Most of FP 2 and FP3 breeding and genetic research in wheat are oriented towards specific trait gene discovery and characterization, genomic markers discovery and applications, and a broad array of methodologies (from many fields of science and statistical mathematics) is used to find, characterize and help assimilate the best genes and gene combinations into advanced WHEAT lines. These research efforts are well documented in WHEAT in publications and bibliometric analyses reported above.

Wheat breeding is a long-term cyclical process. A breeding cycle (defined above) is typically 8-10-years (from final crossing to start of basic seed scale-out of basic seed for release of selected lines). Based on documents review and interviews WHEAT typically initiates about 3,500- 4000 new breeding populations (including spring and winter hexaploid and durum wheat) each year through efforts of CIMMYT and ICARDA. Through document review, site visits (nursery, field evaluation and scale-out/multiplication sites) and interviews the Evaluation Team assessed the quality of science involved in the WHEAT global breeding platform.

The WHEAT breeding process is unique (in terms of scale of total activity) diversity of environments under which lines are selected and evaluated, and the number of participating scientific collaborators involved. Participating collaborators include many of the best wheat geneticists, breeders, and pathologists, and many of the best ARIs and national programs in nearly all wheat producing regions of the world. In wheat breeding for developing regions, there is no comparable alternative platform, as WHEAT includes many wheat scientists, scientific institutions and some private sector groups involved in wheat genetics and breeding. While not all ARI collaborators are focused on WHEAT priority regions, nearly all contribute knowledge, skills, projects, and training relevant to WHEAT and NARS collaborator staff in targeted regions.

The Evaluation Team generally concluded that the WHEAT staff and NARS collaborators in WHEAT are among the best available experts in each region of interest. Furthermore, the collaborating scientists associated with WHEAT are generally very experienced, and represent many of the most advanced institutions and some of the leading companies involved in wheat, globally.

Quality of outputs as measured by quantitative comparisons indicate that WHEAT lines generated by WHEAT and subsequently selected by NARS and other local breeders are among the most widely grown, most productive, pest resistant and resilient varieties in production in several developing regions with significant wheat production. Two recent reviews, one covering 17 years[31] and the other 30 years[32], both confirm fairly consistent genetic advance for yield at nearly 1% per year.

Quality of WHEAT releases from last 2-5 years currently in scale-out include some novel lines that combined high productivity with novel combinations of moderate resistance to near immunity to multiple pathogens, including UG99 stem rust, and also some with improved heat tolerance. These WHEAT outputs in the view of the Evaluation Team reflect high quality outputs of the WHEAT global

[31] Manes,Y. et al. 2012. Crop Science 52(4): 1543-1552.
[32] Lopes, M.S. et al. 2012. Field Crops Research 128: 129–136.

breeding platform collaborative efforts. The breeding process in terms of its efficiency and effectiveness is discussed in Chapter 5.

Breeding methods employed in WHEAT are mostly traditional (pedigree/bulk generation or backcross advance from crosses to homozygous lines), which have implications on likely effectiveness. Haploids would provide a more effective and efficient approach than traditional methods but haploid production efficiencies in wheat are currently too low (by an order of magnitude) for most wheat breeding applications. Shuttle breeding for spring wheat long used in Mexico (CIMMYT) and more recently by ICARDA in Lebanon and Morocco, reduces length of breeding cycles by up to three-years. Shuttle breeding has over the past few years been extended to several African countries via Mexico, but the underlying institutional agreements haven't been extended to WHEAT generally.

4.5. Processes for enabling and assuring quality of science

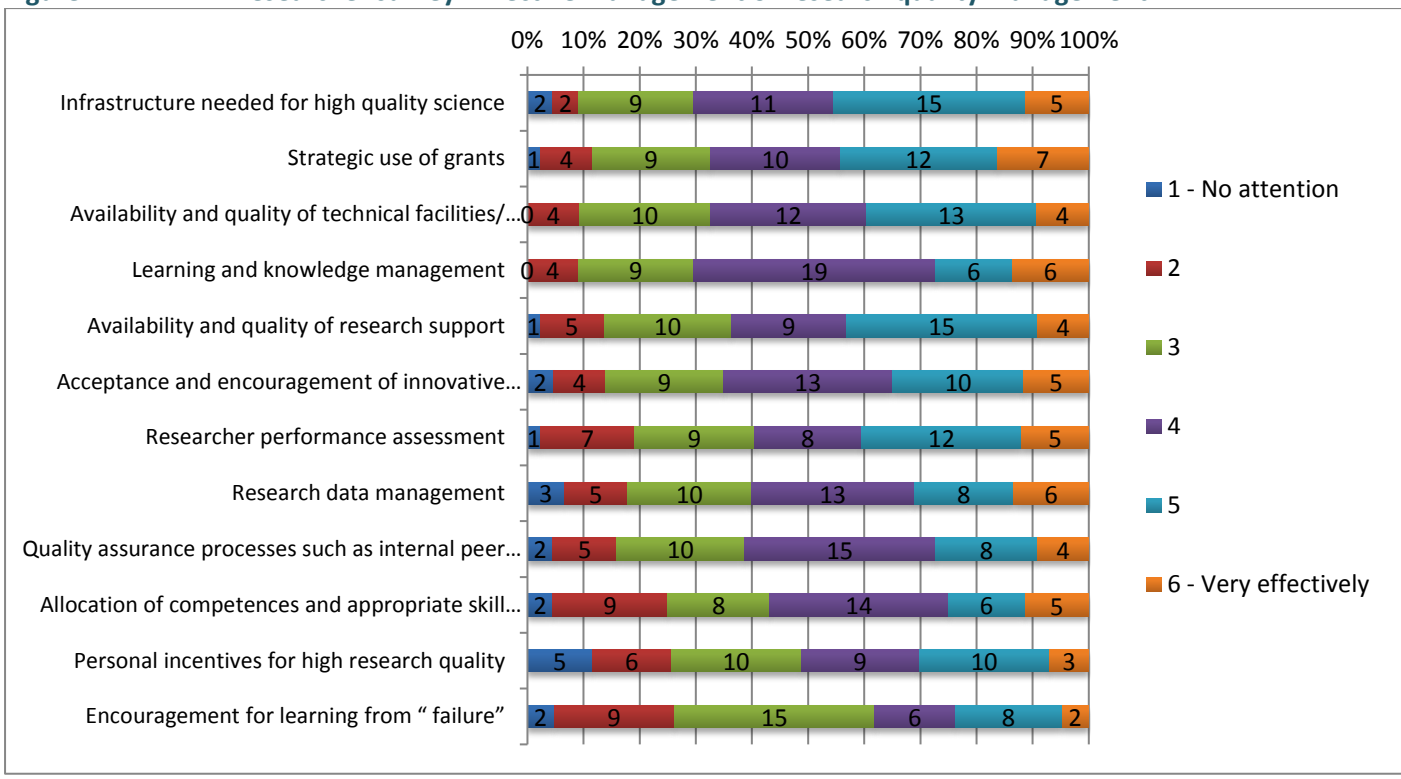
One process that may be used to help assure both QofS and program strategy by the Centers is the Center Commissioned External Reviews (CCERS). The evaluation team noted that CIMMYT and ICARDA have not completed their own CCER in spring wheat program(s) since 2004 although ICARDA and CIMMYT supported use of this tool for the joint winter wheat program (IWWIP) in 2012. The external reviews of FPs (e.g. Stripe Review of natural resource management[33]) and individual projects (e.g. CSISA Phase II Review) may be transitionally replacing the remit of CCERs, as may program-level reviews commissioned by the W-ISC (though potentially through a narrower window of focus than traditional CCERs).

WHEAT's strong cadre of high quality personnel and favorable quality of outputs suggest that effective processes and enabling infrastructure for QofS are present and operational at project, FP and program level. Human resources processes are vested with host and partner institutions (see chapter 8). Where the Evaluation Team had the opportunity to directly evaluate these elements, observations support a general assessment of good or very good infrastructure at some sites but limited at other (e.g. lack of durum grain quality analytical equipment leads to very late evaluation of critical processing characteristics such as product color). Here we provided some limited additional commentary on internal perceptions given their importance to program morale and motivation.

Internally, the perceptions of WHEAT researchers are quite favorable regarding mechanisms and processes to ensure quality of science (Figure 4-2). Some process limitations related to effectiveness are covered under Chapter 5 below.

[33] CGIAR Independent Science and Partnership Council. 2012. A Stripe Review of Natural Resources Management Research in the CGIAR. Independent Science and Partnership Council Secretariat: Rome, Italy.

Figure 4-2: WHEAT researcher survey: Effective management of research quality management [34]



Source: WHEAT researcher survey.

The WHEAT researcher survey established overall general satisfaction with management of aspects relevant to ensuring research quality. Responses reflect high levels of satisfaction on aspects such as "infrastructure needed for high quality of science" "learning and knowledge management". Aspects of researcher performance assessment, research data management and quality assurance processes showed a somewhat higher level of dissatisfaction. It is worth noting that while the respondents rated "Acceptance and encouragement of innovative thinking" rather favorably, the vast majority did not consider that "Encouragement for learning from failure" is used effectively for managing quality.

When asked to rate how well progress reporting is managed as a tool to enhance the effectiveness of WHEAT, almost 80% of researches responded positively (see Annex F for the summary of survey results) suggesting management is perceived as being highly effective in managing this important but often burdensome task of conducting research.

When open-ended responses were solicited regarding incentivizing personal interests, motivations and job satisfaction, respondents identified items reflective of high-quality management such as belief in the mission and strength of peer team.

[34] Question 19. In your view, how effectively are the measures listed below managed in your Center/CRP for assuring and enhancing high quality of research?

However, comparing the responses between researchers that joined in 2011 or after and those who had been working at ICARDA or CIMMYT before 2011 revealed that the newer recruits consistently rated the aspect of management related to science quality less favorably than the older recruits. While the response numbers are very small, mentoring is to be seen as a very important part of science quality management, particularly in the situation of growth and institutional changes.

4.6. Research design

It is important to note that the Sample Project Review which, in combination with field visits and interviews, was intended to be a primary window for aspects of assessing research design and the enabling environment for project quality and leveraging of projects into coherent programs, proved less informative than initially anticipated. This exercise gave some evidence of high quality thinking and application of state-of-the-art knowledge at the project level. Most projects sampled contained significant elements of scientific research under one or both WHEAT strategies. The Evaluation Team categorized 26 (of 34) projects as clearly addressing researchable issues. Eighteen were characterized as using state-of-the art methodologies and/or methodologies that were known to be sound and appropriate to the research question. Judicious use of proven or traditional methods, rather than new technologies, was considered important and an indication of state-of-the-art scientific knowledge, permitting efficiency in project planning and execution. Fourteen projects were found to give moderate to strong indications that choices in research approaches and designs were reflective of high quality scientific thinking and intimate knowledge of the current literature. A typical limitation was the lack of clear statements of testable hypotheses, or too sparse description of research methods (eight projects). Six projects were characterized as strictly for capacity building (people or infrastructure) or technology scale-out. However, the Evaluation Team found the quality, quantity and usefulness of proposals and progress reports to vary dramatically. Documentation on the remaining projects was too limited to understand whether research was being conducted, and to complete QoS assessments. The reporting scope in the sampled projects appears largely driven by requirements of bilateral donors. Where some donors required comprehensive reporting on all aspects of R4D, the project-level science was comprehensively described, the quality of the science was readily apparent and linkages to the supporting infrastructure were clear. In some others documentation provided only broad objectives with less justification, knowledge gaps were not addressed and methods were described only at general level.

4.7. Opportunities to enhance WHEAT QofS

This section addresses aspects of QofS specific to social science and sustainable intensification, with relevance to the germplasm strategy. The issues raised have particular importance for the likely effectiveness of WHEAT which otherwise is discussed in Chapter 5. Although these areas of research are mapped to WHEAT only at CIMMYT, the quality aspects have implications to WHEAT as a program.

Social sciences in WHEAT

Leadership of FP1 is well-respected, knowledgeable and experienced and the growth and diversity of expertise within the social sciences was deemed impressive; overall, the emerging team was perceived as having a high level of knowledge and skills in a range of important areas. Despite the laudable effort by WHEAT leadership to strengthen FP1 to meet programmatic needs, resource limitations remain apparent with consequences for programmatic progress.

In terms of project and program design to deliver the highest quality R4D, demand for social sciences research has increased. Targeting is clearly considered a high priority at the CRP program level and some excellent targeting studies have been undertaken (e.g. delineating WHEAT opportunities in SSA). However, a general lack of human resources appears to limit the Socio-economic Program's involvement in project design and implementation, which limits social sciences inputs for within-project targeting, monitoring and evaluation, and so on. Field visits, interviews and Sample Project Review found that over half of FP1 resources were embedded within a few major projects where bilateral donors have strong interest in ensuring optimal targeting of the projects they fund and monitoring and evaluating field-level impacts, for example CSISA.

Analysis of FP1 studies identified some excellent papers on practice adoption, targeting and farm-level analysis.

4.8. Quality of Science and effectiveness of research on sustainable intensification

Sustainable intensification is now widely recognized as the most plausible theoretical construct under which to simultaneously pursue hunger and poverty eradication and improve agriculture's environmental performance. In developing a SI research strategy, the Sustainable Development Solutions Network notes the key principle that must be recognized: "given the huge diversity of agriculture and the starting points for change – there can be no one-size-fits-all solution."[35] This is in marked contrast to the stand-alone Conservation Agriculture (CA) strategy that dominated sustainable cropping systems research in the CGIAR system until very recently[36]. In tailoring solutions to the localized (biophysical, social, economic, political…) manifestations of problems, SI offers many critical, theoretical improvements over CA. However, operationalizing a research strategy to deliver desired outcomes at local to global scales is correspondingly much more complex and challenging.

