CGIAR Research Program on Rice Agri-Food Systems (RICE)

2018 Annual Report

The CGIAR Research Program on Rice Agrifood Systems (RICE) represents a single strategic and work plan for global rice research. RICE brings together hundreds of scientists to embark on the most comprehensive attempt ever to harness the power of science to solve the pressing development challenges of the 21st century. Cutting-edge science is deployed to develop new rice varieties with high yield potential and tolerance of a variety of stresses such as flooding, salinity, drought, soil problems, pests, weeds, and diseases. Improved natural resource management practices will allow farmers to fully realize the benefits of such new varieties on a sustainable basis while protecting the environment. Future rice production systems are designed to adapt to climate change and to mitigate the impacts of global warming. Policies conducive to the adoption of new varieties and cropping systems will be designed to facilitate the realization of development outcomes. RICE will train future rice scientists and strengthen the capacity of advisory systems to reach millions of farmers. For impact at scale, RICE scientists collaborate with hundreds of development partners from the public and private sector across the globe.

RICE was launched in 2010 (phase I: 2010-2016 – also known as the Global Rice Science Partnership, GRiSP; Phase II: 2017-2021) and is coordinated by three members of the CGIAR Consortium—the International Rice Research Institute (IRRI, the lead institute), Africa Rice Center (AfricaRice), the International Center for Tropical Agriculture (CIAT)—and three other leading agricultural agencies with an international mandate and with a large portfolio on rice: Centre de Cooperation Internationale en Recherche Agronomique pour le Développement (Cirad), L'Institut de Recherche pour le Développement (IRD), and the Japan International Research Center for Agricultural Sciences (JIRCAS). Together, they align and bring to the table consortia, networks, platforms, programs, and collaborative projects with over 900 partners from the government, nongovernment, public, private, and civil society sectors.

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Name of Lead Center: IRRI

Flagship lead institutions (CGIAR Centers or lead partners)

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Flagship 3: Sustainable farming systems

Flagship 4: Global Rice Array

Flagship 5: New rice varieties

Other participating CGIAR Centers: AfricaRice, CIAT, CIRAD, IRD, IRRI, JIRCAS

EXECUTIVE SUMMARY

Details and supporting evidence are found at the GRiSP.NET share site.

More than 600,000 farmers in China, Indonesia, Myanmar, Sri Lanka, Thailand, and Vietnam have been reached with improved management practices. About 118,000 farmers have adopted best practices and increased their rice yield by 11-20%, and profit by 15-25%. In the flood-prone areas of Northern Bangladesh, adoption of flood-tolerant varieties decreased rice production damage by flood, thereby increasing profitability, ensuring food security, and reducing poverty. In the 2017-2018 dry season, 2.1 tons of improved seeds and stress-tolerant rice varieties were distributed to 500 farmers, and in the wet season, 6.7 ton seeds were distributed to more than 1,500 farmers. In Africa, the adoption of the 'smart-valley approach' increased yield by 0.9 t/ha and net income by 267 US$/ha. In Cote d'Ivoire and Guinea, 20 tons of quality seeds were produced and disseminated to partners to increase capacity at national level.

To characterize climate change 'through the eyes of the crop, and to develop new climate-smart rice varieties, we established a global array composed of 25 sites and 71 varieties. The Magic indica Panel was evaluated in 6 sites across Africa, Asia and Latin America.

RICE contributed to the developed of the revised version of the Standard for Sustainable Rice Cultivation of the Sustainable Rice Platform, which provides 41 guidelines in rice cultivation covering farm management, water use, pest management, nutrient management, harvest and post-harvest practices,

health and safety, and labor rights. The Standard is complemented by a set of 12 quantitative Performance Indicators which enable users to monitor impacts of adoption of climate-smart best practices- as well as other field interventions such as developed by RICE.

A study in Ecuador confirmed the importance of women in rice production. Households where women participate in the decision process to select rice varieties, are more likely to adopt modern varieties. In addition, in households that adopt improved varieties, women's participation in the decision about which variety to plant is correlated with a larger land area sown with those varieties than households without female participation. Studies in Odisha, India revealed that women-headed households and caste groups like scheduled castes and tribes exhibited higher levels of adoption of stress-tolerant rice varieties, potentially due to the targeting strategies and working with NGOs for whom the poorest of the poor are the key target groups.

RICE co-organized the XIII International Rice Conference for Latin America and the Caribbean, which attracted 414 attendees from 22 countries, who presented 110 posters and 27 talks. RICE also contributed to the 5th International Rice Congress, which attracted 1,341 attendees from 64 countries, who together presented around 500 oral presentations and 300 posters.

316 scientific papers were published (51% open access). Three publications in Nature journals had Altmetric scores of 437, 248, and 96, respectively

558 scholars (47% female) were enrolled in long-term degree programs. Around 75,000 people (37% female) participated in short-term training courses and capacity-development events.

Part A: NARRATIVE SECTION

1. Key Results

1.1 Progress Towards SDGs and SLOs (sphere of interest, with research results frequently predating the CRP) (max. 400 words)

Significant progress has been made with the adoption of improved varieties, stress-tolerant varieties, best agronomic practices, decision tools and post-harvest technologies.

IRRI, through the "Closing Rice Yield Gaps in Asia with Reduced Environmental Footprint project (CORIGAP-PRO)" and its partners from China, Indonesia, Myanmar, Sri Lanka, Thailand, and Vietnam improved yield and income through innovations towards sustainable rice-based systems in these countries. The project's efforts on promoting best management practices in rice have reached more than 600,000 farmers with best practices. About 118,000 farmers have adopted best practices and increased their rice yield by 11-20%, and profit by 15-25%. In Vietnam, the use of 1 Must 5 Reductions (1M5R)

delivered by CORIGAP focused on reduction of seed and pesticide inputs. This management reduced the production costs by 23% reducing the production by 203 US$/ha per season, and generating 19% additional income, 175 US$/ha more. The adoption of this technology was 28% more beneficial compared to farmers who did not follow 1M5R.

In Bangladesh, the safe use of herbicides reduced costs by 66-73 US$/ha in Aman season and by 57-58 US$/ha in Boro season. There was a reduction of person-days per season (18 in Aman compared to 16 in Boro). The income increase was calculated at 121-151 US$/ha in Aman and 143-145 US$/ha in Boro.

In the flood-prone areas of Northern Bangladesh, adoption of flood-tolerant varieties decreased rice production damage by flood, thereby increasing profitability, ensuring food security and reducing poverty. In the 2017-2018 Boro/dry season, 2.1 tons of improved seeds and stress-tolerant rice varieties were distributed to 500 farmers. In the 2018 Aman/wet season, 6.7 ton seeds of improved and stress-tolerant rice varieties were distributed to more than 1,500 farmers. These varieties are making significant impact on farm income, food security, and livelihood of rice farmers in Bangladesh.

In Africa, the adoption of the 'smart-valley approach' on crop management increased yield by 0.9 t/ha and net income by 267 US$/ha. Surveys conducted among rice chain actors in the Bouake region of Cote d'Ivoire revealed that about 44% of farmers have adopted/used at least one variety from AfricaRice in 2018. Seed and variety dissemination roadmaps were developed for Burkina Faso, Gambia, Guinea, Mali, Nigeria, Sierra Leone, Ethiopia, Uganda and Madagascar. In Cote d'Ivoire and Guinea, 20 tons of quality seeds were produced and disseminated to partners to increase capacity at national level.

1.2 CRP Progress towards Outputs and Outcomes (spheres of control and influence)

1.2.1 Overall CRP progress (max 1000 words)

A major avenue for delivering overall RICE program outcomes was the collaboration with the Sustainable Rice Platform (SRP). The SRP is a multi-stakeholder platform co-convened by UN Environment and IRRI to promote resource efficiency and sustainability in trade flows, production and consumption operations, and supply chains in the global rice sector. The SRP pursues public policy development and voluntary market transformation initiatives to provide private, non-profit and public actors in the global rice sector with sustainable production standards and outreach mechanisms that contribute to increasing the global supply of affordable rice, improved livelihoods for rice producers and reduced environmental impact of rice production. The SRP comprises over 80 institutional members spanning a wide range of actors both within and outside the value chain, and covering public, private, and nongovernmental sectors.

RICE contributed to the development of the revised version of the SRP Standard for Sustainable Rice Cultivation (rice farming guidelines). Drawing on lessons experienced with other agri-food sustainability

initiatives, and from extensive field testing, the revised SRP Standard was developed over a 2-year period with broad stakeholder participation. The world's first voluntary standard for rice sustainability, SRP's rice cultivation standard entails 41 guidelines in rice cultivation covering farm management, water use, pest management, nutrient management, harvest and post-harvest practices, health and safety, and labor rights. The Standard is complemented by a set of 12 quantitative Performance Indicators which enable users to monitor impacts of adoption of climate-smart best practices- as well as other field interventions such as developed in RICE.

1.2.2 Progress by flagships

F1 - Flagship progress:

Several adoption and impact studies were undertaken. Besides those reported in section 1.1, the following were completed:

- In Bangladesh, 17,736 farmers were trained to grow healthy rice seedlings, and 51% of them adopted the management practices (4,700 ha in Boro season and 9,616 ha in Aman season)
- 14,385 ha of rice and wheat were mechanized in Nepal, by selling 2,877 reaper-harvester with profit of 100 US$/ha/season. The mini-tiller adoption increased productivity by 1.1 t/ha (12% technical efficiency). The mini-tiller was used for extra income from rentals by farmers (more than 200 US$/ha/year).
- Rice Crop Manager produced an income gain of 100-200 US$/ha in Asia, with about 1.3 M recommendations in Philippines and 55,000 in India. The RiceAdvice in Sub-Saharan Africa produces 100-250 US$/ha extra income and has been used about 40,000 times.
- Studies in Bangladesh found that women are engaged in more diversified activities than men and have high demands on their time for labour during both the agricultural peak and lean seasons. Engagement of women in new agricultural activities increases their workload. Socio-cultural attitudes towards sharing domestic/family care work need to change so that women are not unduly burdened while leading agricultural activities.

Detailed Annex:

http://www.grisp.net/file_cabinet/files/946597/download/RICE%20annual%20report%202018%20FP1.pdf?m=1554467456

F2 - Flagship progress:

Little is known about the value of sustainably-produced rice and incentive mechanisms for the adoption of sustainable production standards. A consumer survey in the south of Vietnam elicited consumers'

willingness-to-pay for rice produced and labeled under a national sustainable production standard through experimental auctions. Domestic consumers were willing to pay a 9% price premium for certified sustainably-produced rice. This premium gradually increases up to 33% when incremental levels of information on certification and traceability were provided. Promoting certified sustainably-produced rice hence crucially hinges on strengthening consumers' knowledge of and trust in food quality certification.

AfricaRice hosted a consultation workshop on comparative rice competitiveness to share Asia's key strategies for rice value chain success with West Africa. The premise of the workshop was that major rice-producing countries of Asia and West Africa have much in common, relating to the development of rice value chains. Critical success factors that emerged were professionalization of value chain actors, strong farmers' organizations, use of high-yielding varieties and mechanization, credit support system, creation of market outlets for domestic production, private sector participation in the provision of inputs, enabled private sector milling, quality assurance mechanisms, branding and promotional activities, and administered procurement and distribution systems.

Detailed Annex:

http://www.grisp.net/file_cabinet/files/946598/download/RICE%20annual%20report%202018%20FP2.pdf?m=1554467466

F3 - Flagship progress:

A highlight were activities in Myanmar on diversified rice-based farming systems, including collaboration with WorldFish/FISH to increase net production of food and cash incomes of rural households in Central Dry Zone and Ayeyarwady Delta through improvements in –and adoption of– production and post-harvest technologies, including fisheries. The project(s) had direct engagement with some 3,500 farmers, though field days, farmers groups, Learning Alliances, and –more indirectly– with up to 10,000 farmers. A critical step in reaching the large numbers of farmers has been the engagement with multiple levels of government for research, extension, and policy and with the private sector, also at different levels. Changes in postharvest management, by not stacking rice in the field after harvest but before threshing, were widely adopted locally, but engagement at the township level led to an estimated 90% adoption across the township. Based on analyses from experimental sites in 2016-17, farmed fish became regularly available in farmers' diets compared to previous seasonal catch of wild fish. Women, because of their traditional roles in the preparation and selling of fish, played a greater part in making decisions about food choice and distribution. Rice-fish farms generated 100 US$/ha more income than the comparison group.

Detailed Annex:

http://www.grisp.net/file_cabinet/files/946599/download/2018%20CRP%20Annual%20Report%20FP3.pdf?m=1554467475

F4 - Flagship progress:

We established a global array composed of 25 sites and 71 varieties. The Magic indica Panel was evaluated in 6 sites across Africa, Asia and Latin America.
New high-throughput phenotyping (HTP) facilities were deployed in the Magic panel evaluation in two sites in India and in Colombia. AfricaRice upgraded phenotyping facilities in Cote d'Ivoire., and AfricaRice staff was trained on the use of drones for HTP phenotyping. CIAT applied to breeding programs a phenotyping drone-based system for Hoja blanca disease classification..
For diseases tools were developed to (i) detect vectors and for real time monitoring of bacterial leaf blight, (ii) monitor blast in south Asia, (iii) diagnose brown spot causing agents. Representative samples for RYMV and brown spot disease in Africa were collected and characterized. A pilot platform "PathoTracer" was developed to make informed-decision of rice diseases that will allow integration of disease monitoring and breeding interventions.
Genotyping data for the reference and antennae panels was produced by skim sequencing, with SNPs called against the Nipponbare genome at 0.5x depth. For data gathering and sharing, a FP4 project website was created and is functional, providing download links to genotype/phenotype datasets and relevant meta-data from FP4.

Detailed Annex:

http://www.grisp.net/file_cabinet/files/946600/download/RICE%20annual%20report%202018%20FP4.pdf?m=1554467483

F5 - Flagship progress:

New donors for seedling/reproductive stage salinity, stagnant flooding, sheath blight, rice yellow mottle virus, and rice tungro bacilliform virus were identified. Genomic regions for anaerobic germination, sheath blight, Jasmonic Acid root response, panicle architecture, rice Hoja blanca virus, and striga identified. A blast resistant Pta gene was cloned. Six new constructs based on dCAS9 were developed for manipulation of rice root system and gene networks. Genomic prediction was developed with an accuracy of 0.63 and predictive ability of 0.35 for yield. Genetic gain in the marginal breeding program was estimated at 0.7, 1.0 and 1.8% for non-stress, moderate, and severe drought stress, respectively. Initial product profiles were developed for each of the five marginal mega ecosystems. Traits of importance for women were identified for inclusion in the breeding programs. The Stage Gate system to strengthen the performance of breeding programs is in process at IRRI. A superior haplotype-based genomic selection strategy was developed. The Breeding-for-Rice (B4R) tool was used for breeding

procedure optimization and data management. New methodologies of cooking quality attributes were developed.

Detailed Annex:

http://www.grisp.net/file_cabinet/files/946601/download/RICE%20annual%20report%202018%20FP5.pdf?m=1554467492

1.2.3 Variance from Planned Program for this year (max 450 words)

A) Have any promising research areas been significantly expanded?

Due to the environmental and health problems related to the straw burning in most countries, there is a huge interest in sustainable rice straw management. The Department of Agriculture in the Philippines funded a project on sustainable rice straw management for scaling mechanized rice straw collection, mushroom production, animal fodder, and rice straw logistics models in the Philippines. FP2 is rapidly expanding its research portfolio from rice as a commodity to rice-based diets with a strong focus on food choice and nutrition. This expansion was possible thanks to a grant from the "Drivers of Food Choice" Competitive Grants Program funded by the Bill and Melinda Gates Foundation and UK Aid, managed by the University of South Carolina Arnold School of Public Health. Consumer surveys and behavioral experiments on food choice in eastern India have been conducted and the data is currently being analyzed.

