CGIAR

RESEARCH PROGRAM ON Rice

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

2017 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: 2017-2022) 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.

Mailing address: Dr. Bas Bouman, RICE program director, c/o IRRI, DAPO Box 7777, Metro Manila, Philippines
Phone: +63 (2) 580-5600
Fax: +63 (2) 580-5699
Email: b.bouman@irri.org
Web site: ricecrp.org

Suggested citation: RICE (CGIAR Research Program on Rice Agrifood Systems). RICE Annual Report 2017. Los Baños (Philippines): International Rice Research Institute.

Table of Contents

Acronyms and abbreviations

A4NH	CGIAR Research Program on Agriculture for Nutrition and Health
ACIAR	Australian centre for international agricultural research
AfricaRice	Africa Rice Center
AWD	alternate wetting and drying, a water-saving technology for rice
BTF	breeding task force
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CIAT	International Center for Tropical Agriculture
CGIAR	CGIAR is a global research partnership for a food-secure future
CIMMYT	International Maize and Wheat Improvement Center
CIP	The International Potato Center
Cirad	Centre de coopération internationale en recherche agronomique pour le développement (The French agricultural research and international cooperation organization)
CoA	cluster of activity
CORIGAP	Closing the Yield Gap in Asia (SDC-funded project)
CRP	CGIAR research program
CSISA	Cereal Systems Initiative for South Asia (project)
DSR	Direct Seeded Rice
DNA	deoxyribonucleic acid
EiB	CGIAR excellence in breeding platform
FAO	Food and Agriculture Organization of the United Nations
FISH	CGIAR research program on fish
FLAR	Fondo Latinoamericano para Arroz de Riego (Latin American Fund for Irrigated Rice)
FOFIFA	Centre National de Recherche appliquée au Développement Rural, Madagascar
FP	flagship project
FTA	CGIAR Research Program on Forests, Trees, and Agroforestry
GEM	grain quality-enhancer, energy efficient and durable material parboiling technology
GHG	green house gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Corporation for International Cooperation)
GRiSP	Global Rice Science Partnership
GWAS	genome-wide association study
GWP	global warming power
HTP	high throughput phenotyping
ICRISAT	The International Crops Research Institute for the Semi-Arid Tropics
ICT	information and communication technology
IDO	CGIAR intermediate development outcome
IFAD	International Fund for Agricultural Development
IITA	International Institute of Tropical Agriculture
IP	intellectual property
IRD	Institut de Recherche pour le Développement (French National Research Institute for Sustainable Development)

IRIC	International Rice Informatics Consortium
IRRI	International Rice Research Institute
JIRCAS	Japan International Research Center for Agricultural Sciences
LAC	Latin America and the Caribbean
MAGIC	Multi-parent advanced generation inter-cross
MAIZE	CGIAR research program on maize agri-food systems
MELIAG	monitoring, evaluation, learning, impact assessment, and gender workshop
ME&L	monitoring, evaluation and learning
NAM	nested association mapping
NARES	national agricultural research and extension systems
NERICA	New rice for Africa (rice varieties)
NGO	nongovernment organization
NRM	natural resource management
PIM	CGIAR research program on policies, institutions, and markets
PRAY	phenomics of rice adaptation and yield potential
PRISM	the Philippine rice information system
QTLs	quantitative trait loci
RCM	rice crop manager
RCT	randomized control trial
RIICE	Remote sensing-based information and insurance for crops (project)
RTB	CGIAR research program on roots, tubers, and bananas
RICE	CGIAR research program on rice agri-food systems
SSA	Sub-Saharan Africa
SIAC	Strengthening Impact Assessment in the CGIAR (project)
SLO	CGIAR system level outcome
SNP	single nucleotide polymorphism
SRP	Sustainable rice platform
STRASA	stress-tolerant rice for Africa and south Asia (project)
USAID	United States Agency for International Development
WHEAT	CGIAR research program on wheat agri-food systems
WU	Wageningen University

1. Key Results

This report contains the synthesis annual report for the CGIAR Research Program on Rice Agri-Food Systems (RICE). More detailed information, such as individual flagship project reports, center reports from nonCGIAR lead partners, capacity development statistics, publications, and listing of main partners can be found here. Updates on key outcome indicators can be accessed here. Also, more information on RICE can be accessed through its website ricecrp.org.

1.1 CRP Progress Towards Intermediate Outcomes and SLOs

*[Please provide a short narrative on overall CRP progress towards SLOs. Please include brief (1-2 paragraph) summaries of outcome case studies (Sphere of Influence), and highlight key findings of any relevant impact studies (Sphere of Interest) *. Please consider the following in summarizing your outcome case studies: (i) Linkages to earlier research: clarify where the outcome case draws on earlier research; (ii) Make explicit any links to SLOs, IDOs or sub-IDOs as most appropriate; (iii) Mention any cross-cutting dimensions (gender, youth and capacity development). Please complete Tables A-1: CRP progress towards SLOs, and A-2: Outcome case studies, and cross-reference these. *Note that these summaries will be publicly shared in a system level report.]*

In 2017, progress made towards reduction of poverty for both men and women farmers through release and adoption of new high yielding rice varieties in Asia, Africa and Latin America. Rice Breeding programs across institutes initiated implementation of modified breeding strategies, improved breeding operations, standardization of plot size, improved experimental designs across sites, standardized data collection procedure and data management to increase the accuracy of selection and improve yield under intensive and system and reduce yield reduction due to abiotic stresses in unfavorable ecosystems. Development of novel grain quality and nutrition tools as well as development of high Zinc rice lines shall help achieve the SLOs on reducing nutritional deficiencies in men and women farmers as well as rural and urban consumers. Identification of new donors, genes for different biotic stresses such as bacterial blight, blast, sheath blight, rice yellow mottle virus (RYMV), Rice hoja blanca virus (RHBV) as well as for abiotic stresses – drought, seedling stage salinity, stagnant flooding, high temperature, increased nitrogen uptake as well as tightly linked markers shall assist rice breeders to develop better rice varieties to achieve the SLOs on adoption of improved varieties by more farm households.

In its pathway to achieve the IDO “Increased income and employment” and eventually the SLO “Reduced poverty”, we developed strategies for value chain upgrading, which are published in leading journals and being adopted by NARES partners and other projects and programs in action sites. This research is a major extension of the market research that had been conducted under the GRiSP. Gender inclusiveness is implicitly accounted for in product profiles that are being developed and tailored to rice breeding programs at IRRI, AfricaRice and NARES partners. This helps rice breeding programs to become more market-driven, gender-inclusive and climate-resilient. Further, adoption and impact assessment studies of Rapid Generation Advance in rice breeding further helps rice breeding programs of international and national partners to become more cost-efficient. In Africa, several studies have been conducted to assess income opportunities for youth. Several research and development partners and stakeholders from the private sector have been trained in a diversity of areas related to nutrition, post-harvest and entrepreneurship. These activities will help farmers diversifying enterprise opportunities (sub-IDO), securing access to financial and other

services (sub-IDO), reducing pre- and postharvest losses (sub-IDO) and capturing higher value for their produce (sub-IDO). Finally, research on improved management and marketing of rice by-products like straw contributes to reduction in greenhouse gas emissions.

For selected outcomes case studies: see Annex A (in pre-defined format). In addition, the following impacts have been documented:

- Impact of improved rice varieties was assessed and published for 16 countries in Sub-Saharan Africa (Arouna et al., 2017). Results showed that compared with earlier estimates of 200,000 ha estimated in 2006, the total cultivated area for improved rice varieties was estimated at 3.5 million ha whilst that for NERICA was estimated at 0.65 million ha in 2008. The area under NERICA was increased to 1.4 million ha in 2014 from 16 countries Impact of NERICA adoption on rice yield was estimated at 320 kg/ha and the adoption of NERICA increased the rice production by 897 kg per household. The gains in yields and production of paddy for adopters of other improved rice varieties were estimated at 431 kg ha–1 and 1070 kg, respectively. About 8 million persons in 16 Sub-Saharan Africa countries were lifted out of poverty due to the adoption of improved rice varieties and 7.2 million people have been lifted out food insecurity. The impact of adoption of certified seed of improved rice varieties on poverty rate was studied in more detail in Benin (Seye et al., 2017). The results indicated an increase of food expenses of about US$ 211 per household while the poverty rate is reduced by 3.6% with the use of certified seeds of improved varieties of rice.
- In Nigeria, the GEM Parboiling technology installed in Lafia Innovation platform coupled with training of over 1,200 actors had multiple benefits; (i) produced a cleaner and higher-quality product resulting in 50% increase in price above that of traditionally parboiled rice, (ii) reduced wood consumption by 40% and the exposure of the users to smoke and heat compared to the traditional parboiling, (iii) was less time-consuming and safer to operate - particularly for female and younger processors. The system is producing 16 tons of high quality milled parboiled rice per month. Youth and women are the main beneficiary and all are working in the innovation platform which also contains other actors like farmers, traders, financial institutions and policy makers. To sustain the benefits from GEM, 28 youths were trained in the fabrication of GEM parboilers.
- Impact Assessment of RiceAdvice and Smart-Valley technologies: Using a follow up survey based on the 2016 randomized control trial in Nigeria, four categories of RiceAdvice users were found: those who received advice using the application only in 2017, those who received advice in 2016, those who received advice both in 2016 and 2017 and those who never received advice using RiceAdvice. Results showed that the impact of RiceAdvice is consistently positive and with a minimum and significantly impact of 0.520 kg/ha. Impact of Smart-valley technology for water management in lowland rainfed system was assessed on income and yield of smallholder rice farmers. Results showed that adoption of Smart-valley technology increased rice yield by 0.9 t/ha and the net income by US$ 267 /ha. Land tenure, total available area, paddy price, and lowland availability are determinant factors of Smart-valley adoption.
- The rice monitoring network established with FLAR (Latin American Fund for Irrigated Rice) has collected successfully information on the adoption of improved rice varieties and average rice yields across Latin America and the Caribbean. This information has been crucial to establish the foundations of an economic rice observatory for Latin America and the

Caribbean expected to be functional by mid-2018. In 2017 CIAT reported that 52% of the total rice acreage is under CIAT improved varieties with an annual increase of the adoption rate of 2.7%. Only through genetic improvement the adoption of CIAT varieties increased rice yields by 15%. CIAT has also documented that the most valuable traits for adopting improved rice varieties are high yield, insecticide and weed resistance, and vegetative cycle, but on the other side it has been documenting a large heterogeneity on preferences across rice growers.

1.2 Progress by CRP Flagships

[For each flagship: provide a brief narrative summary of major results achieved in the past reporting period; and briefly describe progress with and any changes in the overall flagship theory of change. Please complete Tables B: Milestones; C: Outputs and D-2: Innovations in 2017 and cross reference these.]

FP1 Accelerating impact and equity

- Nearly 5000 women farmers managed demonstration clusters for several stress-tolerant varieties in Eastern India, closely related to quality seed production. More than 70 village level women seed groups carried out seed production, sale and informal dissemination. More than 1000 women were trained in quality rice seed production in India.
- A study was conducted in the Senegal River Valley to analyze the determinants of varietal choices in irrigated system. Preliminary results show that 98% of farmers are market oriented and produce rice to meet consumers' preferences. According to the survey, consumers are more valuing rice with ease cooking, good taste, white grain, good swelling capacity, aromatic and non-sticky. The main channel through which farmers reach market are: direct contact with the market (52%), trader (52%), millers (17%), and less importantly extension services (2%). Results also show that varieties released in 2009 are making good progress and at least 70% of farmers are aware of Sahel 134 and Sahel 177.
- The assessment of willingness to pay for rice fragrance in Senegal suggested that consumers are willing to pay price premiums of 20% on top of the price of non-fragrant rice. These price premiums further increase to 35% for consumers who express positive buying intentions towards domestic fragrant rice. The value of rice fragrance is driven by factors such as ethnicity, household size, and awareness of fragrance and local fragrant rice (Diagne et al, 2017).
- A study on the targeting of cropping season revealed that irrigated rice farmers in the Senegal River Valley are shifting to the dry season with a projected probability of 89% (more than 90% of correctly predicted values). Taking the marginal effects, the factors that increase the likelihood of choosing the dry season are: expectation of higher yield, the importance of livestock in the household, having a field in the public large irrigation schemes known as “Grand Périmètre”; a good planning of the season. The factors preventing farmers from choosing the dry season are: bad road facilities after the wet season; using the same plot for rice, having a field in private irrigation schemes known as “PIP”, and being from the ethnic groups other than Wolof and Pulaar.
- CIAT has developed a first version of the Cost of Production Estimate tool. The objective is to strength FLAR partners in using decision making tools that estimate cost of production of rice and improve their production process by identifying major costs. The spreadsheet is really simple and summarizes a cost benefit analysis. It has been also adapted to estimate

cost of hybrid seed and it was presented to all FLAR partners. It had a great acceptance and some have already test the tool and it will be officially release it in 2018 with some centralized workshops to train partners to use it.

FP2 Upgrading rice value chains

- Regional and national rice value chain upgrading strategies have been developed, published and are being adopted and implemented by national and regional partners. Product profiles based on market analysis have been developed and are increasingly being used by rice breeders in international and national programs. An in-depth review of how rice grain quality is defined (based on consumer, food science, and genetics perspectives) was developed with the aim of identifying and closing gaps and developing policy recommendations, especially for international trade (Cuevas et al., 2017). Research on management and future markets for rice straw has generated insights which may increase enterprise opportunities of rice farmers and mitigate climate change.
- The regional strategy for West Africa developed under FP2 suggests that the optimal portfolio of investment in rice value chain upgrading should be a function of the targeted end-market and its distance from the port and rice cultural heritage center (Demont et al., 2017; Fiamohe et al., 2018). In line with this strategy, improved processing and value addition technologies (GEM parboilers and good processing practices) and marketing practices such as branding of rice to be sold were introduced to the key actions sites in West Africa, resulting in the increase of rice market value. For example, parboilers that use the GEM technology make at least an extra 82 USD on every ton of rice parboiled compared to parboilers using the traditional system. GEM technology adopters recorded (i) reduced quantitative (6% to 0.2%) and qualitative (7% to 0%) losses during parboiling; (ii) reduced firewood used for parboiling by 40% (brick stove) and 100% (gasifier stove) and smoke exposure during parboiling; and (iii) reduced drudgery and back-breaking manual labor during parboiling by women and increased time saving during steaming (35 min/100 kg batch).
- Germplasm accessions with low glycemic index were characterized for pasting properties and sensory profiles. Results indicate that certain organoleptic attributes could be associated (and indicated in a more efficient manner) using certain viscometric parameters (de Guzman et al., 2017, Scientific Reports 7: 5854).
- Business models for service providers for crop establishment were piloted in Bangladesh. The Solar Bubble Dryer was introduced in Nepal for summer rice. Energetic/cost optimization of the Solar Bubble Dryer continued, and a proof of concept for new in-store dryer based on hermetic storage containers was conducted. Postharvest business models for threshing, drying and storage were demonstrated in Myanmar.
- To upgrade processing technologies for wet-milled rice product, Thai traditional rice flake, Kuai chap was selected and studied. Lab-scale preparation was established successfully and causes of shape changes from flake to roll during boiling process was elucidated as heating direction in rice flake preparation process. Traditional rice processing was investigated and pop-rice, roasting rough rice then provide puffed rice kernel similar to popcorn, was studied. Moisture and amylose contents of rough rice was affected puffing rate, kernel expansion rate and product (pop-rice) hardness. The rough rice was easily processed to pop-rice only

roasting, on farm processing is expected. Chemical analysis revealed high gelatinization degree in pop-rice, even initial moisture content of rough rice was lower than required for gelatinization.

FP3 Sustainable farming systems

FP3 had six milestones in 2017 (see Table B). There were no major changes in the overall flagship theory of change. Except for milestone "GHG emissions and carbon capture benchmarked at three action sites", all the milestones were completed or partially competed. GHG emissions were benchmarked in the Philippines and Bangladesh. The benchmarking activity for Vietnam is on-going (output expected in 2018).

- In 2013, AfricaRice initiated development of RiceAdvice, which is a free Android™ application that provides farm-specific advice on rice management practices. RiceAdvice was piloted in 13 Saharan African countries. A recent ex-ante impact assessment in Nigeria showed that RiceAdvice increased yield by about 0.5 t/ha. Farmers receiving from RiceAdvice generally applied more urea and less NPK compound fertilizer. About 80% of the farmers attributed three main advantages of RiceAdvice: increased yield, increased income and reduced use of fertilizer. Up to now, over 40,000 advices have been generated by RiceAdvice and provided to farmers. Some 460 agricultural knowledge service providers (extension workers, staff from development agencies, staff from universities, farmers, etc.) were trained in use of RiceAdvice in 2017; 15 and 54% of them were female and youth, respectively.
- In the mid-west Madagascar Highlands, a first analysis of relationship between farm incomes and crop diversification was completed: diversification was more pronounced in farm having larger incomes. The weed community in upland rice based cropping systems was identified and included in a website. A permanent network of farmers is engaged for prototyping diversified upland rice based cropping systems.
- In west Burkina Faso, the use of a digital terrain elevation model combined with new satellite imagery identified potential lowlands suitable for rice and other crops.
- IRRI and AfricaRice joined the Global Long Term Experiments Network (GLTEN), led by Rothamsted Research. IRRI led a collaborative platform for research and extension in Bangladesh's polder communities, worked with the FISH CRP on establishing rice-fish system research in Myanmar, and established a rice sector platform for building incentive mechanisms for sustainable production in Vietnam.
- Baseline farming descriptions were completed for parts of India (Bihar, Eastern Uttar Pradesh), Bangladesh, and Myanmar. Baseline yield gaps and constraints were quantified in Bangladesh, Thailand, Vietnam, Indonesia, Myanmar, Sri Lanka, and China (Guangdong Province) (IRRI, 2017, CORIGAP Annual Report to SDC; Stuart et al., 2018; IRRI, 2017, Technical Report submitted to Kansas State University).
- Labor use efficiency and women empowerment indicators in the Sustainable Rice Platform (SRP) Performance Indicators (v. 1.0, developed in 2015) were revised based on testing in seven countries, and new version was piloted in 2017. New indicators are currently undergoing review as part of v. 2.0 of the SRP Performance Indicators.
- Greenhouse gas emissions from rice fields were benchmarked in the Philippines and Bangladesh. The benchmarking activity for Vietnam is on-going (output expected in 2018).

FP4 Global Rice Array

- Antennae population and seed multiplication: a list of about 73 genotypes were finalized that included entries from various institutions from different eco-geographic rice types (indica, tropical japonica and few temperate japonica). Seed import from contributing organizations is a big challenge due to seed exchange restrictions. So far, we obtained the seed of about 60 genotypes including those cleared by the IRRI Seed Health Unit and the Philippine Bureau of Plant Industry. About 52 entries were already multiplied for sharing with Indian partners. The trial will be conducted at all the collaborative centres.
- GxE analysis was conducted for PRAY-indica panel (300 accessions) for 15 environments, using Additive Main effects and Multiplicative Interaction (*AMMI*), for phenology and yield potential traits; Methodology documented as blueprint for use by the Global Array network. GWAS analyses from phenotyping for response to water deficit at vegetative of PRAY-tropical japonica in Brazilian fields done. Phenotyping for response to water deficit at reproductive of PRAY-tropical japonica in greenhouse and controlled chamber done. Phenotypic plasticity traits mapped by GWAS (PRAY and MAGIC indica panels) and evidence generated supporting the hypothesis that the traits increase rice response to CO2 fertilization.
- Development of a Galaxy based flexible access to big rice genomic resources (Rice3K, High Density Rice Array 700k SNPs, IRIGIN) with connection to various analytical workflows. Development of Breeding API (BrAPI) standard web services for rice genotyping data (TropGeneDB and Gigwa databases). Improvement of MIAPPE (Minimum Information About Plant Phenotyping Experiment) standard for phenotyping metadata applied to rice (TropGeneDB database).
- Distribution of abiotic stresses in Africa has been mapped and the effects of climate change in Africa have been predicted; Optimal sowing periods for rice in relation to climate variation have been modeled for different regions of Africa (West and East Africa).
- Emerging bacterial diseases caused by *Pantoea* and *Sphingomonas* have been detected in different countries and sources of resistance have been identified.
- Over 7,000 irrigated breeding lines were characterized for some disease resistance genes *e.g.,* BLB (xa3, xa5 & xa13) and Blast (pi2 & pi9) using a 10-panel SNP chip specific for Africa
- Quantitative Trait Loci (QTL) mapping activities, at different stages of progress, have been conducted for disease resistance, iron-toxicity, cold, anaerobic germination, and salinity.
- 28 SNPs associated with 4 traits of interest to Africa (salinity, drought, heat, yield potential) have been validated in segregating F2 populations.
- Completion of baseline information of trials and climate change related modelling activities in Latin America and the Caribbean (LAC); Set up of an antenna panel including promising donors/varieties tolerant of specific stresses in LAC.
- New sources (genes and parental lines) of resistance to rice *hoja blanca* virus, low radiation tolerance; QTL mapping activities for radiation, tungro virus, nitrogen, blast and water use efficiency conducted; New *B. glumae* strains sequenced and analyzed for diagnostics tools development; Obtaining an advanced generation from *Pi9* introgression into a commercial blast susceptible variety; QTLs for rice *hoja blanca* and amylose content have been validated in F2:3 biparental populations.

FP5 New rice varieties

- Phenotyping of subset of 3K panel for stagnant flooding, seedling stage salinity, submergence, rice yellow mottle virus, zinc deficiency, drought, blast and bacterial blight, leaf water potential, mutations in EIF4G with potential resistance alleles, 192 accessions in east-southeast Africa, *O. longistaminata* for yellow stem borer at IRRI; donors from Indonesia for tolerance to iron toxicity, phenotyping of 200 recombinant Nitrogen Use Efficient lines in order to evaluate phenotypic and genetic variability by JIRCAS, phenotyping of a panel of 660 indica accessions selected from the 3,000 genomes panel from IRRI and other sources for Rice *hoja blanca* virus resistance leading to identification of new donors, QTLs and candidate genes are linked to the outcome on use of rice diversity in rice gene banks for identification of traits and discovery of new genes.
- 68 breeding lines with *Pup1* introgressions in IR64 background selected and advanced to F_5 based on field screening in low-input farmers' fields in Madagascar. 20 potential donors with >50% higher panicle weight compared to local check identified in screening trials under low-input conditions in farmers' fields in Madagascar. 75 breeding lines with *Pup1* and *qPef4* introgressions in NERICA background selected in the F_5 based on yield performance in farmers' fields.
- Characterization of breeding lines based on estimated breeding value, development of proof of concept on genomic selection on rice diversity panel, proof of concept for genomic prediction of line value in a synthetic population, release of second major version of MapDisto, development of novel markers for BB (xa4, xa5, xa13, Xa21) , blast (Pi9, Pita2), low chalkiness, submergence (sub1), drought (qDTY12.1, qDTY2.2, qDTY4.1), amplicon based genotyping platform implementation and development of first version of transformation protocols that allows for consistent transformation efficiencies across breeding pool as well as development of Knock-In and allele replacement systems research activities are linked to the outcome on development of novel tools for precision biotech breeding.
- Development of marker profile on a set of diverse lines, use of Single Nucleotid Polymorphism (SNP) assays in trait and varietal development, better understanding of the positive combinations of QTLs, development of consumer and market oriented product profile for different countries of Asia and Africa, initiation of implementation of modified breeding strategy combining MAS and genomic selection, standardization of breeding operations including use of improved designs in trialing, optimization of research data management at different institutes, evaluation of breeding lines with introgressed QTLs for abiotic stresses for rainfed lowland, mega deltas and uplands as well as release of new high yielding lines including lines combining tolerance to drought plus submergence, salinity plus submergence are research activities linked to outcome to reduce yield loss caused by climate change in mega deltas, rainfed lowland and uplands.
- Promising lines selected among advanced lines for adaptation to different environmental pressures (high temperatures, acid soils) for upland conditions, and new segregating populations (elite lines x donor for tolerance to low radiation and NSC translocation) identified for integration into the upland breeding program. Participatory and decentralized breeding for rainfed-upland rice for mid-and high altitudes with a farmer-breeder network including women rice growers established for high elevation areas. Early generation yield testing of 200 F2.4 lines in high elevation and evaluation of each 20 advanced lines (F5-F7) for high and mid-elevations. Multilocation participatory variety selection trials with 10

farmers (each 6 lines) for variety nomination conducted for medium and high elevation areas of Madagascar.

