Draft Report
Analysis of the questionnaire for elicitation of key opportunities for international agricultural research

September 16, 2009

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I. Questionnaire background

In 2008, the Consultative Group on International Agricultural Research (CGIAR) launched a Change Initiative to identify how best to adapt to anticipated global changes and challenges. The proposed reforms will help to strengthen the CGIAR by establishing a results-oriented research agenda (see http://www.cgiar.org/changemanagement/index.html). A Strategy Team was also appointed in 2009 to lead the reform process and help to define the new CGIAR Strategy and Results Framework (SRF).

In order to help the CGIAR to define a results-oriented research agenda and its research priorities for the next decade, the Strategy Team recommended conducting a questionnaire for elicitation of key opportunities for international agricultural research aimed at frontline researchers and scientist in the agriculture research community. The questionnaire's goal was to elicit suggestions for key opportunities for innovation that should be both large-scale and benefit millions of poor people, and have very significant beneficial resource use or environmental impact.

The questionnaire was conduced between August 6-20, 2009 and was distributed to over 1100 frontline researchers within CGIAR and externally. In addition, the questionnaire was also disseminated through Global Forum on Agricultural Research (GFAR) and the regional networks of Forum for Agricultural Research in Africa (FARA), Asia-Pacific Association for Agricultural Research Institutions (APAARI), Forum for the Americas on Agricultural Research and Technology Development (FORAGRO), and Association of Agricultural Research Institutions in the Near East and North Africa (AARINENA) to other key stakeholders in agricultural community. Given the time constraints, the questionnaire was only conducted in English, although non-English respondents' entries were also considered.

Given the short time frame and the context for the questionnaire, no attempt was made to develop any specific sampling framework or in fact to identify some underlying population to be sampled. Instead, the focus was on reaching a large number of CGIAR stakeholders with scientific backgrounds. The questionnaire does not claim to provide a statistically representative set of answers from any population; instead, it represents a summary of the answers from the universe of respondents. The following analysis offers descriptive information about the respondents themselves, and tries to relate responses to the disciplinary and institutional backgrounds of respondents, so that a reader can judge the extent to which responses reflect respondents' backgrounds.

[1] Questionnaire and analysis were conducted as part of the background work for the CGIAR Strategy and Results Framework (SRF) committee, by Ruth Meinzen-Dick, Douglas Gollin, Ewa Sobczynska, and Julia Behrman.

While some of the preliminary respondents did not fill out more than the general section info, the questionnaire received over 400 final and complete responses. These distinct respondents put forward over 500 key opportunities.

The following analysis is focused on assisting the Strategy Team in their research prioritization as well as providing additional information for GFAR's e-consultation process.

II. Summary of respondents' backgrounds

The questionnaire received responses from 407 individuals who identified at least one key opportunity (resulting in 527 proposals).

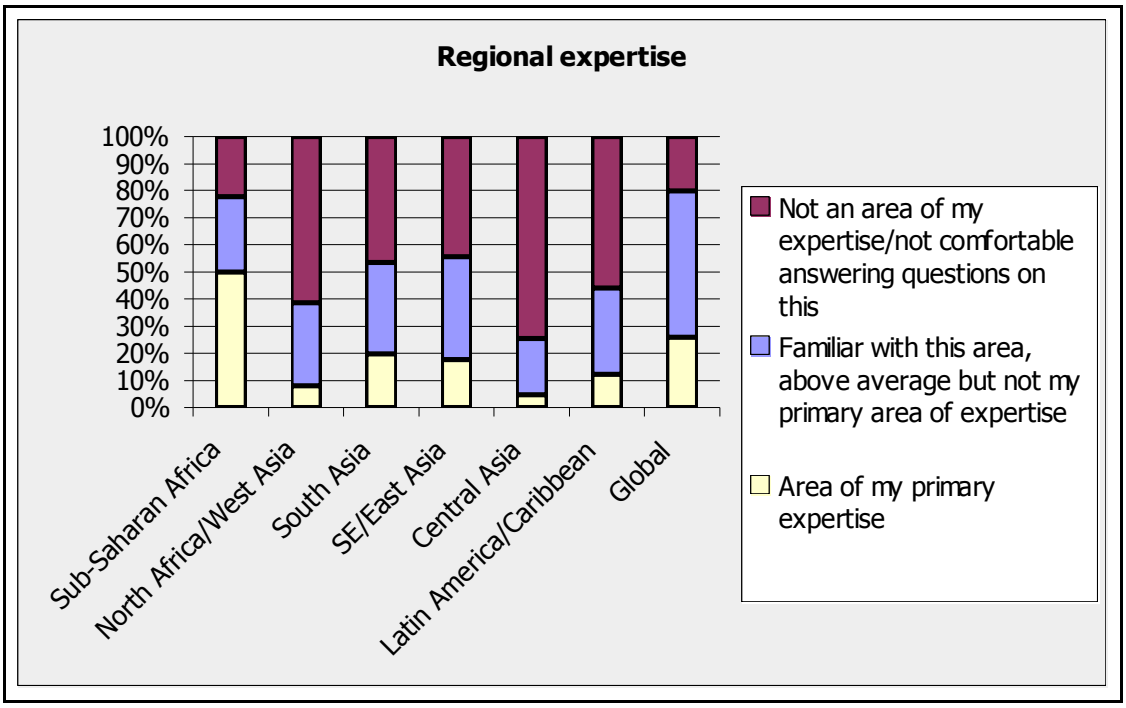
A. Regional expertise

Respondents brought a variety of regional expertise (see Table 1 and Figure 1). Almost half of the respondents reported having regional expertise on Sub-Saharan Africa. South Asia and South East Asia were areas of primary regional expertise for almost one fifth of respondents (20% for South Asia and 18% for South East Asia) and Latin America and Caribbean for 12% of respondents. While less than 10% respondents ranked North Africa/West Asia and Central Asia as the area of their primary regional expertise, many other respondents had above average familiarity with these two regions (30.5% respondents for North Africa/West Asia and 21% for Central Asia indicated above average familiarity with that region).

Table 1: Respondents' regional expertise

Please indicate your level of familiarity with the research and development opportunities that characterize each of the following REGIONS:							
Answer Options	**Area of my primary expertise**		**Familiar with this area, above average but not my primary area of expertise**		**Not an area of my expertise/not comfortable answering questions on this**		**Response Count**
	Response Count	Response Percent	Response Count	Response Percent	Response Count	Response Percent	
Sub-Saharan Africa	203	49.9%	113	27.8%	91	22.4%	407
North Africa/West Asia	33	8.1%	124	30.5%	250	61.4%	407
South Asia	80	19.7%	137	33.7%	190	46.7%	407
SE/East Asia	72	17.7%	154	37.8%	181	44.5%	407
Central Asia	19	4.7%	84	20.6%	304	74.7%	407
Latin America/Caribbean	50	12.3%	129	31.7%	228	56.0%	407
Global	105	25.8%	220	54.1%	82	20.1%	407
						answered question	**407**

Figure 1: Respondents' regional expertise



B. Primary Discipline

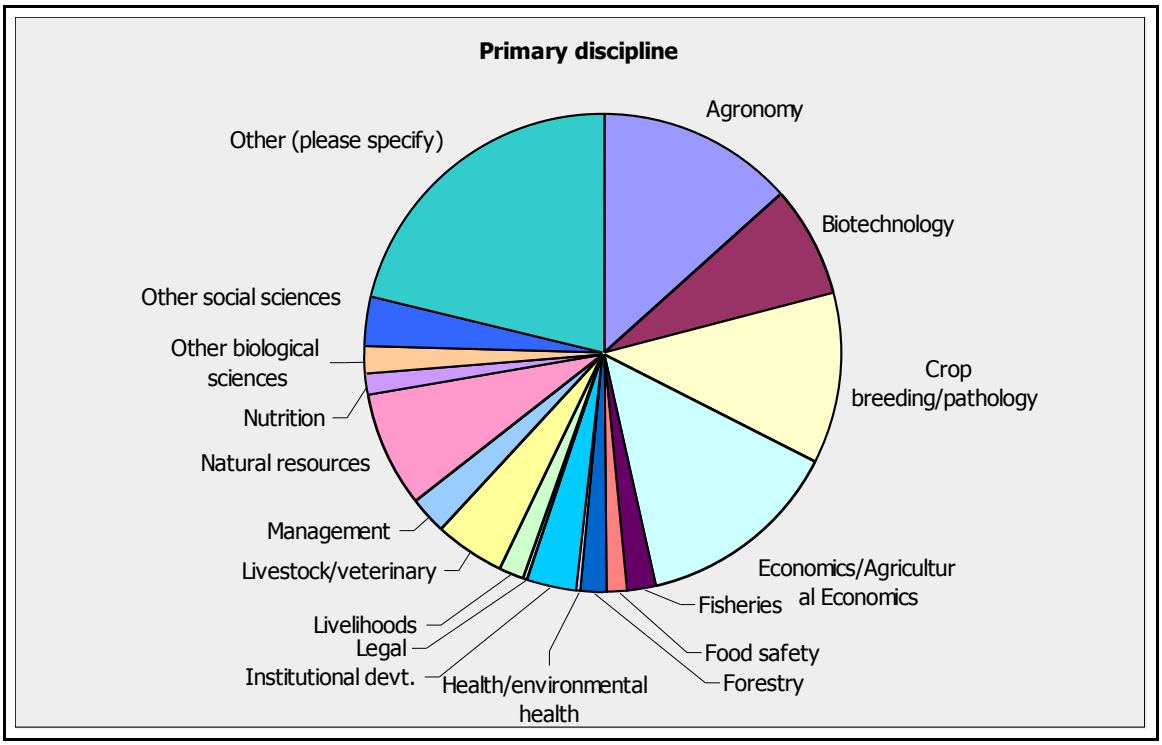
Among respondents' self identified primary discipline, the top three were economics/agricultural economics (14%), agronomy (13%), and crop breeding/pathology (11.5%) (Table 2 and Figure 2). Fewest (less than 2%) respondents identified their primary discipline as health/environmental health, legal, food safety, livelihoods and nutrition. Among those who identified their primary discipline as "Other" (over 21% of respondents), more than 11% identified their primary discipline as horticulture/plant physiology; over 9% as specialized social sciences (development sociology, anthropology or political science); 8% as geography or rural development (each); and 7% as entomology or water resource management and irrigation (each). Fewer than 5% of the respondents in the "Other" category identified their primary discipline as agriculture engineering, environmental sciences, crop physiology, energy, extension services or soil sciences.

Taking these numbers together, by far the largest fraction of the respondents (nearly half) had backgrounds in some field or subfield of plant or animal science (agronomy, crop breeding/pathology, biotechnology, horticulture/plant physiology, livestock/veterinary science). About one quarter of respondents had backgrounds in some field of social science or policy-related areas (law, livelihoods, management).

Table 2: Respondents' primary discipline

Please list your primary discipline (field of highest degree) (Please check only one area):		
Answer Options	**Response Percent**	**Response Count**
Agronomy	13.3%	54
Biotechnology	7.6%	31
Crop breeding/pathology	11.5%	47
Economics/Agricultural Economics	14.0%	57
Fisheries	2.0%	8
Food safety	1.2%	5
Forestry	2.0%	8
Health/environmental health	0.2%	1
Institutional development	3.4%	14
Legal	0.2%	1
Livelihoods	1.7%	7
Livestock/veterinary	4.9%	20
Management	2.5%	10
Natural resources	7.6%	31
Nutrition	1.5%	6
Other biological sciences	2.0%	8
Other social sciences	3.2%	13
Other (please specify)	21.1%	86
answered question		**407**

Figure 2: Respondents' primary discipline



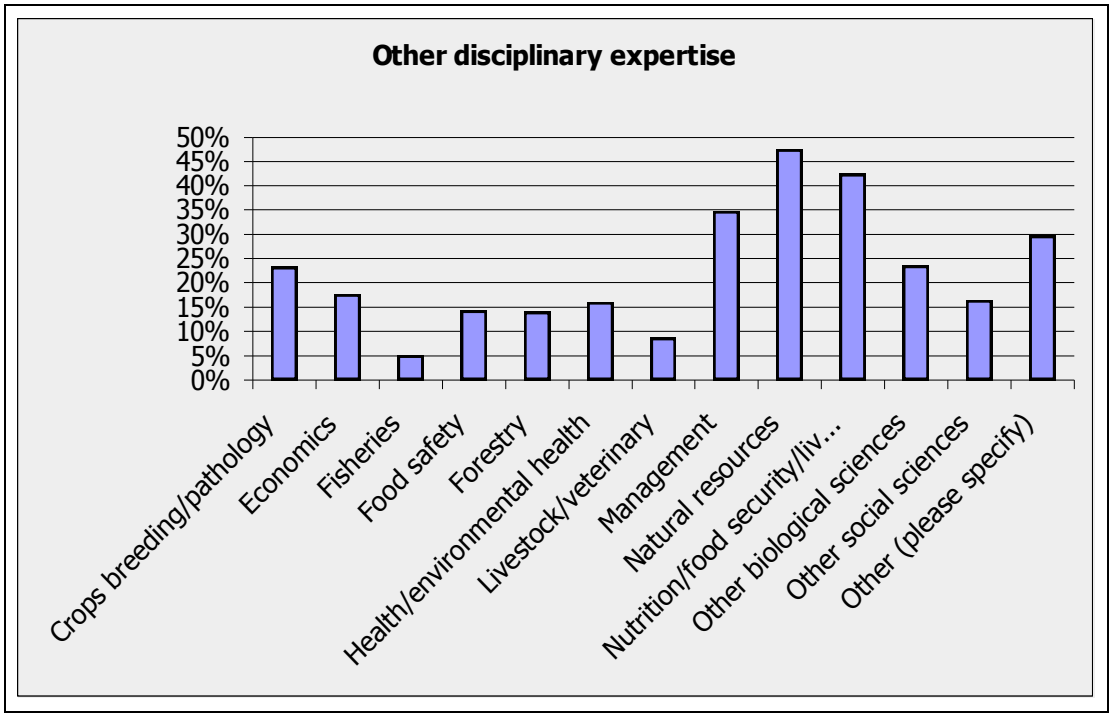
C. Secondary discipline

Almost half of the respondents said that they had other (secondary) area of expertise in natural resource management and more than 42% in nutrition/food security/livelihoods (see Table 3 and Figure 3). Over 35% of respondents also indicated expertise in management and almost one quarter in crop breeding/pathology or other biological

Table 3: Respondents' other (secondary) disciplinary expertise

Please list other disciplinary expertise (Please check up to five areas):		
Answer Options	**Response Percent**	**Response Count**
Crops breeding/pathology	23.3%	91
Economics	17.6%	69
Fisheries	5.1%	20
Food safety	14.3%	56
Forestry	14.1%	55
Health/environmental health	16.1%	63
Livestock/veterinary	8.7%	34
Management	34.8%	136
Natural resources	47.6%	186
Nutrition/food security/livelihoods	42.5%	166
Other biological sciences	23.5%	92
Other social sciences	16.4%	64
Other (please specify)	29.7%	116
answered question		**391**

Figure 3: Respondents' other (secondary) disciplinary expertise



sciences. Among the respondents who self-identified their other area of expertise as "Other" (almost 30%), 9% identified plant sciences/physiology (including horticulture and medicinal plants) as their other area of expertise. Over 6% also identified agronomy and over 5% entomology, food technology or water resource management. Between 3% and 5% of the respondents in the "other" category identified agriculture marketing, genetic resource management, research development, biotechnology, ecology, environmental sciences or rural development as their other (secondary) areas of expertise.