In FP 5 –using W12 funding– AfricaRice included research on low glycemic index rice and effects of storage conditions on mycotoxin concentrations – areas where in 2017 it was not yet active.

B) Have any research lines been dropped or significantly cut back?

Given reduction and uncertainty of W1/2 budget in 2018, most IRRI FP2 activities in Bangladesh were terminated, and activities in CoA 2.2 and 2.4 were reduced.

In FP5, at AfricaRice, DNA-free genome editing with pre-assembled CRISPR/Cas9 ribonucleoproteins did not continue since the prevalent Colombian regulations (where the products are field tested) evaluate the final product instead of the method. Therefore transgenic-mediated genome-edited plants can be used to produce desired edited traits once the transgene are segregated. At CIAT, activities related to

improved germplasm for upland ecosystems have been kept on hold due to lack of funding and early termination of a bilateral funded project.

C) Have any Flagships or specific research areas changed direction?

In order to become more responsive to market and environmental trends, rice breeding programs require forward-looking market and environmental/climate intelligence, and need to accelerate the breeding process. IRRI has started consolidating its market and value chain research through the concept of "digital product profiling," which aims at bringing together several layers of forward-looking data with the aim of developing market-driven, climate-resilient and gender-responsive product profiles for rice breeding. Secondly, IRRI initiated a novel research portfolio on the economics of rice breeding with the aim of providing evidence in support of the global adoption and impact of accelerated breeding technologies.

In FP5, research on C4 rice was considerably reduced due to the ending of the second-phase bilaterally-funded C4 rice project. Research so far also indicate that bundle sheath cells in rice need to be activated to increase the flow of CO2 into the C4 photosynthetic pathway. This will require extra efforts (and funding), and will likely delay the enhancement of rice photosynthesis by 20%. The focus at IRRI was shifted to improved photosynthesis and improved phenotyping research, with a much reduced budget.

1.2.4 Altmetric and Publication highlights (max. 400 words)

RICE co-organized the XIII International Rice Conference for Latin America and the Caribbean, May 15-18, in Piura, Peru. The conference attracted 414 attendees from 22 countries, who presented 110 posters and 27 talks. The conference hashtag @arrozFLAR#2018Arroz generated over 64,000 Impressions.

RICE also contributed to the 5th International Rice Congress (IRC2018), October 14-17 in Singapore. The RICE director was co-chair of the science and program committee and most RICE staff participated as session organizer, moderator, or attendee. IRC2018 attracted 1,341 participants from 64 countries, who together presented around 500 oral presentations and 300 posters. The congress had a pre-event reach of 201,319 on Facebook, 190,406 on Twitter, and 139,757 on LinkedIn, whereas the event reach (October 15-17) was 100,267 on Facebook, 84,268 on Twitter, 7,209 on LinkedIn, and 1,332 on Instagram. There were 4 press releases, 67 news articles, and 59 media outlets. The campaign hashtag #RiceCongress2018/#IRC2018 generated close to 6 million Impressions.

The following papers in Nature journals have a high Altmetric score:
1. Genomic variation in 3,010 diverse accessions of Asian cultivated rice, by Wang et al., 2018; Altmetric score: 437
2. Genomes of 13 domesticated and wild rice relatives highlight genetic conservation, turnover and innovation across the genus Oryza, by Stein et al., 2018; Altmetric score: 248

3. The rice genome revolution: from an ancient grain to Green Super Rice, by Wing et al., 2018; Altmetric score: 96.

In the first paper, the genetic variation, population structure and diversity among 3,010 diverse Asian cultivated rice (Oryza sativa L.) genomes from the 3,000 Rice Genomes Project was analyzed. The results were consistent with the five major groups previously recognized, but also suggested several unreported subpopulations that correlate with geographic location. Some 29 million single nucleotide polymorphisms were identified, 2.4 million small indels and over 90,000 structural variations that contribute to within- and between-population variation. Using pan-genome analyses, more than 10,000 novel full-length protein-coding genes were identified and a high number of presence–absence variations. The complex patterns of introgression observed in domestication genes were consistent with multiple independent rice domestication events. The public availability of data from the 3,000 Rice Genomes Project provides a resource for rice genomics research and breeding.

1.3 Cross-cutting dimensions (at CRP level)

1.3.1 Gender (max. 750 words)

A) List any important CRP research findings

A study in Ecuador confirms the importance of women in rice production. Households, where women participate in the decision process to select rice varieties, are more likely to adopt modern varieties. In addition, in households that adopt improved varieties, women's participation in the decision about which variety to plant is correlated with a larger land area sown with those varieties than households without female participation.

Studies in Eastern India and Africa have highlighted the differential access to land, especially in the rainfed lowland growing ecology in Africa. Studies in Cote d'Ivoire and Madagascar highlighted that without giving women formal ownership right on land along with their husbands, it is hard to ensure their economic empowerment and recognition as farmers. Indian women are still largely excluded from land ownership despite amendments in the laws. The study also found that land title ownership enhances women's status and decision-making influence in the household.

In Madagascar, sowing of rice is an activity performed principally by female farmers. The design of seeders for upland ecology sought to explicitly reflect women's needs and perceptions. In testing four prototypes of seeders, 56 of participants were female farmers. Like male farmers, most of the women also prefer the fertilizer and seed applicator because its combination visibly reduces labour. Although in general the seeders are advantageous and easy to use, they are however heavy and consequently suitable for men.

Developing new business opportunities for women and youth's economic empowerment and nurturing their entrepreneurial engagement in Nigeria highlighted that entry into profitable businesses is limited mainly by the lack of awareness, skills, capital, basic business tools or equipment, and the perception of gender-specific nature of some activities. A qualitative study of various institutional models engaging women in informal seed production and distribution in Eastern India and Nepal revealed that their engagement in seed production triggers their involvement through the seed value chain and not just seed storage. The women were found to diversify into seed production of other crops and have experienced increase in incomes. Their seed literacy increases and higher awareness contributed to varietal replacement in their households and communities. They have also experienced higher access to good quality seed of the promoted varieties.

At farm level in the Philippines, women and men's preferences were elicited to understand gendered differences in product profile priorities for rice breeding. On average, women had almost equal (48%) decision-making power as men (52%), revealing almost perfect gender equity in investment decision making in product profiling. Women were slightly more empowered if they were engaged in off-farm employment and were less experienced in farming. More empowered women had a higher discount factor and based their investment decisions on anticipated future trends.

B) What have you learned? What are you doing differently?

In moving from rice traits to food choice in rice-based diets, FP2 attempts to understand consumer food choices in order to support behavioral change communication programs that aim at nudging consumers to healthier food choices in rice-based diets. In 2018, behavioral experiments were conducted with low-middle income households in urban and rural West Bengal during which both household head and their spouse were given the opportunity to plan their household meals using the newly developed Food Choice Application. Women and men first individually planned their weekly menus and then jointly as a couple. This process will enable us to learn more about intrahousehold decision-making on food choice, while capturing women intrahousehold decision-making power (WIDMP) as a proxy for gender equity and inclusiveness in intrahousehold decision-making. These data will provide crucial insights in intrahousehold roles of food choice and the design of efficient nutrition-sensitive interventions that are gender-sensitive.

C) Have any problems arisen in relation to gender issues or integrating gender into the CRP's research?

none

1.3.2 Youth and other aspects of Social inclusion / "Leaving No-one Behind " (max 600 words)

In terms of business opportunities, on the one hand, male youth –individually or as a group– prefer to be involved in seed production or provide different service especially in tractor/power tiller for hire, rice

threshing, and transportation. On the other hand, female youth –individually or as group– prefer to engage in milled rice marketing, confection of rice-based products (rice snacks, cake, 'chinchin', doughnuts, candy, cookies, etc.), and rice winnowing. Their other potential activities are production of rice husk briquettes, drying parboiled rice and supplying firewood. These are generally new activities that the youth would like to engage in (except for rice parboiling and marketing for female youth and ASI thresher service provision for male youth). Hence physical and financial capital and skills are required.

To support and promote youth entrepreneurship in irrigated systems in Mali and Senegal, a call for expressions of interest was launched and prompted a high volume of applications from young people keen to get involved in the rice value chain. The results show that:

- Youth entrepreneur groups represent 31% and 23% of applications for, respectively, Senegal and Mali.
- The representation of women is 41% in Senegal while it is only 21% in Mali. But in both countries, women represent 31% of applications received.
- Women dominate in youth groups applications with 57% in Senegal and only 25% in Mali.
- In both countries, men dominate in the records of youth individual applications with 66% for Senegal and 81% for Mali

A mobilization/sensitization workshop was organized for the selected 310 youth group/individual entrepreneurs who learned about employment and income-generation opportunities throughout the rice value chain. A total of 80 start-ups or promising projects among the trained youth will benefit from competitive grants to conduct activities and create jobs along the rice value chain. In collaboration with the Syngenta Foundation for Sustainable Agriculture (SFSA), 10 Centres for Mechanized Services (CEMAs) in the two countries will be created. The CEMAs have so far recruited and trained 45 RiceAdvice service agents, and awareness-raising activities have been carried out in rice-growing regions.
Qualitative studies in Philippines have shown that young women and men experience an aspiration-achievement gap. Gender norms limit women's opportunities to learn about and pursue new agricultural practices and dissuade young women from pursuing agriculture-related occupations.

IRRI has developed a novel indicator for social sustainability and an econometric framework for assessing inclusiveness of rice value chain upgrading along the vertical coordination continuum. We find that older, smaller and horizontally-coordinated farmers with higher levels of trust in buyers tend to secure higher levels of buyer investment through increased vertical coordination in Vietnam. We find evidence that Vietnam's 'Small farm, large field' program successfully reduced scale bias of contract farming through horizontal coordination and even reversed under increasing levels of vertical coordination as smaller farmers are found to secure higher levels of buyer investment. This finding highlights the role of policies in fostering inclusiveness of rice value chain upgrading and is forthcoming in an article in Land Use Policy. Secondly, IRRI has assessed the value of cultural heritage with consumers in Metro Manila to develop market strategies for heirloom rice produced by indigenous populations in northern Philippines.

A) List any important CRP research findings

See above

B) What have you learned? What are you doing differently?

See above

C) Have any problems arisen in relation to youth issues or integrating youth into the CRP's research?

none

1.3.3 Capacity Development (max. 300 words)

A complete overview and description of capacity development activities can be found at the GRiSP.NET share site. (http://www.grisp.net/file_cabinet/folders/270452)

A total of 146 scholars (59 female) were enrolled or received their PhD degrees, 16 (48 female) their master's degree, and 182 (102 female) their bachelor's degree. An additional 114 (56 female) scholars were involved in RICE through internships or visiting assignments, bringing the total of long-term scholars to 558, of which 47% were female.

A total of around 75,000 people (26,000 female) participated in short-term training courses and capacity-development events. Of these, some 42,000 were 'end users' (participating in on-farm trials, farmer field days, etc.), 10,500 'next users' (in innovation platforms, policy workshops, etc.), and 17,500 participated in short-term technical trainings (such as tractor driving skills, straw management, statistical experimental design, 3D printing of spare parts, improved post-harvest practices, improved sowing, women entrepreneur skills). A few examples demonstrate the variety and breadth of training events:

- Quality Breeder Foundation Seed Course
- Training on Rice Technology and Experience in Asia for Developing Capacity for Sustainable Rice Value Chain
- Basic Experimental Design and Data Analysis
- Specialized Course on Rice Seed Production and Extension Methods
- Basic Marketing concepts and business planning training
- Climate Smart Rice Production
- Diversified Rice-Based Farming
- Drone based high throughput phenotyping
- Training on "Basic Understanding of Breeding Strategies for Higher Genetic Gain in Rice"
- Leadership People Management
- Commissioning, training and demonstration of the Solar Bubble Dryer
- Training on the use of Mini-GEM (husk fueled) system to produce high quality parboiled rice
- Training on data collection on Sustainable Rice Platform (SRP) standard and performance indicators

• Youth Seed Entrepreneurs Training

1.3.4 Climate Change

RICE breeders worked on several aspects of climate change with special focus on climate change adaptation through genetics and varietal development. New QTLs /genes have been identified for tolerance to high temperature, drought, stagnant flooding, submergence, and tolerance to low radiation. At the same time, research has been also undertaken to better understand the effect of climate change on biotic stresses (diseases). The development of varieties for tolerance to multiple stresses (such as submergence plus drought, submergence plus salinity, salinity plus drought, drought plus high temperature plus cold at seedling stage, as well as varieties combining tolerance to abiotic and biotic stresses) will help to maintain yield under recurring occurrence of climate-related stresses. The development of rice varieties for dry direct seeding and alternate wetting and drying situation will reduce methane emission.

Effects of climate change scenarios have been modeled in Africa (in the context of high temperatures). An agreement was signed between AfricaRice and Wageningen Plant Research to conduct crop modelling to explore adaptions to climate change for rice in Africa, including genetic adaptation traits and optimized sowing windows. In Latin America, climate change scenarios for Brazil were tested and showed the importance of Target Population Environment definition for upland rice breeding adaptation.

In January, IRRI organized a training course titled “Greenhouse Gas Mitigation in Rice Production: Technical Options and Measurement, Reporting, and Verification Guidelines”. The course was attended by more than 20 professionals from universities, government agencies, non-profit, and private institutions directly involved in environmental programs in different parts of the world. Building on the concept of climate-smart agriculture, the course aimed at a good understanding of the manifold co-benefits of mitigation and adaptation in rice production systems.

2. Effectiveness and Efficiency

2.1 Management and governance (max. 300 words)

No changes in the RICE management or governance structure occurred in 2018; terms of references of governance and management bodies can be accessed here (http://www.grisp.net/file_cabinet/folders/265910). The RICE independent steering committee met in June 2018 and detailed minutes are publicly available and can be accessed here (http://www.grisp.net/file_cabinet/folders/265910). (http://www.grisp.net/file_cabinet/folders/265910)

2.2 Partnerships

2.2.1. Highlights of External Partnerships (300 words)

Corteva Agriscience™, Agriculture Division of DowDuPont and IRRI signed a multi-year framework agreement on collaborative rice research, deployment of new breeding technologies, and development of breeding programs. The shared goal for this partnership is to help rice farmers to become more productive and sustainable. The collaboration will offer farmers a broader suite of high-performing products and effective science-based innovations that will optimize yield and crop quality. Also in the breeding domain, FP5 developed new opportunities to partner with private sector companies on the development of accurate markers. IRRI has set up a joint laboratory in Beijing, China, with the Chinese Academy of Agricultural Sciences to jointly research enhanced rice photosynthesis. IRRI also opened a joint lab at Jiangsu Academy of Agricultural Science to work on rice diseases.

In partnership with the BecA-ILRI Hub's Integrated Genotyping Service and Support, AfricaRice outsourced its large genotyping projects to DArT P/L, a private company dealing with genome sequencing. AfricaRice collaborates with various partners including Cornell University and the National Institute of Agrobiological Sciences (Japan) for genetic analysis (QTL analysis, Genome-Wide Association Mapping, and gene discovery) of abiotic stress tolerance.

IRRI establishment the Direct Seeded Rice Consortium - 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 by developing, refining, and catalyzing widespread adoption of improved mechanized and precise direct seeding practices through the public-private partnership. IRRI also established a new partnership with the German Agricultural Society (DLG), which led to cooperation with increased private sector participation in field demonstrations and exhibitions of mechanized rice agriculture in Myanmar and Thailand.

AfricaRice, IRRI, and London School of Hygiene and Tropical Medicine established collaboration to deliver both climate change and health co-benefits of future agricultural development in Africa.