- Genes and gene network involved in rice root development: Genome-wide association study (GWAS) identified new sources of wide root cone angle in rice. It also led to propositions to bypass some drawbacks of GWAS to identify candidate genes deserving further investigation. The Defective in Outer Cell layer Specification 1 (DOCS1) gene that belongs to the Leucine-Rich Repeat Receptor-Like Kinase (LRR-RLK) subfamily, is involved in rice gravitropic responses at several stages of plant development. We demonstrate that the overexpression of AtSHR and OsSHR2 genes in rice roots leads to plants with wide and short roots that contain a high number of extra cortical cell layers. In an experiment with a Fukushima soil highly contaminated with $^{137}Cs^{+}$, plants lacking OsHAK1 function displayed strikingly reduced levels of $^{137}Cs^{+}$ in roots and shoots. These results open stimulating perspectives to smartly produce safe food in regions contaminated by nuclear accidents. 16 constructs were developed for manipulation of rice root system Gene network. Eight of these constructed were transformed in rice plants.
- Integration of grain quality traits including traits preferred by men and women farmers into development of product profile for different breeding zones, use of multinomial logistic regression, random forest prediction tool to identify superior lines, development of markers for amylose and amylopectin, identification of SNPs assay distinguishing novel glycemic index , development of high zinc rice germplasm and at least one QTL linked with high Zinc content shall help achieve the outcome on development of high quality, high nutritious rice varieties. Progress towards development of C4 transgenic lines with increased photosynthetic ability as well as training of young scholars including men and women shall help achieve development of prototype C4 rice lines with increased yield potential.

1.3 Cross-Cutting Dimensions (at CRP level)

1.3.1 Gender:

[Please describe any important CRP research findings, capacity development or outcomes in 2017 related to gender issues. If research findings have been used (including by other researchers), please mention how/where. If an example is already recorded as an 'outcome story', please include a reference. Please briefly highlight any lessons and implications for your future work
on gender.]

- Two AfricaRice researchers participated in the Gender-Responsive Cereal Grain Breeding Course that was offered by GREAT (Gender-responsive Researchers Equipped for Agricultural Transformation), a collaboration between Cornell University (United States) and Makerere University (Uganda). GREAT is centered on delivering high-quality courses to agricultural researchers from sub-Saharan Africa in the theory and practice of gender-responsive research, seeking to increase opportunities for equitable participation and the sharing of benefits from agricultural research and improve the outcomes for smallholder women farmers, entrepreneurs, and farmer organizations across sub-Saharan Africa. The results from the research conducted as part of the course are reported in the 'Household decision making process for adoption of new cold-tolerant rice varieties in Madagascar'. The team won a grant for expanding data collection and publishing the research.

- Women's empowerment and gender equity in agriculture: A different perspective from Southeast Asia. This study presents evidence of women empowerment from Myanmar, Thailand, Vietnam and the Philippines. Akter, S., Rutsaert, P., Luis, J.S., Htwe, N.M., San, S.S., Raharjo, B., (2017). Key findings are that in these countries, Women have equal access to productive resources and a greater control over household income than men. Women play an active role in agricultural groups in Thailand and in the Philippines but not in Indonesia and Myanmar. Country specific gender intervention framework is necessary for effectively addressing gender gaps in agriculture
- Women's land titles and decision-making: An analysis of data from the Rice Monitoring Survey revealed that only 3 % of the 8,000 rural households randomly selected in eastern Uttar Pradesh, Bihar, Odisha, and West Bengal in Eastern India have their land registered under women's names, with significant variation between the states. Results suggest positive associations between women's land title ownership and their participation in decision-making on crop production, livestock production, and household expenditures.
- Identification of suitable business models for women and youth in Nigeria: Through focus group discussions carried out in Nasarawa and Kano rice sector development hubs in Nigeria, suitable business models for women and youth in Nigeria were identified. Five categories of existing business models were identified. New business ideas and new employment opportunities identified for women and youth include: (1) rice based products processing and marketing, (2) fabrication and selling of rice husk briquettes, (3) paddy seedling production and marketing, (4) rice husk fueled gasifier cookstoves production, (5) rice oil extraction, (6) processing of rice bran into building blocks, (7) rice based organic fertilizer production and marketing, (8) milled rice flour processing and marketing, (9) packaging, labeling and branding business, and (10) rice based animal feed.
- Measuring women empowerment: The formal computation of the Women's Empowerment in Agriculture Index (WEAI) through the 5 Domains of Empowerment and Gender parity assessment is still on-going. However, the descriptive findings in Nigeria (Nasarawa, Benue and Kano) reveal that men and women rice farmers engage in almost similar activities in terms of labor allocation. Women spend more time than men on productive and socio-community activities (on average 1.2h for women against 0.5h for men per day). Regarding resource ownership, men own about 51% of household assets. Men individually make most of the decisions concerning choice of crop and variety (58%), management of production (65%), post-harvest operations (53%), use of income (54%), and credit / savings (45%). The computation of WEIA revealed that it is highest in Madagascar (2.55), followed by Sierra Leone (2.51), Cote d'Ivoire (2.4), Nigeria (2.33), Togo (2.23) and lowest in Burkina Faso (1.97). Women join men in decision making in Madagascar while men almost take rice value chain and households decisions individually in Burkina Faso.
- Analysis of gender roles in rice based farming systems in Cote d'Ivoire and Madagascar: the analysis was conducted for the hubs of Gagnoa (Cote d'Ivoire) and Ambohibary (Madagascar) to understand the context for Intensification and Mechanization. Results show that improved technologies (varieties, production equipment, and good agricultural practices) are much more widely used by women than men. The household decision making process for adoption of new cold-tolerant rice varieties in Madagascar was unveiled. The analysis showed that the acceptability is high in both gender groups as both men and women realize that the variety satisfy their mutual needs.

- Results from farming systems survey in Cote d'Ivoire and Madagascar show that men are more involved in rice production than women (2.6 vs. 1.8 hrs/day in Cote d'Ivoire; 1.6 vs. 1.0 hours in Madagascar). In Cote d'Ivoire, women are also involved in rice parboiling activities (additional 1 hr/day). Women spend more time on reproductive activities (taking care of sick/elderly people; child care; water fetching; collection of firewood; house cleaning) people than men in both countries (1-2 hrs/day). Stereotype of rice female farmers in Africa (female farmers work more in rice fields) was not applicable to these sites.
- A study was initiated to investigate gender differences in households' perception of climate change and adaptation strategies. Results from the study confirm the existence of intra-household gender differences in the adaptation strategies. The study found that although spouses perceive climatic stress, they are less likely to adapt to such stresses when it comes farming enterprise, but more likely to adapt to household financial strategies. In contrast, farm operators, in the presence of climatic stresses, undertake both farm and household finance adaptation strategies. The study advocates that investment in climate smart agriculture can help households in managing climatic stresses.
- Gender is at the heart of FP2 for three reasons. First, many of the postharvest technologies are designed with the aim of increasing women's incomes and options and reducing drudgery of work. Rice parboiling in Africa is the example. Secondly, our market surveys are always sex-disaggregated, which enables us to understand preferences of both women and men and helps technology developers to ensure that their technologies are gender-inclusive. Thirdly, by collecting sex-disaggregated data, followed by household consensus, some of our behavioral experiments generate unique data that can be used to understand gender equality issues within agricultural households. A strong collaboration between FP2 and FP5 has resulted in the development of 13 product profiles spanning two seasons and five regions (eastern India, Bangladesh, Philippines). Through two-stage sec-disaggregated data collection (one individual round with husband and wife and one collective round with both as a joint decision-making unit), unique data on intra-household decision-making power were obtained and explained through a set of socio-economic factors. It was found that off-farm income had more impact on intra-household decision-making power of women than education. Secondly, through consumer surveys in 24 cities in 7 countries, we were able to demonstrate that certain traits, such as aroma, are more preferred by women than men. Moreover, we found strong relationships between awareness of farmers towards climate change and the product profiles they prefer. This information enables rice breeders to make their variety replacement programs more market-driven, gender-inclusive and climate-resilient.

1.3.2 Youth

[As for gender]

- Low aspirations and perceived low profile attached to agriculture have intensified the rural exodus to nonfarm employment and migration and are viewed as a coping strategy to overcome the high risk associated with farming. A gender-sensitive rural youth survey was conducted in three states of eastern India to take a stock on current youth involvement, to analyze their willingness to choose agriculture or related value chain activities as their career and to explore what type of policy and institutional support the youth required in-order to pursue agricultural career. Youth, household head and household characteristics as well as

the caste and location are significant factors influencing youth involvement in different farming activities. The female participants varied across the region in their willingness to be involved in rice production and sometimes surpassed their male counterparts. The involvement in rice value chain activities has significant and positive impact on their career choice. The study identified the support and facilitation that youth would like to receive in-order to invest in agriculture and accept it as their future career.

- The role and constraints of women and youth in service provision in Tanzania were assessed. Women' tasks are in the less rewarding value chain segments (farming (40–60%) vs. milling & trading (less than 10%)). Women and youth are poorly represented in different service provision units as owners (<10%) and women-especially young female (20 to 35 years) are just employees (about 80% of staff in different units). Women entry into the Rice Value Chain is constrained by high initial capital requirements.
- In Nigeria, a study with rice value chain actors was conducted to accelerate youth employment. Rice harvest and post-harvest segments using improved equipment for harvesting, threshing, parboiling and milling are the main potential enterprises that may attract youth to work as services providers. A similar study was conducted in Tanzania where youth was poorly represented as owners in different service provision units. The main constraints for youth engagement in rice value chain were the lack of finance, lack of improved equipment and negative perception of youth on agriculture.

1.3.3 Other Aspects of Equity / "Leaving No-one Behind[1]":

[This is an optional space where you can add information on other aspects of equity and your CRP's contribution to "leaving no-one behind", for example with the poorest groups, indigenous peoples, or disability.]

Welfare of marginalized people or society is always an important mission for all developmental and research organizations in agriculture. This study conceptualizes marginalization using the following typology: those with limited factor endowments; those belonging to disadvantaged social groups and those who are subsistence oriented. The study analyzed the degree of mechanization in farm operations using household level data from four Indian states. It further explores the differential returns to farming and assesses the direct and indirect welfare distributional outcomes produced by mechanization. Findings suggest that the marginalized groups exhibit lower levels of agricultural mechanization and earn substantially lower farm and off-farm incomes compared to others. The dilemma of how a technological change can generate major economic benefits but at the same time provoke adverse effects on the marginalized section of society is studied in detail. Decomposition of displaced labor as a result of mechanization shows that the displaced hired labor mainly belongs to the most vulnerable social groups which forms the bulk of the rural labor force. The results demand undertaking development approaches that have the potential of bridging the productivity gaps promoting inclusive growth in the agriculture sector and to formulate strategies that can overcome the constraints faced by the marginalized farmers, thereby making farming more resilient and equitable.

1 https://unstats.un.org/sdgs/report/2016/leaving-no-one-behind

1.3.4 Capacity Development:

[Please summarize key achievements and learning points in Capacity Development this year. If relevant, make reference to Table D-1 Indicator C4.]

A full overview of capacity development statistics is available here (http://www.grisp.net/file_cabinet/folders/265913). A total of 529 (52% women) were involved with RICE as scholars and 19,447 (54% women) people received short term trainings (see Table D-1). Here, some examples of typical short-term training activities are elaborated:

- In Bihar, manual and mat type nursery enterprise was led by women farmers with state rural livelihood mission (Jeevika), and a Private company (ITC Ltd.). Agro advisory information on better bet agronomy practices, improved seed varieties and healthy nursery seedlings practices were disseminated to 50,000 women farmers through Indian Farmers Fertilizers Cooperative Limited (IFFCO), Jeevika and Government of Bihar. 72 women farmer entrepreneurs in Bihar earned an income of $10,224 (INR 6, 64,570) during Kharif 2017. Series of trainings and capacity building events reached 5,000 women farmers.
- Men and women farmers, extension/community workers and NARES partners were engaged in capacity enhancement activities to be more food secure in fragile rice farming environments in South East Asia. During 2014-2017, out of a total of 9,080 trainees, 3,561 were female (40%) and 4,850 are male (60%).
- 460 agricultural knowledge service providers were trained in use of RiceAdvice in 2017. Training to female service providers enhanced access to female farmers in northern Nigeria, where there is religious belief that women are not to be exposed or should be restricted to interaction with the husband only.
- The knowledge/skill set of extension personnel/researchers/policy makers in South Asia is limited in the area of evidence generation using robust sampling approaches and policy analysis, and micro-econometric techniques. Keeping this mind, workshops were conducted with Krishi Vigyan Kendra Knowledge Centers of the Indian Council for Agricultural Research (ICAR-KVKs) as well as with Department of Agriculture, State Governments. Two trainings on experimental economics were conducted at ICAR Centre for Advanced Faculty Training on "Quantitative Methods for Agricultural Policy Analysis" with a total participant of 50 faculty members of State Agricultural Universities and scientists across India. Trainings on robust sampling approaches in evidence generation were conducted with ICAR-KVK scientists.
- Capacity development for women in the rice value chain: Women's groups are increasing showing interest in rice parboiling as an activity which can be turned into a profitable enterprise. In partnership with the The Centre National de Recherche Agronomique, AfricaRice strengthened the capacity of 30 women processors from Bouaké and Gagnoa in Cote d'Ivoire on: the use of AfricaRice's GEM (Grain quality enhancer, Energy-efficient and durable Material) rice-parboiling system to improve the quality of rice and fuel-use efficiency, (2) use of rice husk as an alternative to wood fuel for rice parboiling, and (3) Initiation of innovation platforms to link farmers, parboilers and millers in the respective zones. Following this training, the following immediate outcomes were reported by the platform management committee: Increase in the value of milled rice from 350 FCFA to 450 FCFA per kg leading to better incomes for women in these groups; 3500 FCFA per ton cost saving by substituting wood with rice husk as parboiling fuel; high appreciation of the technology by women because it was found to be user-friendly and produces very little or no

smoke during parboiling. This reduces health risks for women associated with parboiling using traditional systems.

- In Cambodia, the development and implementation of the curricula for (i) Faculty of Agricultural Engineering at the Royal University of Agriculture, Phnom Pen and for (ii) Vocational Training for Agricultural Machinery Mechanics at Don Bosco in Battambang continued. Outlines for new training courses on postharvest and mechanization were developed with IRRI Education. In the context of taking stock of all the tools and curricula for capacity development in the rice value chain analysis, 8 curricula material and 4 related tools were compiled. These materials are being applied in workshop trainings to farmers, leaders in farmers' associations and other value chain actors (millers, traders).
- We trained about 130 Vietnamese, Cambodian, Filipino, Indian and Bangladeshi scientists from the national systems (including famous restaurant holders) in various fields such as behavioral economics, gastronomic systems research and value chain research.
- In Africa, 41 youth (11 females) were trained on theory, tools and methodologies for experimental auctions implementation in Benin and Nigeria; and 38 NARS adults and youth (3 females) trained on theory, tools and methodologies for the assessment of business opportunities for youth in services provision in the harvest and post-harvest segments of the rice value chain. Rice processing skills of 12 young service providers and 50 women processors in Benin and Cote d'Ivoire respectively were enhanced through training on the production of high quality parboiled rice using the Mini-GEM parboiling technology. The technical skills of 25 young male equipment fabricators in Nigeria were developed through training on the fabrication and installation of the GEM parboiling technology. Rice processors who received training recorded better quality parboiled rice (higher total milling return, head rice yield and cleanliness) compared to those who had not received training.

1.3.5 Open Data:

[Please provide a brief summary on CRP progress, challenges, and lessons with implementing the open data commitment. Make reference to Table D-1 Indicator C5.]

- Global rice statistics are kept updated and made open access available through portals such as the World Rice Statistics and Osiriz (which also provided interpretations and analyses of the global and regional rice markets, including monthly bulletins on African rice agriculture).
- Farm household survey data collected in Bangladesh under the Rice Monitoring Survey (RMS) Project, and other projects at IRRI have been uploaded on the Agri-food Policy Platform (APP) website for open access. Initiatives have been undertaken in 2017 to allow integration of all farm household datasets into interoperability mode. In the new interoperability system, info-graphics will be made available on the number of surveys done in Asia, Africa, and the rest of the world. Datasets, especially those from panel surveys will be made visually appealing through graph, chart etc. RICE/AfricaRice farm and household surveys data were shared through a dedicated data platform. Several farm household datasets from IRRI, AfricRice and CIAT were also made available open access on Harvard Dataverse.
- CIAT initiated a process for making publicly available 4 datasets from household surveys implemented in Peru, Bolivia, Ecuador and Colombia. At the same time in collaboration with FLAR, CIAT has embarked in the consolidation of two regional databases that compile the key indicators from the monitoring initiative. CIAT is working towards a full open data policy

regarding socio-economic and expert opinion datasets completed with the support of RICE CRP. For instance the household rice survey dataset collected in Ecuador has been submitted for a data specialized journal (i.e. Data in Brief) to give more visibility to the existent data. The dataset is also available in Harvard Dataverse.

- The RICE project PRISM (The Philippine Rice Information System) provincial level end of season rice area and yield are publicly available but other data are restricted to project partners following the PRISM data sharing policy. As part of the data sharing policy, third parties may send a request for access to data that are not publicly available.
- RiceAtlas, a global spatial database on rice calendar and production was published in Nature Scientific data with data available online. RICE also contributed country-level data to the international Global Yield Gap Atlas.
- In 2017, the FP4-produced open access data were incorporated into the SNP Seek database, under the International Rice Informatics Consortium (IRIC). Public access to the SNP Seek database was over 100 per day. The database was used by the global community to conduct breeding and genetic studies, leading to outcome.
- The AfricaRice web data repository, based on the Comprehensive Knowledge Archive Network , was revamped to align with participating Centers in the RICE CRP. Weather data collected by AfricaRice was migrated to dataverse, and abiotic stress mapping data was uploaded and made fully open and accessible. The core set of 15 metadata elements recommended by the CGIAR Data Management Task Force has been adopted by AfricaRice and templates to gather data and related metadata have been developed and shared with AfricaRice scientists. The following agronomic databases were made available open access and online by AfricaRice: Data sets from yield gap surveys conducted in 2012-2014 in 19 countries, Data from long-term trial on double rice cropping in Senegal, AfricaRice Weather database online, Weed inventory and characteristics.
- Developed donors, QTLs, genes and gene based markers for different traits are shared openly after publication in journals with all participating institutes as well as NARES institutions working on rice. Developed breeding lines are shared openly with public sector organization for evaluation and release. Data generated through METs and well as all INGER data are published on the INGER web site. All reports and analyzed data for multilocation evaluation are also published openly.

1.3.6 Intellectual Assets:

[Please provide a brief summary under the three following headings: (a) How have intellectual assets been strategically managed by the CRP in order to maximize their global accessibility and/or impact in line with the CGIAR Principles on the Management of Intellectual Assets? E.g. taking out intellectual property rights, licensing, new innovative practices, etc. (b) Indicate any published patents and/or plant variety right applications (or equivalent) associated with intellectual assets developed in the CRP and filed by Centers and/or partners involved in the CRP (please fill out or update the Table E); (c) List any critical issues or challenges encountered in the management of intellectual assets in the context of the CRP.]

Asset management

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 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. As lead center for RICE, IRRI developed an

Intellectual Property and Commercialization (IP&C) Policy that spells out provisions in relation to: Governance and oversight of IRRI's Intellectual Property and Commercialization activities; Protection of Intellectual Property; Germplasm Licensing and Commercialization; Trait Licensing; Public Private Partnerships; Background Intellectual Property, Foreground Intellectual Property and Freedom To Operate; Communication Policy and Practice. IRRI also created an Intellectual Property and Commercialization Committee (IPCC), which is a consultative forum which reports directly to IRRI's Board of Trustees and reviews IRRI's IP policy, IP management and proposed PPP agreements. The current IPCC is composed of world-class specialists of impact assessment, PPP in agriculture, business development and social sciences.

2. CRP Effectiveness and Efficiency

2.1 Variance from Planned Program:

[Please provide a brief summary under the following headings. (a) Have any promising research areas been significantly expanded? Please give specific examples. Where has the money for expansion come from? (b) Have any research lines been dropped or significantly cut? Please give specific examples and brief reasons. If funding was reallocated to other work, where did the money go? (c) Have any research areas taken new directions due to unexpected research results (positive or negative)? Please give specific examples. Put "N/A" if not applicable.]

FP1 Accelerating impact and equity

In the seed scaling and varietal adoption acitivites, the areas of research have been diversified to test the effectiveness multiple modern and innovative extension and delivery methods on adoption of seeds of stress-tolerant rice varieties. These include the concept of introducing method of evidence hub/ client cafeteria for triggering seed production and varietal adoption as well as engaging dealers in mainstream demonstration programmes to see the absorption of new varieties in the formal seed sales and distribution channel. A significant number of these innovations have been possible through funding from states and Govt of India. Through collaboration with other CGIAR institutes, e.g., CIP, the domain of research have also been expanded to cropping system intensification by testing the effect of introduction of short duration stress tolerant rice varieties in diversifying and intensifying the cropping systems. The study on intra-household dynamics in the use of stress-tolerant varieties in Uttar Pradesh was expanded with funding from STRASA project.

FP2 Upgrading rice value chains

Due to the environmental and health problems with straw burning in most countries, there is a huge interest in sustainable rice straw management. We have been involved in four project proposals on the topic and one submitted to a call of the Department of Agriculture of the Philippines has a 95% chance of funding. As a result, this area is being expanded under FP2, albeit mostly funded through bilateral funds. However, postharvest and value chain support activities in Bangladesh and Cambodia have been cut and reduced respectively due to the FB2 budget cuts experienced in 2017.

FP3 Sustainable farming systems

Farming systems analysis platforms were expanded to Central Africa, based on joint workshop between RICE, RTB and World Vegetable Center. Farming systems survey was initiated in early 2018 using funds from W1/2 RICE CRP allocated in 2018. Combine-harvester was not tested since the

machine was not developed as planned in 2017 using funds from another project. As that project will end, we will not continue with this work.

FP4 Global Rice Array

Due to funding constraint, there was no significant expansion of research. The number of trial sites in the global array was downscaled due to reduced funding. In Asia, self-sponsored partners were identified in India and China, and in LAC in Brazil and Uruguay. Due to the lack of internal capacity, disease modeling for future climates will not be addressed at AfricaRice.

FP5 New rice varieties

Application of modified breeding strategy that include use of marker assisted selection plus genomic selection strategy, rapid generation advancement protocol for faster breeding cycle advancement, use of SNPs assays, improved designs use in breeding trials evaluation that shall help increase grain yield genetic gain has been one area that has been expanded in 2017. Application of biotechnology including new genotyping platform tools for the characterization of the genetic diversity as well as trait development is another area that has been expanded in 2017. Some research areas, including the characterization of germplasm with tolerance to low radiation, tolerance to high temperatures, non-structural carbohydrates and the identification of resistance genes to emerging pathogens had to be dropped in 2017 due to funding reduction. Research on genome editing using CRISPR/Cas9 (Clustered Regularly Interspaced Short Palindromic Repeats) also did not achieve the required progress even though continued at a much smaller level due to shortage of funding support.

