Partner Survey for the
CGIAR Research Program WHEAT

National and International Priorities and Engagement

Matthew Audley, Victor Kommerell, Nina Jakobi,
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August 2014

CGIAR
RESEARCH PROGRAM ON Wheat

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National and International Priorities and Engagement

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CGIAR RESEARCH PROGRAM ON Wheat

WHEAT (http://wheat.org) is a CGIAR Research Program launched in 2012 and led by the International Maize and Wheat Improvement Center (CIMMYT). Coupling advanced science with field-level research and extension in lower- and middle-income countries, WHEAT works to raise wheat productivity, production and affordable availability for 2.5 billion resource-poor consumers who depend on the crop as a staple food. Partners include the Australian Centre for International Agricultural Research (ACIAR), the British Biotechnology and Biological Sciences Research Council (BBSRC), the International Center for Agricultural Research in the Dry Areas (ICARDA), the Indian Council of Agricultural Research (ICAR), and a community of more than 200 public and private organizations worldwide, among them national governments, companies, international centers, regional and local agencies and farmers. Funding for WHEAT comes from CGIAR and generous donors including national governments, foundations, development banks and other public and private agencies.

Correct citation: 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.

Abstract: This document analyzes 92 responses to a 2012 survey sent by the CGIAR Research Program WHEAT to its more than 200 partners regarding their institutional priorities, engagement and activities under WHEAT strategic initiatives, as well as priorities for research and investment and desired outcomes from the program. Partners across most regions and institution-types prioritized better wheat varieties and resistance/tolerance to diseases and pests for investment, as well as continued research to combat wheat rust disease. Respondents also showed a collective interest in WHEAT's facilitating access to training, information, decision-making tools and breeding materials. Regarding how to measure success, respondents prioritized meeting rising food demands and greater engagement with all stakeholders.

ISBN: 978-607-8263-41-7
AGROVOC Descriptors: Agricultural research; Wheats; Partnerships; Research programmes; Surveys; Strategies; Development strategy; Funding
AGRIS Category Codes: A50 Agricultural research
Additional Keywords: CGIAR
Dewey Decimal Classif.: 658.0420723 AUD

Printed in Mexico.

Contents

Introduction and Key Findings 1

Aims 1

Responses 2

Question A – What is the priority for your own institution's investment, for staff, finances and other resources for each of these Strategic Initiatives, for the next five years? 2

- Strategic Initiative Priority Rankings by ME/Geographical Region 2
- Regional SI Ranking Bi-plot 3
- Correlations Between Regional SI Priority Rankings 4
- Regional Correlations Bi-plot 4
- Institutional Engagement Current/Planned Activities in Each SI 4
- Key Findings for Question A 6

Question B – What should be the priority for investment through international agricultural research for development be, for each SI? 6

- Strategic Initiative Priority Rankings by ME/Geographical Region 6
- Regional SI Ranking Bi-plot 6
- Correlations Between Regional SI Priority Rankings 7
- Regional Correlations Bi-plot 7
- Desirable Information and Research Outputs from International Wheat Research 8
- Common Specific Researchable Issues Suggested for IAR4D Outputs 10
- SI 5: Partner Disease/Pest-specific Desired Focus 11
- Key Findings for Question B 12

Questions A and B Aggregate 13

- Institutional and IAR4D Investment Priority Rankings and Intra-regional Correlations 13
- Gap Analysis 13
- Gap Summary 15

Question C - If you had the opportunity to add one more Strategic Initiative to WHEAT (e.g. an SI 11), what would it be? 15

- SI 11 Suggestions Which Surpass Current Scope of WHEAT 16

Question D – Please indicate which measures of success of WHEAT you consider most important 17

Partner-type Institutional and IAR4D Priorities 19

- Strategic Initiative Priority Rankings by Partner-type 19

Conclusions 19

ANNEX I: List of Respondents 22

Introduction and Key Findings

This survey was sent to all partners asking them to detail their institutional priorities, engagement and activities in each Strategic Initiative,[1] priorities for international agricultural research for development (IAR4D) investment and desired outcomes (e.g., impacts) from the program. Paper questionnaires and an electronic invitation to complete the survey (see: http://wheat.org/partner-priority-survey/) were sent to all partners in September 2012. Reminders were then sent in January 2013 and at this point a pilot analysis was started. The survey closed in May 2014, after receiving 92 responses. The key findings of the survey are:

[1] Strategic Initiatives are now called Flagship Projects.

- Partners across most regions and institution-types prioritized SI 4 (better wheat varieties) and SI 5 (resistance/tolerance to diseases and pests) for institutional and IAR4D investment.
- Continued investment in research to combat wheat rust disease (under SI 5) is a major priority in all regions.
- Partners expressed a collective desire to strengthen the capacity of WHEAT to facilitate access to training, information, decision-making tools and breeding material.
- Planned institutional investment in SIs varied by region.
- IAR4D investment rankings reveal shared priorities among regional partners, with some regions forming distinct groups, based on differing prioritization of SIs.
- Regarding "WHEAT measures of success," respondents placed the greatest importance on *meeting growing food demands* (food security) and *expanding the capacity of agricultural research through greater engagement with all stakeholders*.

These findings reveal that partners believe that the most progress towards achieving the goals of WHEAT will come via continued farm-level yield improvements (SI 4) and mitigation and management of major diseases and pests (SI 5). No clear trends emerged in regional institutional priorities. However, Africa, CWA and China diverged from other regions by ranking SI 1 highly for IAR4D investment. Open-ended responses revealed that capacity development is a significant priority for all partners in all regions with respect to training, education, information and resource sharing and market development.

These results highlight opportunities to strengthen existing Initiatives and expand the scope of WHEAT as it transitions through the 2014-2016 extension phase into Flagship Projects.

Aims

The survey sought to gather feedback on partners' research agendas and priorities, as well as strengthening the roles of all players and enabling them to influence future planning activities. More specifically, the survey was conducted to:

1. Gain an overview of partners' institutional priorities as a basis for comparison, regional clustering and donor relations.
2. Identify partner priorities to assist with further research on scope, prioritization and planning and geographical focus.
3. Open WHEAT to new partners.
4. Satisfy the demand from partners for formalized memorandums of understanding.

Responses

A total of 92 partners replied to the survey, representing around 44 percent of the total number of WHEAT partners. For analysis by mega-environment (ME)[2]/ geographical region, respondents were grouped into the following categories:

Africa	Central and West Asia (CWA)	Middle East and North Africa (MENA)	China	South Asia	EU/US/ CA/AUS	Latin America
Egypt Ethiopia Kenya Mali Uganda Zimbabwe	Afghanistan Armenia Azerbaijan Georgia Iran Kazakhstan Kyrgyzstan Turkmenistan Tajikistan Uzbekistan	Jordan Lebanon Palestine Oman Turkey Yemen	China	Bhutan Bangladesh India Pakistan	Australia Canada Denmark Hungary Romania Spain UK USA	Costa Rica Uruguay
N = 8	**31**	**10**	**10**	**14**	**14**	**2**

[2] In 1988, the CIMMYT Wheat Program formalized the concept of breeding for areas with similar adaptation patterns. These regions, which are not always geographically contiguous, are called mega-environments (MEs). Germplasm developed for a particular ME must show good adaptation to the major biotic and abiotic stresses found throughout that ME.