WHEAT is uniquely positioned to grow the science of SI. The opportunity is likely time sensitive for WHEAT to emerge as a pre-eminent leader in implementation of a clear, novel SI strategy, which

[35] Solutions for Sustainable Agriculture and Food Systems, Technical Report for the Post-2015 Development Agenda. Prepared by the Thematic Group on Sustainable Agriculture and Food Systems of the Sustainable Development Solutions Network.

[36] For discussion on CA, see http://www.sciencedirect.com/science/journal/01678809/187

requires high level of transparency throughout the value chain. However, realizing this opportunity requires WHEAT to take several key steps to enhance QofS in FP4 research. Three opportunities related to QofS are highlighted as prerequisite to improving the overall quality of science and effectiveness of the WHEAT's SI research strategy.

Enhanced lateral learning: SI requires a culture of knowledge, and lateral learning is a critical enabling mechanism in the development of a strategic network of field projects that can be effectively aggregated to address FP and programmatic goals. Field research is costly, time-consuming, and cannot be expected to be implemented on a broad enough scale to address all important management by environment contexts. Thus, experiments and treatments must be designed and distributed judiciously in time and space such that the inference space of the experimental network is optimized with respect to knowledge gaps at project, FP and programmatic levels. The process of network optimization is best pursued in real-time with on-going information exchange to allow iterative improvement of project contributions to the larger goals. Given that most field objectives require two or more seasons/years of data, relegating most lateral learning to occur near or at a project's end (in final reporting and publications) is inefficient and can lead to significant redundancies or gaps and delayed progress.

Field visits and interviews revealed that WHEAT scientists have a strong interest in lateral learning among projects and recognize its importance to accelerating the rate of knowledge gain in FP4. However, when asked directly about opportunities for lateral learning, many stated that these were less frequent than they desired or thought would be useful for programmatic progress, especially given that SI projects relevant to WHEAT are ongoing in multiple CRPs and WHEAT FP4 projects often blend funding from other CRPs. Further, many of the major SI projects (e.g. CSISA in South Asia and MasAgro in Mexico) are funded bilaterally and are developed in consultation with donors and national level partners; research leaders must be proactive and creative in ensuring that project development is in concert with FP and program goals. The sample review of major SI projects showed that the documentation did not convey complementarity with research conducted elsewhere – especially outside a region. Collectively the team's findings suggest there is desire and need for an explicit investment in lateral learning mechanisms (working group meetings for project alignment, scientist exchanges, SI coordination meetings across CRPs, etc.) to instill and facilitate programmatic thinking at the project level, capture efficiencies with WHEAT, and across CRPs, and accelerate knowledge gains. Core-type funding (W1/2) could be channeled for this purpose.

Secure and stabilize funding for long-term projects: Lack of consistent, secure and sufficient funding for long-term research poses a significant challenge to progress under FP4 and achieving real gains for WHEAT's SI strategy. Long-term field research is required to demonstrate the productivity and other ecosystem services benefits of SI technology packages. Intensively monitored benchmark or sentinel sites and their data records are foundational elements for interdisciplinary research to address inter-scaling questions (tradeoffs from farm to watershed, etc.). Benefits such as increases in soil organic matter and improved soil moisture holding capacity are often not evident in the typical 3 to 5 year project/grant lifetime; even trend directionality for a biophysical attribute may be inconclusive over the short-term. Likewise, many site-years are required to fully understand variance as well as mean of a treatment effect. The 2012 Stripe Review of Natural Resource Management

Research within the CGIAR[37] identifies investment in setting up and managing eco-regional, benchmark, hub or sentinel sites and "establishing long-term monitoring and evaluation systems to benchmark and measure change" as one of nine issues governing opportunities to match vision with practice for CRPs.

Field visits and interviews revealed that intensive monitoring of parameters (plant growth and development, water budgets, radiation use efficiency, greenhouse gas and carbon / nutrient balances) is happening in nodes or sites within field networks. The project leaders fully understand the value of the sites and the magnitude of investment required to sustain them and preserve and make accessible their data records (see additional comments below on data infrastructure). Most research leaders characterized funding for these sites as inadequate, sparse and/or sporadic and expressed mixed confidence in the likelihood that such efforts would be maintained without a profound change in funding philosophy.

Invest in Systematic Review (SR) and meta-analysis: The SI strategy is extremely knowledge intensive and the onus is on WHEAT's SI FP to conduct the synthetic research that builds on the primary research of field experiments. At present, SRs (both qualitative and quantitative) and statistical meta-analyses appear under-used in WHEAT and could be a significant opportunity for WHEAT to establish itself in a leadership role among all CRPs conducting SI research. Meta-analytical statistics can untangle knowledge from context and, with the necessary data infrastructure, can permit efficient, recurring re-analysis of an accruing body of primary literature relevant to a specific question. The 2012 Stripe Review explicitly identifies meta-analysis as foundational to generating public goods from cross-site and cross-CRP comparisons. SRs – with or without meta-analysis – not only reveal knowledge gaps, but also have proven extremely useful in improving the overall quality of the contributing primary research. In our analysis of the nine articles identified as "reviews", only two had agronomic focus, one of which used meta-analytical statistics and followed some (but not all) elements of a rigorous SR protocol. Other reviews were strictly narrative reviews or advocacy statements (e.g. calling for more investment in science). Thus, it appears, rigorous synthetic research may be under-prioritized given its importance in refining knowledge gaps and in unbiased characterization of inference space for technology application.

Additionally, SR is an important quality assurance/quality control mechanism for high quality standardization across multiple experiments. The process of developing questions and extracting the data from the primary literature can expose chronic deficits in field studies with respect to characterizing important experimental conditions (e.g. soil characteristics) or variances in treatment effects. SR can be used to establish data and metadata standards, minimum datasets and standardized research protocols – all key elements of effective research networks for SI. The Evaluation Team did not have sufficient resources for a full evaluation of the degree to which SI projects adhere to common protocols, data standards and management plans, but interviews and previous professional experience suggest that there is room for improvement. Fully adopting a

[37] CGIAR Independent Science and Partnership Council. 2012. A Stripe Review of Natural Resources Management Research in the CGIAR. Independent Science and Partnership Council Secretariat: Rome, Italy.

research strategy of aggregating results from field studies into SR will not only improve the ultimate utility of individual projects, but will also ensure that programmatic quality is maintained across regions and partners. Likewise, SR can clarify and prioritize the data infrastructure requirements (workflows, competencies, policies) required to fully deliver on the intent of "open access" agricultural data as a public good (see additional comments below on data infrastructure).

4.9. Conclusions and recommendations

QofS for WHEAT was deemed on par with advanced agricultural research institutions. The evidence available to the team indicates high quality thinking in research project design and use of state-of-the-art methodologies in project execution. Program approaches build on latest scientific thinking and latest research results and explore novel approaches in some exploratory research, but more generally use most appropriate or most cost efficient methodologies. Processes for assuring quality can be assessed as adequate on the basis of the quality of outputs from the program, although external reviews have not been employed in the areas of WHEAT research, with the exception of the external review of the IWWIP (2012). M&E processes, including QofS issues, are needed from project to program level. Program design until recently reflected traditional discipline orientation of staff but more recently reflects clusters related to functions or program level outputs (and outcomes).

While the work done in FP1 is of good quality, resources are a limiting factor (this has implication also for feed-back for enhanced relevance and effectiveness). FP 3 breeding activities and FP4 could benefit from extending lateral learning across projects, FPs and engaging partners. FP2 and FP3 need to stay abreast of very rapidly advancing genetic/genomic sciences and development of new tools (e.g. gene sequence editing which will likely replace GMO transgenic insertion technologies over the next decade and potentially circumvent politically sensitive regulatory issues).

The importance and time sensitivity of investment needed in data management and infrastructure needs to be underscored. It is a science quality issue. In addition, inadequate investment in data management will undermine project utility and seriously jeopardize WHEAT's effectiveness in science. The initial emphasis that has absorbed a major share of effort to date has been on research project/donor reporting management, not data management *per se*. Workflows for data streaming from projects into programs were repeatedly identified as problematic. Challenges have been articulated (culture of not sharing data, managing skyrocketing diversity of data, data quality, etc.) but development of solutions needs to be prioritized; otherwise gains at the project levels cannot be translated to the program level. WHEAT and CIMMYT have taken some important steps in reaching out to other organizations (e.g. Oakridge and the Knowledge Discovery Framework) for collaborations to enhance utility and implementation, but much more is needed.

Recommendation 3: In order to accelerate synthesis and programmatic progress, WHEAT, particularly in the Sustainable intensification strategy, should enhance lateral learning to accelerate the rate of knowledge gain. The mechanisms should include information exchange feeding into new project design rather than occurring at the close of projects, synthesis of studies to span space and time dimensions, engagement with other CRPs and other crops, and better integration among disciplines within WHEAT.

Recommendation 4: WHEAT should improve its data management and infrastructure, as part of enhancing the utility of the Research Management System for researchers and Program-level management. Institutionalizing comprehensive data management starting from project inception is a prerequisite for high quality science in data-intensive research domains, such as those of WHEAT. This upgrading should involve development of repositories, workflows, standards, preservation and

data curation mechanisms, as well as policies to make data searchable, retrievable, reusable, and inter-operable.

Recommendation 5: WHEAT should establish internal mentoring within the CRP for safe-guarding the quality of science in the face of rapid programmatic growth and institutional integration. This is needed especially to strengthen the Program during transitions that involve management, staff increases, de-centralization of ICARDA and restructuring wheat programs into WHEAT. Mentoring is also an important reciprocal mechanism for team progress and delivers benefits also for mentors from mentees who are often source of untapped, innovative thinking.

5. LIKELY EFFECTIVENESS

5.1 Introduction

In this Chapter the Evaluation Team examines progress towards achieving milestones and near-term outputs, and the likely effectiveness of the Program towards WHEAT IDOs, giving consideration to how constraints along the impact pathways are being addressed.

The 2011 WHEAT proposal included ten Strategic Initiatives (thematic areas) each of which listed 4-15 outputs for the period 2011-2016, (93 outputs in total) with about 10 % either shared among WHEAT thematic areas or other CRPs. Strategic Initiative outputs vary from near-term enabling activities (e.g. fund graduate students or review a subject) to outputs linked to program-level objectives (e.g. an annual yield increase of "0.9% in genetic yield potential gains maintained in new cultivars and elite lines for Asia, Africa and Latin America" by 2016). Individual project proposals (for bilateral funding), annual work books, project reports and the 2012 annual report narratives provided better indication of alignment of activities within and across the ten Initiatives. These, supplemented with input from 191 interviews and more than a dozen visits to specific field sites provided evidence to the Evaluation Team to assess progress and potential for impact within the two major strategies and supporting functions.

The adjustments in Program structure from ten discipline-based initiatives to five FPs (2015-2016 Extension Proposal) reflect improved clustering of activities with appropriate alignment towards outputs and associated potential outcomes (as discussed in Chapter 3) and thereby enhanced potential to be effective.

5.2 Progress in the main WHEAT intervention strategies

5.2.1 Genetic intervention strategy

Genetic and breeding projects from six WHEAT SI project clusters in 2012 were re-configured into FPs 2, 3 and 5 (2015-16 WHEAT Extension Proposal). Impact-oriented objectives included: maintaining 0.9% annual advance in yield potential of new varieties; providing durable resistance to rusts (including UG99 type stem rust), and heat and drought resilience traits in otherwise highly productive lines suitable for scale-out or use as parents for further breeding by collaborators. Projects also included efforts to support scale-out of new advanced lines that NARS have selected to become national varieties, and exploratory efforts for new sources of genes and associated markers for several traits to improve productivity, and nutrient (nitrogen and phosphorus) and water use efficiencies.

Concerted efforts to improve resistance to stem rust that follow the emergence UG99 race of stem rust 1998/99 in Uganda and subsequent spread through much of Africa and Iran (2007) have received major attention from 2009 to the present. Initiated in 2008/9 under leadership by Cornell

University, DRRW has brought together CIMMYT and ICARDA (now WHEAT), and other collaborators in 28 countries. Outputs achieved during Phase II of the project included:

- identified and advanced 274 high yielding bread wheat lines with near immunity to moderate resistance through the IWIN (nurseries) or into the program replicated yield trials;
- release of 17 resistant and 44 moderately resistant high yield durum lines;
- release of more than 21,000 tons of rust resistant seed of wheat varieties have been made available for scale-out in priority regions afflicted by the rust;
- the project has also helped establish an international pathogen surveillance and early warning system for wheat including trap nursery seeds distributed by ICARDA as well as rust screening facilities in Ethiopia and Kenya; and
- training for nearly 150 scientists (including 17 students).

The clusters of projects have been effective in achieving many of the planned outputs including genomic markers (eight of the 10 or so stem rust resistance genes considered useful as of this evaluation) as well as for some other genes for desease resistance in wheat. Markers, detectable unique DNA sequences genetically linked with specific resistance (and some other useful genes) can help breeders assimilate appropriate combinations of useful genes into wheat varieties for farmers. At present, durability of stem rust resistance remains tentative because at least one new stem rust race has been confirmed in the last two years. If stem rust resistance from identified useful genes remains durable, the adoption of some varieties conferring moderate-to-high resistance with improved productivity is likely to lead to measurable impact in the next 3-7 years in Africa and may reduce the impact of stem rust disease spreading into other regions. A prerequisite to adoption of new resistant varieties by farmer is that seeds are properly multiplied and the new varieties are properly positioned in the regions or market segments where each provides the greatest improvement in farm productivity or revenue (e.g. the incentive for adoption by farmers).

