CGIAR

RESEARCH PROGRAM ON
Dryland Cereals

A global alliance for improving food security, nutrition and economic growth for the world's most vulnerable poor.

ANNUAL REPORT 2015

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CGIAR

RESEARCH PROGRAM ON
Dryland Cereals

LED BY
ICRISAT
Science with a human face

IN PARTNERSHIP WITH
ICARDA
Science for Better Livelihoods in Dry Areas

and public and private institutes and organizations, governments, and farmers worldwide

CGIAR RESEARCH PROGRAM ON DRYLAND CEREALS
PERFORMANCE MONITORING REPORT FOR CALENDAR YEAR 2015

A. KEY MESSAGES (1 ½ pages)

Synthesis of progress and challenges in implementing the CRP: The CGIAR research program on Dryland Cereals has come a significant way since its official start in June 2012, with the support of a dedicated Research Management Team, oversight of a committed Independent Steering Committee, and consistent guidance from both the CO and the ISPC. The year 2015 constituted the first year of a two-year extension phase for the program, along with all the other CGIAR Research Programs, and the transition from Phase I to a restructured extension phase was fairly smooth for Dryland Cereals from the functional standpoint. Restructuring along a "delivery pipeline" that includes priority setting, crop improvement, crop management, seed systems and output markets has helped ensure appropriate effort in these different areas for all target crops in the different countries, thus enabling a more holistic approach towards ultimate impact. The demand for sorghum and millets continues to grow in Africa, due to their tolerance to drought and poor soils, due to their micronutrient-dense nature (especially finger millet) and due to their new end uses over and above the current end uses for food and fodder in the continent. Recent end-use demand for sorghum include poultry feed in West and Central Africa (WCA), specifically Nigeria, and fish feed in East and Southern Africa (ESA), specifically Kenya. The demand for barley remains stable in Central and Western Asia and North Africa (CWANA), as does that for barley and pearl millet in India, while the decreasing trends in demand for sorghum in India sees potential for reversal through opportunities for the crop in rice fallows and the demand for fodder. The development of hybrids was demonstrated for the first time in post-rainy sorghum in India in 2015, generating renewed interest in this crop in India from the seed industry. Major productivity enhancements (10 to 30% above current) have been demonstrated to be possible for: (1) sorghum in WCA through the exploitation of heterosis in guinea race sorghum, (2) pearl millet in ESA through the introduction and testing of adaptable hybrids from India, and (3) both sorghum and pearl millet in WCA through appropriate agronomy involving microdosing of fertilizers, and the package of practices termed "Improved Striga and Soil Fertility Management (ISSFM)." The combination of strong demand and demonstrated possibilities for productivity enhancements through breeding and agronomy for the target crops in their target countries poises the program for major contributions towards the target SLOs and SDGs. Focused planning, expert implementation, diversification where necessary and sustainability are critical factors for success, and the proposed merger with Dryland Systems and Grain Legumes for the second phase addresses these. Fluctuating budgets and the unrest in several of the target countries present difficulties in both program implementation and staff retention. Despite the challenge of fluctuating W1-W2 budgets, the program has been able to achieve a good proportion of proposed goals through the continued support of bilateral and W3 projects, and new resource mobilization efforts.

Synthesis of the two most significant achievements/success stories in the year: Heterosis/hybrid vigor offers step changes in productivity improvements in crops where it is biologically and practically feasible. Maize is an excellent example where yields in the early 1900s in mid-west USA that remained at ~25 bushels/acre increased significantly with the introduction of hybrids in the 1930s, and now has reached an average of 170 bu/ac. Such step changes combined with optimal agronomy and eventual molecular breeding can provide focused and accelerated genetic gains for desired input and output/quality traits. Riding the wave of the emerging interest in, and opportunities for, productivity enhancements through the exploitation of heterosis in sorghum and pearl millet in Africa, and attempting to emulate the success story from India, two related efforts constitute the first significant achievement during the year. The first was the launch of the **Sorghum Hybrid Parent Research Consortium in Kenya**, with the participation and representation of all seed industries in the region for the selection of ICRISAT-bred hybrid parents. The second was the demonstration of yield enhancements with **hybrid pearl millet in WCA**, and the identification of appropriate hybrid parents.

Yield superiority up to 30% was demonstrated for seven pearl millet hybrids, and following up rapidly on this proof of concept a total of eight new restorer parents were identified from germplasm accessions in WCA. The second major achievement pertain to two first-time demonstrations, specifically in post-rainy sorghum in India: the identification of **QTLs for grain Fe and Zn in sorghum**, and the use of **MABC for shoot fly resistance in sorghum** through the introgression of the resistance QTL from BTx623 into elite sorghum.

In addition, the year saw the **release of 3 finger millet, and 4 sorghum cultivars**, and the entry of several advanced lines of all four crops into National Performance Trials and Participatory Variety Selection. **Finger millet** (*Eleusine coracana* (L.) Gaertn), which was one of the six small millets in ICRISAT's research portfolio, was formally made a **mandate crop of the Center**, based on the decision of the ICRISAT Governing Board in Sep 2015. The **decentralization plan of ICARDA barley** programs continued to be implemented successfully. The satellite and shuttle breeding stations at Terbol in Lebanon, Marchouch and Allal Tazi in Morocco, Sanliurfa & Ankara in Turkey were effectively used. Major activities such as generation advances, nurseries and trials were carried out at the Morocco Platform with the upgradation of farm facilities, equipment and infrastructure over the last year.

Overall financial summary: Cumulative Financial Summary (Report L101)

Report Description

Name of Report:	Cumulative Financial Summary
Frequency/Period:	Annual
Deadline:	Every April 15th

	(a) Total POWB budget since inception					(b) Actual Expenses - Cumulative					(c) Variance - Cumulative				
Centers	**Windows 1 & 2**	**Window 3**	**Bilateral funding**	**Center Funds**	**Total Funding**	**Windows 1 & 2**	**Window 3**	**Bilateral funding**	**Center Funds**	**Total Funding**	**Windows 1 & 2**	**Window 3**	**Bilateral funding**	**Center Funds**	**Total Funding**
ICARDA *	6,632	708	4,680	-	12,020	6,216	491	2,273	-	8,980	416	217	2,407	-	3,040
ICRISAT **	18,309	15,377	30,665	1,023	65,373	17,574	11,183	21,962	1,023	51,742	735	4,193	8,703	-	13,632
GCP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	24,941	16,085	35,345	1,023	77,393	23,790	11,674	24,235	1,023	60,722	1,151	4,410	11,110	-	16,672
Percentage	32%	21%	46%	1%	100%	39%	19%	40%	0	100%	7%	26%	67%	0%	100%

* Including Infrastructure
** Including PMU

B. IMPACT PATHWAY AND INTERMEDIATE DEVELOPMENT OUTCOMES (IDOS) (1/4 page)

The Impact Pathway and Theory of Change were strengthened through a merger with Dryland Systems and Grain Legumes for the submitted Phase II proposal. The IDOs for the current extension phase are intrinsically related to the IDOs and sub-IDOs of the second phase, which in turn are related to the Sustainable Development Goas of the United Nations. Baseline reports and socioeconomic analyses for Dryland Cereals for the target countries saw further progress, including the analyses of several value chains, and these have been significantly complemented during the year by the country strategies for the ICRISAT mandate countries. A draft report was prepared to help prioritize the regions of the globe where dryland cereals and grain legumes were co-cultivated, in support of the Phase II preproposal.