D. Organizational affiliation

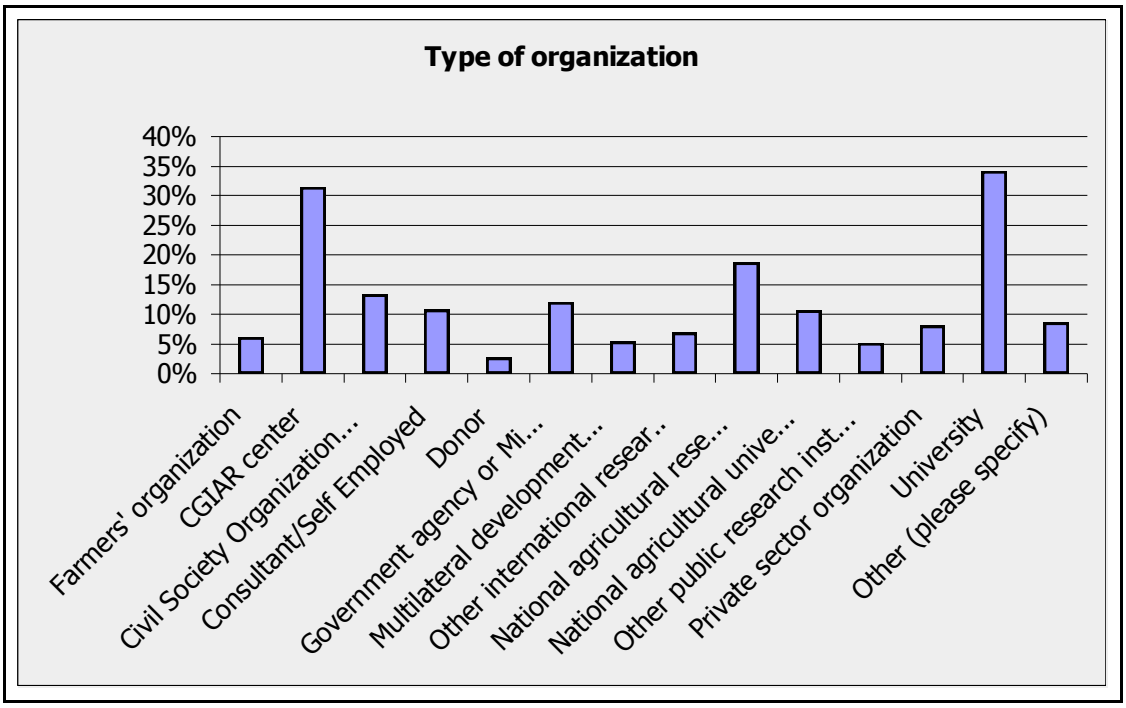
Most of the respondents self identified the organization they work for as a research institution (see Table 4 and Figure 4). More than one third of the respondents indicated their affiliation with university as the type of organization and almost as many with CGIAR centers. Almost one fifth of the respondents have an affiliation with national agricultural research institute (19%). The questionnaire also received a fair number (over 10%) of responses from respondents affiliated with national agricultural universities, civil society organizations (CSOs) and non-governmental organizations (NGOs), and governmental agencies and ministries. The lowest category of respondents was "donor" (11 total, or less than 3%). This is in line with the objectives of the questionnaire to elicit opportunities from frontline researchers; there are other opportunities for donors and other stakeholders (e.g. multilateral development agencies) to give their inputs and priorities.

Given the design of the question, many respondents reported more than one type of institutional affiliation.

Table 4: Respondents' organizational affiliation

Type of organization you work for (Check as many as apply):		
Answer Options	**Response Percent**	**Response Count**
Farmers' organization	6.1%	25
CGIAR center	31.4%	128
Civil Society Organization or NGO	13.3%	54
Consultant/Self Employed	10.8%	44
Donor	2.7%	11
Government agency or Ministry	12.0%	49
Multilateral development agency/UN	5.4%	22
Other international research organization	6.9%	28
National agricultural research institute	18.7%	76
National agricultural university	10.6%	43
Other public research institute	5.2%	21
Private sector organization	8.1%	33
University	34.2%	139
Other (please specify)	8.6%	35
answered question		**407**

Figure 4: Respondents' organizational affiliation



E. Function/position within organization

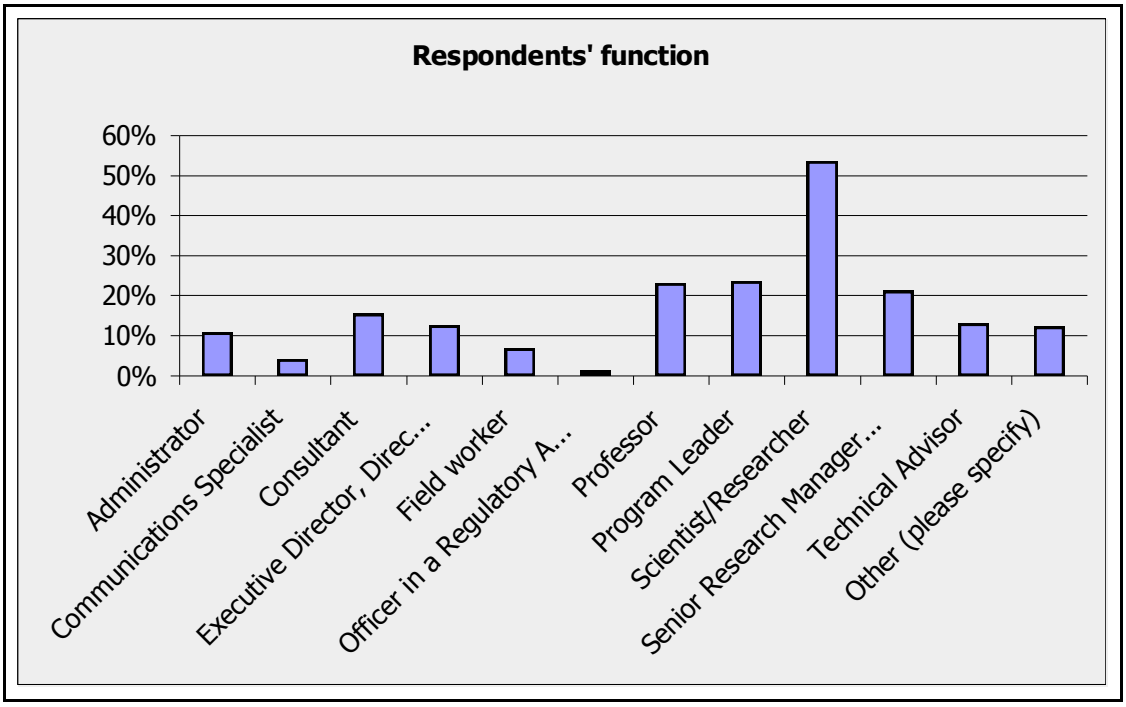
As with organization and secondary discipline, respondents could (and did) identify more than one type of function within their organizations (see Table 5 and Figure 5). More than 50% of the respondents self identified themselves as scientists/researchers and almost one fourth categorized their profession as professor (23%) or program leader (24%). In addition, over one fifth of the respondents categorized their profession as senior research manager or division leader (21%). Over 10% of the respondents classified themselves as administrators (11%), consultants (15%), executive director/director general (12.5%) or technical advisor (13%).

Table 5: Respondents' function within an organization

How do you classify your function within your primary institution? (Check as many as apply)		
Answer Options	**Response Percent**	**Response Count**
Administrator	10.8%	44
Communications Specialist	4.2%	17
Consultant	15.5%	63
Executive Director, Director General	12.5%	51
Field worker	6.9%	28
Officer in a Regulatory Agency	1.2%	5
Professor	23.1%	94
Program Leader	23.6%	96
Scientist/Researcher	53.6%	218
Senior Research Manager or Division Leader	21.1%	86

Technical Advisor	13.0%	53
Other (please specify)	12.3%	50
answered question		**407**

Figure 5: Respondents' function within an organization



III. Analysis of key opportunities for international agriculture research

The questionnaire elicited 527 proposals for key opportunities for international agricultural research. The questionnaire team read through each described opportunity and identified keywords for each of these opportunities. After refining the set of keywords and attempting to identify a useful set of common and/or recurring terms, the team arrived at a list of approximately 200 keywords. These were sorted into approximately thirty "clusters" and further grouped into six main categories. The first cluster in each category broadly relates to that category (e.g. production, or natural resources), with other clusters being more specific. While this clustering process has the potential to force responses into "boxes", some form of clustering is necessary to provide easier reading and for identifying patterns among the suggestions. Clustering also allows for quantification and characterization of the responses in useful ways. In the following pages, the summary report draws on the questionnaire team's quantitative analysis as well as extensive qualitative analysis, including original text provided by respondents themselves.

Although the focus of the questionnaire was on key opportunities for agricultural research, many of the responses related more to needs or challenges for research rather than to specific innovations that are either already developed or are possible over the next five to ten years. This analysis covers both the general and specific suggestions. As the CGIAR reforms move forward, those who are developing Mega Programs can return to

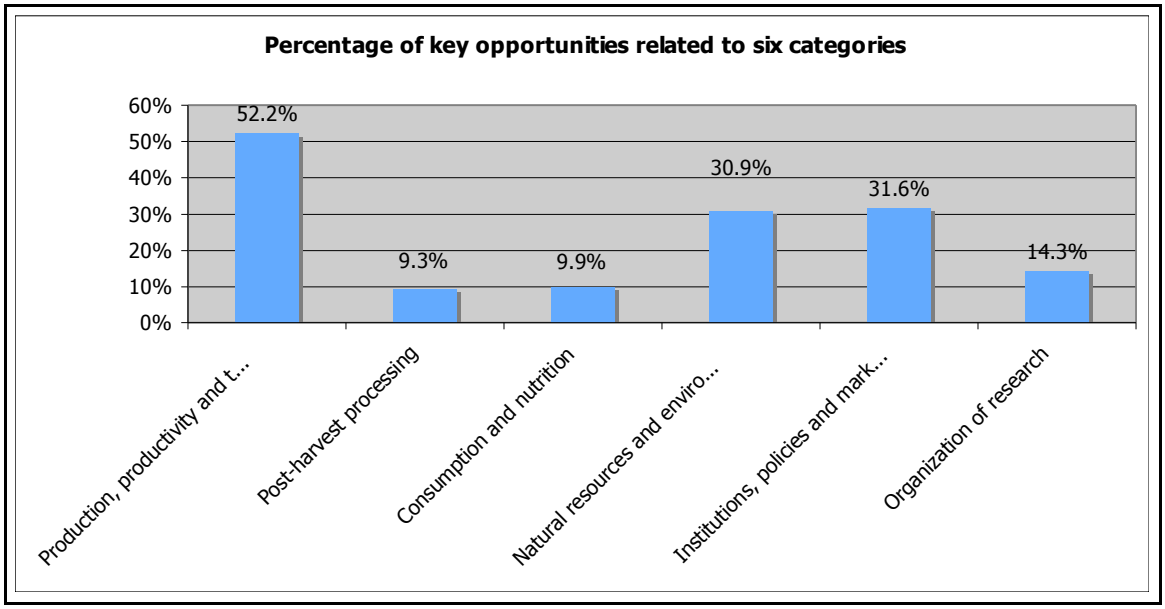
the original responses for more detail about each key opportunity, including the time frame, area of applicability, and potential benefits and scale.
The six main categories identified by the analysis were:

1. Production, productivity and technology (category 1)
2. Post-harvest processing (category 2)
3. Consumption and nutrition (category 3)
4. Natural resources and environment (category 4)
5. Institutions, policies and markets (category 5)
6. Organization of research (category 6).

Among those broad categories (see Figure 6), "Production, productivity, and technology" ranked as the category with highest number of proposals for key opportunities - more than half of the respondents identified a key opportunity that was related to this category. This was followed by proposals in "Natural resources and environment" and "Institutions, policies and markets". Categories in "Organization of research", "Post-harvest processing and marketing", and "Consumption and nutrition" received fewest proposals. Many of the submissions related to more than one of these broad categories.

Since these analytical categories were imposed by the questionnaire team, it is not sensible to view the number of opportunities in each category as any kind of "vote" on the relative importance of the categories; any category could have been made smaller by splitting it in two, or, conversely, larger by lumping them together. Instead, these numbers should be viewed as a rough description of the responses along one set of possible dimensions.

Figure 6: Percentage of key opportunities related to analytical categories



IV. Analysis of key opportunities by respondents' background

Preliminary analysis of key opportunities by respondents' background allowed for better understanding of the kinds of responses provided by respondents who affiliated themselves with certain type of organizations or self identified their primary discipline.

A. Primary discipline

Most of the responses on key opportunities were provided by respondents who self identified their primary discipline as "Other" (for analysis of "Other" primary discipline see section II.B.), economics/agricultural economics, agronomy, or crop breeding/pathology (Figure 7), which confirms the sample composition (see section II.B). Not surprisingly, respondents who self-identified their primary discipline as agronomy provided most key opportunities in the category 1 (Production, productivity and technology), followed by "Other" (where a large number of respondents self-identified their primary discipline as horticulture/plant physiology). Those who self-identified their primary discipline as "Other" also provided most opportunities in category 2, 4, 5 and 6 (Table 6). Agronomists also provided most key opportunities in category 3 (Consumption and nutrition).

Figure 7 and Figure 8 and Table 6 confirm that, not surprisingly, most respondents provided key opportunities in the area of their primary discipline. It is interesting to note that most disciplines identified a substantial number of key opportunities that relate to category 5 (Institutions, policies and markets) and category 6 (Organization of research), which points to the importance of these areas (including capacity building, knowledge sharing, etc.) in international agricultural research, regardless of the discipline.

In addition, as we look within the broad categories at clusters of topics (see Table 7), we see additional variability between the different primary disciplines although the table corroborates again that respondents provided key opportunities in their area of specialization. Interestingly, water is mentioned as top cluster within natural resources confirming the importance of this resource for continuous agriculture development as well as one of the primary concerns related to climate change.

