CGIAR

CGIAR SYSTEM ANNUAL PERFORMANCE REPORT 2018

CGIAR Portfolio – Progress Reported in 2018

II. CGIAR PORTFOLIO – PROGRESS REPORTED IN 2018

Progress towards the Sustainable Development Goals and CGIAR System Level Outcomes

With an aim to ensure that research contributes to development outcomes, the CGIAR System as a whole reports its progress against the CGIAR Strategy and Results Framework (SRF), comprising the three SLOs: to reduce poverty, to improve food and nutrition security, and to improve natural resources and ecosystem services. The SRF also sets out 10 aspirational System Level Outcome Targets for progress to 2022 and 2030, which relate to the international targets established for the Sustainable Development Goals (SDGs).

In 2018, an example of impact was reported by WHEAT, where the CGIAR global wheat breeding program continues to deliver high-yielding germplasm adapted to diverse growing regions worldwide, particularly for low-yielding environments (WHEAT, 2018).

In its annual report, RTB described the adoption of improved cassava varieties in Tanzania, the Democratic Republic of Congo (DRC), Sierra Leone and Zambia which decreased the rate, depth and severity of food insecurity. Adoption yielded a 10.1% gain in overall average daily consumption per capita. Had it not been for the adoption of cassava technology, the rate of food insecurity would have been about 90%, suggesting that adoption of cassava technology led to approximately a 14-percentage point reduction in food insecurity. Adoption resulted in cutting the calorie deficit by 110 kilocalories per capita among the food insecure group of households. It was also found that adoption had a higher food insecurity-reducing impact among female-headed households than among male-headed households (RTB, 2018).

More examples of high-level impact of CGIAR varieties, technologies and other innovations reported in 2018 are shown in Table 1.

Table 1. Examples of high-level impact of CGIAR varieties, technologies and innovations reported in 2018

SLO target 1.1 100 million more farm households have adopted improved varieties, breeds, trees, and/or management practices 	A4NH	**4.5 million farming households** were reached with biofortified planting material in 2018, bringing the total number of farming households growing and consuming biofortified crops globally to 7.6 million (the HarvestPlus global households reached projection model is described in the related links).	Link A4NH 1 Link A4NH 2
	A4NH	**60,000 farmers** treated more than 63,000 hectares with Aflasafe in 2018, allowing production of maize and groundnut with safe aflatoxin levels. Large-scale use of Aflasafe contributed to improved food safety in most of the areas where crops were treated. The large majority of the treated crops contained aflatoxin-compliant concentrations even for the most stringent markets (i.e. less than 4 parts per billion total aflatoxins). In Nigeria, use of Aflasafe increased the income of smallholder maize farmers on average, 11.5% more than regular maize.	Link A4NH 3 Link A4NH 4
	RTB	Release and adoption of potato improved varieties (IVs) were studied in Bangladesh, China, India, Indonesia, Nepal, Pakistan and Vietnam. In terms of area, International Potato Center (CIP)-related varieties were planted on 1.4 million hectares, which is about 19% of the total area. China accounts for most (87%) of the total area cultivated with CIP-related varieties. About 2.8 million households are using CIP-related material, particularly in China (2.5 million), India (0.2 million) and Nepal (0.1 million).	Link RTB 1
	RTB	Adoption estimates of cassava varieties in nine countries (in South and Southeast Asia) indicate that out of 4.1 million hectares of cassava production, **2.7 million hectares** (65% of the total area) are grown using the International Center for Tropical Agriculture (CIAT)-related varieties.	Link RTB 2

	RTB	Release and adoption of sweet potato IVs were studied in Bangladesh, China, India, Indonesia, Nepal, Papua New Guinea, the Philippines and Vietnam. About 88% of the 3.6 million-hectare area is planted with IVs. In terms of area, CIP-related varieties are planted in about **164,000 hectares**, which is about 5% of the total area. China accounts for most (71%) of the total area cultivated with CIP-related varieties. However, this only represents 4% of the total area in China. The country with the highest figure is Vietnam, where 20% of the total area is planted with CIP-related varieties.	Link RTB 3
	FISH	**23,000 new households** benefited from access to aquaculture improvements across five countries: Egypt (1,680), Sierra Leone (170) and Odisha India (17,680 – where women were involved in carp-based polyculture improvements). In Myanmar, 3,149 small-scale aquaculture households and in Timor Leste, 427 small-scale aquaculture households adopted Genetically Improved Farmed Tilapia (GIFT). **12,300 households** are benefiting from improvements in the management of fish refuges in Cambodia.	Link FISH 1 Link FISH 2 Link FISH 3 Link FISH 4
	LIVESTOCK	Commercialization of four Urochloa hybrids (Mulato II, Cayman, Cobra, Camello) and two synthetic mixtures (Mestizo blend, Camello blend) through a private sector partner, Papalotla. Urochloa hybrids had been scaled on **>950,000 hectares** in >30 countries by 2018. Information from Papalotla indicates that an additional **130,000 hectares** were reached in 2018 (the 100,000+ hectares per year are cumulative).	Link to be shared soon
SLO target 1.2 30 million people, of whom 50% are women, assisted to exit poverty 	GLDC	In three states of India, pearl millet hybrids derived through HPRC (Hybrid Parents Research Consortium, based on based on the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)-bred germplasm) were adopted in 60% of the area on average and resulted in estimated "social benefits" of USD 74 per hectare, or a total of **USD 133 million per year** for the entire area, shared between farmers, consumers and others.	Link GLDC 1
	MAIZE	Farm- and market-level impacts of multiple technology adoption choices were estimated in **Ethiopia** using household survey data. Current adoption rates were about 50% for hybrid varieties (some of which were CGIAR derived). When IVs varieties, fertilizer and other technologies were combined, this gave an average estimated 26% cost reduction per kilogram of maize output. If adopted over the whole maize area, this could increase producer and **consumer surpluses by USD 140 and USD 105 million and reduce the number of poor people by an estimated 788,000 per year.**	Link MAIZE 1
	MAIZE	Over 80% of **Nigerian** farming households are smallholders (World Bank, 2017) and they produce an estimated 70% of total maize production (Agra, IITA). The impact of drought tolerant maize varieties (DTMA) in Nigeria showed a **6% reduction in the likelihood of poverty incidence** in the communities studied.	Link MAIZE 2 Link MAIZE 3
	MAIZE	In a national survey in **Ethiopia**, adoption of improved maize varieties (some with CGIAR germplasm) was estimated to **increase per capita food consumption by 3.3%**, the probability of a smallholder being in food surplus by 1.8 percentage points, and decrease food insecurity by 2.5%.	Link MAIZE 4
	RTB	Adoption of cassava varieties tracked using data from DNA-fingerprinting in 2015-16 showed that two thirds of cassava growers in **Nigeria** were using improved varieties. Economic analysis demonstrated that adoption of improved varieties has allowed about **1.6 million individuals to escape poverty** (using a poverty line of USD 1.9 per person per day).	Link RTB 1