2.2.2. Cross-CGIAR Partnerships (300 words)

Through the newly established Agri-food Policy Platform at IRRI, FP1 has renewed its engagement and commitment to a stronger collaboration with PIM. The Agri-food Policy Platform has continued its support and contribution to the foresighting work promoted by PIM as part of the global futures initiative. As a result, RICE FP1, through the policy analysis and foresighting cluster, will contribute to the "CGIAR report on the future of food systems in the world" that should be produced regularly with collaborations from interested CGIAR research centers. FP1 is expected to contribute chapters on the trends and outlook of the rice economy and related spillover effects.

The collaboration between RICE and ILRI on sustainable rice straw management continued in Vietnam, looking at markets for rice straw as ruminant fodder and for improving rice straw quality and nutritional value. Joint proposals for an intensification of the partnership have not yet been funded. FISH/WorldFish and RICE/IRRI continued their collaborative research on rice-fish systems in Myanmar, funded by ACIAR. Other opportunities for further collaborative research on similar systems were explored in meetings between IRRI, WorldFish and IWMI.

The collaboration among IRD, CIRAD, and IRRI in RICE was instrumental in the quick turnaround time in building improved bioinformatics infrastructure (GIGWA, Galaxy). This work benefited from CGIAR partnerships facilitated by the CG Platforms/Projects, particularly EiB, Big Data, and the Genomic Open-source Breeding Informatics Initiative (Cornell-IRRI-CIMMYT-ICRISAT). EIB trained AfricaRice staff on data collection tools and handling genotype-phenotype data.

RICE FP5 activities are closely linked to the Gene bank Platform for use of genetic diversity and development of targeted subsets for trait analysis. FP5 also developed close collaboration with GOBii and EiB on the development of breeding data management tools, development of product profiles, development of the stage-gate breeding system, and the identification of genotyping service providers.

2.3. Intellectual Assets (max. 250 words)

Have any intellectual assets been strategically managed by the CRP (together with the relevant Center) this year?

The RICE CRP is not a legal entity and the management of legal assets relevant to the CRP is managed by its participating CGIAR centers. All RICE CGIAR centers annually prepare and submit a detailed (usually labeled confidential) intellectual asset report to the System Management Board and the information contained therein is not repeated here.

Indicate any published patents and/or plant variety right applications (or equivalent)

The RICE CRP is not a legal entity and the management of legal assets relevant to the CRP is managed by its participating CGIAR centers. All RICE CGIAR centers annually prepare and submit a detailed (usually labeled confidential) intellectual asset report to the System Management Board and the information contained therein is not repeated here.

List any critical issues or challenges encountered in the management of intellectual assets in the context of the CRP

The RICE CRP is not a legal entity and the management of legal assets relevant to the CRP is managed by its participating CGIAR centers. All RICE CGIAR centers annually prepare and submit a detailed (usually labeled confidential) intellectual asset report to the System Management Board and the information contained therein is not repeated here.

2.4 Monitoring, Evaluation, Impact Assessment and Learning (MELIA) (max. 200 words)

The RICE progress indicators report has been completed. The MELIAG workshop held in Bangkok discussed the major lessons learned from implementation of metric indicators. In 2018, IRRI initiated a collaborative effort in creating an institutional capacity for implementing an impact-oriented monitoring, evaluation, and learning (IOMEL) system.

AfricaRice implemented a survey in Benin and Togo to assess the adoption and impact of the 'smart-valley approach' to improve water control and soil management in rainfed lowland. A pilot survey was implemented in Benin, Cote d'Ivoire, Ethiopia, Ghana, Kenya and Madagascar for the purpose of improving the capacity of members of the Coalition for African Rice Development.

In India and Bangladesh, a survey of 6,000 and 1,500 farm households was conducted to study the dynamics of adoption and impact of improved rice varieties. A survey of 1,260 farm households was conducted in Bangladesh to study the adoption and impact of Green Super Rice varieties. Impact assessment of improved rice varieties were also conducted in Guinea and Mali.

2.5 Efficiency (max. 250 words)

Collaboration among RICE centers is leading to efficiency gains and research spillovers. For example, AfricaRice is in the process to set up a flatbed dryer in Senegal using specs and drawings from IRRI. CIRAD, IRRI, and AfricaRice are jointly conducting an assessment of rice value chain upgrading in West Africa. JIRCAS is developing new rice-based products borrowing rice varieties from AfricaRice.

New donors and genomic regions for various traits identified across the RICE institutes are accelerating the delivery of targets for breeding. For example, the recently discovered early-maturity loci will result in the ability to deploy new genes from landraces to elite backgrounds in about 1.5 years. This represents a time saving of 1-1.5 years over current QTL deployment methodologies, and a saving of up to four years over methods in standard use.

The developed golden gate standard for cloning allows multiple genes to be assembled and transformed into rice across RICE centers. This greatly increases the efficiency of rice transformation in terms of resource costs and time to delivery. At AfricaRice, replacement of pedigree breeding with the Rapid Generation Advancement methods pioneered at IRRI has allowed all AfricaRice breeding units to develop larger breeding populations. Commercial outsourcing of genotyping has reduced the costs of genotyping at AfricaRice and accelerated marker validation for forward selection. The use of the same breeding software framework across CG Centers/CRPs/Platforms makes software development efficient, in terms of code base and time-sharing of developers across platforms (eg, one Galaxy developer across three CG Platforms).

2.6 Management of Risks to Your CRP (max. 250 words)

Programmatic

The largest risk was again W1,2 budget uncertainty and decline, which was mitigated by conservative use of W1,2 (see section 3).

Contextual

Some planned activities were constrained by political turmoil in countries. For example, a survey on climate change adaptation of rural households in Bangladesh was postponed because of national election being called for in 2018, which restricted travel to the survey areas. Likewise, there was political uncertainty in Madagascar caused by presidential elections. RICE project activities were continuously adjusted (e.g., changes in hotels to stay and transportation dates from town to activity sites) based on information on emerging protests and events.

Institutional

The aftermath of the reorganization of IRRI's internal research structure led to changes in leadership positions and uncertainty as to how RICE activities were being mapped onto the new structure. Also, 2017-18 saw high staff turnover rates at the RICE centers, at all levels of research and leadership. Like in 2017, this risk was mitigated by substantial mentoring from the RICE director of new staff and hands-on involvement in management and guidance of flagship projects at IRRI. Also, new partnerships were explored to fill the expertise gaps caused by departing staff. For example, the departure of three key crop modelers at AfricaRice and IRRI prevented the development of predictions of climate change on newly developed and tested rice germplasm in FP4. AfricaRice entered an agreement with Wageningen Plant Research for the delivery of these outputs, and involvement of the international rice AgMIP team is explored.

2.7 Use of W1-2 Funding (Max. 250 words)

In general, W1,2 funding provided the backbone of RICE and catalyzed impact through strategic investments along the whole impact pathway, from upstream research to downstream development of business models and multistakeholder partnerships for innovation and scaling out. W1,2 investments included both the research and product development component of the impact pathway as well as the strengthening of the enabling environment (as per Theory of Change), eg through capacity development and partnership building. The long-term nature of W1,2 funding provides the continuity to the program, and guarantees not only short-term impacts (as derived from most bilateral projects) but also long-term impacts on 5-10 year time scales. Most W1,2 funds were used to support key RICE and flagship project staff, key monitoring, evaluation and learning (MEL) activities across all projects and funding sources, gender analyses and gender mainstreaming, capacity development and partnership building for scaling out and achieving impact at scale, and new initiatives (such as farm diversification, value-chain analyses). Details of use of W1,2 funding are provided in Table 11.

3. Financial Summary

In 2018, a RICE W1,2 budget of 15.75 M US$ was approved by the System Council – down from 16.11 M US$ in 2017. However, since in 2017, the actual amount received was only 14.85 M US$, RICE management decided to internally budget for 14 M US$ only. This proved a prudent decision as the received W1,2 budget in 2018 was only 14.15 M US$ (as per 1 March 2019, see decision letter to DG of IRRI from the executive director of the System Management Office). Hence, there is a potential carry over of W12 funds from 2018 into 2019 (offsetting several years in a row of ending with a negative balance and RICE centers having to draw on their financial reserves.

Though the relative share of W1,2 funding has decreased, it still provides the backbone of RICE and catalyzes impact through strategic investments along the whole impact pathway, from upstream research to downstream development of business models and multistakeholder partnerships for innovation and scaling out. W1,2 investments cover both the research and product development component of the impact pathway as well as the strengthening of the enabling environment (as per Theory of Change), eg through capacity development and partnership building. The long-term nature of W1,2 funding provides the continuity to the program, and guarantees not only short-term impacts (as derived from most bilateral projects) but also long-term impacts on 5-10 year time scales. Most W1,2 funds are used to support key RICE and flagship project staff, key MEL activities across all projects and funding sources, gender analyses and gender mainstreaming, capacity development and partnership building for scaling out and achieving impact at scale, and new initiatives (such as farm diversification, value-chain analyses).

Part B. TABLES

Table 1: Evidence on Progress towards SRF targets (Sphere of interest)

SLO Target (2022)	Brief summary of new evidence of CGIAR contribution	Expected additional contribution before end of 2022
100 million more farm households have adopted improved varieties, breeds, trees, and/or improved management practices.	The CORIGAP-PRO's efforts on promoting best management practices in rice have reached more than 600,000 farmers with best practices for lowland intensive rice production across the six Asian countries. About 118,000 farmers have adopted best practices and increased their rice yield by 11-20%, and profit by 15-25% (IRRI news; CORIGAP annual report 2018). Arouna and Akpa (2019) showed that in Benin and Togo where the smart-valley technology has been introduced, the total area improved has increased from 110 ha in 2012 to 474 ha in 2014. The electronic-registration of rice value chain actors conducted in Bouake region of Cote d'Ivoire revealed that about 44% of the households registered has adopted at least one AfricaRice varieties in 2018 (AfricaRice Rice Statistics homepage). In Bangladesh, 17,736 farmers were trained to grow healthy rice seedlings, and 51% of them adopted the management practices.	
30 million people, of which 50%	A total of 14,385 ha of rice and wheat were mechanized in Nepal, by selling 2,877 reaper-harvester with	

are women, assisted to exit poverty	profit of USD100/ha/season. Also the mini-tiller adoption increased productivity by 1.1 t/ha (12% technical efficiency). The mini-tiller was then used for extra income from rentals by farmers (more than USD200/ha/year). In Vietnam, the use of 1 Must 5 Reductions (1M5R) delivered by CORIGAP focused on reduction of seed and pesticide inputs. This management reduced the production costs by 23% reducing the production by USD203/ha per season, and generating 19% additional income, USD175/ha more. The adoption of this technology was 28% more beneficial compared to farmers who did not follow 1M5R. In Bangladesh, the safe use of herbicides reduced costs by USD66-73/ha in Aman season and by USD57-58/ha in Boro season. The income increase was calculated at USD121-151/ha in Aman and USD143-145/ha in Boro.	
2.5 million ha of forest saved from deforestation	NA	
Improve the rate of yield increase for major food staples from current < 1% to 1.2-1.5% per year	(Arouna and Akpa, 2019) showed that the adoption smart-valley enables producers to increase yield by 0.9 tons per ha. In Cambodia, the practice of laser land leveling was reported to have increased yield by 24% (CORIGAP annual report 2018). In Nepal, survey results of 1,050 households showed that the optimal use of irrigation infrastructure	

	increased yields from 3 t/ha to 4.5 t/ha (CSISA annual report 2018). MyRice project in Myanmar increased the rice yield by 20%, reduced the yield loss by 15%, and raised income by 30%. CORIGAP reported yield increase of 11% yield in China, 15% in Myanmar, and between 4-20% in Sri-Lanka (CORIGAP annual report 2018).	
30 million more people, of which 50% are women, meeting minimum dietary energy requirements	Launch of the CIPA project with the aim to boost food, nutrition and income security in rural communities of Côte d'Ivoire and Ghana. CIPA project will be executed by AfricaRice in partnership with the Wageningen University and Research, the National Agricultural Research Center of Côte d'Ivoire (CNRA), the Council for Scientific and Industrial Research-Soil Research Institute of Ghana (CSIR-SRI) and MDF West Africa (AfricaRice Homepage). Based on analyses from experimental sites in 2016-17, farmed fish became regularly available in farmers' diets compared to previous seasonal catch of wild fish. Women, because of their traditional roles in the preparation and selling of fish, played a greater part in making decisions about food choice and distribution.	
150 million more people, of which 50% are women, without deficiencies of one or more of the following essential micronutrients: iron, zinc, iodine, vitamin A, folate,	Golden rice has been approved for feed, food and cultivation by food regulatory agencies of New Zealand, Australia, Canada and USA. In the Philippines, vitamin A deficiency affects 2.1 million children (6 months – 5 years old) pregnant women (9%) and nursing mothers (5%) (PhilRice).	

and vitamin B12		
10% reduction in women of reproductive age who are consuming less than the adequate number of food groups	NA	
5% increase in water and nutrient (inorganic, biological) use efficiency in agro-ecosystems, including through recycling and reuse	Alternate Wet and Drying water management (AWD) testing ongoing in Burkina Faso, Madagascar and Senegal. Additionally, AWD suitability maps are being developed in Philippines and Vietnam (Sustainable farming systems, K. Saito). AWD irrigation in the Senegal River Middle Valley resulted in increasing rice yield, water use and nitrogen use efficiency and reducing the irrigation applications by 27.3% in comparison with continuous flooding when managed at 30 kPa (Djaman et al., 2018). The impact of smart-valley approach to improve water control and soil management in rainfed lowland varies according to gender. The impact is 0.95 tons ha−1 for men and 0.88 tons ha−1 for women (Arouna and Akpa, 2019).	
Reduce agriculturally-related greenhouse gas emissions by 0.2 Gt CO2-e yr−1 (5%) compared with business-as-usual scenario in 2022	The demand for Land Laser Levelling (LLL), a technology that reduces greenhouse gas emissions by saving on energy, reduces cultivation time, and improves input-use efficiency, has increased in Nepal (27 LLL more and 5 sale outlets, from 0 in 2013) (CSISA annual report 2018).	