Three respondents from South Africa (1) and Vietnam (2) were excluded from rank-based analysis due to large numbers of tied ranks. Their responses to open-ended questions were included in the qualitative analysis. A total of 75 respondents could be categorized by three primary institutional activity types:

Partner Type	Total
Agricultural research	29
Agricultural research and extension	37
Seed company	9

Question A – What is the priority for your own institution's investment in staff, finances, and other resources for each of these Strategic Initiatives, for the next five years?

Strategic Initiative Priority Rankings by ME/Geographical Region

Respondents were asked to distribute 100 points among the 10 SIs to indicate their institutional prioritization for internal investment. Scores were sorted by region and mean scores per SI calculated and assigned a rank of 1-10. *SIs 4 and 5 were most often ranked the highest.*

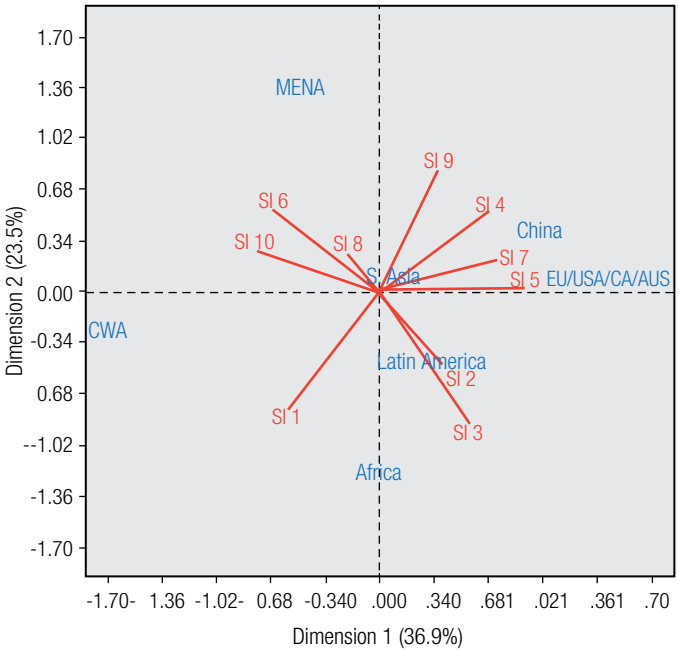
	Rank									
	SI 1	SI 2	SI 3	SI 4	SI 5	SI 6	SI 7	SI 8	SI 9	SI 10
Africa	1	5	3	2	3	6	8	9	10	7
MENA	8	7	10	1	3	2	9	5	6	4
CWA	3	7	6	4	5	2	10	8	9	1
China	10	6	4	1	2	8	3	9	6	5
South Asia	4	9	5	1	2	3	5	7	10	8
EU/US/ CA/AUS	9	5	3	2	1	4	7	10	6	8
Latin America	6	5	4	2	1	8	9	3	9	6

Regional SI Ranking Bi-plot

Principle component analysis (PCA) was used to visualize the data above in two dimensions. Both dimensions (Region and SI) are mathematically transformed into co-ordinates which position them on the bi-plot in the most appropriate configuration to best account for their inter-relationships, based on the amount of variation that each component accounts for. Each SI is given a coordinate on a stem originating from zero, the length of which represents the variability in the strength of preference (i.e. importance) for that SI in relation to the others. The angle between two SI stems is indicative of similarity between the variations that both account for. Therefore, two SIs going in the same direction, with an acute angle between them, account for a similar portion of variation (i.e. they tend to be given similar ranks), whereas two SIs with an obtuse angle (approaching 180°) account for opposing portions of the total variation (for example, SI 1 rankings range from 1 to 10, whereas SI 4 rankings range from 1 to 4 and there is less tendency for them to be given similar ranks).

Regions are then projected onto the bi-plot in positions relative to each other and SI stems which best explain their preferences. Regions placed at extremes have preferences which differ substantially from other regions (for example, Africa and CWA were the only regions to top rank SI 1 and SI 10 respectively). The placement of South Asia in the center indicates that it shares similarities with all other regions. Placement of regions on the bi-plot in relation to each SI stem and its inverse projection is also relative to their ranking preferences. For example, China and EU/US/CA/AUS are located close to the positive end of SIs 4 and 5, which they both ranked either 1st or 2nd, and on the opposite side of SI 1, which they ranked 10th and 9th, respectively.

Question A – What is the priority for your own institution's investment?



Correlations Between Regional SI Priority Rankings

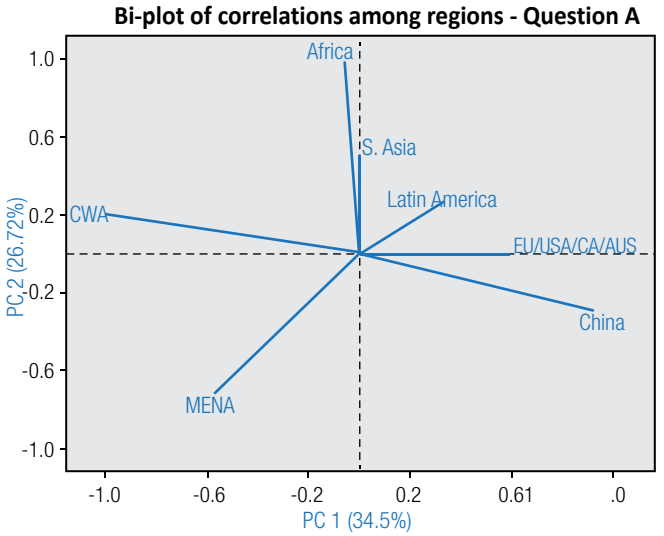
Similarities between regional priorities were determined using Kendall's Tau B correlation of ranks test. Two groups of ranks are compared and a correlation coefficient is generated.[3] A correlation coefficient of 1 indicates a perfect positive correlation, 0 means the two groups are completely independent and-1 is a perfect negative correlation (opposite preferences). African and South Asian institutional priorities are significantly correlated ($p < 0.05$), whereas Chinese and CWA partners' priorities are completely independent of one another:

	Africa	MENA	CWA	China	EU/US/CA/AUS	Latin America
MENA	0.09					
CWA	0.40	0.33				
China	0.20	0.18	0.00			
EU/US/CA/AUS	0.36	0.20	0.16	0.49		
Latin America	0.41	0.25	0.11	0.23	0.34	
South Asia	0.52	0.31	0.31	0.34	0.36	0.32

[3] Wessa, (2012), Kendall tau Rank Correlation (v1.0.11) in Free Statistics Software (v1.1.23-r7), Office for Research Development and Education, URL http://www.wessa.net/rwasp_kendall.wasp/.

Regional Correlations Bi-plot

PCA was performed on the above correlation data to visualize inter-regional relationships. The close proximity on overlapping stems of Africa and South Asia represent their correlation with each other, whereas the separation of China and CWA demonstrates their independence. This isolation of MENA and CWA from the other regions is indicative of their overall low correlations with most other regions or each other.



Institutional Engagement Current/Planned Activities in Each SI

Partners were asked to describe their current and planned activities within their institution under each SI. For each region and SI, common trends were identified and are summarized on the adjoining page.