FP 2 (novel diversity and tools) activities were aimed at improved heat and drought resilience, insect resistance (Hessian fly, Russian Wheat Aphid, leaf miner, saw fly etc.), disease resistance (Septoria, tan spot, root rots etc.), nutrient utilization efficiency and through understanding and breaking yield barriers (examining some physiological responses to genetic, environmental and GXE interactions and through some collaboration with private sector, assessing potential for hybrid wheat). Some of these activities are well advanced and others are at more formative stages. Some advanced WHEAT lines, including at least one variety (Bangladesh) with high levels of tolerance to terminal heat stress (BARI Gom 28), and two other varieties (BARI Gom 26 and 27) that combine high productivity with moderate resistance to stem rust, and other wheat diseases and some heat tolerance, are being scaled out as varieties.

The search for better heat and drought tolerance genes is continuing along multiple fronts, including exploration and evaluation of (i) WHEAT established germplasm collections, (ii) new synthetic wheat derivatives (durum X *T. taushii*), and (iii) recently collected bread wheat land races (Turkey). The evaluation team judged these efforts to be highly collaborative and well organized with testing in multiple countries in high temperature seasons. Although progress has been excellent, it is too early to assess potential impact to date.

There are long-term challenges to improving productivity through increasing wheat yield. The wheat breeding platforms, using traditional methods, have been extremely successful in advancing productivity (yield per unit of resource) of wheat; but those advances on farms have slowed in recent decades (as it has in other major commodity species).[38] Progress in yield and in other quantitative traits is a function of gains from selection per unit time (year). In its commentary on the original proposal, the ISPC called for more analysis on the underpinning causes of this overall decline in the rates of wheat yield gains. WHEAT and its collaborators will need to either find greater useful genetic variability for productivity, apply much greater selection intensities to much larger breeding populations or adopt new methods that shorten breeding cycle length in order to accelerate genetic productivity gains (above 1 % per year) for advanced lines.

FP 2 and 3 have been successful in discovering novel disease resistance genes and linked genomic markers. If the search for additional disease resistance, heat-resilience, nitrogen- and phosphorus-use efficiency genes succeeds, WHEAT will need an efficient process to assimilate and test "converted advanced lines" for both validation of effectiveness and to identify pleiotropic effects. Some seed enterprises have developed procedures to "convert" product lines (several varieties) with multiple genes (transgenes and conventional) using seedling phenotyping supplemented with gene or linked markers and genomic markers to accelerate the introgression of multiple genes in BC2-3 progeny with better recovery of recurrent parent genotype than random BC6 progeny, the more traditional but time consuming process for introgression of new genes into lines or varieties.

The evaluation team observed that availability and farmer adoption of wheat varieties is sometimes delayed by several years, after genetic improvements have been achieved in the breeding process. Sometimes improved attributes of varieties are not known or obvious to farmers; new varieties often have no apparent detectable benefits such as improved disease resistance when disease levels are low in farm fields.

While interviews with partners reflected good satisfaction on the outputs coming from WHEAT, partners also commented that adoption (turnover) of varieties is very slow. In Ethiopia, new disease resistant WHEAT line scale-out efforts may assist more rapid seed availability through recently organized seed cooperatives but more technical training for cooperative members could help improve purity of this "informal seed" source. A view was also heard by the team that lack of pre-basic (breeders) seed of two released lines from WHEAT, and the long delays in getting such stocks, delayed the start of multiplication and thus availability of those varieties by as much as three years.

In conclusion, the evaluation team was informed of a number of factors that limit effectiveness of wheat genetic interventions; some are technical and some tied to impact pathway constraints:

- delays in breeders seed delays local multiplication, and ultimately impact (sometimes by 2-3 years);
- improved varieties may be poorly differentiated or positioned for optimal uptake (adoption by farmers);

[38] Grassini et al. 2013. Nature Communications 4: 2918.

- limited guidance by local extension or government policies (excess inventories or royalty streams of older varieties) may discourage availability and hence adoption of improved newer varieties; and
- limited pedigreed/certified seed capacities in some regions encourage informal seed systems which further limits distinguishability of newer from older varieties (concepts of genetic value by farmers is diminished).

As donors recognize delays in seed multiplication and availability, some have included support of pre-release multiplication of lines (pre-basic seed), as in bilaterally funded DRRW and heat tolerance projects in Asia.

5.2.2 Sustainable Intensification strategy

Two Strategic Initiatives were included in the 2011 CRP proposal; one (# 2) oriented towards Sustainable Wheat-based Systems aimed at protecting the environment while improving livelihood, to a large extent through facilitation of CA principles (minimum tillage, crop rotations and minimal use of pesticides, fertilizers and water) and the second (SI 3) oriented towards nutrient and water use efficiency. These orientations were, in the 2015-2016 Extension Proposal, consolidated into FP4 (driven primarily by CIMMYT activities). ICARDA wheat crop production R&D was embedded in the Dryland Systems CRP (beyond the scope of this evaluation), although the activities have some linkages with FP4 activities in WHEAT and both CRPs have linkages with other CRPs.

The outputs achieved in WHEAT FP4 (SI2/SI3) reflect a broad array of interventions in Central and South America via MasAgro and the Indo-Gangetic Plains of South Asia via CSISA. Starting in 2009, CSISA has been working on an integrated array of development and dissemination activities to improve cropping systems, resource-conserving management practices involving wheat and rice, livestock feeding and feed value chains, aquaculture systems. Technical interventions in wheat in cooperation with CSISA (Phase II, 2012-2015), include farming system changes to permit early wheat sowing, which subsequently permits sowing long-duration and higher yielding wheat varieties (accommodated by earlier and more rapid mechanical harvest of rice), refinement of triple-cropping and intercropping, adoption of bed-planting, minimal tillage or no-till technologies, adoption of mechanical threshing, conversion to more efficient axial flow pumps for surface-water irrigation, and adoption of integrated weed management.

In Mexico outputs include adjustments to nitrogen nutrient applications associated with irrigated durum wheat production to maintain quality (reduce “yellow berry”) while preventing serious off-farm environmental impacts. FP4 has been effective in translating better understanding of nutrient uptake and utilization in wheat into more effective regional irrigated wheat production practices. FP4 has also gained better understanding of benefits and risks associated with individual components of CA. FP4 activities in Mexico and southern Asia have also supported identification of most appropriate varieties for particular farming systems and in some regions, assist seed scale-out functions of FP5. WHEAT focus continues on these two fronts that are both necessary for program and system level outcomes. The work on sustainable intensification needs to contribute to resource efficient production of wheat *per se* (which also requires that socio-economic aspects are addressed)

and the enhancement of wheat-based farming systems. In the latter, cooperation with several other CRPs is needed, including Systems CRPs, GRiSP, MAIZE, CCAFS, WLE and PIM, for greater cross-CRP conceptualization and understanding of factors that are needed for impact from system-based R4D. FP4 will need to continue to help refine production practices regionally with NARS and help develop, evaluate and provide farmer groups with decision support tools for dealing with options not only on water and nutrient management but also on the economic aspects of wheat production and marketing.

FP4 activities in both regions involve significant extension activities and include field demonstration hubs in wheat farming area. Because FP4 R4D functions are common with other CRPs (cropping system and other commodities) they should be evaluated in the context that spans production and crop systems rather than stand-alone performance of the FP. The achievements so far and the on-going focus and efforts indicate that this strategy is essential in order for WHEAT to achieve its IDOs. Lateral learning beyond FP4 and CRP WHEAT (as discussed in Chapter 4) will determine the effectiveness of the Sustainable Intensification strategy and sustainability of the outcomes which are very important for wheat contribution to food security outcomes.

5.3 Conclusions and recommendations

Knowledge of and access to germplasm are two of WHEAT's comparative advantages. WHEAT breeding methods used are traditional but massive in scale and have advanced yield potential about 0.9% per year over the past 30 years, although some observers suggest yield progress has declined over the past decade, perhaps due to diversion of resources and efforts to shore-up disease resistance and heat resilience during this period. Genetically, durum and bread wheat ancestor genomes provide potentially many more segregating loci in addition to more complex inter-genomic interactions at homozygosity than other major cereals. Crosses with genetically distant wheat parents may require very larger populations and greater inbreeding following recombination for rare high performance recombinant inbred lines to become apparent. WHEAT has not adapted microspore- or megaspore-derived haploid, *in vitro* transgenic or sequence-editing approaches perhaps due in part to poor wheat cellular-level *in vitro* responses. Excellent progress in FP2 has identified gene sources and markers for trait improvement although introgression of these genes (for heat tolerance, health nutrition, disease resistance etc.) into multiple high performance varieties for targets may challenging given the diversity of traits and numbers of potential genes involved.

Production technologies are also contributing productivity gains through improved nitrogen and water management and sustainability through low/no till and bed planting approaches, advances in irrigations pump technology and mechanization, and in Asia, through adjustments in rice production that allow earlier planting of wheat. Sustainability issues remain however in some irrigated regions due to salt accumulation as in Bangladesh, or metal accumulation in ground water in well-irrigation as in some areas of India. In spite of the constraints, wheat productivity (yield/ha) in most mandate regions has been increasing enough to meet rising demand although only marginally. Consumption has driven reserves quite low resulting in price spike, and Africa is still quite dependent on significant annual wheat imports to meet demand.

Both WHEAT intervention strategies ultimately depend on decisions made by wheat farmers in mandate regions. Sustainable Intensification interventions require understanding of the interactions of varieties (biological component) with the environmental components and cost benefits among other management options for wheat in the context of the broader farming systems. Learning within and beyond SI research is very important as most options from WHEAT SI each reflect only a small component of farmers' options and associated farmer management decisions. The farmer's decisions regarding WHEAT intervention options depend on his or her knowledge of and confidence (experience or trust) in each option available when making wheat production management decisions. Adoptions studies indicate that turn-over of varieties and adoption of other improved production intervention is slow resulting in a gap between potential and realized production potential (yield). A large part of work that supports farmers' decision-making is tied to MasAgro in Central America and CSISA Hubs (for cropping systems innovations) in southern Asia. These activities support local extension by soil and crop agronomists, economics, production demonstration trials and farmer participation, to improve farmers' awareness and confidence in newer productions options. Availability of better decision guides (regional and on-farm economic costs and benefits guides) associated with crop and farm management options could help support farmer decisions, including adoption of WHEAT outputs that are pre-requisites of IDOs and SLOs. However, while the principles of farmer decision are common for most crops, actual guides need to reflect local economic and technical resources, as well as farming systems, environmental and cultural realities.

Recommendation 6: WHEAT should establish an inter-FP special traits team to accelerate delivery of multiple genes for multiple traits into multiple high performance lines. Given the complexity of these processes, special skills and prioritization are required for enhancing time and cost efficiency. Such a team is needed for accelerating progress towards targets on high priority FP2 trait improvement and for magnifying the potential for impact.

Recommendation 7: To improve wheat genetic yield progress in future, WHEAT should, over the next two years, review the current approaches in FP3, and those used by partners in order to (i) efficiently and systematically explore advanced wheat germplasm sources that can contribute to productivity; (ii) optimize the balance of population number and population size based on the divergence among advanced (elite) parents to improve utilization of both additive, and additive X additive interactions among wheat's genomes; and (iii) more efficiently advance populations to homozygosity for subsequently application of selection, while permitting greater learning about yield relevant germplasm and the gene actions and interactions that make them elite.

Recommendation 8: In order to help narrow the gap between potential and realized wheat productivity WHEAT in FP4 should re-establish its priorities (regions and focus) in the context of the evolving CGIAR research agenda and other CRPs contributing to it. SI should continue to refine how farmers can best manage nutrient, genetic, water, mechanization, and crop protection resources, deal with climatic constraints, and better cropping systems to enhance both farm returns and regional food security. WHEAT should understand the drivers of farm decisions (economic, environmental and cultural), and through its linkages with partners and other CRPs, more effectively

guide and support those decisions. Both technical refinements and effective decision support are necessary to narrow the yield gap across WHEAT target regions.

6. IMPACT AND LIKELY SUSTAINABILITY

6.1. Introduction

In this Chapter the Evaluation Team examines whether or not research activities in wheat in the past have led to outcomes and impact. While impact would not be expected from WHEAT, launched just over three years ago, this summative evaluation looks at wheat research activities at CIMMYT and ICARDA that began prior to the establishment of WHEAT and were transferred into WHEAT. It is reasonable to expect that outputs from earlier research activities have resulted in measurable outcomes and impacts.

The two broad components are covered here are:

Evidence of adoption and impact: This component of the evaluation is restricted by the availability of evidence for outcomes and impact. It draws on a narrative provided by the CRP on WHEAT[39] and an analysis of 16 randomly selected adoption studies and impact assessments published between 2012 and 2015. Fourteen of the studies selected came from a list of studies provided by WHEAT and the remaining two studies were obtained from a literature search.