C. PROGRESS ALONG THE IMPACT PATHWAY

C1. Progress towards outputs (2 pages)

The year 2015 continues the same trend as 2014 with improved rigor of implementation and continuing improvements in alignment with streamlined goals. Selected outputs are presented in this report. The detailed reports of individual projects can be accessed here.

Flagship Project 1 - *Priority Setting & Adoption:*

Five major studies/analyses have been completed and reported during the year under this FP: **(1)** Consumer demand for sorghum and millets in Eastern and Southern Africa: Priorities for the CGIAR Research Program for Dryland Cereals, **(2)** Sorghum in semi-arid subsistence agriculture: the case of Central Mozambique, **(3)** Potential welfare benefits of millet improvement research to inform decision making: multi-country, economic surplus model approach, **(4)**Testing Theories of Change for Dryland Cereals: The HOPE project in Central Tanzania 2009-2012, and **(5)** Sorghum and finger millet flour processing in Tanzania, Kenya and Uganda.

Report (1) is a detailed analysis of current information on **consumer demand for sorghum and millets in ESA**, with particular reference to Kenya, Tanzania, Uganda and Ethiopia, focusing on demand as affected by population growth, urbanisation, income and price. The results have helped to prioritize research on these crops for Phase II. Study (2), initiated in September 2014, is a continuation of a 2013 scoping study and involves a focused interview of 142 households in Central Mozambique and reports a benefit-cost analysis where **sorghum and pearl millet are increasingly advantageous over maize** in more marginal environments, with the primary use being in food for household consumption. One notable way that sorghum was marketed was as beer produced primarily by women at the household level. (3) Empirical results of **a multi-country analysis of the potential welfare benefits of millets research** indicated that the highest expected benefits to millets research could be generated when research is focused on production domains that are warm tropic dryland with growing duration of 120-149 days. In Asia, these production domains had the highest payoff of $479.85 MM expected benefits, while the expected benefits for the production domains for West and Central Africa and East Southern Africa (warm tropics drylands, 90-119 days and warm tropics sub-humid, >150 days), were $242.42 MM and $15.06 MM respectively. (4) A **resurvey of 342 of 360 original respondents** of a baseline survey for the HOPE project (*H*arnessing *O*pportunities for *P*roductivity *E*nhancements in Sorghum and Millets, supported by the Bill and Melinda Gates Foundation) in Tanzania identified that enhancing productivity for dryland cereals requires not just improved varieties but also improved crop management. (5) The last study refers to the completed analysis of interviews from 2011-12 of **53 processing companies of sorghum and finger millet flour** in Tanzania, Kenya, and Uganda. Annual demand was highest for finger millet in Kenya (600+ t). Most companies operated below capacity because of demand constraints, inconsistent supply of raw material, and fluctuating prices for grain. Over 70 % of processors were willing to pay a premium for higher quality grain. There was an expectation for **increased demand, especially for finger millet flour**.

Flagship Project 2 – *Improved Varieties & Hybrids:*

During 2015, the numbers of **elite lines/varieties** that entered **National Performance/Variety Trials** (NPT) were **118, 170 and 474**, respectively, for finger millet, pearl millet and sorghum across the target countries. In barley, more than **30 genotypes with superior yield** and other desirable traits were selected out of 750 evaluated in advanced yield trials at Marchouch, Morocco, and Terbol, Lebanon. Further, a total of **145 highly drought tolerant lines** were selected from more than 1500 advanced breeding lines and seed was increased for international trials and nurseries. The **malting-quality trait** in ICARDA high-input barley germplasm was further **diversified** by the introduction of genotypes/varieties from UC Davis, California, and other sources. From 1414 accessions across five FIGS subsets evaluated in 2015, 98 **sources of resistance** for powdery mildew, 22 for net blotch, 9 for barley yellow dwarf virus and 18 potential sources of tolerance to stem gall midge were identified.

Finger millet collections gaps in Central and Southern Tanzania, and in Eastern, Northern and Western Uganda were filled through collection missions in association with national partners resulting in 134 and 135 collections from Tanzania and Uganda, respectively. **Yield performance above local checks** was confirmed for 3, 5 and 4, respectively, short-, medium- and long-duration accessions of finger millet, which were selected for entry into 2016 regional trials. Notably, medium-duration accessions performed better than the other two groups. In Uganda and Western Kenya, respectively, 3 and 4 out of 25 finger millet genotypes tested for ***Striga* resistance** were selected for high yield under infestation, and 3 in Western Kenya were found to suppress ***Striga* emergence**.

More than **30% yield superiority** was demonstrated for seven **pearl millet hybrids in WCA** over open-pollinated varieties in an evaluation of 16 single-cross, and 12 top-cross hybrids in Niger and Senegal. With this **proof of concept** for superior performance of pearl millet **hybrids** in WCA, foundations are being rapidly laid to tap **heterosis** for yield superiority of the crop in the region, and **eight new restorer inbred parents** have been identified **from germplasm accessions of WCA origin**. In ESA (Tanzania and Kenya), 24 single-cross and about 100 top-cross hybrids were made using

cytoplasmic male sterile (CMS) and R-lines from India and Mali. In India, an evaluation of 130 novel pearl millet accessions from the Gene bank resulted in the identification of 15 superior genotypes that are being used to **diversify the genetic base of current hybrid parents**. In addition, new genetic diversity was introduced to India from the WCA program in the form of 30 genotypes/OPVs and 400 inbreds identified in WCA. **High-tillering germplasm** sources were identified and utilized to generate **disease-resistant, high-biomass pearl millet** materials, using two *Pennisetum violaceum* accessions, IP 21544 and IP 21720, and two germplasm lines/varieties, IP 22269 and ICMV 05555. Of 200 R lines of pearl millet screened in India against 4 **downy mildew (DM)** pathotypes, 30 were resistant to all four and 37 had resistance to at least three, while 17 of 50 high Fe-lines screened against three pathotypes were resistant to all three. B-line screening against **2 blast pathotypes** yielded 35 that were resistant to both. High levels of **blast resistance** were observed in 507 B, ICMR 11003 and IP 21187, with resistance at 8 of 9 test locations in India.