SLO target 2.1 Improve the rate of yield increase for major food staples from the current <1% to 1.2-1.5% per year 	GLDC	An estimated **20% increase in pearl millet grain and fodder yields** in an estimated **1.92 million farms** covering about 1.84 million hectares of farmers' fields in three states of **India** through the Hybrid Parents Research Consortium.	Link GLDC 1
	FISH	**In Bangladesh, 4,350 households** were associated with improvements in hilsa management and reported **productivity gains** in fisheries (Ecofish FY 2017-2018 Report, 2018).	Link FISH 1
	WHEAT	In addition to the gain in wheat production (doubled yield between 1982 and 2014) from Chinese germplasm-derived varieties alone, the estimated average additional increase in annual production reached **10.4 million metric tons** from the use of exotic germplasm in the past three decades. The accumulated contributions of exotic germplasm from CGIAR and other foreign sources to wheat production in **China** represent about **343 million metric tons** (1982 to 2014), about 10% of total production.	Link WHEAT 1
	WHEAT	The annual genetic gain for grain yield of the internationally distributed Semi-Arid Wheat Yield Trials (2002-2003 to 2013-2014) under the International Wheat Improvement Network (IWIN) was assessed in 740 locations across **66 countries** in low- and medium-yielding environments. The rate of Grain Yield Increase ranged from 1.8% (38.13 kilograms per hectare per year) to 1.4% (57.71 kilograms per hectare per year) higher than the average annual global yield growth rates.	Link WHEAT 2
SLO target 2.3 150 million more people, of whom 50% are women, without micronutrient deficiencies 	A4NH	**22.5 million people** (4.5 million farming households) were reached with biofortified planting material in 2018, bringing the total number of farming households growing and thought to be consuming (awaiting studies) biofortified crops globally to 7.6 million (38 million people, based on the HarvestPlus global households reached projection model).	Link A4NH 1
	RTB	Release and adoption of potato IVs were studied in **China, India and Nepal**. In terms of area, CIP-related varieties are planted in about 1.4 million hectares which is about 19% of the total area. China accounts for most (87%) of the total area cultivated with CIP-related varieties. About **2.8 million households** are using CIP-related material, particularly in China (2.5 million), India (0.2 million) and Nepal (0.1 million).	Link RTB 1
SLO target 3.1 5% increase in water and nutrient (inorganic, biological) use efficiency in agro-ecosystems, including through recycling and reuse. 	FISH	In Bangladesh, **59,151 hectares** of new riverine and coastal areas were brought under improved natural resource management in the Padma and Tetulia rivers during 2018, further extending the habitat now under improved co-management measures in the country.	Link FISH 1
	MAIZE	Adoption of **improved water-management practices** in rural **Pakistan** improved wheat and rice yields, household income and food security levels, and reduced poverty levels. Higher food security levels for adopting households, in the range of **3–12%, higher yields** and higher household income levels, in the range of Pakistani Rupees 2,573-4,926 and 2-7% lower poverty levels.	Link MAIZE 1

Source: CRP 2018 annual reports.

Table 1 (above) presents quantitative evidence of significant progress against the 10 aspirational System Level Outcome Targets of the SRF. It lists the targets, shows how they link to the relevant SDGs, and provides evidence based on available adoption and ex-post impact studies published in 2018 on the contribution of CGIAR to each target. Given that the timeframe for research to impact is typically 5-25 years for agricultural research, much of the evidence presented relates to earlier CGIAR research.

The evidence for progress towards the SLOs has been assessed to ensure that statements made reflect the evidence presented, reflect evidence published in 2018, and are clear and comprehensible.

Progress towards Research Outputs and Outcomes

CGIAR's performance management system is structured around a conceptual framework that comprises three spheres that determine the extent to which there is control over research results and the contribution to development impact. This conceptual framework is presented in Figure 1, and further explained in Table 2.

The section "Progress towards the Sustainable Development Goals and CGIAR System Level Outcomes" of this report (before) presents evidence linked to the sphere of interest.

This section focuses primarily on the spheres of control (outputs) and influence

Pearl millet hybrid contributes to economic benefits in India
GLDC 2018 annual report

Pearl millet is one of the most important food crops grown across the drylands of Africa and Asia, predominantly in low-rainfall environments with infertile soils. In India, while the area under production marginally declined, productivity has increased. The development and wider use of hybrids has primarily been responsible for the phenomenal yield increases achieved.

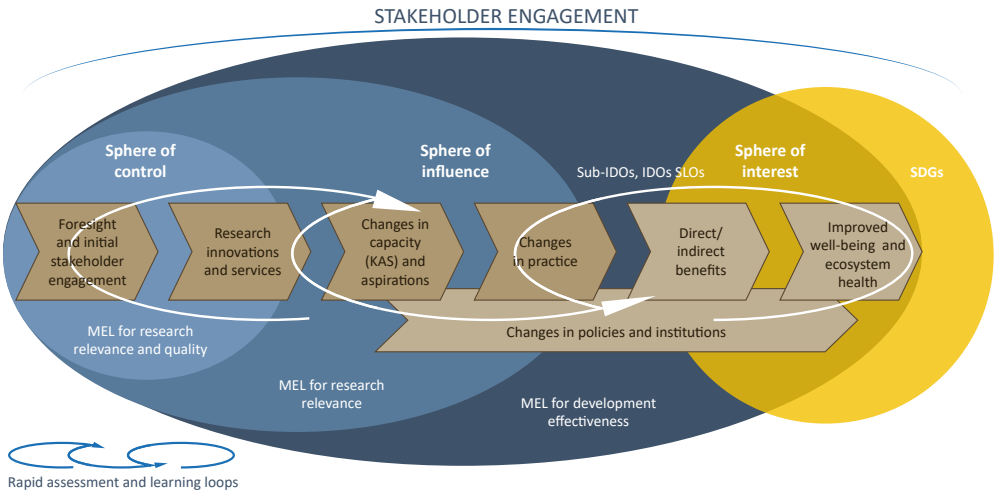
A third-party evaluation of the on-farm impact of pearl millet hybrids was carried out in 2015 and published in 2018. These hybrids had been developed under ICRISAT Pearl Millet Hybrid Parents Research Consortium (PMHPRC) between 2000 and 2010 (based directly or indirectly on ICRISAT breeding lines) in India.

The study, covering 563 pearl millet growers spanning 57 villages and 25 mandals in three states (Rajasthan, Gujarat and Uttar Pradesh) in India, revealed that PMHPRC hybrids covered about 60% of the pearl millet hybrid area during 2013-14. These hybrids provided at least 20% higher grain and fodder than the varieties or other hybrids they replaced.

Income and expenditure data from this study indicate that the sampled farmers are able to save money after meeting their livelihood expenses. This margin was quite small in the Rajasthan sample, moderate in Gujarat and substantial in Uttar Pradesh.

The total benefits that accrued due to these hybrids in the three states totaled USD 133.7 million per year. The overall benefits at the country level could surpass USD 150 million per year if contributions of HPRC hybrids are accounted for in other states of India as well. Considering the average landholding of less than 2 hectares per farm family, the number of households planting improved varieties would be 1.5 million farm families, assuredly reaching 8 million people.

Figure 1: Spheres of control, influence and interest for performance management of agricultural research for development



Source: CGIAR, 2016.

of the performance management system, presenting evidence of progress towards research outcomes related to research use and effectiveness. Innovations, publications, training and partnerships refer to the sphere of control, and influences on policy and legal changes and investments and alternative metric (altmetric) scores relate to the sphere of influence.

Progress towards research outcomes are reported by the CRPs and Platforms in a narrative annual report (based on a common template) and with Common Results Reporting Indicators (CRRIs). These indicators were introduced in 2017and include:

- The number of CGIAR innovations. Innovations are categorized in four stages:
  - Stage 1: discovery/proof of concept
  - Stage 2: successful piloting
  - Stage 3: available or ready for uptake
  - Stage 4: uptake by next user
- The number of peer-reviewed publications authored or co-authored by CGIAR researchers.
- The number of people trained by CGIAR.
- The number of CGIAR partnerships.
- The number of policies, legal instruments, investments and similar modified in their design or implementation, informed by CGIAR research.
- Altmetric scores for publications.

Annexes 1, 2, 3, 4, 5 and 6 list the available data for the CRRIs for 2018. The numbers are summarized in Table 4.

For the first time in 2018, CRPs and Platforms are reporting their progress towards research outcomes using Outcome Impact Case Reports (OICRs). Table 2 presents the number of Outcome Impact Case Reports (OICRs) submitted in 2018 by CRPs and Platforms by level of maturity. It shows that 18% of OICRs were at a “level 3” stage of maturity in 2018; 34% of OICRs were at a “level 2” stage of maturity; and most OICRs in 2018 were at a “level 1” stage of maturity.

Table 2. OICRs by level of maturity in 2018

	LEVELS OF MATURITY			
	LEVEL 1(*)	LEVEL 2 (**)	LEVEL 3 (***)	TOTAL
NUMBER OF OICRS	46	41	8	**95**
%	48%	43%	8%	**100%**

Source: CRP and Platform annual reports.