Figure 7: Number of responses per key opportunity in identified category by respondents' primary discipline

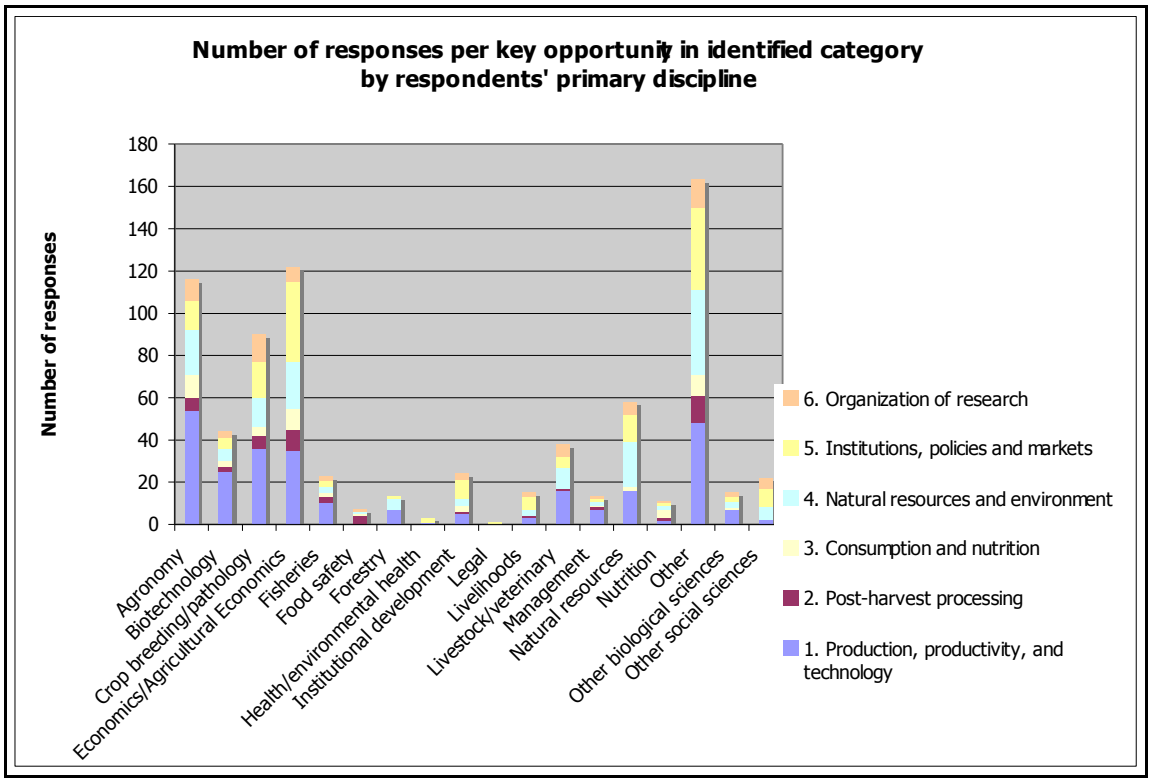


Figure 8: Percentage of key opportunities identified by respondents with particular primary discipline by category

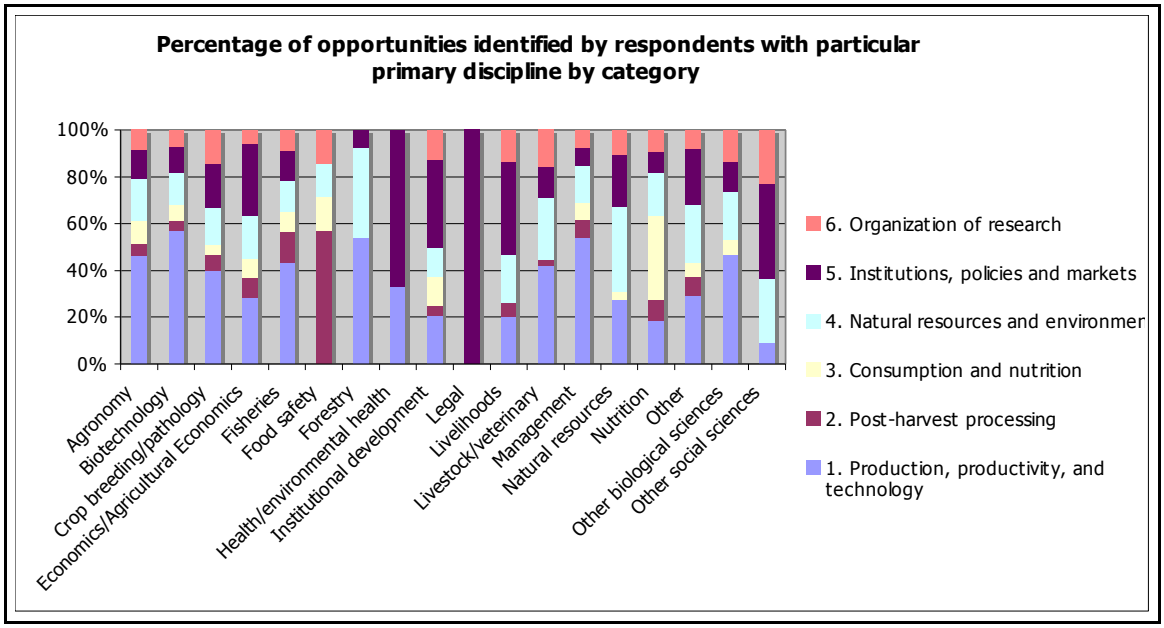


Table 6: Ranking of six categories within each primary discipline listed

	Agronomy	**Biotechnology**	**Crop breeding/pathology**	**Economics/Agricultural Economics**	**Fisheries**	**Food safety***
1	1. Production, productivity, and technology	1. Production, productivity, and technology	1. Production, productivity, and technology	5. Institutions, policies and markets	1. Production, productivity, and technology	2. Post-harvest processing
2	4. Natural resources and environment	4. Natural resources and environment	5. Institutions, policies and markets	1. Production, productivity, and technology	5. Institutions, policies and markets	4. Natural resources and environment
3	5. Institutions, policies and markets	5. Institutions, policies and markets	4. Natural resources and environment	4. Natural resources and environment	4. Natural resources and environment	3. Consumption and nutrition
4	3. Consumption and nutrition	6. Organization of research	6. Organization of research	3. Consumption and nutrition	2. Post-harvest processing	6. Organization of research
5	6. Organization of research	3. Consumption and nutrition	2. Post-harvest processing	2. Post-harvest processing	3. Consumption and nutrition	--
6	2. Post-harvest processing	2. Post-harvest processing	3. Consumption and nutrition	6. Organization of research	6. Organization of research	--
	Forestry*	**Health/environmental health***	**Institutional development**	**Legal***	**Livelihoods**	**Livestock/veterinary**
1	1. Production, productivity, and technology	5. Institutions, policies and markets	5. Institutions, policies and markets	5. Institutions, policies and markets	5. Institutions, policies and markets	1. Production, productivity, and technology
2	4. Natural resources and environment	1. Production, productivity, and technology	1. Production, productivity, and technology	--	1. Production, productivity, and technology	4. Natural resources and environment
3	5. Institutions, policies and markets	--	4. Natural resources and environment	--	4. Natural resources and environment	6. Organization of research
4	--	--	3. Consumption and nutrition	--	6. Organization of research	5. Institutions, policies and markets
5	--	--	6. Organization of research	--	2. Post-harvest processing	2. Post-harvest processing
6	--	--	2. Post-harvest processing	--	--	--
	Management	**Natural resources**	**Nutrition**	**Other**	**Other biological sciences**	**Other social sciences**
1	1. Production, productivity, and technology	4. Natural resources and environment	3. Consumption and nutrition	1. Production, productivity, and technology	1. Production, productivity, and technology	5. Institutions, policies and markets
2	4. Natural resources and environment	1. Production, productivity, and technology	4. Natural resources and environment	4. Natural resources and environment	4. Natural resources and environment	4. Natural resources and environment
3	6. Organization of research	5. Institutions, policies and markets	1. Production, productivity, and technology	5. Institutions, policies and markets	5. Institutions, policies and markets	6. Organization of research
4	5. Institutions, policies and markets	6. Organization of research	5. Institutions, policies and markets	6. Organization of research	6. Organization of research	1. Production, productivity, and technology
5	2. Post-harvest processing	3. Consumption and nutrition	6. Organization of research	2. Post-harvest processing	3. Consumption and nutrition	--
6	3. Consumption and nutrition	--	2. Post-harvest processing	3. Consumption and nutrition	--	--

*Very small sample

Table 7: Ranking of top five clusters for each primary discipline listed

	Agronomy	**Biotechnology**	**Crop breeding/pathology**	**Economics/Agricultural Economics**	**Fisheries**	**Food safety***
1	1c. Crop productivity	1c. Crop productivity	1c. Crop productivity	5a. Policies	1f. Aquatic	2. Post-harvest
2	1m. Biotic and abiotic stress	1n. Biotechnology/genomics	1m. Biotic and abiotic stress	5b. Market-related	2. Post-harvest	3b. Nutritional quality
3	1h. Agronomic practices	1m. Biotic and abiotic stress	6d. Integration	1c. Crop productivity	3b. Nutritional quality	6d. Integration
4	1d. Forestry/agroforestry	1b. Staple crops	6a. Research-general	2. Post-harvest	1d. Forestry/agroforestry	4c. Crop/biodiversity
5	4c. Crop/biodiversity	4c. Crop/biodiversity	5f. Capacity, education, extension	4c. Crop/biodiversity	1e. Livestock	--
	Health/environmental health*	**Institutional development**	**Legal***	**Livelihoods**	**Livestock/veterinary**	**Management**
1	5e. Health	5j. Institutions	5a. Policies	5i. Reduced vulnerability	1e. Livestock	1c. Crop productivity
2	1m. Biotic and abiotic stress	5a. Policies	--	5a. Policies	1d. Forestry/agroforestry	4c. Crop/biodiversity
3	5f. Capacity, education, extension	1c. Crop productivity	--	5f. Capacity, education, extension	1c. Crop productivity	6a. Research-general
4	5j. Institutions	3c. Food safety	--	6d. Integration	4c. Crop/biodiversity	4a. Natural resources
5	--	3b. Nutritional quality	--	4c. Crop/biodiversity	6a. Research-general	5f. Capacity, education, extension
	Natural resources	**Nutrition***	**Other**	**Other biological sciences***	**Other social sciences**	
1	4d. Water	5k. Gender/youth	1c. Crop productivity	1c. Crop productivity	5a. Policies	
2	1c. Crop productivity	3b. Nutritional quality	2. Post-harvest	4c. Crop/biodiversity	6a. Research-general	
3	5a. Policies	3a. Food security	4a. Natural resources	1m. Biotic and abiotic stress	5f. Capacity, education, extension	
4	4a. Natural resources	4d. Water	4c. Crop/biodiversity	6d. Integration	4a. Natural resources	
5	6a. Research-general	1c. Crop productivity	1m. Biotic and abiotic stress	1a. Other crops	4d. Water	

∗Very small sample

B. Organizational Affiliation

Respondents who identified themselves as working at CGIAR centers, universities and national agricultural research centers provided the most responses on key opportunities, which is consistent with the sample composition and the objective of the questionnaire to solicit key opportunities from frontline researchers (see Table 8 and Figure 9). In particular, respondents who reported themselves as working with universities provided the most responses in category 1 (Production, productivity and technology), category 2 (Post-harvest processing) and category 3 (Consumption and nutrition). Respondents who identified themselves with CGIAR centers provided the most responses in category 4 (Natural resources and environment) as well as categories 5 and 6. Given that an overwhelming number of respondents indicated that they are affiliated with either

University, CGIAR Center or national agricultural research institute (see section II.D) such ranking is not surprising.

Figure 9: Number of responses by category identified for each type of institution

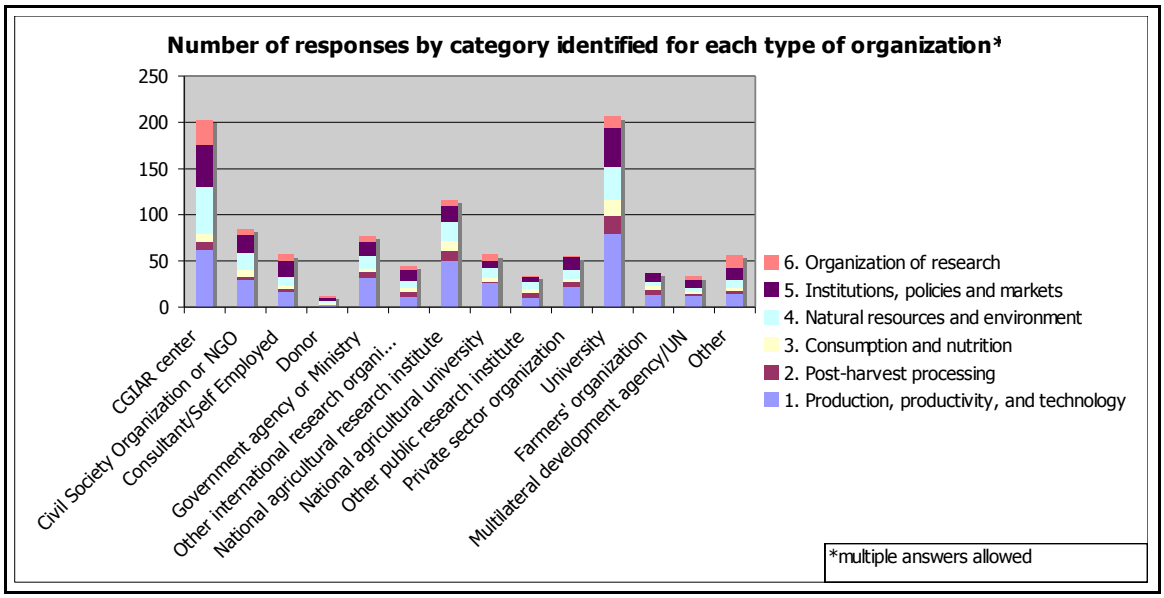
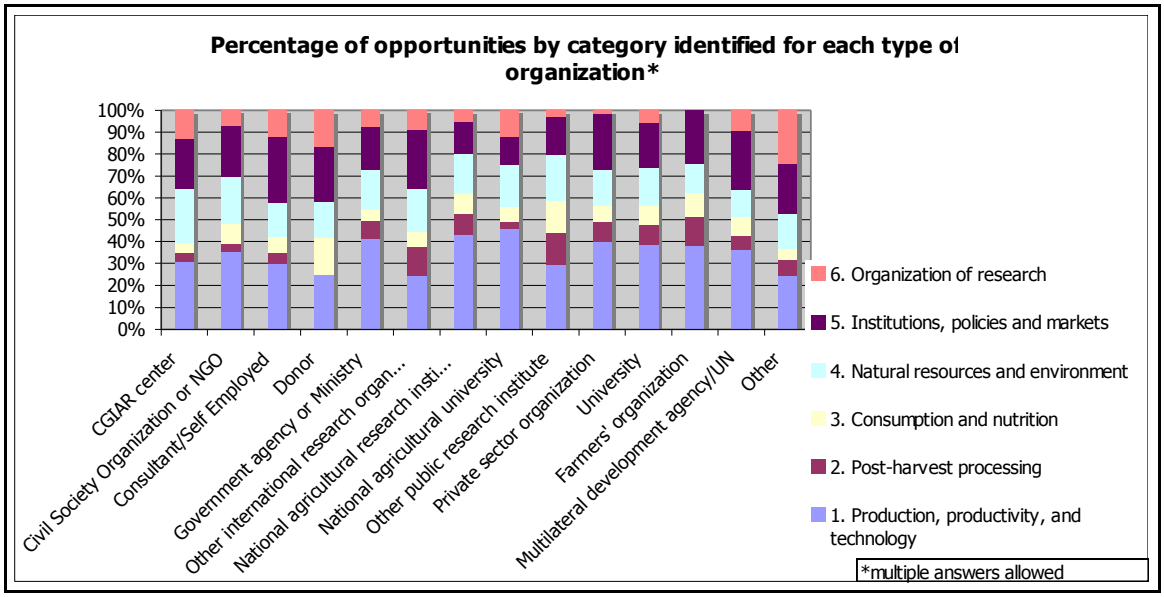


Figure 10: Percentage of opportunities by category identified for each type of organization



There was some variation in the percentage of responses for each category when looking at the type of the organizations the respondents affiliated themselves with (see Figure 10). However only within category 2 and 6 were these fluctuations significant. Within category 2 (Post-harvest processing), the percentage of responses fluctuated between 0 to 15%; within category 6 (Organization of research) – 0 to 17%. Keeping in mind that some of the types of organizations (donors, multilateral development agencies, or farmers' organizations) did not provide many responses, given the questionnaire's objective of aiming frontline researchers, the overall picture across categories shows that most respondents across different types of organizations indicated around one third of

key opportunities in category 1 (Production, productivity and technology) with around 20% of the respondents pointing also to the importance of natural resources and environment as well as institutions and policies.