The credibility of the evidence of outcomes and impact was considered by assessing the quality of the studies, primarily in terms of the transparency and robustness of the methods used for data collection and analysis and the timing of the study. The team also relied, to a lesser extent, on impact information in the WHEAT 2012 and 2013 Annual Reports[40], and complemented its document analysis by observations and interviews during and field visits for additional indication of adoption and impact

Facilitating future impact assessments: In addition to assessing past impact, the WHEAT evaluation team also assessed the processes in place for facilitating impact assessment in the future.

6.2. Evidence of adoption and impact

[39] The IEA requested WHEAT to provide a narrative describing the extent and nature of the ex post impact of CRP-related research outputs documented since the last EPMR. Specifically, the IEA requested that "*the narrative should be concise and reference the specific studies or other sources of evidence underpinning the claims made about adoption of, or the outcomes/impacts resulting from the use, adoption or influence of technologies/policies linked to CRP research.*"

[40] CGIAR Research Program WHEAT, Annual Reports 2012 and 2013; WHEAT. 2014. Wheat: Vital Grain of Civilization and Food Security.

The IEA requested CRPs to provide a narrative describing the extent and nature of the impact of CRP-related research outputs documented since the last EPMR (for CIMMYT in 2004). The narrative provided by WHEAT included a list of documents comprising a mix of adoption/process studies, *ex ante* (7) and *ex post* impact assessments and reviews (19).

While the publications in total represent a significant effort to discuss and present findings about adoption and impact from *ex ante*, *ex post* and a methodological point of view, only a limited number were *ex post* studies that provided evidence to support the narrative. Three observations regarding publications on *ex post* adoption and impact for communicating evidence on impact are warranted:

- publication criteria are not always the same as impact assessment criteria so the underlying assumption that those studies published in high-quality, peer reviewed journals are more useful and robust than those that haven't may not always be valid;
- the target audience, the majority of whom are not adoption/impact specialists, may search the CRP on the WHEAT website for evidence of adoption and impact, but not undertake a laborious journal article search;
- the number of readers could be limited if the studies are solely published in highly-regarded journals where access is restricted.

In addition to the publication record, the WHEAT narrative also provided an overview of peer-reviewed adoption studies and impact assessments. However, the summary of the individual assessments provided limited information on: (a) the scale of adoption; (b) links to relevant publications, databases, or other sources of evidence; (c) a statement about the quality of the evidence provided, including key assumptions and important qualifiers or; (d) extrapolation from specific evidence where the findings are considered generalizable over larger domains than covered in the evidence. In addition, information on the adoption pathway, the projected or realized sustainability of adoption and the timing of the analysis (i.e., the number of years after the completion of the project when the evaluation was undertaken) was also scarce.

A relative dearth of *ex post* impact assessments providing returns to investment of particular investments in WHEAT research activities was noted by the Evaluation Team for the recent years. Personal communication with WHEAT leadership revealed that such studies were not a priority given the limited resources available and, thus, only a limited number of projects completed within WHEAT Phase I timeline were formally assessed for impact and this was primarily farm- or household-level assessments. It appears that a number of WHEAT impact assessments (including 7 *ex ante* and 19 *ex post*) are planned for 2015/2016. Information on what impact assessments will be completed was not available.

It is worth noting that while the WHEAT impact narrative state that 'Nearly all studies used cross-sectional, observational data, thus requiring special econometric approaches to enable assessment of causal effects, which is particularly important in the case of impact assessment', they also recognize that 'the studies vary considerably in terms of the quality of the data and empirical methods used'.

Given the limitations of the narrative in terms of synthesizing information on evidence of adoption and impact, the WHEAT Evaluation Team examined 16 randomly selected adoption studies, impact assessments and reviews of previous evaluations published between 2012 and 2015. CIMMYT was responsible for all the studies included in the sample. This sample comprised seven *ex post* impact assessments, five adoption studies, four reviews and one classified as 'other'. The selected studies covered a broad geographic area including Ethiopia, Turkey, India, Pakistan, Bangladesh, Nepal, Afghanistan and Mexico, and in the case of two of the reviews, the geographic focus was global. The technologies evaluated were varietal improvement (six), improved management technologies (eight) and wheat R&D (two). Overall, while the quality of the studies (in terms of transparency and the robustness of the data collection and analysis) varied considerably, the theoretical robustness of the majority of the studies was considered satisfactory to very good.

In terms of the question of whether or not WHEAT research activities have led to outcomes and impact, the evidence presented in the sample of adoption studies and impact assessments is mixed. Focusing first on germplasm improvement, the adoption studies indicate that while a large number of new wheat varieties have been released and adoption of modern wheat varieties has been significant, the rate of varietal turnover has been estimated to be far slower that the optimal level of five years. For example, varietal turnover was reported to be 13-14 years in India to 19 years in Ethiopia, indicating that the majority of 'adopting' farmers are not growing recently improved wheat varieties. A growing body of evidence from *ex post* (farm-level) impact assessments shows that adoption of new varieties will result in increased productivity, food security, market participation and income. Thus slow adoption and varietal turn-over is a major constraint to outcomes. As one of the reviews concludes, 'substantive investment is still required to realize sustainable productivity growth through better technologies and policy and institutional innovations that facilitate farmer adoption and adaptation'.

With regard to new agronomic practices, the adoption studies and *ex post* impact assessment covered in the sample analysis primarily focused on resource conserving technologies such as zero-till and CA. The evidence of adoption from these studies is varied. For example, while one review states that farm surveys show rapid and widespread adoption of zero tillage wheat in South Asia, an adoption study concludes that care is needed when making sweeping generalizations and extrapolations across northern South Asia or the Indo-Gangetic Plains because there is significant regional variation across northern South Asia. Further, extrapolation across countries is even more risky. As concluded in one of the reviews, uptake of CA has been limited in Mexico and South Africa for numerous social, cultural and economic reasons. As such, the review provided a lessons learnt element which is missing from the sampled *ex post* (farm-level) impact assessments that primarily provided evidence of significant increases in on-farm net revenue due to efficiency gains.

Information on the scale of impact and the attribution of that impact to CGIAR research on wheat was provided in only one of the *ex post* impact assessments, as the remainder focused on measuring farm- or household-level impacts. Without information on the adoption pathway, and the cost of the research activities, it is not possible to obtain even an approximation of potential and realized returns to investment in past wheat research activities, such as developing rust resistant wheat varieties, or resource conserving technologies, which could be used to guide future investment

decisions. However, in the WHEAT 2012 and 2013 Annual Reports there are statements about impact on scale, such as:

- 'In 2012, around 1.6 million farmers made use of the results of 145 projects under WHEAT. Millions more have benefited from input-saving agronomy and precision agriculture tools and other research results generated through past CGIAR funding for wheat research. Indeed, CGIAR-derived improved varieties are grown on over 50 percent of the entire area sown to wheat in the developing world, where two thirds of global production comes from' (WHEAT 2012 Annual Report).
- 'Adoption of GreenSeeker®, an inexpensive handheld sensor of reflected light that measures biomass, has brought Mexican farmers savings in 2013 estimated at US$ 1.7 million' (WHEAT 2013 Annual Report).

The team had difficulty finding credible sources of supporting peer-reviewed evidence for these statements. The team believes that for credibility, it is important that major claims of impact be supported by qualified evidence through peer reviewed *ex post* or through qualified independent 3rd party assessments. In addition, statements such as 'made use of' are vague and the statement 'Millions more have benefited …' refers to historic estimates of adoption, rather that adoption or impact that has resulted from recent research. In other cases information on the source of the data supporting the impact claim has been presented, although without links to the source; for example:

> 'The findings of a 2012 FAO-Investment Centre mission to Kazakhstan suggest that adoption of zero tillage and conservation agriculture had raised domestic wheat production by almost 2 million tons. According to the mission report, this represents an increase in income of US$0.58 billion over 2010-12, providing enough grain to satisfy the annual cereal requirements of almost 5 million people, and sequestering about 1.8 million additional tons of carbon dioxide per year.' (WHEAT 2012 Annual Report)

In documents such as the Annual Report, link(s) to the evidence should be provided so as to make the statements credible, and enable an interested reader to obtain further information.

Regarding the impact from wheat breeding, the Evaluation Team acknowledges that attribution of success (in terms of adoption and impact) is not simple. The Evaluation Team acknowledges that achievement of adoption and impact from wheat research requires a joint effort by WHEAT, many NARS and local institutions in priority regions, and farmers are the ultimate user groups on whose choices subsequent outcomes depend. Regarding the breeding, WHEAT lines are provided as public goods for selection by collaborators, either for use as parents or evaluation for release. Use of varieties from this joint effort varies from regions to region and also by type of wheat.

6.3. Facilitating future impact assessments

Information on what WHEAT is doing to facilitate future impact assessments is limited to the studies planned for 2015 and 2016 and generally how impact assessments will be undertaken. The WHEAT Evaluation Team was unable to find an explicit impact assessment strategy, or the processes in place

for facilitating impact assessment in the future, such as collecting baseline data and budgeting for adoption and impact assessments.

The 2015-16 Work Plan for WHEAT (WHEAT 2015-2016 Extension Proposal Annex 5) indicates that impact assessments in four countries are planned for 2015, while two are planned for 2016. While the countries are not specified in 2015, Turkey and Pakistan are the proposed countries for 2016. There is no information on the research activity that will be assessed or the budgets. The plans indicate that the 'impact assessment will be done by measuring the progress of indicators targeted by the program and how they differ from those without interventions. It will use both qualitative (outcome mapping, narrative stories with key informants) and quantitative methods (econometric, bio-economic modeling and general equilibrium modeling) to evaluate the economic, social and environmental impacts of interventions on the target groups'. WHEAT expects that these evaluations will allow the extraction of useful insights for future interventions.[41] Moreover, according to the WHEAT gender strategy[42] a gender and social equity perspective will be integrated in ex ante and ex post impact assessments wherever possible. In the team's view these approaches are likely to provide lessons and feed-back to the Program.

While the WHEAT Evaluation Team understands that resources (staff and budget) for impact assessment are limited, a clear impact assessment strategy is urgently needed for expanding the body of evidence of impact from WHEAT research, and for drawing valuable lessons. The strategy should address the what, why, when, by whom, how and how much questions in as much detail as possible. Furthermore, care needs to be taken when considering increasing the number of studies that are based on randomized control trails (RCTs) as they are costly, not always robust and can cause some ethical issues. A portfolio approach to impact assessment with a mix of RCTs and lower-cost, but still very transparent, assessments would enable a greater number to be undertaken, and could have a greater aggregate influence on resource allocation, as well as deepening the learning from assessments. Moreover, incorporating detailed project/program Impact Pathway or Theory of Change in each adoption study and impact assessment could increase robustness and transparency, and point to the data that needs to be collected and analyzed.

Finally, a clear understanding of how the studies are going to be used and by whom and the needs and requirements of these users is a prerequisite to ensuring that the results of an adoption study or impact assessment are useful and used. This understanding should guide the key evaluation questions to be addressed, the data and methods of analysis needed to answer those questions and the format of and publication venue for the report.

[41] http://wheat.org/our-strategy/
[42] http://wheat.org/gender-in-wheat/

6.4. Conclusions and recommendation

The Evaluation Team concluded that impact from past research has always followed a joint effort. Although difficult to measure directly, these efforts have contributed to maintaining and increasing production and productivity of wheat as an important source of food energy and protein in much of the priority region. When breeding is coupled in refining production practices for the improved varieties WHEAT (with other CRPs) it has the potential to continuously contribute to the development outcomes.

Considerable effort has been made to undertake adoption studies and (farm-level) impact assessments over the past years, including recently, despite limited resources. Overall, the quality of these adoption studies and impact assessments is considered to range from satisfactory to very good in terms of transparency and methodological rigor.

One of the main limitations revolves around the timing of the analysis. The studies are at times undertaken either during the project life cycle or too soon after the completion of the project to determine sustainability or likely scale of adoption. Another main limitation relates to the level of impact being assessed, and the lack of specificity regarding the research activity being assessed. These limitations make it difficult to judge the scope of technology diffusion and scale of impact, and hence return on investment in any particular research activity or program. The value for learning and feed-back to the Program may be better. Where information on the scale of impact is provided (such as in Annual Reports), evidence of claims should be provided systematically.

WHEAT should strengthen the processes in place for facilitating impact assessment in the future, such as collecting baseline data and budgeting for adoption and impact assessments.

The Evaluation Team concludes that there are several opportunities to improve both the documentation of adoption and impact and the 'impact culture' for facilitating future impact assessment:

- developing an impact assessment strategy could increase the likelihood that the adoption studies and impact assessments undertaken are in line with the needs and priorities of the evaluation audience, are useful and are used;
- incorporating detailed project/program Impact Pathway or Theory of Change in each adoption study and impact assessment, including key assumptions and rival explanations, will increase transparency and rigor;
- providing evidence (links to relevant publications, databases, or other sources) would make claims about large-scale diffusion and impact more credible;
- greater specificity about the research activity or program being assessed would help address attribution issues;
- lessons-learned should be captured in all assessments for feeding back to program design and implementation.

Recommendation 9: WHEAT should develop a clear impact assessment strategy for learning and accountability. The strategy should be based on the needs and priorities of the key audiences for

these assessments to assure that the studies and evaluations are both useful and utilized. The impact assessment strategy should ensure that all claims made about diffusion of WHEAT knowledge and outputs, adoption and impact are supported by credible evidence, and that this evidence and lessons are used in refining strategies and priorities, and for addressing impact pathway constraints through partnerships and capacity development when necessary for outcomes.

