Harnessing Opportunities for Productivity Enhancement (HOPE) of Sorghum and Millets in Sub-Saharan Africa and South Asia

NARRATIVE REPORT

Executive Summary

The HOPE project has successfully completed its third year of operations. The project implemented all activities scheduled for Year 3, and produced a large number of major planned outputs. While a few outputs targeted for Years 2 and 3 still lag behind, quite a number of outputs scheduled for completion in Year 4 have already been produced by the end of Year 3. The following are some key highlights of Year 3 activities (details can be found in the main body of the report):

- **Targeting:** Work on the production of GIS maps progressed well in all regions. Baseline databases have been properly documented, and survey reports are at various stages of preparation. A better understanding of sorghum and millets recommendation domains has been attained in all three regions. The IMPACT model was used to predict future demand and supply for dryland cereals under various scenarios in WCA and SA, and the work is currently underway in ESA. Adoption and diffusion survey instruments have been developed in all regions, and monitoring surveys on early adoption levels has been initiated in SA.
- **Sorghum Improvement:** Sources of resistance to aphids in sorghum were identified in all three regions. Seventeen hybrid parents were identified as resistant to shoot fly and charcoal rot in SA. Striga resistance QTLs were transferred using marker-assisted selection and found to be effective. The effects of different stay-green QTLs under drought and well-watered conditions were validated in Ethiopia. The genetic diversity among shoot fly resistant sources in SA was estimated, and effective methodology was developed for cold tolerance screening and traits for cold tolerance were identified. New B-lines are under conversion and elite A/B-lines were identified in SA and ESA, while new R-lines and hybrids are in advanced stages of multi-location testing in all three regions. "Farmer-to-farmer" videos were produced that illustrate key steps for integrating striga management and control in smallholder farming operations, and distributed as DVDs in local languages in WCA and ESA. In addition, the advantages of integrating a wide range of striga control techniques were documented and evaluated with farmers in WCA and ESA. Procedures for farmer-participatory varietal selection were established in all three regions.
- **Pearl Millet Improvement:** The farmer-preferred pearl millet variety, SUPERSOSAT, which has a yield potential of 4 t/ha, was released in Nigeria in December 2011. On-farm trials were conducted to demonstrate opportunities to improve pearl millet grain yield performance by 150% with currently available improved cultivars and crop management technologies. Replacement pearl millet mapping populations that demonstrate host-plant resistance to striga were advanced two generations, and sets of multi-locational trials were prepared and distributed for evaluating more than 200 F_3 progenies under striga-infested conditions in the current 2012 rainy season. The availability of diverse breeding materials for developing high yielding and stable cultivars for marginal environments in SA and WCA was increased. In SA, major QTLs were detected for resistance to many virulent downy mildew pathotypes, and their flanking markers were identified.

Micronutrient (Zn) application treatments were identified for increasing grain yield; these treatments are based on multi-year and multi-location testing. Hybrid parents and hybrids with high yield potential under drought were identified, and improved hybrid parents with newly introgressed DM resistant QTLs were developed. Farmer-preferred hybrids were identified through farmer participatory trials and scaled up on farmers' fields.