Progressing with the development of **hybrid sorghum in West Africa**, 60 F1 progenies from landrace x CK60B crosses were identified for the transfer of maintainer genes into Nigerian sorghum seed-parent varieties. The landraces, 'SorgGarki' and 'Babbadiya', were identified, respectively, as potential B-line and restorer for the A1 cytoplasm system. A screen of 54 diverse sorghum genotype sources for **resistance to stem borer** and adaptation to the sorghum growing ecologies in Kano and Samaru, Nigeria, resulted in the identification of 5 promising genotypes. A screen of 84 diverse sorghum genotype sources for **resistance to *Striga*** at Samaru and BirninKudu, Nigeria, produced 10 promising lines with low *Striga* score. **In ESA**, 16 of 75 **new sorghum hybrids** developed were selected for fertility restoration, >95% seed set and high yield potential and entered into adaptation trials in target agro-ecologies. Regional sorghum hybrid trials involving 25 hybrids in Kenya identified five with consistently high yields in the range of 3.107 to 3.360 t ha^{-1} across the two tested locations, outperforming the released hybrid check, ATX 623 x MACIA (2.937 t ha^{-1}). A large set of trait-based sorghum hybrid parents developed at ICRISAT (760 B-lines and 616 R-lines) was selected for **assessment of genetic diversity** using GBS in the **GOBII project** at the Genomics Diversity Facility, Institute of Biotechnology, Cornell University, Ithaca, USA. In multi-locational sorghum trials for **post-rainy season adaptation in India**, 5 of 12 elite B-lines and 6 of 12 elite R lines were selected. Further, 2 elite varieties out of 9 tested, and 4 elite hybrids out of 28 tested were identified as superior for grain yield. The *in vitro* organic matter **digestibility** of the selected hybrids was comparable with that of the best check M 35-1. Phenotyping of a RIL population of 342 individuals from the cross 296B × PVK801 for grain Fe and Zn concentrations over 2 years at 3 locations, and genotyping with SSR and DArT markers, revealed **18 QTLs controlling Fe and Zn** that were stable across all six environments. This is the **first report of QTLs for grain Fe and Zn in sorghum**.

Flagship Project 3 – *Integrated Crop Management*:
Conservation tillage practices tested in barley across two locations in India showed that returns to variable cost ($357 ha^{-1}), benefit-cost ratio (1.74) and grain yields were high, and weed growth was less, when malt barley was sown with zero till after reduced-till, direct-seeded rice, with rice residue retention at 6t ha^{-1}. This was relative to reduced-till barley following puddled transplanted rice. Preliminary studies on **relay cropping of barley in standing cotton with zero tillage** have shown promising results with substantially higher grain yields than with conventional delayed sowing after cotton harvest. **Feeding trials in sheep** during April to June in Sadore, Niger, evaluated the effects of **chopped vs non-chopped pearl millet fodder** using two crop varieties. NIRS analysis revealed that the variety, Fadda (IVOMD= 53.20, ME=8.18) was superior to Mota Maradi (IVOMD=50.73,ME=7.67) in fodder quality traits, while the average weight gain was 6.35 kg when fed chopped Fadda, versus 5.8 kg when fed Mota Maradi, against a control of 2.35 kg.

Flagship Project 4 – *Seed Systems & Input Services:*
In **barley**, ICARDA is implementing a project on *'Deployment of malt barley and faba bean varieties and technologies for sustainable food and nutritional security and market opportunities in the highlands of Ethiopia'* with financial support from USAID in Ethiopia, and another on '*Increasing the*

Productivity of Cereal-based Systems to Enhance Food Security' in Iran. In Ethiopia, the project is active in 18 zones, 33 districts and 42 *kebeles* with 28 licensed and 14 non-licensed seed cooperatives with a total membership of 4070 members of which 552 are female farmers. About 231 farmers (30 female) were provided with 8.74 t of small seed pack of malt barley varieties as part of technology out-scaling-cum on-farm seed multiplication through a revolving seed-fund scheme. An estimated 62 ha was planted with anticipated production of 186 t of seed as part of on-farm seed multiplication. A **handbook of sorghum and finger millet seed production and marketing** was produced in English and translated to Amharic (Ethiopia), Tigrinya (Eritrea) and Kiswahili (Tanzania) versions, with 550 manuals distributed in Tanzania alone.

Flagship Project 5 – *Postharvest Value & Output Markets:*
Analysis of the **rancidity profile** of 12 pearl millet hybrid parents and 44 promising released hybrids, towards promoting the availability of shelf-stable pearl millet flour, showed significant diversity in rancidity among the evaluated lines. In Kenya, five **aggregators were trained in agri-business** and were linked to sources of high-quality certified sorghum seed. They were facilitated to disseminate information and sell certified seed on credit to resource-poor farmers. Further, agro-dealers were facilitated to market both small seed packs and small fertilizer packs in Tanzania. **Catalogue** of the two widely released and promoted **finger millet varieties** in ESA, U15 and P224, were developed.

C2. Progress towards the achievement of research outcomes and IDOs (2 pages)
Flagship Project 1 - *Priority Setting & Adoption:*
Country strategies for Ethiopia, Kenya, Malawi, Mali, Niger, Nigeria and Zimbabwe have been completed by the Lead Center, ICRISAT, which provide country overview, baseline information, past achievements, strategic path forward, partnerships and other critical information supporting future planning. These constitute an important resource for strategic planning for the second phase. In addition, Dryland Cereals participated in the **national consultations** in several of its target countries under the CGIAR **site-integration efforts**.

Flagship Project 2 – *Improved Varieties & Hybrids*
The year saw the **release of three finger millet varieties** (KNE 628, KNE 741 and U-15 in Kenya) **and four sorghum cultivars** (2 varieties, EUSS11 (IESV 93042 SH) and EUSS10 (IESV 91018 LT) in Kenya; and 2 hybrids, SPH 1641 and RVICSH 28 in India) by partners using parental material developed by ICRISAT. In **barley**, **649 advanced lines** with improved **tolerance to abiotic and biotic stresses** were shared globally with national programs from the low input barley (174), high input barley (255) and winter barley (70) programs. A total of **353 sets of international barely nurseries** were distributed from AREC, Terbol and Sanliurfa, Turkey, to 54 collaborators across 33 countries. A **remarkable achievement within a two-year period** is the selection of 45 entirely new sources of disease resistance (net form of net blotch: 9 entries; spot form of net blotch: 8 entries; scald: 9 entries; powdery mildew: 10 entries; and leaf rust: 9 entries) from an evaluation of 15,000 advance breeding lines during 2013-2015, and their introduction into the International Spring Barley Disease Screening Nursery. Seventeen barley genotypes with high levels of **resistance to five pathotypes of stripe rust** were selected in India from a screen of 360 genotypes both at seedling stage in the glass house at the IIWBR Regional Station, Shimla, and at adult stage in the field over two years at ARS Durgapura, Jaipur, and IIWBR, Karnal.