2.2 Use of W1-2 Funding:

[Briefly summarize the main areas of expenditure of W1/2 in the current reporting year (including through set aside strategic research funds or partner funds). What were the main achievements and/or cross-cutting work made possible because of W1/2 funding? What were the main learning points? ***Table F*** *is optional for CRP to aid highlighting main areas of W1/2 expenditure in this reporting period. Please fill and refer to the table if relevant.]*

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 (ME&L) 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 F.

FP1 Accelerating impact and equity

The W1/W2 funding was used to support staff time, various studies on impact assessment, adoption of stress-tolerant and improved varieties, gender and youth. The funding was also used to support data collection in Africa and Asia (area-based and hub-based surveys) and also for data analysis for computation of progress indicators. In CIAT, the W1/W2 funding from the RICE CRP made it possible to keep a minimum capacity for running the ME&L efforts with FLAR and to conduct data analysis on impact assessment and gender analysis. Basically it covered 2.5 full research assistant time and 0.3 PhD time for supervision.

FP2 Upgrading rice value chains

In FP2, W1/2 funding is mostly used for the development of theoretical frameworks and strategies, while bilateral funds are mostly used for the collection of data and the development of technologies. In Africa, W1/2 funding was mostly used for the analysis of rice value chain and the assistance to post-harvest technology out-scaling in selected countries especially in the countries where there are no bilateral projects for specific FP2 research activities (Nigeria, Benin, Cote d'Ivoire and Tanzania). The assistance to out-scaling includes showcasing of the postharvest technologies and innovations, strengthening of business skills and capacity for rice value chain actors and capacity building for students on post-harvest and value chains research. Similarly, in Asia, W1/2 funding has mostly been utilized in countries where we do not have bilateral projects for FP2 activities (Bangladesh, Cambodia, also recently Nepal). They were also used to leverage funding from 14 W3 projects (Table F) and to facilitate exchange between and learning from them. W1/W2 funding has been utilized for travel costs and conducting research on Kuai chap properties and pop-rice technology. Also, JIRCAS budget had been utilized for the activities in Thailand, that overlapped with the activities in the JIRCAS project.

FP3 Sustainable farming systems

Funds from W1/2 were used for establishing partnership with other CRPs (RTB, FTA), World Vegetable Center, and Advanced Research Institutes, conducting planned research activities, catalyzing new research areas (farming systems research, diversification options), and addressing cross-cutting issues. Establishment of partnerships, and development of RiceAdvice-weedmanager were major achievements. To maintain partnerships and conduct joint activities with other CRPs, Joint effort on resource mobilization is needed. W1/W2 funds supported the continuation of two long-term experiments at IRRI headquarters, IRRI's participation in the Sustainable Rice Platform (SRP), and the development of IRRI's human nutrition strategy. IRRI staff contributed to the revision of the SRP Standard and Performance Indicators (v. 2.0) and developed successful project proposals for human nutrition research in the Philippines.

FP4 Global Rice Array

W1/W2 funds were mostly used for personnel support, exchange of germplasm between array sites, phenotyping activities, procurement to upgrade phenotyping/screening/laboratory facilities, travel, and institutional overhead. Through engagement with array sites in India, we obtained support from the state and grant support from the Indian government. For China, the discussion with Provinces for funding support is on-going.

FP5 New rice varieties

Main areas of expenditure of W1/2 in 2017 were: characterization of genetic resources leading to the identification of new sources/genes for resistance to the main rice disease rice hoja blanca virus;

characterization of genetic resources with tolerance to drought and nitrogen/water use efficiency leading to the identification of genes controlling these traits; development of protocols and application of gene editing technology for the validation of gene function controlling different traits including rice *hoja blanca* resistance; development of a database for phenotypic data related to important traits for rice breeding and for genomic data on a synthetic population used to train a genomic prediction model; development of a database for phenotypic data related to rice nutritional value on a synthetic population used to train a genomic prediction model; identification of elite breeding lines in breeding programs; and application of biotechnology tolls for the improvement of germplasm and development of new rice varieties.

2.3 Key External Partnerships:

*[Please summarize highlights, value added and points to improve/ learning points from this year, and complete **Table G** on External Partnerships.]*

FP1 Accelerating impact and equity

The private public alliance FLAR (Latin American Fund for Irrigated Rice) has been crucial to continue expanding economic research. The partner's interest aligns well with the main research questions that the center wants to answer like adoption of rice innovations (beyond rice varieties), market value chains, and subsidy policy analysis. The synergies between FLAR and CIAT have continued improving and thought how important is to incorporate private/public views into the research agenda setting for the region.

AfricaRice established partnership with local research (ARI-Ukiriguru) and development organizations to systematically facilitate the stakeholders' forum as an innovation platform. In Lafia, Nigeria, the success of the innovation platform resulted in mindset change of policy makers and inspired other jurisdictions to design projects based on the innovation platform model. Also, the rice hubs provided linkages with development programs and national priorities for further scaling up and sustainability.

In Bangladesh, we have strengthened partnership with the Bangladesh Agricultural University, the Bangabandhu Sheikh Mujub Rahaman Agricultural University, and Khulna University by involving their graduate students in the socioeconomic research of IRRI. Also, IRRI has started collaborating with the Bangladesh Agricultural Research Institute (BARI) to study the diversification of rice-based cropping system in Bangladesh. IRRI has initiated collaboration with Private Companies namely Metal Private Limited and PK Group of Companies to promote mechanization and marketing of premium quality rice. A joint concept note about promotion of Direct Seeded Rice was developed between IRRI and Catholic Relief Services, an international Non Governmental Organization (NGO).

FP2 Upgrading rice value chains

FP2 is quite successful in combining data collection with training and simultaneously strengthening external partnerships. Experimental auctions, for example, require thorough training before they can be implemented. Usually, NARES partners are trained in these methodologies and as a result, they serve as building blocks for capacity development. In addition, the NARES partners receive co-ownership over the data collected, which strengthens the partnership. Partnerships with FAO, the West African Monetary and Economic Union (UEMOA), African Development Bank, Global Affairs Canada and *Centres d'innovations vertes pour le secteur agroalimentaire* 2 (GIAE2) contributed to the technologies and innovations out-scaling. Key partnerships with the private sector were

strengthened for technology development (GrainPro), piloting (Lehner), and promotion of technologies and concepts. A new partnership with Deutsche Landwirtschaftgesellschaft (DLG) was established for the organization of joint events like machinery exhibitions (AGRITECHNICA), mechanization seminars, and field events.

FP3 Sustainable farming systems

In the framework of Africa-wide agronomy task force, joint activities were taken with NARES partners in Burkina Faso, Madagascar, Mali, Tanzania, and Uganda for on-farm testing of good agricultural practices and RiceAdvice. This task force mechanism allowed us to introduce new technologies to different countries. Mostly, these activities have been financially supported by projects led by AfricaRice, using W1/2 as catalyzing funds. New business models are needed for sustaining task force mechanism and its activities.

IRRI continued developing global partnerships through the Sustainable Rice Platform (SRP), and national and regional partnerships (Thailand, Indonesia, Vietnam, China, Myanmar, Sri Lanka, Philippines, Cambodia) through the Irrigated Rice Research Consortium (through the SDC-funded project "Closing Rice Yield Gaps in Asia with Reduced Environmental Footprint") and the Consortium for Unfavorable Rice Environments (CURE). IRRI also developed a new private sector consortium for the improvement of direct-seeded rice technologies.

FP4 Global Rice Array

In China, five Provinces – Guangdong, Yunnan, Guangxi, Henan, and Zhejiang - expressed interest in participating in the Global Rice Array. The discussion with Guangdong Province was the most advanced, with a potential site to be set up at the coastal area. The level of self-funding was discussed. In Africa, partnerships with the Integrated Genotyping Support and Service platform at Biosciences eastern and central Africa (BECA) and the High Throughput Phenotyping Project (hosted at ICRISAT) were very instrumental for the validation of SNP markers related to traits of interest. Through the disease evaluation network, NARES from different countries have contributed to the assessment of the geographic effectiveness of blast resistance genes in Africa. At CIAT, FLAR, University of Tokio, University Javeriana (Colombia), and FEDEARROZ (Colombia) were key partnerships in the development and validation of phenotypic tools (drones and fixed stations). Together with CIAT, FEDEARROZ developed diagnosis tools for blast screening.

FP5 New rice varieties

FP 5 strengthened its collaboration with national programs through implementation of modified breeding strategies. Some of the new collaborations established in 2017 included working with several advanced research institutes on molecular biology studies, provincial Governments as well as Central Government Department of Agriculture in India through a newly developed IRRI South Asia strategy (see Table G for details). There has been some new partnership developed with FAO and Asian Development Bank for undertaking research for development in South East Asia and South Asia in 2017. The C4 consortium is central to the operation and funding of the C4 rice activities.

2.4 Cross-CGIAR Partnerships (other CRPs and Platforms):

*[Please summarize highlights, value added and points to improve/ learning points from this year, and complete **Table H** on Cross-CGIAR Partnerships. Any points you can add here on the added value of the structures, CRP types and platforms and working together would be very useful.]*

RICE collaborates with many other CRPs and with all the CGIAR Platforms. Several researchers or research teams at the RICE CGIAR centers are co-funded by RICE, CCAFS, PIM, A4NH, MAIZE, WHEAT, and the EiB, Big Data, and Genebank Platforms. Through collaborative projects, joint experimental sites exist between RICE and CCAFS, WHEAT, MAIZE, FISH, and RTB in countries such as Bangladesh, India, Myanmar, Philippines, and Vietnam. For example, through collaboration with CIP/RTB, using quality seeds of short duration rice and potato, through multiple treatment and control plots, the effect of short duration rice on intensification of cropping system (by providing window for early sowing and third crop) is being tested in West Bengal. The entire mobilization of farmers and lay out and continuous supervision of the experimental plots are continued (covering multiple seasons of sowing and harvesting) through common partners, shared resources in terms of seed, supervision costs.

FP1 Accelerating impact and equity

The collaboration between RICE and CCAFS has covered various aspects of adaptation and mitigation. Broadly speaking, CCAFS has addressed scaling of new climate-smart technologies developed in the RICE CRP. This has included stress-tolerant varieties and protocols on water-saving techniques that were used in IRRI-led CCAFS project on Climate-smart Villages in the Mekong Basin. Likewise, the CCAFS project on co-benefits of alternate wetting and drying (AWD) has largely capitalized on empirical evidence provided through CRP Rice activities. Finally, bilaterally funded projects have addressed topics at the interface of both CRPs, namely the project on mitigating methane emissions in Vietnam and Bangladesh. IRRI also has organized workshops and training activities on climate change aspects in the rice sector through in-country activities and workshop/ training events held at IRRI-HQ.

RICE collaborated with PIM researchers in the development of a special paper to analyze the potential impacts of different research investments in terms of food security, nutrition, and economic impact. The study consists of exploring how different investments are heterogeneous in terms of their impact on the global food system. Each set of potential investments comes with tradeoff that needs to be examined in relation to the global environment, factors such as technology adoption, food demand, use of water resources, and climate change.

In Bangladesh, RICE, MAIZE and WHEAT (through IRRI and CIMMYT) jointly implement the Cereal System Initiatives in South Asia Project in Bangladesh. RICE and FISH researchers organized two brainstorming discussions to kick-start a joint research project on rice-fish system in Bangladesh.

RICE hosted the Global Future & Strategic Foresight Extended Team Meeting and Writeshop, which was held on 15-19 May 2017 at IRRI, Los Banos, Philippines. 28 Participants from 15 CGIAR Centers contributed to writing a set of papers including supply side foresighting on major cereals; employment and poverty; productivity and environmental tradeoffs.

FP2 Upgrading rice value chains

Collaboration with Livestock/ILRI was established in Vietnam, looking at markets for rice straw as ruminant fodder and for improving rice straw quality and nutritional value. Several proposals including sustainable mechanization and postharvest management/technologies were developed with CCAFS.

FP3 Sustainable farming systems

FP3 established partnerships with RTB, FTA, A4NH, and FISH in 2017, while it continued with partnerships previously established with CCAFS, MAIZE, and WHEAT. Staff, office and laboratory space is shared at IRRI headquarters and in Vietnam with CCAFS, in South Asia with MAIZE and WHEAT through the ongoing project on Cereal Systems Initiative in South Asia (CSISA), and in Myanmar with FISH (WorldFish) through a joint rice-fish project. Fund raising is key issue for sustaining partnerships. The CCAFS focal point in AfricaRice (P. van Oort) is also working for FP3. The development of open-access weather database in Africa was a joint effort between CCAFS and RICE.

FP4 Global Rice Array

FP4 interacted with the Genebank Platform to access genetic diversity. The available diverse germplasm enabled the assembly of rice array populations. IRRI also partnered with the Big Data Platform to provide storage of genotypic and phenotypic data, and climatic data at array sites. The Big Data Platform contributed to CoA 4.5 in terms of co-funding, sharing of experiences, and upgrading of the data management system; it will be essential as more data are generated in 2018. Through the Excellence in Breeding platform (EiB), there is better access to genotyping services; good phenotyping practices are being shared across centers, which is particularly relevant to CoA 4.2. Joint funding from CCAFS and restricted projects enabled completion of climate change modeling in Africa, while joint funding from CCAFS and the European Commission allowed the development of a first data base on modelling and climate change in LAC. FP4 participated in exercises for the phenotyping and bioinformatics component in the EIB platform. CCAFS, together with CIAT, developed the data base on modelling trials for rice in LAC.

FP5 New rice varieties

FP5 continues to develop stronger collaboration with the Genebank Platform for use of the characterized germplasm in breeding programs. Together with FP4, FP5 developed collaboration with the Big Data Platform for systematic data analysis of the large set of genotyping-sequencing data as well as for data storage. Partnerships were with the Excellence in Breeding (EiB) Platform with important contributions on the access to genotyping services, improvement of breeding programs, modifications of breeding operations and assessment of genetic gains. FP5 developed some cross-institutes research collaborations, including the one between IRRI-ICRISAT on increasing yield and farmers' income in rice based system. FP 5 worked closely with A4NH for the development of improved germplasm with nutritional value and for having access to funds for phenotyping training populations for genomic selection.

2.5 Monitoring, Evaluation, Impact Assessment and Learning (MELIA):

*[Please complete **Table I** and provide a summary here on any highlights of MELIA this year, including any actions taken in response to relevant (IEA and others) evaluation recommendations (i.e. where the CRP has been specifically requested to complete actions).]*

RICE held the annual RICE MELIAG (Monitoring, Evaluation, Learning, Impact Assessment, Gender) Workshop, 4-5 September, 2017, Bangkok, Thailand with all of its flagship project leaders and key scientists to review progress made till date, and to further harmonize methods, approaches and tools for computing and monitoring RICE progress indicators. Specifically, there have been more efforts for a harmonized ME&L system across the RICE CRP. With the leadership of IRRI, CIAT and other partners have agreed to estimate a set of key outcome progress indicators that will be

monitored over the years. In the case of CIAT, annual data collected from FLAR partners and data from household surveys in 4 countries are being used.

Impact assessments are reported in section 1.1 and annex A.

2.6 Improving Efficiency:

[Optional space to describe efficiency gains in 2017: please describe any successes and points to improve in future, providing numbers where possible. For example: "sharing laboratory space with another CRP has cut costs by 20%".]

- By developing product profiles that are market-driven, gender-inclusive and climate-resilient, the probability of success of adoption of new varieties developed by rice breeding programs is increased.
- During 2017, breeding programs in FP5 implemented several measures to improve efficiency, such the introduction of the Rapid Generation Advance (RGA) technology . FP1 conducted a meta analysis of the effects of adoption of RGA (Lenaerts et al., 2018) and showed that the additional benefits due to time savings are considerable and offer some insights into the economics of breeding. The results confirm that the adoption of accelerated breeding would lead to substantial advantages to rice breeding programs and the earlier variety release leads to significant economic benefits to society. This can be important to policy makers when reshaping their public breeding methods and optimising their return on research investments in breeding.
- Sharing IRRI staff across CRPs (see section 2.4) has enabled us to recruit and retain expertise that can contribute collaboratively to multiple flagships within RICE and to multiple CRPs.
- At CIAT, approach of planning together the development of field projects in the different research stations to be able to share space, equipment and human resources has helped significantly to be more efficient and reduce costs at least by 10% in 2017.

3. CRP Management

3.1 CRP Management and Governance:

[Describe any major changes to management, governance arrangements and practices, if any. Describe any key top-level program management challenges, if any and how they were addressed.]

No changes in the RICE management or governance structure occurred in 2017. The RICE independent steering committee met in March 2017 and detailed minutes are publicly available and can be accessed here. (http://www.grisp.net/file_cabinet/folders/265910)

3.2 Management of Risks to Your CRP:

*[Brief summary of any encountered risks including any mitigation measures taken. Please provide your summary under the three following headings: programmatic, contextual and institutional risks (see the **CGIAR Risk Management Guidelines**).]*

The largest risk that materialized in 2017 was again budget uncertainty and budget decline, especially the major threat of close-to-zero USAID funding (which in the end did not materialize, but then cost-cutting measures had already been implemented). RICE centers responded by restricting fund flow to scientists and certain activities had to be cancelled or postponed towards the end of the year. Another risk was the reorganization of IRRI's internal research structure which led to changes in leadership positions and uncertainty as to how RICE activities were being mapped onto the new structure. 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. It is expected that as the new structure consolidates, relationships between RICE and IRRI will become clearer in 2018.

The Table in annex B provides an update of the RICE risk register (as presented in the full RICE proposal, section 1.0.15), with specific control and mitigation measures undertaken in 2017.

3.3 Financial Summary:

*[Please give a narrative summary on the financial status and health of the CRP. Complete **Table J**: CRP Financial Report.]*

In the original approved RICE proposal, the budget for 2017 was estimated at a total of 78.51 M USD, of which 16.35 M USD was from W1/2. In the RICE Plan of Work and Budget (15 February 2017), the updated total budget was estimated at 72.04 M USD, of which 16.14 M USD was from W1/2. On May 31 (5 months into 2017), the formal notice of program approval and estimate annual allocation for RICE from the executive director of the CGIAR system organization contained an approved budget of 16.2 M USD W1/2. Throughout the year, there was extreme uncertainty about W1/2 budget allocations, with major contributions coming on close to year end. Eventually, the total actual RICE budget was 74.16 M USD, out of which 16.14 M USD was from W1/2, 51.40 from W3 and bilateral sources, and 7.97 M USD from center own sources (a new category introduced in 2018). Without centers' own contributions, the total actual budget was 66.19 M USD, about 5.82 M USD less than planned for.

Table A: Evidence on Progress towards SLOs

Table A-1: Evidence on progress towards the SLOs (sphere of interest)

[Please complete this table as best you can with findings of published adoption or impact studies. Since this is the first year of reporting in this table, feel free to include any evidence published in 2012- 16, as well as 2017. In the future we will ask for new studies published in the current year (while recognizing that the CGIAR innovation on which the study is based may ultimately come from CGIAR research which predated the CRP). Do not hesitate to state, "no new evidence available in 2017", throughout the second column of the table if necessary, since we are trying to demonstrate evidence gaps and the need for additional funding for this area.]

SLO Target (2022)	Brief summary of new evidence of CGIAR contribution to *relevant* targets for this CRP (with citation)
1.1. 100 million more farm households have adopted improved varieties, breeds, trees, and/or management practices	In Bangladesh and Nepal, 81,078 farmers adopted improved rice varieties (26,819 ha) (CSISA annual report 2017) In Burundi, 150,000 smallholder farmers benefited from the release of 2 varieties for irrigated ecosystems (IRRI, 2017) Around 9.6 million households have adopted improved rice varieties (NERICA) in Africa (Arouna et al. (2017). Over 230,000 tons of seeds were produced and distributed to farmers in South Asia, which are estimated to have reached about 8 million farmers, covering over 4 million ha. In Sub Sahara Africa, 3,662 tons of new seeds were distributed in 2017 to farmers. (Source: STRASA progress report 2017, in prep). RiceAdvice reached 16,000 farmers with improved management advice in 2016, and more than 40,000 farmers till the end of 2017 (Ricenewstoday, 2017). Impact studies showed that on-farm rice yield increased by 0.5 t/ha using RiceAdvice in Nigeria (Arouna et al., 2017). Some 66,000 farmers in Odisha, India, received Rice Crop Manager (RCM) RCM recommendations. The project CSISA disseminated agro-advisory focusing on improved nursery bed management practices to 102,000 households in South Asia (CSISA annual report 2017).

1.2. 30 million people, of which 50% are women, assisted to exit poverty	In Bangladesh, farmers got 100$/ha more with direct-seeded rice (DSR) technologies in 2017. In Nepal, they got 150-200$/ha more with the use of DSR (CSISA annual report 2017) The use of Green Super Rice varieties brought a cumulative 19% increase in returns over 11 years in the dry season and 58% cumulative increase for the wet season in Philippines. 8 million persons were lifted out of poverty in Africa through the adoption of improved varieties (Arouna et al. 2017).
2.1. Improve the rate of yield increase for major food staples from current <1% to 1.2-1.5% per year	6 rice varieties were released in 2017: 2 for drought (Hardinah 3 in Nepal, Sabour Ardhajal in India), with average yield 0.8 to 1.2 t/ha higher than non-improved varieties under drought (IRRI, 2017). 2 rice varieties for irrigated ecosystems were released in Burundi (IR87546-84-3-3-2 and IR13A256) with yields of 7.5 and 6.7 t/ha and blast resistance. (IRRI, 2017) In Nigeria, 2 rice flood-tolerant varieties were released (FARO 66 and 67), with a yield advantage of 6-11% and 10-29% respectively, even under non-submerged conditions (AfricaRice, 2017). Under submergence, African Sub1 varieties can yield 10 to 80 times more than the original varieties (Reliefweb, 2017). The use of Rice Crop Manager recommendation by farmers in India increased rice yields by about 1 t/ha over the farmer's fertilizer practice (IRRI, 2017, Annual Report to Government of Odisha).
2.2. 30 million more people, of which 50% are women, meeting minimum dietary energy requirements	
2.3. 150 million more people, of which 50% are women, without deficiencies in one or more essential micronutrients	In Bangladesh, 270,00 more farmers are growing healthier rice varieties on 6,553 ha and in Nepal, 3,733 farmers on 977 ha (CSISA annual report 2017). Dissemination of high-zinc rice is playing important role in addressing micronutrient deficiency problem in Asia and Africa. (Bouis and Saltzman, 2017)

3.1. 5% increase in water and nutrient efficiency in agroecosystems	Impact study showed that use of RiceAdvice could reduce P and K application rate in Nigeria (Arouna et al. 2017). The use of Rice Crop Manager for improved fertilizer recommendations improved fertilizer use efficiency by 15%, 81% and 42 % for N, P and K, respectively, using farmer's varieties and by 18%, 90% and 56% for N,P and K, respectively, using the new stress-tolerant rice varieties (IRRI, 2017, Annual Report to Government of Odisha). In the Philippines, use of alternative wetting and drying (AWD) contributed to water savings of 11-17% at the field level and 22-33% at the irrigation turnout level (Rejesus et al., 2017, Final report submitted to SPIA on "Adoption and impact of alternate wetting and drying (AWD) water management for irrigated rice production in the Philippines"; still under embargo). In Thailand, adoption of best management practices reduced fertilizer input by 50-64% with no reduction in yield (Stuart et al., 2017).
3.2. Reduction in 'agriculturally'-related greenhouse gas emissions by 5%	Romasanta et al (2017) showed that on an annual basis, rice straw incorporation had the highest total global warming potential (GWP) with 8,023 kg CO2eq ha 1). Straw burning entailed a GWP of 4,913 kg CO2eq ha 1 that was almost identical to the GWP of partial straw removal from the field with 4,531 kg CO2eq ha 1. Complete straw removal had the lowest GWP with 3,470 kg CO2eq ha 1. 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. In the Philippines, implementation of the alternate wetting and drying irrigation technique (AWD) has the potential to reduce net GHG emissions by 10% compared with current irrigation practice (which already utilizes some form of intermittent flooding) (Rejesus et al., 2017; still under embargo) – a joint results with CCAFS.
3.3. 55 M ha degraded land area restored	
3.4. 2.5 M ha forest saved from deforestation	

Table A-2: List of New Outcome Case Studies from This Reporting Year (Sphere of Influence)

[Please complete the following table to share any outcome case studies generated in this reporting year (expected numbers are in the region of 2-5 per CRP). Please provide links to long-term expected outcomes and impacts, and indicate relevant sub-IDOs. Explain why this was considered a successful outcome case and mention any cross-cutting dimensions explicitly, if any.]