Table 8: Ranking of six categories for each type of organization listed

	CGIAR center	**Civil Society Organization or NGO**	**Consultant/Self Employed**	**Donor**	**Government agency or Ministry**
1	1. Production, productivity, and technology	1. Production, productivity, and technology	1. Production, productivity, and technology	1. Production, productivity, and technology	1. Production, productivity, and technology
2	4. Natural resources and environment	5. Institutions, policies and markets	5. Institutions, policies and markets	5. Institutions, policies and markets	5. Institutions, policies and markets
3	5. Institutions, policies and markets	4. Natural resources and environment	4. Natural resources and environment	4. Natural resources and environment	4. Natural resources and environment
4	6. Organization of research	3. Consumption and nutrition	6. Organization of research	6. Organization of research	6. Organization of research
5	2. Post-harvest processing	6. Organization of research	3. Consumption and nutrition	3. Consumption and nutrition	2. Post-harvest processing
6	3. Consumption and nutrition	2. Post-harvest processing	2. Post-harvest processing	--	3. Consumption and nutrition
	Other international research organization	**National agricultural research institute**	**National agricultural university**	**Other public research institute**	**Private sector organization**
1	5. Institutions, policies and markets	1. Production, productivity, and technology	1. Production, productivity, and technology	1. Production, productivity, and technology	1. Production, productivity, and technology
2	1. Production, productivity, and technology	4. Natural resources and environment	4. Natural resources and environment	4. Natural resources and environment	5. Institutions, policies and markets
3	4. Natural resources and environment	5. Institutions, policies and markets	5. Institutions, policies and markets	5. Institutions, policies and markets	4. Natural resources and environment
4	2. Post-harvest processing	2. Post-harvest processing	6. Organization of research	3. Consumption and nutrition	2. Post-harvest processing
5	6. Organization of research	3. Consumption and nutrition	3. Consumption and nutrition	2. Post-harvest processing	3. Consumption and nutrition
6	3. Consumption and nutrition	6. Organization of research	2. Post-harvest processing	6. Organization of research	6. Organization of research
	University	**Farmers' organization**	**Multilateral development agency/UN**	**Other**	
1	1. Production, productivity, and technology	1. Production, productivity, and technology	1. Production, productivity, and technology	1. Production, productivity, and technology	
2	5. Institutions, policies and markets	5. Institutions, policies and markets	5. Institutions, policies and markets	6. Organization of research	
3	4. Natural resources and environment	4. Natural resources and environment	4. Natural resources and environment	5. Institutions, policies and markets	
4	2. Post-harvest processing	2. Post-harvest processing	3. Consumption and nutrition	4. Natural resources and environment	
5	3. Consumption and nutrition	3. Consumption and nutrition	6. Organization of research	2. Post-harvest processing	
6	6. Organization of research	--	2. Post-harvest processing	3. Consumption and nutrition	

In addition, as we look within the broad categories at clusters of topics (see Table 9), we see additional variability between different types of organizations. Cluster 1c (crop productivity) was among the top five clusters listed by all but one of the organizational types; cluster 5b (market-related) was ranked in the top five by 10 of 14 organizational types. However, the overall priority given to category 1 (Production, productivity and technology) by some groups (e.g. Civil Society/NGOs) seems to be partly because there are so many clusters under that category.

Table 9: Ranking of top five clusters for each type of organization listed

	CGIAR center	**Civil Society Organization or NGO**	**Consultant/Self Employed**	**Donor***	**Government agency or Ministry**	**Other international research organization**	**National agricultural research institute**
1	1c. Crop productivity	5b. Market-related	1c. Crop productivity	6a. Research-general	1c. Crop productivity	2. Post-harvest	1c. Crop productivity
2	4c. Crop/biodiversity	1c. Crop productivity	6a. Research-general	5f. Capacity, education, extension	4c. Crop/biodiversity	5b. Market-related	2. Post-harvest
3	5b. Market-related	1d. Forestry/agroforestry	5b. Market-related	1c. Crop productivity	1m. Biotic and abiotic stress	1a. Other crops	4c. Crop/biodiversity
4	6a. Research-general	5f. Capacity, education, extension	1m. Biotic and abiotic stress	5b. Market-related	4a. Natural resources	1c. Crop productivity	1m. Biotic and abiotic stress
5	6d. Integration	1a. Other crops	5f. Capacity, education, extension	5a. Policies	2. Post-harvest	5f. Capacity, education, extension	4a. Natural resources
	National agricultural university	**Other public research institute**	**Private sector organization**	**University**	**Farmers' organization**	**Multilateral development agency/UN**	**Other**
1	1c. Crop productivity	1c. Crop productivity	1c. Crop productivity	1c. Crop productivity	1c. Crop productivity	5f. Capacity, education, extension	6d. Integration
2	5f. Capacity, education, extension	2. Post-harvest	5b. Market-related	2. Post-harvest	2. Post-harvest	1a. Other crops	6a. Research-general
3	4c. Crop/biodiversity	5b. Market-related	2. Post-harvest	5b. Market-related	5f. Capacity, education, extension	6d. Integration	1c. Crop productivity
4	1d. Forestry/agroforestry	4c. Crop/biodiversity	1m. Biotic and abiotic stress	1m. Biotic and abiotic stress	5b. Market-related	1h. Agronomic practices	5f. Capacity, education, extension
5	1m. Biotic and abiotic stress	3c. Food safety	5f. Capacity, education, extension	5f. Capacity, education, extension	1m. Biotic and abiotic stress	2. Post-harvest	5b. Market-related

V. Analysis of key opportunities by regions of relevance

Analysis of key opportunities by region of relevance shows an interesting trend. While the *number* of responses by broad category differs substantially by each region (reflecting the primary regional expertise of the respondents), with Sub-Saharan Africa ranking top with most of responses (see Figure 11), further analysis shows that the key opportunities are relatively equally distributed as a percentage for each region (see Figure 12). One implication may be that these topics and categories are seen to have broad relevance across regions.

Figure 11: Number of responses by category identified for each region

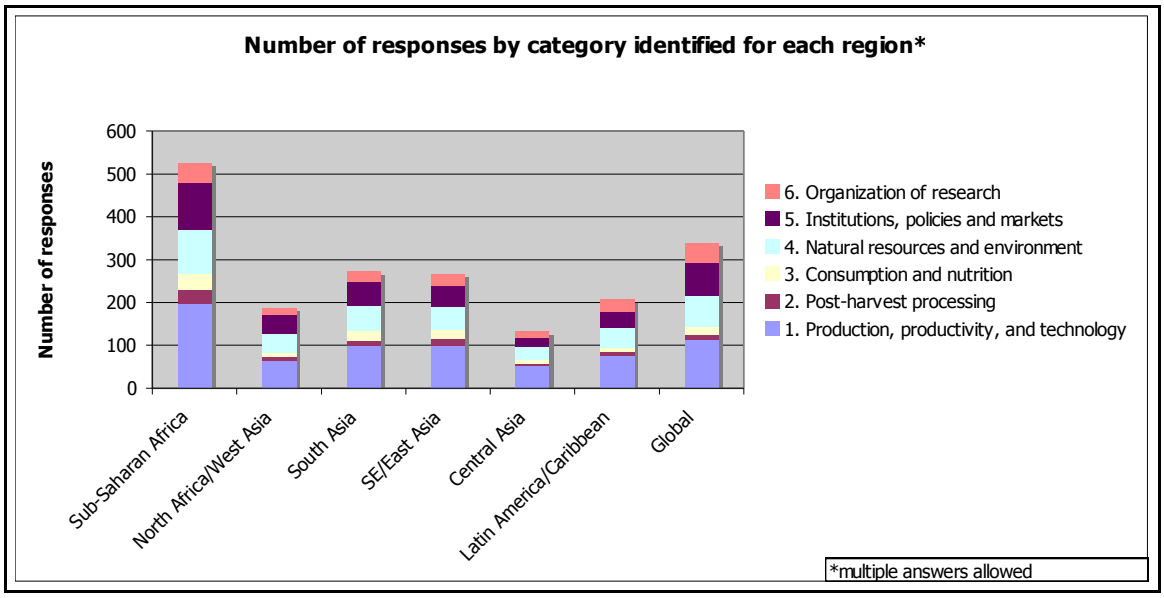
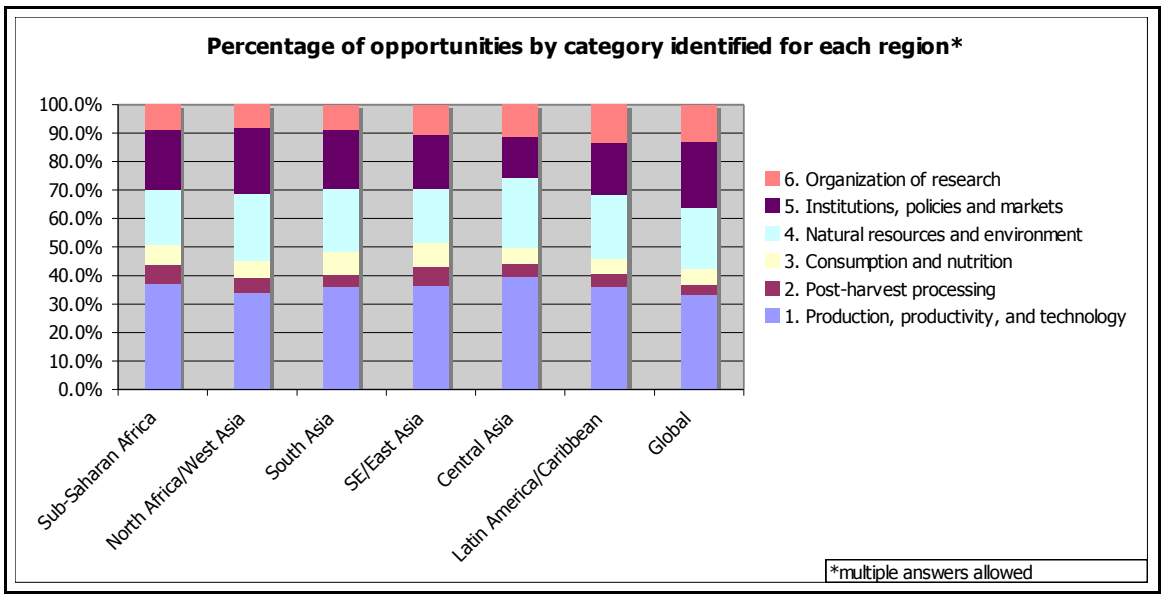


Figure 12: Percentage of opportunities by category identified for each region



Looking at ranking of six categories for each region (see Table 10), we see category 1 (Production, productivity and technology) as dominating category for each region, confirming findings from Figure 11. However, as we look within the broad categories at clusters of topics (see Table 11), we see somewhat more variability between regions, although crop productivity was still most common across all regions. Market-related opportunities were in the top five in all except Central Asia; biotic and abiotic stress cluster in the top five in all except Southeast/East Asia. Water was in the top five clusters in North Africa/West Asia, South Asia, and Central Asia —regions with significant arid or semiarid lands.

Table 10: Ranking of six categories for each region listed

	Sub-Saharan Africa	North Africa/West Asia	South Asia	SE/East Asia	Central Asia	Latin America/Caribbean	Global
1	1. Production, productivity, and technology	1. Production, productivity, and technology	1. Production, productivity, and technology	1. Production, productivity, and technology	1. Production, productivity, and technology	1. Production, productivity, and technology	1. Production, productivity, and technology
2	5. Institutions, policies and markets	4. Natural resources and environment	4. Natural resources and environment	4. Natural resources and environment	4. Natural resources and environment	4. Natural resources and environment	5. Institutions, policies and markets
3	4. Natural resources and environment	5. Institutions, policies and markets	5. Institutions, policies and markets	5. Institutions, policies and markets	5. Institutions, policies and markets	5. Institutions, policies and markets	4. Natural resources and environment
4	6. Organization of research	6. Organization of research	6. Organization of research	6. Organization of research	6. Organization of research	6. Organization of research	6. Organization of research
5	3. Consumption and nutrition	3. Consumption and nutrition	3. Consumption and nutrition	3. Consumption and nutrition	3. Consumption and nutrition	3. Consumption and nutrition	3. Consumption and nutrition
6	2. Post-harvest processing	2. Post-harvest processing	2. Post-harvest processing	2. Post-harvest processing	2. Post-harvest processing	2. Post-harvest processing	2. Post-harvest processing

Table 11: Ranking of top five clusters for each region listed

	Sub-Saharan Africa	North Africa/West Asia	South Asia	SE/East Asia	Central Asia	Latin America/Caribbean	Global
1	1c. Crop productivity	1c. Crop productivity	1c. Crop productivity	1c. Crop productivity	1c. Crop productivity	1c. Crop productivity	1c. Crop productivity
2	5b. Market-related	4d. Water	5a. Policies	5a. Policies	1m. Biotic and abiotic stress	6d. Integration	6a. Research-general
3	1m. Biotic and abiotic stress	5b. Market-related	4d. Water	5b. Market-related	4a. Natural resources	4c. Crop/biodiversity	6d. Integration
4	2. Postharvest	5a. Policies	5b. Market-related	2. Postharvest	4d. Water	5b. Market-related	4c. Crop/biodiversity
5	1d. Forestry/agroforestry	1m. Biotic and abiotic stress	1m. Biotic and abiotic stress	4a. Natural resources	1g. Production technology	1m. Biotic and abiotic stress	1m. Biotic and abiotic stress

VI. Analysis of key opportunities by clusters

Within the broad six categories proposed in section III, the analysis of responses helped to determine a number of clusters for the proposed key opportunities.

