The Global Rice Science Partnership (GRiSP), a research program of the CGIAR, represents for the first time ever a single strategic and work plan for global rice research. GRiSP 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. GRiSP will train future rice scientists and strengthen the capacity of advisory systems to reach millions of farmers. For impact at scale, GRiSP scientists collaborate with hundreds of development partners from the public and private sector across the globe.

GRiSP was launched in 2010 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 Developpement (Cirad), L’Institut de Recherche pour le Developpement (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.

The responsibility for this publication rests solely with the Global Rice Science Partnership.

Suggested citation:
A. Key Messages (1 ½ page)

The development and dissemination of GRiSP’s products and services proceeded as planned. Major steps were made in sharpening the description and analysis of the causal chain leading toward impact of GRiSP research. A synthesis was made of the historic evidence base for the impact of international rice research on the CGIAR system-level outcomes (SLOs) of poverty alleviation, food security, health and nutrition, and environmental sustainability. This analysis led to updates of GRiSP’s impact pathways and theories of change underpinning our IDOs. GRiSP research leads to scientific discoveries that are used to produce products and services (Outputs), which are “brought to market” by intermediate users (resulting in Research Outcomes), adopted large-scale by end users (resulting in IDOs), and from there contribute to CGIAR SLOs. A second pillar of the impact pathway consists of strengthening the “enabling environment” for up-scaling and large-scale adoption of GRiSP-derived technologies to reach “impact at scale.” GRiSP activities helped to strengthen the “enabling environment,” such as capacity building of partners, needs and opportunity assessments, participatory testing, evaluation and modification of new technologies, creation of learning and innovation alliances, participatory impact pathway analysis (PIPA), modern advisory systems, and strengthening of technology delivery networks. Thematic impact pathways and theories of change were specified, and an initial set of indicators of progress along the impact pathways was identified.

Midway through phase I of GRiSP, positive signs of an even stronger and truly global rice R&D partnership have emerged. Collaboration among scientists from AfricaRice, CIAT, and IRRI has reached unprecedented levels as evidenced by numerous joint research activities (e.g., the global phenotyping platform, joint efforts in rice mapping using GIS and remote sensing, joint development of M&E frameworks and tools), cross-institute staff visits, increased exchange of germplasm, and integration of IRRI’s breeding activities in Africa in the Africa-wide Rice Breeding Task Force, convened by AfricaRice. Collaboration with our non-CGIAR founding partners Cirad, IRD, and JIRCAS focuses on prebreeding and variety development and has resulted in the discovery of some major functional genes. The competitive Frontier Projects have greatly contributed to strengthening and expanding these joint activities. Collaboration with partners from all sectors is probably at an all-time high in terms of numbers, diversity (academic, public, private, NGO), and effectiveness—in terms of science, agenda setting, and product development, delivery, and impact.

Synthesis of the two most significant achievements/success stories in the year (gender disaggregated where pertinent), with references to associated evidence and website links for more details.

1. Significant impacts of the adoption of GRiSP technologies were reported. A meta-analysis showed that the adoption of natural resource management technologies by some 1.2 million farmers led to positive impacts on yield and profitability, considerable economic surpluses (US$70.5 million on an $18.5 million investment, over 1997-2012), and high rates of return (25−43% projected to 2016); tangible sociocultural, gender, institutional, and policy impacts; and some positive environmental impacts such as reduced greenhouse gas emissions and reduced use of rodenticides and insecticides. Farmers in Odisha State, India, who adopted the flood-tolerant Swarna-Sub1 variety obtained an average yield benefit of 232 kg/ha (11%), with a maximum of 718 kg/ha (66%) when floods lasted up to 13 days. Swarna-Sub1 is especially advantageous to lower-caste farmers as they occupy more of the lower-lying flood-prone areas and their plots experience floods that last 21% longer (compared with farmers belonging to higher castes).

2. We made excellent progress in our gender program. We developed a new Gender Strategy, with full impact pathways and theories of change for each GRiSP Flagship Project, in which we identified the main entry points for technology development that respond to gender-specific
needs and preferences (new rice varieties, labor-saving and drudgery-removing practices, postharvest technologies, and business and marketing skills). We collected and analyzed gender-disaggregated information on gender balance in our main target domains, on the impacts of adoption of our GRiSP technologies, and on the impacts of climate change on men and women and on their specific response strategies. We strengthened women's agribusiness skills, trained women in the delivery of agro-technologies, targeted women in training on seed preservation technologies, targeted women as recipients of new stress-tolerant varieties, strengthened women’s groups in branding and selling rice, and assisted former combatant women in Burundi to re-integrate into society through rice production activities. We published outcomes of gender analyses and impacts of the adoption of GRiSP technologies for a broad audience. We facilitated transformative changes through the development and dissemination of policy briefs, awareness raising, advocacy events, the inclusion of gender aspects in planning workshops, training of own staff and NARES partners on gender and diversity, and by working with our NARES partners in developing gender RD action plans.

Overall financial summary: actual total spending (from all sources, including bilateral and Window 3) and percentage expended on gender research, compared to expected budget:

B. Impact Pathway and Intermediate Development Outcomes (IDOs) (1/4 page)

Provide a web link to the overall CRP Impact Pathway and theory of change (including gender dimension) and list the CRPs’ IDOs and their associated targets and indicators. Provide a web link to the baseline data of the CRP.

We developed a revised Impact Pathway and Theory of Change as well as gender-specific Impact Pathways and Theories of Change. Major baseline data (household surveys) can be viewed here. Currently, the following IDOs are proposed:

1. Increased rice production that meets local and global demand
2. Increased profitability of rice producers and increased rice affordability to rice consumers
3. Increased efficiency and value added along the rice value chain
4. Increased sustainability and reduced environmental footprint of rice production
5. Increased health and nutrition from rice and from diversification
6. Increased capacity, gender equity, and resilience in the rice sector

In 2014, we will develop a coherent set of indicators and aspirational targets.

C. Progress along the impact pathway

GRiSP builds on investments in rice R&D made by AfricaRice, CIAT, and IRRI prior to its start in January 2011. Research, product development, and delivery are long-term processes and GRiSP did not break off previous activities and start from scratch. In addition to initiating new R&D activities, it continues previous lines of research where relevant; actively works with its partners to test, adapt, and disseminate prototype technologies derived from previous investments; and studies adoption and impacts thereof of both previously and currently released and disseminated technologies. A good example is the decennia-long pipeline (or impact pathway) of research, development, and dissemination of submergence-tolerant varieties. Though Sub1 varieties are currently being developed, released, and adopted, research on further enhancing the tolerance of submergence continues by increasing tolerance of longer flooding periods and of flooding that occurs at other and/or multiple stages of the life cycle of rice. Thus, the development of submergence-tolerant rice is not a one-time “shot” reported only once, but it is a continuous product improvement that will recurrently be reported by GRiSP (as with many other GRiSP product pipelines). In this section, we report on outputs, outcomes, and impacts measured and/or analyzed and published in 2013 except when otherwise indicated (e.g., we sometimes report cumulative data since the inception of GRiSP,
and this is clearly indicated). It should be noted that the outputs are those produced in 2013, whereas the outcomes and impacts are measured or derived from analyses that are published in 2013 on the use of products disseminated before the start of GRiSP. For example, in 2013, we concluded and published an analysis of the adoption of submergence-tolerant rice based on surveys conducted in 2012 on the adoption of Sub1 varieties developed in earlier years — hence, the results of this study are reported here in 2013. There are, however, also outcomes derived from the use of products developed during the past few years of GRiSP itself by intermediate users. We have tried to make this clear as much as possible in the text, but it should be recognized that research is a dynamic and continuous process and it is not always possible to define exactly when the development of a certain R&D line began (before or during GRiSP).1

C.1 Progress towards outputs (2 pages)

Summarize major successes in producing outputs; provide links to additional descriptions of these achievements. Refer to indicators from Table 1, as relevant.

**Prebreeding.** We completed the re-sequencing of 3,000 rice genomes. A database of genomic variation, including 112 varieties relevant for breeding in Latin America, was developed, and more than one million unique SNPs have been assembled. Some 235 SNP markers were developed, of which 188 were highly specific to African rice species *Oryza glaberrima* and *O. barthii*, and used to genotype 279 diverse accessions. Novel genetic resources were created to broaden the genetic base for breeding. We generated multiparent populations (Multiparent Advanced Generation Inter-Cross, MAGIC) to harness new genotypic diversity through recombination. Using disease resistance, abiotic stress tolerance, and grain quality traits as test cases, we demonstrated the value of these populations for genetic mapping and breeding. Twenty nested association mapping (NAM) populations of rice were developed in Latin America and Africa to be used for fine mapping and cloning of numerous QTL alleles for drought tolerance and other traits of interest. A number of high-value genes and QTLs were discovered that will boost the development of high-yielding and stress-tolerant rice varieties. Novel sources of resistance to various rice diseases and pests as well as tolerance of abiotic stresses were identified in *O. sativa*, *O. glaberrima*, *O. barthii*, and several wild relatives. Molecular markers were developed for these resistance genes and multiple resistances were pyramided into elite cultivars. Several new donors for drought, flood, salinity, and heat tolerance were identified, and single QTL and pyramided QTL lines were developed. The FLUIDIGM system for marker-assisted selection (MAS) using SNPs is completely operational at IRRI and CIAT. A new gene was discovered, called SPIKE, which can increase production by 13–36% in long-grain indica varieties. The C4 team pyramided five C4 candidate transgenes into a single transgenic line, a significant step toward developing a C4-like rice prototype.

**Variety development.** We coordinated the evaluation of 545 breeding lines in 390 international nurseries in 24 countries in Asia under different production conditions and for resistance to/tolerance of biotic and abiotic stresses. IRRI implemented three-stage multilocation trials in Southeast Asia and in East and Southern Africa that were integrated in the Africa-wide Rice Breeding Task Force. More than 70 elite lines were converted to male sterile lines for use as parents in the newly established recurrent selection program. Multiple abiotic stress-tolerant lines were developed and made available to partners. Genotypes possessing yield-enhancing genes showed significant differences in yield component traits compared with the recurrent parent genotypes. IRRI’s variety development pipelines were restructured to improve the efficiency and to increase the genetic gain of rice breeding. Consumer preference and target trait maps were developed and published. New drought- and salinity-tolerant varieties were released in various countries, plus an aromatic rice in the Philippines. Golden Rice field trials were conducted in the Philippines and monitored by its national regulatory authority for crop biotechnology research and development. One of the field sites was vandalized by anti-GMO

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1 This preambule is inserted to clarify the dynamic, long-term nature of the research to impact pathway of GRiSP
protesters, an act that was criticized in an editorial of Science Magazine. In sub-Saharan Africa, 560 breeding lines were evaluated in multi environment trials at 218 sites in 29 countries by the Africa-wide Rice Breeding Task Force. A systematic approach to rice varietal screening has been adopted, involving a sequence of three phases with standardized protocols. In Latin America, elite germplasm was shared during breeding workshops, advanced lines were tested by partners, and new varieties have been released (see section C2 for more details). The Hybrid Rice Research and Development Consortium in Asia increased its membership from 64 in 2012 to 68 organizations in 2013 from both the public and private sector, and shared 4,219 lines/parents for testing and evaluation. Fifty-five new IRRI hybrids were named and tested in various trials, while six new Green Super Rice hybrids were released and disseminated in India. In Latin America, 529 lines from CIAT, FLAR, and national programs were test-crossed with IRRI females through the Hybrid Rice Consortium for Latin America (HIAL). Four experimental hybrids were evaluated in the tropics and in temperate regions, and showed a good yield advantage, good grain quality, strong disease resistance, and adequate seed production (>2,500 kg/ha).

**Sustainable rice management.** Scientific principles of ecological intensification were developed to sustain high productivity and profitability, while meeting acceptable standards of environmental quality. In partnership with the Sustainable Rice Platform, guidelines for sustainable rice production were developed with a range of stakeholders from the public and private sector. Testing of a prototype decision tool for rice pest and disease management (RICE-PRE) in the Philippines indicated higher profitability of the proposed technologies than with farmers’ practices. Principles of ecological engineering to increase the resilience of rice landscapes against insect pests continue to be developed across Southeast Asia. Site-specific nutrient management guidelines, incorporated and delivered through the updated multiplatform tool Nutrient Manager, were released in Bangladesh, Indonesia, and the Philippines. In Africa, Nutrient Manager became ready for use in Senegal while validation trials were conducted in Benin and Nigeria. We expanded Nutrient Manager into a Rice Crop Manager and a Rice Advice system by incorporating other management practices, including elements of the decision tool RICE-PRE, climate information, target yield functions, and varietal choice. Rice Crop Manager was released, through our national partners, in the Philippines and Bangladesh. Across Asia, GRiSP tested improved management practices and varieties for tolerance of submergence and stagnant water. In India, crop establishment, nursery bed management, and nutrient management practices were adapted for newly available submergence-tolerant rice varieties. To better understand the performance of varieties and management in the different stress environments in the delta and central dry zone regions of Myanmar, detailed mapping of cropping practices was undertaken using remote sensing. We developed improved practices for rice-based cropping systems, such as rice-mungbean, rice-wheat, and rice-maize rotations, and for integrated rice-shrimp farming. In Latin America, detailed information was collected to validate the Oryza2000 model to support extrapolation of experimental results across the region. In Africa, the first sets of good agricultural practices were introduced in rice-sector development hubs in 15 countries. Good progress was made in developing management options to control weeds, an especially wicked problem in Africa. Mechanical weeders and labor-saving weed management practices were identified through participatory evaluation in 10 countries. A set of management options—use of fertilizer, manure, and rice husk—to control parasitic weeds in upland and rainfed lowland was developed for East Africa. A conservation agriculture (CA) system including zero tillage, intercropping, rotation, and resistant varieties was developed to control the parasitic Striga in Madagascar.

**Postharvest technologies and value adding.** Significant advances were made in developing improved technologies for harvesting, drying, and processing of rice. In Vietnam, 21 business models for combine harvesting, drying, laser leveling, and combined postharvest operations were assessed, of which 10 were taken further in pilot projects. Business models for drying and storage were also piloted in the Philippines and Cambodia, in collaboration with NGOs. In India, business models for open-drum and axial-flow threshers have been successfully taken up by women’s self-help groups,
farmer groups, and service providers. In collaboration with the private sector, a new low-cost solar bubble dryer was developed and tested to improve sun drying. Improved rice parboiling equipment was fabricated and tested in Benin, Cameroon, and Ghana. This equipment is now being assembled for validation for its parboiling efficiency, cost-effectiveness, and user friendliness—especially for women—prior to widespread dissemination. We facilitated training of agricultural machinery manufacturers from eight African countries in the fabrication of an axial-flow thresher. We also facilitated the training of blacksmiths from Tanzania and Benin in the fabrication of different types of rotary weeder. Prototypes fabricated in Benin were sent to 10 countries in Africa for validation and local fabrication. We investigated the use of husk and straw for energy generation and for mushroom cultivation. Feasibility studies for two 1-MW rice-straw-fired power plants began in the Philippines, and business models for farmers collecting rice straw for power plants were outlined.