Data from 2015 regional **finger millet trials** were shared with partners in Ethiopia, Tanzania, Kenya and Uganda, leading to the entry of varieties to NPT. Evaluation of nutrient concentrations in 29 previously selected finger millet accessions across three locations resulted in **the selection of 6 with highest Ca, Fe and Zn** levels for **participatory variety selection** (PVS). Multi-locational (5 locations across Kenya, Tanzania and Uganda) **drought-tolerance** evaluation of 25 previously selected drought-tolerance finger millet accessions resulted in **the selection of 5**, and their **advancement to PVS**.

In an evaluation of 28 pearl millet landraces in WCA for **resistance to the millet head miner, varieties PE08043 and PE00077** were selected and included in the breeding program. **Nine A-lines** of pearl millet in five diverse genetic backgrounds and based on different cytoplasms were developed and designated in India, along with the designation as restorer parents of **nine genetically diverse pollinator lines** (ICMR 15111 to ICMR 15999) with resistance to at least 2 DM pathotypes. Differences in Transpiration Efficiency were confirmed among hybrid pearl millet groups bred for different rainfall zones, with hybrids bred for drier zones having significantly lower TE than those bred for wetter zones. This provides **solid evidence for the suitability of the LeasyScan platform** to differentiate genotypes based on their capacity to restrict transpiration under high evaporative demand. Expansion of load cell capacity to 1500 in 2016 increases throughput for drought screening.

Two promising sorghum OPVs with high Fe and Zn and with good yield performances and drought tolerance have been nominated for release. Based on on-farm dual/multipurpose preliminary trials in collaboration with IER in 5 zones, 13 villages and 26 farmers, followed by advanced trials of 5-6 multipurpose varieties and their agronomic options evaluated by 50 additional farmers **in Mali, 14 new dual/multipurpose varieties** entered national multi-location trials. The **variety, IESV 23010 DL** with highest grain yield of 2.545 t ha^{-1}, was identified as the **most preferred** across ten participatory variety trials in the central zone in Tanzania. In participatory hybrid selection trials involving 6 hybrids and two local OPV checks in central Tanzania, **the hybrid IESH 22010 outperformed** the released hybrid ATX 623 x Macia and the local check by 56% and 110%, respectively. Sorghum hybrids, IESH 22012, IESH 22002, IESH 22009 and IESH 22011, recommended for release in Kenya last year are now **under DUS testing** by the Kenya Plant Health Inspectorate Services (KEPHIS), with breeder seed and on-station phenotypic data from ICRISAT. Three **QTLs for sorghum shoot fly resistance** from BTx623 were introgressed into elite sorghum using MABC, and phenotyping of the resulting progeny led to the identification of two promising resistant lines for each QTL region. This is the **first report on the use of MABC for improving shoot fly resistance in sorghum**. The **post-rainy sorghum variety, ICSR 14001**, completed state-level multi-location testing in Maharashtra and frontline demonstrations in 40 farmers' fields, where it stood first among all entries tested with >30% and >20% higher yield than the check, PVK 801. It entered testing in the All India Coordinated Sorghum Improvement Project.

Flagship Project 3 – *Integrated Crop Management:*

The liquid formulation of the **seed dressing** insecticide Celest ®Top (a.i. Difenoconazole + Fludioxonil+ Thiamethoxam) was confirmed for the control of the wheat stem saw fly on barley. **Integrated pest management** has been central to pearl millet insect control research in WCA. Various experiments have been carried out to fine-tune and standardize rearing techniques for the **parasitoid wasp *H. hebetor* against the millet head miner** and optimize mass production of parasitoids for industrial use. Release of the parasitoid significantly reduced millet head miner as compared to control villages not receiving parasitoids. The greatest incidence of parasitism was recorded in villages where 1,600 parasitoids were released with over 55% head miner mortality. In terms of parasitoid mass production, the number of parasitoids produced and the proportion of females could be increased by 50% by the addition of 20-25% cowpea flour to the millet-based diet of the host larvae. **On-station agronomic data for 4 sorghum hybrids** recommended for release in Kenya and currently under DUS testing were provided to the Kenya Seed Company.

Flagship Project 4 - *Seed Systems & Input Services:*

In **barley**, 21.64 t of breeder seed, 30.7 t of pre-basic seed and 48.25 t of basic seed were produced by EIAR and RARIs in Ethiopia. A total of 288 farmers were provided with pre-basic seed to produce basic seed. In Morocco, 11 t of breeder seed and 23.2 t of pre-basic seed were produced. In Iran, 7.938 t of breeder seed, 77.877 t of pre-basic and 438.33 t of basic seed was produced by DARI. In India, breeder seed was produced for three recent cultivars developed from ICARDA germplasm (PL807: 180 kg, VLB118: 500 kg, UPB1008: 104 kg). A total of 1309 lines of high input, low input and winter barley were multiplied to produce 11.2 t of seed for international nurseries. Ten farmer

groups producing **sorghum quality-declared seed (**QDS) were facilitated to produce and market 7000 Small Seed Packs (SSPs) through agro-vets in Tanzania. A **revolving fund** of 4m Tshs (2,000 USD) was established for seed treatment and packaging, and a forum was initiated including agro-vets, farmer group seed producers, NACO seed company and district extension staff, and a report was prepared on the effectiveness of SSPs and QDS commercialization. About 10 t of QDS seed of improved sorghum were delivered by 20 agro-vets in the five project mandate districts in Tanzania. Under the **post-rainy sorghum 'Seed Consortium'** established by ICRISAT and its partners, 1000 t seed of improved varieties were sold by Mahabeej (Maharashtra State Seeds Corporation), which met the seed needs of 100,000 farmers.

Flagship 5 – ***Postharvest Value & Output Markets:***
During 2015, the **Agribusiness and Innovation Platform** of ICRISAT successfully progressed towards supporting entrepreneurs in **formulating bakery products** using **100% sorghum and millet flours** without the addition of any wheat flour. Multigrain extruded cereal mix was developed for use in the preparations of roti, cakes, cookies, porridge etc. Towards addressing **malnutrition and hidden hunger** using local crops, an energy-dense nutritional food that is gluten- and lactose-free, prebiotic-rich, and prepared from the flours of sorghum/millet, chickpea and peanut paste has been developed for moderately acute malnutrition, severe underweight and /or chronically undernourished children, adolescents and pregnant women. The product has the potential to be introduced into the various **nutrition feeding programs of the Government of India** post efficacy studies being planned to be undertaken jointly with the National Institute of Nutrition, Hyderabad.