7. CROSS-CUTTING ISSUES

In this Chapter the Evaluation Team comments on three areas of WHEAT strategic activities - gender, partnerships and capacity development - that cut across the FPs and impact particularly on the likelihood of WHEAT delivering results towards its objectives and the CGIAR goals.

7.1 Gender

Gender is a relatively new area of research within WHEAT. The CGIAR reform has raised awareness on gender issues and all CRPs have been expected to take measures to mainstream gender. The Evaluation Team assessed the measures implemented in WHEAT in gender awareness and mainstreaming, including consideration given to gender in program design and targeting, and data collection.

Gender activities, which are funded through W1/2, had almost no expenditure in 2012 but almost USD 2.5 million was spent on gender activities in 2013 when a UNDP aligned DAX indicator was introduced to assess gender related expenditures. The WHEAT management expenditures (USD 1.5 million in 2012, compared to budget of 0.672 million; 0.728 million in 2013) included the salaries of the WHEAT management unit, G&M meeting costs, travel costs, contributions to Lead Center support services including communications and ICT systems.

During the past three years, WHEAT initiated a number of steps for raising awareness about gender perspectives in wheat research and to integrate gender and social equity in wheat research process. Some of these important steps are as follows:

- development of a draft “Strategy for Integrating Gender in Wheat' in early 2012 which was subsequently revised, improved (based on the scoping study, gender audit and comments from several sources) and presented as the “CRP WHEAT Gender Strategy” in November 2014;
- commissioned a scoping study on the “Integration of Gender and Social Equity in R4D on Wheat-Based Systems in South Asia” in 2012;
- commissioned a “Wheat Gender Audit” to figure out staff perceptions, organisational culture and capacities to address gender during 2012-2013;
- established a Gender Unit coordinated by a strategic leader of gender research and mainstreaming who reports to the Director of CIMMYT’s Socio-economics Program. She provides technical support to project leaders and other researchers on gender analysis and gender integration and manages the budget for activities related to gender;
- identified 20 staff with gender analysis competencies and initiated efforts to strengthen the gender research portfolio by hiring more researchers;
- developed a note to guide researchers on integration of gender in project proposal development;

- integrated gender into the Monitoring &Evaluation section of the WHEAT Research Management Framework;
- initiated a new project focusing on gender and wheat in Afghanistan, Pakistan and Ethiopia;
- co-developed a cross CRP research project (under joint strategic gender research initiative) on interaction between gender norms and innovation and how this shapes agricultural development and natural resource management outcomes in CRP target regions, and initiated case study work in selected wheat based systems.

The objective of the WHEAT gender strategy is to "strengthen the capacity to address issues of gender and social differentiation in wheat R4D and ensure that interventions do not exacerbate existing gender disparities, but instead contribute to improved gender equality and transformation of unequal gender norms and rights wherever possible". The scope of the strategy includes:

(a) integration of gender analysis and gender research in wheat R4D; and

(b) integration of gender in key wheat R4D management frameworks and procedures.

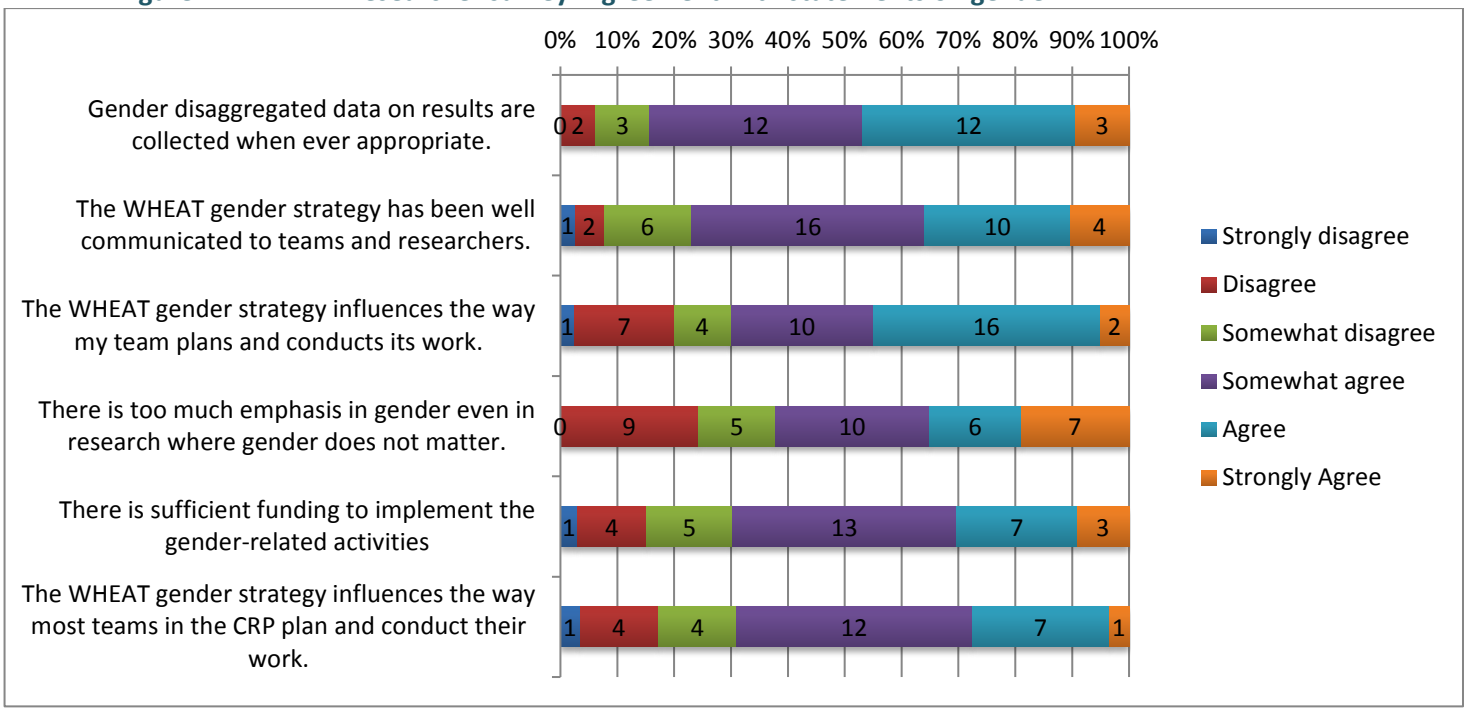
The strategy also elaborates on the critical research questions under each of the WHEAT FPs.

Increasingly, gender disaggregated data (e.g., data on technologies/varieties preferences by women or men farmers, participation of women farmers in trials, demonstrations, trainings etc.) is being collected in several projects. However, the evaluation team saw evidence of this only in very limited number of sample projects that were reviewed.

The evaluation team did not see much evidence of gender being adequately considered in research design or impact pathways described in most of the projects although the number of projects that integrate gender research or mainstreaming has increased from two in 2012 to 5 in 2014 (CSIS, MasAgro/TTF, BMZ, FACASI and Adoption Pathways).

Limited attention to gender is reflected in the responses to the WHEAT researcher survey. Firstly the question on gender was responded to by fewer researchers than other questions, which suggests that some of the respondents either didn't consider the question important or didn't have any perceptions on the gender aspects covered. About 30-40% of those, who responded, agreed or strongly agreed with the statement related to the important aspects to gender shown in Figure 7-1. Secondly, the statement on there being too much emphasis on gender divided the respondents more than the other statement and while 35% of respondents agreed or strongly agreed with this statement, 25% disagreed.

Figure 7-1: WHEAT researcher survey: Agreement with statements on gender[43]



Source: WHEAT researcher survey.

In projects such as CSISA in South Asia, gender is addressed through increased participation of women farmers in field trials, demonstration, training and field days. This is happening for instance, in Pakistan. CSISA India is currently partnering with existing network of rural women who are involved in agriculture. For instance, in Bihar (India), CSISA works closely with the Mahila Samakhya Society (a network of rural women formed by the Government of Bihar). The women farmers who are trained in new technologies and management practices under this initiative are called Kisan Sakhis (women farmer friend). Working with existing rural women networks like these can potentially enhance achievement of the results towards the women's empowerment IDO, but also the overall effectiveness of WHEAT.

CSISA has recruited a gender specialist in Bihar to lead and co-ordinate this activity. CSISA has also started helping women farmers to become entrepreneurs (there are examples of this on rice) However there is very little documentation on how these approaches are evolving and what lessons could be drawn from these with respect to WHEAT. However, recently CSISA in Bangladesh has published highlights in success stories of women who benefitted through the project initiatives.

Although there is an increasing emphasis on collecting data for monitoring progress on gender, impact assessment have lacked a gender perspective. However, WHEAT intends to include gender as an important aspect in future adoption and *ex post* impact assessments. It also intends to systematically integrate a gender and social equity perspective in all *ex ante* impact studies.

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[43] **Q 25. Please indicate your agreement with the following statements that relate to mainstreaming of gender issues in your work and WHEAT.**

Interactions with WHEAT researchers and partners during the field visits clearly revealed that the WHEAT gender strategy hasn't yet fully percolated within WHEAT staff, or among the WHEAT partners. There is a wide variation among teams and researchers on understanding how gender should be addressed within the program (as discussed above, the wheat researcher survey also reflects this uncertainty).

Gender research in WHEAT has yet to gain momentum. Although the data collection for the cross CRP study on "Innovation and Development through transformation of gender norms" has been initiated in selected wheat growing regions, there are no resources for translation of the findings into user friendly knowledge products and engagement with stakeholders to foster uptake of the outputs.

Under the 2015-2016 Extension Proposal, WHEAT has proposed several activities to mainstream gender, including: development and implementation of a protocol for gender and social inclusion in participatory research, screening procedure for gender mainstreaming in project development, larger efforts for gender disaggregated data collection and diagnosis of gender related constraints.

The Evaluation Team concludes that a greater effort is needed to implement the gender strategy in the different regions and among WHEAT partners. This should involve making the gender/end beneficiary perspectives explicit in research objectives and targeting.

WHEAT would have to identify organizations to partner with that can support its research on gender and social inclusion. In programs that explicitly focus on adaptation, diffusion and impact, suitable partners would include NGOs and producer organisations that focus on women and socially excluded groups, so that the interventions have a higher likelihood to lead to sustainable impacts. WHEAT would benefit from more gender expertise in the major regions to support existing projects with regard to gender analysis, identification of specific constraints related to gender, identifying new and relevant opportunities for achieving impact. Though WHEAT has initiated a number of steps to address issues related to gender in wheat research, it should have to do more, especially in undertaking gender analysis across the research portfolio, undertaking gender-specific research and documenting how gender is addressed in the impact pathways.

Recommendation 10: WHEAT should strengthen the development and implementation of the gender strategy by acquiring the necessary expertise either internally or by engaging specialists outside of WHEAT. This should include explicitly addressing gender in the Program, FP and project impact pathways towards WHEAT gender equitable outcomes, sensitizing staff and partners to the need for gender disaggregated data where possible, and promoting equitable access to capacity development initiatives.

7.2 Partnerships

WHEAT is collaborating with more than 200 partners that, according to program information[44] include 86 NARS, 56 Universities, 13 regional and international organisations, 15 ARIs and 15 private sector organizations, 12 NGO/CBOs and governments in 20 countries hosting CGIAR operations. Between 20-30% of the total WHEAT budget goes to non-CGIAR research and development partners. WHEAT also collaborates with other CRPs (including CCAFS, A4NH and Dryland systems) on 45 Innovation Platforms. It partners with other CGIAR Centers in projects such as CSISA in South Asia (IRRI, ILRI, IFPRI & WorldFish) and AIP in Pakistan (ILRI, IRRI, AVRDC, UC-Davis). It is currently partnering with the ICAR in the establishment and management of the Borlaug Institute for South Asia (BISA) in India; with PARC in managing the AIP in Pakistan and with the Government of Mexico in implementing "MasAgro". WHEAT uses W1/2 funding for CPG and commissioned projects that are aimed at filling existing research gaps by engaging external researchers with competence on specific areas. As mentioned previously in Chapters 3-4, several of the major bilaterally funded WHEAT objectives (e.g. rust resistance, heat and drought tolerance, and N-utilization efficiency including resolution of environmental issues) integrate expertise from many ARIs in North America, Europe, Australia and Japan with WHEAT and NARs. Based on sample projects assessments, most of these appear to be well integrated and outcome oriented with one or in some cases both WHEAT strategies. Among these, roles of WHEAT vary widely from leadership, coordinator, or facilitator to component project participant. . Increased collaboration and funding from the private sector is still somewhat under-represented in WHEAT, and as such could be further developed.

During field visits, partners from NARS expressed high appreciation of the role of CIMMYT and ICARDA in provision of characterized gene bank accessions (phenotypic and genomic), elite germplasm and advanced lines, to incorporate into their breeding programs, adapt to their conditions and to release to farmers. NARS partners have also emphasized the importance of the role WHEAT plays in managing rust. The results from the WHEAT commissioned Partnership Survey in 2012 also supported these findings. The results reveal that partners believe that the most progress towards achieving the goals of WHEAT will come via continued farm-level yield improvements and mitigation and management of major diseases and pests, which are currently grouped under FP 2 and FP3 (Global partnership to accelerate genetic gain in farmers' fields).

A large number of projects in the portfolio are implemented in region-wide partnership with national and local partners in different countries. The African Development Bank-funded SARD-SC/Wheat (with partners from 11 African countries); the IWWIP; the CSISA (with partners in 3 countries); Farm Mechanization and Conservation Agriculture for Sustainable Intensification (FACASI) in eastern and southern Africa are some of the important examples of this type of partnership projects primarily managed with bilateral funding.