	Desired Outcomes									
	SI 1	**SI 2**	**SI 3**	**SI 4**	**SI 5**	**SI 6**	**SI 7**	**SI 8**	**SI 9**	**SI 10**
	Technology for greatest impact	Sustainable wheat-based systems	Nutrient- and water-use efficiency	Productive wheat varieties	Durable pest and disease resistance	Enhanced heat and drought tolerance	Breaking the yield barrier	More and better seed	Seeds of discovery	Capacity building
Africa	Development and uptake of innovation	Better, regionally adapted agronomy	Development of breeding material, methods and decision tools	Development of suitable varieties	Resistant varieties and management systems	Tolerant varieties allowing expansion of production	Yield increase	More effective seed systems	Sharing and incorporation of genomic technologies	Expansion of training
CWA	Better molecular selection tools, improved quality	Better, regionally adapted agronomy	Better resource use efficiency	Development and sharing of suitable varieties	Resistant varieties and management systems	Tolerant varieties	Adoption of biotechnologies to improve yield	More effective seed systems	Germplasm collection, application of technology	Expansion of training and capacity
MENA	Better integration between stakeholders and uptake of technology	Better, regionally adapted agronomy	Better agronomy with a focus on fertilizer technology	Development and exchange of suitable breeding material	Resistant varieties and management systems	Tolerant varieties and management systems	Development and sharing of high yielding varieties	More effective seed systems	Sharing and incorporation of genomic technologies with a focus on nutrition	Expansion of training
China	More collaboration for development of new innovations	New methods and guidance for improved food security	Better resource use efficiency	Development of suitable varieties	Resistant varieties	Tolerant varieties	New germplasm and technical support for breeding	Access to material and technology for breeding	Access to data and material	Expansion of training
EU/US/ CA/AUS	Better use and uptake of existing technologies	Improve agronomic systems through modelling	New varieties and practices for better resource use efficiency	Development of suitable varieties	Improved varieties	Tolerant varieties	New germplasm and genetic resources	Improvement of local seed systems for better quality	Exploration of new germplasm	Expansion of training
South Asia	Capacity building and new varieties		Better information and systems	Breeding and incorporation of novel genomic technology	Resistant varieties and management systems	Tolerant varieties	New genetic resources	Development of national seed programs	Application of genomic technologies	Expansion of training
Latin America		New technologies for sustainability	New varieties	Development and exchange of suitable breeding material	Resistant varieties	Regionally adapted varieties	New germplasm		New germplasm	Partner Interaction

Key Findings for Question A

- SI 4 and SI 5 ranked highly among all regional groups.
- Lesser preferences were distributed more widely across the SIs.
- Only Africa prioritized SI 1, and only CWA prioritized SI 10.
- The positive correlation between South Asian and African institutional priorities is statistically significant ($p < 0.05$).
- CWA and Chinese priorities are completely independent.
- Correlations between regional rankings are generally low.
- PCA shows MENA, CWA and Africa as having separate priorities from other regions.
- Institutional engagement in SIs is broadly similar.

Question B – What should the priority be for investment through international agricultural research for development, for each SI?

Strategic Initiative Priority Rankings by ME/Geographical Region

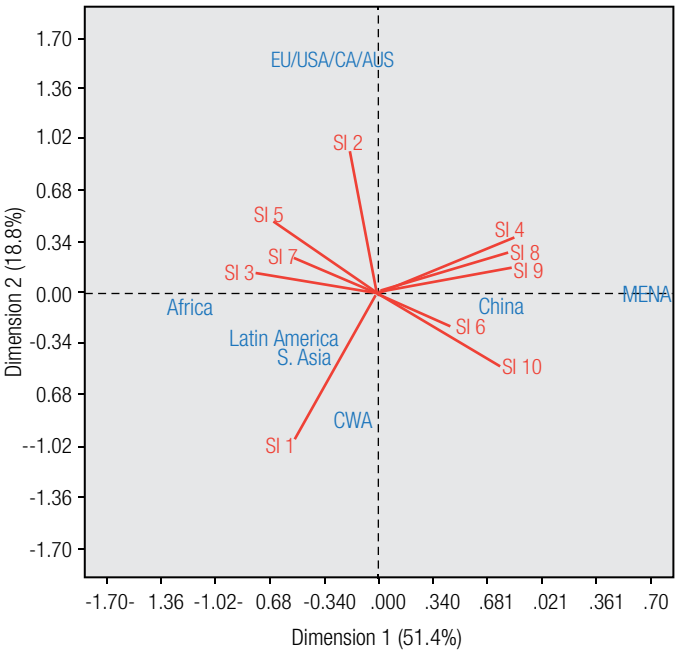
Partners were asked to distribute 100 points across the 10 SIs to indicate their priority for further investment through IAR4D. Scores were sorted by region and mean scores per SI calculated and assigned a rank of 1-10: *SI 5 was most often the top-ranked priority; SIs 1, 4 and 6 also scored highly.*

	Rank									
	SI 1	SI 2	SI 3	SI 4	SI 5	SI 6	SI 7	SI 8	SI 9	SI 10
Africa	2	7	3	4	1	8	5	9	10	6
MENA	8	7	10	1	4	2	9	5	6	3
CWA	1	7	8	3	4	2	6	9	10	5
China	7	9	10	1	2	5	4	8	6	3
South Asia	2	7	8	3	1	4	6	9	10	5
EU/US/CA/AUS	10	3	6	2	1	4	5	8	9	7
Latin America	3	8	3	3	1	2	6	9	9	6

Regional SI Ranking Bi-plot

PCA was performed on the above data. SIs 4, 8 and 9 form a distinct group from SI 1 while SIs 6 and 10 are separate from SIs 2, 3, 5 and 7. EU/US/CA/AUS and MENA are isolated from other regions. Latin America and South Asia have similar ranking preferences, as they are positioned together. Africa, CWA, Latin America and South Asia ranked SI 1 highly (first-third) and are therefore clustered in the bottom left quadrant of the bi-plot around the SI 1 stem. SI 2 received its highest ranking from EU/US/CA/AUS (3rd), whereas all other regions ranked it much lower, explaining the position of EU/US/CA/AUS in relation to the SI 3 stem.

Question B – What should the priority be for investment through international agricultural research?



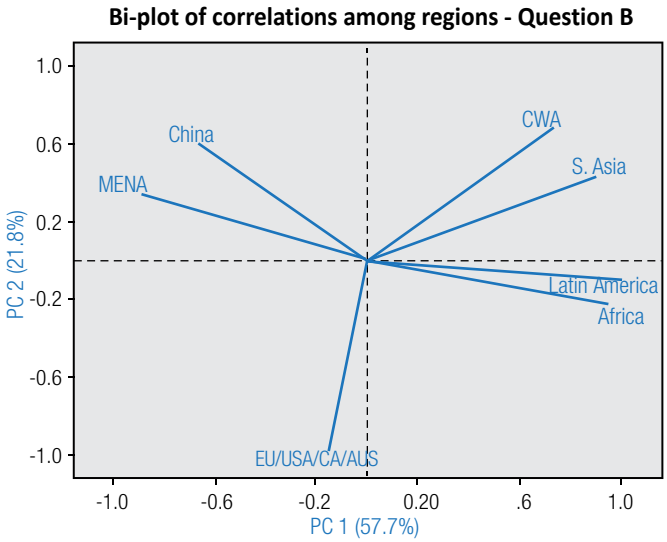
Correlations Between Regional SI Priority Rankings

Similarities between regional priorities were determined using Kendall's Tau B correlation of ranks test. Six comparisons resulted in statistically significant correlations (boxes shaded in green). MENA versus African and Latin American priorities result in coefficients very close to zero, indicating they are close to independence.