(*) Level 1: (sphere of influence) CGIAR research (and related activities) that has contributed to changed discourse and/or behavior among next users (related to the theory of change). Examples of evidence: outcome mapping study, media analysis or e-mail correspondence.

(**) Level 2: (sphere of influence) CGIAR research (and related activities) that has contributed to documented policy change and/or a change in practice by end users. This may include changes such as income and nutrient intake in the sphere of influence – usually this will be a development project involved in the "delivery"/scaling up of an innovation. Example of evidence: a study of adoption and effects, commissioned at project level.

(***) Level 3: (sphere of interest) Policy and/or practice changes influenced by CGIAR research (and related activities) that have led to adoption or impacts at scale or beyond the direct CGIAR sphere of influence (for example, not in a development project). Examples of evidence: an at-scale adoption study or ex-post impact assessment.

Table 3 presents 15 selected examples of OICRs for 2018 at maturity levels 1, 2 and 3. A full list of OICRs is available in Annex 1. An example of a level 2 OICR is the water planning data platform, "Agua de Honduras", piloted and adopted by the Government of Honduras, which provides data on hydrology, vegetative cover, soil properties, along with future climate scenarios (WLE, 2018). At level 3, an OICR reported by RTB documented a study on the release and adoption of improved sweet potato varieties in eight major producing countries in Southeast, South and East Asia. Data on varietal release showed that over a total of 434 varieties released, 195 (45%) had been adopted and cultivated, and that 45 of the 434 were CIP-related varieties. In 2015, the sweet potato cultivated area was 3.6 million hectares and 88% of this area was planted with improved varieties. 5% (164,000 hectares) of this area was planted with CIP-related varieties (RTB, 2018).

ICRAF laboratory assistant Agnes Were performs seed extraction from 'Adansonia digitata' fruits. Photo: Michael Major/Crop Trust

Table 3: Selected OICRs for 2018

CRP	TITLE OF OUTCOME IMPACT CASE REPORT (OICR)	LEVEL OF MATURITY
A4NH	"Reach, Benefit, Empower" framework of indicators for monitoring programs and policies incorporated into trainings conducted by partners	Level 1
WHEAT	Heat and drought-resistant wheat varieties in Pakistan help farmers combat climate change stress and is success of physiological breeding approach	Level 2
Livestock	RHoMIS: A rapid, standardized and cost-effective tool for tracking agricultural performance has reached over 21,000 households in 27 countries	Level 1
CCAFS	CGIAR Climate change West Africa Program informs the adoption of a public-private partnership business model for climate information services in Ghana	Level 1
FISH	Myanmar Government approved the Agricultural Development Strategy and the 'Naypyidaw Agreement' that enables the spread of nutritious and profitable rice-fish farming practices	Level 1
FTA	The Cocoa of Excellence Programme has facilitated connection between producers and other stakeholders, providing an international platform, visibility, and tools to improve fermenting and roasting techniques	Level 1
RICE	Adoption of Alternate wetting and drying in Asia to save water and reduce methane emissions	Level 2
A4NH	Busia County Biodiversity Policy (Kenya) recognizes importance of native species for nutrition and food security and allocates resources for the conservation of regional food biodiversity	Level 2
MAIZE	Fast-tracking maize varietal replacement in Ethiopia	Level 2
WLE	Water planning system "Agua de Honduras" used to improve Honduran investment decisions (WLE-CIAT)	Level 2
WLE	Soil-plant spectral technology guiding soil fertility investments in Africa (WLE-ICRAF)	Level 2
PIM	Improved targeting for the largest safety net program for ultra-poor women in rural Bangladesh, reaching 750,000 women and their 3.5 million family members	Level 2
PIM	Improving returns to public investments in China's agricultural sector	Level 2
GLDC	Impact of ICRISAT Pearl Millet Hybrid Parents Research Consortium (PMHPRC) on the Livelihoods of Farmers in India	Level 3
RTB	In Southeast and South-Asia, CIP-related varieties cover 5% (164,000 hectares) of the of the total area planted to sweet potato (3.6 million hectares)	Level 3

Source: CRP and Platform 2018 annual reports.

Table 4: Common Results Reporting Indicators for 2018

COMMON REPORTING INDICATORS	TOTALS FOR 2018	HIGHLIGHTS
Number of CGIAR innovations	In 2018: 938 innovations were reported, of which: 270 were at Stage 1 (29%): end of research 170 were at Stage 2 (18%): end of piloting 407 were at Stage 3 (43%): available for uptake 91 were at Stage 4 (10%): uptake by next users A full list of innovations is available in Annex 2	Details on Stage 3 innovations (Available for uptake n = 407): 50 (12%) represented research and communication methodologies and tools 37 (9%) were production systems and management practices 294 (72%) were genetic innovations (varieties/breeds) 22 (5%) were significant social science findings and evidence 4 (1%) were related to biophysical research (e.g. computational biology, decision support tools, geospatial analysis)
Number of peer-reviewed publications authored/co-authored by CGIAR researchers	1,888 publications were reported in 2018 A full list of peer-reviewed publications is available in Annex 3	1,110 (59%) were open access (OA) 1,556 (82%) were published in international scientifically indexed (ISI) journals
People trained by CGIAR in 2018	1,016,814 people trained and 48% of women (488,323)	Long term (degree or other long courses): 3,842 (39% women) Short term: 1,012,972 (48% women)
CGIAR partnerships	1,003 partnerships reported in 2018 Information on external partners is available in Annex 4	368 (37%) on research 164 (16%) on delivery 188 (19%) on policy 231 (23%) on capacity development 52 (5%) on another topic
Number of policies, legal instruments, investments and similar modified in their design or implementation in 2018, informed by CGIAR research	81 policies/strategies 7 legal instruments 12 budget or investments 7 curricula Total: 105 A full list of contributions to policies, legal instruments and investments is available in Annex 5	Among those reported for 2018 were contributions to the design or redesign of: 17 global policies/legal instruments 8 regional policies/legal instruments 62 national policies/legal instruments
Altmetric scores (mentions in media and on social media of CGIAR peer-reviewed publications).	For 2018, 4 CRPs (A4NH, MAIZE, LIVESTOCK, PIM) and 1 Platform (BIG DATA) provided altmetric information on 664 peer-reviewed publications out of 1,888	Highlights of altmetric scores for the top 10 publications are available in Table 7 3 articles received altmetric scores over 1000, and 4 received scores over 300

Source: CRP and Platform 2018 annual reports.

Innovations

In 2018, 10% of innovations were at stage 4 – "uptake by next user"; 43% were at stage 3 – "available for use"; 18% were at stage 2 – "piloting"; and 29% were at stage 1 – "discovery of proof of concept". The majority (66%) of innovations were the result of genetics research including new improved varieties with increased genetic gain and they represent 74% of total stage 3 innovations. Unique tagging of innovations was introduced into the reporting system in 2018, which will improve the ability to track – and manage – innovations through the innovation pipeline in future years. Table 5 presents a summary of the stages and types of innovations reported.

Of note is the remarkable number of genetic innovations (619), including 417 improved varieties of which 10% have been taken up by next users in 2018, an uptake level that is comparable with private sector patented varieties. MAIZE reported the release of 81 elite maize varieties, RICE 108 Green Super Rice varieties, RTB 90 improved advanced clones of potato, WHEAT 58 improved bread wheat and durum wheat varieties, GLDC 58 innovative varieties including, groundnut (28), sorghum (8), pearl millet (10), and A4NH 22 bio-fortified varieties of bean, pearl millet, wheat and maize (MAIZE, 2018; RICE, 2018; RTB, 2018; WHEAT, 2018; GLDC, 2018; A4NH, 2018).

RICE (108):
Green Super Rice varieties are defined as rice cultivars (inbreds, hybrids) that can produce high and stable yield under less input, with 95 in stage 3 in Asia (the Philippines, Bangladesh, Vietnam, India and Indonesia) and Africa (Tanzania and Mozambique); and 13 at stage 4, having already been taken up by next users in Pakistan and the Philippines (RICE, 2018).