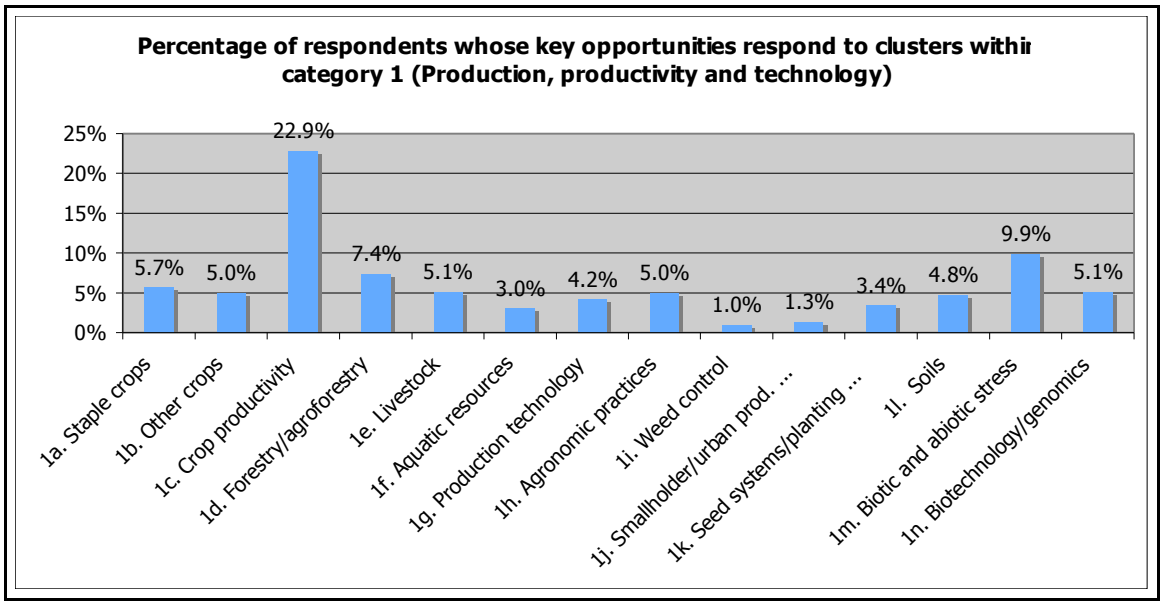
1. Production, productivity, and technology

Within production, productivity, and technology category, the following clusters responding to the proposed key opportunities were identified (see also Figure 13 for additional information):

a. Staple crops

b. Other crops
c. Crop productivity
d. Forestry/agroforestry
e. Livestock
f. Aquatic resources
g. Production technology
h. Agronomic practices
i. Weed control
j. Smallholder/urban production systems
k. Seed systems/planting materials
l. Soils
m. Biotic and abiotic stress
n. Biotechnology/genomics

Figure 13: Percentage of respondents whose key opportunities respond to clusters within category 1 (Production, productivity, and technology)



1a. Staple crops

Approximately 6% of the respondents made explicit mention of one or more of the CGIAR mandate or staple crops, including rice, wheat, maize, potato, sweet potato, tubers, sorghum, legumes, and soybeans. These were generally within the context of key opportunities related to increasing productivity, yield stability, or other traits of that crop, including their potential capacity for improving nutrition.

1b. Other crops

Approximately 5% of the respondents mentioned other specific crops, which are not normally within the CGIAR's mandate crops. These included horticulture, fruit, vegetables, tomato, rapoko, banana, coconut, as well as cash crops such as palms, cacao,

shea, Arabic gum, and bamboo. In general, these were mentioned as being potentially of high value. This cluster also links to the cluster of crop diversification (see section VI.4c.).

1c. Crop productivity

Approximately 23% of respondents identified a key opportunity that related, in some way, to increased productivity, including crop yields, yield stability, or resource use efficiency. In many cases these were very general, although some respondents identified pathways through which these opportunities could be achieved, including plant breeding, hybrids and open pollinated varieties, plant modeling. The most specific suggestion in this cluster related to the potential for improving photosynthetic efficiency of crops:

> "C3 is the photosynthesis pathway that are used by most plant species such as rice, wheat, and potato. C4 is a more efficient way of plants to fix carbon, adopted by maize, sugarcane, and some other species. It was reported that if C4 were engineered into rice, the yield would increase 50%. As C4 plants also have better tolerance to heat and drought, they are likely better adapt to climate change. Increase of C4 acreage also potentially can mitigate the increase of CO2."

1d. Forestry/agroforestry

Although there were not as many responses related to trees as to other crops, the key opportunities identified in forestry and agroforestry identified a number of potential avenues, as well as benefits, from forestry and agroforestry. Natural forest regeneration, participatory tree domestication, and planting of new or improved tree species (e.g. shea nut, gum arabic, palms, cocoa) can provide multiple functions. The research spectrum ranges from selecting, propagating, integrating and marketing of high-value local food and medicinal plants trees, to improving systems for production, processing and marketing tree crops high value regional and international markets, and identifying appropriate forestry policies and institutions.

The multiple functions identified for trees include providing food, medicines, and timber and other products for income and livelihoods, as well as ecosystem services such as preventing land degradation and improving agricultural productivity, and mitigating climatic change. The latter may even increase incomes through Reducing Emissions from Deforestation and Forest Degradation (REDD) schemes. To realize these opportunities, however, requires better understanding of how forests are important and to whom, as well as designing policies and institutions that balance ecoservices and livelihoods improvement; re-considering the role of communities in forest-management, and shifting incentives through expanded markets, benefit sharing (e.g. payment for environmental services), as well as addressing tenure and rights issues (see also section VI.5).

1e. Livestock

Approximately 5% of key opportunities related to livestock, often in the context of integrated crop-livestock production systems involving small holders, as a sustainable

way to increase incomes, nutrition, and the "insurance" value of livestock. Livestock systems were also identified as a source of feeds for aquaculture. Particular mention was made of small-scale dairy, chicken, pig, sheep and goats, even for urban agriculture, with small stock being more likely to be under women's control.

Specific opportunities were identified in terms of:

- germplasm, including indigenous animal genetic resources and genomics-based breeding);
- feeds, including appropriate browse and tropical forages to enhance livestock performance as well as agro-industrial wastes like shea nut cake to improve animal protein availability, lower costs and reduce competition for cereals;
- disease control (with specific mention of vaccines for East Coast fever and thermotolerant Newcastle disease, and control of trypanosomiasis);
- improving knowledge and production/management systems; and
- value-added processing and marketing.

1f. Aquatic resources

Opportunities identified in aquatic resources cluster included both aquaculture and fisheries. Small and medium scale aquaculture as well as community-based fish culture in seasonal flood plains and development of local fish species for culture were all identified as having potential for:

- increasing incomes and protein availability;
- creating investments to improve input and output markets;
- affordable feed using locally available raw materials (agricultural byproducts or plant produce less commonly consumed by human, e.g. cotton seeds, palm kernel meal),
- technologies, knowledge support and capacity building, and necessary regulatory frameworks.

Research opportunities in capture fisheries related more to policies such as defining rights and responsibility for communities and individuals to manage fisheries; developing sustainability indicators for integrated assessment of the management of small-scale fisheries or monitoring migratory species; and fish trade models to analyze the effects of food quality and safety related policies. Respondents noted that improvements in fisheries would also require technologies for improved fish processing to reduce losses, improvement of food safety, and improved nutritional quality of food. On the other hand, to reduce vulnerability and increase resilience of both the fishers and the ecosystems would require development of a range of livelihood diversification options that can be used to lessen people's exclusive dependence on small-scale fisheries.

1g. Production technology

Although technology was mentioned as a key opportunity relatively frequently (8 % of responses), specific farm-level production technologies (as opposed to technologies for research or ICTs, discussed below) were not mentioned, beyond simple technologies,

mechanization, and labor saving technology like mini combines for paddy fields. One respondent suggested small-scale mechanized and multipurpose equipment that could run on renewable energy (solar, biofuel, etc.). Another suggested the need to investigate the calories expended in farm labor compared to caloric intake, which might highlight the importance of labor saving and explain reduced productivity.

1h. Agronomic practices

5% of respondents identified opportunities to improve productivity through enhancement of agronomic practices. One respondent noted that this requires knowledge of local or regional crop production processes. Several others called for conservation agriculture (resource-conserving technologies), including minimum tillage, residue retention, diversified crop rotation, and proper weed management. Precision conservation agriculture (also mentioned) goes one step further, using satellite images to identify health status of crops and precision devices for application of agrochemicals, with mulching and rotations. Other sustainable farming methods such as composting, agroforestry, and increased legume crops/pastures in the systems; integrated pests and diseases management; and system of rice intensification were also proposed. While some suggested low carbon or low input, ecological farming and organic farming, using natural biodiversity, others called for further work on low-cost hydroponic production in areas with restricted cultivatable land, as well as greenhouses operating on minimum power demands with solar photovoltaic electricity.

1i. Weed control

Although weed control can be considered part of agronomic practices, five responses (1.3%) gave particular attention to control of invasive species and other weeds. Chemical weed control to reduce hand weeding was mentioned, along with developing herbicide tolerant rice. One specific technique is using the Striga pathogen Fusarium oxysporum f.sp. strigae as a mycoherbicide, applied as seed treatment, which is estimated to reduce Striga infestation 50 to 70% and increase yields by 15 to 20% in striga-infested areas.

1j. Smallholder/urban production

Most of those suggesting opportunities for small-scale production systems were also concerned with peri-urban production, and impact on urban consumers. Methods of small scale food production in confined spaces using recycled resources were suggested, along with intensive, organic vegetable production using a wide variety of (mainly) local, indigenous food and medicinal crops, as were income generating activities like small livestock. However, respondents also noted the need to ensure safe and healthy food systems through the elimination of the injudicious over use of pesticides, food adulteration from using composts and manures with excess heavy metal concentrations, contamination of food products through poor storage or use of wastewater in peri-urban environments. Programs like Equador's the Canastas Comunitarias to link periurban farmers to poor consumers were suggested as one way to allow urban populations, in

particular the poor, to access affordable, healthy food, and for smallholder farmers to receive fair prices for their commodities.

1k. Seed systems/planting materials

Within the 3% of responses related to seed systems, there was still diversity of approaches. Some focused on availability of "improved" seed (e.g. high-yielding, disease free, or treated seeds, tissue culture or clonal propagation of planting materials) combined with timely fertilizers in chemical combinations, in small packages to suit poor producers. Others focused on community seed banks and farmer to farmer seed fairs to maintain agrobiodiversity through land races and local tree species for local adaptation and food sovereignty.

1l. Soils

Nearly 5% of responses related to soil fertility as a way of ensuring agricultural productivity and environmental benefits, especially carbon sequestration. Some of these dealt with soil conservation or ensuring fertilizer availability and affordability for smallholder farmers, including small packages; others focused on efficiency of fertilizer use by developing microdosing techniques or breeding for low soil fertility requirements. In addition to chemical fertilizers, a number of respondents stressed use of locally available materials such as biochar or composting and recycling organic materials. Respondents also noted that methods of integrated use of cover crops, trees, and legumes to provide nutrients, especially atmospheric nitrogen and below-ground carbon sequestration are currently available. On the other hand, pelleting of livestock waste and manure management to use as fertilizer could increase crop production while reducing pollution, but this would require further work to be affordable and widespread. Other opportunities, such as breeding non-leguminous crops for N fixation, would require more time. Finally, five responses suggested using soil microorganisms (e.g. Mycorriza and Rhizobia) as a bio fertilizer for plant nutrition and health, reducing environmental degradation and controlling emission of greenhouse gases.

1m. Biotic and abiotic stress

While reducing crop losses has always been important to farmers, climate change has the potential to increase the frequency, severity, and unpredictability of weather-related shocks as well as insect and disease attacks. Ten percent of the responses identified key opportunities related to responses to abiotic and biotic stress. Drought was the most commonly cited abiotic stress, but heat, submergence, salinity, acid soils, and low soil fertility were also mentioned. Breeding—using conventional and marker-assisted or biotechnology approaches—was the main strategy cited for abiotic stress resistance, but some also suggested agronomic practices (e.g. composting) and use of wild relatives and crop diversification to increase adaptation. Biotic stresses mentioned included both pests (usually insects, but some other animals) and diseases. Pest control can also affect human health, both when the insects affected (e.g. ticks, mosquitoes) are also vectors for human diseases, and when levels of pesticide use are increased/decreased. Many suggested

breeding (using conventional and marker-assisted or transgenic approaches drawing on wild relatives) and vaccines for disease resistance, but a wide range of integrated pest management (IPM) approaches were also suggested. Building partnerships between scientists and farmers with indigenous knowledge was seen as important for achieving this. Specific techniques include understanding foodwebs and their role in disease transmission in agroecosystems; phenology modeling, risk mapping, crop and varietal diversity to reduce disease transmission; improved quality and dissemination of diagnostic protocols and toolkits; ICTs for sharing information on pests and disease, and improved quarantines; healthy seeds and planting materials; and plant nutrition and association with microorganism for disease reduction. In view of concerns to reduce the negative environmental and health effects of chemical pesticides, there were numerous suggestions of promising alternatives, including biological pesticides and biofungicides using botanical extracts, semiochemicals, insect sex pheromones, and even specific suggestions such as using weaver ants for biological control.

1n. Biotechnology/genomics

The 3.4% of respondents whose answers fall in the biotechnology cluster identified a range of opportunities, from upstream genomics to applied technologies such as marker-assisted breeding and diagnostics. Several were vague, referring only to biotechnology's potential to improve crop varieties. Others were quite specific. For example, among the relatively upstream opportunities, one respondent suggested further work with model plant species could help to identify useful genes and genetic switches that could be used to shed light on the genomics of crop plants. Another suggested basic research into the manipulation of meiotic recombination—the process that actually governs the exchange of genes and traits via the breeding process. Yet another suggested that high-throughput sequencing approaches might make it easier to identify connections between genes and traits:

> "Second-generation DNA sequencing technologies have dramatically lower down the cost of genomic research, making it possible to fully unveil the allelic variation of all important agricultural species. Association of this unprecedented resource with existing and coming phenotyping data will lead to defined relationship between genes and traits, a key knowledge for breeders to produce better versions of plants and animals."

The use of molecular techniques for direct breeding and germplasm enhancement was mentioned several times—with reference to crops including maize, cocoa, coconut, and bananas. Several respondents indicated that there might be complementarities between new molecular technologies and the collection and conservation of germplasm resources. In particular, molecular techniques might make it easier to identify useful genes and to transfer them from landrace crop varieties into improved varieties, or from indigenous livestock breeds into high-productivity animals. One response focused on the capacity building aspects of biotechnology, along with other research tools and procedures:

> "Development of regional crop improvement networks that provide researchers in developing countries better access to improved germplasm, information management tools, standardized protocols, and biotechnology tools to improve the effectiveness of selecting improved cultivars."

2. *Post-harvest processing and marketing*

Post-harvest processing has not been a major focus of the CGIAR in the past, but there is growing attention to this area, with 9.3% of respondents mentioning some aspect of post-harvest storage, processing, or value addition. Respondents noted that many producers lose a lot of the quantity, nutritional quality, and value of their output due to poor storage and handling. While this affects staple grains as well, it is particularly serious for potentially high-value produce such as horticulture, fish, or livestock products. Poor storage and processing also limits the availability and affordability of food between harvests.

Respondents suggested such opportunities as improved storage, preservation, packaging, value added processing, and development of a supply-chain innovation between producers and processors (in order to enable a better return to the primary producer and health benefits from improved food safety and nutrition for the consumer). Innovations in this area are particularly likely to benefit women because post-harvest processing is often in women's domain (e.g. in fisheries), and the benefits are seen not just in income increase, but also in improvement of nutritional quality and safety of foods, as well as potentially in reducing women's labor burdens for processing. Reducing post-harvest losses is also an environmentally beneficial way of increasing food availability without the damage that may be caused by expanding cultivated areas or harvesting more fish (and the same principle would apply to other types of harvests).