Policy and information support. We published an updated version of the Rice Almanac, with coverage of 99.9% of the world’s rice production and 81 of the 117 rice-producing countries, including 19 in Latin America. Throughout the year, we provided analyses of global rice prices, supply and demand of rice, and rice market and policy issues through popular media such as blogs and *Rice Today* articles. We facilitated the development and launching of a regional initiative to boost the rice sector in West Africa led by ECOWAS (Regional Rice Offensive in West Africa) and in collaboration with the West African Economic and Monetary Union (WAEMU), the African Union, Hub Rural, ROPPA, the Permanent Interstate Committee for Drought Control in the Sahel (CILSS), and the national programs. In Latin America, we worked with national programs to explore options to take advantage of underused water resources.

C.2 Progress towards the achievement of research outcomes and IDOs (2 pages)

*Summarize major successes in the progress towards research outcomes and IDOs. Refer to relevant indicators from Table 1, where relevant, and to the indicators of progress towards the CRP’s IDOs.*

Adoption of GRiSP products by partners. At the start of GRiSP, some 450 development partners were involved in evaluating and disseminating GRiSP products, and this number has probably increased significantly since then. In Bangladesh, India, and Nepal alone, 447 partners are involved in the multiplication and dissemination of stress-tolerant varieties. Together, they delivered an estimated 80,000 tons of new seeds to farmers in 2013. Local partners in Bangladesh distributed close to 316,000 packs of seeds of stress-tolerant rice. Increasingly, private-sector partners disseminate GRiSP technologies through their own advisory agents and distributors in the field. Syngenta disseminates information on GRiSP water-saving technologies (called panipe) to tens of thousands of farmers in Asia. Commercial cell phone service providers distribute nutrient and crop management advice to farmers and extension agents. Other programs and aid agencies have also taken up and disseminated GRiSP technologies, such as the drum-seeder by the USAID-funded HARVEST program and International Development Enterprise, and laser land leveling by the CAVAC program, all in Cambodia.

The use of GRiSP products by partners is typically illustrated in the breeding pipeline. In total, around 110,000 seed lots were requested by, and shared with, partners across the globe. Many prebreeding lines were selected by partners to develop their own new varieties. Eight national programs used 173 promising entries from the INGER nurseries. Some 4,219 hybrid lines/parents were shared among the members of the Hybrid Rice Development Consortium in Asia. A total of 113 new varieties were released in various countries as a direct result of breeding efforts by AfricaRice, CIAT, and IRRI, bringing the total number of released varieties since the start of GRiSP in January 2011 to an estimated 180–190. BRRI dhan62, the world’s first zinc-rich rice, was released in Bangladesh. It has 20–22 parts per million (ppm) of zinc while the average zinc content of rice is 14–16 ppm.

Adoption of GRiSP products by end users. From a synthesis of adoption studies over the past two decades, we conservatively estimate that, annually, new rice varieties that have AfricaRice, IRRI, or CIAT material in their pedigree replace old varieties grown by an estimated 7.7 million farmers on
close to 5 million hectares globally. GRiSP aims to accelerate this process considerably. In South Asia alone, since the start of GRiSP, we reached almost 5 million farmers in 2013 with new stress-tolerant rice varieties. Of these, submergence-tolerant Swarna-Sub1 reached more than 4 million farmers. Initial adoption studies (results analyzed and published in 2013) in eastern India and northern Bangladesh revealed adoption rates of 5−40% in 2011-12. In Bangladesh, we provided more than 128,000 farmers with new rice varieties tolerant of saline soils, and about 1 million farmers with new stress-tolerant and high-yielding rice varieties over the past 2 years (these data became available in 2013). Quality seed of improved varieties was distributed among more than 700,000 farmers in Africa through collaborative efforts with partners in 2009-13 (these data became available in 2013). The adoption rates of improved crop management technologies are difficult to assess. In Indonesia, some 30,000 farmers requested advice in 2013 on nutrient management through the mobile phone and web-based Nutrient Manager (77% of this advice was requested through mobile phones). A synthesis study conducted and published in 2013 concluded that, through the Irrigated Rice Research Consortium, improved crop management technologies had reached 1.2 million farmers in Bangladesh, India, Indonesia, Myanmar, the Philippines, and Vietnam over the 1997-2012 time frame. More than 185,000 cereal (rice, wheat, maize) farmers in India implemented sustainable intensification practices.2 In eastern India, improved dry-seeding technologies for rice reached adoption rates of 61%. GRiSP has been successful in introducing improved postproduction technologies through PPP partnerships. A draft synthesis report produced in 2013 indicated that, since 2008, some 5,000 combine harvesters were introduced by Kubota in Cambodia, and 8,000 in the Mekong Delta of Vietnam, potentially reducing harvesting losses by 3−5%. About 500 improved mechanical dryers have been installed in Myanmar, Cambodia, and Indonesia. GRiSP also strengthened whole rice value chains by bringing together private operators (traders, processors) and farmers in cooperative models that are backstopped by micro-financial institutions. In Cameroon, Chad, and the Central African Republic, six processing centers for quality rice were established, and 179,000 farmers were engaged in business.

Progress towards IDOs. The following indicators testify to progress towards IDOs: Genetic gain: A 2013 experiment at CIAT demonstrated a genetic gain for yield of 84 kg/ha/year (1.27%) in the high-light season and of 45.5 kg/ha/year (0.8%) in the low-light season. For upland rice, the annual genetic gain was nonsignificant in 1984-92, 15.7 kg/ha (0.53%) in 1992-2002, and 45 kg/ha (1.44%) in 2002-09. For comparison, a genetic gain of 75−81 kg/ha/year (1%) was reported earlier (in 2000) at IRRI in the dry season for varieties developed till the turn of the century.

Yield and yield gap: We initiated the combination of simulation modeling, remote sensing, GIS approaches, statistical information, and expert opinion to map yield gaps in Asia. In 2013, yield gap and diagnostic surveys were conducted in 20 countries in Africa. We also analyzed trends in rice production across the African continent, placing particular emphasis on the period before and after the 2007-08 rice crisis. The production growth rate in sub-Saharan Africa increased from 3.2% per year before the rice crisis (2000–07) to 8.4% per year after the rice crisis (2007−12). Paddy rice production increased by 2.8 million tons (Mt) from 2000 to 2007, and then accelerated, increasing by 4.7 Mt in the period 2007−12. Rice yield increased by about 11 kg/ha per year from 1961 to 2007 and by a spectacular 108 kg/ha per year from 2007 to 2012. Average rice yield jumped by about 30% from 2007 to 2012. A study in 2013 (pages 161-170) reported that, in the first decade of the 2000s, improved agronomic practices introduced through FLAR raised yield from 5.4 to 7.2 t ha−1 in irrigated rice in the cone of South America. A panel of experts convened in 2013 to further identify and analyse yield gaps across Latin America. Technologies exist to increase the yield at the farm level by 2 t/ha and reduce production cost by about 30%. Constrains to adoption of improved agronomic practices are unfavorable land tenure arrangements, price protection, weak local institutions, lack of coordination among value chain actors, and lack of well-trained extension personnel and advisors.

2 Since most farmers grow (rotate) a combination of cereal crops, it is difficult to separate these numbers for rice-specific technologies; these are joint results of the CRPs GRiSP, WHEAT, and MAIZE.
Resource-use efficiency: A 2013 meta-analysis synthesized increased efficiencies of improved rice production technologies in Asia realized between 1997 and 2012. A snapshot shows that site-specific nutrient management increased yield by 7–11% and, with similar fertilizer use, increased profit by 6–29%. Alternate wetting and drying reduced water inputs by 5–30%, changed yield by −5% to +16%, and increased profit by −6% to +130%. The integrated “1 Must Do, 5 Reductions” technology in southern Vietnam significantly reduced inputs such as seed, fertilizer, water, and pesticide, with an average increase in profitability of 13%. Integrated crop management in Indonesia increased yield by 8–51% and net income of farmers by 21–56%. Improved postproduction technologies reduced grain losses considerably in Southeast Asia: combine harvesting can reduce harvesting loss by 1.6–4.4%; mechanical dryers can reduce physical losses by 3–4%, increase milling recovery by 8%, and maintain quality; hermetic storage can reduce storage losses by 3–5% and (in Cambodia) increase head rice recovery by 8%.

Environmental footprint: Adapted water management in farmers’ fields was shown to have multiple benefits to the environment. Alternate wetting and drying reduced water inputs while at the same time decreasing methane emissions by 43% on average. In addition, when pumps are used for irrigation, energy use and irrigation costs declined. Following the recognition of the technology by the UNFCCC as the first agricultural Small-Scale Methodology in the Clean Development Mechanism, we carried out and published a concrete feasibility study in 2013.

Nutritious and safe rice: New rice lines were developed with significantly increased micronutrient content: high-zinc rice with 25–51 ppm Zn (up from 14–16 ppm) and high-iron/high-zinc rice with 12–15 ppm Fe (up from 2 ppm).

Equitable and resilient rice sector. See section D for progress on gender equity and section F for progress on capacity building. We worked with an array of approaches and tools to catalyze innovation systems that increase capacity to respond to change and enhance resilience in the rice value chain: Learning Alliances, farmer clubs using Ricecheck approaches, message design workshops, Digital Green videos, rice-sector development hubs, Africa-wide Rice Task Forces, community approaches to rodent and insect pest control, etc.

C.3 Progress towards impact (1/4 page)

If/when relevant major contributions towards understanding impact and impact per se should be summarized, with a web link to more detailed documents.

New impact studies revealed the value-for-money from previous investments in rice R&D that were carried forward by GRiSP (see also the impact studies reported in 2012 for a complete picture). A meeting of experts in Latin America and the Caribbean (LAC) in 2013 concluded that the percentage of varieties released with CIAT parentage in Peru, Bolivia, Venezuela, Ecuador, Nicaragua, Costa Rica, and Panama increased from 40% before 1990 to 78% after 2000. This translated directly into a larger area under rice varieties with CIAT parentage: from 11% of the total area of rice in the 1990s to 64% currently. In 2013, we analyzed and reported early evidence of adoption of submergence-tolerant rice in India, a country where 12–14 million ha of its total of 44 million ha are prone to flash flooding. In 2011-12, adoption rates of the flood-tolerant Swarna-Sub1 variety were around 30% in Uttar Pradesh and 12–18% in Odisha. On average, farmers in 128 villages of Odisha who adopted Swarna-Sub1 obtained a yield benefit of 232 kg/ha (11%). The yield advantage increased as flood severity worsened, with a maximum advantage of 718 kg/ha (66%), occurring at some 13 days of flooding. Swarna-Sub1 is especially advantageous to lower-caste social groups as they occupy more of the lower-lying flood-prone areas and their plots experience 21% longer flood durations (than farmers belonging to higher castes). Simulation results showed that replacement of all Swarna with Swarna-Sub1 during the 2011 floods would have resulted in an increase in total rice production of 25% for higher-caste farmers and 40% for lower-caste farmers.
A meta analysis conducted and reported in 2013 assessed the impacts of research on natural resource management by the Irrigated Rice Research Consortium in Asia. A long-term investment of $18.5 million from 1997 to 2012 led to more than 1.2 million farmers adopting new technologies over the past 4 years, benefiting financially through increased yield and lower costs of production. An economic surplus analysis in just four of the ten countries the IRRC operated in suggested economic benefits of $70.5 million and rates of return of 6–30% (depending on how the surplus for different technologies was aggregated). Projecting benefits 4 more years until 2016, rates of return increased to 25–43%. IRRC technologies also produced tangible sociocultural, gender, institutional, and policy impacts. Common sociocultural impacts were improved farmer livelihoods and well-being, improved food security, reduced vulnerability to adverse economic and climatic conditions, improved social cohesion in communities, and fewer social conflicts. There was also some evidence of the environmental impacts of selected IRRC technologies, such as lower greenhouse gas emissions and reduced use of rodenticides and insecticides.

D. Gender research achievements (1 page)

Explain the significance of the main gender research achievements of the CRP with reference to the CRP’s outputs and outcomes to which they contributed. Describe main successes and challenges encountered in mainstreaming gender research and mitigation actions taken by the CRP. Use the process indicators specified in the CRP Gender Strategy to assess the effectiveness of gender research mainstreaming in 2013.

In 2013, we made considerable effort to strengthen and completely rewrite our gender strategy. We developed an impact pathway and theory of change on how “empowerment” of women in the agricultural research for development (AR4D) arena and in the rice value chain (women farmers, postharvest operators, processors) accelerates the delivery of GRiSP’s intermediate development outcomes. The term “empowerment” integrates the strengthened role of women in the design, execution, and evaluation of AR4D, as well as improved access to resources and control over outputs.

We recognize that enhanced empowerment of women will take place only after substantial transformative changes have taken place in the mind-sets and behaviors of all actors in the AR4D arena and in the rice value chain, from grass-roots to leadership levels, among both men and women. The write-up of our revised gender strategy includes an impact pathway and entry points for gender R&D for each of GRiSP’s Flagship Products, as well as an indication of current resources invested, including staffing (scientists and managers) with responsibility for gender R&D. All socio-economic data collected by GRiSP (through household surveys, focus group discussions, other surveys) are gender disaggregated. A synthesis of gender-related constraints and of the main dimensions of gender balance in GRiSP’s main target domains began in 2013 and will be reported in 2014.

Research outputs. Impact stories of our gender work have been synthesized in the report “GRiSP: Women in Motion, 2013.” In Latin America, our understanding of the role of women in rice farming and along the rice value chain is still very limited; hence, we initiated steps to obtain such insights. In south and southwest Bangladesh, monoculture commercial aquaculture farming (CAF)—particularly fish, shrimp, and prawn farming—has been expanding in rice fields over the past decades. In a study in Mymensingh, Khulna, and Sathkhira districts, we found that the shift from rice to CAF improved household income and food security. However, this new financial resource is controlled by men who sell the products directly to the traders and women do not benefit from the higher income from CAF. The adoption of CAF made women more dependent on their husbands to secure food (e.g., rice, pulses, and vegetables) for their families. In rice-based farming, women had more access to and control over crop products at the household level. Households stocked rice for a whole year and women decided on its use for family consumption. Women had influence on the amount of grains to be sold and the amount to be saved. The traders came to the village to purchase rice, which allowed women to know exactly how much money they were getting from selling their rice.