MENA	-0.11					
CWA	0.42	0.29				
China	0.20	0.51	0.33			
EU/US/CA/AUS	0.29	0.33	0.24	0.29		
Latin America	0.66	0.09	0.61	0.28	0.42	
South Asia	0.60	0.29	0.82	0.42	0.42	0.71
	Africa	**MENA**	**CWA**	**China**	**EU/US/ CA/AUS**	**Latin America**

Regional Correlations Bi-plot

Principal component analysis of the above regional correlation data displays the high correlations between groups of regions and clustering of groups with similar priority rankings. The bi-plot reveals three clear pairings of MENA–China, CWA–South Asia and Latin America–Africa, while EU/US/CA/AUS is isolated from other regions.



Desirable Information and Research Outputs from International Wheat Research

Partners were asked for an open ended response describing what they considered to be the most desirable outputs from each SI. For each region and SI, common trends are identified and summarized on the adjoining page.

	Institutional Engagement/Planned Activities									
	SI 1	**SI 2**	**SI 3**	**SI 4**	**SI 5**	**SI 6**	**SI 7**	**SI 8**	**SI 9**	**SI 10**
	Technology for greatest impact	Sustainable wheat-based systems	Nutrient- and water-use efficiency	Productive wheat varieties	Durable pest and disease resistance	Enhanced heat and drought tolerance	Breaking the yield barrier	More and better seed	Seeds of discovery	Capacity building
Africa	New varieties, breeding and production technologies	Improved agronomy with a focus on resource use efficiency	Irrigation and fertilizer innovation	Breeding	Resistance breeding and management	Breeding	Variety and management development	Seed system and market development	Breeding	Provision of training
CWA	New varieties, breeding and production technologies	Conservation agriculture and management improvement	Breeding and management systems	Breeding	Resistance breeding and management	Breeding + biotechnological approaches	Variety and management development	Seed system and market development	Collection and selection of germplasm	Provision of training
MENA	New varieties, breeding and production technologies	Improved agronomy with a focus on conservation agriculture and resource use efficiency	Irrigation and fertilizer innovation	Breeding	Resistance breeding and management	Breeding + biotechnological approaches	Variety and management development	Seed system and market development	Breeding and collection building	Provision of training
China	Application of genetic technologies	Improved agronomy	Breeding and management systems	Breeding	Resistant varieties and management	Breeding	Application of novel technology for raising yield	Public-private sector interaction	Incorporation of novel germplasm for resistance	Provision of training
EU/US/ CA/AUS	Expansion and adoption of new technologies	Conservation and sustainable agriculture	Breeding and management systems	Breeding	Resistant varieties and genetic tools	Breeding	Integration of technologies in breeding		Expansion of genetic resources for improving nutrition	Provision of training
South Asia	New varieties	New varieties, management and support	Breeding and management systems	Breeding	Resistant varieties and management	Breeding + genomic and hybrid technology	New varieties incorporating novel genomic technology	Seed system developments	Germplasm collection	Provision of training
Latin America			Fertilizer innovation	Breeding	Resistance breeding and management					

Common, Specific Researchable Issues Suggested for IAR4D Outputs

More specific researchable outputs within the current scope of WHEAT as suggested by partners, for each SI, are summarized for each region and partner-type below.

	SI 1	SI 2	SI 3	SI 4	SI 5	SI 6	SI 7	SI 8	SI 9	SI 10
MENA	CA impact	CC ROTATE, RCT	RCT	GE, HY Q	GE	GE SALT FWC		NTM	LRWR	Young
Africa		MECH	DMS	GE, HY BTech	GE	GE SALT	HY	PRIV NTM	New genes	Young
China		MECH	RCT	GE, HY	GE	GE SALT	HY Hybrids	NTM		Young
S.Asia				GE BTech	GE	GE	Transgenic HY, Q	PRIV	CC	
CWA	CA impact	CC RCT	Genotypes	GE, HY Q BTech	GE	GE, CC SALT		NTM	LRWR	
EU/US/CA/ AUS		CC		GE, HY	GE	GE	HY			
Agri Res only	CA impact	CC ROTATE RCT	Genotypes RCT	GE, HY Q BTech	GE	GE SALT FWC	HY	PRIV	LRWR	Young
Agri Res & Extension		ROTATE	RCT	GE, HY Q BTech	GE	GE SALT FWC	Hybrids Synthetics	NTM	LRWR	Young
Seed Companies		CC ROTATE RCT		GE, HY BTech	GE	GE SALT FWC	HY Hybrids	PRIV NTM	LRWR	Young women

BTech = Biotechnology (including use of molecular markers).
CC = Climate change (impacts, mitigation).
DMS = Decision-making support tools explicitly mentioned.
FWC = Frost, winter, cold tolerance.
GE = Germplasm exchange/material transfer.
HY = High-yielding varieties, also adaptable, resilient (pest/diseases, weeds).
LRWR = Better use of landraces and wild relatives.
MECH = Mechanization explicitly mentioned.
NTM = New technologies, methods for seed production, multiplication.
PRIV = Increase, engage more private sector.
Q = Quality (of grain, nutritional).
RCT = Use less inputs, resource-saving technologies.
ROTATE = Rotation system, approaches specifically mentioned.
SALT = Salinity.
Young = Focus capacity development efforts on young professionals, scientists.

SI 5: Partner Disease/Pest-specific Desired Focus

SI 5 focuses on disease and pest resistance and management. The following table indicates where references regarding specific diseases were indicated, in response to desirable SI 5 outputs, by region and partner type.

	Brown Rust	Stem Rust	Yellow Rust	FHB	Powdery Mildew (Oidium)	Septoria	Spot Blotch	Helmin-thosporium	Leaf minor	Scab	Root Rot	Smuts	RWA (Aphid)	Sunn-pest	Other insect pests (aphids)
MENA	√	√	√	√											
Africa	√	√	√		√	√							√		
China			√	√						√					
South Asia	√	√					√								
CWA		√	√						√		√	√		√	√
EU/US/CA/ AUS	√	√	√	√	√			√							
Agricultural Research	√	√	√	√		√		√			√	√		√	
Agricultural Research and Extension	√	√	√		√										√
Seed Companies	√	√	√		√	√						√			

Key Findings for Question B

- SI 5 was most frequently ranked as a first priority for IAR4D investment.
- SIs 1, 4 and 6 also ranked highly. SIs 8 and 9 were scored low.
- IAR4D priorities were more correlated than institutional priorities.
- China–MENA, Latin America–Africa and CWA-South Asia formed distinct groups with distinct preferences:
  - » Africa, CWA, Latin America and South Asia IAR4D priorities were highly correlated with each other and less so with those of other regions.
  - » MENA and China priorities were significantly correlated and formed a separate group.
  - » EU/US/CA/AUS priorities were isolated from those of other regions.
- Desirable IAR4D researchable issues were broadly similar, with some region-specific focus.
- Wheat rust diseases are a major global focus.