There was particular emphasis on development of technology of processing (e.g. drying) at the local level, with locally adapted technology, small-scale mechanized and multipurpose equipment that could run on renewable energy (see also section VI.1g). Sanitary and phytosanitary measures (SPS) were noted as particularly important. Specific technologies suggested in this area include application of enzymes for detoxification of cassava (previously done through a traditional process of heap fermentation that takes a long time and is not foolproof) using the fungi Rhizopus oligosporus; elimination of methyl bromide for food preservation using new technologies for dates, dried fruits and vegetables; concentration of juice for nutritional preservation without heating; and development of readily available/accessible starter cultures for fermented foods.

However, before investing too much in the development of new technologies, it is relevant to note one submission:

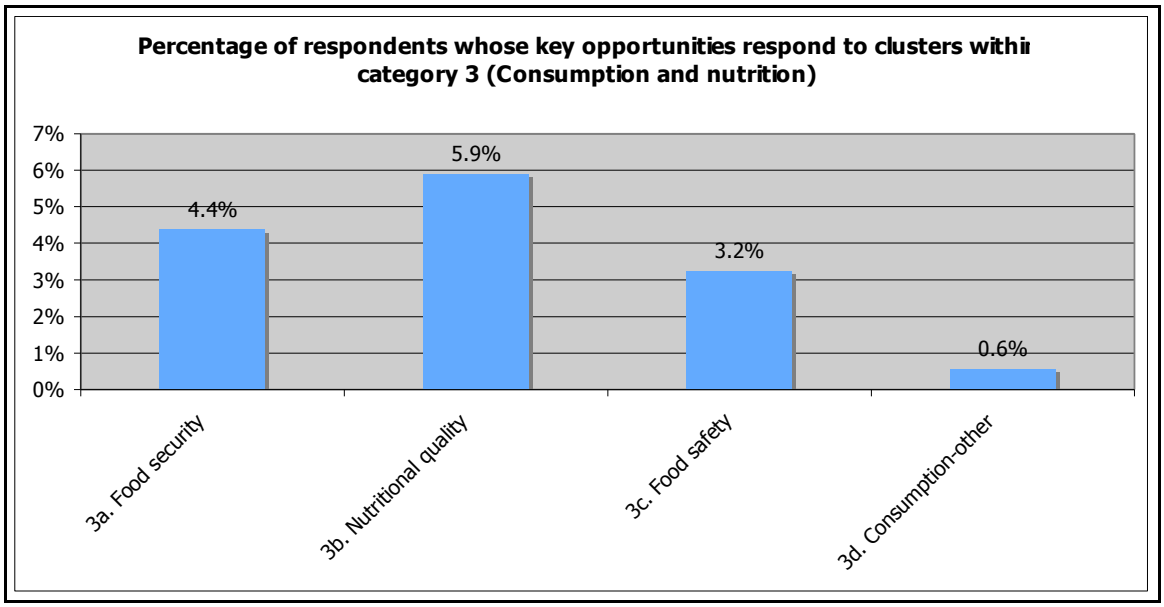
> "Many postharvest technologies are available in the shelves but rarely are they disseminated at large scale. Dissemination activities need to recognize that actors other than farmers need to be involved (i.e. collectors, wholesalers), as they decide over quality traits (i.e. maturity, color) and packaging of produce that they purchase from farmers."

3. *Consumption and nutrition*

Within this category, the analysis of responses helped to determine a number of clusters for the proposed key opportunities as the following (see also Figure 14 for additional information):

a. Food security
b. Nutritional quality
c. Food safety
d. Consumption-other

Figure 14: Percentage of respondents whose key opportunities respond to clusters within category 3 (Consumption and nutrition)



3a. Food security

Nearly 5% of respondents cited food security as a key opportunity. Within this subset of responses, many respondents focused on improving crop production and productivity and reducing waste of resources. The frequently mentioned mechanisms for achieving such results included improvements in production technology, post-harvest storage, post-harvest processing and food supply chains and reductions in the seasonal variability in food availability that artificially drives prices up or down. In addition to responses related to production, a large number of respondents stated that improvements in nutrition security are key to improving overall food security. Several of these respondents maintained that this is particularly essential in order to reduce the disparities in nutritional status often faced by women and youth.

3b. Nutritional quality

Improving nutritional quality was cited by almost 6% of respondents. There were three broad mechanisms mentioned for achieving this: biofortification; improved methods of post-harvest processing; and diet diversification. Respondents emphasized that there needs to be a wide scale shift from indigenous vegetables to improved varieties and diet diversification. In particular, a few respondents stressed the importance of legumes and vegetables to improving nutritional quality. One respondent warned against relying too heavily on food processing by bringing up the case of Ecuador where the divide between

rural producers and urban consumer prevented the urban poor from accessing healthy unprocessed food and sparked an obesity epidemic.

3c. Food safety

Most of the 3.2% of respondents who reported key opportunities in the area of food safety dealt with improvements in food processing, such as reductions in usage of harmful substances used in preservation; application of appropriate enzymes for detoxificiation during processing; and reduction of spoilage through increased efficiency in processing and decreased storage time. In addition to these suggestions, a sub-set of respondents stated that food security could best be achieved through phytosanitary controls (see also section VI.2). A few respondents also cite the important role that education can play in improving food safety.

3d. Consumption-other

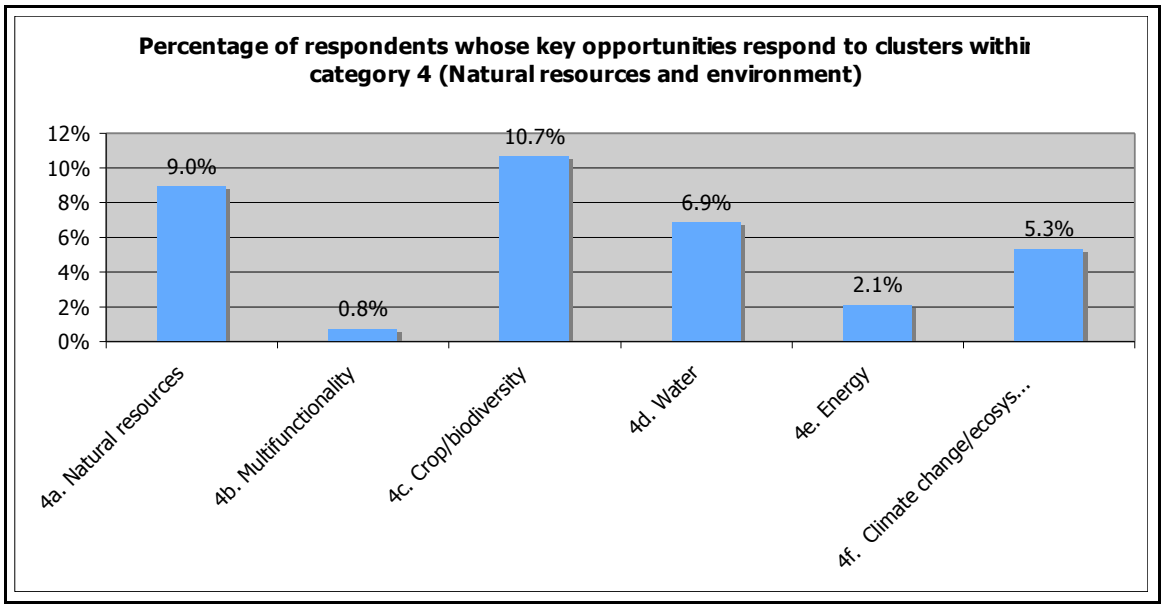
Key opportunities classified as 'other consumption' (about 0.6%) ranged from farmer to farmer seed fairs, to development of late blight resistant varieties with improved culinary qualities.

4. *Natural resources and environment*

Within this category, the analysis of responses helped to determine a number of clusters for the proposed key opportunities, as the following (see also Figure 15 for additional information):

a. Natural resources
b. Multifunctionality
c. Crop/biodiversity
d. Water
e. Energy
f. Climate change/ecosystem services

Figure 15: Percentage of the respondents whose key opportunity classifies within the clusters of category 4 (Natural resources and environment)



4a. Natural resources

Nine percent of responses related to the broad category of natural resources stressed efficient use and conservation of natural resources for food production to improve productivity, sustainability and resilience, as well as generating multiple ecosystem services (e.g. soil water storage, increasing rural energy security, conservation of biodiversity, reduced pollution and green house gas emissions). Particular mechanisms mentioned included land use planning and management at the landscape level. Some responses stressed the need for active participation of farmers, others pointed to the potential value of models (but noted the difficulty of getting necessary data for modeling many ecological niches, and therefore the need for collaboration between CGIAR and NAR centers), while others called for adaptive learning processes:

> "Adaptive management of natural resources…. is a systematic process for continually improving management policies and practices by learning from outcomes of operations. It is flexible and responsive to new knowledge gained by targeting research to management needs; monitoring, evaluation, review and reporting of progress and by continually improving stakeholder capacity, skills and learning. It involves synthesizing existing knowledge, exploring alternative actions by making predictions about future trends and outcomes, then agreeing on and implementing the preferred strategy. Further research, objectives and actions are then based on improved understanding and outcomes of monitoring and review."

Several mentioned the need for accompanying institutional arrangements (e.g. secure property rights and coordination mechanisms) for smallholders to make the adoption of improved resource management viable. Many responses related to this overall category pointed to the importance of interdisciplinary approaches such as:

> "Interdisciplinary frameworks for environmental management and human development and simple methodologies for participatory diagnostic approaches to governance that are appropriate for developing country contexts… "

> "Food-Water-Ecosystem nexus with a Poverty focus: research at the interface between food, water and ecosystem to increase the social and ecological resilience of farming systems and beyond (up to global system)."

4b. Multifunctionality

Four of the responses provided under this cluster referred to the importance of understanding the multifunctionality of agriculture and natural resource management, especially regarding water and forests.

4c. Crop/biodiversity

With 10.7% of respondents mentioning some aspect of biodiversity or agrobiodiversity, this cluster was second only to the general category of crop productivity in frequency of mention. Conservation and use of diversity was mentioned, including diversity of varieties of crops and livestock breeds, diversity of plants cultivated (greater attention to underutilized crops), as well as wild relatives of crops and recognizing the interactions between agriculture and wild flora and fauna, especially in biodiversity hot spots. Reasons for stressing diversity, as opposed to monocropping, included improvement of health and resilience of humans (through diet diversity for improved nutrition, and medicinal plants), of agricultural systems (through improved resistance to disease or adaptation to climate change), and of ecosystems.

Some respondents stressed technical approaches to use of genetic diversity through breeding, molecular analysis, or resequencing combined with genetic analysis of crop diversity panels. Others emphasized the need to tap into indigenous knowledge and practices (e.g. participatory tree domestication as a process of selecting, propagating, integrating and marketing of high-value local food and medicinal plants; developing improved propagation materials; or farmer to farmer seed fairs) and to create incentives for farmers to maintain biodiversity, especially by increasing the profitability of diverse agricultural enterprises, e.g. through increasing agroprocessing and expanding markets for underutilized crops. This approach calls for looking beyond the main crop fields to also include home gardens and plants that are wild harvested on the commons or fallow lands.

4d. Water

Approximately 7% of responses related to some form of improved water management. While water has always been important to agriculture, several respondents noted the changing context of water management, including climate change and greater competition between water use sectors.

> "Current water resource management is clearly inadequate to cope with the flexibility necessary to satisfy multiple and changing demands (agriculture, urban, industry,

> environment) from a single source (freshwater). A framework that involves multiple water sources and quality (blue water, recycle water, urban runoff, etc.) and multiple demands will be necessary."

Several of the responses noted the need for water systems that address multiple uses, including domestic water supplies, livestock, home gardens and irrigation. Recommendations represented a continuum from improved land management practices for soil water conservation, local water harvesting or aquifer recharge, to supplemental irrigation, to technologically sophisticated techniques such as drip irrigation or fertigation, desalination, and developing crops suited to saline agriculture. However, respondents noted that technologies alone are not sufficient:

> "Research highlights the potential of agricultural water management (AWM) for poverty alleviation. In practice, however, adoption rates of AWM interventions remain low. Moreover, even where adoption has taken place locally, implementing programs promoting adoption at a large scale, in a manner that is sustainable, and that targets benefits to the poorest people, including women, remains a challenge. Understanding the constraints to AWM adoption in different settings and concrete measures to overcoming them opens significant opportunities for successfully achieving pro-poor, gender-equitable AWM investments in the future."

Thus, water management requires complementary interventions such as microfinance, building of social capital and collective action for joint investment and management of water, or other policy interventions such as energy pricing to control groundwater depletion.

4e. Energy

Approximately 2% of responses related to agriculture-energy links, either stressing the need for alternative energy sources (e.g. wind, solar, electricity) as an input to agriculture, or the need for further research on ways that agriculture can produce fuel, including biofuels, alternate fuel feedstock (e.g. switchgrass), and rural energy for cooking, etc.

4f. Climate change/ecosystem services

Five percent of responses related to the cluster on climate change and ecosystem services. Of these, the potential for agriculture and forestry to contribute to the mitigation of climate change was noted, both through above-ground carbon sequestration (especially through trees and other plant matter and agronomic practices), but also soil carbon through changes in the soil microbial community to control the carbon and nitrogen cycles. As in the case of biodiversity conservation, achieving this requires incentives and viable mechanisms for compensating the rural communities for the maintenance of the ecosystems services (e.g. REDD):

> "To realize these opportunities, however, national policies and institutions should consider new development paradigms, find a balance between development and forest, ecoservices and livelihoods improvement; shift incentives, introduce new benefit sharing and co-benefit schemes, re-consider the role of communities in forest-

> management, employ the markets; address tenure and rights issues and many other challenges."

Other responses in this cluster related to agricultural research for adaptation to climate change. This includes many of the approaches on breeding, water harvesting, and agronomic practices to adapt to abiotic stresses discussed above, but also information on climate change, insurance mechanisms, etc.

> "Science-based solutions to the adaptation challenges to climate change for the rural poor, especially the Joint climate scenario development and disaster risk mapping at community level for sustainable agricultural and weather-indexed insurance schemes; involving local government, scientific institutions and communities."