- **Finger Millet Improvement:** Two finger millet varieties, U15 and P224, were officially released in Tanzania during the year. Sources of resistance to blast and striga in finger millet were identified. Finger millet genotypes with superior agronomic traits were identified for immediate use, from which 20 accessions were fast-tracked for variety development and release. Protocols for finger millet DNA extraction and SSR genotyping were developed and made available. Some 384 accessions were genotyped and the diversity of finger millet in the region established. A number of management practices for controlling finger millet blast and striga were recommended.
- **Identification and Development of Markets:** In WCA, emphasis was placed on analyzing the household and market baseline data, developing the associated reports, establishing processing equipment at the village and urban levels, and working on linkages between grain producers and processors as well as processors and traders via formal contracts. Household consumer preferences were computed for Mali and Niger using national statistics. In ESA, the demand for sorghum and millet by processors was quantified, and the quality standards required by processors were identified. Surveys were conducted in Kenya and Tanzania to determine consumer demand and preferences. In SA, market channels for sorghum and pearl millet grain and fodder were mapped. Preferred quality traits for food and different end uses were identified, and data on the volume of trade and price premiums were generated. Value-added products and low-cost equipment for value addition were identified for both grain and fodder for sorghum and pearl millet. Opportunities for market linkages were explored and the formation of linkages was facilitated as appropriate.
- **Enabling Technology Adoption:** In WCA, a total of 12,714 small packs of improved sorghum seeds, and 23,343 small packs of improved pearl millet seed were sold during the year. Some 1,280 kg of sorghum breeder seed, 85,070 kg of foundation seed, and 132,000 kg of commercial seed were produced in Mali and Burkina Faso. Further, 10,080 kg of pearl millet breeder seed, 41,340 kg of foundation seed and 722,900 kg of commercial pearl millet seed were produced in all four WCA countries. Twenty-six sorghum OPVs and hybrids, and 15 pearl millet OPVs were diffused in WCA. In ESA, a total of 111 on-farm demonstrations and 25 field days on improved sorghum technologies were held. The number of on-farm demonstrations and field days focused on improved finger millet technologies were 249 and 24, respectively. Some 5,170 small packs of improved sorghum seed, and 8,745 small packs of improved finger millet seed were sold and distributed during the year. The amount of breeder, foundation, and commercial/certified sorghum seed produced across ESA countries was 10,300 kg, 330,600 kg, and 882,600 kg, respectively. For finger millet, 4,900 kg of breeder seed, 27,200 kg of foundation seed, 55,400 kg of commercial seed were produced across the ESA countries in Y3 of the project. In SA, a total of 8050 new farmers were supplied with improved sorghum production technology, bringing to 25,200 the total number of farmers so far reached with improved sorghum technology in Maharashtra state. The two partner universities, MAU and MPKV, produced 36.2 tons and 31.2 tons of seeds of improved sorghum varieties, respectively, for distribution to participating farmers in

Maharashtra. In addition, 8,882 new households were provided with improved pearl millet production technology in Rajasthan, Gujarat and Haryana. Some 4,170, 3,900, and 3,915 kg of improved pearl millet hybrids were distributed to farmers for on-farm demonstrations in Rajasthan, Gujarat and Haryana, respectively.

- **Capacity Enhancement:** In WCA, a total of 1,060 farmers, comprising 879 men and 181 women, were trained in improved sorghum and pearl millet production technology. Some 50 field agents from partner institutions and collaborating NGOs and farmer organizations in Mali, 20 from Niger, 30 from Burkina Faso and 36 from Nigeria were trained in improved sorghum and pearl millet production technologies during the year. Furthermore, four partner institution technicians from each of the four countries and one PhD student from Nigeria participated in short courses on various subjects. In ESA, two MSc students completed their fieldwork, while one completed his thesis, all focused on HOPE-related topics. A total of 1,945 farmers, 32 partner research scientists, and over 70 field agents from partner institutions across ESA countries participated in various training courses during the third year of the project. In SA, 10 training programs and short courses on various aspects of sorghum production were conducted in Maharashtra, and attended by researchers from partner institutions, KVK[1] and the department of agriculture field staff. Some 300 farmers were trained in soil sample collection, post-rainy season sorghum crop management, purity maintenance in seed production plots, and grain and stover marketing. One training program was conducted for women's self-help groups (40 members) and KVK field staff (7 members). In addition, 24 field staff of partner institutions were trained in monitoring survey and secondary diffusion of improved technologies in the states of Maharashtra, Rajasthan Gujarat and Haryana. A number of graduate students are undertaking their field research in HOPE-related topics in India.
- **Project Outputs:** The HOPE project seeks to achieve a total of 311 major outputs through its 4-year operation. As of the close of its third year of operation, the project had achieved some 166 of the outputs that were scheduled for within the first 3 years. As of the end of Year 3, some 39 outputs due in during this period are delayed and are at various stages of production/implementation. An additional 104 outputs are scheduled for Year 4, and related activities are ongoing and on target. Two outputs are reported to be unattainable within the life of the project.