Questions A and B Aggregate

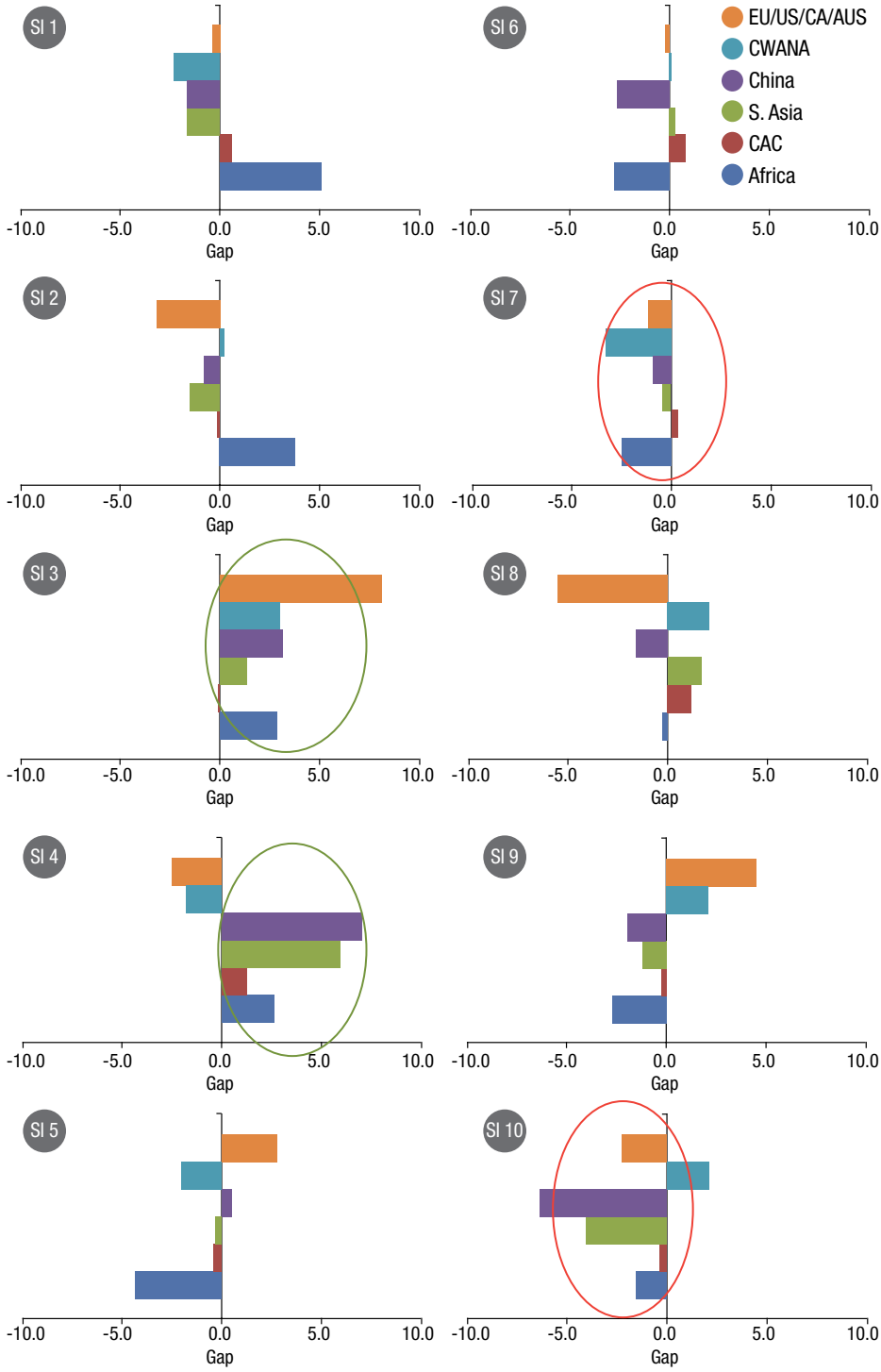
Institutional and IAR4D Investment Priority Rankings and Intra-regional Correlations

Regional SI priority rankings for both institutional and IAR4D investments were collected in the table below. Intra-regional rank correlations were determined using Kendall's Tau B correlation of ranks test. Correlation coefficients are presented with the relevant two-sided p value for statistical significance. *With the exception of China and Latin America, institutional and IAR4D are significantly correlated.*

		Rank											
Region	**Investment Priority**	**SI 1**	**SI 2**	**SI 3**	**SI 4**	**SI 5**	**SI 6**	**SI 7**	**SI 8**	**SI 9**	**SI 10**	**Correlation coefficient**	**p**
Africa	Institutional	1	5	3	2	3	6	8	9	10	7		
	IAR4D	2	7	3	4	1	8	5	9	10	6	0.63	<0.05
MENA	Institutional	8	7	10	1	3	2	9	5	6	4		
	IAR4D	8	7	10	1	4	2	9	5	6	3	0.96	<0.01
CWA	Institutional	3	7	6	4	5	2	10	8	9	1		
	IAR4D	1	7	8	3	4	2	6	9	10	5	0.56	<0.05
China	Institutional	10	6	4	1	2	8	3	9	6	5		
	IAR4D	7	9	10	1	2	5	4	8	6	3	0.45	0.08
South Asia	Institutional	4	9	5	1	2	3	5	7	10	8		
	IAR4D	2	7	8	3	1	4	6	9	10	5	0.63	<0.05
EU/US/ CA/AUS	Institutional	9	5	3	2	1	4	7	10	6	8		
	IAR4D	10	3	6	2	1	4	5	8	9	7	0.64	<0.05
Latin America	Institutional	6	5	4	2	1	8	9	3	9	6		
	IAR4D	3	8	3	3	1	2	6	9	9	6	0.24	0.40

Gap Analysis

Gap analysis was performed to determine regional perception of what contributions either funding source (institutional or IAR4D) should be making to each SI. For each SI regional mean IAR4D priority scores were subtracted from mean institutional priority scores to give a gap value. A negative gap value indicates that regional partners desire a larger contribution to that SI from IAR4D than from their institution. A positive gap value indicates the opposite, while a value of zero shows that partners believe that IAR4D should match institutional contributions.


SI 1
SI 2
SI 3
SI 4
SI 5
SI 6
SI 7
SI 8
SI 9
SI 10
EU/US/CA/AUS
CWANA
China
S. Asia
CAC
Africa
-10.0
-5.0
0.0
5.0
10.0
Gap

Gap Summary

- Africa placed greater emphasis on institutional funding for SIs 1 and 2, in contrast to other regions, which prioritized IAR4D or equal contributions.
- Institutional funding for SI 3 is prioritized everywhere, except in MENA where the gap value is ≤ 0.
- CWA and EU/US/CA/AUS partners believe IAR4D should contribute slightly more to SI 4, whereas others favor institutional funding.
- Africa and CWA disagree with EU/US/CA/AUS about SI 5 funding. Other regional gaps are ≤ 0.
- Most regions prefer an equal IAR4D/institutional contribution for SIs 6 and 7, except Africa and China, which favor IAR4D funding for SI 6 and EU/US/CA/AUS, CWA and Africa, which favor IAR4D funding for SI 7.
- EU/US/CA/AUS strongly prefer IAR4D funding for SI 8.
- MENA gap values are generally low.
- Only CWA favors institutional funding for SI 10.