RTB (90):
Seventy varieties (506 advanced clones) of potato with resistance to late-blight and viruses and high productivity were released. Ten Late-Blight Heat Tolerant clones showed high marketable tuber yield and a glycoalkaloid content under the safe level in tubers. Eight clones with low glycoalkaloid content and high marketable tuber weight were selected to be used to develop new varieties suitable for high heat stress or as suitable parents in breeding programs aimed at improving heat tolerance with minimum risk of glycoalkaloid accumulation under high temperature stress. Two high-yielding, consumer-acceptable apple banana hybrids (Musa species, AAB genome group) with resistance to *Fusarium oxysporum f. sp. cubense race 1* were also released (RTB, 2018).

MAIZE (81):
Unique CGIAR-derived maize varieties have been released across Africa, Asia and Latin America. Fourteen varieties were hybrid combinations, showing that regional or multinational seed companies use MAIZE-improved germplasm to develop and release improved maize hybrids. These include abiotic stress (such as drought, heat or N use efficiency) and biotic stress (such as maize lethal necrosis, rust, ear rot or striga). Twenty of the released varieties are nutritionally enriched (with Provitamin A, Quality Protein Maize and High Zinc) as result of the MAIZE partnership with A4NH and HarvestPlus (MAIZE, 2018).

Table 5: CGIAR innovations reported by stage of research and type of innovation in 2018

STAGE OF INNOVATION	RESEARCH AND COMMUNICATION METHODOLOGIES AND TOOLS	PRODUCTION SYSTEMS AND MANAGEMENT PRACTICES	GENETICS	SOCIAL SCIENCE	BIOPHYSICAL RESEARCH	TOTAL
1- Research/proof of concept	30	27	185	21	7	**270**
2- Piloting	28	31	94	14	3	**170**
3- Available for use	50	37	294	22	4	**407**
4- Take up by "next users"	10	19	46	13	3	**91**
Total	**118**	**114**	**619**	**70**	**17**	**938**

Source: CRP 2018 annual reports.

WHEAT (58):
Ten new wheat varieties have been multiplied in collaboration with seed producers located in strategic growing areas of Mexico. WHEAT also reported nine bread wheat winter varieties, 22 bread wheat spring varieties, 16 durum wheat spring varieties and one triticale (WHEAT, 2018).

GLDC (58):
New varieties were released for groundnut (28), sorghum (8), pearl millet (10), lentil (3), chickpea (2), pigeon-pea (3), cowpea (2) and soybean (1) (GLDC, 2018).

Managing innovations toward scaling
RTB 2018 annual report

RTB is contributing to rethinking scaling in research for development interventions. Under the leadership of Wageningen University, CIP and the International Institute of Tropical Agriculture (IITA), RTB is advancing a "Scaling Readiness" approach. This approach has been developed to facilitate the rigorous assessment of innovation readiness for going to scale and to support, through a stepwise approach, the design, implementation and monitoring of scaling strategies. It is a project management and innovation portfolio management system to support investment decisions related to the scaling of innovations at project, Center and CGIAR level.

Scaling Readiness seeks to achieve three objectives:

1. At the project level: enhance the scaling performance of CGIAR research and delivery projects by supporting the design, implementation and monitoring of cost-efficient and realistic scaling strategies;
2. At the CGIAR Center and System levels: support innovation portfolio management by providing a dashboard for monitoring the scaling readiness of, for example, all CGIAR innovations.
3. At the CGIAR Center and System levels: support fundraising for CGIAR and CGIAR Centers, as Scaling Readiness provides evidence of which innovations have been proven to work to achieve certain livelihood outcomes (SDGs) in specific locations.

The Scaling Readiness project was conceived in response to a lack of rigorous, evidence-based approaches to the scaling of innovation. It examines CGIAR innovations as packages of technologies, new policies, market mechanisms and partnerships, and assesses the readiness for scaling along a 9-level ladder that is also being used by the National Aeronautics and Space Administration (NASA) and the European Union (EU).

The readiness assessment reveals which of the elements in an innovation package form critical bottlenecks for scaling (for example, access to finance, absence of a regulatory framework or seed systems). This assessment enables the design of site-specific scaling strategies to overcome these bottlenecks, and supports scaling partner selection.

A draft Scaling Readiness Quick Guide has been developed and RTB is currently finalizing an Implementation Manual and web-platform where all relevant materials will be available. The approach is being used by multiple projects inside and beyond RTB to develop and implement their scaling strategies, and RTB is in the process of systematically documenting the outcomes of the project.

Source: RTB, AR 2018.

Table 6 shows a further list of innovations at stages 3 and 4. A complete list of innovations is available in Annex 2.

Table 6: Examples of innovations at stages 3 and 4

CRP OR PLATFORM	INNOVATION	TYPE OF INNOVATION	STAGE
A4NH	Aflasafe, a biocontrol product used for maize and groundnut, was approved in Ghana, Tanzania and Zambia, and is now available for commercial use	Production systems and management practices	Stage 4: uptake by next user
A4NH	Impact evaluation of a nutrition sensitive intervention that was scaled up through preschools	Social science	Stage 4: uptake by next user
BIG DATA	The Global Agricultural Data Innovation and Acceleration Network (GARDIAN)	Research and communication methodologies and tools	Stage 3: available or ready for uptake
CCAFS	Analytical approach for predicting potential areas of agroforestry expansion	Biophysical research	Stage 3: available or ready for uptake
CCAFS	Food security, drought monitoring and an early warning tool that considers local vulnerabilities	Research and communication methodologies and tools	Stage 4: uptake by next user
FISH	Design of a tilapia single nucleotide polymorphisms (SNP) chip	Genetic (varieties and breeds)	Stage 3: available or ready for uptake
FISH	The use of water storage ponds and homestead irrigation channels for fish production in Myanmar	Production systems and management practices	Stage 3: available or ready for uptake
FTA	Ecophysiological model of coffee response to climate change	Biophysical research	Stage 4: uptake by next user
FTA	A sustainable landscapes rating tool (SLRT)	Research and communication methodologies and tools	Stage 4: uptake by next user
GLDC	Introgression of high oleic trait in groundnut	Genetic (varieties and breeds)	Stage 3: available or ready for uptake
LIVESTOCK	RHoMIS – a rural household multiple indicator survey tool	Research and communication methodologies and tools	Stage 4: uptake by next user
LIVESTOCK	CLEANED-R (Comprehensive Livestock Environmental Assessment for Improved Nutrition, a Secured Environment and Sustainable Development along Livestock and Fish Value Chains) tool	Production systems and management practices	Stage 3: available or ready for uptake
MAIZE	Five hybrids of high yield potential for the seed sector of Mexico	Genetic (varieties and breeds)	Stage 3: available or ready for uptake
MAIZE	Scaling conservation agriculture-based sustainable intensification systems in Ethiopia	Production systems and management practices	Stage 4: uptake by next user
PIM	Poverty sensitive scorecard tool: combining risk scoring with poverty scoring to help lenders and policymakers prioritize development projects	Social science	Stage 3: available or ready for uptake
PIM	A rural investment and policy analysis model	Social science	Stage 4: uptake by next user

RICE	Alternate wetting and drying (AWD) taken up by users in Asia	Production systems and management practices	Stage 4: uptake by next user
RICE	Satellite-based rice monitoring system in India and the Philippines	Production systems and management practices	Stage 4: uptake by next user
RTB	Potato varieties biofortified with iron and zinc, resistant to late blight and potato virus Y adapted for tropical highland and mid-elevation ecologies	Genetic (varieties and breeds)	Stage 4: uptake by next user
RTB	High quality cassava peel for animal feed	Production systems and management practices	Stage 3: available or ready for uptake
WHEAT	Ten new wheat varieties multiplied in collaboration with seed producers located in strategic growing areas of Mexico	Genetic (varieties and breeds)	Stage 3: available or ready for uptake
WHEAT	Foresight into changing consumption patterns and implications for research	Social science	Stage 3: available or ready for uptake
WLE	WABEF (Western Africa Bio-wastes for Energy and Fertilizer), a toolkit to promote anaerobic digestion of bio-wastes in West Africa	Production systems and management practices	Stage 3: available or ready for uptake
WLE	An approach developed to convert torrential flood to productive use	Production systems and management practices	Stage 3: available or ready for uptake

Source: CRP and Platform 2018 annual reports.