In South Asia, hundreds of millions of people depend on cereal cropping and mixed crop-livestock systems for their food, employment, and income. The Cereal Systems Initiative for South Asia
(CSISA) project aims to reduce food and income insecurity through accelerated development and deployment of new cereal varieties, sustainable management practices for crop and resource systems, and better access to information. Understanding the gendered nature of asset distribution and how this influences individual and household livelihoods is essential to designing effective agricultural research and development for interventions and policies. This understanding will help strengthen, within the context of CSISA, women’s access to and control over key agricultural assets. Qualitative research and midline surveys were conducted in Maharajganj and Deoria districts in Uttar Pradesh and East Champaran in Bihar. Focus group discussions on asset-related information were conducted with separate gatherings of men and women from upper- and lower-caste groups. These discussions were followed by in-depth interviews with the principal men and women in 60 households on the importance of assets. In 2012, midline surveys of 318 households in 18 villages were conducted to collect gender-disaggregated data on household composition and assets. In 2013, we analyzed and reported the results (pages 45-48 of the GAAP report). Farmlands were mainly owned by the principal males, which restricted female farmers’ opportunity to receive farm inputs and participate in training activities. No women owned, used, or controlled any agricultural machinery or equipment. Outcomes of labor-saving technologies (such as mechanized crop establishment) were reduced drudgery and health risks for women who work on their own farms and loss of income for women who work as agricultural wage laborers. To benefit fully from agricultural innovations, women need increased access to agriculture-relevant physical assets (land and machinery) and human capital (education and extension services). Development programs should increase women’s ability to earn agricultural and nonagricultural income. Group-based programs targeting women have greater potential to address gender relations within the household and society than programs targeting women as individuals. Our study in Uttar Pradesh and Bihar was supplemented by a gender assessment in rice-based farming systems in Odisha, India. A rapid field survey was conducted with men and women farmers from the scheduled caste (SC), commonly known as untouchable/lower caste, and other backward class (OBC), who are marginalized and poor smallholder farmers. Traditionally, members of these castes worked as agricultural daily wage laborers, but, with landlords moving out of rural areas, the majority of these groups are now cultivating leased-in farmland on a crop-sharing basis. We found that the role of women from these marginalized/disadvantaged groups is significantly increasing within the household and in farm management. Specific activities and promising approaches were recommended for the CSISA project in Odisha, such as demonstrations on mechanized rice transplanting and on mechanized (combine-) harvesting, training of women farmers on quality seed preservation and storage, and strengthening the capacity of women entrepreneurs.

An independent assessment led by Johanna Bergman Lodin from Lund University reported on the benefits and burden derived from the adoption of NERICA4 in Hoima District, Uganda, for men, women, and children of farming households. The team conducted more than 50 focus groups and key stakeholder interviews, and gathered daily diaries from 13 households detailing precise time and labor use for each family member. Because of gender and generational norms that influence practice, women, with help from their children, take on the responsibility for protecting the rice crop from pests and weeds — especially from bird pests. Findings reveal that, while households that have adopted NERICA4 have become better off in economic terms, the extreme labor burden that NERICA4 demands in bird scaring and weeding affects women’s and children’s wellbeing negatively by exacerbating their time and energy expense, and poverty. However, because men feel a vested economic interest in NERICA4, they are willing to deviate from traditional gendered divisions of labor and pitch in to ensure maximum yield. Though men’s participation is still lower and less back-breaking, it does point to adjustments and renegotiations that could lead to more balanced and sustainable investments in household labor for NERICA4 production. Likewise, women in the study report are gaining a greater voice within the household. Traditionally, men control the sale of cash crops and all of the proceeds. But the joint management and labor investment in the NERICA4 rice crop is giving women more bargaining power. NERICA4 production is providing socioeconomic leverage for women and an effective entry point into more commercially oriented modes of production. It is opening up a window of opportunity for women in a way that other crops, such as tobacco never has. The study
concludes that further advances and support are needed to reduce the crop’s heavy demands on women’s labor, especially related to weeding. Likewise, gender inequities in access to land remain to be resolved. By more fully understanding how NERICA4 affects gender dynamics within the household and addressing the policy and technology challenges raised in this research work, gender researchers and partners can help shift the success of NERICA4 from success measured solely by growth in household income and production to success that also transforms women’s lives.

We analyzed the interlinkages among climate change variability, livelihoods, food security, and gender roles in rice-based farming systems in Africa and Asia. Using gender-sensitive qualitative methods, we investigated the gendered adaptation to flooding in rice farming communities in Nueva-Ecija, Philippines. Flooding, brought about by heavy rainfall and frequent typhoons, is predicted to increase in a climate change-prone country such as the Philippines. As a country that often experiences climate-related disasters, men and women have developed adaptation strategies that make them resilient to extreme weather events. Though men and women mostly adapt to flooding according to their traditional roles, they start to assume new roles due to changing weather patterns that affect their livelihoods. This alteration of gender roles has significant impacts on men and women farmers and on the welfare of their households. This study highlighted the importance of understanding gendered adaptation strategies and their consequences that can provide a basis for designing long-term strategies for adaptation to climate variability. In Benin, Senegal, Uganda, Nigeria, Cameroon, Mali, and Côte d’Ivoire, both men and women observed changes in temperature and incidence of drought and flooding leading to lower yield and sometimes to total crop failure. Coping strategies for men included migration. Women tried to start small businesses or asked family members for help. In Cameroon, women changed eating habits (eating cassava instead of rice) and cropping patterns, planting early-maturing and more stress-tolerant rice varieties. We also studied gender balance in rice production, decision making, technological knowledge, and access to production resources in Benin. Women had easier access to credit than men, who in turn had greater access to land, technological knowledge, and labor. Men were largely in control over rice production resources. Women mainly controlled benefits derived from nonagricultural activities. In terms of rice production constraints in the study area, the three major ones for both men and women were drudgery of land preparation, the difficulty of access to inputs, and difficulty of access to credit.

**Technology development and delivery.** In developing improved rice varieties, about 30% of the women farmers were included in PVS and variety preference analyses, and the results of these studies are gender disaggregated. In a study in Bangladesh and parts of eastern India, we found that sociocultural norms limited the mobility of women farmers to the confines of their homesteads. They are seldom allowed by their male “guardians” to be consulted or interviewed. GRiSP partner the Ashroy Foundation conducted a series of meetings and personal consultations with husbands, religious leaders, and other influential people in the local community so that the women were allowed to take part in interviews and be involved in livelihood activities. During these sessions, it was emphasized that, if women practice the improved methods of rice seed preservation, this will lead to increased yield, increased surplus, and more income for their families. The work was extended across Khulna, Satkhira, Narail, and Bagerhat districts of Bangladesh with 23,000 farmer participants, including 17,250 women. Some 200 women from 10 districts in Tien Giang Province, Vietnam, were trained on keeping rice fields ecologically sound and balanced by planting flowers all around, a practice called ecological engineering. “Friendly” insects and other organisms that live in the diverse vegetation around the rice fields help control pests of rice, such as the brown planthopper, that yearly affect hundreds of thousands of hectares. In Africa, we worked with women’s groups to enhance their marketing skills through research on the effects of labeling and branding of rice. Women (groups) engaged in processing and marketing of parboiled rice were helped with improved and affordable parboiling technologies. In Burundi, the innovative program to train ex combatant women on rice farming techniques to enable them to reintegrate into society has increased to cover 800 women.
Transformative change. We conducted a large number of awareness activities, workshops, and training events: the International Women in Rice Forum (IRRI, 14 March), a Review and Planning Meeting of the African Gender in Rice Research and Development Task Force (Cotonou, 6-10 May), the Women in Rice Farming Day (IRRI, 8 August), representation at a number of international events, a set of two-day “Gender and Diversity” training (IRRI staff), and various hands-on gender training activities of NARES partners. In Bangladesh, the InfoLadies extension approach was used to transfer rice technologies to women farmers who do not have access to information. InfoLadies are young female extension workers who disseminate agricultural information using information and communication technologies.

E. Partnership building achievements (1 page)

Describe partnership building achievements (if any new ones since last year) and associated strategic partnership issues, including public-private partnerships where relevant. Include a brief description of mechanisms designed to align CRP with priorities in national, regional bodies etc... Include a brief analysis of new strategic interactions with other CRPs and their effectiveness. Include a brief commentary on how different key partners are using the CRP’s outputs and outcomes.

In 2013, GRiSP published a special partnership report explaining in detail the modalities of its partnerships. A variety of partnership arrangements operate under GRiSP (consortia, platforms, networks, and (grant) projects) that evolve in size and composition across the impact pathway. Partners are actively engaged in agenda setting and guidance of GRiSP through participation on GRiSP’s Oversight Committee and on the Steering Committees and boards of the subpartnership arrangements. GRiSP employs several mechanisms for alignment with national rice programs and with the priorities and strategies of its partners:

- In Asia, IRRI holds consultative planning meetings every 2–4 years with its partner countries. In 2013, the 4-year India-IRRI work plan was fully aligned with GRiSP, including allocation of ICAR funds to GRiSP activities in India. The Council for Partnership on Rice Research in Asia (CORRA), which includes members of all Asian rice-producing countries, is the main regional advisory body of GRiSP. In 2013, the Rice Research and Training Center for Central and West Asia became active with its first training activities on rice research.

- AfricaRice Center is an autonomous intergovernmental association of 25 member countries covering West, Central, East, and North Africa. Its objectives, strategies, and research activities are aligned with those of its member states and get approved by the AfricaRice Council of Ministers.

- In Latin America, the Latin American Fund for Irrigated Rice (FLAR), which is led by CIAT, and includes 18 member countries, is the main mechanism for regional coordination. It includes partners from the public and private sector.

GRiSP interacts closely with all major regional fora and economic communities that have a major interest in development of the rice sector, such as FARA, FORAGRO, APAARI, CORAF, ASARECA, CAADP (NEPAD), CARD, ASEAN, SAARC, APEC, UEMOA and ECOWAS.

GRiSP has three main mechanisms to engage in public-private partnerships. Through Scientific Knowledge Exchange Programs, we engage in joint R&D on specific topics such as prebreeding, research tool development (e.g., survey tools for pest and disease monitoring), technology development (e.g., drying equipment, parboiling), and information generation (e.g., rice production forecasts). Second, we engage with private-sector partners for effective dissemination of GRiSP products, such as new rice varieties, management recommendations, and postharvest technologies. The Asian and Latin American hybrid rice consortia are examples that embody both mechanisms. Third, we work with local small and medium enterprises to develop business models for GRiSP technologies, especially in the field of postharvest. A new PPP is the Sustainable Rice Platform: a

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3 Acronyms are explained in Appendix 5.
global multistakeholder platform, co-convened by the United Nations Environment Programme (UNEP) and IRRI, to promote resource efficiency and sustainable trade flows, production and consumption operations, and supply chains in the global rice sector. Partners include the food sector, international traders, agro-input suppliers, public R&D, and national government agencies.

We collaborate with the MAIZE and WHEAT CRPs in strengthening cereal-based crop production systems in South Asia; with AAS and WLE in optimizing the use of aquatic resources in Bangladesh; with A4HN in the delivery of high-zinc rice; with the Genebank CRP on enhancing the quality, effectiveness, scope, and global use of the rice germplasm collection; and with CCAFS on the development and delivery of rice technologies that are climate-change-proof and/or mitigate greenhouse gas emissions. Collaboration with these CRPs is mainly done through large cross-cutting projects (e.g., CSISA, Global Futures, HarvestPlus). GRiSP focuses on the development of novel technologies at the level of plant (and below), field, crop, and farm, whereas the other CRPs look at larger geographic scales and at the wider enabling environment (e.g., policies and institutions).

F. Capacity building (1/2 page)

Provide a summary and highlights of training and its outputs and outcomes. Use indicators from Table 1, as appropriate.

We provided degree training to 391 scholars, of which 42% were females. Out of an estimated total of 15,156 partner staff that received short-term training (Table 1), 31% were females. It was estimated that, by the beginning of 2013, the fourth phase of the Irrigated Rice Research Consortium had trained an accumulated 20,782 partner staff on improved crop management technologies. We invested in training of farmers and other end users (such as rural entrepreneurs) through field demonstrations, farmer field schools, and other short-term events. The reported total of 78,725 (of which 26% were females) underestimates this number significantly as only a few of our partners actually monitor and report these numbers. Partners in South Asia have trained some 73,000 farmers on quality rice seed production since 2011. In Latin America, a total of 3,279 farmers in nine countries were trained on improved rice management practices. Together with the CRPs MAIZE and WHEAT, GRiSP contributed to the training of more than 52,000 farmers in India and Bangladesh on improved crop management and seed technologies for cereal crops (rice, wheat, maize).4

G. Risk management (less than 1/2 page)

List the three major risks that may hinder the expected delivery of results by the CRP and describe the mitigation actions taken to manage these risks.

GRiSP developed a risk register that identifies risk type, source, impact, level, likelihood, mitigations, and additional actions to meet gaps.5 It includes the following three main risks:

Inadequate overall GRiSP management by GRiSP lead center IRRI. Impact: high; risk likelihood and level: low. Mitigations: risk management strategy and implementation plan (risk register) by GRiSP lead center IRRI (principal risk owner); IRRI Board; internal audits of implementation and management of GRiSP by IRRI.

Failure of GRiSP coordinating and executing CGIAR partners (IRRI, AfricaRice, CIAT) to deliver their GRiSP contributions. Impact: high; risk likelihood and level: low. Mitigations: risk management strategies and appropriate implementation plans (registers) by GRiSP coordinating centers (that are principal risk owners); boards of the GRiSP coordinating CGIAR centers; GRiSP Program Planning and Management Team; GRiSP Oversight Committee; GRiSP Milestone register (annually reviewed, 5

4 Since most farmers grow a combination of cereals, it is difficult to separate these numbers for rice-specific technologies.

5 Available on request
evaluated, and updated); annual planning and evaluation workshops organized by GRiSP partner centers.

**Insufficient W1 and W2 funds for GRiSP implementation.** Impact: high; risk likelihood and level: high in 2013, medium in 2014-15. Mitigations: continuous advocacy for adequate funding with the Consortium Office and donors; continuous fund raising for W3 and bilateral grants; GRiSP communication strategy (dedicated team with financial resources); raising awareness on GRiSP’s gender strategy, outcome culture, and partnerships.