For implementation of specific project interventions on the ground, projects such as CSISA have set up partnership with local NGOs (at the different hub locations), extension and training units of the Government (e.g. Bihar Agricultural Management and Extension Training Institute in India; Department of Agricultural Extension, Bangladesh), local service providers (who can support farmers

[44] http://wheat.org/partner-institutions/

with zero till and other land and water management interventions) and women's development program (eg: Mahila Samaykhya in Bihar) of local government. These types of partnerships at the downstream and at the technology adaptation and promotion stage have the potential to enhance WHEAT effectiveness towards impact on a reasonably large scale. These arrangements also help in developing capacities on the ground that can help sustain the project interventions even after the closure of specific projects.

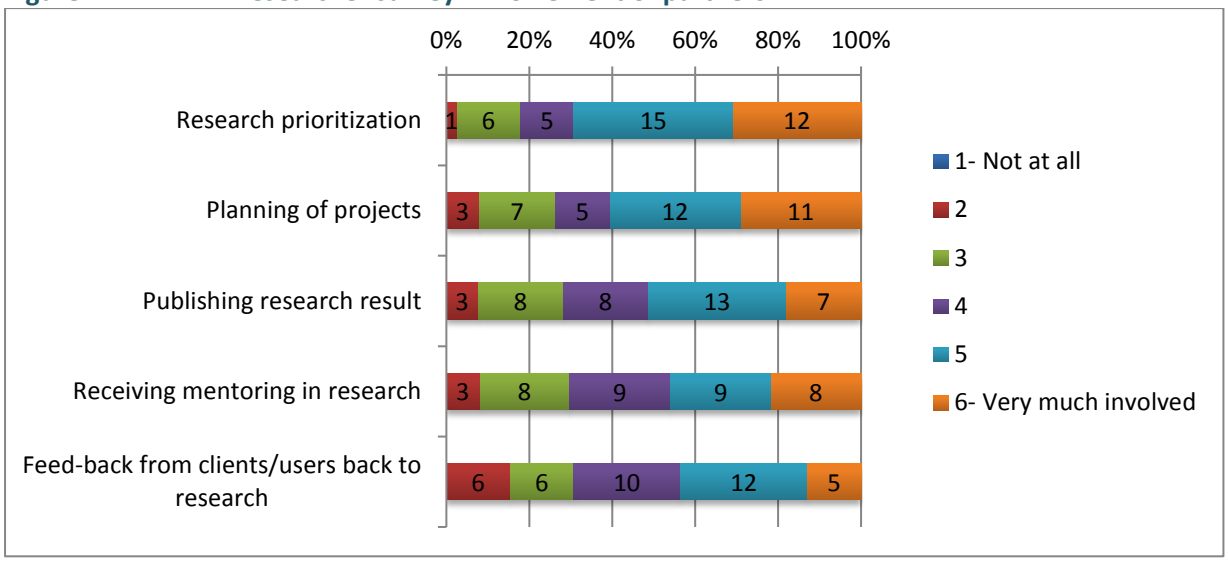
CSISA is also partnering with private seed entrepreneurs in its project sites (India and Bangladesh) to multiply and sell seeds of new and improved varieties, which enhances the adoption of new wheat varieties. In Ethiopia, the wheat researchers are working with farmer cooperatives to enhance farmers' access to new wheat varieties.

Importance of partnership is clearly acknowledged by researchers. According to them the partners that are both important and most involved in WHEAT are the national research institutions, universities in developed countries and other CGIAR centers. Both importance and involvement of agricultural extension agents and NGOs are rated low, below the importance and involvement of farmer organizations (which are partners mostly in Mexico).

According to the survey, researchers perceive that partners are particularly involved in research prioritization and planning. However, the responses highlighted that feed back from partners back to research could be improved (Figure 7-2).

Extension and advisory services (comprising many players in the public, private, NGO and producer organization sector) do play an important role in promoting new knowledge among farmers and it would be useful for WHEAT to look for increasing partnership with these agencies. The evaluation team considers that more emphasis should be put into "enhancing the capacities of the enablers" rather than putting all efforts in directly engaging with limited number of farmers in the project sites.

Figure 7-2: WHEAT researcher survey: Involvement of partners[45]



Source: WHEAT researcher survey

The Evaluation Team's assessment of selected research publications showed that NARS partners are authors and co-authors in many papers published with CIMMYT/ICARDA scientists on wheat research. Analysis of sample projects revealed an element of dichotomy: strategic upstream research is in most cases led by wheat researchers based at CIMMYT/ICARDA and downstream (adaptation/ evaluation/screening/ promotion) research is led by national partners (mainly NARS and NGOs). Some partners in the stronger NARS are not entirely happy with their role in the adaptive and downstream research. For instance, In India, the NARS partners are looking to WHEAT for initiating collaborative research with the best scientists (inside and outside CGIAR) in emerging areas where their capacities to do research are also enhanced. Some partners involved in R&D expressed some concerns that they are sometimes treated like workers more than scientists that ought to be engaged in strategy and priority setting. The interviews revealed reluctance to apply for CRGs where these partners could end up being isolated with focus on specific issues.

In Bangladesh, the NARS partners are looking at WHEAT for capacity building of researchers especially in new research tools in breeding, physiology and other fields through trainings at CIMMYT. The findings from the WHEAT commissioned Partnership Survey also revealed that capacity development (including training, education, and sharing of information and resource) is a significant priority for all partners in all regions. The feedback from partners clearly shows the varying demands for partnerships and the need for a nuanced partnership strategy by WHEAT based on a need and opportunity assessment, including the extent to which capacity can be addressed through partnerships, and optimizing resources for strategic partnerships.

The ISPC, while reviewing the WHEAT Extension proposal, noted that "WHEAT is built on long standing partnerships, particularly with many ARIs and NARS; about 230 collaborators in 70

[45] Question 22- In your view, to what extent are the partners in WHEAT involved in Program activities as listed below?

countries, as CRP co-designers, and with 22% of the budget allocated for partners' activities aligned to the CRP agenda. However, most of the partnerships described seem to be in the North (e.g. G20 countries), more than in the developing world". There is a need to learn from choice of partners, the value added by the partners in different stages/steps in the wheat innovation process, experiences with the different types of partnerships as these lessons are crucial for improving the ability of WHEAT through these partnerships to achieve greater impact.

Recommendation 11: WHEAT should develop a partnership strategy that should address the following purposes and partners: program strategy development and priorities; impact pathway development and adjustments following constraint analysis (e.g. from program planning, lessons from impact analyses) including closing the knowledge diffusion gaps between scientists and those farmers, whose adoption decisions determine wheat outcomes.

7.3 Capacity development

A lot of capacity development happens through experimentation and learning within joint research projects undertaken as part of WHEAT. Opportunities for such informal capacity development have already been alluded to in the previous section about partnerships. Specific capacity development interventions are undertaken as part of many of the research projects managed by WHEAT. These include:

- CIMMYT and ICARDA scientists acting as guides/supervisors to Masters and PhD students working on institute projects as part of their research work;
- financing participation of wheat researchers from developed countries in scientific exchanges (workshops/conferences etc.);
- scholarships for in-country MSc and PhD students (e.g. CIMMYT support to Bangladesh Agricultural Research Council);
- organising international short term and long term trainings at CIMMYT Mexico and also regional centers and increasingly in the regions (e.g. Conservation Agriculture in India, quality seed production for wheat researchers in Uzbekistan);
- training farmers and extension workers (e.g. Training on wheat production techniques in Ethiopia; Training on use of conservation agricultural machinery in South Asia; AIP, Pakistan);
- training to local service providers (e.g. CSISA, South Asia);
- support for graduate and short term training in partnership with US Universities (e.g.,: UC Davis leading this initiative under AIP Pakistan);
- support for renovation of facilities and equipment upgrade (e.g. renovation of national rust facility in Pakistan).

WHEAT reports annually to the CO on trainings against targets set. These reports provide the information disaggregated by gender. Table 7-1 presents the reported data for 2012 and 2013 and shows some targets set for 2014.

Table 7-1: Number of trainees on programs facilitated by WHEAT

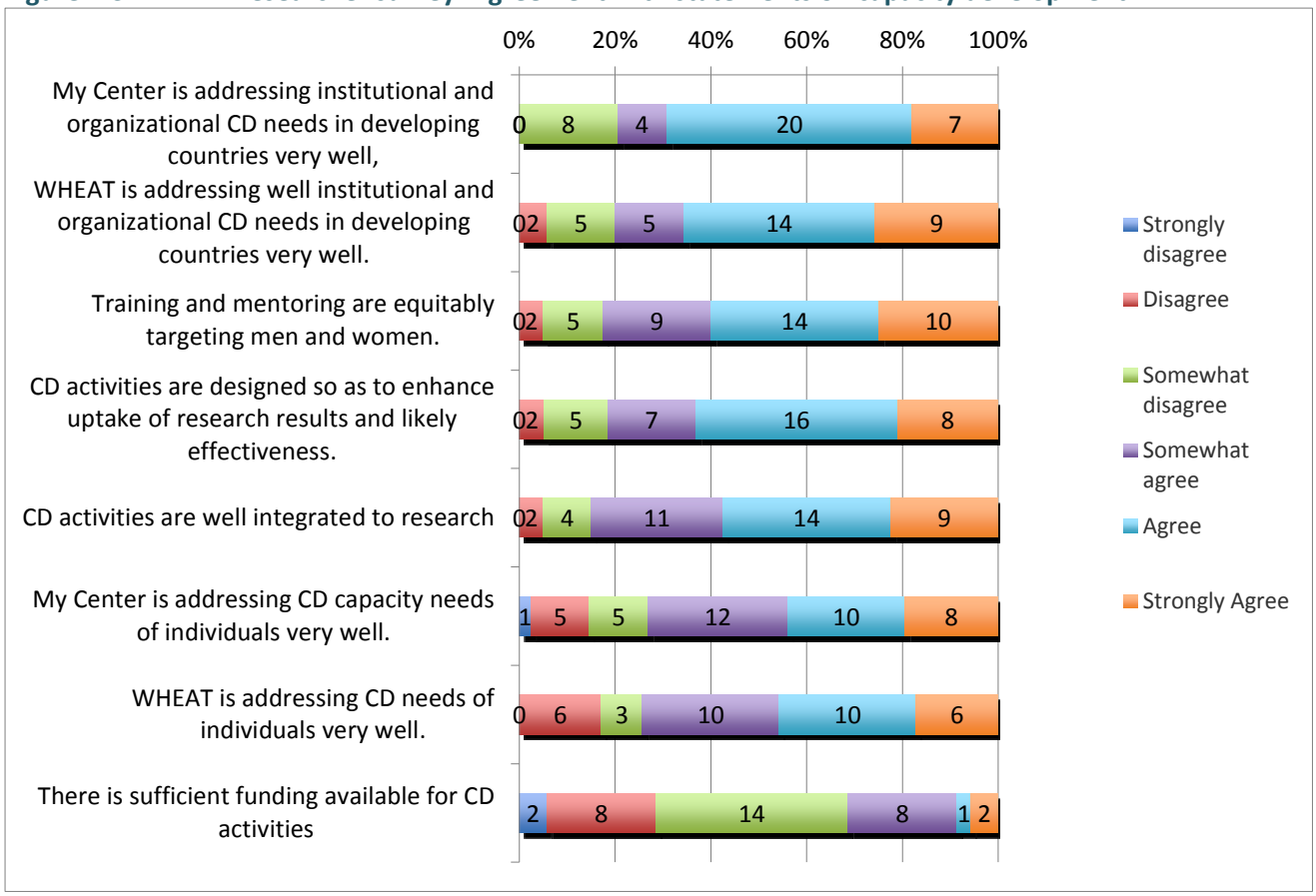
		2012	2013	Target 2014
Number of trainees in short-term programs	Male	18,220 (14,144 shared with other CRPs)	14,232 (171 with other CRPs)	17,000
	Female	4,886	3,068 (73 with other CRPs)	n/a
Number of trainees in long-term programs	Male	30	121 (7 with other CRPs)	n/a
	Female	19	65 (4 with other CRPs)	n/a

Source: WHEAT Annual Progress Reports 2012 and 2013

The Evaluation Team was not in the position to analyse the data on training in any depth. The numbers themselves do not tell much about the targeting of training, nature of the training or the effectiveness. However, the fact that training is very much in demand by partners (as the team learned during field visits and through interviews), indirectly speaks for the success of WHEAT's training efforts. Women (by chance or design) appeared to be the majority of students in post graduate training programs within WHEAT and associated NARs in CWANA, based on interviews and site visited by the Evaluation Team. Monitoring and setting appropriate targets for both men and women may enhance training opportunities for women.

In the researcher survey about 60% of the respondents agreed or strongly agreed that the purpose, equity and integration of capacity development were well addressed in WHEAT (or the respondents home Center). However, only 40% of the respondents agreed or strongly agreed that individual capacity development needs were well addressed (either in WHEAT or in the Center). About 70% of the respondents implied that funding of capacity development was not adequate. (see Figure 7-3 for the responses).

Figure 7-3: WHEAT researcher survey: Agreement with statements on capacity development[46]



Source: WHEAT researcher survey.

On basis of the interviews and field visits, the Evaluation Team concludes that, overall, there is an increasing demand for long duration (minimum 30 days) training for wheat researchers to develop/enhance capacities in emerging areas (e.g., molecular breeding and marker assisted selection, conservation agriculture, advances in crop physiology etc.). Apart from these types of formal training, there is also demand by regional and national partners for more collaborative research projects with CIMMYT and other ARIs to enhance partner research capacities.