Title of outcome case study	No. of Sub-IDO	Links to evidence	Space for additional, very brief details, including on cross-cutting issues
implementing satellite remote-sensing technology to provide rice monitoring information for crop insurance application in Tamil Nadu, India	A1.4 C1.1	RIICE -Satellite technology expedites insurance payouts in India's crop insurance programme	Through an effective public-private partnership collaboration, IRRI under the RIICE project accomplished the project goal of strengthening NARES partners with the technical know-how to generate satellite-based rice monitoring information needed by the State Department of Agriculture in Tamil Nadu, India and effectively influence key stakeholders involved in the implementation of Pradhan Mantri Fasal Bima Yojana (PMFBY) crop insurance program in this southern Indian state to accept the satellite-based technology as the key source of information for assessment of drought affecting small holder rice growers in the state.
Impact assessment of improved rice varieties in 16 Sub-Saharan African countries	2.1.2 3.3.2 C1 D1	https://www.sciencedirect.com/science/article/pii/S2211912416300700	Impact of NERICA adoption on rice yield was estimated at 320 kg/ha and the adoption of NERICA increased the rice production by 897 kg per household. The gains in yields and production of paddy for adopters of other improved rice varieties were estimated at 431 kg ha–1 and 1070 kg, respectively. About 8 million persons in 16 Sub-Saharan Africa countries were lifted out of poverty due to the adoption of improved rice varieties and 7.2 million people have been lifted out food insecurity.
Analyzing the pathways to food and nutrition security in Sub-Saharan Africa (SSA)	2.1.2 3.3.2	https://www.ifpri.org/project/global-futures-and-strategic-foresight	This outcome case study is expected to be submitted to Global Food Security Journal (Gbegbelegbe, S., Alene, A., Chan, C.Y., Diagne, M., Enahoro, D., Fiamohe, R., Kikulwe, E., Marshall, M., Swamikannu, N. , Tesfaye, K., Thomas, T. 2017. Pathways to food and nutrition security in sub-Saharan Africa). This work is done in collaboration with IFPRI through PIM CRP and is under review for publication

Establishment of monitoring network with FLAR	1.3.2 1.4.2 1.4.3 3.3.2 C1 D1	http://ciat.cgiar.org/global-partnerships/flar/.	The monitoring network established with FLAR has collected successfully information on the adoption of improved rice varieties and average rice yields across Latin America. This information has been crucial to establish the foundations of an economic rice observatory for Latin America and the Caribbean expected to be functional by mid-2018
Trade-offs in Achieving Food and Nutrition Security at Global and Regional Scales	2.1.2 3.3.2 A1 C1 D1	https://www.ifpri.org/project/global-futures-and-strategic-foresight	This work was done in collaboration with IFPRI through the PIM CRP. The study discusses trade-offs between agricultural productivity and environmental costs needed to achieve food and nutrition security at global and regional Scales. This work is under review for publication
NARES partners equipped with technical know-how to operate satellite-based rice monitoring system in the Philippines	A1.4 C1.1	PRISM https://www.riceinfo.ph/	IRRI and sarmap successfully equipped PhilRice and Philippines Dept. of Agriculture Regional Field Officers with technical know-how on utilizing satellite and ICT-assisted ground data collection for nationwide rice monitoring system, complementing the existing information generated using conventional methods.
NARES partners equipped with Rice-pulse monitoring system in Odisha, India	C1.1	PRISM https://www.riceinfo.ph/	IRRI-Odisha project funded by Odisha Sate Government equipped Dept. of Agriculture districts officers, academic institution and other stakeholders with technical know-how on utilizing mobile application based technology to monitor rice-pulse monitoring system.
Adoption and impact of alternate wetting and drying (AWD) water management for irrigated rice production in the Philippines (Rejesus et al. 2017, final report to SPIA)	3.1, 3.2		Demonstrated water savings from of 11-17% at the field level and 22-33% at the irrigation turnout level, and GHG emissions reduction at 10% (Rejesus et al., 2017).
Competitiveness of Philippine Rice in Asia (Bordey et al., 2016)	1.1, 2.1	http://www.philrice.gov.ph/wp-content/uploads/2016/08/Book_CPRA_22June2016_3.pdf	Demonstrated widespread adoption of improved varieties, improved seed quality, and improved fertilizer management practices in Philippines, Thailand, China, Vietnam, Indonesia.
Inclusiveness of contract farming in rice value chain upgrading in Vietnam	Improved access to financial and other services	Article under review in *Journal of Development Studies*	As 92% of the surveyed farms were male-headed, which can be interpreted as a gender bias in itself, we were not able to find any gender bias in inclusiveness of contract farming participation.

Impact and adoption of Rapid Generation Advance in rice breeding by NARES partners	Increased capacity for innovation in partner research organizations	Articles forthcoming in *PloS ONE* and *Agriculture & Food Security*	Three gender gaps were identified in rice breeding around the world as (i) 78% of globally surveyed breeders are male, (ii) a majority of male breeders have a PhD and a third only an MSc degree, while this balance is reversed for female breeders, and (iii) female breeders who are head of their department dispose of only one third of the budget their male counterparts dispose of. Finally, the ages of the rice breeders ranged from 28 to 73 with a mean of 45 years.
RiceAdvice	2 (Closed yield gaps through improved agronomic and animal husbandry practices; More efficient use of inputs)	Rice Today MELIAG meeting in Sept 2017	In addition to links in left side, RiceAdvice and Rice Crop Manager were selected as good practices in e-Agriculture call for good and promising practices in 2017. Publication is in process. 460 agricultural knowledge service providers were trained in use of RiceAdvice in 2017 (unpublished data). 15 and 54% of them were female and youth, respectively.

*Please submit outcome case studies in MARLO, MEL or other MIS, and provide links, using the outcome case study template.

Table B: Status of Planned Milestones

[Please include the status update on the planned milestones (i.e., complete, extended or cancelled). If completed, please include evidence; if extended or cancelled, please provide a rationale.]

FP	Mapped and contributing to Sub-IDO	2022 Outcomes	Milestone = outcome progress markers/ output use	2017 milestones status (Complete, Extended or Cancelled)	Provide evidence for completed milestones or explanation for extended or cancelled
1	Increased capacity for innovation in partner research organizations	Foresight analyses and priority setting used by RICE and partner scientists to develop and target technology options	Updated rice supply-demand scenario analyses, horizon scanning, and target domains for RICE technologies identified or refined (rolling plan)	Complete	Global rice statistics updated and available through portals such as the World Rice Statistics and Osiriz, which also provided interpretations and analyses of the global and regional rice markets, including monthly bulletins on African rice agriculture. Establishment of monitoring network with FLAR The Future Rice Strategy for India (book) implementing satellite remote-sensing technology to provide rice monitoring information for crop insurance application in Tamil Nadu, India Analyzing rural transformation to understand the future of cereal-based agri-food systems. NARES partners equipped with technical know-how to operate satellite-based rice monitoring system in the Philippines NARES partners equipped with Rice-pulse monitoring system in Odisha, India
1	Improved capacity of women and young people to participate in decision-making	Improved role in decision making by women and youth in rice value chains as evidenced by empowerment	Measures of women empowerment quantified using RICE baseline data at key action sites study on youth's	Complete	See section 1.3.1 for full overview. Women's empowerment and gender equity in agriculture: A different perspective from Southeast Asia.

<table>
<tr><td></td><td></td><td>measures at key action sites</td><td>role in decision making initiated</td><td></td><td></td></tr>
<tr><td>1</td><td>Increased capacity for innovation in partner development organizations and in poor and vulnerable communities</td><td>Well functioning multistakeholder platforms for innovation at six action sites (Bangladesh, India, Nepal; Nigeria, Senegal, Tanzania)</td><td>10% of key regions have at least one functional multi-stakeholder platform at key action sites</td><td>Complete</td><td>Contributed to Guidelines for innovation platforms

The Bangladesh coastal zone platform was established with multiple national, international, and public and private sector partners.

AfricaRice joined Sustainable Rice Platform (SRP), which is co-convened by UN Environment and IRRI. SRP standard and indicators are now under revision. AfricaRice evaluated SRP standard in Nigeria.</td></tr>
<tr><td>1</td><td>Enhanced individual capacity in partner research organizations through training and exchange</td><td>New cadre of young, well-trained scientists - 30% women - engaged in rice research</td><td>250-300 scholars (30% women) enrolled in advanced degree training (bachelors, masters, PhD)</td><td>Complete</td><td><table><tr><th>Scholar type</th><th>Female</th><th>Male</th><th>Total</th></tr><tr><td>BS</td><td>89</td><td>69</td><td>158</td></tr><tr><td>MS</td><td>45</td><td>40</td><td>85</td></tr><tr><td>PhD</td><td>71</td><td>75</td><td>146</td></tr><tr><td>Other</td><td>78</td><td>74</td><td>152</td></tr><tr><td>Total:</td><td>283</td><td>258</td><td>541</td></tr></table></td></tr>
<tr><td>1</td><td>Increased capacity of beneficiaries to adopt research outputs</td><td>Effective public and private delivery systems for seeds of improved rice varieties in six countries (Bangladesh, India, Nepal; Nigeria, Senegal, Tanzania)</td><td>Assessment and validation of improved seed multiplication & delivery systems for enhanced adoption of rice varieties in India, Bangladesh and Nepal</td><td>Complete</td><td>A total production of 3,662 tons of seeds, including 32 tons of breeder seed, 689 tons of foundation seed, and 2,940 tons of certified seed, was reported in 2017 from Benin, Burkina Faso, Ethiopia, Ghana, Guinea Conakry, Mali, Rwanda, Senegal and Sierra Leone A total of 31 new varieties were released in Burundi (4), Ethiopia (4), Ghana (6), Nigeria (2) and Senegal (15). SARD-SC Project Reports

Nearly 35,000 farmers were directly linked to quality seed production process by making them part of seed production linked demonstrations. About 30% of them were women. Also, 8,000 farmers were made part of dealer led varietal demonstration, having a great potential for linkages towards seed delivery chain. About 3,000 farmers were trained</td></tr>
</table>

					on quality seed production at key action sites. The 35,000 farmers trained quality seed producers are expected to strengthen the supply chain of quality seed production by ensuring the spread and adoption of the new and quality seeds in both formal and informal chain.
1	Increased capacity of beneficiaries to adopt research outputs	Impacts and adoption of RICE technologies assessed	Adoption and impact studies on NRM technologies and/or varieties - rolling plan based on progress of technologies along the impact pathway	Complete	See sections 1.1 and 2.5 and Table I-1 of this report for full overview and references/links.
1	Increased capacity for innovation in partner research organizations	Functional and effective results-based management system for RICE and its partners	Annual updates of progress and performance indicators reflective learning workshops commissioned reviews and evaluations (rolling plan)	Partially complete	Baseline report with key outcome indicators for Asia was developed based on household surveys from 2010-2016. Harmonization of methods, approaches and tools for computing RICE progress indicators RICE MELIAG (Monitoring, Evaluation, Learning, Impact Assessment, Gender) Workshop, 4-5 September, 2017, Bangkok, Thailand. No commissioned evaluations since 2017 was first year of second phase of RICE.
2	Diversified enterprise opportunities	Diversified enterprise opportunities through upgraded value chains at six action sites (Indonesia, Myanmar, Vietnam; Cote d'Ivoire, Nigeria,	Upgrading strategies developed with partners for increasing value capture by actors in two action sites	Complete	Restructuring the Vietnamese Rice Sector: Towards Increasing Sustainability, Demont and Rutsaert, 2017. What is the Value of Rice Fragrance? Consumer Evidence from Senegal. Diagne, M., Demont, M. & Ndour, M. 2017. Developing a framework of gastronomic systems research to unravel drivers of food choice. Cuevas, R., De Guia, A. & Demont, M. 2017.

		Tanzania)			
2	Improved access to financial and other services	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)	Existing value chain services, finance options, and constraints identified at two action sites	Extended	Agossadou et al. in prep (Unpublished observations & Conference paper for Nigeria); Technical report & Data base available for Nigeria and MSc student dissertation available for Tanzania The work for Cote d'Ivoire will contribute to the Milestone which will be achieved in 2018
2	Reduced pre- and postharvest losses	Income by value-chain actors increased by 15% through adoption of at least one of the postharvest or value addition practices or technologies at six action sites (Bangladesh, Cambodia, Indonesia; Benin, Cote d'Ivoire, Nigeria)	Baseline surveys conducted and entry points for loss reduction/value addition identified	Extended Activities in Bangladesh delayed due to budget cuts in FP2. Flat bed dryer adoption increasing in South Sumatra, Indonesia Field drying / stacking eliminated in MyRice project sites in Myanmar.	GEM parboiling has been demonstrated on fewer sites than expected (Benin = 4 over 15), Cote d'Ivoire (1 over 4), Nigeria (3 over 12). The equipment has already been fabricated and demonstration and training will continue in 2018; Mapiemfu et al. 2017 MyRice evaluation report. In progress

				Utilizing pop-rice technology to prevent losses during rice husking and milling, especially in Africa	
2	Increased value capture by producers	Functional value chains for improved processing and novel products from rice at six action sites (Bangladesh, Cambodia, Indonesia; Benin, Cote d'Ivoire, Nigeria)	Rice varieties with potential for novel product development for Asia screened and markets identified for rice by-products in two action sites	Extended Business models for rice straw mushroom production transferred from Vietnam to Cambodia. Initial uptake by Cambodian farmers. Straw baling business model transferred from Vietnam to Cambodia. Kuai chap production can be improved through	Ndindeng et al. 2018 (under review) Zohoun et al. 2018 (Accepted); Zohoun et al. 2018 (under review); Due to relocation to Cote d'Ivoire, this milestone was not completed but it is on-going. BMZ project report BMZ project report

				elucidation of their processing.	
3	Enhanced capacity to deal with climate risks and extremes	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)	Farming systems analyses platform established within RICE and with other CRPs at six key action sites (Cote d'Ivoire, Madagscar, Indonessia, Bangladesh, Myanmar)	Complete	CIRAD, NARIs, and AfricaRice were involved in SPAD in Madagascar. JIRCAS, CIRAD, and AfricaRice established good working relationship for farming systems research in central highlands of Madagascar. RICE and RTB jointly organized workshop on farming systems research, and initiated farming systems survey in Central Africa. IRRI and AfricaRice, which have long-term trials in the Philippines and Senegal, respectively, joined workshop on global long-term trial network. Rothamsted and AfricaRice jointly analyzed plant and soil samples, and have developed plan to change treatments in existing long-term trial. AfricaRice and WU jointly conducted farming systems survey in Senegal. One MSc student from WU was supervised. Platform was established in Bangladesh among IRRI, KSU, BRAC (IRRI, 2017. Unlocking the production potential of "polder communities" in coastal Bangladesh through improved resource use efficiency and diversified cropping systems. Technical Report submitted to the Kansas State University, USA.) Public and private sector platform established for including sustainability incentives in the rice sector in Vietnam (Demont & Rutsaert, 2017) IRRI worked with the FISH CRP on establishing rice-fish system research. in Myanmar
3	Closed yield gaps through	Improved management	Baseline rice yield gap quantified, and	Complete	Six papers on yield gap analysis were published in Africa (Niang et al., 2017, 2018; Paresys et al., 2018; Saito et al., 2017; Tanaka et al., 2017;

	improved agronomic and animal husbandry practices	practices that reduce yield gap by 10-15% developed and disseminated at eight action sites (Nigeria, Senegal, Tanzania, Madagascar, Vietnam, Indonesia, Bangladesh, Myanmar)	constraints and opportunities identified at eight key action sites		van Oort et al., 2017). Country-level yield gaps were quantified in Cote d'Ivoire, Egypt, Madagascar, Rwanda, and Senegal, and will be added to Global Yield Gap Atlas. Yield gaps and constraint and opportunities in Southeast Asia were already reported in 2016. Baseline yield gaps and constraints were quantified in Bangladesh, Thailand, Vietnam, Indonesia, Myanmar, Sri Lanka, and China (Guangdong Province) (IRRI, 2017, CORIGAP Annual Report to SDC; Stuart et al., 2018; IIRRI, 2017. Unlocking the production potential of "polder communities" in coastal Bangladesh through improved resource use efficiency and diversified cropping systems. Technical Report submitted to the Kansas State University, US)
3	Technologies that reduce women's labor and energy expenditure developed and disseminated	Value chain actors including farmers and service providers using new mechanization options designed to increase women's labor productivity at seven action sites (Nigeria, Senegal, Tanzania, Vietnam,	Benchmark indicators established for women farmers' labor use at seven action sites	Complete	Women and men farmers' labor use was quantified in Cote d'Ivoire and Madagascar (some results are available in this report on gender section). Social impact indicators of SRP including Women empowerment and labor requirements were revised and shared with SRP members. SRP standard study in Nigeria assessed requirements for SRP standard, and the result showed that child labor and labor rights are major issues, followed by safety and health issues.

		Indonesia, Bangladesh, Myanmar)			
3	Reduced net GHG emissions from agriculture, forests and others forms of land use	Improved rice management practices that reduce GHG by 5% disseminated at three action sites (Bangladesh, Philippines, Vietnam)	GHG emissions and carbon capture benchmarked at three action sites	Extended	Achieved in two out of three target countries, in collaboration with CCAFS: • Philippines: Rejesus et al., 2017, Adoption and impact of alternate wetting and drying (AWD) water management for irrigated rice production in the Philippines), a final report submitted to the Standing Panel on Impact Assessment (SPIA). • Bangladesh: http://ccacoalition.org/en/news/farmers-northwestern-bangladesh-learn-grow-climate-friendly-rice • Vietnam: extended to 2018
3	Increased livelihood opportunities	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)	Baseline farming system description completed at six action sites	Completed, and extended for more analyses	A paper on farming systems analysis was published in Africa (Paresys et al., 2018). Farming systems surveys were conducted in Madagascar, Rwanda, and Senegal. Preliminary study in Madagascar identified positive relationship on farm size, revenues and level of crop diversification, and key important crops for farm diversification in both lowlands and uplands. We could not finalize data collection and analysis in all the countries in Africa due to delayed implementation of farming systems survey. Thus, this milestone will be extended to 2018. The reasons for delayed implementation was due to the fact that AfricaRice and other partners (RTB, World Vegetable Center, WU) spent a lot of time discussing content of the survey and developing survey protocols. Baseline farming descriptions were completed for parts of India (Bihar, Eastern Uttar Pradesh), Bangladesh, and Myanmar. Unlocking the production potential of "polder communities" in coastal Bangladesh through improved resource use efficiency and diversified cropping systems. Technical Report submitted to the Kansas State

					University, USA.
3	Increased capacity for innovation in partner research organizations	Increased capacity for innovation on sustainable farming systems in partner research organizations	Capacity development needs on sustainable farming systems identified among partner research organizations	Partially complete (in Africa)	Expert survey was conducted in Africa, and data were analyzed. Key interventions that will help strengthening capacity on farming systems research were financial support, training, and information sharing.
4	Enhanced capacity to deal with climate risks and extremes	Predicted global rice production risks used to guide development and targeting of climate change-adapted technologies at least for the most vulnerable rice agroecosystems	Global array delimited, baseline information including gender mapping (FP1) and historic climate and crop performance data gathered for crop-model assisted constraint mapping (current scenario) Four sites identified in South Asia; 4 sites identified in Southeast Asia; 4 sites identified in China Three sites identified in Africa Three sites identified in Latin	Completed CIAT Partly achieved (publication pending), importation of antenna panel underway	The draft protocol for the Antenna and Reference population was developed and shared with all the partners for their comments. Target sites in SA, SEA, China, Africa and LA are identified for the GRA panels. Zwart SJ et al. Future rice climates in Africa. Rice Today IRRI. June 10 2017 Van Oort and Zwart. Impacts of climate change on rice production in Africa and causes of simulated yield. Global Change Biology. DOI:10.1111/gcb.1396 https://dataverse.harvard.edu/dataverse/AfricaRice?q=pepijn Publication of the baseline information underway (work funded by a consultancy for the European Commission).