**H. Lessons learned (1 page)**

i. *Estimate the overall level of confidence/uncertainty of the indicators provided in Table 1.*

The column “actual 2013” details how each indicator was estimated. Some indicators can easily be measured and are relatively accurate, such as the number of publications and databases maintained, while others are “educated guesses” since they are not measured on a routine basis, such as the number of users of databases and number of adopters of technologies.

ii. *Description, if relevant, of research avenues that did not produce expected results, and description of actions taken by the CRP, such as new research directions pursued and their expected outputs and outcomes.*

Overall, research avenues proceeded as planned. A major challenge we are taking up is the transformation of our breeding program into a model for product-oriented, outcome-driven breeding in the public sector. We are therefore completely restructuring our breeding program, with the development of specific product profiles derived from a combination of producers (the environment they produce in), consumers, and market analyses. The expected outcome is a more efficient and effective breeding program that will significantly speed up the increase in genetic gain, both in breeding plots and in farmers’ fields. Another major challenge we are taking up is the development of a new M&E system that is based on a meaningful set of indicators to monitor progress along the research to impact pathway. The current system with indicators as in Table 1 does not produce the expected results of allowing us to manage for results (the numbers and their use run the risk of degenerating into a bean-counting exercise). A third major challenge — that we are still wrestling with in working with our non-CGIAR center partners — is the dichotomy of the CGIAR in being both CRPs as well as institutions. Cirad, IRD, and JIRCAS are co-founding and coordinating partners in GRiSP. The Consortium increasingly aims to set standards — through CGIAR policies and implementation guidelines — related to management of data, intellectual assets, staff (e.g., gender balance), open access, etc. CRPs should adopt and implement such standards, even though most institutes consider many of those standards institutional aspects. Non-CGIAR centers find it difficult to see how they can collaborate in CRPs if such standards are imposed on them as well. Similarly, our non-CGIAR partners find it difficult to comply with all the reporting requirements of GRiSP and hence, our annual report focuses on achievements by the CGIAR centers. For our NARES partners, the situation is even more complicated — for example, they are not particularly keen to comply with a CRP obligation to centrally store and make available data (potentially to a CGIAR-managed repository) that they produce — and, hence, relinquish their own IP rights. The way GRiSP is handling this challenge is (1) to view most of these standards and requirements as an institutional issue and not a CRP issue per se, and (2) we are exploring options to separate the identities of GRiSP and CRP 3.3: GRiSP would be the overall, global partnership, while CRP 3.3 would become the CGIAR contribution to GRiSP, taking a leading and coordinating role while harnessing the CGIAR-center resources on international and trans-boundary rice R&D.

iii. *Lessons learned by the CRP from its monitoring of the indicators and from its qualitative analyses of progress.*
The current set of CRP indicators in Table 1 covers a variety of results, outputs, and outcomes without an underpinning conceptual framework. Some can be measured quite well on an annual basis whereas others have to be estimated or are collected at intervals longer than one year. Hence, we do not consider them to be very useful for monitoring and managing our progress towards IDOs. We initiated the development of a results-based framework, which will be based on our IDOs and measurable indicators of progress at global and national levels, and at key action sites. Overall, we consider our progress well on track as evidenced by the reported outputs and outcomes.
Annex 1: CRP indicators of progress, with glossary and targets

<table>
<thead>
<tr>
<th>CRPs concerned by this indicator</th>
<th>Indicator</th>
<th>Glossary/guidelines for defining and measuring the indicator, and description of what the CRP includes in the indicator measured, based upon the glossary</th>
<th>Deviation narrative (if actual is more than 10% away from target)</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>KNOWLEDGE, TOOLS, DATA</td>
<td>All</td>
<td>1. Number of flagship “products” produced by CRP</td>
<td>Glossary: These are frameworks and concepts that are significant and complete enough to have been highlighted on web pages and publicized through blog stories, press releases, and/or policy briefs. They are significant in that they are likely to change the way stakeholders along the impact pathway allocate resources and/or implement activities. They should be products that change the way these stakeholders think and act. Tools, decision-support tools, guidelines, and/or training manuals are not included in this indicator. Specify what type of products, from above glossary, you have included in the number indicated under 2013; if relevant, specify geographic locations</td>
<td>More identified flagship products for 2014</td>
<td>23</td>
<td>23</td>
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</table>

GRiSP's flagship products are considered at a higher aggregation level than products listed under #18, #23, and #27. In fact, they are more product pipelines such as sets of genes/QTLs influencing specific traits (such as quality, diseases resistance, tolerance to abiotic stress, etc), new varieties with a targeted profile related to groups of traits (eg disease resistance, submergence tolerance, etc), crop and natural resource management technologies, and postharvest technologies. Within these product pipelines, a continuous stream of improvements is generated; hence, most if not all of these flagship products are continuous throughout the lifetime of GRiSP.

1. High-yield genes (large panicle, tillering)
2. Submergence-tolerance genes (not only Sub1)
3. Phosphorus-deficiency genes (not only PSTOL)
4. Salinity-tolerance genes (not only Salto1)
5. Drought-tolerance genes
6. Genes related to pest and disease resistance
7. Genes conferring aroma
8. Genes related to quality “appearance” (e.g., chalkiness, length and width of grains, texture)
9. Stress-prone rice (drought, submergence, salinity)
10. Golden Rice
11. High-zinc rice
12. C4 rice
13. Aerobic rice
14. Hybrid rice
15. Ecological engineering
16. Direct-seeded rice as production system
17. Nutrient management options (such as, but not limited to, site-specific nutrient management)
18. Water-saving technologies
19. Ecologically-based pest control (e.g., insect pests, rodents)
20. Remote sensing and GIS-based rice mapping
21. Improved (hermetic) storage
22. Improved drying technologies
23. Improved parboiling
<p>| | | | |</p>
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<tbody>
<tr>
<td>24.</td>
<td>Rice marketing strategies</td>
<td></td>
<td></td>
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<tr>
<td>25.</td>
<td>Conservation agriculture options for rice (including minimum tillage)</td>
<td></td>
<td></td>
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<tr>
<td>26.</td>
<td>Mechanization options (laser leveling, mechanized transplanting, mechanized seeding, combine harvesting, etc.)</td>
<td></td>
<td></td>
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<tr>
<td>27.</td>
<td>Weed diagnostics and weed control technologies</td>
<td></td>
<td></td>
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<tr>
<td>28.</td>
<td>Good Agricultural Practices (integrated, holistic packages of management technologies)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29.</td>
<td>Community seed banks</td>
<td></td>
<td></td>
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</tbody>
</table>

**Glossary:**

- "The web pages, blog stories, press releases, and policy briefs supporting indicator #1 must have an explicit focus on women farmers/NRM managers to be counted. Provide concrete examples of what you include in this indicator.

More flagship projects with women as target than initially planned because of increased attention to gender in the program.

We excluded the gene-related flagship technologies in the calculation as these do not have a gender dimension in themselves.

<p>| | | |</p>
<table>
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<tbody>
<tr>
<td>All</td>
<td>2. % of flagship products produced that have explicit target of women farmers/NRM managers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Glossary: The web pages, blog stories, press releases, and policy briefs supporting indicator #1 must have an explicit focus on women farmers/NRM managers to be counted. Provide concrete examples of what you include in this indicator.</td>
<td></td>
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<tr>
<td></td>
<td>More flagship projects with women as target than initially planned because of increased attention to gender in the program.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>We excluded the gene-related flagship technologies in the calculation as these do not have a gender dimension in themselves.</td>
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<tr>
<td></td>
<td>22%</td>
<td>22%</td>
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<tr>
<td></td>
<td>38%</td>
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</table>

Not all of the flagship technologies have a gender dimension. Genes under flagship technologies 1-8 have no gender implication as such; it’s when these genes get incorporated into new varieties that gender implications become relevant. A number of products from Flagship Projects 2-4 have, in certain locations, women farmers or women entrepreneurs in the rice value chain as explicit target. In some cases, groups of technologies, such as best management practices that involve multiple crop management technologies, explicitly target women farmers and/or entrepreneurs:

1. Rice farming technologies for ex-combatant women in Burundi (expanded from 2012); addresses # 29 above
2. Improved marketing strategies for women’s groups in Africa; addresses # 24 above
3. Ecological engineering by women in Vietnam (continued from 2012); addresses # 15 above
4. On-farm hermetic storage of rice (mainly done by women of the households); addresses # 21 above
5. Improved parboiling technologies for women entrepreneurs in Africa; addresses # 23 above
6. Stress-tolerant rice; addresses # 9 above
7. Labor-saving (mechanization) technologies (reducing back-breaking and drudgery work done by women farmers); addresses # 26 above
8. Community seed banks targeted at women farmers (groups); addresses # 29 above

Following the logic explained above, these 8 technologies cover 38% of the 21 relevant technologies listed under indicator 1 (excluding the 8 gene-related technologies).

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<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>3. % of flagship products produced that have been assessed for likely gender-disaggregated impact</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Glossary: Reports/papers describing the products should include a focus on gender-disaggregated impacts if they are to be counted. Provide concrete examples of what you include in this indicator.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>More flagship projects with women as target than initially planned because of increased attention to gender in the program.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13%</td>
<td>13%</td>
</tr>
<tr>
<td></td>
<td>20%</td>
<td></td>
</tr>
</tbody>
</table>

- Improved marketing strategies for women’s groups in Africa; addresses # 24 above
- Improved parboiling technologies for women entrepreneurs in Africa; addresses # 23 above
- Stress-tolerant rice for women farmers; addresses # 9 above
- Labor-saving (mechanization) technologies (reducing back-breaking and drudgery work done by women farmers); addresses # 26 above

Following the logic explained above, these 8 technologies cover 20% of the 21 relevant technologies listed under indicator 1 (excluding the 8 gene-related technologies).
Following the logic explained above, these 4 technologies cover 20% of the 21 relevant technologies listed under indicator 1 (excluding the 8 gene-related technologies).

Most tools are not “one-shot” events but, after release, are continuously updated and improved. Hence, there is repetition with tools reported in 2012 — but only on those tools that were updated/improved in 2013:

1. 16 Rice Knowledge Banks (14 country-specific, 1 global, 1 CSISA)
2. Nutrient Manager on computer and cell phone
3. Crop Manager on computer and cell phone
4. Improved Rice Doctor
5. Sustainable rice criteria (Sustainable Rice Platform)
6. Rice management practices for stress-prone environments
7. Rice simulation models (RIDEV, Oryza)
8. International Rice Information System
9. Season-long extension training manual
10. Weed management decision-support tool
11. Large number of technology videos, and videos on community approaches, Digital Green videos
12. FieldLab (Software for data collection using handheld devices) released.
13. STAR (Statistical Tools for Agricultural Research) released.
15. Facilities for high-throughput DNA extraction and SNP genotyping made available for GRiSP partners.
16. Online SNP analysis tools through the IRRI GSL-Galaxy Resource.

### Glossary:

**Decision-support tools, guidelines, and/or training manuals** that are significant and complete enough to have been highlighted on web pages and publicized through blog stories, press releases, and/or policy briefs. They are significant in that they are likely to change the way stakeholders along the impact pathway allocate resources and/or implement activities.

### Outputs included in this indicator:

#### New tools:

<table>
<thead>
<tr>
<th>All</th>
<th>Number of “tools” produced by CRP</th>
<th>Glossary: These are significant decision-support tools, guidelines, and/or training manuals that are significant and complete enough to have been highlighted on web pages and publicized through blog stories, press releases, and/or policy briefs. They are significant in that they are likely to change the way stakeholders along the impact pathway allocate resources and/or implement activities. Based on the glossary, describe the types of outputs you include in this indicator.</th>
<th>Elimination of tools already reported in 2012 that were not updated or improved in 2013</th>
<th>16</th>
<th>16</th>
<th>16</th>
</tr>
</thead>
</table>

#### Tools that have an explicit target of women farmers:

| All | 5. % of tools that have an explicit target of women farmers | Glossary: The web pages, blog stories, press releases, and policy briefs supporting indicator #4 must have an explicit focus on women farmers/NRM managers to be counted | 0 | 0 | 0 |

#### Tools assessed for likely gender-disaggregated impact:

| All | 6. % of tools assessed for likely gender-disaggregated impact | Glossary: Reports/papers describing the products should include a focus on gender-disaggregated impacts if they are to be counted | 0 | 0 | 0 |

#### Open access databases:

<table>
<thead>
<tr>
<th>All</th>
<th>7. Number of open access databases maintained by CRP</th>
<th>Indicate the type of databases (e.g., socioeconomic survey data; crop yields in field experiments...) you are reporting on in the following columns</th>
<th>More databases identified</th>
<th>6</th>
<th>6</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td></td>
<td>Databases and their tracked users in 2013 (when no user numbers are provided, these data are not currently tracked):</td>
<td>1. International Rice Information System (IRIS)</td>
<td>2. Rice genebank collection Information provided through Genesys</td>
<td>3. World Rice Statistics (2,000)</td>
<td>4. Farm Household Survey Database</td>
</tr>
<tr>
<td>All</td>
<td>8. Total number of users of these open access databases</td>
<td></td>
<td>8. ORYZA2000 simulation model database</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Rice Google Books: all scanned IRRI books (0.5 million book views; 3.8 million page views/23,135 full-book downloads)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Flickr rice pictures (estimated from cumulative data: 500,000 yearly)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Scribe: all IRRI Discussion Papers, Technical Bulletins, reports, Rice Today issues, etc. (estimated from cumulative data: 300,000 yearly)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Rice videos – click here and here (1 million views; 600 new subscribers in 2013)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2−5.6 million (first included whole-book views, second only page views of #11 in indicator 7)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See above at indicator #7 for details. For many of the open-access databases, the number of users is not tracked. Hence, our total number under estimates the true number of users.

| All | 9. Number of publications in ISI journals produced by CRP | Publications can’t really be planned with 100% accuracy | 267 |
| 267 |

Appendix 3 gives the complete list.

| All | 10. Number of strategic value chains analyzed by CRP | Clearly indicate the type of value chains you are reporting on in the next columns | 1 |
| 1 |

Rice value chain

| All | 11. Number of targeted agro-ecosystems analysed/characterised by CRP | Specify the type of system, using its main products as descriptors (e.g., mixed crop, livestock system; monoculture of XX; agroforestry with maize, beans, etc.; mixed cropping with upland rice, cassava, etc... by geographic location and agroecological zones (FAO typology) | NA |

| All | 12. Estimated population of above-mentioned agro-ecosystems | | NA |

CAPACITY ENHANCEMENT AND INNOVATION PLATFORMS

| All | 13. Number of trainees in short-term | Glossary: The number of individuals to whom significant knowledge or skills have been imparted through interactions that are | 1,702 |
| We significantly improved the | 1,702 |