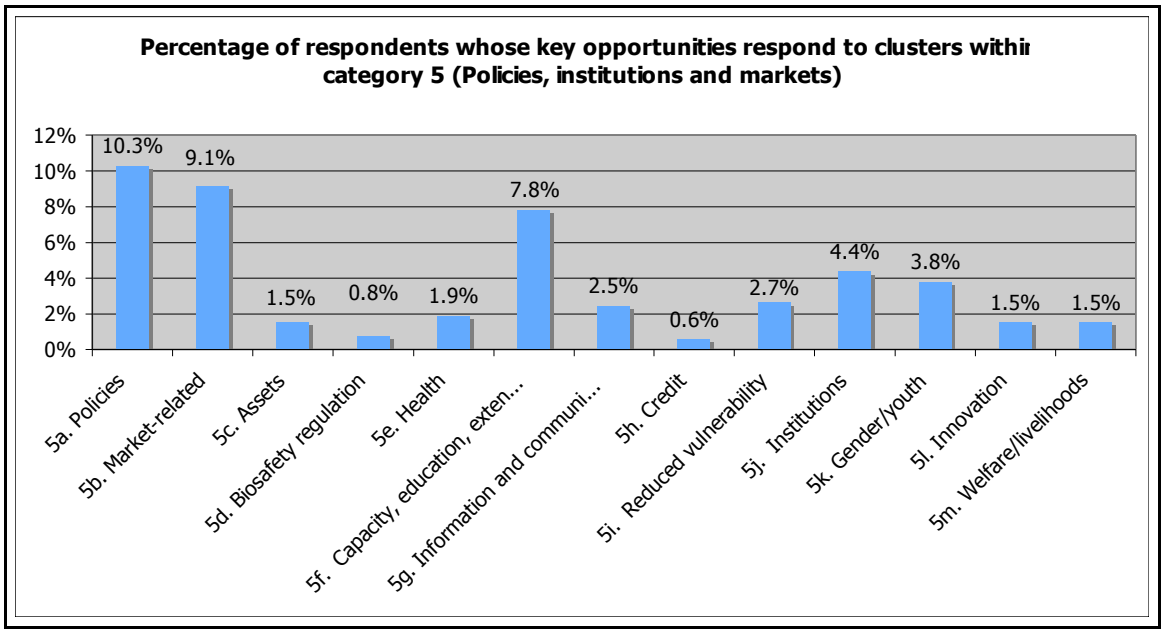
> "Rural Climate Information Services: Routine provision of climate information (historic observations, monitoring, prediction at multiple lead times); including value-added information in the form of agricultural production forecasts, and training and guidance on interpretation and management implications; targeting rural communities and institutional stakeholders. Climate information should be part of a package with, e.g., market and soil information and technical guidance."

5. *Institutions, policies and markets*

Within institutions, policies and markets category, the analysis of responses helped to determine a number of clusters for the proposed key opportunities, as the following (see also Figure 16 for additional information):

a. Policies
b. Market-related
c. Assets
d. Biosafety regulation
e. Health
f. Capacity, education, extension
g. Information and communication technology
h. Credit
i. Reduced vulnerability
j. Institutions
k. Gender/youth
l. Innovation
m. Welfare/livelihoods

Figure 16: Percentage of the respondents whose key opportunity classifies within the clusters of category 5 (Institutions, policies and markets)



5a. Policies

Over 10% of responses referred to or provided direct key opportunities in the area of policy environment. While a large number of these responses simply pointed to the importance of the appropriate and nurturing policy environment, need for policy changes in certain area of agricultural research or ensuring the implementation of the right policies, there were several appeals for establishing better policies for natural resource management, in particular in the areas of fisheries, forestry and water. These policies were closely linked with establishing also a legal framework for land tenure, land tenure reform and property rights. A number of respondents pointed out that in the area of carbon sequestration and REDD, without a proper policy framework in most developing countries, local ownership and the emphasis community-driven natural resource management, those opportunities for fighting climate change and assisting forest-dependent communities are not going to be realized.

Several key opportunities referred to the importance of community-driven and small-scale farmers' responsive policies as well as the importance of linking the global scale research with local scale efforts. Finally, a number of responses pointed to the importance of local governance, local capacity building (including boundary spanning) and participatory methods.

> "Further applying tested stakeholder participatory methods and supporting tools (predominantly used at farm scale to date) - however, we still need to link these systems approaches better with policy domain in a meaningful way. The key opportunity for innovation is developing the boundary-spanning people and institutions to effect appropriate responses to multiple drivers. Critical elements include: avenues for stakeholder recognition and publication, clear career paths and reward systems for

> boundary spanners. Subsidiary innovation is around the methods for linking the farm scale with the policy scale."

> 'Innovations in local scale efforts and global analyses remain disconnected by a lack of understanding of the intermediate processes and structures. There is little research that can link local, context-specific dynamics to global policy processes. Understanding the policies, institutions and networks that work in this middle ground is particularly necessary considering the wide-ranging effects of global processes / crises (e.g. food price, fuel price and economic and financial crises)."

Given that altogether over 50 responses mentioned policies, it is clear that this area is an important pillar in the area of agricultural research. Further, many of the responses indicate the need for policy work to complement other types of research, especially on NRM (see also section VI.6).

5b. Market-related

Over 9% of responses referred to agricultural markets and market access, marketing, value chains, and trade issues. Most responses simply pointed to the importance of creating the appropriate market access, especially for small-scale farmers and women, many of them focusing on access to information (see section VI.5g.) as an important pre-condition for successful marketing and ensuring fair prices to the small-scale producers.

A large number of key opportunities also focused on the innovation along value chains, especially those that would benefit small-scale farmers; "farmer institutions for collective marketing and joint experimentation"; further development of farmers' cooperatives; outgrower schemes as an alternative to improving input and output markets or "supply-chain innovation between producers and processors; and Participatory Market Chain Approach (PMCA):

> "The PMCA focuses on innovation in products, technologies, and ways of working together. By carefully selecting market chains and partners, and building in social responsibility, the PMCA can lead to favorable outcomes and impacts for poor farmers, typically the weakest link in the chain. To ensure that impacts are sustained, the PMCA is best used as part of a broader programme of market chain development. It facilitates group processes in which market opportunities are identified and assessed, and innovations developed. Three types of innovation may result: > Commercial innovations, such as new or improved products > Technological innovations, such as new production or post-harvest practices > Institutional innovations, such as new ways for small farmers to work with market agents or service providers."

> "Strategies for developing key value chains for getting the poor over the threshold into market-oriented production. Adopting an integrated, holistic approach to designing and supporting implementation of upgrading of agricultural commodity value chains that includes growing local service and input provision (e.g. BDS) to support more intensive production systems, institutional arrangements that improve access to input markets, services and output markets, and growing the commodity value chains in such a way to promote broad-based development and employment opportunities."

There was a dichotomy between some respondents who suggested focusing on improvement of value chains for major commodities ("value chain for exports", "value

chains Development in Major Commodities focuses on GDP gains and global national / regional food security") and those who proposed research and investment in developing value chains for specific, oftentimes niche, but possibly high value crops, such as cocoa, or medicinal herbs or plants.

Finally, a number of responses pointed to the importance of policies related to trade, both at the national level but also across boundaries at a regional level; one respondent even proposed to "help SSA economic regions to set up a Common Agricultural Policy".

5c. Assets

Most of key opportunities within this clusters referred to the issue of property rights and the need for land tenure policies (see section 5a.), the importance of enforcement of such tenure rights (if they exist), and securing access to assets (such as land or property rights), especially to the most vulnerable groups, such as women.

> "Measure the gap between tenure rights "on paper" and actual enforcement of these tenure rights in community forestry in developing countries."

> "Secure ownership of land resources including services such as carbon sequestration and the role of forests in watershed management, (availability of water for consumption and hydropower) and establish viable mechanisms for compensating the rural communities for the maintenance of the ecosystems services."

5d. Biosafety regulation

Key opportunities in this area focused on the need for regulations and regulatory systems for biosafety and food safety to be firmly established in developing countries and functional. One proposal called for:

> "Streamline regulation of biotechnology innovation- based on expected benefit cost ratio adjusted to risk of regulatory process."

5e. Health

Within this clusters, the key opportunities looked mainly at the health risks of agriculture, both as a problem to be solved but also an opportunity. On the one hand, respondents noted that there still exists a need "to ensure safe and healthy food systems" and to reduce negative health impacts (also in the area of environmental health) in such areas as:

> "vector born diseases for instance through increased level of irrigated agriculture in Africa; also food contamination through mycotoxins (often vectored by insects); zoonotic diseases"

Agriculture can also have a direct impact on human health and one proposal included looking at the implications of "prevention dividend" as related to food security and disease prevention. On the other hand, some proposals put forward agriculture as an opportunity for improving human health through, for example, delivery of vaccines

through plants or in feed. Finally, there were proposals to look at the impact of trainings incorporating health dimension into farmers' education (and inclusion of such training into agricultural extension programs and farmer field schools) to ensure less incidence of sickness among farmers and hence higher potential productivity.

5f. Capacity, education, extension

In this area, many respondents stated that capacity building and education matters, but is not sufficiently addressed at the farmer level or at the local through national levels. Many respondents also underlined the importance of education and delivering the innovative research in a 'user-friendly' way to the farmers (knowledge sharing). As emphasized in one response, there is a need to build capacity of farmers' leaders and venues for farmers' perspectives to be heard:

> "Building capacity of farmer leaders to source information, markets and their ability to articulate their needs to government staff and other stakeholders. This was done by establishing a platform with different stakeholders in the intervention community to ensure that community based organizations and other local organizations that have longer term interests and who are well rooted in the community should be part and parcel of the initiative for sustainability issues."

> "Capacity-building in support of all chains of the educational systems in view of developing locally adapted, problem/problem-solving oriented, holistic/multidisciplinary curricula, based on close dialogue/joint projects between producers (farmers, industries, service providers), public authorities, civil society organizations, and the educational institutions."

Some number of respondents brought up capacity building in the context of integrated water resources and natural resource management in general. Others mentioned "agriculture as a profession," understanding that no agricultural revolution (technological or otherwise) is going to occur without a cadre of young professionals who perceive agriculture as a business enterprise and income opportunity, especially in Sub-Saharan Africa, and suggested the use of Field Farmer Schools "to educate farmers in the skills necessary for a modern, market-oriented economy."

5g. Information and communication technology

Responses in this area concentrated not only on the latest trends, like using information and communication technology, especially cell phones, to access technical and market information by farmers but also on the need to develop wider technology networks and systems and create information hubs at regional level. A number of responses also pointed to the linkages between knowledge sharing and information technology - that with improved technological innovations, we should expect more information sharing at the level of scientific community as well as farmers' groups but that this is not currently the case. Some offered proposals on linking information technology with better natural resource management as well as weather and crop advisory services. Some pointed to the importance of education (basic and advanced) for the information technology to be picked up by the poorest and least educated farmers.

5h. Credit

In this area, respondents focused mainly on the access to finance in the agriculture sector and specifically on the importance of development microfinance institutions for agriculture:

> "Microfinance addresses the small (micro) credit needs of families which are normally not included by mainstream rural credit institutions. Although hundreds of Microfinance Institutions (MFIs) have mushroomed globally very few of them have perfected the art of financing farmers with small loans. With Housing Microfinance already being recognized as a sub-sector of Microfinance, similarly we need to focus on Agriculture Microfinance also as a major sub-sector of Microfinance."

5i. Reduced vulnerability

Recognizing that agriculture is prone to fluctuations and vulnerability is an important aspect of poverty, some of the key opportunities related to developing formal programs of cash transfers and safety nets as well as social networks for poor families in rural areas as a means of reducing their vulnerability. Some responses also called for increased resilience of small-scale farmers through development of alternative livelihoods (which, some argued, is key for diversification of incomes in areas such as small-scale fishing), crop diversification or greater integration of crop and livestock production.

5j. Institutions

Among the 5% of responses that referred to institutions, many of the key opportunities proposed focused on strengthening local and national institutions (including improved governance and reforming public administration in charge of agriculture) and called for more responsiveness to farmers' needs. Others saw key opportunities in fostering farmers' organization, including cooperatives as well as institution building within producer organizations. A few responses referred to specific opportunities in collective action, especially focused on collective production (for example, of medical and aromatic plants) as well as forestry (tree planting) and fisheries.

5k. Gender/youth

In addition to indicating the gender impact of key opportunities for each proposal provided, some respondents also provided more specific suggestions on importance of gender analysis and the inclusion of the needs of women and youth in agricultural research. A number of entries in this regard, simply underlined the importance of creating "platform for gender-responsive agricultural R&D", "addressing gender issues/gender inequality in all stages of agricultural research and dissemination", "empowering women with the knowledge, access to assets, and decision making authority to contribute fully to agricultural development." There were also a number of more specific suggestions regarding gender and research opportunities:

> "Another opportunity is to foster gender equitable change processes. Current research is underway to understand the dynamics of network formation (by gender) and mapping the network architecture of rural communities."

> "Link agricultural research on market performance to small-medium regional units' (municipality, province, etc) programs addressed to women."

In addition, a number of respondents emphasized the need for inclusion of women in decision-making processes in natural resource management, strategies for adaptation and mitigation to climate change (as an integral part of agricultural development programs), and agricultural production, to recognize the key role that women play in agricultural production as well as the constraints that they face, and direct resources and programs to them, drawing on sociological and anthropological knowledge and understanding of family dynamics. Finally, youth was mentioned also in the context of inclusion in agriculture R&D as well as one of the vulnerable groups that deserves more attention in project implementation.

5l. Innovation

Opportunities in this area focused on proposals that would foster innovation in research and productivity enhancement. Some respondents suggested examining and learning from current programs (such as "Convergence of sciences") that try to look at farmers' own experimentation in the area of productivity enhancements, understand why it works and see if there is an opportunity for scaling-up this innovation more globally; or find CGIAR consensus on agricultural innovation systems approaches. Others suggested looking at the success of innovation after adoption in form of prize reward programs:

> "A "prize rewards" program could pay innovators, including NARS and CG centers as well as private firms and NGOs, cash awards in proportion to measured impacts of their innovations after adoption."

5m. Welfare/livelihoods

The cluster on welfare and livelihoods included responses highlighting the need to look at agriculture within a broader picture of welfare and livelihoods, including the creation of off-farm employment opportunities as a means of income diversification, and even to go beyond narrow economic measures to include human rights approaches and:

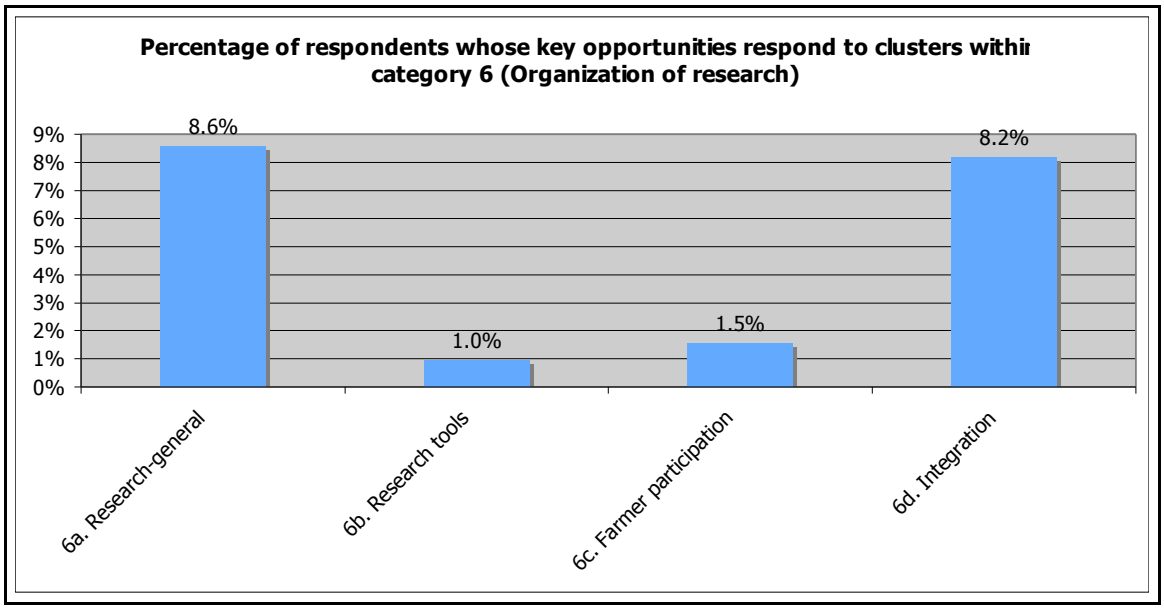
> "To develop a "well-being index" and "partner satisfaction index" at national level for developing countries we work in, based on indicators identified by our beneficiaries and partners. This would determine, monitor and assess that the aims of our agricultural research, technological interventions and policies are consistent with the needs of those whom we claim to serve."