			America Seeds of reference populations transferred to action sites in Asia		
4	Enhanced genetic gain	A functional global phenotyping network composed to 30% by non-CRP partners (including self-sponsored), and genetic donors (>10) and ideotypes (2-4) adopted by breeding programs to develop climate-smart rice varieties	(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 AfricaRice Existing HTP field-based and specialized platforms upgraded and 20% of phenotyping sites managed by NARES	In process as formal seed importation, multiplication and dispatch take a long time. Testing sites would be fully functional in 2018.	1. Antenna Panel is finalized through global consensus with participating institutions like IRRI, CIAT, AfricaRice, CIRAD and JIRCAS. 2. Seed import from contributing organizations is a big challenge but we have obtained seed of about 60 genotypes including those cleared by the IRRI Seed Health Unit (SHU) and the Philippine Bureau of Plant Industry (BPI). 3. MAGIC – Indica population will be used as reference population but discussion is going on for future reference panel. 4. Antenna panel shared with 7 locations for 2018 DS [IRRI-HQ (1), India (2), Myanmar (1), Vietnam (1), Bangladesh (1) and Burundi (1)]. 5. Some of the national partners are investing in the GRA (ICAR-India). Has procured 2 drones setup in India for HTP. Training on drone-based HTP is planned in 2018 by IRRI expert to support the project's efficiency. Target sites are operational but due to limited funding no NARES site was included. Phenotyping/screening facilities are being upgraded in Mbe http://onlinelibrary.wiley.com/doi/10.1111/pbi.12675/full http://onlinelibrary.wiley.com/doi/10.1111/pbi.12731/full; https://www.sciencedirect.com/science/article/pii/S0924271617300357

			identified in 4.1)		
4	Enhanced capacity to deal with climate risks and extremes	Characterized pathogens populations and diversity used to predict varietal deployment for at least 3 major rice diseases	Spatial distribution of pests and diseases and deployment of available isolines completed in at least 60% of the target sites	AfricaRice Extended IRD achieved	Delay was due to the relocation from Cotonou to Bouake. Will be considered as a 2018 milestone - Design of VNTR primers for *Burkholderia glumae* typing, and validation on a collection of strains isolated in Colombia - Design of an MLVA scheme for *Pantoea* species - Development of multi-pathogen molecular detection tools - Intensive field work in six sites from southwestern Burkina Faso in ca 45 farmer's fields with farmer's interviews (rice variety and agricultural practices) and detailed epidemiological data for RYMV, bacterial leaf streak (BLS) and brown spot - Assays (three varieties, two agricultural practices treatments) in two sites with detailed symptom data for viral, bacterial and fungal diseases, nematodes and insects - Upgrading RYMV core collection (serotyping of 150 isolates from Bénin, Togo, Niger, Mali, Ghana and Nigeria) and sequencing of 35 isolates - Nematode survey in Vietnam, Philippine and Cambodia. A core collection and cryo-conservation of rice parasite nematodes was built. Mitochondrial genome was sequenced from these populations to assess their diversity. Publication by Ma et al. 2018. in Nematology (2018) - Field survey in Vietnam (Hai Duong) in highly nematode infected fields due to agricultural change practices: Description of the microbiome, soil and cultural practices to reveal major factors that should explain the parasitism - Building of a large collection of bacterial rice endophytes from Senegal, Burkina-Faso and Vietnam (>2000 isolates), characterized at taxonomic level (16S sequencing) and screen for in vitro plant-growth properties. - First RNAseq data of the transcriptomic response of the Rice Nipponbare (roots, leaves) to the colonization by two bacterial endophytes, has been produced and is being analyzed for publication.
4	Enhanced genetic gain	At least 5 major QTLs/genes that are stable across	Genomic information obtained for	Achieved	Availability of the genotypic data for the MAGIC indica population was confirmed (see details for FP4 in section 1.2).

		environment and management, for all four mega rice environments, are integrated in the respective varietal development pipelines	populations to be phenotyped in CoA 4.2		Publication of NSC promising QTls underway - SNiPlay workflows for diversity, population structure analysis and GWAS studies was achieved (http://sniplay.southgreen.fr/) -A Common Galaxy Rice instance integrating Reusable workflows for rice genomic and genetic analyses has been developed (http://galaxy.irri.org/ and http://13.250.212.83/) - An R package dedicated for rice gene functional annotation has been developed (collaboration with Dr Ho Bich Hai).
5	Increased conservation and use of genetic resources	Rice diversity in rice gene banks used globally for identification of traits and discovery of new genes	5-10 donors/genes achieved from GRiSP in use by breeding programs. Screening of of 100 accessions from 3 K panel each year to identify 2-3 donors for different traits (biotic, abiotic) initiated; Description of within group diversity for basmati group. Fine mapping of 1-2 root development genes	Completed	At IRRI- 422 entries screened for stagnant flooding with 10 tolerant types found. Initial GWAS accomplished. 2190 genotypes screened for seedling stage salinity with 12 tolerant genotypes identified. Reproductive stage salinity screening is on-going, 663 genotypes screened for zinc deficiency identifying 4 tolerant genotypes. 100 genotypes screened for drought, blast and blb identifying several donors per trait. 800 indica lines screened for leaf water potential, 100 selected for further evaluation. All 3K genotypes examined for mutations in EIF4G with 12 potential resistance alleles in 271 genotypes for RTSV, 90% confirmed by phenotyping. Lines possessing horizontal resistance for blast identified at IRRI, new donors for sheath blight possessing partial resistance identified at IRRI. Photosynthetic and leaf morphology measurements taken on 400 indica lines. 30 contrasting entries chosen for screen house phenotyping. zinc/Iron grain content evaluated for HDRA aus panel (250 entries), several donor lines identified and with significant GWAS peaks. Confirmatory evaluation is on-going. At JIRCAS-12 Indonesian donors/recipient screened for tolerance to Iron toxicity.
5	Increased conservation and use of genetic resources	Novel tools for precision biotech breeding based on genetic diversity shared open access and	Based on GRiSP results, analysed and identified new breeding tools and resources for precision breeding,	Completed	At IRRI- 1k Amplicon panel now available as GSL service (http://gsl.irri.org/genotyping/rice-custom-amplicon-1k) and manuscript nearly completed. At CIAT-The second major version of MapDisto was released, with several new major features: (i) handling of very large genotyping datasets like the ones generated by GBS; (ii) direct importation and conversion of Variant Call Format (VCF) files; (iii)

		globally	gene editing, genomic selection, breeding simulations, candidate genes (20), markers (16)		detection of linkage, i.e. construction of linkage groups in case of segregation distortion; (iv) data imputation on VCF files using a new approach, called LB-Impute. Features i to iv operate through inclusion of new At CIAT, Java modules that are used transparently by MapDisto; (v) QTL detection via a new R/to graphical interface. The version 2 beta 109 of MapDisto now provides a tool to calculate local recombination values using a sliding window and smoothing methods, and to display Marey maps. It handles recombinant inbred lines populations, and therefore handles NAM data. Download is available at http://mapdisto.free.fr. 22 NAM recombinants around one major QTL for resistance to Striga hermonthica (collaboration with Julie Scholes, University of Sheffield, UK) as well as recombinants around two new QTLs for secondary branching rate in panicles, contrasting between indica and japonica (publication in preparation) were identified. Release of MapDisto v2 (gene /QTL mapping tool) with several new major features suitable for large genotyping datasets and QTL detection in recombinant inbred lines populations and NAM populations. Download is available at http://mapdisto.free.fr. - Application for precision breeding around 2-3 candidate QTLs of interest by the identification of NAM recombinant lines.
5	Enhanced genetic gain	New rice varieties resulting in 1.3 % genetic gain in intensive systems	Upgraded breeding programs; and 10-15 lines from GRiSP with 5% higher yield nominated for release	Completed	More than 10 lines from GRiSP nominated for release by national partners. Rice varieties from FLAR germplasm released in LAC MARIEN FL (Dominican Republic) include-IDIAP FL 72-17 (Panama), ESTRELLA FL 161 (Panama), FL FEDEARROZ Orotoy (Colombia), FL FEDEARROZ Itagua (Colombia), INIAP FL Arenillas (Ecuador). At AfricaRice- 6 irrigated lowland varieties were released in Senegal including ARICA 12, AR051H (hybrid), WAS 73-B-B-231-4, IR 72593-B-3-2-3-8-2B, 08 FAN 10, WAB 2098-WAC3-1-TGR2-WAT 85, FAROX 521-288-H1. At IRRI two varieties- Musesekara, Kazogi in Burundi and NSICRc 508 in Philippines were released
5	Enhanced	Rice varieties	Upgraded breeding	Completed	New breeding lines with high yield and at least 10% reduced loss under

	adaptive capacity to climate risks	with 20, 15, 10% reduction in yield loss caused by factors induced by climate change, in mega deltas, rainfed lowlands, and uplands, respectively	programs; 10-20 lines from GRiSP with 5-10% higher yield nominated for release; validated traits/donors/genes for single tolerance of submergence, stagnant flooding, salinity, high/low temperatures, iron toxicity, low soil fertility, drought, and blast; 5-10 first-generation stress-tolerant varieties from GRiSP released		drought, submergence, salinity developed for mega deltas. At AfricaRice- for stagnant flooding - 495 F5 lines screened and 280 lines advanced to F6; 110 F6 lines screened and 70 lines advanced to F7, for drought- 543 F4 lines screened and 185 advanced to F5; 115 F5 screened and 25 lines advanced to F6, for Iron-toxicity - 280 F6 lines screened and 170 lines advanced to F7.
5	Increased access to diverse nutrient rich food	High quality and high nutritious rice varieties that are preferred by men and women farmers and consumers	Consumer values estimated for grain quality traits and food products	Completed	Consumer and market oriented product profile developed for different breeding zones in South Asia, South East Asia and East and Southern Africa. At IRRI- product profile for 26 breeding zones for 17 countries developed, At AfricaRice- product profile for 20 countries developed- Burkina Faso, Cameroon, Cote d'Ivoire, DR Congo, Ethiopia, Gabon, Ghana, Kenya, Malawi, Mali, Morocco, Nigeria, Rwanda, Sudan, Uganda, Tanzania, Zambia, Zimbabwe, Madagascar, Guinea.
5	Increased conservation and use of genetic resources	Prototype C4 rice lines with increased yield potential available	25 genes validated for C4 photosynthesis	Partially completed	Development of transgenic lines with 10 genes under progress. During 2017, selection of homozygous lines with 10 genes are underway.

* Milestones include both outputs, output use and outcomes along the impact pathways.

** Provide link to any relevant open accessible document.

Table C: Cross-cutting Aspect of Outputs

[Please present % of outputs with principal (scored 2), significant (scored 1), and not targeted (scored 0), for gender, youth and capacity development and total overall number of outputs]

Cross-cutting	Number (%) scored 2 (Principal)	Number (%) scored 1 (significant)	Number (%) scored 0	Total overall number of outputs
Gender	9 (13)	31 (46)	27 (40)	67
Youth	7 (10)	23 (34)	37 (55)	
CapDev	7 (10)	33 (49)	27 (40)	

Table D: Common Results Reporting Indicators

Table D-1: Key CRP Results from 2017, in Numbers

[Please complete the table on the common reporting indicators below. See instructions in separate guidance in the common results indicators manual (available early 2018). Please note that supporting evidence must either be uploaded to an MIS system (MARLO, MEL or others) or keep evidence on file for possible checking.]

Sphere	Indicators	Data	Comments
Influence	I1/I2*. Projected uptake (women and men) /hectares from current CRP investments (for innovations at user-ready or scaling stage only – see indicator C1)	2.7 million hectare under improved rice technologies globally/year; taken up on 2.7 million farms by 5.4 million men and women (50%) farmers.	The computations to estimate the adoption rate of new RICE technologies is provided in detail in Annex 16 of the full RICE proposal. With an originally estimated annual budget of 100 million $, adoption rates were estimated at 3.6 million hectares/year. The total RICE budget in 2017 was around 75 million $, so we downscaled our estimated impact to 2.7 million hectares in futures years (due to the research-adoption time lag). With a global-average farm size of 1 hectare, these technologies are adopted on 2.7 million farms. Since usually both male and female household partners are involved in rice production, it can be estimated that this benefits 2.7 million women farmers and 2.7 million men farmers.
	I3. Number of policies/ investments (etc) modified in 2017, informed by CGIAR research	6	1. Siem Reap, Cambodia (9–10 June 2017) - Two more countries have joined a regional seed policy agreement that speeds up the distribution of modern rice varieties across nations in South and Southeast Asia. This agreement was formalized during a meeting of agriculture ministers and representatives of nine countries, titled "Seeds without Borders: Regional cooperation for seed-sharing," on 9-10 June at Siem Reap 2. The regional agricultural policy on rice in West Africa 3. Institutionalization of PRISM within the Philippine Department of Agriculture. Administrative Order signed by Department of Agriculture Secretary creating PRISM unit within PhilRice. 4. National investment informed by RICE research: Philippine Rice Road Map 5. National investment informed by RICE research: Small Farm Large Field programs in Vietnam and Myanmar

			6. National investment informed by RICE research: GHG-NAMAs in Thailand and Vietnam
Control	C1. Number of innovations by phase - new in 2017	13 innovations at proof of concept 7 piloted successfully 17 available for uptake (includes policy recommendations) 18 taken up by next users (includes policy change), see Table D-2	Data summarized over Table D-2 below, and including policies listed above under indicator I-3.
	C2. Number of formal partnerships in 2017, by purpose (ongoing + new)	254 research partnerships 18 policy partnerships 91 delivery partnerships	Detailed records can be accessed here. (http://www.grisp.net/file_cabinet/folders/265913) The listed partnerships include the partners with whom the six RICE Centers have a formal agreement (letter of agreement, memorandum of agreements, etc). The number of subcontracted partners in target countries is substantial (leading to a total of 600-900 partners in RICE) but included. Partner information is extracted from center management systems such as OCS and hence does not originally contain the requested specifications in terms of partner type. Based on a survey of partner names listed, the following percentages of the total number of partners were used to estimate the categories: research: 70%; policy: 5%; delivery 25%. Most of the subcontracted partners fall in the category delivery partners.
	C3. Participants in CGIAR activities 2017 (new +ongoing)	46,682 'end-users' (54% women) in on-farm trials, farmer field days and	Detailed records can be accessed here. (http://www.grisp.net/file_cabinet/folders/265913) A list of total participants in all events (through the six RICE coordination centers) is

		similar 11,671 'next users' (54% women) in innovation platforms, policy workshops and similar	compiled for RICE from individual center contributions, in which distinction is not originally made between 'participants in CGIAR activities' and 'short term trainings' and the categories 'end users' and next users'. From a survey of the listed event titles, we estimated that 60% of total participants can be classified as end users and 15% as next users in CGIAR activities, and 25% as short term trainees.
	C4. People trained in 2017	Long term (new + ongoing): 541 (52% Women) Short term: 19,451 (54% women)	Detailed records can be accessed here (http://www.grisp.net/file_cabinet/folders/265913) See comment above.
	C5. Number of peer-reviewed publications	392 in 2017 of which 229 (58%) are openly published	A full publication list can be accessed here (http://www.grisp.net/file_cabinet/folders/265913)
	C6. Altmetrics	New indicator being introduced in 2018 – details tbc	

*Please note: I = Sphere of Influence and C = Sphere of Control

Table D-2: List of CRP Innovations in 2017 (From indicator #C1 in Table D-1)

[Please list all innovations which entered phases AV (available for use) and/or USE (uptake by next users) in 2017. If you wish to highlight a couple of new and exciting innovations in phases PC (proof of concept) and PIL (successful pilot), then these can be added (OPTIONAL). See instructions in separate guidance in the common results indicators manual (available early 2018)].

Title of innovation (minimum required for clarity)	**Phase of research ***	**Novel or adaptive research**	**Contribution of CRP (sole, lead, contributor)**	**Geographic scope: for innovations in phases AV* or USE* only (one country, region, multi-country, global)**
RiceAtlas, A spatial database on the seasonal distribution of the world's rice production	USE	Novel	lead	global
Satellite-based rice monitoring	USE	adaptive	lead	Multi-country: Philippines (PRISM, www.riceinfo.ph) Cambodia, Vietnam (RIICE, www.riice.org) India: Odisha, Andhra Pradesh
Framework for gastronomic systems research (Cuevas et al., 2017)	AV	Novel	Lead	Global
Mini-GEM for rice parboiling in Africa. Mini-GEM is a combination of GEM (Ndindeng et al. 2015) and top-lit up draft rice husk gasifier for rice parboiling	PIL	Adaptive	Lead	Rice parboiling communities in sub-Sahara Africa
Production of rice with weak digestive properties using GEM steaming time and variety interactions.	PC	Novel	Lead	Global
Solar Bubble Dryer Version 2	PIL	Adaptive	Contributor	All rice growing countries with need for drying at village level
GrainSave™ Dry	PC	Adaptive	Contributor	AV: Initial - India, Myanmar, all countries where we have postharvest collaboration
Pop-rice	PC	Novel	Contributor	Asia
Yield trends predictions in relation to climate variation and adaptive traits	PC	Novel	Contributor	Region

Stress maps for Africa	AV	Novel	Sole	Region
SNP-chips	USE	Adaptive	Contributor	Global
QTL for Anaerobic germination	PC	Novel	Sole	Global
Identification of new donors, QTLs and genes for biotic and abiotic stresses	AV	Novel	Lead- IRRI, CIAT, JIRCAS, AfricaRice	Global
Model for genomic prediction of line value	PC	Novel	Contributor- CIAT, CIRAD	Global
Genome editing using CRISPR/Cas9 as a technology to accelerate precision breeding	PC	Novel	Contributor- IRRI, CIRAD	Global
At IRRI- 1k Amplicon panel now available as GSL service (http://gsl.irri.org/genotyping/rice-custom-amplicon-1k). At CIAT-The second major version of MapDisto was released, with several new major features	AV	Novel	Contributor- IRRI, CIAT, AfricaRice, CIRAD	Global
Novel markers for BB (xa4, xa5, xa13, Xa21), blast (Pi9, Pita2), low chalkiness, submergence (sub1), drought (qDTY12.1, qDTY2.2, qDTY4.1) developed. 3 sets of 10 SNP trait marker sets now available globally through Intertek (http://gsl.irri.org/genotyping/trait-based-genotyping/10-snp-panel) at a price of $1.5 per sample including DNA extraction. At JIRCAS-KASP marker system established in-house.	AV	Novel	Contributor- IRRI, CIAT, CIRAD, AfricaRice	Global
More than 10 lines from GRiSP nominated for release by national partners.? Rice varieties from FLAR germplasm released in LAC MARIEN FL (Dominican Republic) include-IDIAP FL 72-17 (Panama), ESTRELLA FL 161 (Panama), FL FEDEARROZ Orotoy (Colombia), FL FEDEARROZ Itagua (Colombia), INIAP FL Arenillas (Ecuador). At AfricaRice- 6 irrigated lowland varieties were released in Senegal including ARICA 12, AR051H (hybrid), WAS 73-B-B-231-4, IR 72593-B-3-2-3-8-2B, 08 FAN 10, WAB 2098-WAC3-1-TGR2-WAT 85, FAROX 521-288-H1	USE	Adaptive	Contributor- CIAT, AfricaRice	Regional

More than 20 lines from GRiSP identified for release/released in different countries. At Africa Rice- The following varieties were released in 2017- FARO 66 and FARO 67 (Nigeria), NERICA8 (Burundi), Scrido17, Scrido006, ARCC16Bar21, WAB880-1-3-2 (Ethiopia), CRI-Dartey, CRI-Emopa, CRI-Mpuntuo, CRI-Aunty Jane, CRI-Kantinka (Nerica L-41), CRI-Oboafo (FAROX508), (Ghana),; at IRRI- Salinas 22, Salinas 23, Salinas 24 (Philippines), CSR49, CSR52, CR dhan801, Rajendra Neelam (India), Baghugunidhan1, Baghuguni dhan 2 (Nepal)	Use	Adaptive	Cotntributor- IRRI, AfricaRice	Regional
Novel tools to assess milling and cooking quality has been established and applied to screen the breeding material. Development of markers for amylose and amyopectin established. Novel glycemic index assessment techniques established.	AV	Novel	Lead- IRRI	Regional
Identified novel genomic regions that associate with starch-based properties of the rice grain using the genome-wide association study (GWAS) using 320 diverse indica accessions experimentally grown during the wet and dry seasons at IRRI and estimating percent amylose and amylopectin proportions using size exclusion chromatography (SEC). Identified a peak on chromosome 6 which collocated with the Granule Bound Starch Synthase I, a cloned major gene for amylose biosynthesis. The targeted association analysis within GBSSI resulted in identifying 3 important SNPs (intron/1st exon boundary, 6th exon and 10th exon) based haplotype which distinguishes wide range of amylose classes.	PIL	Novel	Contributor-IRRI	Global
High zinc rice germplasm employed to develop	AV	Adaptive	Contributor- IRRI, CIAT	Global

pre breeding material in high yielding background. Generation of new segregating lines (F4:6 generation) involving high zinc parental lines in progress. At CIRAD-- new segregating lines (110 F4) with nutritional values greater than 24 ppm (50% above the base line) - Four candidate lines selected by partner for variety release process in Bolivia, Nicaragua, Guatemala and Colombia. At least one QTL linked with high Zinc content and markers linked to it identified				
Development of transgenic lines with 10 genes under progress. During 2017, selection of homozygous lines with 10 genes is underway.	PC	Novel	Contributor-IRRI	Global
RiceAdvice (electronic and mobile rice management decision support system)	USE	Adaptive	Lead	Irrigated and rainfed lowland in sub-Saharan Africa
Micro-dosing fertilizer application for direct seeding	AV	Adaptive	Lead	Dibbled seeding in non-flooded conditions in poor soils in sub-Saharan Africa
Mechanical weeder (ring hoe) to establish uniform sowing conditions in sub-Saharan Africa	AV	Adaptive	Lead	Sub-Sahara Africa
RiceAdvice -weedmanager	PC	Novel	Lead	Global
No-tillage Rice based cropping system with stylosanthes cover crop managed by an efficient animal traction roller	PC	Adaptive research	Contributor	Africa
Automon (water-saving tech.)	PC	Novel	Lead	Multi-country (South and Southeast Asia)
Water governance (water-saving tech.)	PIL	Novel	Lead	Multi-country (South and Southeast Asia)
Safe alternate wetting and drying (AWD) protocol (water-saving tech.)	USE	Adaptive	Contributor	Multi-country (South and Southeast Asia)
Rice Crop Manager (RCM)	USE	Novel	Lead	Philippines
Crop Manager	USE	Novel	Lead	India
Nursery bed nutrient management	AV	Novel	Lead	India
Nutrient management after flood recedes	AV	Novel	Lead	region (SE Asia)
GHG Mitigation:	USE	Novel	Contributor	global

AWD included in IPCC guidelines				
GHG Mitigation: other crop management practices (straw, land prep) in IPCC guidelines	USE	Novel	Contributor	global
Climate change adaptation: Crop management recommendations for stress-tolerant varieties	AV	Adaptive	Lead	India, Bangladesh, Tanzania, Burundi
Climate change adaptation: Salinity monitoring system (in collaboration with CCAFS)	PIL	Novel	Lead	Vietnam
Climate change adaptation: Climate smart villages (in collaboration with CCAFS)	AV	Adaptive	Contributor	Vietnam, India
Remote sensing and real-time crop management	PC	Novel	Lead	Philippines, India
Ecological engineering with vegetables	PIL	Adaptive	Lead	Cambodia, Indonesia
Rice Doctor	USE	Adaptive	Lead	India, Philippines
SRP Standard	USE	Adaptive	Contributor	Global
SRP Performance Indicators	AV	Adaptive	Lead	South and Southeast Asia
Field Calculator	PC	Adaptive	Lead	Thailand, Vietnam
Learning Alliances	USE	Adaptive	Lead	Thailand, Vietnam, Philippines

* Phases: PC - proof of concept, PIL - successful pilot, AV - available/ready for uptake, USE - uptake by next users.

Table E: Intellectual Assets

Year reported	Applicant(s) / owner(s) (Center or partner)	Patent or PVP Title	Additional information *	Link or PDF of published application/ registration	Public communication relevant to the application/registration

** For patents, please indicate: (a) type of filling: provisional / non-provisional; national direct, national designated; multi-territory; (b) patent status: filled, pending, matured to non-provisional, discontinued, registered or lapsed; (c) application / registration; (d) date of filling; (e) Date of Registration; (f) Date of Expiry / renewal*
** For PVP, please indicate: (i) variety name, (ii) status, (iii) country; (iv) application/registration number, (v) date of filling, (vi) date of registration/grant; (vii) date of expiry/renewal, (viii) breeder and crop*

Detailed information related to patents and PVPs relevant to RICE is reported in the 2017 intellectual asset reports of AfricaRice, CIAT, and IRRI, and is not duplicated here.

Table F: Main Areas of W1/2 Expenditure in 2017

Expenditure area *	Estimated percentage of total W1/2 funding in 2017**	Space for your comments
Planned research: principal or sole funding source	25	• Developing a framework for establishing innovation platforms, competence and skills enhancement of innovation platform actors on technologies and entrepreneurship • The Future Rice Strategy for India, book published in 2017. (https://www.elsevier.com/books/the-future-rice-strategy-for-india/mohanty/978-0-12-805374-4) • Survey data analysis and computation of RICE progress indicators. Report on 2014 and 2016 surveys has been completed and will be published in 2018 • Impact of demographic rice transformation on future rice farming in Asia. The paper from this work has been submitted to "Outlook on Agriculture" • A Spatial Assessment of C4 Rice: A Novel Rice Technology to Secure Future Food Security in collaboration with IFPRI/PIM (Murty, MVR, Tao Li, Quick, WP, Mohanty, S., Setiyono, T., Wiebe, K.): This paper used ORYZA model to estimate the potential yield benefit of C4 rice over C3 rice across South and Southeast Asia during 2035-39, under with and without CO2 ambient increase scenarios • Impact assessment of DSR in India. This study has been published in Food Policy. Mishra, A.K., Khanal, A. R., and Pede, V.O (2017). Is direct seeded rice a boon for economic performance? Empirical evidence from India. Food Policy 7:10–18. • Evaluation of IRRI contribution to rice improvement in India • Impact of mechanization on welfare of marginalized people • Assessing the impact of local development project on social capital • Assessing neighborhood and spillover effects on technical efficiency of irrigated rice farmers • Case study on youth and career choice in rice value chain • Impact assessment of non-germplasm technologies in Africa • Impact assessment of improved rice varieties in Africa (Arouna et al., 2017).