*Note: This is not a list of top 24 innovations, but a selection of 2018 innovations at Stage 3 or Stage 4, chosen to demonstrate range.

Participatory approaches to disaster risk management in Latin America
CCAFS 2018 annual report

Latin America is engaging in a bottom-up approach in relation to the implementation of the Regional Strategy for Disaster Risk Management in the Agriculture Sector and Food and Nutrition Security in Latin America and the Caribbean, through the promotion of CCAFS' Local Technical Agroclimatic Committee (LTAC) approach. The LTAC approach aims to strengthen local capacities to deal with climate variability and seeks to help close the gap between climate information and farmers' decision-making processes. The LTAC's basic premise is that knowledge-intensive practices require learning through interaction and shared understandings, rather than through one-way direct knowledge transfer.

In 2018, Chile was added to the group of Latin American countries that have adopted the LTAC approach, and Peru, Bolivia, Paraguay and Ecuador are incorporating the approach into their disaster risk management plans according to their context-specific needs and capacities, supported by collaborative work between the Food and Agriculture Organization of the United Nations (FAO) and CCAFS. The recently developed LTAC manual, which provides a step-by-step guide to implement the approach, will be used by countries to determine LTAC approaches that take into consideration context specific conditions.

Source: CCAFS, AR 2018.

Development of winter wheat varieties
WHEAT 2018 annual report

The International Winter Wheat Improvement Program (IWWIP) has developed, characterized, published and offered synthetic germplasm for use. IWWIP is a joint program between the Government of Turkey's Ministry of Food, Agriculture and Livestock, the International Maize and Wheat Improvement Center (CIMMYT) and the International Center for Agricultural Research in the Dry Areas (ICARDA). The program's main objective is to develop winter/facultative wheat germplasm for Central and West Asia. Advanced breeding lines are distributed annually to over 100 partners in more than 50 countries. In addition, interested breeding programs submit their material to IWWIP for inclusion into international testing. IWWIP also facilitates winter wheat germplasm exchanges for the global breeding community.

The seeds from new winter and facultative wheat varieties developed by IWWIP for irrigated and semi-arid environments have been deposited in the CIMMYT genebank and shared with several breeding and research programs.

New synthetic winter wheat varieties were developed using winter durum wheat germplasm from Ukraine and Romania and *aegilops tauschii*. These varieties contain important sources of resistance to certain diseases and demonstrate strong grain mineral content and drought tolerance. The new varieties are now available through the IWWIP nursery.

Source: WHEAT, AR 2018.

Protecting the contribution of fish to food and nutrition security
FISH 2018 annual report

Recent results highlight the extent to which fish are a key dietary component of the poor and the challenges faced in maintaining this supply.

CGIAR research on small-scale fisheries provided new knowledge of global human dependence on marine ecosystems, indicating high dependency of 775 million people on marine fisheries, and providing the basis for targeted management and policy for vulnerable small-scale fishing communities.

Further, new studies which chart consumption rather than catch reporting suggest that freshwater catches are, on average, likely to be approximately 65% higher than those officially reported by national governments to FAO. These "hidden harvests" are particularly concentrated in low income, riparian countries or countries having extensive wetlands such as Bangladesh, Cambodia, Myanmar and Ghana. This is a significant finding because long-term underreporting of inland fisheries has masked their critical role in feeding the world's poor and confounds efforts to evaluate the impact of overharvest and ecosystem degradation adequately. FISH is working with FAO to gauge the full extent of this underreporting globally by 2020.

Using foresight modelling, FISH, with the International Food Policy Research Institute (IFPRI), provided new understanding of future fish supply-demand trends in Africa, with an article published in *Global Food Security* laying an important foundation for strategic planning and the investments in aquaculture and capture fisheries that will be required. An analysis of the Zambian fish sector presents a picture of national fish demand outstripping supply. Unless further investments are made in small-scale fisheries management and in aquaculture (with the opportunity to capitalize on the technological and industry growth seen in Asia), fish consumption in the continent will have to be heavily underwritten by

imports by 2030. FISH research continues to produce and disseminate a suite of research innovations for sustainable development of aquaculture and fisheries across Africa, Asia and the Pacific.

Innovations include three fish genetics research platforms for aquaculture, providing new improved generations of tilapia in Malaysia and Egypt, and three on key carp species in Bangladesh. Research in these platforms identified several new traits for future genetic selection using genomics tools, including feed efficiency and disease resistance, all critical traits for sustainable intensification under climate change. The growth in global tilapia aquaculture was one of the successes derived from CGIAR research. Here too, protecting gains is critical.

Fish disease and biosecurity research provided new surveillance and diagnostic techniques and tools for addressing the global challenge from the emerging tilapia lake virus (TiLV). Assistance with application of these tools was provided to several countries to improve policies for health management, notably in Bangladesh, Egypt and Zambia. New partnerships established with the private sector at global and national levels are providing new avenues for future scaling of innovations from FISH and CGIAR research.

Source: FISH, AR 2018.

Publications

In 2018 a total of 1,888 publications were produced by CRPs and Platforms. 59% of these were open access (1,109) and 82% (1,556) were published in international scientifically indexed (ISI) journals. Compared to 2014, there was a 35% increase in 2018. Table 7 shows the number of peer-reviewed publications per year.

In 2018, three articles received altmetric scores over 1,000: "Options for keeping the food system within environmental limits" (PIM/CCAFS, with a score of 2,080); "The 2018 report of the Lancet Countdown on health and climate change: shaping the health of nations for centuries to come" (A4NH, with a score of 1,786); and "The genome of cultivated sweet potato contains Agrobacterium T-DNAs with expressed genes: An example of a naturally transgenic food crop" (RTB, with a score of 1,236).

Table 8 presents a list of publications with the highest altmetric scores. A complete list of peer-reviewed publications is available in Annex 3.

Table 7: Number of peer-reviewed publications and open access percentages since 2014

	2014	2015	2016	2017	2018
Number of peer-reviewed publications (% open access)	**1,604**	**1,860**	**1,808**	**1,988 (61% OA)**	**1,888 (59% OA)**

Source: CRP 2014-18 annual reports.

Table 8: CGIAR publications in 2018 with the high altmetric scores

CRP	JOURNAL TITLE	ISI	OPEN ACCESS	AUTHORS	TITLE	DOI	ALTMETRIC SCORE	MENDELEY READERS	URL
PIM/CCAFS	Nature	yes	no	Marco Springmann et al.	Options for keeping the food system within environmental limits	http://dx.doi.org/10.1038/s41586-018-0594-0	2,080	750	https://www.altmetric.com/details/49477107
A4NH	The Lancet	yes	yes	Nick Watts et al.	The 2018 report of the Lancet Countdown on health and climate change: shaping the health of nations for centuries to come	http://dx.doi.org/10.1016/s0140-6736(18)32594-7	1,786	228	https://www.altmetric.com/details/51888253
RTB	Proceedings of the National Academy of Sciences of the United States of America	yes	yes	Tina Kyndt et al.	The genome of cultivated sweet potato contains Agrobacterium T-DNAs with expressed genes: An example of a naturally transgenic food crop	https://doi.org/10.1073/pnas.1419685112	1,236	618	https://www.altmetric.com/details/3925112
RICE	Nature	yes	yes	Wensheng Wang et al.	Genomic variation in 3,010 diverse accessions of Asian cultivated rice	https://doi.org/10.1038/s41586-018-0063-9	427	218	https://www.altmetric.com/details/39302980
LIVESTOCK	Nature Sustainability	yes	no	Jules Pretty et al.	Global assessment of agricultural system redesign for sustainable intensification	http://dx.doi.org/10.1038/s41893-018-0114-0	345	182	https://www.altmetric.com/details/46527722
GLDC	Nature	yes	yes	Rajeev Varshney et al.	Pearl millet genome sequence provides a resource to improve agronomic traits in arid environments	http://dx.doi.org/10.1038/nbt.3943	338	160	https://www.altmetric.com/details/26196583
FISH	Nature Climate Change	yes	yes	Joshua E. Cinner et al. (W. Neil Adger, Edward H. Allison, Michele L. Barnes, Katrina Brown, Philippa J. Cohen, Stefan Gelcich, Christina C. Hicks, Terry P. Hughes, Jacqueline Lau, Nadine A. Marshall and Tiffany H. Morrison)	Building adaptive capacity to climate change in tropical coastal communities	https://doi.org/10.1038/s41558-017-0065-x	282	312	https://www.altmetric.com/details/32356413
WHEAT	Communications Biology	yes	yes	Clare M. Lewis, et al.	Potential for re-emergence of wheat stem rust in the United Kingdom	http://dx.doi.org/10.1038/s42003-018-0013-y	197		https://www.altmetric.com/details/32821781
MAIZE	Current Opinion in Plant Biology	yes	yes	Cairns, J.E., Prasanna, B.M.	Developing and deploying climate-resilient maize varieties in the developing world	https://doi.org/10.1016/j.pbi.2018.05.004	61	43	https://www.altmetric.com/details/42162511
MAIZE	Journal title: Agriculture, Ecosystems and Environment	yes	yes	Steward, P. R. Dougill, A. J. Thierfelder, C. Pittelkow, C. M. Stringer, L. C. Kudzala, M. Shackelford, G. E. J. Thierfelder, C. Pittelkow, C. M. Stringer, L. C. Kudzala, M. Shackelford, G. E.	The adaptive capacity of maize-based conservation agriculture systems to climate stress in tropical and subtropical environments : a meta-regression of yields	https://doi.org/10.1016/j.agee.2017.09.019	47	131	https://www.altmetric.com/details/27125879