	Romasanta et al. showed that on an annual basis, rice straw incorporation had the highest total global warming potential (GWP) with 8023 kg CO2eq/ha. Straw burning entailed a GWP of 4913 kg CO2eq/ha that was almost identical to the GWP of partial straw removal from the field with 4531 kg CO2eq ha 1. Complete straw removal had the lowest GWP with 3470 kg CO2eq/ha. However, full GHG accounting of straw removed from the field will depend on the ensuing utilization of straw and the off-field emissions involved which was outside of the boundaries of the study.	
55 million hectares (ha) degraded land area restored	NA	

Table 2: Condensed list of policy contributions in this reporting year (Sphere of Influence)

Name and description of policy, legal instrument, investment or curriculum to which CGIAR contributed (20-50 words, ideally around 30 words)	Level of Maturity	Link to sub-IDOs (max. 2)	CGIAR cross-cutting marker score				Link to OICR (obligatory if Level of Maturity is 2 or 3) or link to evidence (e.g. PDF generated from MIS)
			Gender	Youth	Capdev	Climate Change	
183 - Expansion of the 'seeds without borders' agreement to Bhutan. Bhutan can now import improved variety seeds without much hassle from six countries in the region. Bangladesh, Cambodia, India, Myanmar, Nepal, and Sri Lanka are the other members of the network agreement	Level 1	• Adoption of CGIAR materials with enhanced genetic gains	0 - Not Targeted	0 - Not Targeted	1 - Significant objective	1 - Significant objective	OICR2724
211 - Contribution to the Rice Industry Roadmap Plan 2030	Level 1		0 - Not Targeted	0 - Not Targeted	0 - Not Targeted	0 - Not Targeted	OICR2779

Table 3: List of Outcome/ Impact Case Reports from this reporting year (Sphere of Influence)

Title of Outcome/ Impact Case Report (OICR)	Maturity level	Status
OICR2710 - Implementation of satellite-based rice monitoring system	Level 2	New Outcome/Impact Case
OICR2724 - Expansion of the 'seeds without borders' agreement to Bhutan	Level 1	New Outcome/Impact Case
OICR2741 - Adoption of Alternate wetting and drying in Asia	Level 3	New Outcome/Impact Case
OICR2742 - Adoption of Rice Crop Manager	Level 3	New Outcome/Impact Case
OICR2749 - Adoption of flood-tolerant rice varieties in Bangladesh (sub1)	Level 3	New Outcome/Impact Case
OICR2750 - Adoption of '1 Must Do - 5 Reductions' rice		

management practices in Vietnam	Level 2	New Outcome/Impact Case
OICR2752 - Adoption of smart-valley approach in Benin and Togo	Level 3	New Outcome/Impact Case
OICR2778 - Use of global rice sustainability standards	Level 3	New Outcome/Impact Case
OICR2779 - Use of RICE research outputs in the formulation of the Philippines Rice Industry Roadmap 2030	Level 1	New Outcome/Impact Case

Table 4: Condensed list of innovations by stage for this reporting year

Title of innovation with link	Innovation Type	Stage of innovation	Geographic scope (with location)
532 - Solar Bubble dryer in Nepal	Production systems and Management practices	Stage 2: successful piloting (PIL - end of piloting phase)	National, Nepal
533 - Solar Bubble Dryer version 2	Production systems and Management practices	Stage 3: available/ ready for uptake (AV);	Global
534 - GrainSafe™ Dry hermetic rice storage system	Production systems and Management practices	Stage 2: successful piloting (PIL - end of piloting phase)	Regional, South-Eastern Asia, Southern Asia
535 - Super bag rice grain storage	Production systems and Management practices	Stage 3: available/ ready for uptake (AV);	Global
536 - Flat bed dryer	Production systems and Management practices	Stage 4: uptake by next user (USE)	Regional, South-Eastern Asia

571 - Seeds without borders	Social Science	Stage 4: uptake by next user (USE)	Multi-national, Nepal, Bhutan, India, Bangladesh, Sri Lanka
595 - SMART-Valleys approach	Production systems and Management practices	Stage 4: uptake by next user (USE)	Multi-national, Benin, Togo
596 - RiceAdvice	Production systems and Management practices	Stage 3: available/ ready for uptake (AV);	Regional, Western Africa
597 - Two-row Motorized Paddy Weeder	Production systems and Management practices	Stage 3: available/ ready for uptake (AV);	Regional, Eastern Africa, Southern Africa
598 - Seeder cum fertiliser micro-dose applicator (Fertiseeder)	Production systems and Management practices	Stage 1: discovery/proof of concept (PC - end of research phase)	National, Madagascar
599 - Cropping calendar construction model	Production systems and Management practices	Stage 1: discovery/proof of concept (PC - end of research phase)	Multi-national, Senegal, Madagascar
600 - Alternate wetting and drying (AWD)	Production systems and Management practices	Stage 3: available/ ready for uptake (AV);	Multi-national, Senegal, Burkina Faso, Madagascar, Côte d'Ivoire

602 - Alternate wetting and drying (AWD)	Production systems and Management practices	Stage 4: uptake by next user (USE)	Multi-national, China, Vietnam, Bangladesh, Philippines, Thailand
604 - Weather-rice-nutrient integrated decision support system (WeRise)	Production systems and Management practices	Stage 2: successful piloting (PIL - end of piloting phase)	Multi-national, Indonesia, Philippines
605 - Field Calculator	Production systems and Management practices	Stage 1: discovery/proof of concept (PC - end of research phase)	Global
606 - Rice Crop Manager	Production systems and Management practices	Stage 4: uptake by next user (USE)	Multi-national, India, Philippines
607 - Rice Doctor Odiya	Production systems and Management practices	Stage 2: successful piloting (PIL - end of piloting phase)	National, India
608 - Sustainable Rice Platform (SRP) Standard and Performance Indicators	Production systems and Management practices	Stage 4: uptake by next user (USE)	Global
609 - AutoMonPH- a decision tool for system	Production systems and Management	Stage 2: successful piloting (PIL - end of	National, Philippines

level water management using AWD principle	practices	piloting phase)	
610 - Improved water governance	Production systems and Management practices	Stage 2: successful piloting (PIL - end of piloting phase)	National, Bangladesh
611 - EasyHarvest	Production systems and Management practices	Stage 1: discovery/proof of concept (PC - end of research phase)	National, Philippines
612 - Laser land leveling	Production systems and Management practices	Stage 3: available/ ready for uptake (AV);	Multi-national, Cambodia, Vietnam, Thailand
613 - Laser land leveling	Production systems and Management practices	Stage 2: successful piloting (PIL - end of piloting phase)	Multi-national, Indonesia, Philippines, Myanmar (Burma), Sri Lanka
614 - Bio-diversified upland rice based cropping systems designing	Production systems and Management practices	Stage 1: discovery/proof of concept (PC - end of research phase)	National, Madagascar
615 - SeedCast mobile app	Social Science	Stage 1: discovery/proof of concept (PC - end of research phase)	National, India

616 - Semi automatic rice husk furnace	Production systems and Management practices	Stage 1: discovery/proof of concept (PC - end of research phase)	Multi-national, Cambodia, Myanmar (Burma)
617 - Training and business model for linking farmers to markets for sustainable rice production	Research and Communication Methodologies and Tools	Stage 3: available/ ready for uptake (AV);	Global
618 - Rice straw pelletizing	Production systems and Management practices	Stage 1: discovery/proof of concept (PC - end of research phase)	National, Vietnam
619 - Rice straw mushroom production Business Models (Training Manual)	Research and Communication Methodologies and Tools	Stage 3: available/ ready for uptake (AV);	National, Vietnam
620 - Anaerobic digestion of rice straw, household batch system	Production systems and Management practices	Stage 1: discovery/proof of concept (PC - end of research phase)	National, Philippines
621 - Learning Alliance for Scaling	Social Science	Stage 2: successful piloting (PIL - end of piloting phase)	National, Myanmar (Burma)
622 - Training Module: Life Cycle Assessment for Agriculture	Research and Communication Methodologies and Tools	Stage 3: available/ ready for uptake (AV);	Global

623 - Vocational training program for Agricultural Machinery Mechanics	Research and Communication Methodologies and Tools	Stage 3: available/ ready for uptake (AV);	National, Cambodia
624 - IRRI Rice Quality Kit	Production systems and Management practices	Stage 3: available/ ready for uptake (AV);	Global
645 - Implementation of drone HTP phenotyping in multiple sites globally	Production systems and Management practices	Stage 3: available/ ready for uptake (AV);	Global
648 - Satellite-based rice monitoring system	Production systems and Management practices	Stage 4: uptake by next user (USE)	Multi-national, India, Philippines
649 - satellite-based rice monitoring system	Production systems and Management practices	Stage 3: available/ ready for uptake (AV);	Multi-national, Cambodia, Vietnam
650 - Flood-tolerant rice varieties for Bangladesh (sub1)	Genetic (varieties and breeds)	Stage 4: uptake by next user (USE)	National, Bangladesh
651 - Premium Quality Rice (PQR) varieties BRRI	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake	National, Bangladesh

Dhan 50 and BRRI Dhan 63		(AV);	
652 - '1 Must 5 Reductions (1M5R)' integrated rice management package	Production systems and Management practices	Stage 4: uptake by next user (USE)	National, Vietnam
653 - Array sites established in multiple locations in India, Southeast Asia, Latin America, and Africa	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Global
654 - MINCER micrometerological station used to improve spikelet sterility estimations in crop models	Production systems and Management practices	Stage 3: available/ ready for uptake (AV);	Global
656 - Rice biomass software for drone image analysis	Research and Communication Methodologies and Tools	Stage 2: successful piloting (PIL - end of piloting phase)	Global
657 - Hoja blanca disease screening system	Research and Communication Methodologies and Tools	Stage 1: discovery/proof of concept (PC - end of research phase)	Multi-national, Ecuador, Bolivia, Venezuela, Brazil, Panama, Peru, Argentina, Chile, Paraguay, Colombia, Costa Rica, Mexico, Guyana, Honduras, Uruguay, Dominican Republic,

			Nicaragua
658 - PhenoSense	Research and Communication Methodologies and Tools	Stage 1: discovery/proof of concept (PC - end of research phase)	Global
659 - Molecular marker for blast resistance in West Africa	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Regional, Western Africa
660 - Rice yellow mottle virus (RYMV) resistance-breaking risk map for Africa	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Regional, Sub-Saharan Africa
661 - Pantoea diagnostic multiplex PCR	Production systems and Management practices	Stage 3: available/ ready for uptake (AV);	Global
662 - Pathotracer, a platform to take informed-decision on rice diseases	Research and Communication Methodologies and Tools	Stage 2: successful piloting (PIL - end of piloting phase)	Global
663 - Application of AMMI model to multi-site data allowed exploration of G x E effects in GWAS.	Research and Communication Methodologies and Tools	Stage 1: discovery/proof of concept (PC - end of research phase)	

664 - Prototype Data Hub	Research and Communication Methodologies and Tools	Stage 3: available/ ready for uptake (AV);	Global
667 - Novel genomic regions and donors for grain zinc content	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Global
668 - Early-maturity loci introgression	Genetic (varieties and breeds)	Stage 1: discovery/proof of concept (PC - end of research phase)	Global
669 - C4 Rice	Genetic (varieties and breeds)	Stage 1: discovery/proof of concept (PC - end of research phase)	Global
671 - Multiline variety for blast resistance	Genetic (varieties and breeds)	Stage 1: discovery/proof of concept (PC - end of research phase)	Global
672 - Species diagnostic SNP markers for quality control genotyping in four rice (Oryza L.) species	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Global
673 - Haplotype-specific markers for use in	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Global

parental selection			
675 - New QTLs/genes for the control of rice hoja blanca virus disease in Latin America	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Regional, South America, Caribbean, Latin America & the Caribbean
676 - Improved rice lines with high Zinc concentrations	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Regional, Latin America & the Caribbean
677 - Rice lines with improved water use efficiency and nitrogen use efficiency	Genetic (varieties and breeds)	Stage 1: discovery/proof of concept (PC - end of research phase)	Global
679 - Green Super Rice varieties	Genetic (varieties and breeds)	Stage 3: available/ ready for uptake (AV);	Global
680 - 246 sequenced African rice genomes	Genetic (varieties and breeds)	Stage 1: discovery/proof of concept (PC - end of research phase)	Global

Table 5: Summary of status of Planned Outcomes and Milestones (Sphere of Influence-Control)

FP	Outcomes 2022	Summary narrative on progress against each FP outcome this year.	Milestone	2018 milestones status or changed)	Provide evidence for completed milestones (refer back to means of verification, and link to evidence wherever possible) or explanation for extended, cancelled or changed
F1	F1 Outcome: Foresight analyses and priority setting used by RICE and partner scientists to develop and target technology options	Official document from Andhra Pradesh, India, State Level Coordination Committee on Crop Insurance (SLCCI) in 2018 mentioned IRRI Satellite based rice monitoring system to be used to support the 'Pradhan Mantri Fasal Bima Yojana' (PMFBY) crop insurance program for paddy. SLCCI is a legal entity in India responsible for elaborating and implementing crop insurance schemes in that state. IRRI's key partner in Tamil Nadu, Tamil Nadu Agricultural University, registered as member of the State Level Coordination Committee on Crop Insurance. This allow for continued contribution of satellite-based rice monitoring technology in the PMFBY crop insurance program.	2018 - Application of the rice monitoring system for national food security program in Cambodia, supporting Thailand disaster relief program for rice farmers, crop insurance implementation in Tamil Nadu, India, Cambodia and Mekong River Delta, Vietnam, and development of remote sensing based rice monitoring system for Bihar, India	Complete	http://news.irri.org/2017/02/satellite-based-monitoring-system-to.html https://www.asean-agrifood.org/press-release-satellite-technology-expedites-insurance-payouts-in-indias-crop-insurance-programme/ http://news.irri.org/2017/02/satellite-based-monitoring-system-to.html

	F1 Outcome: Improved role in decision making by women and youth in rice value chains as evidenced by empowerment measures at key action sites	Evidence in Ecuador for female participation in adoption and sowing of improved rice varieties. In Cote d'Ivoire and Madagascar empowering the rural women not only make them economically empowered, but also help them to get credit for productive work. In Nigeria, it is possible for women to run profitable businesses, but some constraints remain: lack of awareness, skills, capital, basic business tools/equipment and the perception of gender-specific nature of some activities.	2018 - Gender-youth business models in rice value chain reinforced through better understanding of changing roles on decision making of women and youth in rice farming	Complete	https://cgspace.cgiar.org/handle/10568/78294
	F1 Outcome: Well-functioning multistakeholder platforms for innovation at six action sites (Bangladesh, India, Nepal; Nigeria, Senegal, Tanzania)	The Economic Rice Observatory has incorporated additional indicators to track rice value chain information and withdraw policy lessons across the region. This initiative is supported by the Latin American Confederation of Entities of Rice (CELARROZ) which is interested into diverse market-related research topics. Well-functioning multi-stakeholder innovation platforms with active local IP	2018 - Establishment of a formal Economic Rice Observatory to provide policy briefs to the FLAR member countries	Complete	https://flar.org/ Innovation platform and governance of local rice value chains in Benin: Between game of power and internal democracy? doi.org/10.1080/23311932.2018.1433346

		coordination and facilitation teams have been established in Nigeria, Benin, Uganda and Madagascar. IPs have also been initiated in Senegal, Ghana and Cote D'Ivoire and are being facilitated to refine their governance structures. Key lessons on IP governance published in peer-reviewed journal articles.			
	F1 Outcome: New cadre of young, well trained scientists (30% women) engaged in rice research	558 scholars (47% female) were enrolled in long-term degree programs. Around 75,000 people (37% female) participated in short-term training courses and capacity-development events.	2018 - 250-300 scholars (30% women) enrolled in advanced degree training (bachelors, masters, PhD)	Complete	http://www.grisp.net/file_cabinet/folders/270452
	F1 Outcome: Effective public and private delivery systems for seeds of improved rice varieties in six countries (Bangladesh, India, Nepal; Nigeria, Senegal, Tanzania)	18 tons of foundation seed delivered to seed SMEs for onward multiplication to certified seed which will eventually be made available to farmers. With an expected production of 1,080 tons of certified seed this can potentially reach 43,200 farmers. Seed and variety dissemination roadmaps were developed for Burkina Faso, Gambia, Guinea, Mali, Nigeria, Sierra Leone, Ethiopia, Uganda and Madagascar. In Cote d'Ivoire and Guinea, 20 tons of quality seeds were produced and disseminated.	2018 - Sufficient commercial seed produced by the seed system to provide seeds for at least 5 million farmers, of which at least 50% are women, at the key action sites	Complete	https://www.researchgate.net/publication/326263766_Impact_of_Submergence-Tolerant_Rice_Varieties_on_Smallholders'_Income_and_Expenditure_Farm-Level_Evidence_from_Bangladesh