At the technology adaptation/promotion end, in several projects a number of training activities, demonstrations and field days are organized for farmers. While this remains important, there is a need to include the wide range of rural intermediaries, such as extension and advisory services, NGOs and producer organizations so as to help magnify and scale-out the capacity development efforts for greater effectiveness and sustainability.[47]

[46] Q 26. Please indicate your agreement with the following statements that relates to capacity development (CD) in your work and WHEAT.

[47] Some capacity issues related to activities that go beyond WHEAT projects, for instance in seed multiplication that is a local activity, became evident in the field visits; one example is given here. Impact from new rust resistant varieties is highly dependent on increasing Ethiopia' s domestic seed multiplication and distribution system capacity (apparently the current Ethiopian current annual certified seed production capacity is about

Many of the capacity development activities are funded through bilateral projects and therefore the activities are directed at building capacities to address the specific problems identified in these projects. This is affecting the development of second generation wheat researchers with adequate scientific skills and managerial expertise to assume leadership responsibilities in the wheat sector.

WHEAT has recognized some of these limitations as indicated in WHEAT Extension Proposal (2015 2016). The importance of post-doctoral training and addressing the needs of the next generation of wheat researchers is being acknowledged and as such, no specific recommendation is proposed for capacity development.

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20 % of annual wheat seed planted). Evaluation Team members visited three Community Based Seed Multiplication cooperatives and one local seed enterprise, all involved in multiplication of new WHEAT/national program varieties. While the local seed enterprise has a staff agronomist, the cooperatives had limited access to support. Seed production fields of all three cooperatives (in total more than 30 ha) appeared to be harboring an identical very visible off-type, all at a similar frequency 2-3 %, which was in need of roguing. However, the cooperative growers seemed to be unaware of the problem. This may have been a singular occurrence but it suggests that some training in seed production would be helpful.

8. ORGANIZATIONAL PERFORMANCE

8.1 Introduction

In this Chapter, the Evaluation Team assesses G&M arrangements of WHEAT, their evolution over the course of the evaluation, and the extent to which they influence the efficiency and effectiveness of G&M. The Evaluation Team's findings are based on presentations given to the team during the inception meeting in May 2014, desk review of available documentation (including WHEAT proposal 2011 and Annual Reports), the minutes and background documents for the WHEAT Stakeholder Committee (W-SC; recently transformed to WHEAT Independent Stakeholder Committee, W-ISC), WHEAT- Management Committee (W-MC), and CIMMYT Board (BoT) meetings since WHEAT inception, direct observation of the W-SC and BoT meetings in September 2014 in Beijing, informal conversations with meeting participants in Beijing, written responses received, interviews with senior management and scientists, leader of M&E and selected stakeholders, and interactions by various team members during field visits to project sites in several countries. The Team also reviewed agreements related to WHEAT: Program Implementation Agreement (PIA) between the Consortium Board (CB) and CIMMYT (as the Lead Center for the WHEAT CRP), the Program Participant Agreement (PPA) between CIMMYT and ICARDA. Reference is made to the 2014 IEA Review of CGIAR Research Programs Governance and Management (RPGM)[48], and selected documents related to the Fund Council (FC), Consortium Board (CB), and the CGIAR reform program, including the December 2014 CRP Governance Agreement/ recommendation of the FC's Evaluation and Impact Assessment Committee (EIAC), which has been endorsed by the FC and CB in January 2015.

8.2 WHEAT Governance and management

WHEAT is governed by a set of formal agreements. The WHEAT G&M arrangements were established in the PIA in 2012 after WHEAT was approved by the Fund Council in 2011. The Board of CIMMYT as the Lead Center has the fiduciary and legal responsibility and accountability for implementing performance contracts with the CGIAR[49]. CIMMYT BoT is accountable to the Consortium for the use of the W1/2 funds that are transferred to CIMMYT, and for the satisfactory performance of WHEAT. The PPA was signed by CIMMYT and ICARDA outlining the individual Center use of W1/2 funds.

Since the evaluation commenced in May 2014, there have been changes to the G&M arrangements of WHEAT. Initially, the CIMMYT BoT was advised by the W-SC, which made recommendations on various CRP-related matters to the BoT. Program implementation was guided by the W-MC, consisting of CIMMYT global program directors, one research program director from ICARDA and

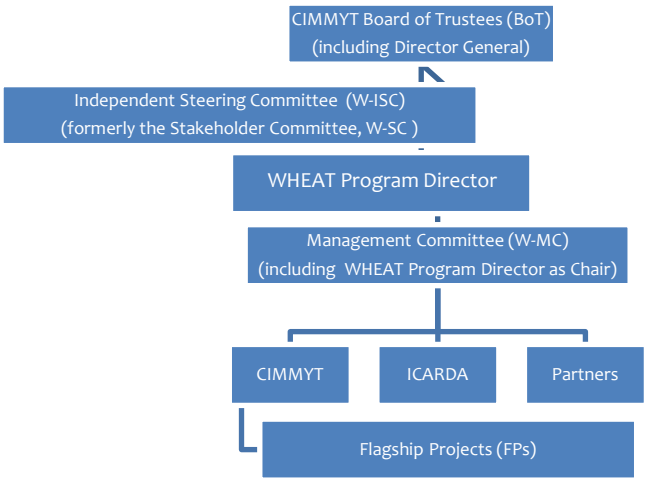
[48] Review of CGIAR Research Programs Governance and Management, 2014.

[49] WHEAT proposal, 2011

three non-CGIAR Primary Research Partners: BBSRC-UK, ACIAR-Australia, ICAR-India. Administratively WHEAT has been managed by a small management team headed by a Program Manager. As such, the W-MC, chaired by the DDG of Research & Partnerships at CIMMYT, was the Leader of WHEAT. Though it may not have been 'in line' with the subsequent RPGM recommendations, the WHEAT-MC had and has the collective responsibility of running the CRP, which the WHEAT-ISC recently noted and which has been inserted into WHEAT-MC ToRs: "WHEAT-ISC considered it essential that CRP management decisions, which have ramifications across centers and their departments and for non-CGIAR partners, be consensus-based. Involving centers' Program Directors is the best way to ensure that all those responsible for the delivery of large project portfolios are behind decisions and implement them." In September 2014 the W-SC made several recommendations to the CIMMYT BoT, which were endorsed and accepted by the BoT. The process for considering these changes was at least partially triggered by the RPGM, which concluded that a) leadership and reporting of the WHEAT Stakeholder Committee and Management Committee were consolidated within CIMMYT management, thus leaving the CIMMYT BoT without an independent source of oversight for the program; and b) reporting relationships in the CRP made the leadership of the CRP part of middle management in the center and was problematic and did not provide sufficient leadership in WHEAT for managing for results. The changes include nominating a CRP WHEAT Director, changes in the name and status of the W-SC, to become the WHEAT Independent Steering Committee (W-ISC), and steps to move towards one global WHEAT Program between CIMMYT and ICARDA. The W-ISC would advise the CIMMYT BoT on the selection of the WHEAT CRP Director (who in the first instance would be the Director of the CIMMYT Global Wheat Program).

The W-ISC was established in January 2015, as part of the continuing evolution of the WHEAT governance structure and operational principles. The W-ISC is chaired by an independent non-CGIAR member, and it advises both the Program Committee of the CIMMYT BoT and the W-MC. ICARDA's Chair of the Program Committee is being invited to attend CIMMYT's Board meetings on matters related to wheat. In the revised W-ISC TORs, as per the January 2015 WHEAT Handbook, the W-ISC has an advisory role in WHEAT Program-level strategy, annual work plan, budget and progress report, CRP Director/W-MC performance, and conflicts of interest. The TORs state that the W-ISC provides guidance on the CRP's strategic direction and effective and efficient management at program level. The TORs of the W-ISC provide for inclusiveness and diversity of membership, as well as appointment of an independent Chair unaffiliated to a CGIAR institution. The new WHEAT G&M structure is shown in Figure 8-1.

Figure 8-1: Governance Structure of WHEAT – February 2015



Source: Constructed by the evaluation team on basis of decisions made by CIMMYT BoT in September 2014, and subsequent information by WHEAT.

Revised TORs of the CRP Director give the position greater authority and resources for delivery of results, and strengthen the Director's reporting relationship to the Board and Management of CIMMYT, as well as to the Program Committee of the ICARDA Board. The proposed strengthened collaboration between the Boards of CIMMYT and ICARDA are also in line with the general recommendations of the FC and CO, appropriately adapted to the particular circumstances and requirements of WHEAT governance at this time.

The CIMMYT BoT has been proactively involved in WHEAT governance, and has taken its oversight and fiduciary responsibilities seriously. In response to the RPGM, and based on its own experience of WHEAT governance, it has taken the lead in further strengthening CRP governance in collaboration with the ICARDA Board and the W-ISC[50] . The proposed changes specifically seek to strengthen strategic and programmatic collaboration and joint action between CIMMYT and ICARDA, and accountability and 'management for results' at all levels. The Boards of both CIMMYT and ICARDA are committed to a closer partnership on a global, better-integrated WHEAT CRP, including for its planning, implementation, monitoring, and oversight. Key aspects of the CIMMYT and ICARDA Boards' approach include the two Centers' commitment to achieving greater and better coordination around WHEAT, sharing their strategic thinking, and on that basis making decisions about what to coordinate or collaborate on and how, including separate responsibilities under a joint/global program. The global WHEAT CRP would 'manage for results' by monitoring progress on agreed deliverables, and would act if deliverables are not likely to be met, including by shifting budgets and people resources, with W-MC endorsement. The follow-up expected in 2015 includes the development of rules of cooperation between the two Centers, development of benchmarks/milestones for the next five years for both BoTs to monitor progress of the CRP-related

[50] The BoT's letter of April 2014 to the Consortium Board (CB), and subsequent follow-up action by the BoT with ICARDA.

collaboration, and detailed planning for the preparation and implementation of the CRP 2nd cycle activities.

The Evaluation Team considers that the changes in WHEAT G&M from September, 2014 to February, 2015, including the updated role and responsibilities of the WHEAT-ISC and TORs of the global WHEAT Director; the apparent commitments of both CIMMYT and ICARDA BoTs on program strategy, coordination and managing for results in WHEAT, have been necessary, relevant and appropriate for this CRP, and they take into account the partners' current interests, expectations, capacity, and plans for further improvement for the benefit of the CRP.

The evaluation team also assessed the manner by which the bodies involved in WHEAT G&M operate. The W-ISC, W-MC, and CIMMYT BoT and Program Committee hold open meetings regularly, with participation by stakeholders, trustees, managers, and staff. All eight W-ISC members are non-CGIAR, and two are women; and three of the nine elected (i.e., non-ex-officio) CIMMYT BoT members are women. The information provided for the meetings is adequate and easily accessible. Background documentation is comprehensive and thorough, briefing notes and power-point presentations are relevant and useful, and various documents and minutes of meetings are posted on the CIMMYT and WHEAT websites. On the basis of its direct observation, the Team found that the discussions, led by the respective Committee chairs, were open and in-depth, with good participation. CIMMYT trustees and senior management, WHEAT leaders and committee members, and Center and WHEAT staff seek consensus and are responsive to diverse views. The meetings provide useful updates, including on program issues and WHEAT G&M. Based on this direct observation, feedback received from various stakeholders, and a review of the minutes of BoT, W-IAC and W-MC meetings since WHEAT inception, the Evaluation Team considers the effectiveness of relationships, collaboration and communication among the various WHEAT G&M bodies to be good.

Communications between the CO and WHEAT G&M bodies were considered by CIMMYT to be less effective, in part due to lack of transparency of W1/W2 funding allocations, changing requirements for monitoring and reporting, and process overload relating to the preparation and approval of plans for CRP Extension (2015-2016) and regarding information concerning the 2nd cycle of CRP implementation and funding. The Evaluation Team judges that the less than optimal collaboration has also been due to gaps in understanding the somewhat erratic implementation processes of the reform, rather than principles, and perhaps process-oriented "overload" relating to the preparation and approval of work plans and reports. Since some of these systemic issues between the CO, CRPs and Centers would be addressed during follow-up of the CGIAR MTR's governance-related recommendations, the Evaluation Team expects that the communication and collaboration between the CO, CIMMYT, and WHEAT would also improve in the coming months. Hence it does not suggest any specific additional measures at this stage, except to encourage continuing efforts of the CO and CIMMYT and WHEAT Management to resolve pending concerns in a mutually satisfactory manner.

The leadership changes anticipated in CIMMYT (a new DG, DDG-CS, and HR Director by spring 2015) and the continuing discussions following the CGIAR Mid-Term Review (MTR), the revised SRF, and CRP Phase II selection process will need to be carefully considered when plans for CRP governance

are further fine-tuned and implemented. The Lead Center BoT and W-ISC will also need to respond appropriately to the FC and CB's recommendation for the CRP governance structure after 2017.

8.3 Institutional Management Support

WHEAT implementation is managed by the W-MC. As announced in January, 2015, composition of the management committee has been adjusted and now includes the WHEAT Director, director of wheat research in ICARDA, and representatives of three external partners: ICIAR (AU), BBSRC (UK) and ICAR (India). The W-MC is Chaired by the CRP WHEAT Director and co-chaired by ICARDA. The W-MC is assisted by a Program Management Unit and its Manager, under supervision of the WHEAT Director. The Program Management Unit is responsible for communication, M&E, contractual arrangements, CRP administration and budget management.