AfricaRice: 632 (research and extension partners; # farmers trained currently not tracked) | 50,000 |
<table>
<thead>
<tr>
<th>programs facilitated by CRP (male)</th>
<th>collection of training statistics. The increased numbers over 2012 indicate an improved monitoring system rather than an increase in the number of people trained. The estimate for 2014 is based on the assumption that our partners keep sending us training statistics.</th>
<th>IRRI: 65,013 (9,716 research and extension partners, and 55,297 farmers) CIAT: Total of 2,770 discriminated as follows: 2,623 farmers trained on improved agronomic practices (estimated as 80% males of 3,279 farmers participating in 28 field days); 75 breeders participating in breeding workshops, and 72 technicians participating in rice production course in Peru Trainees include partners in academia, NGOs, the public sector (mainly involved in research and extension), the private sector (seed industry, input suppliers, machine and equipment manufacturers, agro-industry, rural entrepreneurs, processors, millers, and other actors along the rice value chain), on topics including biotechnology and breeding tools/technologies, hybrid rice production, community seed bank development, seed purification, rice quality, survey techniques, database management, statistics, rice insect taxonomy, field-level pest monitoring methodologies, agronomy (land preparation, crop establishment, weed, water, nutrient, pest, disease, crop, soil management), harvest and postharvest technologies (combine harvesting, drying, milling, storage, parboiling, etc.), business model development and marketing skills, climate change adaptation and mitigation strategies, greenhouse gas emission measurement, remote sensing, modeling, GIS, phenotyping, and field and laboratory instrumentation. Trainees also include farmers who received training on improved rice husbandry. Details are available on demand</th>
</tr>
</thead>
</table>
| 14. Number of trainees in short-term programs facilitated by CRP (females) | (see above, but for females) | 936 25,430
Africare: 180 (research and extension partners; # farmers trained currently not tracked) IRRI: 24,576 (4,428 research and extension partners, and 20,148 farmers) CIAT: Total of 674 discriminated as follows: 656 (estimated as 20% female of 3,279 farmers participating in 28 field days) 10 breeders participating in breeding workshops, and 8 technicians participating in a rice production course in Perú Details are available on demand |
| 15. Number of trainees in long-term programs facilitated by CRP (males) | Glossary: The number of people who are currently enrolled in or graduated in the current fiscal year from a bachelor’s, master’s, or Ph.D. program or are currently participating in or have completed in the current fiscal year a long-term (degree-seeking) advanced training program such as a fellowship program or a postdoctoral studies program. A person completing one long-term training program in the fiscal year and currently participating in another long-term training program should be counted only once. Specify in this cell the number of master’s | 238 225
Africare: 81 in total (39 PhD students, 42 MSc/BSc students) IRRI: 138 in total (63 PhD, 21 MSc, 20 BSc, 34 interns and fellows) CIAT: 6 in total (1 PhD student, 5 MSc/BSc students) Details are available on demand |
<table>
<thead>
<tr>
<th>All</th>
<th>16. Number of trainees in long-term programs facilitated by CRP (females)</th>
<th>154</th>
<th>154</th>
<th>166</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(see above, but for females)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AfricaRice: 31 in total (10 PhD students, 21 MSc/BSc students)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IRRI: 128 in total (44 PhD, 33 MSc, 26 BSc, 25 interns and fellows)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>CIAT: 7 in total (2 PhD students, 5 MSc/BSc students)</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>Details are available on demand</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1,5,6,7</th>
<th>17. Number of multi-stakeholder R4D innovation platforms established for the targeted agro-ecosystems by the CRPs</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Glossary: To be counted, a multistakeholder platform has to have a clear purpose, generally to manage some type of tradeoff/conflict among the different interests of different stakeholders in the targeted agro-ecosystems, and inclusive and clear governance mechanisms, leading to decisions to manage the variety of perspectives of stakeholders in a manner satisfactory to the whole platform. Indicate the focus of each platform in this cell, including geographic focus.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TECHNOLOGIES/PRACTICES IN VARIOUS STAGES OF DEVELOPMENT</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>67</td>
<td>67</td>
<td>120</td>
</tr>
<tr>
<td>Flagship Projects 1 and 2 research/develop genes, markers, QTLs, etc., and produce a large number of germplasm materials, pre-breeding lines, elite breeding lines, etc., that are embodied in GRiSP’s breeding products. Flagship Projects 3-4 develop NRM and post-harvest products.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 High-resolution SNP genotypes of diverse accessions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Whole-genome sequencing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Specialized genetic stocks and novel populations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Genes for drought-tolerant and aerobic rice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Genes for flood-prone environments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Genes for nutrient-deficient and problem soils</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Genes for temperature extremes and grain quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Genes for disease and insect resistance</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Based nutritional supplementation such as vitamin A-rich sweet potatoes or rice, or high-protein maize, or improved livestock breeds; soil management practices that increase biotic activity and soil organic matter levels; and livestock health services and products such as vaccines

- Chemical: Fertilizers, insecticides, and pesticides sustainably and environmentally applied, and soil amendments that increase fertilizer-use efficiencies
- Management and cultural practices: sustainable water management practices; sustainable land management practices; sustainable fishing practices; information technology, improved/sustainable agricultural production and marketing practices, increased use of climate information for planning disaster risk strategies in place, climate change mitigation and energy efficiency, and natural resource management practices that increase productivity and/or resiliency to climate change. IPM, ISFM, and PHH as related to agriculture should all be included as improved technologies or management practices.

New technologies or management practices under research counted should be only those under research in the current reporting year. Any new technology or management practice under research in a previous year but not under research in the reporting year should not be included.

Clearly indicate, from the list above, the type of technology and geographic location that you are reporting on in next columns.

| 9 | Genes for improving the architecture of rice roots and panicles |
| 10 | Transgenic prebreeding events for stress-response genes |
| 11 | Gene identification and validation pipeline |
| 12 | C₃ rice |
| 13 | Novel gene sources for breeding |
| 14 | Disease-resistant rice |
| 15 | Insect-resistant rice |
| 16 | Population improvement |
| 17 | Drought-tolerant rice |
| 18 | Submergence-tolerant and other flood-tolerant rice |
| 19 | Improved varieties tolerant of salt stress and other problem soils |
| 20 | Varieties tolerant of cold or hot temperatures |
| 21 | New generation of elite inbreds with increased yield potential |
| 22 | High-yielding varieties for irrigated systems in Asia |
| 23 | High-yielding varieties for irrigated systems in Africa |
| 24 | High-yielding varieties for irrigated systems in Latin America |
| 25 | Rice varieties for dry seeding in aerobic rice and conservation agriculture systems |
| 26 | Improved rice varieties for temperate rice environments |
| 27 | Rice hybrids for Asia |
| 28 | Rice hybrids for Africa |
| 29 | Rice hybrids for Latin America |
| 30 | Pro Vitamin A-enriched rice (Golden Rice) |
| 31 | High-Zn rice |
| 32 | High-Fe rice |
| 33 | Rice with enhanced folic acid |
| 34 | Strategies to improve water-use efficiency |
| 35 | Principles and tools for site-specific nutrient management |
| 36 | Management options for pests, weeds, and diseases |
| 37 | Integrated good agricultural practices (GAP) |
| 38 | Diversified cropping systems in Asia |
| 39 | Mechanization and conservation agriculture |
| 40 | Management options for drought, submergence, and salinity |
| 41 | Management options for pests, diseases, and weeds |
| 42 | Mechanization and conservation agriculture for low-input and upland systems |
| 43 | Land and water development options for inland valleys |
| 44 | Field management technologies to reduce greenhouse gas emissions |
| 45 | Strategies to adapt to climate change and increase resilience |
| 46 | Improved technologies and management options to increase postharvest yield |
| 47 | Business models for postharvest technologies and tools for improved rice market information systems |
| 48 | Postharvest practices for reduced mycotoxin contamination of milled rice |
| 49 | Institutional and organizational innovations enabling greater access to output markets for smallholder farmers |
| 50 | Rice straw with increased digestibility for feeding to livestock |
| 51 | Climate change mitigation through renewable, profitable, and sustainable energy production and carbon sequestration options based on rice residues |
| 52 | Innovative, profitable, and sustainable processing options for rice husks and rice straw |
| All | 19. % of technologies under research that have an explicit target of women farmers | The papers, web pages, blog stories, press releases, and policy briefs supporting indicator #x must have an explicit focus on women farmers/NRM managers to be counted | We excluded the Flagship Project 1 technologies in the calculation as these do not have a gender dimension | 8% | 8% | 24% |
| --- | --- | --- | --- | --- | --- |

All 20. % of technologies under research that should include a focus on gender-disaggregated impacts if they are to be counted | Reports/papers describing the products should include a focus on gender-disaggregated impacts if they are to be counted | We excluded the Flagship Project 1 technologies | 0 | 0 | 15% |

The following technologies were assessed on their gender impacts:
1. Improved marketing strategies for women’s groups in Africa; addresses # 49 above
2. Stress-tolerant rice for women farmers; addresses # 17, 18, 19 above
3. Community seed banks targeted at women farmers (groups); addresses # 17, 18, 19 above

These products relate to 10 of the 41 technologies listed under indicator 18 (excluding the 13 Flagship Project 1 technologies from the 54): 27%

53 Speciality rice with good eating quality for high-value markets
54 Processing techniques that add value to low-grade rice

It is beyond the purpose (and means) to list all genes, markers, pre-breeding lines, advances in genetic stocks, processes underlying NRM technologies, etc of these products in a Table like this. Each year, around 100,000 germplasm ‘materials’ flow through F1-F7 pedigree nurseries to/through replicated yield trials and advanced yield trials, with around 5,000 being qualified as ‘elite pre-breeding lines’ at the end of the pipeline. Appendix 4 gives details (including quantitative numbers) of concrete progress in 2013 in our breeding pipeline (including work on genes, QTLs, genetic stocks, genome characterization, etc) in 2013, and gives a sense of the size of breeding efforts.

In our total count of technologies, we summed the 66 component technologies under research in 2013 listed in appendix 4 and the 54 GRiSP products listed above: 120.

Not all of the technologies under research have a gender dimension. Technologies delivered by Flagship Project 1 do not target a specific gender by their very nature. The discovery of a SNP or the creation of a mutant population, for example, has no gender implications. It’s when these technologies get incorporated into new varieties that gender implications become relevant. A number of products from Flagship Projects 2-4 have, in certain locations, women farmers or women entrepreneurs in the rice value chain as explicit target. In some cases, groups of technologies, such as best management practices that involve multiple crop management technologies, explicitly target women farmers and/or entrepreneurs:
1. Rice farming technologies for ex-combatant women in Burundi; addresses # 37 above
2. Improved marketing strategies for women’s groups in Africa; addresses # 49 above
3. Ecological engineering by women in Vietnam; addresses # 41 above
4. On-farm hermetic storage of rice (mainly done by women of the households); addresses # 46 above
5. Improved parboiling technologies for women entrepreneurs in Africa; addresses # 54 above
6. InfoLady farmers in Bangladesh trained on rice technology transfer; mainly addresses # 37, 47 above
7. Stress-tolerant rice for women farmers; addresses # 17, 18, 19 above
8. Labor-saving (mechanization) technologies (reducing back-breaking and drudgery work done by women farmers); addresses # 39 above
9. Community seed banks targeted at women farmers (groups); addresses # 17, 18, 19 above

These products relate to 10 of the 41 technologies listed under indicator 18 (excluding the 13 Flagship Project 1 technologies from the 54): 27%
<table>
<thead>
<tr>
<th>have been assessed for likely gender-disaggregated impact</th>
<th>in the calculation as these do not have a gender dimension. See narrative for under section D for assessment results and hyperlinks</th>
<th>above 2. Improved parboiling technologies for women entrepreneurs in Africa; addresses # 54 above 3. Stress-tolerant rice for women farmers; addresses # 17, 18, 19 above 4. Labor-saving (mechanization) technologies (reducing back-breaking and drudgery work done by women farmers); addresses # 39 above 5. Community seed banks targeted at women farmers (groups); addresses # 17, 18, 19 above Following the logic explained above, these products relate to 6 of the 41 technologies listed under indicator 18 (excluding the 13 Flagship Project 1 technologies from the 54): 15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,5,6,7 21 Number of agro-ecosystems for which CRP has identified feasible approaches for improving ecosystem services and for establishing positive incentives for farmers to improve ecosystem functions as per the CRP’s recommendations</td>
<td>Use the same classification of agroecosystem as for indicator 11 above, including geographic location and agroecological zone</td>
<td>NA</td>
</tr>
<tr>
<td>1,5,6,7 22. Number of people who will potentially benefit from plans, once finalised, for the scaling up of strategies</td>
<td>Indicate the potential number of both women and men</td>
<td>NA</td>
</tr>
<tr>
<td>All, except 2 23. Number of technologies/NRM practices field tested (Phase Glossary: Under “field testing” means that research has moved from focused development to broader testing (pilot project phase) and this testing is underway under conditions intended to duplicate those New way of counting technologies as suggested by the</td>
<td>67 67 1,928 At this stage, we do not include the pre-breeding products of Flagship Project 1 (discovered genes, QTLs, breeding populations, etc.) that don’t really get field tested. In Flagship Project 2, we count those lines that are field tested in multi environment testing trials or in the</td>
<td>1,900</td>
</tr>
</tbody>
</table>
II) encountered by potential users of the new technology. This might be in the actual facilities (fields) of potential users or it might be in a facility set up to duplicate those conditions. Clearly identify in this cell the type of technology and the geographic locations of the field testing/pilot projects reported in next columns.

<table>
<thead>
<tr>
<th>Consortium office. See also appendix 4 for details.</th>
</tr>
</thead>
</table>

International Network for the Genetic Evaluation of Rice (INGER). Many of the products of Flagship Projects 3-4 are both under research and under field testing by some of GRiSP’s partners. Many of these products are even at the same time in the dissemination stage by yet other partners. For example, the technology of alternate wetting and drying for saving water is under research for its effects on greenhouse gas emissions and for improved nutrient management (e.g., at IRRI), while it is under field testing under conventional nutrient management with certain partners (e.g., in Africa), and released and disseminated with other partners in other countries (e.g., in the Philippines, Vietnam, and Bangladesh).