		• Framework of gastronomic systems research to identify entry points for intervention (Cuevas et al., 2017) • Characterized milled rice retail samples from Philippines, Bangladesh and eastern India • Farmers' investment priorities and intra-household decision-making power in future rice breeding traits in Philippines: 3 manuscripts prepared • FP2-FP5 interaction on developing product profiles • Opportunities for youth engagement in agribusiness services provision identified in harvest and postharvest segments in Nigeria • Performance and constraints in service provision in the rice value chain assessed in Tanzania • Upgrading of postharvest technologies for loss reduction pilot-tested in Nigeria • Rice parboiling parameters that are rewarding for physical and nutritional quality of rice identified • Value chain support service strengthening in Cambodia, Curriculum for Agricultural Engineering Faculty and for vocational training for Agricultural Machinery Mechanics. • Crop establishment business models and promotion of mechanized harvesting in Bangladesh. • Upgrading processing technologies for wet-milled rice products • AfricaRice organized meeting with ICRAF, and RTB and WorldVeg to seek opportunities for collaboration in Cote d'Ivoire, and East and Central Africa, respectively. • On-farm dietary survey protocol was adapted, and used for farming systems survey. • Farming system survey was conducted in Madagascar and Senegal. • IRRI & AfricaRice participated in workshop on global long-term trial network led by Rothamsted. • SRP standard was assessed in Nigeria. • Yield gap analysis was conducted (Niang et al., 2017, 2018; Tanaka et al., 2017; Saito et al., 2017). • New countries (Egypt, Cote d'Ivoire, Madagascar, Rwanda, Senegal) were added to Global Yield Gap Atlas. • Gender analyses in Cote d'Ivoire and Madagascar. • Micro-dose fertilizer application was validated in farmers' fields in Tanzania (Vandamme, in press). • Locally-adapted motorized weeder was manufactured. • RiceAdvice-weed manager was developed and under testing. • Several functions (e.g. adding new languages, incorporating feedback survey) were added to RiceAdvice. • Crop simulation models were used to identify alternative cropping patterns for intensification and

		diversification. • Diversification options were tested in Cote d'Ivoire • Multi-crop seeder and mechanical weeder were tested with farmers in Cote d'Ivoire. • Data from farming systems survey in Madagascar were analyzed. • Prototype diversified upland rice based cropping systems in Madagascar were developed. • Weed inventory and harmfulness in upland rice based cropping systems were developed in Madagascar. • N soil restoration in the rice-stylosanthes based cropping systems were assessed in Madagascar. • Connection to local metrological services in Madagascar was established. • Crop and farm yard manure management practices were evaluated for the effective use of nutrient resources in Madagascar • Effects of planting period and nursery management were assessed in Madagascar. • Long term experiments at IRRI HQ: Long term continuous cropping experiment (1 ha, 3 seasons rice), rice-upland crop (maize) rotation experiment (0.25 ha, 2 seasons) • Baseline climate and crop performance data gathered (RGT & YGT) • Climate change impacts (CO2, cold, heat, drought) modelled for Africa • Site characterization for global array • Phenotyping/screening/lab facility upgrading • Geographic effectiveness of blast resistance genes • Database of modelling trials in LAC • Drone phenotyping tools for rice *hoja blanca* • Sequence of strains for panicle bacterial blight • Identification of promising donors for low radiation tolerance and NSC translocation • Identification of new donors for submergence, salinity • Enhanced used of indica panel in trait development • Database for phenotypic data related to important traits for rice breeding and for genomic data on a synthetic population used to train a genomic prediction model • Identification of elite breeding lines in two environments prone to climatic stresses • Characterization of genetic resources leading to the identification of new sources/genes for resistance to the main rice disease rice *hoja blanca* virus

		• Characterization of genetic resources with tolerance to drought and nitrogen/water use efficiency leading to the identification of genes controlling these traits • Development of protocols and application of gene editing technology for the validation of gene function controlling different traits including rice hoja blanca resistance
Planned research: Leveraging W3/bilateral funding	25	• Regional rice value chain upgrading strategy for West Africa published (Demont et al., 2017) • National rice value chain upgrading strategy in Vietnam published (Demont and Rutsaert, 2017) • Consumer willingness to pay for sustainably-produced rice in Vietnam (feeds into SRP) (My et al., Food Policy, under review) • National rice value chain upgrading strategy developed for Nigeria, Tanzania • Upgrading and testing of the husk densification systems based on feedback from first time users in Cote d'Ivoire • Upgrading and testing of the fan-assisted cook-stove using densified and non-densified products in Cote d'Ivoire • Developing and testing special combustion stoves for briquettes for household use in Cote d'Ivoire • New pilot project for 3D printing of agricultural spare parts funded (BMZ) • Solar Bubble Dryer Transfer to Nepal (GIZ) and Sri Lanka (FAO) funded • Postharvest need assessment in Nepal (CSISA) • Study visit to University of Arkansas and Kellogg's, USA (Kellogg's) • Postharvest support to Heirloom Rice project, Philippines (Kellogg's) • Sustainable Rice Straw Management Project in Vietnam, Cambodia, Philippines (BMZ) • Rice straw future market workshops in Vietnam, Cambodia and Philippines (June–August 2017) • Direct Seeded Rice Consortium (Private Sector) • Postharvest processing improvements at Loc Troi, Vietnam (IFC) • Postharvest loss reduction program, Thailand (Kellogg's) • Closing the Yield Gap in Asia CORIGAP (SDC) • Agricultural Development Sector Program ADSP, Myanmar (World Bank) • Vietnam Sustainable Agricultural Transformation Project VNSat (World Bank) • Sustainable Rice Platform, SRP (Private sector) • Screening tool for glycemic index (published in Scientific Reports) • Rapid Appraisal of Agricultural Innovation systems (RAAIS) was used to identify constraints and

		opportunities for intensification options in Nigeria • Experiments were taken in Senegal to assess canopy temperature for improving modules in crop simulation model. • A series of experiments were taken to assess crop establishment under drought-prone conditions. • RiceAdvice was disseminated together with development partners (e.g. CARI, green innovation center) in Nigeria and Burkina Faso. • RiceAdvice was validated in Ghana, Nigeria, Ethiopia, Madagascar, Rwanda, and Tanzania. • Integrated crop management practices were validated in farmers' fields in Tanzania and Uganda. • SMART-valley approach was validated in Liberia and Sierra Leone. • RiceVideo website was developed. • Through the Sustainable Rice Platform (SRP), IRRI leveraged consultancy funds from the International Finance Corporation for training farmers and extension agents in implementation of the SRP Standard • Common MINCER-Net trials • Genetic mapping and gene discovery • SNP design and validation • Data acquisition/management tools and services • Development of fixed phenotyping stationsSNP design and validation for rice *hoja blanca*, amylose content • Epidemiological studies including new emerging disease scopes. Development of new diagnostic protocols and tools for HTP genotyping. Cropping system-based management of epidemics and résistance • Identification and validation of new avirulence determinants, effectors etc. Frequency in pathogen populations. Contribution to pathogen fitness and evaluation of the potential of resistance breakdown. Pilot experiments on long term monitoring of resistance effectiveness and durability in using selected materials and in selected sites. • Description of pathogen populations (diversity – structure). Analyze of population changes and evolution according to climatic conditions and in the different rice growing ecologies (irrigated, rainfed lowland , upland) in characterized environment. • Phenotyping and pathogenicity activities for the characterization of virulence spectrum. Identification of resistant phenotypes and underlying resistant genes useful for FP5. Targeting *in*

		silico searching for allelic diversity of important resistance-related genes in genetic resources. • Exploring the microbiome and soil health at key-sites and characterization of the beneficial microorganisms (arbuscular mycorrhizal fungi (AMF), Rhizophagus, Bradyrhizobium, Bacillus, Bulkholderia etc.. that display endophytic/PGPR activities or any favourable effects on plants such as pathogens and abiotic stress resistance, micronutrient uptake etc..). • Enhanced used of 3K panel in trait development • Gene regulatory network (root and panicle development) available to develop appropriate plant type • Genomic selection as a possible breeding methodology for plant breeders-50% • Priority gel-based 16 markers identified, converted SNPs validated across panels-80% • An indica specific 1k SNP panel designed and proof of concept of the 1k SNP panel on the Illumina TSCA platform developed and available for use by breeders • 10-15 promising lines identified for nomination to release in Asia, Africa and Latin America- for favorable environment • Gene based markers for root adaptive development, tool for validation of gene network involved in adaptive traits available • At least 2 first-generation stress-tolerant varieties from GRiSP released • Traits/donors/genes for single tolerance of submergence, stagnant flooding, salinity, high/low temperatures, iron toxicity, drought, and blast validated -70% • Detailed characterization of guanine deaminase, drought tolerance, salinity, rice *hoja blanca*, high temperature, carried • Database for phenotypic data related to rice nutritional value on a synthetic population used to train a genomic prediction model • Evaluation and selection of rice germplasm adapted to aerobic upland conditions under drought stress, acid soils, low phosphorus and aluminum toxicity • Establishing the consumer values for distinguishing premium versus medium quality in the hybrid and inbred • Genetic diversity and sequencing analysis carried for 3K genomes, African rice lines and wild relatives to identify multipurposes donors • Landrace population from Vietnam screened for QTL and gene discovery for important traits • Development of PSB approach to identify key genes and regulation gene networks for adaptation,

		resources use efficiency and yield potential related traits (focused on root development and Panicle architecture)
Catalyzing new research areas	5	• Analyzing rural transformation to understand the future of cereal-based agri-food systems in collaboration with IFPRI. • Identification of key agriculture development opportunities in Sub-Saharan Africa in collaboration with IFPRI • Ex Ante Economic Assessment of C4 Rice Adoption in collaboration with IFPRI/PIM (Bairagi, S., Wiebe, K., Murty, MVR., Mohanty, S.): This study evaluates the potential benefits of adopting C4 rice, expected to be available in 2035 to 13 Asian countries, employing a crop model linked with a partial equilibrium economic model. • Analysis of the pathway to food and nutrition security in sub-Saharan Africa in collaboration with IFPRI • Framework of gastronomic systems research to identify entry points for nutritional intervention (Cuevas et al., 2017) • Farming systems analysis platforms were established (see Table B, and milestone "Farming systems analyses platform established within RICE and with other CRPs at eight key action sites") • Developed IRRI's human nutrition strategy and wrote five proposals for future funding, with two of these projects already initiated in Dec 2017 • Revised the Sustainable Rice Platform (SRP) performance indicators to include "level 3" scientific data collection for research • Application of biotechnology tools including marker assisted selection for the optimization of breeding strategies and introgression of disease resistance genes • Generate transgenic rice lines with candidate C4 genes •
Gender	10	• Survey data collection for identification of business models for women and youth gaps in Nigeria. • Survey data collection for developing Women Empowerment Indexes in Nigeria. • Analysis of gender issues in lowland rice growing environment in Benin • Gender differences in household perception of climate change and adaptation strategies • Mid-term evaluation of adoption and spread of seeds of stress-tolerant rice varieties through women

		led community institutions in Uttar Pradesh with 1000 households • Gendered adoption study on stress-tolerant varieties have been carried out in Bangladesh and Uttar Pradesh, each with a set of 1500 households • FP2-FP5: 13 product profiles spanning 2 seasons & 5 regions (eastern India, Bangladesh, Philippines) • Sex-disaggregated data collected through consumer surveys in 24 cities in 7 countries • Measuring women's intra-household decision-making power on most needed future varietal traits • Assess influence of socio-demographic factors on women's intra-household decision-making power • Refining breeding product profiles to render them gender-inclusive • All the value chain research involved men, women and youth • Processing technologies and innovations developed for women small-scale processors in West Africa • Female famers' labor use was assessed through gender studies. • Rice productivity and input use were assessed for male-headed and female-headed households. • Training to female service providers in use of RiceAdvice in Nigeria.
Youth	3	• Survey data collection for identification of business models for women and youth gaps in Nigeria. • gender-sensitive rural youth survey conducted in three states of eastern India to take a stock on current youth involvement, to analyze their willingness to choose agriculture or related value chain activities as their career and to explore what type of policy/institutional support the youth required in-order to pursue agricultural career. • Assessment of role and constraints of women and youth in service provision in Tanzania • Assessing employment opportunities for youth in providing services related to improved harvest and postharvest technologies in Nigeria • Performance and constraints in service provision by youth in the rice value chain assessed in Tanzania • Training to young service providers in use of RiceAdvice.
Capacity development	12	• Capacity building supported the data collection process (on qualitative data collection for rice value chain businesses identification and on collecting data for measuring the women empowerment in rice value chain in Nigeria) and the data analysis stage through provision of internship. • Supervision of 2 PhD studies on gender related aspect in Ghana and Tanzania by AfricaRice.

		• Capacity building training jointly conducted with ICAR-KVK, department of Agriculture, and State government on “Quantitative Methods for conducting gender research” • Training of seed technicians in Senegal on seed quality control • Participation RICE scientists in Capacity development for conducting gender research offered by GREAT (Gender-responsive Researchers Equipped for Agricultural Transformation), a collaboration between Cornell University (United States) and Makerere University (Uganda). • Capacity development for women in the rice value chain, organized in Cote d’ ivoire by AfricaRice and CNRA. • Capacity building training on mat seedling raising method for mechanical transplanting of rice in Bangladesh. . • Capacity building on rice processing technologies for women groups in West Africa • Capacity building on value chains upgrading for associations of value chain actors in Benin, Cote d’Ivoire, Nigeria and Tanzania • Developing new postharvest training courses for the new IRRI Education • Resource persons for IRRI’s annual standard training programs: Postproduction to Market; Laser leveling; Tractor and combine harvester operation; Rice production. • Capacity development needs on farming systems research were assessed among partner research organizations including national agricultural research institutes (NARIs). • Training in use of new decision support tool to identify new cropping patterns. • Training to service providers in use of RiceAdvice. • 3 MSc and 2 PhD students were trained in Africa. • 2 researchers were trained on drone operations. • 9,176 Students, farmers, and technicians attended training activities in agronomy for the dissemination and adoption of improved agronomical practices to reduce yield gap and increase rice production. • Two-week course entitled "Understanding and Assessing Rice Seed Systems", coordinated by IRRI and FLAR, with the technical and logistic contribution of CIAT and FEDEARROZ, and the sponsorship of the Taiwanese International Development Cooperation Fund (ICDF). This training was held in Colombia from October 17 to 27, 2017. The first week of the course was held at the CIAT

		headquarters and the second week at the FEDEARROZ headquarters in Ibague, Colombia. • Twenty professionals participated in this course: seven ICDF technicians in Haiti, Indonesia, Solomon Islands, Nicaragua and Taiwan and 13 participants from Bolivia, Colombia, Ecuador, Japan and Panama. It is expected with this training to have achieved the objective of building knowledge about the production of good quality seeds and rice seed systems with a regional focus for South America and Central America. • We run a pre-Symposium webinar on Genome Editing that brought 105 participants from Colombia, Peru, Costa Rica, Argentina and Uruguay, and a Symposium at CIAT's Kellogg Auditorium attended by over 180 people.
Start-up or maintenance of partnerships (internal or external)	5	• Consultation meeting and policy dialogue in West Africa in collaboration with ECOWAS and Rural Hub for the development of the National Agricultural Investment Program for Food and Nutrition Security (NAIP-FNS) and the Regional Agricultural Investment Program for Food and Nutrition Security (RAIP-FNS). • The seed without borders initiative. • Intensive collaboration FP1-FP2 on policy for sustainable rice value chain upgrading: align PIRCCA (CCAFS), CORIGAP, vnSAT projects in Vietnam, IRRI & IPSARD • FP1-FP2-FP3 interaction on market-based incentive mechanisms and policies for sustainability • FP1, FP3, FP5, PIM, NARS, FAO, UEMOA, AfDB, Global Affairs Canada and *Centres d'innovations vertes pour le secteur agroalimentaire* 2 (GIAE2, GlobE Wetlands, CARI • Private sector collaboration with Trimble, GrainPro, CLAAS, John Deere, Lehner • Organization of mechanization seminar during AGRITECHNICA Asia, Bangkok. Initiate Cooperation with DLG • Farming systems analysis platforms were established (see Table B, and milestone “Farming systems analyses platform established within RICE and with other CRPs at eight key action sites” • Maintained external partnerships (with some new start-ups) through the Sustainable Rice Platform (SRP) • Partnership with CIRAD, IRD, JIRCAS, Harvest Plus and NARS (CORPOICA, INIA, INIAP, IDIAP, etc), Private/Public sector: Fedearroz-Colombia, I Rapid Generation Advance-Brazil, etc.)

Monitoring, learning and self-evaluation	5	• Update of the Mlax system • Panel data collection in Nigeria for monitoring of outcomes • Adoption surveys for tracking improved varieties in Asia and Africa • Surveys for gathering impact stories from IRRI intervention in Asia • Hub-based surveys in Africa and area-based surveys in Asia • Harmonization of methods, approaches and tools for computing RICE progress indicators RICE MELIAG (Monitoring, Evaluation, Learning, Impact Assessment, Gender) Workshop, 4-5 September, 2017, Bangkok, Thailand • Explored prospective ways to collaborate with CIRAD on image-based phenotyping
Evaluation studies and Impact Assessment studies	10	• Data processing and cleaning of area-based surveys conducted in 2014 and 2016 in Asia • Drafting of RICE progress indicators • Impact of improved rice varieties in Africa (Arouna et al. 2017) • Impact of RiceAdvice in Nigeria • Impact of GEM in Benin • RCT experiment of Green Super Rice varieties in Bangladesh. Data collection has been completed in 2017. Data will be analyzed in 2018 for publication in peer-reviewed journals. • Elaboration of impact stories for Myanmar, Philippines, Vietnam and Indonesia. Reports will be published in 2018 • Impact assessment of Direct Seeded Rice in India. Paper has been accepted for publication and will be printed in 2018 • Qualitative study on effectiveness and impact of AWD in Bangladesh • Inclusiveness of rice value chain upgrading in Vietnam (feeds into SRP) (Ba et al., Journal of Development Studies, under review) • Impact and adoption of Rapid Generation Advance in breeding (Lenaerts et al., Plos ONE, Agriculture & Food Security, under review) (FP2-FP1)
Emergency/contingency	0	

Other	8	Management
TOTAL FUNDING (AMOUNT)	14,763 million $	

*use these categories wherever possible, delete unneeded rows and add rows if none of these are suitable.

**we recognize that (i) some funding may fit more than one category but please try to apportion funding to its principal use and (ii) percentages may not add up to 100%

Table G: List of Key External Partnerships

[Please list up to five important partnerships for 2017 for each flagship, using the following table. An agreed list of partners' types and areas of partnerships will be provided in the common results indicators manual (available early 2018).]

FP	Stage of research*	Name of partner	Partner type*	Main area of partnership*
1	AV/USE	Sarmap	AV/USE	Satellite-based Rice Monitoring
1	PC	Cornell University and Makerere University	University	Capacity building Design, Analysis and Communicating results GREAT - Gender -responsive Researchers Equipped for Agricultural Transformation (by
1	USE, AV	NARES, Small Medium Enterprises, Women processors, Farmers,	farmers' Organizations, NGOs, WASP/CORAF	Seed production, capacity building
1	USE	Graduate Institute of Geneva, University of Illinois (USA), University of Saskatchewan (Canada);	Research Institution	Adoption and impact assessment of rice technologies
1	USE, AV	ECOWAS	Regional organization	Development of investment plans
2	PC	University of Parakou, Benin; Institut national des recherches agricoles du Benin; National Cereals Research Institute, Nigeria; Nassarawa Agricultural Development Program; Kano Agric. & Rural Dev. Authority ; Nat. Agricultural Ext. Research & Liaison Services; Centre National de Recherche Agronomique, Cote d'Ivoire	NARS	Market and value chain research Improved postharvest systems
2	PC	ARI Ilonga (Tanzania) / AfrII (Uganda); CARI; Value chain actors	Development and research partners	Policy and development

2	USE	TRIMBLE	Private	Promotion of laser leveling
2	AV	LEHNER	Private	Piloting precision application technologies
2	PC	Institute of Food Research and Product Development, Kasetsart University	Public	Collaborative research on Kuai chap processing and pop-rice technology
3	PC	Africa-wide Agronomy Task Force	NARIs	Introduction and validation of technologies in sub-Saharan African countries
3	PC	SPAD	NARIs, CIRAD, IRD, AfricaRice	Development of sustainable farming systems in highlands in Madagascar
3	USE	Sustainable Rice Platform	85 institutional partners, including NARES, ARIs, NGOs, private sector, growers' associations	joint research and outscaling
3	PC	Direct Seeded Rice Consortium	private sector	joint research
3	USE	Irrigated Rice Research Consortium	NARES, ARIs, private sector	joint research and outscaling
4	PC	Disease testing network	NARES in Africa	Disease testing (incidence, severity, effectiveness of resistance genes)
4	AV	IGSS / HTPG platforms	Service provider	Genotyping/Sequencing
4	PIL	4 sites in India	NARES in India	Generated data from array sites
4	PC	Universidad Javeriana	Regional Universities	Phenotyping tools using drones and fixed stations
4	AV	Embrapa, CCAFS, European Commission	NARES, CCAFS and European Commission	Database on modeling exercises in LAC
5	PIL	Texas Tech University	Advanced Research Institute	Drought molecular Genetics
5	PIL	Fedearroz-Colombia	Private	Rice breeding and tech. delivery
5	PIL	CIAT-Bolivia, DICTA- Guatemala, INTA-Nicaragua, IDIAP-Panamá	NARS	Evaluation of elites lines for nutritional values
5	PC	NIAS-Japan; University of Adelaide-Australia	NARS	Genetic transformation
2,3,4,5	PC,PIL,AV	FOFIFA (Centre National de Recherche appliquée au Développement Rural, Madagascar)	NARES	Development, evaluation, and dissemination of new rice knowledge and technologies

* Phases: PC - proof of concept, PIL - successful pilot, AV - available/ready for uptake, USE - uptake by next users.