		In Bangladesh, in 2017-2018 8.7 ton seeds of improved and stress-tolerant rice varieties were distributed to 2000 farmers.			
	F1 Outcome: Impacts and adoption of RICE technologies assessed	Too many results to synthesize in this box; see sections on MELIA in RICE synthesis report. Examples: Rice Crop Manager (RCM) produced an income gain of 100-200 US$/ha in Asia, with about 1.3 M recommendations in Philippines and 55,000 in India. The RiceAdvice in Sub-Saharan Africa has been used about 40,000 times. In Africa, the adoption of the 'smart-valley approach' increased yield by 0.9 t/ha and income by 267 US$/ha. Surveys conducted among rice chain actors in the Bouake region of Cote d'Ivoire revealed that about 44% of farmers have adopted/used at least one variety from AfricaRice in 2018.	2018 - Adoption and impact studies on NRM technologies and/or varieties - rolling plan based on progress of technologies along the impact pathway	Complete	https://csisa.org/wp-content/uploads/sites/2/2018/12/CSISA-III-BD-NP-USAID-annual-report_2017-18.pdf http://congresos-rohr.com/arroz-en/index_htm_files/KAZUKI%20SAITO.pdf http://www.grisp.net/file_cabinet/files/941898/download/2018_AnnualProgressReport%20CORIGAP.pdf?m=1551320606 https://www.sciencedirect.com/science/article/pii/S0378429018300868 https://ageconsearch.umn.edu/record/274356/files/Abstracts_18_05_22_22_08_07_70__202_123_56_189_0.pdf https://link.springer.com/chapter/10.1007%2F978-3-319-77878-5_11

					http://data.africarice.org/RiceStatistics.php
	F1 Outcome: Functional and effective results-based management system for RICE and its partners	The RICE CRP has adopted in 2018 the MARLO system as platform of management information system for planning and reporting. MARLO Training for senior RICE staff was organized during the MELIAG workshop in September, 2018. The RICE progress indicator report was completed in 2018 and is now available at www.grisp.net. IRRI initiated an institute wide impact oriented Monitoring and Evaluation strategy (IOMEL). The strategy is still at its early stage of implementation. On September 3-6, 2018 the Monitoring Evaluation, Learning, impact assessment and gender annual workshop was held in Bangkok.	2018 - Annual updates of progress and performance indicators; reflective learning workshops; commissioned reviews and evaluations (rolling plan)	Complete	https://marlo.cgiar.org/Rice/crpDashboard.do?edit=true (accessible to RICE members) http://www.grisp.net/file_cabinet/folders/267850 http://www.grisp.net/file_cabinet/folders/270448 (accessible to RICE members)
F2	F2 Outcome: Diversified enterprise opportunities	This milestone has made significant progress in West Africa but has been	2018 - Upgrading strategies developed	Extended	Insufficient finances to complete Also, one of the scientists involved in this task

	through upgraded value chains at six action sites (Indonesia, Myanmar, Vietnam; Cote d'Ivoire, Nigeria, Tanzania)	extended because not all the sites have been covered particularly in East Africa. Also, one of the scientists involved in this task resigned and has just been recently replaced.	with partners for increasing value capture by actors in three action sites		resigned and has just been recently replaced.
	F2 Outcome: Income by value-chain actors increased by 10% at six action sites through improved access to financial and other services (Indonesia, Myanmar, Vietnam; Cote d'Ivoire, Nigeria, Tanzania)		2018 - Rice market value captured by women scale-processors increased thanks to the improved parboiling system introduced for rice products diversification in Cote d'Ivoire.	Extended	Insufficient finances to complete Also, one of the scientists involved in this task resigned and has just been recently replaced.
			2018 - Opportunities for youth engagement in agribusiness services provision identified along the rice value chain in Côte d'Ivoire.	Extended	Insufficient finances to complete Also, one of the scientists involved in this task resigned and has just been recently replaced.
	F2 Outcome: Income by value-chain actors increased by 15% through adoption of at least	The development of the GEM parboiling technology and piloting in sites in West Africa reduced losses and increased the	2018 - At least two loss reduction or value addition options	Extended	Lack of internal resources (personpower; finances)

	one of the postharvest or value addition practices or technologies at six action sites (Bangladesh, Cambodia, Indonesia; Benin, Cote d'Ivoire, Nigeria)	value of rice by adopters. The coupling of the GEM technology to a rice husk gasifier to create the Mini-GEM has increased the value of rice husk in sites by using it as a parboiling fuel. This activity has been extended because publications on this are being prepared.	identified and piloted		
	F2 Outcome: Functional value chains for improved processing and novel products from rice at six action sites (Bangladesh, Cambodia, Indonesia; Benin, Cote d'Ivoire, Nigeria)	Prototypes of GEM technologies using rice husk as fuel and rice husk gasifier stoves for household use with increased gas burning time have been developed. However, testing has been done only for Mini-GEM system in Cote d'Ivoire. Therefore, this activity has been extended to allow for testing in other sites in West and East Africa.	2018 - Prototype improved processing and novel products developed and tested at six action sites	Extended	Lack of internal resources (personpower; finances)
F3	F3 Outcome: Improved management practices that reduce yield gap by 10-15% developed and disseminated at eight action sites (Nigeria, Senegal, Tanzania, Madagascar, Vietnam, Indonesia, Bangladesh, Myanmar)	Crop management practices for enhancing rice yield identified in Africa including (1) fertilizer application (NPK, micro-nutrients, zinc, gypsum), (2) water management (AWD), and (3) other crop management Effect of P and S application on yield and nitrogen use efficiency confirmed, and technologies for improving P cycling tested in Madagascar (JIRCAS)	2018 - Integrated management options identified for reducing yield gaps at six action sites (Nigeria, Senegal, Madagascar, Bangladesh, Myanmar, Indonesia)	Complete	https://doi.org/10.1016/j.geoderma.2018.11.036 https://doi.org/10.1080/03650340.2018.1552785 https://doi.org/10.1016/j.fcr.2018.02.016

		Farmers reached in Asia for improved management practices for irrigated lowland rice increased from 379,000 in 2017 to 612,800 in 2018. Of these 125,000 have reduced their yield gap by 10%.			https://doi.org/10.1007/s10705-017-9898-y https://doi.org/10.3390/w10060711 https://doi.org/10.1016/j.fcr.2017.02.014 https://doi.org/10.1007/s10333-018-0666-7 http://www.tropentag.de/2018/proceedings/proceedings.pdf Presentation in IRC https://doi.org/10.1016/j.fcr.2017.02.005 https://doi.org/10.1016/j.fcr.2018.10.001
	F3 Outcome: Improved management practices that increase input use efficiency by 5% developed and disseminated at eight action sites (Nigeria, Senegal, Tanzania, Madagascar, Vietnam, Indonesia,	Situations of fertilizer recommendations for rice-based systems in SSA including Senegal reviewed, and farmers' inputs use including fertilizer quantified in West Africa Nutrient (NPK) gap for rice yield quantified in Africa.	2018 - Baseline input use efficiencies quantified, and constraints and opportunities identified at six action sites (Nigeria, Senegal, Madagascar, Vietnam,	Complete	https://doi.org/10.1007/s10333-018-0649-8 https://doi.org/10.1016/j.fcr.2017.02.014 https://doi.org/10.1016/j.geoderma.2018.11.036

	Bangladesh, Myanmar)	Baseline input use efficiencies quantified, and constraints and opportunities identified using SRP standard/performance indicators in Nigeria In Vietnam and Myanmar, outreach of increased input use efficiency has been mediated through two World Bank projects that require farmer organizations to meet best practice guidelines before they can avail of financial support for machinery and infra-structure.	Indonesia, Myanmar)		http://www.grisp.net/file_cabinet/folders/271258 https://csisa.org/wp-content/uploads/sites/2/2018/12/CSISA-III-BD-NP-USAID-annual-report_2017-18.pdf http://www.grisp.net/file_cabinet/files/941898/download/2018_AnnualProgressReport%20CORIGAP.pdf?m=1551320606
	F3 Outcome: Options to diversity rice farms with other crops, animals, or trees developed and disseminated at six action sites (Cote d'Ivoire, Madagascar, Tanzania, India, Bangladesh, Myanmar) (together with other CRPs)	Promising diversification options identified in Cote d'Ivoire, Madagascar, Rwanda, Senegal. Rice-legumes rotation systems (pigeon pea, mung bean, and stylosanthes) tested, Cote d'Ivoire. Over 10 short duration vegetables and legumes identified for further development of rice-veg systems in Madagascar. A multi-criteria approach revealed the best rotation options for upland rice ecological intensification in Madagascar. Stylosanthes managed as a living mulch in rice crops showed to be less competitive while controlling the striga. Introduction of cover/relay crops after wet season rice on	2018 - Options for farm diversification developed and tested at four action sites (Cote d'Ivoire, Madagascar, Bangladesh, Myanmar)	Complete	http://www.tropentag.de/2018/abstracts/links/Rajaona_ux7lSiYh.pdf https://www.scienceforum2018.org/sites/default/files/2018-09/SF18_case_study_irrigated_rice_senegal_0.pdf http://www.grisp.net/file_cabinet/folders/271258 http://www.ewrs2018.org/programme/boo

		the hydromorphic plains, rainfed lowlands and irrigated scheme in Cambodia. Research on rice-fish systems established at three sites Myanmar.			k-of-abstracts/ https://doi.org/10.1016/j.agee.2017.12.005 http://www.agroecology-europe.org/abstratcts-talks-posters/ http://gsdm-mg.org/wp-content/files/JAE_6.pdf
	F3 Outcome: Diversified on-farm diets sourced through diversified farming systems at four action sites (Cote d'Ivoire, Madagascar, Bangladesh, Myanmar) (together with other CRPs)	Baseline on-farm diets characterized at Madagascar	2018 - Baseline on-farm diets characterized at three action sites (Madagascar, Bangladesh, Myanmar)	Extended	Partially completed (Madagascar only)
	F3 Outcome: Improved rice management practices that reduce GHG by 5% disseminated at three action sites (Bangladesh, Philippines, Vietnam)	Promotion of rice management practices, particularly alternate wetting and drying, in Vietnam (via CORIGAP and VnSAT projects), Philippines (via WateRice project) and Bangladesh (via CSISA project)	2018 - Improved rice management practices that reduce GHG emissions demonstrated in Vietnam	Complete	https://csisa.org/wp-content/uploads/sites/2/2018/12/CSISA-III-BD-NP-USAID-annual-report_2017-18.pd fhttp://www.grisp.net/file_cabinet/files/941

					898/download/2018_AnnualProgressReport%20CORIGAP.pdf?m=1551320606
	F3 Outcome: Results of completed farming systems analyses used to focus development activities on key opportunities for adapting to climate risks at eight action sites (Nigeria, Senegal, Tanzania, Madagascar, Vietnam, Indonesia, Bangladesh, Myanmar)	Predictors of drought in inland valleys and enabling factors for rice farmers' mitigation measures identified in Nigeria. Options for reducing risks caused by climate change identified in Africa including Senegal and East Africa Development of a hydraulic and agronomic model to support the design and assess a water control facility based on bunded plots with drain/canal system (CAD) for lowland rice in Burkina Faso. IRRI with national agencies of Bangladesh demonstrated strategic land-use pattern and improved water governance to increase resilience against climate change.	2018 - Options for reducing risks caused by climate risks identified at six action sites (Senegal, Madagascar, Vietnam, Indonesia, Myanmar)	Complete	https://doi.org/10.3390/su11010079 https://doi.org/10.1111/gcb.13967 https://doi.org/10.1016/j.eja.2016.06.012 www.tropentag.de/2018/abstracts/posters/422.pdf www.tropentag.de/2018/abstracts/posters/353.pdf www.tropentag.de/2018/abstracts/links/Asch_er8MRdHW.pdf www.tropentag.de/2018/abstracts/links/Abera_r6SypZ3B.pdf
	F3 Outcome: Value chain actors including farmers and service providers using new mechanization options	A gender-neutral mechanical weeder for reducing labour identified in Africa. Seeders and 1 fertilizer seed applicator	2018 - Prototype labor-saving technologies identified at two action sites	Complete	https://doi.org/10.1017/S001447971700059X

	designed to increase women's labor productivity at seven action sites (Nigeria, Senegal, Tanzania, Vietnam, Indonesia, Bangladesh, Myanmar)	identified which can reduce at least 60% of labor input in Madagascar. Locally manufactured motorized weeder developed that can reduce labor inputs by 80% per cropping season in Africa. In Bangladesh, women have taken lead to be service provider for mechanical harvesting of rice in polders. Laser leveling and mechanical transplanter were identified as new mechanization options in Bangladesh and Philippines.	(Madagascar, Myanmar)		http://www.grisp.net/file_cabinet/folders/271258
F4	F4 Outcome: Predicted global rice production risks used to guide development and targeting of climate change-adapted technologies at least for the most vulnerable rice agroecosystems	Sequenced Antenna panel distributed to Global Array sites, covering climate vulnerable areas. Effects of climate change on rice production in Africa have been determined and the Distribution of abiotic stresses (drought, cold, Fe toxicity, salinity /sodicity) in Africa was mapped. TPE for upland systems in Brazil were mapped and the impact on breeding evaluated The antenna panel was sent to countries that cover a wide difference in climate/management and soils. Array sites in southeast Asia, Myanmar and some	2018 - Global array refined based on preliminary results to capture major TPEs (target populations of environments of breeding programs) and major climate trend scenarios	Changed	Staff turnover eliminated the capacity to do modelling and TPE definition within the RICE –CG partners. Fewer sites in the global array than initially planned (due to reduced funding) and departure of GIS and crop modelling specialists. https://onlinelibrary.wiley.com/doi/full/10.1111/gcb.13967

		locations in India were differentiated by high yield potential, presence of abiotic stresses, and high diversity of diseases and pests:			https://www.sciencedirect.com/science/article/pii/S0378429017317173?-via%3Dihub https://doi.org/10.1111/gcb.14071 https://doi.org/10.1016/j.fcr.2018.11.009
	F4 Outcome: A functional global phenotyping network composed of 30% non-CRP partners (including self-sponsored), and genetic donors (>10) and ideotypes (2-4) adopted by breeding programs to develop climate-smart rice varieties	Reference panel running in Africa (Senegal and Cote d'Ivoire), Colombia (Palmira), Raipur (India), Yezin (Myanmar), Los Banos and Iloilo (Philippines) Dissemination of drone-base technologies across array sites (India, Colombia, Cote d'Ivoire).	2018 - (i) Phenotyping facilities and network up and running in at least 60% of the target sites, (ii) new HTP platforms established at Mbé (HTP field-based), CIAT PALMIRA, and IRRI, (iii) Efficient reporting (data acquisition, quality control, annual reports, etc.) mechanisms/tools are in place mechanisms/tools are in place	Extended	The full establishment of a drone-based phenotyping platform was delayed either because (i)a strong regulation of drone-base technologies in some countries, (ii) the delay in obtaining the necessary hardware, desktop, GPS platform for planning and operation of field mapping and image processing (iii)late hiring of the plant phenotyping specialists.
	F4 Outcome: Characterized	Different diagnosis tools for RYMV, blast	2018 - Spatial		Due to lack in common operational funding

	pathogens populations and diversity used to predict varietal deployment for at least 3 major rice diseases	and bacteria were developed and tested in Africa and Asia. And a Diagnosis web platform developed. Genotypes with increased resistance to blast were generated in Africa. And Maps to guide the deployment of lines were generated.	distribution of pests and diseases and deployment of available isolines completed in at least 60% of the target sites	Changed	and communication there has not been a common strategy between Coa 4.1 and pathologist to tackle the 3 diseases in the target sites. We will do a workshop to build a common strategy in specific sites where bilateral funding is available https://www.biorxiv.org/node/137320.abstract https://apsjournals.apsnet.org/doi/abs/10.1094/PHYTO-05-17-0190-R
	F4 Outcome: At least 5 major QTLs/genes that are stable across environment and management, for all rice mega-environments, integrated in the respective varietal development pipelines	Genome-Wide Association Mapping analyses accomplished on GRISP global phenotyping data with interesting regions identified for yield, cold and other traits. AMMI model used for G x E analysis combined with Genome-Wide Association Mapping. Work in progress in Africa for salinity, anaerobic germination and drought	2018 - Value added to candidate genes from Global Phenotyping Network GWAS through postGWAS analyses with data curated.	Complete	Sequencing data aligned to Nipponbare reference genome and SNPs called at high density. With the availability of higher depth genotype data where HDRA genotypes were imputed with 3K genotypes to 5.2M SNPs, analyses of the GRISP phenotyping panels are being revisited to improve the accuracy and power.
	F4 Outcome: A functional rice data hub providing open access phenotypic and genotypic	The components of the rice hub are implemented already. In the pilot stage are the database (GIGWA) and analysis	2018 - (1) Data analysis tools: a) GWAS pipeline - a data	Changed	Restructuring of FP activities