Source: CRP 2018 annual reports. (*) PlumX metrics.

People Trained by CGIAR

In 2018, a total of 1,016,814 people were trained by the CGIAR, from which 1,012,972 were trained in short-term courses, with 48% of these being women. There were 3,842 people involved in long-term training courses (39% were women), including 545 PhD students. CCAFS reported in their annual report that "in 2018, more than 700,000 participants benefitted from capacity development activities, with a focus on UNFCCC processes." As an example, CCAFS provided training on nationally determined contributions (NDCs) in Africa (CCAFS, 2018).

Table 9 presents an overview of the number of people trained by CGIAR in 2018.

External Partnerships

Partnerships are central to the outcomes and impact achieved by the CRPs and Platforms. CRPs and Platforms engage in partnerships with a range of organizations and individuals, including academic institutions, policymakers and government agencies at various levels, international agencies, public and private sector companies and non-governmental organizations (NGOs). A database of the full list of CGIAR partnerships is available at the CGIAR Results Dashboard and information on external partnerships is available in Annex 4.

Taking the CRPs and Platforms as a whole, the main area of external partnerships in 2018 was research, which accounted for 37% of external partnerships. Other partnerships for all CRPs and Platforms related to capacity development (23%), policy (19%), delivery (16%) and other (5%).

For the agri-food system (AFS) CRPs, 40% of partnerships were related to research, 22% were related to capacity development, 21% were related to policy, 14% were related to delivery and 3% of partnerships were designated as "other".

The integrating CRPs' partnerships were also mostly linked to research (34%). Following this, 26% were related to capacity development, 19% were associated with delivery, 15% were related to policy, and the remaining 6% were designated as "other".

For Platforms, the main area of partnership in 2018 was delivery, which constituted 37% of their total external partnerships.

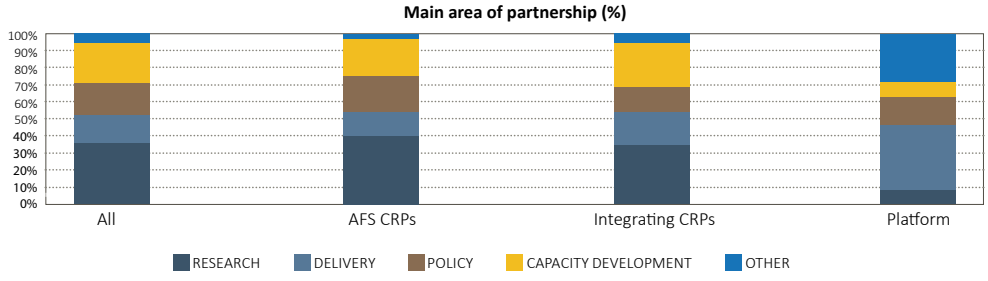
Figure 2 presents the main areas of external partnerships.

Table 9: Number of people trained by CGIAR in 2018

NUMBER OF TRAINEES IN SHORT-TERM PROGRAMS		NUMBER OF TRAINEES IN LONG-TERM PROGRAMS		TOTAL
1,012,972		3,842		1,016,814
FEMALE	MALE	FEMALE	MALE	
486,807 (48%)	526,165 (52%)	1,516 (39%)	2,326 (61%)	

Source: CRP and Platform 2018 annual reports.

Figure 2: Main areas of external partnerships in 2018



% OF PARTNERSHIP FOR...	RESEARCH	DELIVERY	POLICY	CAPACITY DEVELOPMENT	OTHER
All (CRPs + Platforms)	36.7	16.4	18.7	23.0	5.2
AFS CRPs	39.9	13.4	21.9	21.8	3.5
Integrating CRPs	34.2	19.1	14.8	26.2	5.7
Platform	8.6	37.1	17.1	8.6	28.6

Source: CRP and Platform 2018 annual reports.

Table 10 highlights the external partnerships related to research collaboration. It shows the top 25 research institutes that co-published peer-reviewed articles with CRPs and Platforms in 2018. The top three institutes were Wageningen University in the Netherlands, which collaborated on 144 publications; the French Agricultural Research Center for International Development (CIRAD), which co-authored 80 publications; and the Chinese Academy of Agricultural Sciences, China, which co-published 56 publications with CRPs or Platforms.

Partnerships which led to large numbers of publications were between CIRAD and RICE, the University of Montpellier and RICE, SupAgro and GLDC, and Wageningen University and CCAFS. The figures in this table demonstrate the importance of well-designed strategies for engagement with CGIAR, as, for example, the Netherlands' engagement strategy is evident in the level of Wageningen University's collaboration with CRPs.

Table 10: Top 25 research institutes co-publishing peer-reviewed articles with CRPs and Platforms in 2018

Source: CRP and Platform 2018 annual reports.

Public-private partnership established to improve rice production systems in Asia
RICE 2018 annual report

The lead center for RICE, the International Rice Research Institute (IRRI), established the Direct Seeded Rice Consortium (DSRC) – a public-private multi-stakeholder research for development platform with the overall goal of improving the environmental and economic sustainability of rice production systems in Asia.

The DSRC seeks to develop, refine and catalyze widespread adoption of improved mechanized and precise direct seeding practices. Private companies that have partnered with IRRI in the DSRC include Bayer and BASF. The DSRC aims to make direct seeded rice (DSR) accessible and widely available to rice farmers in Asia, thus enhancing the economic and ecological sustainability of rice production.

DSR has been widely practiced in many Asian countries such as Malaysia, Sri Lanka, Vietnam, Thailand, Cambodia and the Philippines, and many other countries including those in South Asia are going through the transition from manual transplanting to mechanized DSR. DSR has emerged as an efficient and economically viable alternative to manual puddled transplanted rice as it saves scarce and expensive resources such as labor and water, and reduces greenhouse gas emissions.

Source: RICE, AR 2018.

Engaging with regional governance to impact national and regional agroforestry policies
FTA 2018 annual report

Scientists from FTA working on landscape dynamics, productivity and resilience partnered with the Association of Southeast Asian Nations (ASEAN) to help deliver advances on agroforestry policies throughout the region. The 10 member states that make up ASEAN, with a combined population of more than 650 million people, are fast-tracking the adoption of agroforestry practices as part of efforts to mitigate, and adapt to, climate change.