Table H: Status of Internal (CGIAR) Collaborations among Programs and between the Program and Platforms

Name of CRP or Platform	Brief description of collaboration (give and take among CRPs) and value added*	Relevant FP
PIM	Work on foresight analysis to explore the future scenario of economic development in a context of climate change. Various draft papers for a submission to a special issue of journal: • Gbegbelegbe, S., Alene, A., Chan, C.Y., Diagne, M., Enahoro, D., Fiamohe, R., Kikulwe, E., Marshall, M., Swamikannu, N. , Tesfaye, K., Thomas, T. 2017. Pathways • to food and nutrition security in sub-Saharan Africa. • Kruseman, G., Mottaleb, K., Tesfaye, K., Robertson, R., Bairagi, S., Diagne, M., Frija, A., Gbegbelegbe,S., Alene,A., Prager, S. 2017. Using rural transformation to understand the future of cereal-based agri-food systems. • Wiebe, K., Petsakos, A., Terheggen, A., Kruseman, G., Setiyono, T., Bairagi, S., Pacheco, P., Dermawan, A. Trade-offs in Achieving Food and Nutrition Security at Global and Regional Scales • Murty, MVR, Tao Li, Quick, WP, Mohanty, S., Setiyono, T., Wiebe, K. A Spatial Assessment of C4 Rice: A Novel Rice Technology to Secure Future Food Security in collaboration with IFPRI/PIM • Bairagi, S., Wiebe, K., Murty, MVR., Mohanty, S . An Ex Ante Economic Assessment of C4 Rice Adoption **Give**: Information on rice technologies and data **Take**: results from econometric modeling, reports, publications (expected)	1
CCAFS	RICE/ **give**: Stress-tolerant varieties provided; shared salinity monitoring RICE/ **take**: Implementation in Climate-smart Villages supported	3, 5
CCAFS	RICE/ **give**: Protocols on Water-saving techniques provided RICE/ **take**: Upscaling of water-saving techniques supported and co-benefits assessed	3
CCAFS	RICE / **give and take** (mutual benefit): Joint proposal development for bilateral projects addressing topics at the interface of both CRPs	1, 3
CCAFS	RICE/ **give**: Consortium of Unfavorable Rice Environments has organized in-country workshops and one international workshop on climate change	3
CCAFS	RICE/ **give**: Training activities on climate change including one course on mitigation at IRRI-HQ; joint activities on GHG reduction	3
CCAFS	RICE/ **take**: Funding of CCAFS Regional Office in Hanoi was also beneficial for IRRI activities in VN	3
CCAFS	**RICE / give and take**: Collaborating on a study on Youth and migration in Vietnam	1

PIM	**Take**: Received a small grant to study Institutional innovations in women-led seed systems	1
Gender Platform	**RICE / give and take**: Knowledge, experience and tools exchange for gender research	1
PIM	Joint publications and communications producing mutual scientific benefits	2
Lifestock	Cooperation in sustainable rice straw management: RICE- sustainable markets for rice straw products, Lifestock - improved nutritional value of rice straw based ruminant fodder	2
CCAFS	Cooperation in assessment sustainability of different mechanization and postharvest practices	2, 3
CCAFS	Aligning policy for sustainable rice value chain upgrading	1, 2
EiB	Access to genotyping services; phenotyping tools, methods and good practices; data management, bioinformatics and biometrics tools	4, 5
Big Data	Funding for data management system upgrade, data discoverability across CGIAR	4, 5, 3, 2
CCAFS	Climate change data, adaptation and mitigation options	4, 3
Genebank	Accessing new genetic diversity	4
Various CGIAR Institutes	Exchange of germplasm, collaboration on bilateral/W3 projects on molecular genetics	5
EiB	Access to genotyping services, genetic gain assessment	4,5
A4NH	Access to funds for phenotyping training population for genomic selection	4,5
RTB	RICE and RTB jointly organized workshop in Rwanda, in which AfricaRice, CIAT, IITA, IRRI, and WorldVeg participated in. We agreed to conduct joint scoping studies to identify opportunity for diversification in rice-based systems in Central Africa. Protocol was developed and field study is on-going.	3
FTA	AfricaRice and ICRAF had meeting in Cote d'Ivoire for identify collaboration areas. Based on discussion, two concept notes were developed and we are looking for calls/donors.	3
A4NH	A4NH visited M'be station in AfricaRice to discuss collaboration for effect of land use in lowland on mosquito population. It was agreed that from 2018, A4NH monitors populations of mosquito larvae in different agronomy trials, which AfricaRice will conduct, to examine how management options affect the population.	3
CCAFS	AfricaRice focal point for CCAFS is also working for FP3 in RICE. Development of weather database was joint effort between CCAFS and RICE. Joined field sites for developing and evaluating climate-smart management practices and farming systems in Asia.	3
FISH	Joint proposal was submitted to IFAD. Target countries are Cote d'Ivoire and Malawi. Joint rice-fish project in Myanmar	3

*e.g. scientific or efficiency benefits

Table I: Monitoring, Evaluation, Impact Assessment and Learning

Table I-1: Status of Evaluations, Impact Assessments and Other Learning Exercises Planned in the 2017 POWB

Studies/learning exercises in 2017 (from POWB)	Status	Comments
RICE MELIAG (Monitoring, Evaluation, Learning, Impact Assessment, Gender) Workshop, 4-5 September, 2017, Bangkok, Thailand.	Completed	This workshop was organized to Evaluate and monitor overall progress of RICE towards outcomes and impacts including gender objectives and outcomes; and to document learning from in relation to RICE theories of change. The workshop report is available at http://www.grisp.net
Report summarizing RICE progress indicators	Completed	The report was prepared as part of the area-based survey implemented in 6 Asian countries in 2014 and 2016.
Surveys completed in Philippines, Vietnam, Indonesia and Myanmar to gather impact stories from IRRI interventions in Southeast Asia	Completed	The Most Significant Change (MSC) approach was used to gather impact information and data to develop impact stories for the 4 countries. Report summarizing the impact stories will be published in 2018.
ME&L training workshop	Completed	The RICE ME&L training workshop was organized on May 15-19 in Los Baños, Philippines
Adoption and impact of alternate wetting and drying (AWD) water management for irrigated rice production in the Philippines	Completed	This study was commissioned by the Standing Panel on Impact Assessment (SPIA)
Impact assessment of Direct Seeded Rice (DSR) in India	Completed	This study has been published in Food Policy. Mishra, A.K., Khanal, A. R., and Pede, V.O (2017). Is direct seeded rice a boon for economic performance? Empirical evidence from India. Food Policy 7:10–18.
Gender differences in perception and adaptation to climate change	Completed	This study is part of the collaboration between RICE and CCAFS in Vietnam. Mishra, A. K and Pede, V.O. (2017) "Perception of climate change and adaptation strategies in Vietnam: Are there intra-household gender differences?", International Journal of Climate Change Strategies and Management, Vol. 9 Issue: 4, pp.501-516,
Adoption and Impact assessment of Swarnasub1	Completed	Veettil, P.C., Reghu, P.T., Gupta, I. and Mohanty, S. (2017). Swarnasub1 adoption and its impact on household welfare. Report submitted to

		Global Futures and Strategic Foresight (GFSF) project and CGIAR Research on Policies, Institutions and markets (PIM), IFPRI, Washington, DC.
Developing sustainable institutional interventions to improve seed system	Completed	Two manuscripts were written from this study, and have been submitted to peer-reviewed journals. Veettil, P.C., Johny, J. and Yashodha, Y. 2017. "Seed contracts and sustainability of seed production groups – Experimental evidences from India." Veettil, P.C., Gupta, I., Yamano, T., Reddy, V.B. and Kretzschmar, T. 2017. Investigating Rice Seeds Sold by Dealers in Eastern India: Evidence from DNA Fingerprinting.
Evaluation of IRRI's contribution to rice improvement in India	Completed	Janaiah, A., Veettil, P.C., Joshi, E. and Mohanty, S. 2017. IRRI's contribution to yield improvement and its impact on rice sector in India. Presented at IRRI Thursday seminar series on 16th February 2017.
Impact of mechanization on welfare of marginalized	Completed	A manuscript has been written from this study, and is awaiting submission to peer-reviewed journal after internal clearance. Joshi, E. and Veettil, P.C. and Vikraman, S. 2017. Effect of Mechanization on the welfare of marginalized sections of the society.
Assessing the impact of local development project on social capital	Completed	A manuscript has been published on this work. Hogeun Park, Takuji W. Tsusaka, Valerien O. Pede and Kyung-Min Kim. (2017). "The Impact of a Local Development Project on Social Capital: Evidence from the Bohol Irrigation Scheme in the Philippines" *Water*, 9 (3): 1-15.
Assessing neighborhood and spillover effects on technical efficiency of irrigated rice farmers	Completed	Villanueva, Donald.; Sumalde, Zenaida.; Garcia, Yolanda, Valerien O. Pede and Rodriguez, Prime. (2017). "Assessment of Neighborhood and Spillover Effects on Technical Efficiency of Irrigated Rice Farmers" *Asian Journal of Agriculture and Development*, 14(2):103-125.
Impact assessment of improved varieties in Africa	Completed	Done and published in Arouna et al., 2017 Impact of other new germplasms is on-going
Impact of non-germplasm technologies	Completed	Done for ASI thresher and Smart-valley technology for water management. Adoption of contractual arrangement in rice value chain was done. Impact for GEM, and RiceAdvice is on-going

Update of the mlax system for monitoring, evaluation and learning in Africa	Completed	Update done and improvement is on-going
Monitoring of progress of indicators of sub-IDOs and IDOs	Completed	Panel data were collected in Nigeria, Cote d'Ivoire, Togo, Sierra Leone and Benin Training and pilot survey on new method of rice statistics survey in Benin, Cote d'Ivoire, Nigeria, Senegal, Ghana, Guinea-Bissau and Niger
Rural organizations and the adoption of improved varieties	Report in progress	To be submitted in 2018
Economic value of rice varietal traits in Ecuador from farmers perspective	Report in progress	To be submitted in 2018
Promissory rice lines for los Llanos in Colombia	Report in progress	To be submitted in 2018
CIAT impact assessment brief	Completed	It estimates the economic benefits from all CIAT mandate crops including rice
Adoption and impact of stress tolerant rice varieties in Bangladesh	On-going	Household survey completed and data analysis is ongoing.
Adoption and impact of Green Super Rice varieties in Bangladesh	On-going	Household survey completed and data analysis is ongoing.
Adoption and impact of high zinc rice varieties in Bangladesh	On-going	Household survey completed and data analysis is ongoing.
Adoption and impact of Green Super Rice varieties; and Adoption and impact of Zinc-rich rice varieties.	On-going	Three separate farm household surveys were conducted to study the following adoption and impact studies in Bangladesh:
A Randomized Control Trial (RCT) experiment in Bangladesh to assess the impact of micronutrients training on zinc-Rice demand among mothers	On-going	Household surveys have been completed and a preliminary report has been drafted. This work will continue in 2018 and will lead to peer-reviewed publication.
Assessing the impact of AWD water management in the Philippines.	On-going	This study was commissioned by IFAD. A preliminary report summarizing all inputs has been prepared and submitted to IFAD in 2017. This work will continue in 2018 and will lead to peer-reviewed publication
Participatory Impact Pathway Analysis Workshop conduced	Inception	With W3 funding from India

on “Improved Mechanization in Post-Harvest to Reduce Losses and Improve Quality of Rice in Odisha, India to start up a new postharvest initiative. 7-8 November 2017	phase of new 5year project for reducing PH losses	
ProRice project in Myanmar on village level postharvest value chain upgrading and linking farmers to markets through Learning alliances.	Completed and reviewed by ACIAR	With W3 funding from ACIAR

Table I-2: Update on Actions Taken in Response to Relevant Evaluations (IEA, CCEEs and Others)

Independent Evaluation Arrangement Evaluation of CGIAR Research Program on rice (GRiSP). The Table below contains the original management response and lists in the last column the updated status in 2017.

Evaluation Recommendation	Actions to be taken	By whom	By when	Status 2017
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.	In RICE, it is proposed to expand our multi-disciplinary and participatory activities with local institutions at 'action site (hub)' level through strengthening of our innovation platforms and learning alliances. After multi-disciplinary stakeholder analysis and yield gap analyses (FP3.1), crop and resource management technologies that are adapted to local situations will be developed (FP3.2, FP6.1), and scaled out (FP3.4, FP 6.2). Whereas more upstream research of RICE will focus on development of generic principles, tools and technologies for integrated crop and resource management (as International Public Goods), work at the action sites will tailor such options to local conditions	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.
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	In agricultural research, it usually takes a minimum of two years to conduct new experiments. The whole process from the analysis of data, to the development of manuscripts, to the publication of journal articles, usually takes another	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	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

jointly authored, high quality publications	2 years. Hence, after 4-5 years of GRiSP, we expect to start seeing publications from the new multi-institutional collaborative efforts – with authors from a number of GRiSP participants. The RICE management will further encourage the development of high-quality multi-partner publications through continued investment in collaborative activities and by using institutional mechanisms/protocols for upholding scientific excellence in publications.		attention of CRP and FP management teams	Saito et al. (2018) were publications from joint efforts by at least two key RICE CRP partners. Explicit partnership plans were developed in the RICE workplan of 2017. See also section on partnerships in this annual report
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 delivery, especially for management and post-harvest technologies, coupled with capacity development of relevant partners	The need for improvement in strategies and frameworks for scaling out was also recognized in self-assessments of GRiSP staff. A major effort was made to design a new FP in RICE, entitled 'Accelerating impact and equity' (FP6), with a strong underpinning theory of change and conceptual framework. Scaling out through strategic partnerships and enhanced (institutional) capacity are specifically articulated clusters of activity. During full proposal development, the concepts and implementation mechanisms of this new FP will be further elaborated. Two new development partners have been invited to contribute their specific expertise: GIZ and ICRA.	GRiSP PPMT, FP1 leaders	Design in 2016; implementation will be 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 annual report 2016 (Key messages).
Recommendation 4: GRiSP should deliver a single integrated rice research	Though tremendous progress has been made in enhancing the	GRiSP PPMT; AfricaRice and	Design in 2016; implementation will be	AfricaRice and IRRI management teams have developed closer

program in Eastern & Southern Africa, coordinated by AfricaRice and drawing on the relative strengths of *both* AfricaRice and IRRI, in order to improve efficiency and complementarities, and enhance the image of GRiSP among its stakeholders in the region	collaboration between AfricaRice and IRRI in Africa, we agree that collaboration can be further strengthened The three CGIAR Centers in GRiSP (AfricaRice, CIAT and IRRI) under GRiSP have responded to this need by signing a revised Framework Agreement in January 2016 reconfirming their respective responsibilities and the need for enhanced coordination.	IRRI management teams and boards	initiated in 2016 under GRiSP, and more fully in RICE 2017-2022 In 2016, AfricaRice and IRRI will develop 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 partners')	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 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.
Recommendation 5: AfricaRice should modernize and intensify its rice breeding program 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	Taking advantage of the move of AfricaRice to its 700ha experimental facility in M'bé, Côte d'Ivoire, where the three major agro-environments are present, AfricaRice will install infrastructure for rapid generation advancement, for high through-put phenotyping for major target traits and basic infrastructure for forward marker assisted selection (MAS). Background selection will be outsourced to service providers. AfricaRice will continue and expand	Leaders of RICE FP4 and 5	Design in 2016; implementation will be initiated in 2016 under GRiSP, and more fully in RICE 2017-2022	Ongoing strengthening of breeding program at AfricaRice.

	the range of markers used by introducing them through links with advanced research institutes and through literature reviews. Detailed physiological studies and QTL/gene finding activities will continue to be done in collaboration with GRiSP core partners, in particular IRRI, Cirad, IRD and JIRCAS. This will further strengthen the product-oriented approach used by AfricaRice and in the Africa-wide Rice Breeding Task Force convened by AfricaRice, ultimately leading to enhanced and accelerated uptake of recently developed and improved rice varieties by farmers in Africa.			
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	The need for increased interdisciplinary R&D was also recognized in self-assessments of GRiSP staff. In RICE, it is proposed to strengthen our multi-disciplinary R&D activities - with our collaborators - at better-defined 'action sites (hubs), in specific agro-ecosystem ecologies (see RAFS pre-proposal, pages 21-22). We will also collaborate with other CRPs and other centers on multidisciplinary approaches in selected countries through 'site integration'. We aim to put more emphasis on the development of cross-cutting and multidisciplinary R&D projects.	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. Also, see response to recommendation 1.
Recommendation 7: The rapid acceleration of rice research	GRiSP partners are continually exploring new partnerships in search	PPMT; Leaders of all RICE FPs	The development of new partnerships is a continuing	RICE has developed a strong partnership strategy that specifically

worldwide over 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.	of scientific excellence and opportunities to tap into, and exploit, new and cutting-edge scientific breakthroughs, concepts, tools, and technologies. To facilitate and further strengthen partnerships, a new partnership strategy was developed for RICE, see pp 126-131 of the RAFS pre-proposal. This strategy will be further strengthened in 2016 and will guide partner mobilization in RICE. Many strategic ARI partners are already identified and listed in the strategy and in the six FP sections of the RAFS pre-proposal. Some specific mechanisms that will be continued to foster new collaborations with ARIs are the USAID-CGIAR linkage grant scheme and the constructions of sandwich PhD projects with universities.		activity, and 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.
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.	The need for increased capacity on capacity development was also recognized in self-assessments of GRiSP staff. A new capacity development strategy was developed for RICE, see pp 132 of the RAFS pre-proposal and the relevant sections in the CRP and FP narratives. The strategy builds on the overall CGIAR CapDev strategy developed by the CGIAR CapDEV community of practice, and targets institutional as well as individual capacity development within participating countries. Whereas	PPMT; Leader of FP1; Leaders of all RICE FPs	A comprehensive and new capacity development strategy will be 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

	CapDev is implemented in all FPs of RICE, the further development of the underpinning strategy and guidance for implementation is concentrated in a new specific cluster of activities in FP6.4. ICRA will be involved as a new partner in RICE and will strengthen our expertise on long-term capacity development.			committee of GIZ's Better Rice Initiative in Asia. Specific capacity development initiatives in 2017 are found in the RICE plan of work and budget 2017.
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	Though we made good progress in GRiSP, we recognize the need to keep investing in unearthing and understanding the particular roles, constraints, and opportunities that women face in the rice sector and in rice value chains. Hence, a dedicated cluster of activities is proposed under RICE FP 1.3 (page 43). Also, in developing the full RICE proposal, we will include gender-specific targets, IDOs, and indicators across our FPs so we can target and monitor progress.	Leader FP1; GRiSP and RICE gender team	In 2016 under GRiSP, we will systematically synthesize 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 in scientific journals, eg Akter et al 2017.
Recommendation 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.	We agree with the need to institutionalize, with our partners, a robust framework of adoption studies and impact assessment. However, we have our reservations about doing this at the global level, specifically for equity, nutrition and environmental impacts for which other CRPs may have comparative advantage (PIM, A4NH, and WLE respectively). At selected action sites across Asia and Africa, we will develop a rolling,	Leadership FP1	In 2016 under GRiSP, we will finalize 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	Key outcome indicators have been developed and were computed from various household data to establish the baseline for RICE. A detailed report is available here.

	annual household survey plan that will allow us to track adoption of technologies and progress towards RICE's IDOs and impact targets through a set of well-defined SMART indicators (to be defined in the RICE full proposal). Indicators will be related to targets on reduction of poverty, hunger, malnutrition, and to the improvement of equity, nutrition, and environmental quality. This will be complemented by the use of technologies such as remote sensing, modelling, GIS, cellphone applications, and DNA fingerprinting. With RICE's underlying theory of change and impact pathway, this information will contribute to our attribution and contribution claim. In addition, we will develop an impact assessment plan based on case studies related to the adoption of GRiSP/RICE technologies, using scientifically sound methodologies.		implementation of the schema will start in 2017 and continue throughout RICE in 2017-2022.	
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 stakeholders.	We will encourage the GRiSP OC to reflect on their role and effectiveness in 2016, and propose improved governance mechanisms for RICE. Besides the OC, however, we will explore mobilizing other (improved) mechanisms to establish consultation processes (such as CORRA, NEC, FLAR – see RAFS pre-proposal for explanation); see also our response to recommendation # 13 on expansion of GRiSP beyond the	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 first meeting are publicly available.

	CGIAR research program.			
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.	We agree that RICE will commission CRP level external reviews, but there may be instances where center-commissioned reviews may be more appropriate because of regional-specific (Africa, Asia, Latin America and the Caribbean) circumstances and conditions, and/or because of particular needs of centers.	RICE ISC; Center Boards	Design in 2016; implementation in RICE 2017-2022	No external reviews were commissioned in 2017 as this is just the first year of RICE.
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 management if included	In RICE, there will be a stronger and more articulate role for research management and research implementation by Cirad, IRD, and JIRCAS. Specific clusters of activities have been identified that these centers will implement and (co-)lead based on their comparative advantage and particular interests, see pp 25-26 of the RAFS pre-proposal. These activities will be specifically co-funded from W1,2 in RICE. GIZ and ICRA will become new partners in RICE, specifically for the topics of outscaling and capacity development. RICE's proposed partnership strategy (see pp 126-131 of the RAFS pre-proposal) articulates principles for governance and management for various types of RICE partners. In 2016, we will actively explore the expansion of the concept of a global rice science partnership beyond being a CGIAR research program.	PPMT	Design of strengthened roles on nonCGIAR partners already started in the second half of 2015, and will continue 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 will be further strengthened by additional center-level reporting.

	This will open to way for more inclusivity and flexible partnerships.			
Recommendation 14. The Consortium (W1) and the Fund Council (W2) should provide expanded and reliable core funding to GRiSP in order to take full advantage of the innovative scientific partnerships available for collaborative research, as envisaged in the SRF.				

Table J: CRP Financial Report

All numbers in 000 US$.

Flagship Name	Planned Budget (POWB2017)*			Realized budget (AR 2018)**			Difference				
	W1/W2	W3+bilateral	Total	W1/W2	W3+bilateral	Center own***	Total	W1/W2	W3+bilateral	Center own***	Total
1: Accelerating impact and equity	2,959	16,505	19,464	2,736	14,308	1,151	18,195	-223	-2,197	1,151	-1,269
2: Upgrading rice value chains	1,343	2,121	3,465	1,185	1,471	368	3,024	-158	-650	368	-441
3: Sustainable farming systems	2,674	10,348	13,022	2,438	10,573	1,150	14,161	-236	225	1,150	1,139
4: Global Rice Array	3,195	7,260	10,455	2,813	6,733	1,021	10,567	-382	-527	1,021	112
5: New rice varieties	4,015	19,663	23,678	3,666	20,140	4,275	28,081	-349	477	4,275	4,403
CRP Management & Support Cost	1,952		1,952	1,952			1,952	0	0	0	0
Less CGIAR Collaboration (double counting)					-1,824		-1,824	0	-1,824	0	-1,824
Total	16,138	55,896	72,035	14,790	51,401	7,965	74,156	-1,348	-4,495	7,965	2,121

*Source: RICE POWB2017; ** Source: prepared by lead center (IRRI) from submitted audited reports by RICE partners and as submitted to the SMO (15 April 2018);

***: introduced in 2018 financial reporting

Annex A: Selected RICE outcome studies

RICE Outcome case study 1: impact of improved rice varieties in sub-Saharan Africa

Title
Impact of improved rice varieties in Sub-Saharan Africa

Short outcome/impact statement
[In a succinct statement of 1-3 sentences that can fit into a table, make the outcome crystal clear to readers. The following points should be covered: (i) the CGIAR research innovation that led to the outcome/impact, (ii) the specific users of/beneficiaries from the research innovation, and (iii) the nature of the outcome/impact]
The adoption of improved rice varieties by farmers in 16 countries in Sub-Saharan Africa, was estimated at 3.5 million ha, including 1.4 million ha for NERICA varieties. Yields increased with 431 kg per hectare with adoption of improved varieties, and with 320 kg per hectare with adoption of NERICA varieties. About 8 million people were lifted out of poverty and 7.2 million people out of food insecurity. Average income also increased from US$ 25 capita^{-1} to US$ 58 capita^{-1} for NERICA adopters.

Link to Common Results Reporting Indicator #I3
Does this outcome reflect a contribution of the CGIAR in influencing or modifying policies (or strategies / laws/ regulations/ budgets/ investments or curricula)? [See guidance for common reporting indicator #I3 for further explanation and definitions of what is included under the term 'policy'] **YES/NO**
NO

Maturity of change reported
[Tick one of the following boxes corresponding to the highest level of maturity]

***Stage 1**: (sphere of influence) CGIAR research (and related activities) has contributed to changed discourse and/or behavior among next users (related to the theory of change). Examples of evidence: outcome mapping study, media analysis, e-mail correspondence*
***Stage 2:** (sphere of influence) CGIAR research (and related activities) has contributed to documented policy[2] change and/or a change in practice by end users. This may include changes such as income, nutrient intake etc. in the sphere of influence (e.g. project level). Example of evidence: a study of adoption and effects, commissioned at project level.*
***Stage 3:** (sphere of interest) Policy and/or practice changes influenced by CGIAR research (and related activities) has led to impacts at scale or beyond the direct CGIAR sphere of influence. Example of evidence: ex-post Impact Assessment*

STAGE 3

[2] See common reporting indicator #I3 for definitions of what is included under the term 'policy'

Links to the Strategic Results Framework

To which CGIAR IDOs and targets does the outcome you are describing make a direct contribution?
5. a) Sub-IDOs - drop down list, multiple selection possible -- max. 2
5. b) SRF 2022/2030 targets drop down list, multiple selection possible -- max. 2
5 c) Comment box

Sub-IDOs: Enhanced genetic gain;
SRF targets: 100 million more farm households have adopted improved varieties; 30 million people assisted to exit poverty.

Geographic scope - Countries

[Specify the country(s) of where the outcome/impact case occurred]
Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ethiopia, The Gambia, Ghana, Madagascar, Mali, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Tanzania, and Togo

Key Contributors

Contributing CRPs : drop-down list (choose multiple)
Contributing Flagships: drop-down (choose multiple) [not public domain]
Contributing external partners: drop-down list (choose multiple from dropdown list)

RICE CRP
Flagship projects "1 Accelerating impact and equity" and "5 New rice varieties"
Large number of national partners in the 16 countries

Elaboration of Outcome/Impact Statement

Up to 400 words. This should include:
a) Description of the outcome/impact in a bit more detail, including on how the change happened.
b) Clear specification of the CGIAR innovation that resulted in this outcome. If relevant, please link this to the common reporting indicator on innovations (#C1) (using an identical title)
c) Description of users/beneficiaries of the CGIAR innovation and how the innovation was used or produced its benefits. If possible, differentiate between the use/benefits for types of users/beneficiaries, for example by gender, youth, wealth, ethnic group etc.
d) Spell out any important activities that were conducted to link the innovation to the outcome (e.g. "a major dissemination campaign was conducted, in which …"; "a science-policy workshop was conducted, attended by …").