	information and data analysis tools for users worldwide	workbench (Galaxy). Already available is the FP4 project website that provides download links to genotype/phenotype datasets and relevant meta-data from FP4. Electronic field books created and staff trained for automated data capture and upload We will include additional Genome-Wide Association Mapping tools recently benchmarked to be better than existing one installed (FarmCPU). (b) (c) is also still under active development .	analysis tool available to users through IRRI Galaxy. (b) Genotype imputation tools available through IRRI Galaxy environment). (c) haplotype clustering and visualization tools. (2) Datasets: (a) imputed data for most used genomic datasets (e.g. 3K, HDRA (b) haplotype database for all/major rice genes based on 3K and HDRA data.		
F5	F5 Outcome: Rice diversity in rice gene banks used globally for identification of traits and discovery of new genes	New donors for seedling-reproductive stage salinity, stagnant flooding, sheath blight, rice yellow mottle virus, rice tungro bacilliform virus identified. Genomic regions for anaerobic germination, sheath blight, Jasmonic Acid root response, panicle architecture, rice hoja blanca virus, striga identified. Blast resistant Pta gene cloned. 6 new constructs based on dCAS9 developed for manipulation of rice root system and gene networks.	2018 - 20% of targeted traits/donors/QTLs/genes identification achieved	Complete	The available evidences are the many research manuscripts published (too many to list here, see RICE 2018 publication list in the GRISP.NET file cabinet http://www.grisp.net/file_cabinet/folders/270452) Use of the donors, QTLs and genomic

					regions in the breeding programs
	F5 Outcome: Novel tools for precision biotech breeding based on genetic diversity shared open access and globally	Deployment of high-value genes for disease, abiotic stress, grain quality and other characters into IRRI 154. Developed genomic prediction (GP) model to estimate accession performance 332 diagnostic SNPs were identified that clearly discriminated between the three indigenous Africa species complex Role of AG04 gene validated for resistance against virus through gene editing. Plants edited for the TDF1 gene showed 100% sterile pollen, in the case of the EA gene, the edited plants did not show the expected phenotype. Two CRISPRs were designed to edit the gene GN1A	2018 - Models and computational methods to characterize inter(sub) specific mosaic structure of rice genomes and its impact on traits transmission	Complete	IRRI,-List of current QTL Deployment products is available at this link (IRRI intranet only). IRRI, CIRAD- genomic predictions in use in GS breeding program AfricaRice identified SNPs in use in current studies. https://link.springer.com/article/10.1007/s11032-018-0885-z
	F5 Outcome: New rice varieties resulting in 1.3 % genetic gain in intensive systems	Elite germplasm characterized. Breeding cycle reduced to 4 years with potential to reduce to 2 years in a few years when there's more	2018 - 25-50 New rice varieties for intensive system	Complete	IRRI: 384 lines tested globally. 2,000 more predicted. 50 lines advanced to MET team. Breeding lines available for use. AfricaRice: tables with product profiles are available. Other activities continue each year

		Multiline variety for true genes of blast resistant with an Indica Group rice IR 64 genetic background. Product profiles for replacing dominant irrigated lowland varieties were developed for 16 African countries; RGA system through SSD in Ndiaye, Senegal delivered 80,000 F2s, 50,000 F3s and 14,000 F4s. Six new improved rice varieties were released for irrigated rice in Latin America (Nicaragua, Panama, Costa Rica, Honduras, Guyana, Venezuela)			using new sets of germplasm.
	F5 Outcome: Rice varieties with 20, 15, 10% reduction in yield loss caused by factors induced by climate change, in mega deltas, rainfed lowlands, and uplands, respectively	Climate smart multiple stress tolerant varieties released in Asia. Genetic gain for yield under irrigated control, moderate drought and severe drought analyzed. Breeding lines with adaptation to low soil fertility selected in farmer's fields in Madagascar: Uplands - 22 F7 lines, lowlands - 16 Pup1 lines. RGA system through SSD has been established for rainfed upland, rainfed lowland and high elevation ecologies, five lines with more than 30% yield advantage over FARO 44 and another five lines with over 36% yield advantage over the best check FARO 67 were identified. Corpoica Porvenir 12 for	2018 - Genes conferring tolerance of submergence, stagnant flooding, salinity, high/low temperatures, iron toxicity, drought, and blast conferred to elite backgrounds; initial elite lines nominated for release	Complete	https://doi.org/10.1186/s12284-019-0269-y https://doi.org/10.1038/s41598-019-39084-7 https://doi.org/10.1111/pbi.13087

		uplands llanos of Colombia released			
	F5 Outcome: High quality and high nutritious rice varieties that are preferred by men and women farmers and consumers	Phenotyping methods estimated for capturing cooking quality traits and defined genetic regions. Diagnostic markers developed for use in forward breeding to improve Zinc content in rice and MAGIC lines identified with enriched Zn. Studies on consumer preferred grain quality traits in Benin identified that for domestic rice, grain length should be increased (3.2mm) and chalkiness and amylose contents should be reduced (16-18% and 22%, respectively).A diverse panel of 209 genotypes was sown in Palmira in an alpha-lattice design with three replications. Quality traits were measured (apparent amylose content, gelatinization temperature and grain chalkiness). Marker genotyping and validation underway.	2018 - Novel tools and processes to capture specialty traits developed at key action sites to minimize chalk, enhance head rice recovery, capture cooking quality	Complete	R.P.O. Cuevas, C.J. Domingo, N. Sreenivasulu. Multivariate-based classification of predicting cooking quality ideotypes in rice (Oryza sativa L.) indica germplasm. Rice 11(1): 56, 2018. doi: 10.1186/s12284-018-0245-y. G. Misra, et al. Deciphering the genetic architecture of cooked rice texture. Frontiers in Plant Science 9:1405, 2018. doi: 10.3389/fpls.2018.01405. https://www.doi.org/10.1002/fsn3.617
	F5 Outcome: Prototype C4 rice lines with increased yield potential available	Rice lines generated containing 10 C4 genes	2018 - One line with a basic C4 pathway with at least 20% enhanced photosynthetic rate and improved biomass production fed to FP4 for validation of genetic gain from C4	Complete	None

Table 6: Numbers of peer-reviewed publications from current reporting period (Sphere of control)

	Number	Percent
Peer-Reviewed publications	316	100%
Open Access	162	51%
ISI	316	100%

Table 7: Participants in CapDev Activities

Number of trainees	Female	Male
In short-term programs facilitated by CRP/PTF	26,000	49,000
In long-term programs facilitated by CRP/PTF	59	87

Table 8: Key external partnerships

Lead FP	Brief description of partnership aims (30 words)	List of key partners in partnership. Do not use acronyms.	Main area of partnership (may choose multiple)
F1	Partnership with GREAT (Gender-Responsive Researchers Equipped for Agricultural Transformation) to design, conduct and deliver innovations that integrate gender (https://www.greatagriculture.org/).	• Cornell University • FOFIFA - Centre National de Recherche Appliqué au Développement Rural	• Research • Delivery • Development • Capacity
F1	Collaboration with the Technical Centre for Agricultural and Rural Cooperation (CTA) in implementing the project "Promoting Youth Entrepreneurship and Job Creation in West Africa's Rice Value Chain"	• CTA - The Technical Centre for Agricultural and Rural Cooperation • Syngenta Foundation for Sustainable Agriculture	• Capacity • Delivery • Research
F1	Collaboration with University of Illinois, University of Arizona, Colorado State University, University of Connecticut and University of Nicosia for impact assessment of rice technologies in Africa.	• University of Arizona • CSU - Colorado State University • UCONN - University of Connecticut • University of Illinois	• Research • Capacity
F1	Continued partnership with Philippine government agencies, namely, Philippine Rice Research Institute, Bureau of Plant Industry, Department of Agriculture (DA)-	• PhilRice - Philippine Rice Research Institute	• Research • Policy

	Central and Regional Field Offices through three projects funded by the DA	• DA - Department of Agriculture (Philippines)	• Capacity
F1	New partnership to support work on crop insurance, development of new algorithm for historical yield data generation and integrating remote sensing based information into Rice Crop Manager	• UM - University of Maryland	• Research
F2	Partnership with private companies (i.e Advanced Chemical Industries Ltd (ACI), Metal Private Ltd) in Bangladesh to bring sustainability in the seed sector with respect to climate resilient rice	• GrainPro - GrainPro Inc	• Development • Delivery
F2	CIRAD collaborates with research and development organization on the upgrading of rice value chains in West Africa.	• INERA - Institut de l'Environnement et de Recherches Agricoles	• Research • Capacity
F3	Direct Seeded Rice Consortium, a multi-stakeholder (public-private) consortium, which aims to develop a comprehensive, science-based, agronomic package adapted for direct seeded rice production in Asia	• Bayer Crop Science • PhilRice - Philippine Rice Research Institute • CARDI - Cambodian Agricultural Research and Development Institute	• Delivery • Development • Research
F3	A Global Long-Term Experiment Network (GLTEN) for Sustainable Agriculture	• Rothamsted Research • CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo • AfricaRice - Africa Rice Center	• Research

		• INIA - Instituto Nacional de Investigacion Agropecuaria (Uruguay) • CAU - China Agricultural University • IITA - International Institute of Tropical Agriculture • MSU - Michigan State University	
F3	les Systèmes de Production d'Altitude et Durabilité (SPAD), which aims to develop sustainable farming systems in highlands in Madagascar	• FOFIFA - Centre National de Recherche Appliqué au Développement Rural • CIRAD - Centre International de Recherche Agricole et du Developpppement • IRD - Institut de Recherche pour le Développement	• Capacity • Delivery • Research
F4	Sequencing heat MAGIC to identity genes conferring heat tolerance, as key trait in rice for adapting to climate change	• UCL - University College London	• Research
F4	AfricaRice partnered with BECA-ILRI hub and Intertek (through high-throughput phenotyping project led by ICRISAT) for high throughput genotyping of rice	• ILRI - International Livestock Research Institute	• Other
F4	Improvement of crop models and prediction of climate change effects and adaptations on rice production	• WUR - Wageningen University and Research Centre • NARO - National Agriculture and Food	• Research

		Research Organization (Japan)	
F4	CIAT collaborate with EMBRAPA to study the upland environments in Brazil and determine the specificities for breeding (TPE) using modelling approaches (Oryza model)	• EMBRAPA - Empresa Brasileira de Pesquisa Agropecuária	• Research
F4	CIAT collaborate with Rothamsted , tokyo university and universidad javeriana for the development of software and hardware for data analysis from drones and satellites..	• Rothamsted Research	• Research
F4	Analysis of disease resistance, characterization of pathogens and development of diagnosis tools	• Ghent University • Goettingen University • CIRAD - Centre International de Recherche Agricole et du Developpppement	• Research
F5	CIAT works closely with partners (FEDEARROZ and FLAR), universities (Universidad Javeriana, University of Tokyo, University of Texas) to develop a low-cost fixed station platform that monitors crop growth, soil status	• FLAR - Fondo Latinoamericano para Arroz de Riego • FEDEARROZ - Federación nacional de arroceros • University of Texas, Health Sciences Center at Houston, School of Public Healt	• Research

F5	To expand C4 mutant screening capacity, IRRI has initiated collaboration with CAAS, China to formulate a joint laboratory in the Biotechnology Research Institute, Beijing that will become operational in 2018	• CAAS - Chinese academy of agricultural sciences	• Research
F5	CIRAD and EMBRAPA work together on dissection of genetic bases of female outcrossing ability and female hybrid seed production ability	• EMBRAPA - Empresa Brasileira de Pesquisa Agropecuária	• Research
F5	CIRAD-CIAT-FLAR collaborate on inventory of elites lines for major irrigated rice breeding programs in Latin America.	• FLAR - Fondo Latinoamericano para Arroz de Riego	• Delivery • Research

Table 9: Internal Cross-CGIAR Collaborations

Brief description of the collaboration	Name(s) of collaborating CRP(s), Platform(s) or Center(s)	Optional: Value added, in a few words
RICE FP1 will work with the Socioeconomic CoP from the Big Data Platform, particularly with the 100Q and the SociO! Groups to achieve adequate data standards for data collection through the design of modular survey questionnaires.	BigData	Increased research efficiency gain
Assessment of rice straw markets, processing options for higher digestibility and life cycle assessments for rice straw as animal fodder. Contribution for sustainable rice production (reduced GHGE and pollution), value adding options for farmers, cattle owners and machinery service providers.	ILRI, Livestock	Rsearch
ICRISAT and IRRI co-presentation at International Rice Congress workshop session entitled, “Mobile Data Collection for Rice Research.”	ICRISAT	Research
Through the Big data platform, AfricaRice is collaborating with the other CG centers in CGIAR e-research (CeRES) to facilitate data discoverability across CGIAR	BigData	Research efficiency gain

Modernization of breeding programs and automation of the breeding operations through development and implementation of standard tools and steps across breeding programs to develop better varieties for dissemination.	EiB	Efficiency gain
RICE-FP1. Joint proposal development for Green Climate Fund (GCF). Title: Climate-Smart Agriculture for Transforming the Rice Sector in the Vietnamese Mekong DeltaGive = Climate smart resilient rice technologiesTake = Prioritization tools	CCAFS	Because of the complication in getting the required endorsement this proposal development did not proceed.
RICE-FP1. RICE collaborates with the Gender Platform of PIM to implement an assessment of women-led informal seed systems to understand how they contribute to women's engagement and empowerment and, how they enhance women's access to good quality and affordable seed at the right time.	PIM	scientific benefits
RICE-FP1. Joint proposal development for 2018 Global Futures and Strategic Foresight. Title: Achieving income and dietary diversification goals through sustainable intensification in Asia.Give = report and peer-reviewed publicationTake = Foresight modeling tools and methods	PIM	The proposal was fully developed and submitted for funding, but has not been successful.
RICE-FP1. RICE works with the Socioeconomic CoP from the Big Data Platform, particularly with the 100Q and the SociO! Groups to achieve adequate data	BigData	The benefits will be at the scientific and efficiency level, since the data standards, dictionaries and

standards for data collection through the design of modular survey questionnaires.		ontologies for social sciences vocabulary do not currently exist at IRRI and the in house knowledge is basic on these topics.
RICE-FP1. RICE collaborates with PIM in the study of price distortions through the Ag-Incentives consortium. The collaboration aims to foster joint analytical work between IFPRI and IRRI teams to achieve a first milestone directly linked to the cluster 3.1.1 existing activity on Ag-Incentives: a stocktaking exercise on price policies impacting rice farmers on global and local markets and the elaboration of a priority list regarding rice policy reforms.	PIM	The literature review has been completed in 2018 and data are being collected. Further analysis will contribute to the measurement of distortions to agricultural production incentives in selected Asian and African countries. The study will allow to identify gaps, and also to compare between rice markets and other commodities by region.
RICE-FP2. Align policy research on sustainable and climate-smart rice value chain upgrading (efficiency benefits)	CCAFS	Scientific
RICE-FP2. Assessment of rice straw markets, processing options for higher digestibility and life cycle assessments for rice straw as animal fodder.Contribution for sustainable rice production (reduced GHGE and pollution), value adding options for farmers, cattle owners and machinery service providers.	ILRI	Mostly efficiency benefits