Question C – If you had the opportunity to add one more Strategic Initiative to WHEAT (e.g., an SI 11), what would it be?

Partners were asked to suggest how they would expand the scope of WHEAT by suggesting an additional SI. Responses were grouped according to common themes. *The largest proportion (45 percent) of respondents did not suggest any further addition of SIs for WHEAT.* Of those who did, most made suggestions that were either specific to their region or already fall under the scope of WHEAT. The remaining suggestions were categorized into four groups.

SI 11 Suggestion Category	Percentage of Total Respondents	Percentage of Total SI 11 Proposers
I. Post-harvest management for value addition – Mobilize all stakeholders' resources along the value chain.	3	9
II. Develop management and marketing in R4D: • Relationship among research, NGOs and small-scale industry. • Extension and technology transfer.	15	20
III. Improve quality, with regard to nutrition and health, competitiveness and markets.	8	13
IV. WHEAT University: Researchers interact on one global platform (information resources).	6	15
V. Other – Specific suggestions, many within current WHEAT scope.	24	43
VI. No suggestion.	45	-

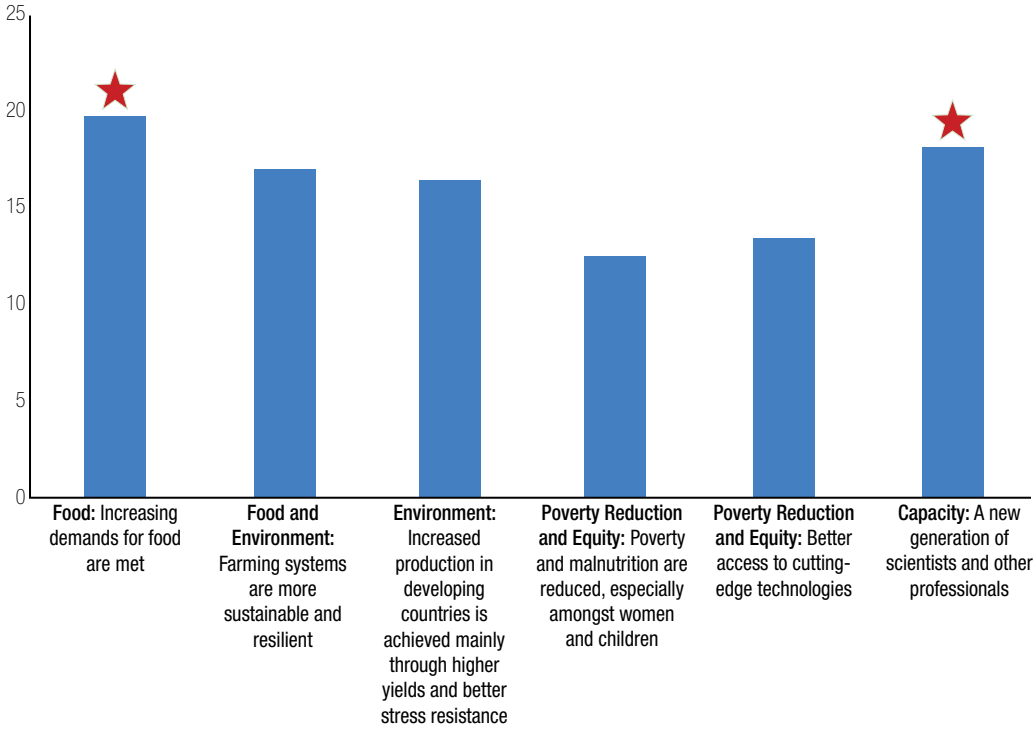
SI 11 Suggestions Outside Current Scope of WHEAT

Further details of regional and partner-type SI 11 suggestions are presented in the table below. Recurrent themes outside the scope of WHEAT are grouped within columns and highlighted in blue.

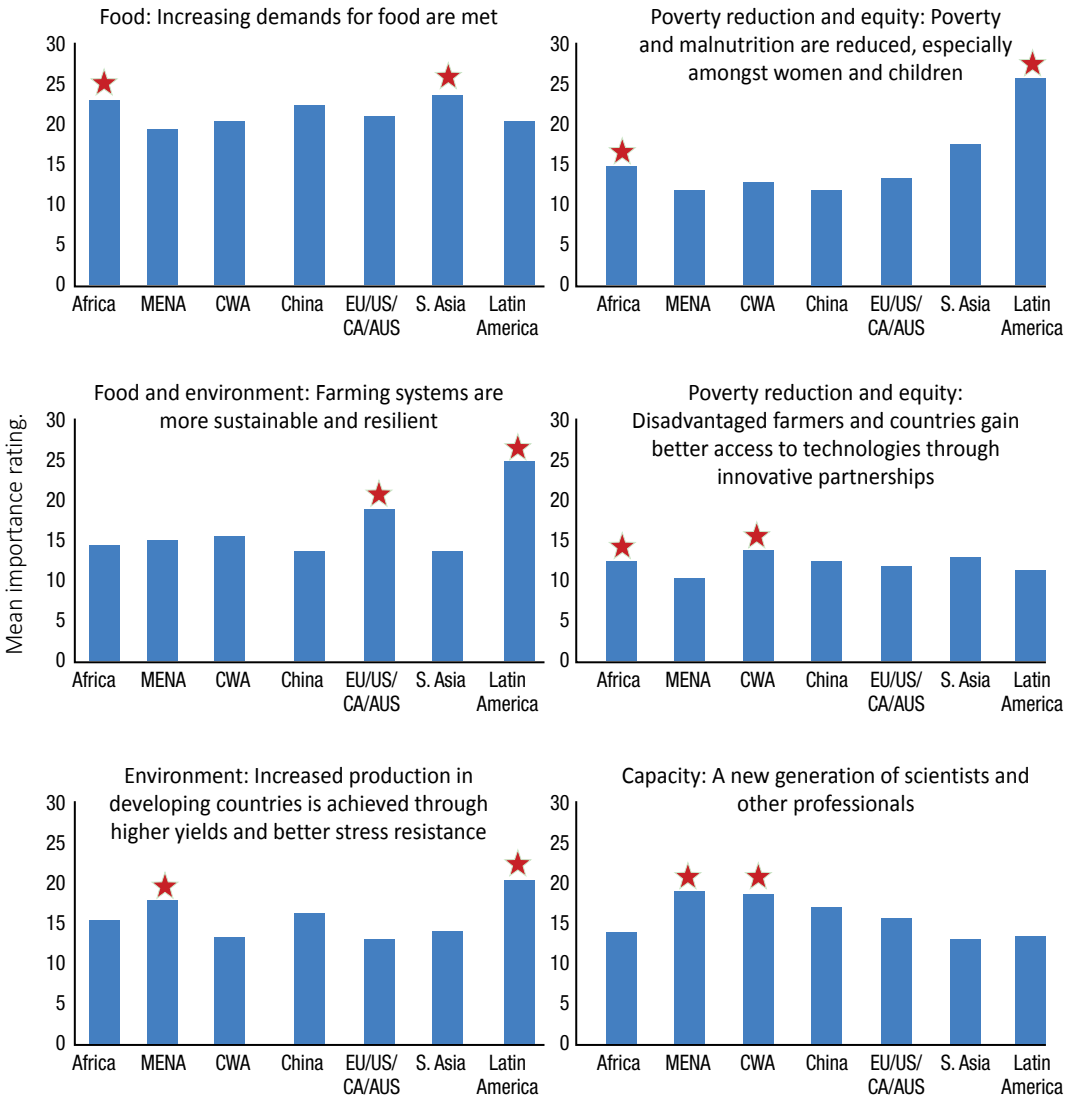
MENA	Develop management and marketing competence in agricultural science/ deal with weak development of management and marketing research in organizations.	Post-harvest storage.	Consolidate national programs and align them with IAR4D initiatives such as WHEAT.	
China			Construct a platform of resource-sharing services.	
South Asia		Biofortification, post-harvest management and value addition.		
Africa	Relationship among research, NGOs and small-scale industry.	All stakeholders' resource mobilization (access to loans, market price information, market chains).		
EU/US/CA/ AUS		Weed management including management of herbicide resistance – SIs 2 and 3?	WHEAT University: A global platform for researchers.	(Nutritional) quality for improved diets and health; maintain this despite climate change; develop export markets.
Agricultural Research only	Extension and technology transfer (see also SIs 2-3, 8, partially I4).	Weed management including management of herbicide resistance – SIs 2 and 3?		(Nutritional) quality for improved diets and health.
Agricultural Research and Extension		Post-harvest storage - proper storage and marketing are critical for farmers to make money.	Construct a platform of resource-sharing services.	
Seed Companies	Develop management and marketing competence in agricultural science / deal with weak development of management and marketing research in organizations.	All stakeholder resource mobilization (access to loans, market price information, market chains).		Study and monitor wheat quality globally, by regions, with regard to climate change effects – focus on health, nutrition and competitiveness, maintaining a top-quality grain supply.