1. Disease-resistant rice  
2. Insect-resistant rice  
3. Drought-tolerant rice  
4. Submergence-tolerant and other flood-tolerant rice  
5. Improved varieties tolerant of salt stress and other problem soils  
6. Varieties tolerant of cold or hot temperatures  
7. New generation of elite inbreds with increased yield potential  
8. High-yielding varieties for irrigated systems in Asia  
9. High-yielding varieties for irrigated systems in Africa  
10. High-yielding varieties for irrigated systems in Latin America  
11. Rice varieties for dry seeding in aerobic rice and conservation agriculture systems  
12. Improved rice varieties for temperate rice environments  
13. Rice hybrids for Asia  
14. Rice hybrids for Africa  
15. Rice hybrids for Latin America  
16. Pro Vitamin A-enriched rice (Golden Rice)  
17. High-Zn rice  
18. Strategies to improve water-use efficiency  
19. Principles and tools for site-specific nutrient management  
20. Management options for pests, weeds, and diseases  
21. Integrated good agricultural practices (GAP)  
22. Diversified cropping systems in Asia  
23. Mechanization and conservation agriculture  
24. Management options for drought, submergence, and salinity  
25. Management options for pests, diseases, and weeds  
26. Mechanization and conservation agriculture for low-input and upland systems  
27. Land and water development options for inland valleys  
28. Field management technologies to reduce greenhouse gas emissions  
29. Strategies to adapt to climate change and increase resilience  
30. Improved technologies and management options to increase postharvest yield  
31. Business models for postharvest technologies and tools for improved rice market information systems  
32. Innovative, profitable, and sustainable processing options for rice husks and rice straw  
33. Specialty rice with good eating quality for high-value markets

A total of 1895 lines were field tested in multi environment testing trials and in the International Network for the Genetic Evaluation of Rice (see Appendix 4 for details). In our total count of technologies, we add this number to the 33 products given above: 1928.
agro-ecosystems for which innovations (technologies, policies, practices, integrative approaches) and options for improvement at system level have been developed and are being field tested (Phase II)

technology and the geographic location of the field testing/pilot projects, and use the same classification of agroecosystem as for indicator 11, specifying the type of agroecosystems in which field testing is taking place.

1,5,6,7

25. % of above innovations/approaches/options that are targeted at decreasing inequality between men and women

1,5,6,7

26. Number of published research outputs from CRP used in targeted agro-ecosystems

All, except 2

27. Number of technologies/NRM practices released by public and private sector partners globally

Glossary: In the case of crop research that developed a new variety, for example, the variety must have passed through any required approval process, and seed of the new variety should be available for multiplication. The technology should have proven benefits and be as ready for use as it can be as it emerges from the research and

After a few years in operation, the African Rice Breeding Task Force is showing increased

77

77

128

At this stage, we do not include the pre-breeding products of Flagship Project 1 (discovered genes, QTLs, breeding populations, etc). In Flagship Project 2, 113 new rice varieties were released in 2013 — 7 through CIAT/FLAR, 62 through African Rice and partners, and 44 through IRRI and partners (see Appendix 4 for a complete listing). Products developed under Flagship Projects 3 and 4 are not formally "released"; rather, they are adapted and disseminated by national partners. Many of the products listed under indicator 23 are also under...
(Phase III) testing process. Technologies made available for transfer should be only those made available in the current reporting year. Any technology made available in a previous year should not be included. Clearly identify in this cell the technologies/practices thus released (scale-up phase) and the geographic areas concerned.

<table>
<thead>
<tr>
<th>POLICIES IN VARIOUS STAGES OF DEVELOPMENT</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Number of agricultural enabling environment policies/ regulations/administrative procedures in the areas of agricultural resource, food, market standards &amp; regulation, public investment, natural resource or water management and climate change adaptation/mitigation as it relates to agriculture that underwent the first stage of the policy reform process, i.e., analysis (review of existing policy/regulation/ administrative procedure and/or proposal of new policy/regulations/administrative procedures). Please count the highest stage completed during the reporting year – don’t double count for the same policy. Clearly identify in this cell the type of policy, regulations, etc., from the above list.</td>
</tr>
<tr>
<td></td>
<td>We facilitated the development and launching of a regional initiative to boost the rice sector in West Africa led by Ecowas (Regional Rice Offensive in West Africa).</td>
</tr>
</tbody>
</table>

The total number of released technologies is 113 varieties plus 15 NRM and post-harvest technologies = 128.
| All | Number of policies/regulations/ administrative procedures presented for legislation (Stage 3) | ... underwent the third stage of the policy reform process (policies were presented for legislation/decree to improve the policy environment for smallholder-based agriculture). Clearly identify in this cell the type of policy and the country/region concerned. | Not inventoried |
| All | Number of policies/regulations/ administrative procedures prepared passed/approved (Stage 4) | ... underwent the fourth stage of the policy reform process (official approval (legislation/decree) of new or revised policy/regulation/administrative procedure by relevant authority). Clearly identify in this cell the type of policy and the country/region concerned. | Not inventoried |
| All | Number of policies/regulations/ administrative procedures passed for which implementation has begun (Stage 5) | ... completed the policy reform process (implementation of new or revised policy/regulation/administrative procedure by relevant authority). Clearly identify in this cell the type of policy and the country/region concerned. | Not inventoried |

### OUTCOMES ON THE GROUND

| All | Number of hectares under improved technologies or management | Clearly identify in this cell the geographic locations where this is occurring and whether the application of technologies is on a new or continuing area. | 4,763,000 | 4,763,000 | 4,763,000 |

For lack of a comprehensive system that tracks global adoption of varieties, crop management, postharvest, and all other technologies generated by GRiSP, we compute an estimate based on a synthesis of pertinent literature and adoption studies (the same methodology has been employed to derive USAID FTF indicators since 2011): ex post impact studies show that 70% of Asian rice area is modern varieties, 70% of which have IRRI.
practices as a result of CRP research

<table>
<thead>
<tr>
<th>All</th>
<th>Number of farmers and others who have applied new technologies or management practices as a result of CRP research</th>
<th>Clearly identify in this cell the geographic location of these farmers and whether the application of technologies is on a new or continuing area and indicate: 34 (a) number of women farmers concerned 34(b) number of male farmers concerned</th>
<th>7,741,000</th>
<th>7,741,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>7,741,000 (50% males, 50% females)</td>
<td></td>
</tr>
</tbody>
</table>
Asia: Estimating that 70% of the harvested rice area is physical rice area, that the average farm size of rice farmers is 1 hectare, and assuming an average of two farmers per household, the number of farmers applying new technologies is 1.4 times the area under new technologies: thus, the number of farmers is 6,128,000.  
In Africa, with farm size of 0.5 ha and assuming three to four farmers per household, this gives 3.5*187,000/0.5 = 1,309,000 farmers.  
For Latin America: Farm sizes in southern LA are large (we assume 20% of total area), but we estimate 1 ha again for Central America and northern LA. Assuming again two farmers per household, we arrive at 0.8*2*196,000 = 313,000 farmers. On average across the globe, about half of the rice farmers are females. | 7,741,000 |
### Annex 2: Performance indicators for gender mainstreaming with targets defined

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>CRP performance approaches requirements</th>
<th>CRP performance meets requirements</th>
<th>CRP performance exceeds requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gender inequality targets defined</td>
<td>Sex-disaggregated social data are being collected and used to diagnose important gender-related constraints in at least one of the CRP’s main target populations</td>
<td>Sex-disaggregated social data collected and used to diagnose important gender-related constraints in at least one of the CRP’s main target populations And The CRP has defined and collected baseline data on the main dimensions of gender inequality in the CRP’s main target populations relevant to its expected outcomes (IDOs)</td>
<td>Sex-disaggregated social data collected and used to diagnose important gender-related constraints in at least one of the CRP’s main target populations And The CRP has defined and collected baseline data on the main dimensions of gender inequality in the CRP’s main target populations relevant to its expected outcomes (IDOs) And The CRP targets changes in levels of gender inequality to which the CRP is or plans to contribute, with related numbers of men and women beneficiaries in main target populations</td>
</tr>
</tbody>
</table>

| 2. Institutional architecture for integration of gender is in place | - CRP scientists and managers with responsibility for gender in the CRP’s outputs are appointed and have written TORs And Procedures defined to report use of available diagnostic or baseline knowledge on gender routine for assessment of the gender equality implications of the CRP’s flagship research products as per the Gender Strategy -CRP M&E system has protocol for tracking progress on integration of gender in research | - CRP scientists and managers with responsibility for gender in the CRP’s outputs are appointed, and have written TORs and funds allocated to support their interaction. - Procedures defined to report use of available diagnostic or baseline knowledge on gender routine for assessment of the gender equality implications of the CRP’s flagship research products as per the Gender Strategy -CRP M&E system has protocol for tracking progress on integration of gender in research And A CRP plan approved for capacity development in gender analysis | CRP scientists and managers with responsibility for gender in the CRP’s outputs are appointed, and have written TORs and funds allocated to support their interaction And Procedures defined to report use of available diagnostic or baseline knowledge on gender routine for assessment of the gender equality implications of the CRP’s flagship research products as per the Gender Strategy -CRP M&E system has protocol for tracking progress on integration of gender in research And A CRP plan approved for capacity development in gender analysis And The CRP uses feedback provided by its M&E system to improve its integration of gender into research |
Annex 3: GRiSP ISI Publication list 2014


82. Gaihre, Y. K., R. Wassmann, G. Villegas-Pangga. Impact of elevated temperatures on greenhouse gas emissions in rice systems: interaction with straw incorporation studied in a growth chamber


222. Yuan, W. L., D. Y. Xing, Y. B. Zhang, R. M. Visperas. Integration of yield and physiological traits for developing new rice varieties with higher yield potential in tropical environment. J. Food


Annex 4: Details on GRiSP’s breeding pipeline (indicators 18, 23, and 27 of Table 1).

Details are given to explain the size of GRiSP’s breeding pipeline and to support the data provided for indicators 18, 23, and 27 of Table 1. As a preamble, a (very) brief explanation is given first on the breeding pipeline. Flagship Project 1 develops prebreeding tools and products that will be used by geneticists and breeders to increase the effectiveness of breeding new rice varieties. We develop architectures that will enable us to systematically access diversity. We also create new diversity itself, through, for example, the use of new tools such as mutagenesis and Talens (Transcription Activator-Like Effector Nucleases) and the development of MAGIC (Multiparent Advanced Generation Inter-Cross) and NAM (Nested Association Mapping) populations. We discover SNPs, QTLs, and genes, and develop markers for use in variety development. Below, we list and explain the outputs of Flagship Project 1 that contribute to indicator 18 of Table 1. Flagship Project 2 uses the outputs of Flagship Project 1 through techniques such as marker-assisted selection (MAS) and marker-assisted backcrossing (MAB), but also develops new varieties using pedigree breeding. The pedigree breeding pipeline consists of “materials” moving (after original crosses have been made in a hybridization block) from F1 (single crosses) to F2 (multiple crosses), when, upon segregation, single plants are selected that move into the F3 to F7 pedigree nurseries that undergo increasing levels of selection. After F7, advanced material (which may be labeled elite (pre-) breeding lines) moves into replicated yield trials and then into advanced yield trials. Under GRiSP, advanced systems of multi-environment testing (MET) trials have been set up (and still more are being developed) in Africa (through the Africa-wide Rice Breeding Task Force) and in Asia. Here, breeding lines are being tested with partners at different locations. Entries are also provided to evaluation platforms such as INGER, in which lines are being evaluated at a large number of locations by INGER partners using a systematic protocol of observations. At the end of this selection/breeding process, national partners in collaboration with AfricaRice, CIAT, and IRRI nominate ‘entries’ to national governments for release as variety. When that happens, such varieties are most easily tracked as GRiSP-produced varieties (the numbers reported in our narrative). However, any of the pre-breeding lines can be shared with partners, used as parent material in their own breeding program, and end up in the parentage of eventually released varieties. When that happens, such varieties are most easily tracked as GRiSP-produced varieties (the numbers reported in our narrative). However, any of the prebreeding lines can be shared with partners, used as parent material in their own breeding program, and end up in the parentage of eventually released varieties. Add to this described scheme MAB, MAS, recurrent selection, hybrid rice, creation and use of specialized genetic stocks such as MAGIC and NAM, techniques such as PVS, and one gets an idea of the impossibility of quantifying each GRiSP reporting year the number of prebreeding lines, and listing them under indicator 18. We estimate that, each year, somewhere between 80,000 to 100,000 germplasm materials are moved through the F1 to F7 pipeline, with the largest number of materials present at the F2 stage. Out of this, we estimate that around 5,000 lines might be labeled elite pre-breeding lines further down the pipeline. In this appendix, we list the progress made with component technologies of our breeding products developed in Flagship Projects 1 and 2 that support the numbers provided under indicator 18 in Table 1. When breeding lines enter the MET and INGER stages for field testing, their numbers are down to several hundred, but still too many to list. In this appendix, we provide the number of breeding entries to these multi-location trials to support the data provided under indicator 23 in Table 1. Finally, we provide the complete list of released varieties to support the numbers provided under indicator 27 in Table 1. Note that these refer only to those varieties that have a very direct link to the center breeding programs and do not include varieties released with center-parentage.

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6 After review of the GRiSP annual report in March 2014, the Consortium Office requested an overview of the size of GRiSP’s breeding pipeline as well as specifics on breeding products to be listed under indicators 18, 23, and 27 of Table 1.
4.1. Indicator 18: number of technologies (pre-breeding products) under research (phase I)

The numbers refer to GRiSP product number

1.2.1: High-resolution SNP genotypes of diverse accessions
1. Two hundred and thirty five SNPs markers, of which 188 are highly specific to African rice species *O. glaberrima* and *O. barthii*, were developed and used to genotype 279 diverse *O. glaberrima* and 102 *O. barthii* accessions. These African rice SNPs are available for use on Vera Code Golden Gate Genotyping Assay.
2. The GBS study in a CSSL population derived from a Caiapo Glaberrima cross that was evaluated in 2013 led to a very dense genotyping with 15,000 SNPs, allowing a 26 kb-resolution of recombination breakpoints in each line.

1.2.1: Whole genome sequencing
3. In collaboration with Beijing Genomics Institute (BGI)-Shenzen and Chinese Academy of Agriculture Science (CAAS), we have completed the re-sequencing of 3000 genomes.

1.2.4: Specialized genetic stocks and novel populations
4. Ten Nested Association Mapping (NAM) populations of rice comprising 2000 RIL were developed by AfricaRice.