C3. Progress towards impact (1/4 page)
Continuing from the success of the BMGF-supported HOPE project during its Phase I, the Seed Consortium formed in India for post-rainy sorghum produced and sold 1000 t of seed meeting the needs of **100,000 farmers in Maharashtra state alone**, in India. Successful utilization of rice fallows of the state of Andhra Pradesh in India for post-rainy sorghum, coupled with the development, for the first time, of hybrid parents and **hybrids of post-rainy sorghum** has attracted the attention of the seed industry in India, with testing already under way in three companies with ICRISAT-developed material. It is to be noted that a good part of the past success in productivity gains for sorghum and pearl millet in India resulted from the collaborative efforts of the Hybrid Parent Research Consortium led by ICRISAT in India where there was active participation of the seed industry. A **spill-over effect in ESA**, with consequent potential for new impact, is the release of sorghum and finger millet varieties in Malawi, where the government has requested for sorghum seed, and where farmers are seeking more drought tolerant crops, including pearl millet. Three early-maturing sorghum cultivars are in the process of getting released in Malawi, while the introduction of three finger millet varieties selected by farmers is expected to resurrect a crop that had 'disappeared' in the southern region of the country. The **USAID-supported project on barley in Ethiopia** (along with faba bean) is paving the way for increased access to improved seed, with seed production anticipated at 186 t with the current planting.

D. GENDER RESEARCH ACHIEVEMENTS (1 page)
The program had a successful year in implementing Gender Research both in Africa and Asia. The main area of investment was in strategic gender research. Dryland Cereals continued to make significant contributions to the **GENNOVATE global qualitative study on Gender norms** and innovations, where eleven CRPs have contributed case studies from Asia, Africa and Latin America. **Nine case studies** were completed by Dryland Cereals in **Mali, Burkina Faso and Niger** representing Francophone Africa. A further **five case studies in India** representing the South Asia region address sorghum and barley cropping systems. The analysis of this global dataset is being initiated in 2016 to start exploring global patterns on similarities and differences in gender roles and norms among regions/sub-regions. The analysis aims to understand the regional patterning of gender norms (gender orders) as configured by specific combinations of wider forces (e.g. political histories, public policies, economic globalization, donor preferences etc). It takes into consideration indigenous

notions of gender which underpin the similarities and variability across world regions. Insights on the influence of this global patterning on adoption of innovations in agriculture and NRM will help gauge how research and development agents can enhance adoption of innovations for food and nutrition security, household income and environmental sustainability.

Dryland Cereals has **recruited a postdoc**, in collaboration with the Gender and Agriculture network and Grain Legumes, to investigate the inclusion of gender preferences during the history of breeding of the crops under Dryland Cereals and Grain Legumes. This study is **focused on the development and implementation of Participatory Varietal Selection (PVS)**, with specific relevance to PVS as a methodology for inclusion, the integration of PVS in the breeding process, the influence of PVS on the outcomes of breeding programs, and the different preferences of men and women in PVS and the influence of these preferences on the adoption of breeding products and nutritional outcomes among communities. In the initial stages of the study in 2016, the focus will on the breeding programs of sorghum, barley and pigeon pea, and will involve the analyses of PVS data and breeding outcomes spanning the last 10-15 years.

Collaborative efforts with national partners In Niger and Mali were further strengthened through a partnership effort that investigated the **labor involvement in weeding** of sorghum and millets in West Africa, and **the role of women**. The collaboration undertook a survey-based assessment of the involvement of women in weeding, the types of weeding and the potential implications for adoption of innovative approaches. The survey data was collected in 2015 and results of the analysis will be reported in 2016.

Mainstreaming of gender-relevant research activities across flagships continues to be a conscious target now. The crops of the program being primarily considered as 'women's crops' in most of the developing countries identified as targets for Dryland Cereals, almost all of the research in the program always had, and continues to have, a gender relevance in one way or the other. Emphasis on gender equity in smallholder agriculture has had an impact on conscious decision making, planning and execution of research activities. The Gender Scientist for Dryland Cereals resigned in mid-year 2015, and two consecutive searches to fill the position in Mali, West Africa, yielded no suitable candidates. The Gender Scientist of GL currently has responsibilities for CRP DC until the start of Phase II in Jan 2017, and coordinates research for DC with the help of an on-site scientific officer in Mali. This scientific officer managed data collection for the GENNOVATE study in local languages, translation to French and later to English. Dryland Cereals did, however, make progress in the process of identifying an appropriate replacement for the gender scientists to be located in Mali during 2015, and this person has just been recruited in May, 2016.

E. PARTNERSHIP BUILDING ACHIEVEMENTS (1 page)

An **important partnership-building accomplishment** during the year was the **formation of a Sorghum Hybrid Parents Research Consortium (HPRC) in Kenya** by the Seed Traders Association of Kenya (STAK) and ICRISAT, modeling after the successful HPRCs in India which contributed to significant out scaling of sorghum and pearl millet in India. At its launch on March 15, 2015, at the ICRISAT Kiboko Research Facility in Makindu, >20 seed companies participated in the field day and examined sorghum hybrid parents developed by ICRISAT for adaptability in the dry lowland areas of Kenya. The **post rainy sorghum 'Seed Consortium'** initiated in 2015 under Dryland Cereals with a limited funding USD 5000 has been a significant success within a short time, and contributed to the production and supply of a total of 1000 t of certified seed of improved varieties benefitting 100,000 farmers in Maharashtra, India. In the 2015 post rainy season, seed production was undertaken in 2000 ha area and seed was harvested from a good crop in early 2016. A nearly self-sustaining seed initiative now, it is well-received by all stakeholders as obvious at the 8th National Seed Congress in India. A private sector partners' consultation meeting for sorghum was organized in January 2015 in India to showcase promising hybrids, hybrid parents, OPVs and advanced breeding lines developed for post rainy adaptation. Of the 11 seed companies that participated, two are currently testing selected material in farmers' fields, and one with specific interest in sorghum hybrids for rice fallows

is testing ICRISAT material adapted for the post rainy and rainy season. In addition, Dryland Cereals participated in a convening in Oct, 2015, co-organized by the Agropolis Fondation, DuPont Pioneer and Heartland Global as a first step towards a **Public-Private Partnership Platform** to share visions and define **strategies to support sorghum and millet production** by smallholder farmers in Africa.

Partnership efforts through the HOPE project, supported by the Bill and Melinda Gates Foundation, continued with the approval of the second phase of the project in 2015. The **Agribusiness and Innovation Platform** (AIP) at ICRISAT held a consultative meeting with the primary aim to promote the export of sorghum and sorghum products, which resulted in the draft of **a strategic plan for a Sorghum Export Development Platform** in partnership with the Agricultural and Processed Food Products Export Development Authority (APEDA), Indian Institute of Millet Research (IIMR) and other stakeholders across the sorghum value chain in India. The consultative meeting was attended by over 100 participants from the public and private sectors, exporters, experts from R&D organisations, government officials and representatives from the seed and food processing industry.