Most general management processes that affect WHEAT rest with the Lead, Partner, and Collaborators' institutions, and are therefore somewhat beyond the scope of this evaluation. Some elements of management between the participating Centers have been imbedded in the PPA. CIMMYT is lead center from the perceptive of 'fiduciary compliance' with legal provisions of the PIA with CIMMYT BoT, but is also responsible for directly implementing a large part of the WHEAT research program. Therefore, the Evaluation Team assessed several of CIMMYT's institutional support functions that affect efficiency of WHEAT, including HR, Risk Management, Financial Management, IP Management, mostly through interviews, presentation and available documents. The findings are summarized as follows.

Human resources management: CIMMYT (and ICARDA) manage staff performance through a systematic process, but the systems used in the two Centers differ, and some improvements in implementing current HR systems are needed (and are planned at CIMMYT). The BoT regularly oversees the HR management services provided by CIMMYT, and follow-up actions by the HR department are monitored through regular progress reports. The new HR Director is expected to take suitable follow-up action on pending issues and concerns, and report regularly to the BoT meetings.

Financial management, monitors budgeting, and reporting: An external audit of CIMMYT and CRP finances is undertaken annually by a reputed firm of external auditors; and an internal audit of CRP financial recording and reporting processes by the CIMMYT Internal Audit Unit is expected in 2014-2015. An audit of CRP financial management is expected in 2015 by the CO's central Internal Audit Unit.

The CRP budgeting and reporting have been inefficient due to shortfalls in the RMS, which is not yet fully compatible with the needs of the CRP. Though bilateral funding for WHEAT projects has significantly increased, mainly due to resource mobilization efforts of Center and CRP managers and staff, there is considerable unpredictability in W1/2 funding for WHEAT through the CGIAR Fund. Also, changing CO guidance on resource allocation and reporting, and communication gaps between the CO and the Lead Center have adversely affected WHEAT research activities. Efforts are ongoing

for resolving these difficulties, but additional efforts to overcome systemic issues related to the CGIAR-wide governance and financial reforms are also necessary.

Risk management - Identification and management of risks related to CRP implementation and sustainability: In 2014, the Lead Center and CRP management systematically identified risks related to CRP implementation and sustainability. Efforts are underway to mitigate these risks. The CIMMYT BoT regularly discusses and follows up on CRP-related risks and provides guidance to the CRP gG&M bodies. These in 2014 included risks associated with regulatory compliance and IP risks associated with GMOs and specific recommendations to BoT to mitigate such risks.

IP management: IP associated with non-CGIAR intellectual property used for research purposes is covered by CIMMYT policies. Potential IP associated with research by WHEAT is managed by CIMMYT as 'public goods'.

The Evaluation Team recognized that these Lead Center institution support functions are specific to CIMMYT and probably reflect 'norms' for most CGIAR centers. Given the commitments of CIMMYT and ICARDA in their summit meeting regarding Managing for Results and anticipated follow-up discussions in 2015 (as discussed above under Governance), there may be an opportunity to align policies and management oversight in the two Centers which would be necessary to improve the efficiency and effectiveness of research towards outcomes.

8.4 Conclusions

The current (February 2015) governance structure and processes of WHEAT are suitable for effectively implementing WHEAT and facilitating increased programmatic collaboration between CIMMYT, ICARDA and other CRP partners of the global WHEAT Program. The changes made in January 2015, after intensive consultations between CIMMYT and ICARDA, are suitable for WHEAT at the present time. They are also directionally appropriate, for they are in general alignment with the relevant 'good governance' criteria and principles outlined in the RPGM.

The WHEAT operational principles and TORs of the W-ISC, W-MC, and the WHEAT Director (as per the 9 January 2015 update from W-ISC Chair and the CIMMYT and ICARDA DGs) are consistent with the two 'key principles' guiding the recommendation for the governance structure mandated by the FC and CB for all CRPs after 2017 – i.e., to "promote greater authority/capacity of the CRP Leader to drive for results; and to ensure that the CRP governance is free of conflict of interest (legitimacy and independence)." Hence, the Evaluation Team commends the BoTs and management of CIMMYT and ICARDA, and those involved in the WHEAT G&M for their proactive involvement, and forward-looking approach that seeks to continually improve WHEAT G&M while remaining responsive to ongoing changes in the CGIAR context.

9. VALUE ADDED OF WHEAT

9.1 Introduction

This Chapter focuses on the Evaluation Team's synthesis of its findings regarding the overarching program-level questions identified set by the Team (see Chapter 1). The synthesis is based on the Evaluation Teams' in-depth and reflective assessments of some of the key components of WHEAT; observations made during field visits; progress and contributions in support of CGIAR reform principles; and synthesis of program level conclusions regarding the evaluation criteria and program.

9.2 Addressing the overarching question

Does CRP WHEAT operate *as an integrated program (programmatic-level thinking, strategy and management)?*

In WHEAT, Program-level ToC and strategies are apparent although most project development processes at least partly respond to donor expression(s) of funding opportunity. Formulation of project proposals, including work plans, definition of milestones, key performance indicators and project budget respond to both donor requirements and to the CGIAR requirement to show explicit linkages towards IDOs. The approval involves donors, program directors and W-MC. In these processes, concepts of program design and management are not prominent.

However, there is evidence that a number of appropriate program-level decisions have been implemented. These include generally appropriate kinds of collaborators, some of whom receive funding through WHEAT, using competitive and contracted research to engage partners to fill gaps; continuation of international shuttle breeding and evaluation trials to improve efficiency for outputs in terms of shorter cycles; development of some evaluation platforms serving multiple FPs, and interaction with other CRPs to avoid duplications of efforts and improve over-all cost efficiencies.

Following the analysis of documents related to governance and program management and having gained more understanding of program management through interviews and field observations, the Evaluation Team concludes that while WHEAT is not a fully integrated program, it is functional as a CRP. Particularly the recently revised arrangements concerning CRP oversight, leadership and W-MC are likely to help WHEAT employ program-level outcome-oriented thinking from both institutions at both governance and management levels. These arrangements put in place an appropriate management structure to enhance relevance, effectiveness and efficiency of WHEAT. The Evaluation Team also observed mutual commitment, something that structures alone cannot enforce. There is evidence of good cooperation on strategic issues between both BoTs as pointed out above and appropriate W-ISC guidance on strategy, regional priorities and work plans. WHEAT staff and leaders for the most part support strategic research and seem disposed to more cooperation and collaboration among WHEAT partner institutions, and WHEAT appears to be moving toward thinking and executing its research as an outcome-oriented CRP, which the Evaluation Team strongly endorses.

Has the implementation of WHEAT elevated the program's comparative advantage and improved its prospects to achieve its objectives and contribute more efficiently towards the program's intended IDOs and the CGIAR System-level Outcomes?

The most important achievement from the establishment of WHEAT, not yet fully operationalized, is that the mandates of CIMMYT and ICARDA on wheat are brought together in a single program with high potential for enhanced comparative advantage and synergy, given the two institutions' complementary strengths and statures in the geographic regions where they have operated. That, with the commitments of the respective partner BoTs to manage for results (impact), the cooperation of WHEAT research staff since formation of the CRP to develop and share available facilities and responsibilities toward achieving efficiencies, and the refinements of W-MC and W-ISC in January 2015 have in the view of the Evaluation Team dramatically improved the prospects the program to achieve its objectives and contribute more efficiently and effectively towards IDOs and SRF SLOs going forward.

Have CGIAR reforms assisted WHEAT deliver its objectives, achieve program IDOs and contribute to System-level Outcomes?

The program is clearly driven by the two IDO-oriented strategies, which are responding to the new outcome and accountability-oriented strategy of the CGIAR. However, the majority of projects are defined by individual Donor funding interests (W3 and bilateral arrangements fund 75 % of project activities). In this regard, the CGIAR reform has not met its promise. However, most funds from bilateral arrangement at present are in high priority IDO-oriented projects. Program leadership and staff (of both Centers) prefer working with strategic R4D. The recent governance and management changes, also partly triggered by the CGIAR reform will help. Nonetheless, it will take some time for W-MC with W-ISC to fully refine Program-level strategies and better define and prioritize objectives, and associated projects, and mobilize necessary resources both financial and collaborative. Attention is also necessary to refine M&E processes to help drive and enhance efficiency, accountability and certainty in outcome-oriented R4D objectives. So far M&E in WHEAT has been oriented toward management support of individual donor projects and the necessary host institute support functions, and it has been heavily focused on dual reporting (to donors and to the CGIAR) – another set-back in the reform. Partner institutions have very different systems for M&E. Program-level M&E as a process for managing for results and IDO's is still work in progress but one that must be implemented if the full potential of the CGIAR reforms is to be fully realized in WHEAT.

Have W1/W2 funding mechanisms sufficiently helped WHEAT achieve its Impact-oriented objectives?

W1/2 funding reflects a small part (25 %) of WHEAT funding. As stated above, the bilateral funding arrangements have over the period covered by the Evaluation been quite strategic but also region-specific (presumably reflecting donor interests). Therefore the Evaluation Team considers that W1/2 funding has appropriately filled resource the gaps both regional and in priority research topics in part through collaborating partners, and thus has served to enhance or preserve coherence of WHEAT.

On its own account, WHEAT has experienced disappointingly low levels of Window 1 & 2 funding, high *transactional costs, and heavy management burden associated with the CRP program reforms (and associated reporting dialogues) in comparison to other bilaterally-funded initiatives: If true, how can these aberrations be managed or resolved?*

WHEAT W1/2 funding has accounted for a relatively small proportion of the total funding, partly because the success of the Centers in securing bilateral funds. The fact that W1 and W2 funds have been linked has reduced the incentives to mobilize this type of core funding. There have also been problems associated to the CGIAR system-level governance that were analysed in the Mid-Term Review and are being addressed. Greater transparency on funding allocation is expected as the new CGIAR Strategy and Results Framework is approved and the 2nd cycle of CRP implementation and funding commences. The Evaluation Team therefore expects that there will be progress in resolving the issues that have tested the CRP and CO relations in particular during the initial phase of the CRP.

9.3 Value added by WHEAT

Below the Evaluation Team presents its synthesis on the extent to which WHEAT is furthering the six reform principles of the CGIAR as articulated in the Performance Implementation Agreement, which are:

(1) pursuit of a clear vision with focused priorities that respond to global development challenges;

(2) Center collaboration;

(3) streamlined and effective system-level governance with clear accountability;

(4) strong and innovative partnerships with National Agricultural Research Systems (NARS), the private sector and civil society that enable impact;

(5) strengthened and coordinated funding mechanisms that are linked to the systems agenda and priorities;

(6) stabilization and growth of resources.

Overall, WHEAT is making considerable efforts to comply with, and contribute to the advancement of the six reform principles. As adherence to most of these principles is addressed in other sections of the report, the comments here are limited to a few brief points.

- Global development challenges clearly drive WHEAT's R4D strategies while funding opportunities drive FPs scientific project activities. These are not necessarily at odds, but high dependency on bilateral funding, and particularly on a few major donors for that funding, adds some level of risk to the long-term sustainability of this type of research which has very long impact pathways and where the delivery pipeline is dependent on investment on innovation at the upstream.
- Collaboration between WHEAT partners (CIMMYT and ICARDA) at the research level continues to strengthen. Management and Governance relationships have also improved, particularly over the past 12-months, as reflected in commitments of both partners' BoTs to assist in WHEAT strategy refinements and management for results; clarification of make-up,

roles and authority of WHEAT ISC; and in the WHEAT MC, which is still defining its role but appears to be fostering greater collaboration, cooperation and trust.

- WHEAT is affected by the System-level governance and related transparency in communications and reporting for accountability needs further work in order to eliminate confusion and misunderstanding particularly between the Consortium and the Lead Center over a number issues.
- Over time partnerships for innovation with NARS, private sector and civil society have increased but further improvements are required for resolving constraints along the impact pathways and for extending opportunities for WHEAT program-wide arrangements to accelerate output diffusion and associated outcomes.
- The funding mechanisms that are linked to the CGIAR System's agenda and priorities require greater transparency.
- Resources (staff, facilities and funding) have grown considerably since WHEAT was launched, largely as a result of increased bilateral funding which has been outcome-oriented, but also region-specific. This has been challenging for WHEAT in terms of its ability to maintain or enhance program coherence.

Going forward, the sustainability of WHEAT being able to continuously provide solutions that the intermediate and ultimate beneficiaries need will require strong leadership, strong management and staff focused towards outcome-oriented program objectives and more coordinated efforts to integrate and optimize all prerequisites for effective breeding and sustainable intensification among the broader research and development partnerships brought together by WHEAT. Knowledge at national level is essential not only for local nursery and performance trials but also more importantly for helping to prioritize the opportunities (define current and anticipate future needs) and help understand local constraints and contributions to productivity gains. Finally, farmers, as the key decision-maker along the impact pathway for both of the WHEAT strategies, will in a major way determine the success of WHEAT enabling contributions to the IDOs it targets and ultimately the CGIAR's goals these supports.

Recommendation 12: Programmatic orientation and management focus on results that enable IDOs and impact should be enhanced in WHEAT. This involves reorientation of resource mobilization aligned with priorities, WHEAT oversight, strategy development and refinement, and management, including M&E, on WHEAT's purpose, and to the extent possible, aligning partners' and collaborators' contributions towards the same purpose.

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