1.3.3. Genes for nutrient deficiency and problem soils
5. Two yield related QTLs (qGY11 and qTN11) were identified and mapped to the same position on chromosome 11 in three 3 genetic backgrounds NERICA-L-19, Sahel 108 and BG90-1.
6. A new allele of the *Pup1* gene was found in CG14 and allele-specific markers were designed by JIRCAS. About 150 accessions including NERICA varieties, widely grown lowland (*O. sativa indica*) and upland (*O. sativa japonica*) varieties, some *O. glaberrima* and *O. barthii* accessions were genotyped using the new allele-specific markers. The CG14-allele at the PSTOL1 locus was largely present in the *O. glaberrima* and *O. barthii* accessions tested and in the majority of upland NERICA and *japonica* varieties while it is under-represented in the lowland varieties (lowland NERICA and *indica* varieties).

1.3.5. Genes for disease and insect resistance
7. Five QTLs linked to AfRGM (African Rice Gall Midge) resistance were detected in the *O. sativa* TOS14519 cross. The largest QTL (LOD > 33.1) is our prime target for fine mapping and positional cloning research. Initial fine mapping with near-isogenic lines (NILs) verified the QTL effect, resolving two tightly linked QTLs which together increase resistance by 20%. Based on these fine mapped results and the results of metabolomics analysis on parental lines, we examined the rice genome annotation near the AfRGM QTL, and found a tightly linked candidate gene.

1.3.6. Genes for improving the architecture and function of rice roots and panicles
8. Three putative QTLs for seminal root elongation in response to N were detected on chromosome 1, and one QTL on chromosome 3 was associated with low P concentration were identified in a CSSL population between cv Curinga and wild specie O. rufipogon.

1.3.8. Genes identification and validation pipeline
9. Discovery of a rice gene called SPIKES that plays a role in increasing panicle size and yield. Isolation of the gene and understanding its function has enabled rapid incorporation of the gene into varieties. Field data showed that SPIKE can increase production by 13–36% in long-grain indica varieties.
10. Two yield related QTLs (qGY11 and qTN11) were identified and mapped to the same position on chromosome 11 in three genetic backgrounds NERICA-L-19, Sahel 108 and BG90-1.
1.4.1. C4 rice
11. We pyramided five C4 candidate transgenes into a single transgenic line, a significant step towards developing a C4-like rice prototype. To accelerate discovery of C4-characters, a mutagenized Setaria population was produced to screen for loss of C4 functions. A high-throughput laboratory-based phenotyping system has been established to facilitate screening of the mutant population.

2.2.1. Novel gene sources for breeding
12. Novel sources of resistance to bacterial blight and sheath blight diseases were identified in O. latifolia (CCDD genome) and O. barthii (AA genome) respectively.
13. A novel gene source for salinity tolerance is identified in the wild species O. coarctata (KKLL genome) and new sources of resistance to blast, ragged stunt and grassy stunt viruses are detected in O. punctata (BB genome).
14. Three resistance genes (Bph18, Xa21 and Pi40) derived from wild Oryza species were successfully pyramided into elite cultivars IR72 and NSIC Rc222.
15. Six Pik K type alleles (functional) and one Pi2/9 allele (functional) were identified from 400 different O. glaberrima entries.
16. A 1.75 Mb region of qDTY12.1 sequenced in parental lines and NILs for drought tolerance, and candidate genes indentified in qDTY1,1.

2.2.2. Disease-resistant rice
17. DNA markers specific to SNP in six non-susceptible (resistance) alleles of RTSV resistance gene (tsv1) were developed while gene- and gel-based markers for Pi2 and Pi9 for blast resistance have been developed.
18. An artificial inoculation method at booting stage has been optimized for resistance screening to false smut. The variety NSIC Rc158 has been widely used as an ideal susceptible check line.
19. The Magnaporthe oryzae avirulence gene AvrPi9 has been cloned. Perfect correlation of existence of AvrPi9 and its avirulence to Pi9 plants provided an ideal example for the assessment of effectiveness of its cognate Pi9 gene to blast.
20. New QTLs/genes derived from O. rufipogon (Acc. 104423) for resistance to BB races 4 and 6 were mapped on chromosomes 3 and 7, respectively.
21. High blast pressure in Akagoma (Burundi) showed that effective R genes are Piz5 and Pi9. Moderate resistance was observed for Pita2, Pik-h, Pik-m and Piz-t, while the other genes in the monogenic lines show susceptibility.
22. The efficacy of the Pb1 and pi21 loci for blast resistance was evaluated in both West and East Africa.

2.2.3. Insect resistant rice
23. A set of near isogenic lines (NILs) possessing 13 major BPH resistance genes/QTLs produced in the background of IR24.
24. Three major BPH resistance genes, Bph18, Bph20 and Bph21 of wild species origin were pyramided in the background of IR72 and NSIC Rc222.
25. A glasshouse facility for BPH and GLH testing was developed, four BPH colonies of Philippines maintained and services were provided to evaluate advanced and early generation breeding lines against BPH and GLH for varietal development.

2.2.4 Improved populations
26. More than 70 selected elite lines are being converted to male sterile. 40 are at BC3F1 stage, while the others are at BC2F1 stage.
27. Three 8-parent and one 12-parent recurrent selection populations were developed by hand pollinations.
28. More than 200 advanced lines are tested in observational yield trial (OYT); 10 advanced lines are provided to the irrigated breeding program and more than 2000 lines are being advanced by RGA.
29. Male sterile gene of msIR36 is fine mapped to 28kb and tightly linked markers are identified and validated.

2.3.1. Drought tolerant rice
30. 30 new drought tolerant donors identified. Among the donors -, AUS 299, AUS 304, LIEN-CHAN-SHA-PU-TSAN, Dular, IR 83614-1005-B-B, Kalia, AUS BAK TULSI also showed resistance to 12-13 strains of bacterial blight pathogen.
31. Improved pre-breeding drought tolerant QTL lines for qDTY1.1, qDTY3.2, qDTY3.3, qDTY2.2, qDTY4.1 qDTY6.1, and qDTY6.2, qDTY12.1 and various QTLs combinations developed.
32. qDTY1.1, qDTY3.1, qDTY3.2, and qDTY12.1 for lowland drought, qDTY1.1, qDTY2.3, qDTY6.1, qDTY6.2 for upland drought: major drought yield QTLs with multiple genetic background effects identified. qDTY1.1, qDTY12.1 characterized.
33. Vandna introgressed with qDTY12.1, IR64 introgressed with qDTY12.2, qDTY4.1, Anjali introgressed with qDTY12.1, Sambha Mahsuri introgressed with qDTY2.2 and qDTY4.1
34. HHZ 8-SAL 6-SAL 3-Y2/GSR IR1-8-S6-S3-Y2, HHZ12-DT10-SAL1-DT1/ GSR IR1-12-D10-S1-D1, IR83142-B-7-B-B, IR83142-B-19-B, IR83140-B-36-B, IR83142-B-60-B are the promising drought tolerant lines developed in Green Super Rice. Drought tolerant breeding lines -IR 84170-14-74-B-B, IR 84170-14-57-B-B, IR 87728-409-B-B, IR 87728-162-B-B, IR 87728-23-B-B, IR 87705-31-3-B, and IR 86790-557-B-B-B, also tolerance to both blast and brown spot are developed in STRASA.

2.3.2. Flood tolerant rice
35. Out of 100 F6-bulked selected material, 21 lines identified as tolerant to AG stress (survived under control and severe field screening), at least 2 lines are tolerant to both AG and submergence.
36. AG1 and AG2 introgressed into more genetic backgrounds, including popular varieties from Philippines and Sri Lanka
37. IR64-AG1 and AG1+Sub1 NILs and IR64-Sub1+AG1+Saltol NILs performed well under AG and complete submergence stresses in IRRI greenhouse and field
38. Swarna-Sub1 +BB and Swarna-Sub1+photoperiod sensitivity fixed lines were developed and ready for further confirmation and evaluation.
39. Varieties and breeding lines with high tolerance of stagnant flooding (SF) and lines combining Sub1+SF were developed and being field tested

2.3.3. Improved varieties tolerant of salt stress and other problem soils
40. Mapped the salinity tolerance QTL in Hasawi at seedling stage using F6 recombinant inbred lines population and identified 17 QTLs distributed in Chromosomes 1, 4, 7,9, and 12; QTLs for the reproductive stage using FL478/Sadri F2 tagged on chromosome 2, 4, 6 and 8.
41. Early maturing salt tolerant lines with better grain quality are now available for evaluation. Some with good tolerance to Zn def. being evaluated in Bangladesh, Philippines, India, and Myanmar.
42. 15 new “2-in-1” rice: combined tolerance of salinity and submergence with better grain quality were sent to NARES partners in Bangladesh, India, Myanmar, Iran, and SS Africa for evaluation
43. Multiple abiotic stress tolerant lines from GSR now available- a) GSR IR1-8-B-S6-S3-Y2 (highest yielder in MET2) and GSR IR1-5-S8-D3-SU1 pre-released, early maturing with saline, drought and submergence tolerances, b) pre-release promising DT pyramiding lines IR83140-B-11-B, c) IR83140-B-28-B with good level of salinity tolerance, and d) pre-release high yielding premium grain quality aromatic and most preferred line by the farmers at PVS trials GSR IR1-12-D10-S1-D1.

2.3.4 Varieties tolerant to cold and hot temperatures
44. Four early morning flowering (EMF) lines identified from 421 alien introgression lines with the EMF-QTL introgressed into the mega-varieties TDK1 and Swarna.
45. Heat tolerance QTL qHTSF1.1 and qHTSF4.1 fine mapped to 5 cM with BC3F1 for qHTSF1.1 and BC6F1 for qHTSF4.1 fine mapping populations developed.
46. Four new heat tolerance QTL from IR64/Giza178 and Milyang23/Giza178 populations identified.
47. Best breeding lines in field trials (IR90138-53-1-1-2, IR90340-59-1-2-1, IR90138-5-3-2-1 IR86990-112-1-4-2, IR90141-34-2-1-1, and IR89292-11-1-1-3) and under controlled conditions (IR91457-13-1-1-2, IR93358:11-B-4-1-3-1, and IR93328:26-B-3-2-2-1, IR94000-59-3-2-2, IR93974-71-2-2-2, IR93945-44-3-1-1) identified.

48. Studies on the physiological mechanisms leading to high day temperature- and high night temperature-induced yield losses initiated.

2.4.1. New generation of elite inbreds with increased yield potential

49. Donor genotypes possessing yield enhancing genes showed significant differences in yield component traits such as grain number per panicle, panicle size and culm strength compared to the 12 recurrent parent genotypes in replicated yield trials, and new donors (20 from indica diversity panel of 359 and 9 from alien introgression lines) for yield enhancing traits were identified.

50. Based on physiological characterization and modeling experiments, ten genotypes were selected from the 300 indica diversity panel as donors for yield potential component traits and given to irrigated breeding program for crosses and the growth model SAMARA was calibrated for 12 high-yielding genotypes which is now ready for theoretical plant type studies to raise the yield ceiling.

51. In the preliminary yield trials (PYT) of the irrigated program, 69 and 23 elite breeding lines outperformed the high-yielding inbred check IRRI 154 by more than 10% in the dry and wet season respectively and an introgression line in IR64 genetic background, YTH183 increased grain yield by 20-30% compared to IR64.

52. A single nucleotide polymorphism (SNP) marker (C/T) was developed for panicle size gene, Spl14 was identified through SNP association analysis.

53. Three newly bred high yield potential Green Super Rice (GSR) materials (GSR IR3-S13-Y1-S1; GSR IR1-22-T3-D1-Y1, GSR IR1-21-Y4-Y2-Y1) with multiple abiotic and biotic stress tolerance traits were nominated into national yield trials of the Philippines.

2.4.2. High yielding varieties for Asia

54. Major re-design of irrigated breeding pipeline with improved efficiency and effectiveness including implementation of rapid generation advance (RGA) and pre-MET trial testing.

55. Further generation advancement and evaluation of elite irrigated breeding lines including the development of specific breeding lines developed for Cambodia.

56. A new aromatic irrigated variety (IR04A285) has been approved for release. Development of new high yielding, breeding lines with enhanced stress tolerance by GSR program.

57. A new Gates-funded research proposal for irrigated rice called “Transforming Rice Breeding (TRB)” worth $12.5 M for 5 years was awarded to IRRI.

2.4.5 Direct-seeded rice

58. QTLs for component traits under DSR identified: gain yield- qGYDS1.1, qGYDS2.1, qGYDS2.2, qGYDS6.1, qGYDS8.1, qGYDS10.1, early uniform emergence- qEUE8.1; high early vegetative vigor- qEVV9.1; lodging resistance- qLDG3.1

59. Common QTL for root hair density and nutrient uptake- qRHD5.1 identified in two populations under low nutrient, drought-stressed, direct-seeded field conditions.

60. QTLs for grain yield under nematode infestation co-locating with QTLs for low root galling identified- qGYNT3.1, qGYNT10.1

61. Pre-breeding material (F6) suitable for DSR having high tolerance to flooding during germination (AG) alone or both combinations of AG+SUB1 with various duration of maturity developed. Some of these materials were used in the rainfed breeding program in IRRI, India and the IRRI Hub in SEA (Mozambique and Burundi).

2.5.1. Hybrid Rice for Asia

62. 6 GSR hybrids were released and currently expanded in India;

63. 55 new IRRI hybrids named and being tested in various trials;

64. 4219 HRDC lines/times shared with HRDC members;
65. New CMS lines improved with large stigma transferred from wild rice started for testcross and backcross.

2.5.3. Hybrid Rice for Africa

66. 529 lines from CIAT and FLAR that test-crossed with IRRI parents shared and evaluated by members of the Hybrid Rice Research Consortium for Latin America.

Each year, some 80,000-100,000 germplasm materials move through the F1-F7 to Replicated yield Trials and Advanced Yield Trials pipeline – with the largest number of material present at the F2 stage. Out of this, some 5,000 lines might be labeled elite pre-breeding lines further down the pipeline.

4.2. Indicator 23: number of technologies (breeding products) field tested (phase II)

2.1.4. Multi-environment testing (MET) and international germplasm evaluation (INGER)

1 Implemented Stages 0, 1 and 2 of the IRRI irrigated lowland rice MET at 5, 6, and 12 locations, respectively, in the Philippines and 5 other Southeast Asian countries with 480, 228, and 82 promising and elite breeding lines, respectively, as entries.

2 Selected the following MET2 entries for the National Cooperative Tests of the Philippines and for possible release as new varieties: IR 09A220, IR 10N108, IR 09A136, IR 09N522, IR 10A155, IR 09N538, IR 07A179, IR 05N419, and IR 10F336.

3 Organized 545 breeding lines from 16 NARES, CIAT and IRRI into 9 types of international nurseries for evaluation under irrigated, rainfed lowland, and upland conditions and for resistance/tolerance to biotic and abiotic stresses with 387 nursery sets sent to 24 countries.