The ASEAN Working Group on Social Forestry, together with FTA's partner, World Agroforestry (ICRAF), FTA's lead center, the Center for International Forestry Research (CIFOR), FAO, national governments, the Center for People and Forests (RECOFTC), the Non-Timber Forest Products Exchange Programme, the Southeast Asian Center for Graduate Study and Research in Agriculture and the Mekong Expert Group on Agroforestry developed guidelines to provide a broad framework and set of principles for member states to adopt as appropriate for their national and local contexts.

At the 40th ASEAN Ministers on Agriculture and Forestry meeting, held in Hanoi, Vietnam on 11 October 2018, the ministers formally endorsed the ASEAN Guidelines for Agroforestry Development.

The guidelines have prompted Cambodia and Myanmar to embark on "road maps" for agroforestry development. In parallel, developments have been inspired by the wider discussion about agroforestry. Vietnam has established a national working group on agroforestry and the Philippines has called for a national agroforestry policy or similar guiding document.

Source: FTA, AR 2018.

Contributions to International and National Policies, Legal Instruments and Investments

CGIAR contributions to international and national polices, legislation and significant investments in 2018 were spread over global, regional, multi-country, national and sub-national contributions. The majority were contributions at the national level, which accounted for 59% of contributions. The range of contribution types included policies or strategies, budgets or investments, curricula, legal instruments and others. The majority were policy and strategy contributions, which accounted for 77% of contributions. Ten contributions had gender as a principal objective, and 35 had gender as a significant objective.

Examples at the global level in 2018 included contributions to the World Health Organization (WHO) on nutrition, WHO's Animal department on zoonotic disease, Codex Alimentarius, the International Fund for Agricultural Development (IFAD) on biofortification, the CGIAR Antimicrobial Resistance Hub strategy, and the Group of 7 (G7) on empowering women.

Regional or multi-country contributions were made to the regional plan for Cassava Mosaic disease in Southeast Asia, the African Development Bank's multi-sectorial nutrition action, the Climate Research for Development (CR4D) Africa 2018-2022 Strategic Plan and intra-regional Fish Trade in sub-Saharan Africa.

Examples of national policy contributions reported in 2018 included the National Fisheries Strategy for Timor Leste, the Scientific Fish Farming in Gram Panchayat Tanks by Women Self Help Groups policy in Odisha, China's Rural Revitalization Strategy, the Direct Seed Marketing Program in Ethiopia, and the Rwanda Livestock Master Plan. A private-sector policy contribution was also made in 2018, with Mbale coffee management.

Major investments influenced by CGIAR in 2018 included the Indian government rolling out national solar irrigation investment, the Bill & Melinda Gates Foundation's first investment in aquaculture in Bangladesh and Nigeria, and World Bank investments in greenhouse gas emission reduction.

The number of contributions is summarized in Table 11. A full list is available in Annex 5.

Table 11: CGIAR contributions to international and national policies, legislation and significant investments reported in 2018

	GLOBAL	REGIONAL	MULTI-COUNTRY	NATIONAL	SUB-NATIONAL	TOTAL
Policy or strategy	16	7	1	46	11	**81**
Budget or investment	1	1	2	7	1	**12**
Curriculum	-	-	-	3	2	**5**
Legal instrument	-	-	-	6	1	**7**
Others	-	-	-	-	-	**-**
Total	**17**	**8**	**3**	**62**	**15**	**105**

Source: CRP 2018 annual reports.

A seminar discussing the findings of *The 2017–2018 Annual Trends and Outlook Report: Boosting Growth to End Hunger by 2025—The Role of Social Protection,* a publication that takes an in-depth look at the state of social protection in Africa. Photo: Jamed Falik/IFPRI

Seeds without Borders agreement expands to Bhutan
RICE 2018 annual report

The Seeds without Borders agreement was initiated by IRRI and first signed between Bangladesh and India in 2013. Originally applying to rice seeds, the agreement allows for any given rice variety that has been tested, approved, and released in one country to be released in other countries that are part of the agreement without undergoing further testing and evaluation, as long as they are grown under similar agroclimatic conditions. The seed agreement has since expanded to cover a number of rice-based crops such as maize, wheat, vegetables, pulses and others, with the possibility to include many more in future.

Cambodia, Myanmar, Nepal and Sri Lanka are now also members of the network agreement, with Bhutan's agriculture secretary, Dasho Rinzin Dorji, formally signing the agreement on June 13 2018.

The agreement is a rare opportunity for like-minded countries to share commercial crop varieties to enhance crop production and food and nutrition security. The vision ultimately is to have countries freely share their improved crop varieties of seeds with each other for the benefit of farmers, producers and consumers, and especially the disadvantaged population.

Source: RICE, AR 2018.

Examples of policies, legal instruments, investments and similar to which CGIAR contributed in 2018

- In order to increase fish production, reduce malnutrition and increase the income of women in Odisha, India, the Department of Panchayati Raj and Drinking Water (PR&DW), in consultation with the Department of Fisheries and Animal Resources Development (FARD) and WorldFish, formulated a policy corrigendum for long-term leasing (3-5 years) of approximately 65,000 village public water bodies called Gram Panchayat Tanks (GP tanks) spread over 50,000 hectares. Previously, these GP tanks had been underutilized or not used for fish production. The revised policy enables these tanks to be leased to women self-help groups for fish production on a priority basis (FISH, 2018).
- Research outputs from a collaborative project of IRRI and PhilRice – Benchmarking the Philippine Rice Economy Relative to Major Rice Producing Countries in Asia – were drawn on for the formulation of the Philippines' Rice Industry Roadmap (PRIR) 2030 (RICE, 2018).
- PIM research using computable general equilibrium modeling informed the development of the National Agricultural Investment Plans of Malawi and Rwanda. These strategic documents provide a country-wide framework to coordinate and prioritize investments by government agencies, development partners and other actors in the agricultural sector (PIM, 2018).
- LIVESTOCK researchers and partners used their modelling expertise to provide a guide for public and private investments in Ethiopia, with the objective of reducing poverty; achieving food and nutritional security; contributing to economic growth, exports and foreign exchange earnings; and contributing to climate mitigation and adaptation. This roadmap, or master plan, was then

used by various actors including the World Bank to shape their investments, which will ultimately impact more than 2.3 million of Ethiopia's 11 million livestock-keeping households (LIVESTOCK, 2018).

- CCAFS is supporting a five-year (2018-2022) pan-African climate research for development (CR4D) strategy that links climate research to agriculture for food security and resilience. CCAFS contributed to CR4D's initial agenda and launch, and its 2018-2022 Strategic Plan, which sets priorities and strategy to catalyze climate research that is responsive to development stakeholder needs at local, national and regional levels (CCAFS, 2018)

See more examples and details in Annex 5.

Source: CRP 2018 annual reports.
*Note: This is not a list of top examples, but a selection to demonstrate range.

Capacity Development

In 2018, capacity building initiatives across the CRPs and Platforms continued to play a crucial role in a range of activities. These encompassed training programs for a range of stakeholders; the production and dissemination of tools and manuals; guidance on, and support for institutional and organizational changes and improvements; and support for improved practices and methods.

An increased mix of digital approaches to capacity development was evident, with blended learning and digital and online resources and tools important components of capacity development initiatives. Engagement with governments, NGOs and the private sector was also included in numerous capacity development programs, as well as support and mentorship for young people.

Support for PhD students was also integral to capacity development activities. Table 12 presents an overview of the number of PhD students supported as part of CGIAR capacity development efforts, as an example of support for the next generation of research leaders in agricultural research and science.

Table 12: Number of PhDs supported in 2018

FEMALE	MALE	TOTAL
244	301	545

Source: CRP and Platform 2018 annual reports.

Education on nutrition improves the diets of young children
RTB 2018 annual report

A large community-level agriculture-nutrition intervention, led by CIP, implemented the program Scaling up Sweet Potato through Agriculture and Nutrition (SUSTAIN), used a combination of nutrition education and social and behavior communication (SBC) strategies to improve infant and young child feeding (IYCF) practices among different categories of women in western Kenya.

Nutrition education activities comprised nutrition messaging, counselling, cooking demonstrations in health facilities, mother-to-mother clubs, public awareness campaigns and SBC. These approaches were used to promote the incorporation of biofortified orange-fleshed sweet potato (OFSP) into the diets of children 6-23 months of age. The SBC focused on addressing cultural and psychosocial factors that hinder or facilitate the adoption of recommended IYCF practices.