In a study supported by the **Competitive/ Commissioned Grants Program** of Dryland Cereals, the use of the **doubled haploid (DH) technology** for genetic studies in barley has been initiated at ICARDA in **partnership with the Institute de Genech, Lille, France**. Seed of the DH lines is expected to be available by the end of June 2016 at ICARDA from the partner institution. In order to breed adaptable seed and pollen parents of pearl millet for the A1 zone**, a shuttle breeding program** was initiated **between ICRISAT and SKRAU-Bikaner Rajasthan**. A total of 35 F2 populations for BXB and 28 F2 populations for RXR were shared by ICRISAT for screening utilizing SKRAU's excellent phenotyping facility.

A **planning meeting** of Dryland Cereals in **preparation for Phase II** was held in March 2015 in Addis, and was participated by more than seventy partners and stakeholders. **Strengthening of existing partnerships** is a continuous effort across the program and an example is the two-day interaction meeting of 24-25 April, 2015, at ICARDA Rabat, Morocco, that was attended by 14 scientists and program managers from the six focal countries (Ethiopia, India, Iran, Kazakhstan, Morocco and Turkey) and 7 scientists from ICARDA. This allowed the review of progress made under the Dryland Cereals collaboration between ICARDA and barley focal countries and the planning for phase-II.

The USAID Linkage Grants to Dryland Cereals as well as the Competitive/ Commissioned Grants Program of Dryland Cereals offer significant opportunities for collaborative research as evident from the hyperlinked reports.

Collaborative efforts with other CRPs continued from 2014, and included **fodder quality** research with Livestock & Fish; **biofortification research** for pearl millet with A4NH where Dryland Cereals contributed high-yielding adaptable material and A4NH supported the screening for high Fe and Zn; collaborations with PIM on **foresight analysis**; and strengthened collaborations with Dryland Systems to continuously fortify **agronomic and sustainability research** needs within Dryland Cereals. An important outcome of collaborative discussions and planning meetings during the year was the heightened recognition of the need for closer partnerships with Dryland Systems and Grain Legumes for the delivery of sustainable intensification and diversification solutions for dryland regions to achieve the SRF targets and SDGs, and the submission of a Phase II proposal merging Dryland Cereals, Dryland Systems and Grain Legumes into a single program, **Dryland Cereals and Legumes AgriFood System (DCL AFS or DCL)**.

F. CAPACITY BUILDING (1/2 page)

An important capacity development effort launched in 2015 is the **Dryland Cereals Scholarship Program** jointly administered by the CRP, in partnership with APAARI for Asia, RUFORUM for East and Southern Africa, and WACCI for West Africa. The program currently supports 1 Masters' student (partial), 16 Ph D students (4 fully and 12 partially), 2 post-docs, 2 interns after their Master's degrees. The focus of study is any one of the Dryland Cereals crops. Of the total 21 students supported, 7 are women.

Farmers' field days during the year for sorghum and millets were attended by 3633 farmers, 1605 of them women. The barley program organized a total of 17 field days where an estimated 3570 participants attended, which included 510 women. Reported short training programs trained 127 researchers including 63 women and 64 men. During the 2015 cropping season, the ICARDA barley program organized training on "barley breeding techniques" for Indian scientists from 18 to 25 April, under ICAR-ICARDA. In addition, two 'train-the-trainers' in-country courses on 'Community-based seed production and marketing' were organized at Kulumsa Agricultural Research Center (ARC), Asella, and at Amhara Regional Agricultural Research Institute in Bahir Dar, Ethiopia, in a joint effort with Grain Legumes (fab bean and chickpea), and 53 trainers (8% women), 758 farmers (about 17% women) and 87 development agents (about 14% women) were trained. Finally, during 2015, seven Masters' students, all men, completed their program, along with 2 Ph D students which included 1 woman and 1 man. Further, one male student is continuing his Master's program as are 20 Ph D students, including 10 men and 10 women.

Dryland Cereals follows the CGIAR Open Access Policy as indicated in the Intellectual Assets Report submitted by the Lead Center, ICRISAT, for 2015.

G. RISK MANAGEMENT (1/2 page)

Budget fluctuations pose significant hazards to program implementation at all levels. Cyclical breeding activities, other research operations and collaborative implementation with partners are all affected one way or the other. The Dryland Cereals Scholarship Program also had to be scaled back in early 2016 after its launch just one year earlier. In order to lower transaction costs of program implementation under the existing budget constraints, the **CRP Office is now very lean** with one CRP Director, one Administrative Officer and one Program Manager, supporting both Dryland Cereals and Grain Legumes. This did place a serious load on this office during the last quarter of 2015 with the additional demands for preparing preproposals, revisions and full proposals for the second phase. As reported earlier, **sub-optimal staffing and the absence of succession planning** in the participating CG centres in the target countries is a risk, and can prolong the time to impact or dilute the intensity of potential impact. Further, and again as indicated in previous reports, the **social and political instability** in the regions of operation of the program pose risks in both project implementation and staff retention.

H. LESSONS LEARNED (1 page)

Overall level of confidence/uncertainty of the indicators provided in Table 1:

The confidence level this year is fairly good on almost all indicators. As before, indicators 33 and 34 remain approximations based on calculations of seed sold, seed-rate used, and smallholder farm size. As with last year, uniformity in reporting can improve further across Flagships and Clusters of Activities with better understanding of the different indicators. It is likely that the full capture of all efforts in the program has not occurred in the report. This is primarily due of the absence, as yet, of a software system in the CRP for planning and reporting. The CRP office is actively pursuing this need for implementation in 2016.

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:

Active engagement with stakeholders to utilize the socioeconomic reports and policy analyses prepared within the program can lead to faster and greater impact. Having stated this, it is to be noted that during 2015, ICRISAT was involved in the preparation of six policy briefs that were well-received by the Govt of India.

Lessons learned by the CRP from its monitoring of the indicators and from its qualitative analyses of progress:

- The program is at a time and place where it is poised for delivering towards the continuing demand for the crops involved. This is because of: (1) successful proof of concept for

productivity enhancements through heterosis in both WCA and ESA for sorghum and pearl millet and its acceptance by farmers, (2) newer technologies and wide natural diversity enabling allele mining and molecular breeding, and (3) improved streamlining of implementation and delivery against targets as a consequence of the new reform process. However, understaffing and the consequent additional workload can impede productivity, and would need to be addressed in the various target regions of the program to ensure that R&D efforts continue to be strong.

- Short-duration funding, as with the one-year Competitive/Commissioned Grants, are less desirable for most projects due to the nature of the research (biological, breeding), and due to timing issues when grant allocation and planting season do not always coincide.

Annex 1: CRP indicators of progress, with glossary and targets.

List of published blog stories and press releases can be accessed here.