Question D – Please indicate which measures of success you consider most important for WHEAT

Partners were asked to distribute 100 points across 6 measures of success. Mean scores for each measure from all respondents are displayed below.



Mean regional importance scores are displayed below.



Partner-type Institutional and IAR4D Priorities

Strategic Initiative Priority Rankings by Partner-type

Partners were grouped by main types of activity. SI priority rankings for institutional and IAR4D investment were calculated and are displayed below. Correlations between institutional and IAR4D rankings were calculated and are displayed with respective two-sided p values for statistical significance.

		Rank											
Partner Type	**Investment Priority**	**SI 1**	**SI 2**	**SI 3**	**SI 4**	**SI 5**	**SI 6**	**SI 7**	**SI 8**	**SI 9**	**SI 10**	**Correlation Coefficient**	**p**
Ag. Res. only	Institutional	7	4	5	1	2	3	10	9	8	6		
	IAR4D	8	6	7	1	2	3	5	9	10	4	0.64	<0.05
Ag. Res. and Ext.	Institutional	6	6	3	1	4	2	9	8	10	5		
	IAR4D	7	8	3	3	1	2	5	9	9	5	0.62	<0.05
Seed Co.	Institutional	8	6	10	1	4	2	7	5	9	3		
	IAR4D	9	8	10	1	5	2	6	4	7	3	0.82	<0.01

- SI 4 was most frequently ranked as the first priority for institutional and IAR4D investment.
- SIs 5 and 6 also ranked highly.
- All partner-types' institutional and IAR4D rankings were significantly correlated.

Conclusions

Survey responses were received from 92 WHEAT partners, representing 44 percent of all partners. For the purpose of detailed analysis, respondents were grouped by mega-environment/geographical region and institutional primary-activity categories.

Question A – What is the priority for your own institution's investment, for staff, finances, and other resources for each of these Strategic Initiatives, for the next five years?

SIs 4 and 5 ranked highly for institutional investment priority across most regions and partner-types. However, correlation analysis reveals little similarity between overall regional SI priority rankings and this is reflected by the distribution of regions around the bi-plot. Africa and South Asia are the exception, with significantly correlated ($p < 0.05$) SI rankings.

Respondents were also asked to describe their institution's current and planned engagement and activities within each SI. A wide range of research activities across the scope of WHEAT were reported; nonetheless, responses could be categorized into broad, descriptive groups which show that partners generally engage in similar types of activities. Consistently reported activities included investing in the provision of training (relating to SI 10) and the application of breeding technologies to improve varieties across a range of SIs.

Question B – What should be the priority for investment through international agricultural research be, for each SI?

Strategic Initiative 5 was most frequently ranked first across regions for IAR4D investment priority, with SIs 4 and 6 also ranking highly. Greater similarities between regional groups' IAR4D priorities resulted in more significant correlations between regions than in the results from question A. This is manifested in the bi-plots as regional groupings in distinct groups based on shared preferences: MENA-China top-ranked SI 4; CWA-South Asia ranked SI 1 highly; Latin America-Africa ranked SIs 1 and 5 highly; EU/US/CA/AUS were the only region to give SI 2 a high rank.

Partners were asked for desirable IAR4D outputs and information from each SI. Responses could be broadly categorized, which demonstrated that partners' desired outputs were very similar overall. Further analysis of respondents' detailed comments revealed region-specific priorities, such as a focus on improving the impact of conservation agriculture in MENA and for CWA SI 1. Furthermore, analysis of detailed responses for SI 5 reveals that further improvements in combatting rust diseases are a major priority for most partners.

Question A and B – Gap Analysis

Gap values were obtained for each SI by region quantifying partners' preferences for institutional or IAR4D investment. Preferences were highly variable among regions; however, Africa and EU/US/CA/AUS exhibited the greatest differences with regard to preferences. All regions except CWA favored IAR4D funding for SI 10, whereas all regions except MENA preferred institutional funding for SI 3.

Question C – If you had the opportunity to add one more Strategic Initiative to WHEAT (e.g., an SI 11), what would it be?

Partners were asked how they would expand the scope of WHEAT with an additional SI. Forty-five percent of respondents did not offer a suggestion. Of those who did offer a suggestion, 43 percent of the suggestions could not be categorized or are already within the scope of WHEAT. Most of the remaining respondents wished to see a greater focus on better management and marketing competence in agricultural science. The establishment of a WHEAT academy platform to improve information-sharing and training was a priority. Smaller numbers made specific reference to the creation of an SI dedicated to improving nutritional quality research or post-harvest storage research.

Question D – Please indicate which measures of success of WHEAT you consider most important

Partners were asked to score six measures of success of WHEAT to indicate their importance. Increasing yields, production and scientific research capacity were clear favorites with partners; outputs concerning environmental sustainability or social development scored lower. This does not necessarily reflect the overall focus of the WHEAT program, but rather the nature of the partner-types responding to the survey. Most respondents belonged to agricultural research institutions; therefore the prioritization of breeding for yield improvement is unsurprising.

The Future of WHEAT

WHEAT is in an extension period until 2017. During 2015-16, the 10 SIs will be regrouped into five Flagship Projects (FPs) with associated clusters of activities (CoAs). Many of the highlighted gaps in the WHEAT SI program have been addressed under the new FPs; for example, CoA 5.3 outlines the creation of a WHEAT University training platform to provide partners greater access to training and

educational resources. Similarly, research and breeding for durable resistance to rust diseases becomes an independent CoA, separate to activities addressing other pests and diseases. The results of this survey will inform ongoing discussions with WHEAT partners and stakeholders about further activity planning, prioritization, scope and geographical focus.