RICE-FP3. One BSc and two MSc students were jointly supervised by AfricaRice, IITA (RTB) and WUR for farming systems research in Rwanda.	RTB	scientific and efficiency benefits
RICE-FP3. IRRI and ICRAF organized a joint session on rice agroforestry in International Rice Conference, Oct.	ICRAF	Scientific
RICE-FP3. AfricaRice, IRRI and A4NH (London School of Hygiene and Tropical Medicine, IITA) established collaboration to deliver both climate change and health co-benefits of future agricultural development in Africa, and jointly submitted proposal to Trust Fund.	A4NH	Scientific
RICE-FP3. Delivered agronomic assessment of the rice part of the rice-fish cropping system and together with WorldFish develop domain maps of suitable rice-fish production areas in the Ayeyarwady delta in Myanmar. WorldFish and AfricaRice jointly wrote proposal to IFAD.	WorldFish, Fish	Scientific
RICE-FP4. CIAT-RICE works closely with RTB to adapt cassava and rice phenotypic tools for both crops and to upgrade the high-throughput phenotyping capacities for both CRPs. The CRPs will jointly improve computational efficiency of the image analysis pipeline, and will support the joint implementation of the fixed platform at two different sites.	RTB, CIAT	Increased efficiency in data management

RICE-FP4. Through the Big data platform, AfricaRice is collaborating with the other CG centers in CGIAR e-research (CeRES) to facilitate data discoverability across CGIAR	BigData	Increased efficiency in data management
RICE-FP4. Collaboration on the development of the phenotyping module, of tools to combine phenotypic and genotypic data in Galaxy, of BrAPI for B4R/GOBII/G4R/SNPSeek/Galaxy interoperability, and to enhance capacity for fine mapping.	EiB	Develop a community to collectively negotiate a lower cost for genotyping services. Efficiency in software development, sharing of server resources
RICE-FP5. Modernization of breeding programs and automation of the breeding operations through development and implementation of standard tools and steps across breeding programs to develop better varieties for dissemination.	EiB	IRRI: Efficiency benefits will be realized through use of accurate marker systems implemented at Intertek. Genomic selection is being enabled through the development of affordable mid-density genotyping platforms. AfricaRice, CIAT: Larger breeding populations and shortened breeding cycles
RICE-FP5. Continue to use genetic diversity present in the gene bank in Asia, Africa and Latin America for identification of donors, QTLs, genes and their utilization in the breeding program as well as for C4 rice research	Genebank	IRRI: Valuable genes from Genebank material are being deployed into agronomically-useful genetic backgrounds to form superior donors for use in modern precision breeding

	programs. AfricaRice, CIAT: Broaden genetic base for better adaptation and consumer acceptability

Table 10: Monitoring, Evaluation, Learning and Impact Assessment (MELIA)

Studies/learning exercises planned for this year (from POWB)	Status	Type of study or activity	Please include links to MELIA publications here.
S2746 - Adoption of improved rice management practices	On Going	Effectiveness study (development project- level adoption and impact studies)	More than 600,000 farmers in China, Indonesia, Myanmar, Sri Lanka, Thailand, and Vietnam have been reached with improved management practices. About 118,000 farmers have adopted best practices and increased their rice yield by 11-20%, and profit by 15-25%. (http://news.irri.org/2019/01/corigap-pro-surpasses-goal-of-half.html; http://www.grisp.net/file_cabinet/files/941898/download/2018_AnnualProgressReport%20CORIGAP.pdf?m=1551320606)
S2747 - Drill-sown direct seeded rice in Nepal	On Going	Effectiveness study (development project- level adoption and impact studies)	The Cereal Systems Initiative for South Asia (CSISA) has been evaluating and promoting drill-sown direct seeded rice (DSR) for the last seven years in select western Terai districts of Nepal where use continues among a core group of farmers. Despite many constraints to DSR adoption, farmers still continue to use the technology because it eliminates the need for seedling raising and transplanting, as well as lowers the cost of field preparation and crop establishment, increases the opportunities for timely crop establishment, reduces drudgery and labor requirements, increases profit and does not reduce yields compared to the transplanted rice. https://csisa.org/wp-content/uploads/sites/2/2018/12/CSISA-III-BD-NP-USAID-annual-report_2017-18.pdf

S2748 - Adoption of Premium Quality Rice varieties BRRI Dhan 50 and BRRI Dhan 63 in Bangladesh	On Going	Effectiveness study (development project- level adoption and impact studies)	The Premium Quality Rice varieties BRRI Dhan 50 and BRRI Dhan 63, both of which were introduced and popularized with support from the Cereal Systems Initiative for South Asia (CSISA), were planted on over 29,000 hectares across Barisal, Faridpur and Jessore. This indicates strongly that value chains have emerged to sustain rice farmers' continued cultivation of these varieties, both for home consumption as well as for the market. Although CSISA cannot claim full responsibility for these results, the project's pioneering efforts to expand the use of these varieties have had a clear and lasting impact. (https://csisa.org/wp-content/uploads/sites/2/2018/12/CSISA-III-BD-NP-USAID-annual-report_2017-18.pdf)
S2753 - Dissemination of stress-tolerant rice varieties in Bangladesh	On Going	Effectiveness study (development project- level adoption and impact studies)	In Bangladesh, in the 2017-2018 Boro/dry season, 2.1 ton seeds of improved and stress-tolerant rice varieties were distributed to 500 farmers. Likewise in the 2018 Aman/wet season, 6.7 ton seeds of improved and stress-tolerant rice varieties were distributed to more than 1,500 farmers. https://www.researchgate.net/publication/326263766_Impact_of_Submergence-Tolerant_Rice_Varieties_on_Smallholders'_Income_and_Expenditure_Farm-Level_Evidence_from_Bangladesh
S2754 - Production and dissemination of quality seed of new rice varieties in South Asia	On Going	Effectiveness study (development project- level adoption and impact studies)	18 tons of foundation seed delivered to seed SMEs for onward multiplication to certified seed which will eventually be made available to farmers. With an expected production of 1,080 tons of certified seed this can potentially reach 43,200 farmers.

S2756 - Assessment of functioning of multi-stakeholder platforms in Africa	On Going	Effectiveness study (development project- level adoption and impact studies)	Well-functioning multi-stakeholder innovation platforms with active local IP coordination and facilitation teams have been established in Nigeria, Benin, Uganda and Madagascar. IPs have also been initiated in Senegal, Ghana and Cote D'Ivoire and are being facilitated to refine their governance structures. Key lessons on IP governance published in peer-reviewed journal articles, eg https://www.cogentoa.com/article/10.1080/23311932.2018.1433346
S2757 - Empowerment of rural women in Cote d'Ivoire and Madagascar	On Going	Effectiveness study (development project- level adoption and impact studies)	In Cote d'Ivoire and Madagascar empowering the rural women not only make them economically empowered, but also help them to get credit for productive work. In Nigeria, it is possible for women to run profitable businesses, but some constraints remain: lack of awareness, skills, capital, basic business tools/equipment and the perception of gender-specific nature of some activities.
S2758 - Seed and variety dissemination roadmaps in Africa	On Going	Effectiveness study (development project- level adoption and impact studies)	Seed and variety dissemination roadmaps were developed for Burkina Faso, Gambia, Guinea, Mali, Nigeria, Sierra Leone, Ethiopia, Uganda and Madagascar. In Cote d'Ivoire and Guinea, 20 tons of quality seeds were produced and disseminated to partners to increase capacity at national level.
S2759 - Female participation in adoption and	On Going	Other	Si bien las mujeres no son identificadas como productoras principales, sí contribuyen como tomadoras de decisiones sobre las actividades asociadas al cultivo de arroz. La participación de las mujeres en la toma de decisiones asociadas a las actividades del cultivo de arroz guarda relación stadísticamente significativa con el uso de variedades modernas.

sowing of improved rice varieties.			https://cgspace.cgiar.org/bitstream/handle/10568/78294/Reporte_v2.pdf?sequence=2&isAllowed=y
S2760 - Adoption of improved rice management practices in Bangladesh	On Going	Effectiveness study (development project- level adoption and impact studies)	In Bangladesh, 17,736 farmers were trained, and 51% of them adopted the management practices (4,700 ha were covered during the Boro season and 9,616 ha in Aman season). https://csisa.org/wp-content/uploads/sites/2/2018/12/CSISA-III-BD-NP-USAID-annual-report_2017-18.pdf
S2761 - Mechanization (use of reaper-harvester) in Nepal	On Going	Effectiveness study (development project- level adoption and impact studies)	A total of 14,385 ha of rice and wheat were mechanized in Nepal, by selling 2,877 reaper-harvester with profit of 100 US$/ha/season. Also the mini-tiller adoption increased productivity by 1.1 t/ha (12% technical efficiency). The mini-tiller was then used for extra income from rentals by farmers (more than 200 US$/ha/year). https://csisa.org/wp-content/uploads/sites/2/2018/12/CSISA-III-BD-NP-USAID-annual-report_2017-18.pdf
S2762 - Use of RiceAdvice decision support tool in Sub-Sahara Africa	On Going	Effectiveness study (development project- level adoption and impact	The RiceAdvice in Sub-Saharan Africa produces 100-250 US$/ha extra income and has been used about 40,000 times. http://congresos-rohr.com/arroz-en/index_htm_files/KAZUKI%20SAITO.pdf

		studies)	
S2763 - Safe use of herbicides in Bangladesh	On Going	Effectiveness study (development project- level adoption and impact studies)	In Bangladesh, the safe use of herbicides reduced costs by 66-73 US$/ha in Aman season and by 57-58 US$/ha in Boro season. There was a reduction of person-days per season (18 in Aman compared to 16 in Boro). The income increase was calculated at 121-151 US$/ha in Aman and 143-145 US$/ha in Boro. https://csisa.org/wp-content/uploads/sites/2/2018/12/CSISA-III-BD-NP-USAID-annual-report_2017-18.pdf

Table 11: Update on Actions Taken in Response to Relevant Evaluations

Name of the evaluation	Recommendation number (from evaluation)	Text of recommendation (can be shortened)	Status of response to this recommendation	Concrete actions taken for this recommendation.	By whom (per action)	When (per action)	Comments (including expenditure, where relevant – relate this back to predicted budgetary implications in the management response to the evaluation)
Independent Evaluation Arrangement Evaluation of CGIAR Research Program on rice (GRiSP)	1	Recommendation 1: Taking into account local institutional capacity for adaptive research, GRiSP should work with national partners to ensure that interdisciplinary research on the social, economic and natural context is used to tailor crop and resource management technologies more precisely to the needs of intended beneficiaries.	Complete	Response	Leaders of FP3 (Sustainable farming systems for improved livelihoods) and FP1 (Accelerating impact and equity)	Design in 2016; implementation already in GRiSP 2016, and more fully in RICE 2017-2022	Fully implemented in design of RICE proposal and operational in 2017, see this annual report 2017. (e.g. gender and socio-economic research activities were jointly conducted between FP1 and FP3).Explicit partnerships with national partners were further elaborated in the RICE workplan of 2017 .

Independent Evaluation Arrangement Evaluation of CGIAR Research Program on rice (GRiSP)	2	Recommendation 2: GRiSP management should encourage and incentivize stronger research collaboration among GRiSP centers and their partners in advanced research institutes for improving the overall quality of the scientific output through jointly authored, high quality publications	Complete	Response	RICE management team; FP leaders	Continuous. Already in the last year of GRiSP, we will pay particular attention to co-analysis of results and to co-publication among centers and partners. In RICE, this will receive strong attention of CRP and FP management teams	Co-analysis of data and co-publications are being emphasized by FP leaders and was a special point of attention at the 2017 FP leaders workshop. For example, Fiamohe et al. (2018),Laborte et al. (2017), Randrianjafizanaka et al. (2018), and Saito et al. (2018) were publications from joint efforts by at least two key RICE CRP partners.Explicit partnership plans were developed in theRICE workplan of 2017 . See also section on partnerships in this annual report
Independent Evaluation Arrangement Evaluation of CGIAR Research Program on rice (GRiSP)	3	Recommendation 3: GRiSP should articulate a strategy for scaling up and scaling out beyond its immediate beneficiaries, by researching methods and business models for effective and equitable	Complete	Response	GRiSP PPMT, FP1 leaders	Design in 2016; implementation initiated in 2016 under GRiSP, and more fully in RICE 2017-2022	Strong impact pathways and theories of change that include up- and out-scaling mechanisms are articulated for each flagship project in RICE. See also the analysis and summary of upscaling in

		delivery, especially for management and post-harvest technologies, coupled with capacity development of relevant partners					annual report 2016 (Key messages).
Independent Evaluation Arrangement Evaluation of CGIAR Research Program on rice (GRiSP)	4	Recommendation 4: GRiSP should deliver a single integrated rice research program in Eastern Southern Africa, coordinated by AfricaRice and drawing on the relative strengths of bothAfricaRice and IRRI, in order to improve efficiency and complementarities, and enhance the image of GRiSP among its stakeholders in the region	Complete	Response	GRiSP PPMT; AfricaRice and IRRI management teams and boards	Design in 2016; implementation initiated in 2016 under GRiSP, and more fully in RICE 2017-2022 In 2016, AfricaRice and IRRI developed a large joint 'East and Southern Africa Rice Initiative', to increase the productivity and competitiveness of locally produced rice in the East and Southern Africa (ESA) region by strengthening rice research and advisory capacity and establishing strong linkages with major development partners from public and private sectors ('scaling	AfricaRice and IRRI management teams have developed closer collaboration in 2017, which culminated in the agreement early 2018 that AfricaRice and IRRI agree to a step-change in partnership to harness synergies and accelerate their impact in Africa on rice-based food systems. The two CGIAR Centers will join together to offer a comprehensive, pan-African, multi-focus program of research for development services aligned with national priorities. The key areas of change will include more foresighting and capacity development

						partners')	services, addressing gender and youth opportunities, contributing to nutrition and health needs, providing evidence-based policy research, developing climate-resilient rice varieties, and assuring high performance production systems and value chains to better link smallholder farmers to markets.In 2018, AfricaRice and IRRI initiated talks on aligning their activities in Africa; an external company Dalberg was commissioned to provide assessments and further guidance. From 2018 on, this has moved beyond the CRP and has become institutional explorations.
Independent Evaluation Arrangement Evaluation of	5	Recommendation 5: AfricaRice should modernize and intensify its rice breeding program	Complete	Response	Leaders of RICE FP4 and 5	Design in 2016; implementation was initiated in 2016 under GRiSP, and is carried	Ongoing strengthening of breeding program at AfricaRice. Close interaction with –and

CGIAR Research Program on rice (GRiSP)		for feeding elite lines to the Africa-wide Rice Breeding Task Force, for all major rice ecosystems in Africa. GRiSP core partners, especially IRRI, should give support to the African program, developing traits and elite populations targeting African needs				out in full in RICE 2017-2022.	support from– the EiB Platform. In 2019, a new Cluster of Activity was created in FP5 (Breeding) entitled ''Modernization of rice breeding"
Independent Evaluation Arrangement Evaluation of CGIAR Research Program on rice (GRiSP)	6	Recommendation 6: Opportunities, incentives and modalities should be created to increase interdisciplinary research, in order to deliver integrated solutions consistent with the IDOs on critical problems of major rice production systems especially at the hubs and sites where GRiSP works	Complete	Response	Leaders of all RICE FPs, but especially FP3 and FP1	Design in 2016; implementation in RICE 2017-2022	Implemented, see RICE proposal ; In 2017, IRRI reorganized its internal research structure to move from disciplinary-based divisions to multidisciplinary 'Platforms' with cross-cutting multi-disciplinary and outcome-focused themes. This move will support integrative activities in RICE.
Independent Evaluation Arrangement	7	Recommendation 7:The rapid acceleration of rice research worldwide over	Complete	Response	PPMT; Leaders of all RICE FPs	The development of new partnerships is a continuing activity, and	RICE has developed a strong partnership strategy that specifically