A study on the impact of the intervention on the behavior of caregivers showed that early breastfeeding initiation was largely adopted (75%). Adoption of other practices included

the provision of diverse diets (21%), and the incorporation of OFSP roots (21%) and OFSP leaves (11%) into the diets of young children.

The findings indicate that using a combination of nutrition education strategies has a positive effect on improving the use of recommended IYCF practices, but long-lasting efforts are needed to influence behaviors at scale.

Source: RTB, AR 2018.

Knowledge dissemination through online tools
PIM 2018 annual report

In 2018, the global program, Soil Protection and Rehabilitation for Food Security, implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) for the German Federal Ministry for Economic Cooperation and Development (BMZ), launched a free Massive Online Open Course (MOOC) in cooperation with the University of Leeds' School of Earth and Environment and PIM partner, ICRISAT. The online course, titled "Land Matters! Integrating Soil Degradation Concerns and Solutions into Policy Processes" was attended by 1,600 participants. The course sought to help participants understand how to influence policymaking to foster sustainable soil protection and rehabilitation.

Source: PIM, AR 2018.

Fostering a global community of researchers on agriculture, nutrition and health
A4NH 2018 annual report

In 2018, the Agriculture, Nutrition and Health Academy (ANH Academy) Week was held in Accra, Ghana. ANH Academy Week helps convene a global community of researchers and research users working on agriculture, nutrition and health challenges. Since 2016, A4NH has co-organized this annual event with the London School of Hygiene and Tropical Medicine.

These events enhanced individual capacity of early-career researchers from low- and middle-income countries and filled a gap in networking opportunities around agriculture, nutrition and health.

The 2018 ANH Academy Week attracted 343 participants from 49 countries, who attended 17 learning labs and heard results from nearly 200 scientific presentations. A4NH researchers led learning labs on metrics for diets, women's empowerment, food safety, and child growth; research communication strategies; and co-led a session with the Global Alliance for Improved Nutrition on public-private collaboration.

Source: A4NH, AR 2018.

Business mentoring supports seed businesses in Nepal
MAIZE 2018 annual report

MAIZE partner, CIMMYT's Nepal Seed and Fertilizer Project (NSAF), is engaging more than 100 Nepalese seed companies and service providers in a business mentoring process to equip them with the required skills to run viable and competitive seed businesses.

Nepal's agriculture is mostly small-scale and subsistence-oriented, characterized by a mix of crop and livestock farming. The agriculture sector represents approximately one-third of the country's GDP and employs 75% of the labor force.

The NSAF project facilitates sustainable increases in Nepal's national crop productivity, income and household-level food and nutrition security across 20 districts, including five earthquake-affected districts. The project promotes the use of improved seeds and integrated soil fertility management technologies along with effective and efficient extension, including the use of digital and information and communications technologies.

Source: MAIZE, AR 2018.

Open Data and Open Access

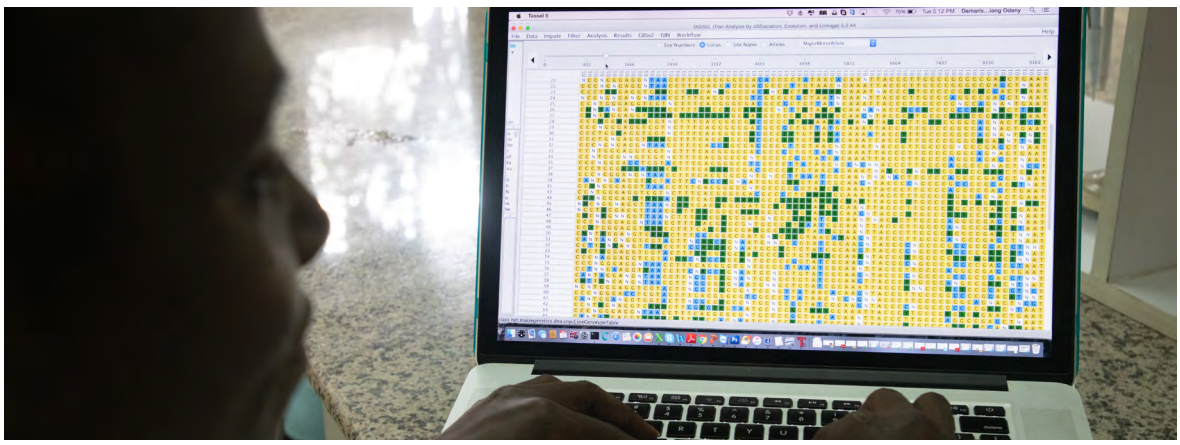
CGIAR is committed to the widespread dissemination of the results of its research and activities. CGIAR has made a strong commitment to open access and open data (OA-OD), and all Centers have signed CGIAR's 2013 Open Access and Data Management Policy. The rationale behind OA-OD is to achieve the maximum impact to advantage the poor, especially smallholder farmers in developing countries.

OA-OD enhances the visibility, accessibility and impact of research and development activities, and improves the speed, efficiency and efficacy of research. It enables interdisciplinary research; assists novel computation of the research literature; and allows the global public to benefit from CGIAR research.

It also ensures that the results of research and activities can more easily and collectively build the infrastructure necessary for CGIAR to be at the forefront of the OA-OD for agriculture movement.

To further support CGIAR's open access objectives, BIG DATA was launched May 2017. It aims to mobilize CGIAR data to accelerate research and spur new data-driven innovations, build data collaboration internally and externally, and leverage CGIAR expertise while claiming a unique leadership voice in digital agriculture. It also supports and promotes open data.

In 2018, BIG DATA created new data-driven capabilities, built new digital partnerships and alliances, and developed digital innovations.



ICRISAT's Damaris Odeny analyzes SNPs (single nucleotide polymorphism) to detect differences in the DNA of finger millet.
Photo: Michael Major/Crop Trust

OA-AD and initiatives of the Big Data Platform
BIG DATA 2018 annual report

In 2018, BIG DATA launched the Global Agricultural Research Data Innovation Acceleration Network (GARDIAN), a pan-CGIAR data search and discoverability portal. For the first time, datasets, publications and crop traits became discoverable and easily accessible in one portal, regardless of where they were archived across CGIAR's 15 Research Centers and 11 genebanks.

A number of data ontologies were developed that enable the cross-domain data querying and exploration necessary to form and address complex research questions across CGIAR. These included:

- An agronomy ontology developed by Bioversity International and IFPRI, which was incorporated into the Agronomy Field Information Management System (AgroFIMS).
- A mature crop ontology with new species and trait classes, which was released through a collaboration led by Bioversity International.

Source: BIG DATA, AR 2018.

Making data more efficient and accessible
GLDC 2018 annual report

For GLDC, implementation of strong data management and analytical research support tools has greatly benefited crop breeding activities.

GLDC data management systems and tools include the Breeding Management System, the genomic data management system Genomic Open-Source Breeding Informatics Initiative and public data sharing portals such as Dataverse and the Comprehensive Knowledge Archive Network.

Such databases render crop breeding highly efficient through access to pedigrees, electronic field books and in-field auto data validation. In addition, automated workflows to generate barcodes, tools for auto-generation of field books with updated records of pedigree data and quick exploratory statistical analysis aid efficiency and the timely flow of communication.

As an example, electronic field books have eliminated the need to key in data and enabled the data in the database to be available immediately after recording. This reduces the time for breeding decisions and incorporates greater rigor by integrating high quality statistical data analysis. As each plot – or plant in some cases – is barcoded, researchers can perform genomic selection in routine breeding by linking barcodes from phenotypic databases to genomic databases.

Source: GLDC, AR 2018.

CGIAR is a global research partnership for a food-secure future. CGIAR science is dedicated to reducing poverty, enhancing food and nutrition security, and improving natural resources and ecosystem services. Its research is carried out by 15 CGIAR Research Centers in close collaboration with hundreds of partners, including national and regional research institutes, civil society organizations, academia, development organizations and the private sector.

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