CRPs concerned by this indicator	Indicator	Glossary/guidelines for defining and measuring the indicator, and description of what the CRP includes in the indicator measured, based upon the glossary	Deviation narrative (if actual is more than 10% away from target)	2013		2014		2015	
				Target	Actual	Target	Actual	Target	Actual
KNOWLEDGE, TOOLS, DATA									
All	1. Number of flagship "products" produced by CRP. *Finger millet a mandate crop in ICRISAT portfolio; HPRC model launch in Kenya; Successful concepts from HOPE I (review); HOPE II Project approval; 5 socioeconomic publications*	Glossary: These are frameworks and concepts that are significant and complete enough to have been highlighted on web pages, publicized through blog stories, press releases and/or policy briefs. They are significant in that they should be 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.		2	3	3	9	3	9
All	2. % of flagship products produced that have explicit target of women farmers/NRM managers. *Note: The dryland cereals crops being considered primarily as women's crops, percentage flagships with target on women farmers will be more than 50%, but is accepted here as 50%.*	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.		50	67	50	50	50	50

All	3. % of flagship products produced that have been assessed for likely gender-disaggregated impact. *Note: Gender research staffing has only started in 2014, and it is expected that there will be better address of required analysis in the coming years.*	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		50	67	50	11	25	20
All	4. Number of "tools" produced by CRP *Introduction of the Breeding Management System; 3 Production manuals for sorghum and millets in ESA; Establishment of high-throughput genotyping platform in barley; Initiation*	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, publicized through blog stories, press releases and/or policy briefs. They are significant in that they should be 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.		5	9	5	8	5	6
All	5. % of tools that have an explicit target of women farmers. *Note: As indicated under point 2*	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		50	100	50	75	50	50
All	6. % of tools assessed for likely gender-disaggregated impact. *Note: As indicated under point 2 above.*	Glossary: Reports/papers describing the products should include a focus on gender-disaggregated impacts if they are to be counted		50	25	50	0	0	0
All	7. Number of open access databases maintained by CRP. *Note: 3 existing ones are included in the total number, in addition to 2014 reported numbers. Intellectual assets report attached here.*	Indicate the type of data bases (e.g., socio-economic survey data; crop yields in field experiments…) you are reporting on in the following columns		3	4	3	5	3	3

All	8. Total number of users of these open access databases. *Note: Using baseline numbers of 2013*			200	514	300	>300	300	>300
All	9. Number of publications in ISI journals produced by CRP. *Note: Intellectual assets report attached here.*			45	52	45	47	45	49
1,2,3, 4, 6	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) Sorghum and millet flour processing in ESA, (2) Case for sorghum in Mozambique, (3) Consumer demand for sorghum and millets in ESA.		2	3	4	5	3	3
1,5,6,7	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 geographical location and agroecological zones (FAO typology)							
1,5,6,7	12. Estimated population of above-mentioned agro-ecosystems								
CAPACITY ENHANCEMENT AND INNOVATION PLATFORMS									
All	13. Number of trainees in short-term programs facilitated by CRP (male). *Note: Farmers field school training is included.*	Glossary: The number of individuals to whom significant knowledge or skills have been imparted through interactions that are intentional, structured, and purposed for imparting knowledge or skills should be counted. This includes farmers, ranchers, fishers, and other primary sector producers who receive training in a variety of best practices in productivity, post-harvest management, linking to markets, etc. It also includes rural entrepreneurs, processors, managers and traders receiving training in application of new technologies, business management, linking to markets, etc., and training to extension specialists, researchers, policymakers and others who are engaged in the food, feed and fiber system and natural resources and water management. Include training on climate risk analysis, adaptation, mitigation, and vulnerability assessments, as it relates to agriculture.		1000	1218	1000	6596	1000	8228

All	14. Number of trainees in short-term programs facilitated by CRP (female)	(see above, but for female)		500	616	750	3503	750	~2320
All	15. Number of trainees in long-term programs facilitated by CRP (male)	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 post-doctoral 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 number of Master's and number of PhD's		20	45	20	22	20	24
All	16.Number of trainees in long-term programs facilitated by CRP (female)	(see above, but for female)		20	8	15	7	10	11
1,5,6,7	17. Number of multi-stakeholder R4D innovation platforms established for the targeted agro-ecosystems by the CRPs	Glossary: To be counted, a multi-stakeholder 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 geographical focus.							
TECHNOLOGIES/PRACTICES IN VARIOUS STAGES OF DEVELOPMENT									

All	18. Number of technologies/NRM practices under research in the CRP (Phase I)	Glossary: Technologies to be counted here are agriculture-related and NRM-related technologies and innovations including those that address climate change adaptation and mitigation. Relevant technologies include but are not limited to: • Mechanical and physical: New land preparation, harvesting, processing and product handling technologies, including biodegradable packaging; • Biological: New germplasm (varieties, breeds, etc.) that could be higher-yielding or higher in nutritional content and/or more resilient to climate impacts; affordable food-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 geographical location that you are reporting on in next columns		750	>750	750	6329	2500	>2500
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		50	50	50	50	50	50

All	20. % of technologies under research that have been assessed for likely gender-disaggregated impact	Reports/papers describing the products should include a focus on gender-disaggregated impacts if they are to be counted		50	50	50	10	10	15
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	Use the same classification of agro-ecosystem as for indicator 11 above, including geographical location and agro-ecological zone							
1,5,6,7	22. Number of people who will potentially benefit from plans, once finalised, for the scaling up of strategies	Indicate the potential number of both women and men							
All, except 2	23. Number of technologies/NRM practices field tested (phase II). *Note: Not all numbers are captured.*	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 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 geographical locations of the field testing/pilot projects reported in next columns		700	>700	700	2173	700	>700
1,5,6,7	24. Number of agro-ecosystems for which innovations (technologies, policies, practices, integrative approaches) and options for improvement at system level have been developed and are being	Clearly identify in this cell the type of technology and the geographical 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 utilised in targeted agro-ecosystems								
All, except 2	27.Number of technologies/NRM practices released by public and private sector partners globally (phase III) 3 finger millet varieties; 4 sorghum cultivars; parasitoid wasps for IPM in pearl millet	Glossary: In the case of crop research that developed a new variety, e.g., 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 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), the geographical areas concerned		15	>15	15	8	10	8
POLICIES IN VARIOUS STAGES OF DEVELOPMENT									
All	28. Numbers of Policies/ Regulations/ Administrative Procedures Analyzed (Stage 1)	Number of agricultural enabling environment policies / regulations/ administrative procedures in the areas of agricultural resource, food, market standards & 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		3	3	4	4	3	3