WHEAT Extension Phase – Flagship Projects

FPs	1. Maximizing value for money, social inclusivity through prioritizing WHEAT R4D investments.	2. Novel diversity and tools to adapt to climate change and resource constraints.	3. Global partnership to accelerate genetic gain in farmers' fields.	4. Sustainable intensification of wheat-based cropping systems.	5. Human and institutional capacities for seed systems and scaling-out; a new generation of wheat scientists.
CoAs	1.1 Foresight and targeting (ex ante).	2.1 Seeds of Discovery.	3.1 Global Breeding Platform (International Wheat Improvement Network; IWIN) for traits suited to different needs and target groups.	4.1 Multi-scale farming system framework to better integrate and enhance adoption of sustainable intensification options (linked to FP5, which works at a wider scale).	5.1 Enable a national coalition of multiple partners to scale out technology packages, including seed system innovations.
	1.2 Adoption / impact pathway analysis and (ex-post) impact assessment.	2.2 Affordable hybrids.	3.2 Accelerate breeding cycle through genomics, improved bioinformatics and data management.	4.2 Participatory approaches to adapt and integrate technological components.	5.2 International short-term training (POWB 10.1–10.4) for female and male professionals.
	1.3 Gender strategic research and support for mainstreaming.	2.3 International Wheat Yield Partnership (IWYP) to break the genetic yield barrier.	3.3 Precision field-based phenotyping platforms for key traits.	4.3 Development and field testing of agronomic technologies (has 6 sub-categories).	5.3 WHEAT University and WHEAT Volunteers: To build the next generation of scientists.
		2.4 Heat and Drought Tolerance to Combat Climate Change (The Heat and Drought Wheat Improvement Consortium; HEDWIC).	3.4 Durable rust resistance and monitoring for gender-responsive food security.		
		2.5 Biological nitrification inhibition: Cytogenetic and pre-breeding for nitrogen use efficiency.	3.5 Resistance and monitoring of major diseases and pests other than rusts.		
		2.6 Pre-breeding: Transfer new alleles, translocations for prioritized traits from exotic sources into elite lines.	3.6 Genetic improvement to contribute to food safety.		

ANNEX I: List of Respondents

Afghanistan	Faculty of Agriculture Kabul University
	AAEP
	Joint Development Associates International
	Noor Agriculture Seeds Company
Armenia	Armenian Research Center for Farming
	Armenian National Agrarian University
	Guimri Breeding Station
Australia	South Australian Research & Development Institute (SARDI)
	Australian Centre for Plant Functional Genomics
Azerbaijan	Azerbaijan Institute of Genetic Resources
	Azerbaijan Research Institute of Agriculture
Bangladesh	Lal Teer Seed Ltd.
	Wheat Research Centre, BARI
Bhutan	Renewable Natural Resources Research and Development Centre
Canada	National Research Council Canada
	Agriculture and Agri-Food Canada
	Alberta Agriculture
China	Crop research institute, Ningxia Academy of Agriculture and Forestry Sciences
	Nanjing Agricultural University
	Institute of Crop Science, Chinese Academy of Agricultural Sciences
	Wheat Research Institute of Henan Academy of Agricultural Sciences
	Hubei Academy of Agricultural Sciences
	Gansu Academy of Agricultural Sciences
	Institute of Food Crops, Yunnan Academy of Agricultural Sciences
	Institute of Nuclear & Biological Technology, Xinjiang Academy of Agricultural Sciences
	Crop Research Institute, Sichuan Academy of Agricultural Sciences
	Crop Research Institute, Shandong Academy of Agricultural Sciences
Costa Rica	Inter-American Institute for Cooperation on Agriculture (IICA)
Denmark	Aarhus University, Agroecology Department
Egypt	National Research Centre
Ethiopia	Ministry of Agriculture
	Eastern Africa Agricultural Productivity Project (EAAPP)- Ministry of Agriculture
	EIAR4D
Georgia	Agrarian University of Georgia
	Lomtagora Firm (Seed production)
Hungary	Centre for Agricultural Research, Hungarian Academy of Sciences

India	IAR4DI-Regional Station, Indore
	Institute of Agricultural Sciences, Banaras Hindu University
	Satmile Satish Club “O” Pathagar (SSCOP)
	Directorate of Wheat Research (DWR)
	Maharastra Hybrid Seeds Company, Ltd. (MAHYCO)
	Punjab Agricultural University
	The Energy Research Institute
Iran	Seed and Plant Improvement Institute
	Dryland Agricultural Research Institute (DARI), Maragheh
Jordan	National Center for Agricultural Research and Extension (NCARE)
Kazakhstan	Kazakh Research and Production Center of Grain Husbandry
	Kazakh Breeding Company “Fiton”
	Karabalyk Agricultural Research Station
	Karaganda Agricultural Research Institute for Crop Production and Breeding
	The Kazakh Research Institute for Plant Protection and Quarantine
	Kazakh RI of Agriculture and Farming
	“Krasnavodopadskaya” Breeding Station
	Pavlodar Agricultural Research Institute
	LP “East Kazakhstan Research Institute of Agriculture”
	LLP “Aktobe Agricultural Experiment Station”
	Kaz Agroinnovations JC, Kazakhstan
Kenya	KARI
Kyrgyzstan	Kyrgyz Research Institute of Crop Husbandry
Lebanon	National Council for Scientific Research (CNRS)
Mali	Institut D’economie Rurale (IER)
Oman	Ministry of Agriculture & Fisheries, Sultanate of Oman
Pakistan	University of Agriculture, Faisalabad
	Cereal Crops Research Institute Pirsabak Nowshera (CCRI), Pakistan
	Ayub Agricultural Research Institute, Faisalabad
	Pakistan Agricultural Research Council
Palestine	National Agricultural Research Center (NARC)
Romania	National Agricultural Research & Development Institute – Fundulea
South Africa	Experico- A division of Farmsecure
Spain	Instituto de Agricultura Sostenible
	IRTA (Institute for Food and Agricultural research and Technology)
	Agrovegetal S.A.
Tajikistan	Research Institute of Crop Husbandry under the Tajik Academy of Agricultural Science

Turkey	Field Crop Reseach Center (TARM)
	Aegean Agricultural Research Institute
	GAP Agricultural Research Institute
	General Directorate of Agricultural Research and Policies (GDAR)
	Trakya Agricultural Research Institute
Turkmenistan	Turkmain Grain Institute
Uganda	National Agricultural Research Organisation-Buginyanya Zardi
U.K.	NIAB UK
Uruguay	INIA, Instituto Nacional de Investigación Agropecuaria
USA	International Plant Nutrition Institute
Uzbekistan	Kashkadarya Research Institute of Grain Breeding and Seed Production
	Gallya-aral Branch of Uzbek Scientific Research Institute of Grain and Grain Legumes on Irrigated Lands
	Uzbek Scientific Research Institute of Plant Industry
	Research Institute of Grain and Legumes Crops under Irrigation
Vietnam	Plant Resources Center
Yemen	Agricultural Research and Extension Authority
Zimbabwe	Seed-Co

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ISBN: 978-607-8263-41-7