The potential of improved rice varieties to increase food security and to reduce poverty is widely documented in the literature. The review of existing literature and update of empirical evidence based on data collected in 2014 in 16 sub-Saharan African (SSA) countries, revealed that the adoption of improved rice varieties has a positive impact on different development outcomes including productivity, production, income, expenditure, poverty reduction, and food security. Both metadata and primary data analyses showed an increase in adoption rate, especially after the 2008 food crisis. Thus, during the period from 2000 to 2014, more rice farmers were adopting improved rice varieties every year. By 2014, the adoption of improved rice varieties by farmers in the studied countries was estimated at 3.5 million ha, including 1.4 million ha NERICA varieties. Yields increased with 431 kg per hectare with adoption of improved varieties, and with 320 kg per hectare with adoption of NERICA varieties. The increase in adoption rate has had an impact on income

corresponding to US$ 3.9 per capita per year for NERICA adopters. In addition, about 1 million households totaling 8 million individuals, and 0.9 million households totaling 7.2 million individuals in SSA have been lifted out of poverty and food insecurity, respectively, in 2014. Findings suggest that improved rice varieties and NERICA varieties in particular, brought hope to millions of poor, small-scale farmers, in sub-Saharan Africa by reducing poverty and income inequality. This could be enhanced not only with a wider dissemination of improved rice varieties, but also by addressing production constraints and certified seed bottlenecks (Arouna et al., 2017).

References cited

Please limit this to references cited in Section 7 which provide evidence for the statements made, and do not include publications that are interesting but only marginally relevant.

Arouna A, Lokossou JC, Wopereis MCS, Bruce-Oliver S and Roy-Macauley H. 2017. Contribution of improved rice varieties to poverty reduction and food security in sub-Saharan Africa. Global Food Security. 14: 54-60. https://doi.org/10.1016/j.gfs.2017.03.001

Quantification

By 2014, the adoption of improved rice varieties by farmers in the studied countries was estimated at 3.5 million ha, including 1.4 million ha NERICA varieties. About 1 million households totaling 8 million individuals, and 0.9 million households totaling 7.2 million individuals in SSA have been lifted out of poverty and food insecurity, respectively, in 2014.

Gender, Youth, and Capacity Development

Optional: only if supporting evidence is available.

Other cross-cutting dimensions

Optional, where applicable; Describe any other cross-cutting dimensions, like equity dimensions, climate change, environment. Please be specific. Please cite references for statements.

Communications materials

[Please attach or provide links to any materials relating to this outcome that could be used for system-level communications purposes, e.g. CRP publicity material, videos. Ensure you use permanent identifiers for any files, e.g. cgspace.]

Contact person

Please indicate: Name, Position, CRP, Center and Email of the person to whom any questions can be addressed. This should be a lead researcher, or someone able to discuss technical aspects of the innovation, outcome and evidence.

Dr Aminou Arouna, RICE CRP, researcher AfricaRice Center, a.arouna@cgiar.org

RICE Outcome case study 2: Remote sensing-based rice insurance in Tamil Nadu, India

Title

Remote sensing-based insurance in Tamil Nadu, India

Short outcome/impact statement

RIICE - Satellite technology expedites insurance payouts in India's crop insurance programme in 2016-17 Samba season.

Link to Common Results Reporting Indicator #I3

NO

Maturity of change reported

Stage 2

Links to the Strategic Results Framework

Sub-IDOs: Improved access to financial and other services; increased household capacity to cope with shocks
SRF targets: 30 million people assisted to exit poverty.

Geographic scope - Countries

Tamil Nadu State, India

Key Contributors

RICE CRP
Flagship projects "1 Accelerating impact and equity"
Tamil Nadu Agricultural University, State Department of Agriculture in Tamil Nadu, Department of Economics and Statistics in Tamil Nadu, International Rice Research Institute, Sarmap and GIZ

Elaboration of Outcome/Impact Statement

Through an effective public-private partnership (IRRI-Sarmap) collaboration, IRRI under the RIICE (Remote Sensing based Information and Insurance for Emerging Economies) project accomplished strengthened NARS partners with the technical capacity to generate satellite-based rice monitoring information needed by the State Department of Agriculture in Tamil Nadu, India and effectively influence key stakeholders involved in the implementation of Pradhan Mantri Fasal Bima Yojana (PMFBY) crop insurance program in this southern Indian state to accept the satellite-based technology as the key source of information for assessment of drought affecting small holder rice growers in the state.
In 2017, farmers in several districts in Tamil Nadu received payouts because their losses had been identified by satellite data**.** Early insurance payouts were surging during the 2017 Rabi cropping season. For the first time in India, a state government made use of satellite data in assessing various damages and offered compensation to farmers for the prevented sowing feature of the 2.8 bn USD-heavy national crop insurance programme called Pradhan Mantri Fasal Bima Yojanna (PMFBY).
The Tamil Nadu Agricultural University in Coimbatore (TNAU) is the local research partner of IRRI and sarmap has been delivering information about in-season losses and end-of-season yields to the Department of Agriculture, Government of Tamil Nadu for the first time during 2016-2017 Samba

season after testing the use of remote sensing technology in previous years and delivering accuracy rates around 90% when compared to either official data or own measurements.
RIICE technology has the capability to generate efficient and accurate information of abiotic stress and assess damage caused by abiotic stress i.e. flood and drought. In 2015 RIICE technology was used to assess flood damage which helped quick and timely payouts and also maximizes the compensation to ensure farmers social protection and climate resilience. Apart from insurance claim settlement, in 2015 this technology was also used for the assessment of flood damage which expedites relief activities among the Rice farmers in the Cuddalore district. During this time, 400 farmers in the Cuddalore district received 50 tons of short duration paddy seeds and 30,000 vegetable seedlings, enabling them to start growing new crops once the floods had receded.
A pilot insurance scheme for small holder farmers based on RIICE technology has been planned in An Giang province in Vietnam and it will commence in August 2018 and implementing parties are Swiss Re, BaoMinh, sarmap, CTU, SDC and GIZ. In this pilot insurance scheme three rice seasons will be covered (i) 2018 Summer Autumn, (ii) 2018 Autumn Winter and (iii) 2018/2019 Winter Spring in 15 communes from 7 districts. Total of 45,000 ha of farm land will be covered across all 3 seasons in year 1 and sum Insured per hectare is VND 20,000,000. Insurance premium is fully subsidised by An Giang government for year 1.RIICE technology will be used to declare rice damage ratio to settle insurance claim from natural catastrophic events including flood, drought and storm.

References cited

Release ASEAN Crops: Satellite technology expedites insurance payouts in India's crop insurance programme.

Nelson A, Setiyono T, Rala AB, Quicho ED, Ravis JV, Abonete PJ, Maunahan AA, Garcia CA, Bhatti HZM, Villano LS, Thongbai P, Holecz F, Barbieri M, Collivignarelli F, Gatti L, Quilang EJP, Mabalay MRO, Mabalot PE, Baroga MI, Bacong AP, Detoito NT, Berja GB, Varquez F, Wahyunto, Kuntjoro D, Murdiyati SR, Pazhanivelan S, Kannan P, Mary PCN, Subramanian E, Rakwatin P, Intrman A, Setapayak T, Lertna S, Minh VQ, Tuan VQ, Duong TH, Nguyen QN, Kham DV, Hin S, Vaesna T, Yadav M, Chin C, Nguyen NH. 2014. Towards an operational SAR-based rice monitoring system in Asia: examples from 13 demonstration sites across Asia in the RIICE project. Special Issue of Remote Sensing in Food Production and Food Security, Remote Sensing 6(11):10773-10812. www.mdpi.com/2072-4292/6/11/10773

Setiyono, T.D., Quicho, E.D., Gatti, L., Campos-Taberner, M., Busetto, L., Collivigarelli, F., Garcia-Haro, F.J., Boschetti, M., Khan, N.I., Holecz, F. Spatial rice yield estimation based on MODIS and Sentinel-1 SAR data and ORYZA crop growth model. Remote Sensing 2018 10(2),293. https://doi.org/10.3390/rs10020293

Southeast Asia: Satellite data sources rice farmers' income - https://www.giz.de/en/workingwithgiz/43933.html

Quantification

- Total of >300,000 farmers received timely crop insurance payout in Tamil Nadu, India under the Central Government insurance program in 2016-17 Samba Season.
- Preventive sowing payout received by 47,513 farmers.
- Total crop failure claim payout received by 256,190 farmers.

Insurance claim payout was provided by Agriculture Insurance Company of India (AICI).

Gender, Youth, and Capacity Development

Other cross-cutting dimensions

Communications materials
https://aseancrops.asean-agrifood.org/press-release-satellite-technology-expedites-insurance-payouts-in-indias-crop-insurance-programme/

Contact person
Dr Nasreen Islam Khan, RIICE project Leader, Theme Leader: Enabling Data Driven Decision Support for Rice Agri-Food Systems and Cluster leader: Geospatial science and modeling, IRRI, Philippines.
n.khan@irri.org

RICE Outcome case study 3: Healthy rice seedlings in Bangladesh

Title
Farmers adopt healthy rice seedling practices in Bangladesh

Short outcome/impact statement
Awareness-raising activities through a 10-minute instructional video by the CSISA project (Cereal Systems Initiative South Asia) in Bangladesh resulted in 60,000 hectares planted with healthy rice seedlings in 2017, while direct training resulted in an additional 28,300 hectares planted under healthy rice seedling techniques.

Link to Common Results Reporting Indicator #I3

NO

Maturity of change reported

Stage 2

Links to the Strategic Results Framework

Sub-IDOs: 100 million more farm households have adopted improved management technologies; Increased household capacity to cope with shocks
SRF targets: 30 million people assisted to exit poverty.

Geographic scope - Countries

Bangladesh

Key Contributors

RICE CRP
Flagship projects "3 Sustainable farming systems"
The NGO Agricultural Advisory Society (AAS); Department of Agricultural Extension Bangladesh

Elaboration of Outcome/Impact Statement

Most farmers in Bangladesh who are able to locate and afford hired labor, transplant rice seedlings into flooded fields. The quality of seedlings used for transplanting however varies considerably among farmers. Use of young and healthy rice seedlings (HRS) tends to result in reduced transplanting shock, better crop establishment, early vigorous growth, and can fetch yields 7–10% compared to poorer quality seedlings. Remarkably, most farmers are unaware of the simple methods that can be used to raise more healthy seedlings. They therefore transplant poor quality seedlings, which are tall and thin with less vigor, that are older than their optimum age for transplanting, and often have damaged root systems due to late removal from rice seedbeds.
A short 10-minute farmer-friendly instructional video on techniques to raise HRS in the winter boro and summer monsoon aman seasons was developed in Bangla. The instructional video features farmers using a series of 10 recommended practices to produce seedlings of high vigor and quality. Partnering with the NGO Agricultural Advisory Society (AAS), CSISA arranged video showings for farmers in villages in open-air public gathering places, community centers and markets across Jessore and Faridpur Hubs. The video was shown to 37,117 registered viewers in 498 video-showing events in the winter of 2016– 17. Each showing was followed by extended question and answer sessions during which farmers were invited to ask technical questions on HRS practices. The following summer, an additional 17,736 registered viewers saw the videos in 265 showings implemented using the same protocols. Taking into account unregistered audience members, the total number of farmer viewers is estimated at approximately 89,000 people in the winter, and another 23,950 people in the summer. Follow-up telephone surveys conducted after transplanting in the winter indicated that 62% of the registered viewers adopted at least one of the recommended HRS practices on their own rice fields. Adoption of HRS practices was lower in the summer aman season; 8,638 (49%) farmers on 3,113 ha land reported that they practiced at least one method. When combining the both boro and aman seasons, 31% of the registered farmers who saw the video adopted three or more HRS practices. It is estimated that healthy rice seedlings were used on at least 60,000 hectares because of CSISA's awareness-raising efforts.
CSISA also provided training-of-trainers in the first half of 2017. In the second half of the year during the summer aman season, the training was suspended because of funding uncertainty. In total, 612 block/village level Department of Agricultural Extension staff and 80 NGO field workers were trained on better bet agronomy management practices of rice cultivation, with a strong emphasis on HRS raising methods. Subsequent farmer trainings conducted by this group reached 8,419 farmers (10% women). Of these, HRS practices were adopted on 2,778 hectares of seedbed area, resulting in 28,300 hectares of rice grown using HRS techniques.

References cited

CSISA annual report 2018, page 17-18. (http://csisa.org/wp-content/uploads/sites/2/2018/01/CSISA-III-BD-NP-USAID-annual-report_2017_for-DEC.pdf)

Quantification

88,000 hectares in 2017 established under healthy rice seeding technologies.

Gender, Youth, and Capacity Development

Other cross-cutting dimensions

Communications materials

Contact person

Dr Sudhanshu Singh, Rainfed Lowland Agronomist & IRRI Coordinator, RICE, IRRI, sud.singh@irri.org

Annex B: RICE risk table

Area	Risk	Risk Management Approach	Risk holder(s)	Control and status 2017 (in bold)
1. Institutional				
1.01	Loss of physical assets	Lead center and partner centers have a risk management plan and a business continuity plan in place	Center Boards of Trustees	Center risk management plans and center business continuity plans; **updated and reviewed by center boards in 2017**
1.02	Loss of information assets	Lead center and partner centers have appropriate on- and off-site back-up systems and IT security systems and expertise	Center heads of ICT	Center risk management plans, center business continuity plans, Research Data Management Policies; **updated and reviewed by center boards in 2017**
1.03	Loss of intellectual assets	RICE intellectual asset management policy in line with CGIAR and center intellectual asset management policies	RICE program director; Center Boards of Trustees	**Centers prepared, reviewed, and submitted their 2017 intellectual asset reports to the SMB. IRRI developed a new Intellectual Property and Commercialization (IP&C) Policy and created an Intellectual Property and Commercialization Committee.**
1.04	Loss of staff; staff safety	Attractive remuneration and work place at lead and partner centers; security information during travels	Relevant center DDG/heads of HR and Operations	Center risk management plans and center business continuity plans Center HR policies and procedures; international travel security system, medical, and repatriation arrangements **No specific updates in 2017**
2. Compliance and failure to meet obligations				
2.01	RICE fails to meet contractual obligations with the CGIAR Systems Office	Timing and quality of critical RICE management documents (work plans, reports, budgets, template agreements) produced by the RICE and its FP management teams are overseen by the RICE Independent Steering Committee, which reports to the Board of Trustees of the RICE lead centre	RICE Independent Steering Committee, Board of Trustees of the RICE lead centre	**The RICE POWB2017 was reviewed and endorsed by its ISC and timely submitted to the SMO; was well received with no major comments. All RICE contracts between IRRI as lead center and the partners AfricaRice, CIAT, Cirad, JIRCAS, and IRD were develope, approved, and signed in 2017.**

2.02	Participating centers, subcontractors, and consultants fail to meet contractual obligations with the lead center	Work plans, reporting, and disbursement schedule in place and monitored for all participating centers, subcontractors, and consultants. Divergences from schedule brought to attention of the RICE management team, corrective action is taken	RICE management team, Board of Trustees of the RICE lead centre	**The RICE POWB2017 was reviewed and endorsed by its ISC and timely submitted to the SMO; was well received with no major comments. All RICE contracts between IRRI as lead center and the partners AfricaRice, CIAT, Cirad, JIRCAS, and IRD were develope, approved, and signed in 2017.**
2.03	Legal/compliance issues with CGIAR intellectual assets management principles and policies	RICE intellectual asset management policies in line with CGIAR and center intellectual asset management policies	RICE management team; Center Boards of Trustees	RICE intellectual asset management strategy (Annex 10) Center Board of Trustees certification reports on the management of intellectual assets. **Centers prepared, reviewed, and submitted their 2017 intellectual asset reports to the SMB.**
2.04	Compliance and legal claims cause liability (including Inappropriate use of funds)	Lead and participating center policies and procedures; quality of legal/IP personnel; internal and external audits; insurance.	Boards of Trustees of lead and participating centers	Lead and participating center policies and procedures; annual center compliance statements to CGIAR; internal and external audit reports. **All RICE contracts between IRRI as lead center and the partners AfricaRice, CIAT, Cirad, JIRCAS, and IRD were developed, reviewed by legal specialists and center oversight bodies, approved, and signed in 2017.**
3. Governance, and program and flagship project management				
3.01	Ineffective governance, conflict of interest between lead and participating centers and RICE	Independent Steering Committee with adequate independent members and clear terms of reference	Lead center Board of Trustees	**The minutes of the 2017 RICE Independent Steering Committee meeting is publicly and open access available here.**
3.02	Ineffective RICE program director	International competitive recruitment of RICE director; clear terms of reference	Lead center director general, RICE Independent Steering Committee	**Performance appraisal of CRP director over 2017 done at lead center**

3.03	RICE management team insufficiently empowered to manage for results	RICE management team includes high-level line managers (deputy director generals, directors) of lead and participating centers; flagship project leaders empowered to manage by results within their centers	RICE director, RICE Independent Steering Committee	-
3.04	Ineffective team interactions due to decentralized posting	RICE management team with clear terms of references; calendar of physical and virtual meetings in place; clear work plans	RICE director	**Face to face meeting of RICE program management team in March and June; virtual meeting in September; team meetings of CRP director with flagship project leaders in March and September, separate workshops for each flagship project throughout the year; visits of RICE director to CIAT, Cirad and IRD. All minutes of meetings and workshops available here at www.grisp.net.**
3.05	Friction among RICE partners	RICE program and flagship projects management team operates fairly and transparently; RICE conflict resolution policy	RICE director; Independent Steering Committee; Lead center board of trustees	**Face to face meeting of RICE program management team in March and June; virtual meeting in September; team meetings of CRP director with flagship project leaders in March and September, separate workshops for each flagship project throughout the year; visits of RICE director to CIAT, Cirad and IRD. All minutes of meetings and workshops available here at www.grisp.net.**
4. General RICE nonperformance				
4.01	Women insufficiently benefit from development outcomes and impacts, and gender inequity is maintained or enhanced	A strong gender assessment CoA that identifies constraints to full and justly-rewarded participation of women in the rice sector and in rice value chains, and that identifies entry points for improvement and empowerment of women. All FPs take note of concerns, needs, and requirements of both men and women beneficiaries in technology development and dissemination. See section 1.0.10, FP descriptions (sections 2.x.1.2–6) and Annex 4 for more details.	RICE management team; center management teams	RICE baseline data, progress indicators, adoption data, and impacts are fully gender disaggregated; results-based management framework (Annex 6). **Gender-disaggregated baseline and progress data made available here, draft report gender-disaggregated progress produced and will be available in 2018.**
4.02	Lack of partner capacity for innovation, ability to take up and deliver research results, and ability to engage in cutting-edge science	Capacity development is taken up along the whole impact pathway in all FPs, following the CGIAR capacity development strategy and its ten steps of implementation. Special attention is paid to institutional capacity development through skills training on innovation systems, development and	RICE management team; center management teams	Work plans, annual reports; results-based management framework (Annex 6). **RICE plans of work and budget (POWB) for 2017 and 2018 are publicly available here; RICE annual report for 207 will be**

		maintenance of multistakeholder platforms, and hands-on on joint R&D activities. Scholarships are awarded to train young scientists to become experts in their field and science leaders of the future. See Annex 3 and section 2.x.1.10 in each FP description (sections 2.x.1.2–6) for more details.		**made available here (by July 2018).**
4.03	Insufficient connection with cutting-edge new scientific developments to develop new science-based technologies and other solutions to the SRF grand challenges and SLOs	Actively establish collaboration with advanced research institutes across the globe. See Annex 2 and section 2.x.1.8 in each FP description (sections 2.x.1.2–6) for more details.	RICE management team; center management teams	RICE partnership arrangements (including subcontractors and consultants). **New partnerships developed in 2017, listed in this annual report 2017.**
4.04	Not able to deliver outcomes and impacts at scale	Actively establish collaboration with scaling and development partners at key action sites, at target country level, and elsewhere where impact can be accelerated. Develop multistakeholder platforms aimed at delivery of development goals (specifically in CoA 1.3). Strengthen or develop (where nonexistent) seed systems through CoA 1.4. See Annex 2 and section 2.x.1.8 in each FP description (sections 2.x.1.2–6) for more details. Investments in institutional capacity development among partners, especially on capacity to innovate and deliver outcomes and impacts.	RICE management team; center management teams	RICE partnership arrangements (including subcontractors and consultants); work plans, annual reports; results-based management framework (Annex 6). **New partnership arrangements developed in 2017, listed in this annual report 2017.**
4.05	Full potential for outcomes and impact is not realized because RICE operates in isolation from other CRPs and from country development strategies	Extensively engage with other CRPs in thematic collaboration and in site integration at key RICE action sites in CGIAR priority countries and RICE target countries. Develop projects that involve several CRPs/centers such as CSISA. See Annex 7 for more details. Engage with national partners through rice sector development (policy) dialogues and consultations; see section 1.0.9 for summary of mechanisms to do so.	RICE management team	CGIAR site integration plans; RICE work plans, annual reports; results-based management framework (Annex 6). **RICE plans of work and budget (POWB) for 2017 and 2018 are publicly available here; RICE annual report for 207 will be made available here (by July 2018).**
4.06	Delivery of outcomes and impact is hindered by insufficient learning and feedback loops within RICE – leading to static impact pathways and theories of change	Implementation of a results-based management strategy with a state-of-the art monitoring, evaluation, and learning system. Each FP will regularly assess progress, reflect on learning, assess risk and effectiveness of mitigation actions, and update impact pathways and theories of change accordingly. See Annex 6 for details	RICE management team	RICE results-based management framework (Annex 6). **RICE learning and feedback workshop held in September 2017; outcomes and impacts reported in this annual report.**

4.07	Development of new products is hindered by inability to access proprietary or patented technologies	Development and implementation of an active intellectual asset management strategy; see 0.s 1.12 and 1.0.13, Annex 10, and subsection 11 in each FP description (sections 2.x.1.2–6) for more details.	RICE management team; center management teams	RICE work plans, annual reports; contracts with partners, subcontractors, and consultants (including PPP). **See chapters in this annual report 2017.**
4.08	Full potential for outcomes and impact is not realized because of restricted access to data, information, and products and services generated by RICE	Development and implementation of an active open access and data management strategy; see section 1.13, Annex 9, and subsection 11 in each FP description (sections 2.x.1.2–6) for more details.	RICE management team; center management teams	Center-managed open access data bases. **See section 1.3.5 of this annual report for progress on open access; 57% of all RICE publications are open access.**
4.09	Full potential for outcomes and impact is not realized because of insufficient communication	Development and implementation of a broad communication strategy, and mainstreaming of good communication practices across the impact pathway in all of RICE's FPs and other activities; see section 1.0.14 and Annex 13	RICE management team; center management teams	Annual work plans and reports that include communication results; RICE results-based management framework (Annex 6). **Newly developed RICE website in 2017 has opened a new communication channel; summary of outcomes over RICE phase I; 4 issues of Rice Today, various media releases through institutional websites and outlets.**
5. Financial				
5.01	Insufficient budget (including W1,2, W3, and bilateral) to deliver outcomes	Maintain a modular set of outcomes and milestones to adjust to budget fluctuations; aggressive fund raising; renegotiate outcomes with donors	RICE director; lead and participating center DGs	Budgets as uploaded in the Financial System. **W1,2 budget reduction in 2017 of around 1.3 million $, managed by reduced activities in second half of 2017.**

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.