All	29. Number of policies / regulations / administrative procedures drafted and presented for public/stakeholder consultation (Stage 2).	….. ……that underwent the second stage of the policy reform process. The second stage includes public debate and/or consultation with stakeholders on the proposed new or revised policy / regulation / administrative procedure. Clearly identify in this cell the type of policy, regulations and so on, and the geographical location of the consultations		0	0	1	1	0	0
All	30. 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		0	0	1	1	0	0
All	31. 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		0	0	1	1	0	0
All	32. Number of policies / regulations / administrative procedures passed for which implementation has begun (Stage 5). *Note: Related to barley in Morocco Green Plan.*	: …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		0	0	1	1	1	1
OUTCOMES ON THE GROUND									

All	33. Number of hectares under improved technologies or management practices as a result of CRP research. *Note: A full capture of data is not yet there for 33 and 34 for all the Clusters of Activities. Information is a combination of pre-existing acreage and farmers, plus new. There are likely underestimations in some cases but not overestimations.*	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		20,000 in WCA 15,000 in ESA 15,000 in WA and NA 30,000 in SA	20,000 in WCA 15,000 in ESA 15,000 in WA and NA 30,000 in SA	20,000 in WCA 15,000 in ESA 15,000 in WA and NA 30,000 in SA	30,800 in WCA; 30,000 in ESA; 15,000 in WA and NA; 222,000 in SA	20,000 in WCA 15,000 in ESA 15,000 in WA and NA 30,000 in SA	30,000 in WCA; 20,000 in ESA; 15,000 in CWANA; >100,000 in SA
All	34. Number of farmers and others who have applied new technologies or management practices as a result of CRP research	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		10,000 in WCA 5000 in ESA 30,000 in WA and NA 25,000 in SA	10,000 in WCA 5000 in ESA 30,000 in WA and NA 25,000 in SA	10,000 in WCA 5000 in ESA 30,000 in WA and NA 25,000 in SA	31,000 in WCA; 30,000 in ESA; 5000 in WA and NA; 311,000 in SA	10,000 in WCA 5000 in ESA 30,000 in WA and NA 25,000 in SA	30,000 in WCA; 30,000 in ESA; 30,000 in CWANA; 50,000 in SA

Annex 2: Gender mainstreaming in Dryland Cereals

Level n-2: Cluster of activities	**Expected research outcomes and outputs that have a gender/equity dimension** (from Table 1).
Role of gender in PVS and the science of breeding: Identify how preference data are collected and defined (in PVS, in adoption studies, etc.) and used by breeders and others working on development and delivery of improved varieties to meet the needs of women and men smallholders. Methods: quantitative and qualitative analysis. Will contribute to IDO1 Productivity 40%; IDO2 Increased & Stable Access 40%; IDO5 Increased Capacity to Adapt 20%. Geographical focus: Dryland Cereals Focus Countries *(falls under CRP overarching strategic gender research)*	A candidate to this position was indentified in 2015, Dr Krista Isaacs, who is currently located in Bamako Mali. She has prioritised the crops to start with [sorghum, millets and pigeonpeas]; she is establishing links with the breeders in ESA and WCA; identifying the available datasets in the history of PVS of those priority crops and designing the methodology for the study implementation
Global study on Gender Norms, Agency & Innovation in Agriculture: This gender study involves comparative case study research that applies a standardized qualitative methodology to build understanding of changing gender norms and agency in the context of agricultural or NRM innovation. The study objectives are to: Provide robust empirical evidence on the relationship between gender norms, agency and agricultural innovation, and how these interactions support or hinder the achievement of the Intermediate Development Objectives (IDO) in the grain legumes research. Will contribute to IDO1 Productivity 40%; IDO2 Increased & Stable Access 40%;IDO5 Increased Capacity to Adapt 20%**.** Geographical focus: Mali, Burkina Faso & Niger (other regions of interest to Dryland Cereal focus are covered under other CRP case studies.) *(falls under CRP overarching strategic gender research)*	For Mali, data were collected in the villages of Dieba, Madina, M'pegnesso and Sirakele in the region of Sikasso and in the village of Seribila in the region of Koulikoro in the Fall of 2014. In 2015 the data was translated into English by Kadidia Daouda of ICRISAT Niger. The data was placed into Excel Sheets by Almamy Sylla of ICRISAT Mali in preparation for data analysis. For Niger data were collected in the village of Kaboy Kora in the Dosso region, in the village of El Kolta in the Maradi region, in the village of Zindigori in the region of Tera. The data was translated into English by Kadidia Daouda of ICRISAT Niger. The data was placed into Excel Sheets by Almamy Sylla of ICRISAT Mali in preparation for data analysis. For Burkina Faso data were collected in the village of Kera in the Hauts-Bassins Region. The data was translated into English by Kadidia Daouda of ICRISAT Niger. The data was placed into Excel Sheets by Almamy Sylla of ICRISAT Mali in preparation for data analysis. The glossaries for each country were created to capture the nuances of the local languages and maintain accuracy in translation. In dryland systems of India under the auspices of both Dryland Systems and Dryland Cereals CRPs, 3 case studies were initiated in Rajasthan on October 4, in three villages which differ in gender norms, technological and socio-economic dynamics: Masangar (low economic dynamism and high gender gap) and Eatawal Bopji (low gender gap and high economic dynamism) and Mundru (low gender gap and high economic dynamism). Introduction of barley crop, contract farming, and frontline demonstrations of barley and Marwari goats were innovations selected for in depth exploration respectively in the three villages. The differences in gender norms, technological and socio-economic dynamics will highlight the key variations and make their significance more evident towards achieving gender equality in innovations and resource access and control. Data collection is completed and notes are being translated for coding and analysis.

Gender Analysis of "the role of weeds" in breeding for barley and pearl millet in village communities. The aim is to develop a comparative case study to illustrate how scientists can integrate gender into their bio-physical work at both conception of research and application of findings in communities. Will contribute to IDO1 Productivity 35%;	Analyzing weeding techniques of millet and sorghum in Mali and Niger: In Mali, AMEDD (Association Malienne d'Eveil au Developpement Durable) was responsible for conducting this study. In Niger, this work was done by the National Agricultural Research Institute of Niger (INERA). The objective of this work was to understand the implication of women in weeding activities that are highly labour intensive. Weeding is one of the most time consuming activities of sorghum and millet production. In Mali the study was conducted in the region of Bougouni and Koutiala which are the main zones of sorghum and millet production. In Niger, the study was conducted in the regions of Tahoua and Maradi. The preliminary results show the existence of many weeding techniques and that there is no particular technique that is used by women. The use of particular weed controls techniques depends on the level of equipment and the training of farmers. However, manual weeding is mainly performed by women because they have little access to farm equipment. Some women farmers are also using herbicide to control for weeds but they are not receiving appropriate training to ensure maximum results.In total, data were collected from 359 women farmers in Mali and 166 in Niger. We are now in the process of finalizing these reports.
IDO2 Increased & Stable Access 35%;	
IDO3 Increased Consumption 30%.; Geographical Area: Niger and Morocco	
(falls under CRP overarching strategic gender research)	