Evaluation of CGIAR Research Program on rice (GRiSP)		the past 15 years is an opportunity for GRISP to develop new partnerships with ARIs. GRISP should enrich its portfolio of new frontier and discovery research projects in partnership with ARIs with the objective of exploring new concepts and tools to achieve its goals.				already in 2016 under GRiSP, new partnerships are initiated. For RICE, we will explore again new partnerships during the design stage in 2016; implementation in RICE 2017-2022	includes tapping into advanced expertise of ARIs, see Annex 2 of the RICE proposal. Explicit partnership plans were developed in the RICE workplan of 2017 . See also the section on partnerships in this annual report.
Independent Evaluation Arrangement Evaluation of CGIAR Research Program on rice (GRiSP)	8	Recommendation 8: In order to achieve sustainable outcomes from investments in institutional and human capacity development, GRiSP should support participating countries to develop long-term capacity building strategies and tailor GRiSP capacity building support to the priorities of those strategies.	Complete	Response	PPMT; Leader of FP1; Leaders of all RICE FPs	A comprehensive and new capacity development strategy was designed in 2016, with two new major partners in RICE: ICRA and GIZ; Full implementation in RICE 2017-2022	Annex 3 of the RICE proposal contains a full capacity development strategy. Though ICRA was initially part of the design process of RICE, links were less strong than anticipated. Collaboration with GIZ includes capacity development activities as specified in a signed memorandum of Agreement with IRRI in 2017. AfricaRice set up a BMZ-supported Green Innovation center in

							Benin with a strong capacity development reach. To further strengthen ties, the RICE director is member of the steering committee of GIZ's Better Rice Initiative in Asia.
Independent Evaluation Arrangement Evaluation of CGIAR Research Program on rice (GRiSP)	9	Recommendation 9: GRiSP should do more in-depth analysis to understand opportunities and constraints of women in rice farming and value chains in order to better address the effectiveness and equity impacts of its research and technology delivery	Complete	Response	Leader FP1; GRiSP and RICE gender team	In 2016 under GRiSP, we systematically synthesized our learnings to date on opportunities and constraints of women in rice farming and value chains. These learnings will feed into the design and implementation of RICE in 2017-2022	Section 1.0.4 of the RICE proposal and Annex 4 of the RICE proposal contain a full description of RICE's gender strategy. In 2016, RICE initiated in-depth constraint analyses of women in rice farming, which was reported in a separate gender report 2016. Based in these analyses, gender workplans were developed in 2017, while further syntheses got published in 2017 and 2018 in scientific journals, eg Akter et al 2017 .
Independent		Recommendation 10:				In 2016 under GRiSP,	Key outcome indicators

Evaluation Arrangement Evaluation of CGIAR Research Program on rice (GRiSP)	10	GRiSP with its national partners should institutionalize a systematic process of assessing its equity, nutrition and environmental impacts at a global level, especially for its germplasm, employing the latest tools and methods to achieve credible standards of rigor at reasonable costs.	Complete	Response	Leadership FP1	we finalized a schema to assess progress towards the IDOs that RICE will address, based on a systematic set of indicators collected in the field. We will already compute baseline values of these indicators in 2016, based on extensive household surveys conducted during the last 2-3 years of GRiSP. Full implementation of the schema will start in 2017 and continue throughout RICE in 2017-2022.	have been developed and were computed from various household data to establish the baseline for RICE. A detailed report for 2017-2018 is availablehere .
Independent Evaluation Arrangement Evaluation of CGIAR Research Program on rice (GRiSP)	11	Recommendation 11: The Oversight Committee should define its processes of consultation for establishing global strategic priorities in rice research, and communicate this process widely to its	Complete	Response	GRiSP OC; PPMT, center management, center boards	Design in 2016; implementation through the new Independent Science Committee of RICE.	In 2017, the TOR of the newly formed RICE independent steering committee got established and these and the minutes of the 2017 and 2018 meetings are publicly available .

		stakeholders.					
Independent Evaluation Arrangement Evaluation of CGIAR Research Program on rice (GRiSP)	12	Recommendation 12: GRiSP level external reviews of particular areas of research should be commissioned by the Oversight Committee in consultation with the Board Program Committees and managed by the PMU.	On Going	Response	RICE ISC; Center Boards	Design in 2016; implementation in RICE 2017-2022	No external reviews were commissioned in 2017 and 2018 as these were just the first years of RICE.
Independent Evaluation Arrangement Evaluation of CGIAR Research Program on rice (GRiSP)	13	Recommendation 13: GRiSP should review and clarify the roles and expectations of its non-CGIAR partners (JIRCAS, IRD and CIRAD) in governance, management and research implementation. This review should also consider the desirability of expanding core partnerships for specific Themes, the criteria for doing so, and their role in	Complete	Response	PPMT	Design of strengthened roles on nonCGIAR partners already started in the second half of 2015, and continued with the development of the full RICE proposal in 2016; implementation in RICE 2017-2022	Roles and responsibilities of Cirad, IRD and JIRCAS have been strengthened in RICE phase II, and the centers have explicit leadership for a number of Clusters of Activities under 3 flagship projects. In 2017, reporting of these centers was fully integrated into the flagship-level reporting of RICE and in 2018 this was further strengthened by additional center-level

		management if included					reporting.

Table 12: Examples of W1/2 Use in this reporting period (2018)

Please give specific examples, one per row (including through set aside strategic research funds or partner funds)	Select broad area of use of W1/2 from the categories below - (drop down) Selecet only one category.
Participation in regional policy dialogue and consultation meeting to contribute to the evelopment and implementation of the national and regional investment plans in West Africa	Policy
Survey to identify new business opportunities for women and youth's economic empowerment in Nigeria	Research
Panel data collected in Nigeria, Cote d'Ivoire and Benin for impact assessment and MEL	Other Monitoring, learning, evaluation and impact assessment (MELIA)
Participation in workshop on business opportunities for youth in the rice value chain in West Africa	Policy
Support the development of seed and variety dissemination roadmaps in Africa and Asia	Delivery

Support survey for master students in collaboration with the National and international universities	Capacity development
Implementation of portfolio-wide impact-oriented monitoring, evaluation, and learning (IOMEL) ystem	Other Monitoring, learning, evaluation and impact assessment (MELIA)
Development of RICE progress indicators: Learnings and future plans	Other Monitoring, learning, evaluation and impact assessment (MELIA)
RICE CRP MELIAG annual workshop	Other Monitoring, learning, evaluation and impact assessment (MELIA)
Maintaining and updating the IRRI Global Rice model (IGRM)	Policy
Scenario implementation for global rice market trends	Policy
Participation in workshops and policy dialogue, consultation meetings and conferences	Policy
Survey on rice Metal contamination in Agusan and Palawan, Philippines	Research

Revisiting rice yield gap decomposition through genetics, environment, management, socio-economic – Evidence from four countries in SE Asia	Research
Smallholders' Households Perception of climate change and choice of adaptation strategies	Research
Impact of Green Super Rice adoption on rice cropping system.	Other Monitoring, learning, evaluation and impact assessment (MELIA)
Study on understanding the impact of different training approaches to improve knowledge on insurance products and explore the scope of digital approaches in awareness creation.	Capacity development
Mini-GEM systems that uses rice husk as parboiling fuel developed and optimized for small to medium scale parboiling	Research
Mini-GEM systems that uses rice husk as parboiling fuel piloted in four sites in Cote d'Ivoire (Daoukro, Bouake, Gagnoa and Man)	Delivery
The burning time of the fixed bed batch refueling gasifier has been increased from 35 min to 90 min and adapted for household cooking processes	Research

Close to 270 parboilers mostly women and youth from four groups in Cote d'Ivoire and one group in Niger trained on the use of Mini-GEM and GEM systems respectively to produce high quality milled rice.	Capacity development
Private enterprise (TCMS) in Benin accesses Mini-GEM parboiling technology and award first contract to construct and install six systems in six communities in Glazoue (Benin)	Delivery
44 men and 56 women from 4 villages in Kilombero Hub, Tanzania trained on improved methods for market-oriented quality production and processing of rice.	Capacity development
Exploration of the rice value chain in Côte d'Ivoire and Burkina Faso	Partnerships
Review about public policies for agricultural growth poles in West Africa	Policy
Research on economics of rice breeding	Research
Research on digital product profiling	Partnerships

Research on sustainable rice value chain upgrading (policy) in Africa	Research
One MSc student and one Ph.D. student was jointly trained by JIRCAS and LRI	Capacity development
Technologies for improving yield and nutrient use efficiency cycling evaluated in Madagascar.	Research
Development of database for statistical downscaling of seasonal climate predictions in Madagascar.	Research
Conducted gender-related research/capacity development in FP3 in collaboration with FP1 (see 1.3.1 in this report)	Other cross-cutting issues
Support for strategic research including continuation of long-term trials maintenance of decision support tools	Research
One BSc and two MSc students were jointly supervised by AfricaRice, IITA (RTB) and WUR for farming systems research in Rwanda	Capacity development
Supporting dissemination of tools/technologies (RiceAdvice, SRP approach, cropping pattern analysis tool) to scaling partners	Delivery

Study on economic indicators at farm level related to diversification	Research
Prototyping diversified upland rice cropping systems	Research
Assessment of yield losses and yield gap indicators related to weed pressure in upland rice cropping Systems	Research
Construction of database for future prospective modelling	Research
Collaborate with institutions to evaluate sequenced antenna and reference panels at array sites: IARI New Delhi; CIARI Port Blair, ICAR Goa, Rajendra nagar, Cuttack, IRRI-Hyderabad and NRII Pantnagar, Maruteru-ANGRAU, RARS-AAU-Titabar and IGKVV Raipur, Uruguay.The goal is to generate genomics and phenomics data for multiple environments and climatic conditions.	Partnerships
All training materials including presentations, high-throughput phenotyping manual, example data sets, R processing scripts, and list of links to additional resources were also provided in a Google Drive share folder accessible to all participants.	Capacity development

Development of image analysis pipeline for rice hoja blanca virus (hardware/software/ methods and connection to servers)	Research
The Exploration of the AMMI model as promising approach to handle G x E effects in Genome-Wide Association Mapping.	Research
Workshop at Hanoi Nov 27-29 for data analysts/data managers/resource developers with partners	Partnerships
Evaluation of antenna and reference panels in Senegal and Cote d'Ivoire as well as establishment of Common MINCERNet experiments	Research
Analysis of disease resistance, characterization of pathogens and development of diagnosis tools	Research
Strengthening AfricaRice internal capacities on drone-based phenotyping of rice and application of UAV in agriculture	Capacity development
Partial funding of four PhD theses in the Global Rice Array	Capacity development
Upgrade AfricaRice research facilities in particular for plant phenotyping in Mbe, Bouake, Cote	

d'Ivoire	Other: Infrastructure upgrade
Workshop to increase management efficiency across partners (Montpellier)	Partnerships
Identification of donors, genomic regions for different biotic and abiotic stresses	Research
Development of early-maturity loci to further improve speed of delivery of QTL Deployment products.	Research
Partial funding of PhD, MSc and BSc students including young, women students in rice breeding	Capacity development
Capacity development of young scientists, women scientists through collaborative research in rice breeding	Capacity development
Modernization of AfricaRice breeding facilities	Other: Infrastructure upgrading
Exploring different genetic populations including wild rice species for the identification of relevant genes conferring tolerance to biotic and abiotic stresses	Research

Release of new climate smart multiple stress tolerant varieties	Partnerships
Assessment of genetic gain in marginal environment at IRRI	Research
Identification of gender sensitive traits for inclusion in the product profile and breeding program	Other cross-cutting issues
Genomic selection predictions and haplotype based genomic selection strategy	Research
Development of new computing tools for analyzing data for identification of new genes/QTLs	Research
Development and selection of advanced and improved rice lines to be used as sources of valuable genes to be introgressed into new rice varieties for irrigated ecosystem	Delivery
Development and selection of improved rice lines for unfavored upland ecosystems	Research
Development and selection of improved rice lines with better nutrition and cooking quality	Research

Table 13: CRP Financial Report (all in US$)

	Planned Budget 2018*			Actual expenditure*			Difference*			Comments
	W1/W2	W3/Bilateral	Total	W1/W2	W3/Bilateral	Total	W1/W2	W3/Bilateral	Total	
F1 - Accelerating impact and equity	3,641,554	13,273,667	16,915,221	1,911,863	10,794,337	12,706,200	1,729,691	2,479,330	4,209,021	-
F2 - Upgrading rice value chains	1,591,342	2,436,504	4,027,846	934,146	1,273,639	2,207,785	657,196	1,162,865	1,820,061	-
F3 - Sustainable farming systems	2,574,998	12,088,418	14,663,416	3,140,107	9,937,208	13,077,315	-565,109	2,151,210	1,586,101	-

F4 - Global Rice Array	3,117,205	7,480,183	10,597,388	3,103,405	6,522,617	9,626,022	13,800	957,566	971,366	-
F5 - New rice varieties	3,482,669	28,180,356	31,663,025	4,049,848	21,410,884	25,460,732	-567,179	6,769,472	6,202,293	-
Strategic Competitive Research grant	.00	.00	.00	.00	.00	.00	.00	.00	.00	-
CRP Management & Support Cost	1,341,622	.00	1,341,622	1,037,016	.00	1,037,016	304,606	.00	304,606	-
CRP Total	**15,749,390**	**63,459,128**	**79,208,518**	**14,176,385**	**49,938,685**	**64,115,070**	**1,573,005**	**13,520,443**	**15,093,448**	

RICE's Mission

RICE's aims to reduce poverty and hunger, improve human health and nutrition, adapt rice-based farming systems to climate change, promote women's empowerment and youth mobilization, and reduce rice's environmental footprint.

Through research and development in collaboration with large numbers of partners in public and private, national and international research and development institutions, national agricultural research and extension systems, and nongovernmental organizations, RICE expects to

- help at least 13 million rice consumers and producers, half of them female, to exit poverty by 2022, and another 5 million by 2030;
- assist at least 17 million people, half of them female, out of hunger by 2022, rising to 24 million by 2030; and
- assist at least 8 million people, half of them female, to meet their daily Zn requirements from rice by 2022, rising to 18 million by 2030.

These outcomes will be possible by

- helping at least 17 million more households to adopt improved rice varieties and/or farming practices by 2022 and a further 19 million by 2030;
- improving the annual genetic gain in rice (as measured in breeders' trials) to at least 1.3% by 2022, rising to 1.7% by 2030;
- helping increase annual global (milled) rice production of 479 million tons in 2014 to at least 536 million tons by 2022 and to 544 million tons by 2030;
- increasing water- and nutrient-use efficiency in rice-based farming systems by at least 5% by 2022, rising to 11% by 2030, and
- helping reduce agriculture-related greenhouse gas emissions in rice-based farming systems by at least 28.4 megatons carbon dioxide (CO_2) equivalent/year by 2022 and by a further 28.4 megatons CO_2 equivalent/year by 2030, compared to business-as-usual scenarios.

Flagship projects

1. Accelerating impact and equity
2. Upgrading rice value chains
3. Sustainable farming systems
4. Global Rice Array
5. New rice varieties

CGIAR RESEARCH PROGRAM ON Rice

CGIAR is a global research partnership for a food-secure future. Its science is carried out by the 15 research centers of the CGIAR consortium in collaboration with hundreds of partner organizations.

AfricaRice

IRRI

CIAT
International Center for Tropical Agriculture
Since 1967 Science to cultivate change

cirad
AGRICULTURAL RESEARCH FOR DEVELOPMENT

IRD
Institut de Recherche pour le Développement
FRANCE

JIRCAS