4 Identified from 167 INGER trials conducted in 17 countries the best entries as CT 19021-3-4-1VI-3, IR 09N127, PSB RC82, MTU-1117, BP10618F-B88-13-B88, PR37126-PB-2-3-4-10-8, Pant Sugandh Dhan 15, Basmati 370, and 2000049-TR 2072-4-1-1 for irrigated lowland, NR 1887-8-1-1-2-2, PSB RC 68, and CT 18545-9-9-1-1-2 for rainfed lowland, and TB 368B-TB-25-MR-2, UPL Ri-7, and IR74371-70-1-1 for upland conditions.

5 560 breeding lines were evaluated in Multi Environment Trials at 218 sites in 29 African countries by the Africa-wide Rice Breeding Task Force.

4.3. Indicator 27: number of technologies (breeding products) released (phase III)

In 2013, a total of 62 varieties were officially released with AfricaRice ancestry or derived through the Africa-wide Rice Breeding Task Force. A complete overview of AfricaRice-related varieties released or adapted in Africa is available separately.

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<td>Gambia (Informal)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigated</td>
<td>Mauritania</td>
<td></td>
</tr>
<tr>
<td>Sahel 134</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sahel 159</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
It is noteworthy that, in 2013, AfricaRice and partners decided to assign new names to particularly promising breeding lines that result from the Africa-wide Rice Breeding Task Force activities: ARICAs, which stands for Advanced RICe for Africa. ARICA varieties can be considered as the next generation of rice varieties for Africa, after the success of the NEw RICe for Africa (NERICAs) developed in the 1990s and the first decade of this century. For a breeding line to be nominated as an ARICA line, it must have a clear advantage over the best check varieties in a region, backed by quality data over at least three seasons. Moreover, at least one country should show interest in nominating the line for varietal release. The ultimate decision on naming an ARICA line is made by AfricaRice, and is based on data gathered in the Task Force trials, and any other data gathered during the breeding process. In 2013, five ARICAs were named: ARICA1, 2, and 3 are suited for the rainfed lowland growth environment and are proposed for varietal release in Mali (ARICA1, ARICA2, and ARICA3) and Nigeria (ARICA2 and ARICA3). ARICA4 and ARICA5 are suited for the upland growth environment and were released in Uganda. All ARICAs outyielded local checks, including NERICA-19, in the rainfed lowland environment and NERICA4 in the upland environment. In addition, ARICA3 has better grain quality, higher milling recovery, lower chalkiness, and shorter cooking time than NERICA-19.

In 2013, CIAT and its FLAR partners released seven new varieties: two in Panama (Estrella FL11 and FCA616FL), two in Venezuela (Soberana FL and ASP12 FL), two in Ecuador (INIAP FL01 and SFL 12), and one in Nicaragua (2012FL), and lines are being considered for release in 2014 in Colombia (one), Bolivia (one), Costa Rica (one), Panama (one), the Dominican Republic (one), and Chile (one).

In 2013, a total of 44 rice varieties were released from IRRI (18) and NARES/private-sector partners (26) in 2013:

<table>
<thead>
<tr>
<th>Sl</th>
<th>Country</th>
<th>Name of variety</th>
<th>Designation/other name</th>
<th>Parents/source</th>
<th>Ecosystem/stress environment</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Bangladesh</td>
<td>BRRI dhan59</td>
<td>BW328</td>
<td>INGER</td>
<td>Irrigated</td>
</tr>
<tr>
<td>2</td>
<td>Bangladesh</td>
<td>BRRI dhan60</td>
<td>BR7323-48-1</td>
<td>BR7166-4-5-3/ BR26</td>
<td>Irrigated</td>
</tr>
<tr>
<td>3</td>
<td>Bangladesh</td>
<td>BRRI dhan61</td>
<td>BR7105-4-4-2</td>
<td>IR6419-3B-4-3/ BRRI dhan29</td>
<td>Saline-prone</td>
</tr>
<tr>
<td>4</td>
<td>Bangladesh</td>
<td>BRRI dhan62</td>
<td>BR71517-2R-27-3</td>
<td>Jirakateri/BRRI dhan39</td>
<td>Irrigated/high Zn in the grain</td>
</tr>
<tr>
<td>5</td>
<td>BiNA dhan 11</td>
<td>IR09F436 (Ciherang-Sub1)</td>
<td>Ciherang</td>
<td>Saline-prone</td>
<td>Submergence-prone</td>
</tr>
<tr>
<td></td>
<td>Country</td>
<td>Variety/Description</td>
<td>Variety/Description</td>
<td>Note</td>
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</tr>
<tr>
<td>6</td>
<td>India</td>
<td>BINA dhan 12</td>
<td>Sambha Mahsuri</td>
<td>Submergence-prone</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>India</td>
<td>Sambha Mahsuri-Sub1</td>
<td>IR07F101</td>
<td>Sambha Mahsuri</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>India</td>
<td>IR64 Sookha 1</td>
<td>IR 87707-445-B-B-B</td>
<td>IR64-NIL with Vandana</td>
<td></td>
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<tr>
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<td></td>
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<tr>
<td>9</td>
<td>Myanmar</td>
<td>Myaungmya May</td>
<td>PRAM BEI KOUR</td>
<td>PRAM BEI KOUR</td>
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<td>10</td>
<td>India</td>
<td>Sangankhan Sinthwelatt</td>
<td>Yn 3220 MAS 62-2-4</td>
<td>IR 53936-60-3-2-1/Pokkali</td>
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<td>11</td>
<td>India</td>
<td>Yeanelo -2</td>
<td>UPLRI -7</td>
<td>C22/IR26//C22/OS4</td>
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<tr>
<td>12</td>
<td>India</td>
<td>Thukha Hmwe</td>
<td>Yn 3248-BC4F2-33</td>
<td>Manawthukha/Basmati 370</td>
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<tr>
<td>13</td>
<td>Cambodia</td>
<td>Damnoeb Sbai Mongkul</td>
<td>Glutinous No 6</td>
<td>Damnoeb Krapeu</td>
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</tr>
<tr>
<td>14</td>
<td>Cambodia</td>
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<td></td>
<td></td>
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<tr>
<td>15</td>
<td>Vietnam</td>
<td>08Fan10</td>
<td></td>
<td>GSR-CAAS</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Indonesia</td>
<td>hybrid- BSHS6-GSR</td>
<td></td>
<td>GSR-CAAS</td>
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<tr>
<td>17</td>
<td>Philippines</td>
<td>NSIC 2013 Rc308</td>
<td>Tubigan 26</td>
<td>PR35766-B-24-3</td>
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<tr>
<td>18</td>
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<td>NSIC 2013 Rc310H</td>
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<td>INH10001</td>
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<td>22</td>
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<td>NSIC 2013 Rc318H</td>
<td>Mestiso 48</td>
<td>PR35664H</td>
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<td>23</td>
<td>Philippines</td>
<td>NSIC 2013 Rc320H</td>
<td>Mestiso 49</td>
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<tr>
<td>24</td>
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<td>NSIC 2013 Rc322H</td>
<td>Mestiso 50</td>
<td>P2010-31</td>
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<td>25</td>
<td>Philippines</td>
<td>NSIC 2013 Rc324</td>
<td>Salinas 10</td>
<td>PR31607-2-B-B-B-B</td>
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<tr>
<td>26</td>
<td>Philippines</td>
<td>NSIC 2013 Rc326</td>
<td>Salinas 11</td>
<td>IR84084-B-B-1-1</td>
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<tr>
<td>27</td>
<td>Philippines</td>
<td>NSIC 2013 Rc328</td>
<td>Salinas 12</td>
<td>IR62700-2B-9-2-2</td>
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<tr>
<td>28</td>
<td>Philippines</td>
<td>NSIC 2013 Rc330</td>
<td>Salinas 13</td>
<td>PR37435-30-1</td>
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<tr>
<td>29</td>
<td>Philippines</td>
<td>NSIC 2013 Rc332</td>
<td>Salinas 14</td>
<td>PR38566-WAGWAG V9-3- 2-15-2</td>
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<tr>
<td>30</td>
<td>Philippines</td>
<td>NSIC 2013 Rc334</td>
<td>Salinas 15</td>
<td>IR83410-6-B-4-1-1-2</td>
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<td>31</td>
<td>Philippines</td>
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<td>Salinas 16</td>
<td>IR84095-AJY3-8-SDO1-B</td>
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<td>32</td>
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<td>Salinas 17</td>
<td>PR30665-1B-1-B-Cg</td>
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<td>NSIC 2013 Rc340</td>
<td>Salinas 18</td>
<td>IR84096-AJY 4-2-SDO-4-B</td>
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<td>34</td>
<td>Philippines</td>
<td>NSIC 2013 Rc342SR</td>
<td>Mabango 4</td>
<td>PR37299-31-69-16-2-1-2 (A)</td>
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<td>District</td>
<td>Name</td>
<td>Variety/IR</td>
<td>Type</td>
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<td>35</td>
<td>NSIC 2013 Rc344SR</td>
<td>Mabango 5</td>
<td>IR04A285 (A)</td>
<td>Irrigated/special purpose</td>
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<tr>
<td>36</td>
<td>NSIC 2013 Rc346</td>
<td>Sahod Ulan 11</td>
<td>PR34350-4-POKKALI-24-M5R-10 (DrS 88)</td>
<td>Rainfed dry seeded</td>
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</tr>
<tr>
<td>37</td>
<td>NSIC 2013 Rc348</td>
<td>Sahod Ulan 12</td>
<td>IR81047-B-106-2-4</td>
<td>Rainfed dry seeded</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>Tanzania</td>
<td>Komboko</td>
<td>IR05N221</td>
<td>Rainfed/Irrigated</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Tanzania</td>
<td>Tai</td>
<td>IR03A262</td>
<td>Rainfed/Irrigated</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Mozambique</td>
<td>M’ziva</td>
<td>IR 77080-B-34-3</td>
<td>Rainfed drought-prone</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>Rwanda</td>
<td>08Fan10*</td>
<td></td>
<td>GSR-CAAS</td>
<td>Rainfed lowland</td>
</tr>
<tr>
<td>42</td>
<td>Nigeria</td>
<td>UPIA 1</td>
<td>IR68</td>
<td>IR 19660-73-4/IR 2415-90-4-3-2//IR 54</td>
<td>Irrigated and rainfed lowlands. Tolerant of Fe toxicity and drought</td>
</tr>
<tr>
<td>43</td>
<td>Nigeria</td>
<td>UPIA 2</td>
<td>IR 69513-21-SRN 2-UBN 1-B-7-2</td>
<td>IR 57514-SRN-299-3-2-4/IRRI 119//IR 43524-55-1-3-2</td>
<td>Rainfed lowland; tolerant of Fe toxicity and drought</td>
</tr>
<tr>
<td>44</td>
<td>UPIA 3</td>
<td>IR 74371-54-1-1</td>
<td>IR 55419-4*2/WAY RAREM</td>
<td>Rainfed lowland; tolerant of drought and Fe toxicity</td>
<td></td>
</tr>
</tbody>
</table>

*Same variety released in Vietnam*
Annex 5. Acronyms and abbreviations

A4HN  CGIAR research program on agriculture for nutrition and health
ADB  Asian Development Bank
AfricaRice  Africa Rice Center
AfDB  African Development Bank
AMAF  ASEAN Ministers on Agriculture and Forestry
APAARI  Asia-Pacific Association of Agricultural Research Institutions
ASARECA  Association for Strengthening Agricultural Research in Eastern and Central Africa
ASEAN  Association of Southeast Asian Nations
CAADP  Comprehensive Africa Agriculture Development Program
CARD  Coalition for African Rice Development
CCAFS  CGIAR Research Program on Climate Change, Agriculture and Food Security
CIAT  International Center for Agriculture in the Tropics
CGIAR  CGIAR is a global research partnership for a food secure future.
Cirad  Centre de coopération internationale en recherche agronomique pour le développement (French Agricultural Research Centre for International Development)
CORAF  Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricoles – West and Central African Council for Agricultural Research and Development
CORRA  Council for Partnership on Rice Research in Asia
CRP  CGIAR Research program
CSISA  Cereal Systems Initiative for South Asia
CURE  Consortium for Unfavorable Rice Environments
ECOWAS  Economic Community of West African States
FARA  Forum for Agricultural Research in Africa
FLAR  Latin American Fund for Irrigated Rice
FORAGRO  Foro de las Américas para la Investigación y Desarrollo Tecnológico Agropecuario (Forum of the Americas for Agricultural research and technology Development)
GRISP  Global Rice Science Partnership
IFAD  International Foundation for Agricultural Research
INGER  International Network for Genetic Evaluation of Rice
IRD  Institut de recherche pour le développement (French research institute for development)
IRRC  Irrigated Rice Research Consortium
IRRI  International Rice Research Institute
JIRCAS  Japan International Research Center for Agricultural Sciences
LAC  Latin America and the Caribbean
NARES  National agricultural research and extension system
NEC  National Experts Committee (24 AfricaRice member countries)
NEPAD  New Partnership for Africa’s Development
PIM  CGIAR research program on policies, Institutions and Markets
QTL  Quantitative Trait Loci
SAARC  South Asian Association for Regional Cooperation
SKEP  Scientific Knowledge and Exchange Program
SNP  Single Nucleotid Polymorphism
SRP  Sustainable Rice Platform
STRASA  Stress-Tolerant Rice for Africa and South Asia
UEMOA  West African Economic and Monetary Union
GRiSP’s Mission

GRiSP’s mission is to reduce poverty and hunger, improve human health and nutrition, reduce the environmental footprint, and enhance the ecosystem resilience of rice production systems through high-quality international rice research, partnership, and leadership.

Objectives

1: To increase rice productivity and value for the poor in the context of a changing climate through accelerated demand-driven development of improved varieties and other technologies along the value chain.

2: To foster more sustainable rice-based production systems that use natural resources more efficiently, are adapted to climate change and are ecologically resilient, and have reduced environmental externalities.

3: To improve the efficiency and equity of the rice sector through better and more accessible information, improved agricultural development and research policies, and strengthened delivery mechanisms.

Global research themes

1: Harnessing genetic diversity to chart new productivity, quality, and health horizons.

2: Accelerating the development, delivery, and adoption of improved rice varieties.

3: Ecologically and sustainably managing rice-based production systems.

4: Extracting more value from rice harvests through improved quality, processing, market systems, and new products.

5: Enhancing impact through technology evaluations, targeting, and policy options.

6: Supporting the growth of the global rice sector.

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.