6. Organization of research

Within organization of research category, the analysis of responses helped to determine a number of clusters for the proposed key opportunities, as the following (see also Figure 17 for additional information):

a. Research-general
b. Research tools
c. Farmer participation
d. Integration

Figure 17: Percentage of the respondents whose key opportunity classifies within the clusters of category 6 (Organization of research)



The research-general cluster included suggestions on *how* research should be done. One percent of responses referred to specific tools, and 1.5% explicitly to the need for farmer participation. The final cluster on integration underscores the limitations of narrowly defined topical or disciplinary research: eight percent of responses related to any of the categories or clusters listed for the whole questionnaire referred to the need for integrated approaches. In addition, there were some general trends that ran through all of the clusters in category 6 that are worth mentioning. Many respondents underlined the importance of policy-oriented research that can be easily converted into practical recommendations and in-the-field applications, especially for developing countries. Respondents indicated the need for more participatory nature of research that is, on the one hand, customer demand-driven (whether this customer is a consumer, smallholder farmer or policy maker) but also bottom-up rather than top-down in its design. This also spoke to the need to be more inclusive in the research design to ensure inclusion of such vulnerable groups as women, youth and children and the poorest farmers in the priority setting and research design.

Respondents pointed to the importance of facilitating meaningful interactions among a wide range of stakeholders but also emphasized that knowledge sharing, even among research hubs and institutions is still lacking and unsatisfactory despite the progress in communication technology; this oftentimes results in the inability to deliver appropriate knowledge products to the ultimate users of the agricultural research – the farmers.

> "Truly integrated approach of research for development, that tackles local problems with the support of global knowledge pool. Research for development resources should not be used for research only aimed at filling the global knowledge pool."

Many therefore offered opportunities related to designing better diagnostic and analytical tools, including better modeling.

VII. Correspondence between key opportunities and emerging Mega Programs

The analysis of key opportunities identified by scientists was done without reference to the latest work by the SRF committee on identifying Mega Programs (although some of the clusters were influenced by earlier broad categories of research identified by the SRF committee's prior reports). Nevertheless, it is possible to link most of the clusters from the questionnaire into one or more of the emerging Mega Program topics. Table 8 provides an overview of these linkages. A bolded **indicates a primary linkage, while a single * indicates a secondary linkage, where a particular cluster is still relevant to a particular Mega Program. The following discussion briefly summarizes the clusters from the questionnaire under each Mega Program. As each Mega Program is developed, it would be worth revisiting the original responses under each cluster that is identified as relevant, to identify key opportunities as building blocks of that Mega Program.

1 Crop Germplasm Enhancement and Production

The following clusters from the questionnaire are all of direct relevance to this potential Mega Program:

1b. Staple crops
1c. Crop productivity
1e. Livestock
1g. Production technology
1h. Agronomic practices
1i. Weed control
1k. Seed systems/planting materials
1m. Biotic and abiotic stress
1n. Biotechnology/genomics

The following clusters are also relevant to this Mega Program, although they may be more relevant to one of the other MPs:

1a. Other crops
1d. Forestry/agroforestry
1f. Aquatic resources
1l. Soils
1m. Biotic and abiotic stress

2 Agricultural Systems Strengthening for the Poor and Vulnerable

The following clusters from the questionnaire are all of direct relevance to this potential Mega Program:

1a. Other crops
1d. Forestry/agroforestry
1e. Livestock
1f. Aquatic resources
1j. Smallholder/urban production systems
1m. Biotic and abiotic stress
3a. Food security
4c. Crop/biodiversity
5i. Reduced vulnerability

The following clusters are also relevant to this Mega Program, although they may be more relevant to one of the other MPs:

1g. Production technology
1h. Agronomic practices
5a. Policies
5c. Assets
5m. Welfare/livelihoods
6a. Research-general
6c. Farmer participation
6d. Integration

3 Agricultural Innovation for Health and Nutrition

The following clusters from the questionnaire are all of direct relevance to this potential Mega Program:

2. Post-harvest
3b. Nutritional quality
3c. Food safety
3d. Consumption-other
5e. Health

The following clusters are also relevant to this Mega Program, although they may be more relevant to one of the other MPs:

1j. Smallholder/urban production systems
1n. Biotechnology/genomics
3a. Food security
5d. Biosafety, regulation
6a. Research-general

4 Innovations in Institutions and Information

The following clusters from the questionnaire are all of direct relevance to this potential Mega Program:

5a. Policies
5b. Market-related
5c. Assets
5d. Biosafety, regulation
5g. Information and communication technology
5h. Credit
5i. Reduced vulnerability
5j. Institutions
5m. Welfare/livelihoods

The following clusters are also relevant to this Mega Program, although they may be more relevant to one of the other MPs:

1j. Smallholder/urban production systems
2. Post-harvest
5f. Capacity, education, extension
5l. Innovation
6d. Integration

5 Water, Soils, and Ecosystems

The following clusters from the questionnaire are all of direct relevance to this potential Mega Program:

1l. Soils
4a. Natural resources
4b. Multifunctionality
4d. Water

The following clusters are also relevant to this Mega Program, although they may be more relevant to one of the other MPs:

4f. Climate change/ecosystem services
6d. Integration
1a. Other crops

6 Sustainable Use and Conservation of Tropical Forests, energy, biomass

The following clusters from the questionnaire are all of direct relevance to this potential Mega Program:

1d. Forestry/agroforestry

4e. Energy

The following clusters are also relevant to this Mega Program, although they may be more relevant to one of the other MPs:

4a. Natural resources
4b. Multifunctionality
4f. Climate change/ecosystem services
1h. Agronomic practices
4c. Crop/biodiversity

7 Climate Change

The clusters from the questionnaire on 4f. Climate change/ecosystem services matches directly to this potential Mega Program. In addition, the questionnaire clusters 4a. Natural resources and 4e. Energy contain a number of key opportunities of relevance to a Mega Program on climate change.

8 Gender and women

In addition to cluster 5.k. from the questionnaire focused on gender issues and women's needs, most of the clusters had at least some responses that related to the particular relevance of that topic to gender. Even where the respondents did not make the identification, there is often a strong link. Respondents were also asked to say whether each key opportunity would be likely to have a different effect on men and women. Although not all respondents had thought about such gender dimensions, these responses could be revisited as each mega program is developed. In addition to involving women farmers, a number of the responses also noted the need to involve women in agricultural research. As one respondent indicated: "We need to bring … women's voices to the lab, to the field and into the board rooms." Furthermore, there were a number of responses to the open-ended questions that relate to the need to pay specific attention to gender issues.

The electronic consultation on gender integration in the CGIAR also provided a more detailed scientist elicitation on key opportunities under this topic, noting the linkages between gender and certain specific areas of research, e.g. nutrition, post-harvest processing and energy systems.

9 Capacity building and capacity strengthening

Questionnaire cluster 5e. Capacity, education, extension flags many of the key opportunities that relate to this Mega Program.

The questionnaire category 6. Organization of research, with clusters on general research issues, research tools, farmer participation, and the need for integration relates more to *how* research is to be done, rather than to particular topic areas. These responses are therefore most relevant to the overall process of agricultural research, and may apply to

all Mega Programs. However, they would have special relevance to a Mega Program on Capacity Building and Capacity Strengthening, particularly if capacity is interpreted broadly, to include the capacity of CGIAR centers, NARES, and farmers.

	1 Crop Germplasm Enhancement and Production	2 Agricultural Systems strengthening for the Poor and Vulnerable	3 Agricultural Innovation for Health and Nutrition	4 Innovations in Institutions and Information	5 Water, Soils, and Ecosystems	6 Sustainable Use and Conservation of Tropical Forests, energy, biomass	7 Climate Change	8 Gender and women	9 Capacity building and capacity strengthening
1a. Other crops						**	*	*	
1b. Staple crops					**	*	*	*	
1c. Crop productivity					*	*	**	*	
1d. Forestry/agroforestry	*	**				**		*	
1e. Livestock					**	*			
1f. Aquatic	**	*				*		*	
1g. Production technology		**				*		*	
1h. Agronomic practices	*				**				
1i. Weed control					**				
1j. Smallholder/urban production systems		*		*	*			*	*
1k. Seed systems/planting materials	*	**							
1l. Soils	**								
1m. Biotic and abiotic stress	**								
1n. Biotechnology/genomics	**	**						*	
2. Postharvest	*	**						*	
3a. Food security	**	*							
3b. Nutritional quality	**								
3c. Food safety		**	*	*				*	
3d. Consumption-other	**								
4a. Natural resources	*	**							
4b. Multifunctionality	**		*						
4c. Crop/biodiversity			**	*				*	
4d. Water		**	*					*	
4e. Energy			**					*	

	1 Crop Germplasm Enhancement and Production	2 Agricultural Systems strengthening for the Poor and Vulnerable	3 Agricultural Innovation for Health and Nutrition	4 Innovations in Institutions and Information	5 Water, Soils, and Ecosystems	6 Sustainable Use and Conservation of Tropical Forests, energy, biomass	7 Climate Change	8 Gender and women	9 Capacity building and capacity strengthening
4f. Climate change/ecosystem services			**					*	
5a. Policies			**					*	
5b. Market-related		*		**				*	
5c. Assets		*		**				*	
5d. Biosafety, regulation			*	**					
5e. Health			**					*	
5f. Capacity, education, extension				*				*	**
5g. Information and communication technology				**				*	
5h. Credit				**				*	
5i. Reduced vulnerability		**		**				*	
5j. Institutions				**				*	
5k. Gender/youth								**	
5l. Innovation			*						
5m. Welfare/livelihoods		*		*				*	
6a. Research-general		*	*						*
6b. Research tools									*
6c. Farmer participation		*						*	*
6d. Integration		*		**	*			*	*

Note: ** indicates a strong (primary) linkage between questionnaire cluster and Mega Program
* indicates a secondary linkage: questionnaire cluster contains key opportunities related to that Mega program

VIII. Analysis of open-ended responses

The questionnaire concluded with a set of open-ended questions to allow respondents to raise other issues and recommendations, and to say what measures are needed to ensure the uptake of the key opportunities they had raised.

For the analysis of the open-ended questions, the questionnaire team read through the responses and generated a broad list of thematic categories and sub-categories based on the contents of these responses. Once this list of themes was established, all of the responses were coded thematically using Nvivo Qualitative Coding Software. Responses were coded into more than one thematic category, if applicable. In Annex 1 (online), the output of the coding exercise is presented: the verbatim responses to question 1, 2 and 3 clustered into the broad thematic categories and sub categories used for coding, with the organizational affiliation of the respondent. Because the question asked for the respondents' opinions, it is appropriate to let the voices speak for themselves.

The list of thematic categories and sub-categories speaks to the issues that were of most interest, as does the number of responses in each category. Many of the entries reiterate or reinforce responses on key opportunities, although there are also considerable entries related to *how* research should be done, including management, prioritization, integration, and partnerships.

The following are the themes that emerged from the analysis of the open-ended answers.

Question 1: What is the key message you as a scientist would like to convey to policymakers and other stakeholders in the regional and global research system?

1: Change the CGIAR with respect to
- A. Management
- B. Prioritization of Research

2: Increase Investment in/Focus on
- A. Agricultural Research—general
- B. Agricultural Research—specific topic
  - Biodiversity
  - Fisheries
  - Livestock
  - Pests
  - Plant Breeding & Health
  - Seed & Crops (including varieties)
  - Soil Management
  - Storage of Produce
  - Water Management
- C. Ecological Farming, Conservation & Climate Change
- D. Energy (Affordability and Accessibility)

E. Extension, Capacity Building & Education
F. Gender
G. Institutions, Regulation, Good Policy & Government
H. Local Problems & Solutions
I. Markets & Marketing
J. Nutrition & Food Security
K. Production Systems
L. Technology (Investment, Accessibility & Usability)
M. Trade
N. Small Scale Farmers

3: Do Work on
A. Global Level
B. National/Regional Level
C. Rural Areas
D. Urban Areas

4: Ensure that Research is
A. Based on Past Lessons
B. Creative & Innovative
C. Holistic/Interdisciplinary
D. Scientifically Based
E. Translated into Policy/Practice & Shared with the Public
F. Long Term

5: Promote Partnerships with
A. Farmers
B. National Centers
C. Policy Makers & Researchers
D. Private Sector
E. Stakeholders (general)

Question 2: What needs to be done to improve or ensure continued collaboration between farmers, national and regional research organizations and international agricultural research?

1: Increase Involvement of
A. Civil Society
B. Donors
C. Disadvantaged Groups
D. Farmers
E. IARCS
F. NARS
G. Non-Agricultural Experts
H. Private Sector
I. Public Sector

J. Stakeholders
K. Women

2: Improve Upon
A. Allocation of Resources & Augmentations in Funding
B. Communication & Information Sharing (including meetings, events, seminars)
C. Education, Capacity Development & Application of Knowledge
D. Needs Assessment & Objective/Impact/Role Definition
E. Participatory & Transparent Research Methods
F. Promotion of Respect &Trust Between Stakeholders
G. Provision of Incentives & Regulations
H. Marketing Opportunities & Income Generation
I. Technology
J. Usage of Local Knowledge & Empowerment of Farmers

3: Shift Focus
A. To National Organizations/Institutions
B. To Comparative Advantage of CGIAR
C. To Beneficiaries & Researchers on the Ground (Bottom Up, Regionally Based)

Question 3: What needs to be done in terms of policy and institutional development to ensure the uptake of your proposals for innovation?

1: Strengthen & Support
A. CGIAR
B. Civil Society Organizations
C. Government, Political Will & Institutional Capacity
D. International Organizations
E. Local Farmers, Populations and Researchers
F. NARS
G. Private Sector

2: Promotion of
A. Communication of Findings, Problems etc.
B. Extension & Capacity Building
C. Farmer Empowerment
D. Interdisciplinary, Long term & Multicultural Research and Policy Innovations
E. Project Enforcement & Evaluation Mechanisms

3: Partnerships between
A. Donors and Beneficiaries
B. Researchers & Policy makers
C. Researchers & Farmers
D. Stakeholders (general)

4: Pay Attention to

A. Environmentally Friendly Research & Policies
B. Fisheries
C. Gender & Youth
D. Land Issues (Including Urban/Rural)
E. Nutrition & Health
F. Marketing, Investment & Agro Business Support
G. Seed Regulation & Distribution
H. Technology Adoption