The project is currently at an advanced stage of compiling a summary of "big picture" results arising from activities carried out in the last three years. This will be presented separately, in the coming days.

[1] Krishi Vigyan Kendra (KVK)

OBJECTIVE 1: TARGETING OPPORTUNITIES FOR TECHNOLOGY DEVELOPMENT AND DELIVERY TO MAXIMIZE ADOPTION AND IMPACTS OF INNOVATIONS ON LIVELIHOODS IN WCA, ESA AND SA

ACTIVITIES CARRIED OUT IN THE PERIOD JULY 2011 – JUNE 2012

Activity 1.1 - Targeting innovations for up-scaling and for reaching resource poor farmers

WCA (Mali, Niger, Nigeria and Burkina Faso): The IMPACT model from IFPRI was used to simulate the demand and supply projections of sorghum and pearl millet under four different scenarios. First, the baseline scenario was simulated to reflect the status quo demand and supply projections under current levels of population growth, income growth, investment in research and development options, climate circumstances, and crop subsidies. Four other scenarios were then simulated, reflecting 1) an optimistic (high income and low population growth) and a pessimistic (high population and low income growth) scenario; 2) the effects of research impacts simulated through higher yields; 3) the effects of climate change, using MIROCK and CSIR simulations; and 4) changes in the consumer subsidy equivalent (CSE) or the producer subsidy equivalent (PSE). The major indicators used include the changes in total and per capita demand, changes in total and per capita supply, price fluctuations, the number of malnourished children, the kilocalories consumed, and changes in demand or supply of substitutes for sorghum and/or pearl millet, such as maize and rice.

Preliminary findings for WCA as a whole showed that, in the baseline (status quo) scenario, 1) the area planted to sorghum and pearl millet will be increasing at 0.79% and 0.9% each year, respectively; 2) per capita food demand for sorghum and pearl millet will be increasing by 0.34% and 0.31% each year, respectively; 3) the total aggregate food demand will also increase by 1.71% and 1.91% for sorghum and pearl millet, respectively; 4) in the next fifty years, WCA countries as a whole will experience sorghum and pearl millet trade deficits; 5) the supply of pearl millet and sorghum will be increasing by 2.4% and 2.29%, respectively; 6) yields of these two crops will also be increasing by 1.5% and 1.51%, respectively; and 7) the per capita intake of kilocalories will increase by 2.06% and the number of malnourished children will still increase by 1.82%. Under the status quo, all indicators are expected to increase less than population growth.

In the pessimistic scenario (i.e., the scenario in which population is increasing while income is decreasing), simulated results showed that 1) areas planted to sorghum and pearl millet would increase more than the baseline results; 2) per capita and aggregate food demand for both crops would increase for both crops more than under the baseline scenario; 3) trade deficits would be higher than in the baseline scenario; and 4) per capita calorie intake would decrease and the total number of malnourished children increase.

In the optimistic scenario (i.e. where the population is increasing moderately and income is growing), the IMPACT simulation showed that 1) the number of malnourished children would decrease more than in the baseline scenario; 2) the per capita calorie intake would increase faster and more than in the baseline; 3) the areas planted to sorghum and pearl millets would increase moderately, but more than in the baseline; 4) aggregate food demand would increase, but by less than the baseline; and 5) trade deficits would decrease less than under the baseline projections.

Under the climate change scenario (using the CSIR simulation), it is projected that 1) the number of malnourished people would increase faster and the per capita kilocalorie intake

would decrease less than in the baseline; 2) the total food demand for sorghum and pearl millet would increase, but less than in the baseline; 3) the area planted with the two crops would increase, but not by much compared to the baseline projections; and (4) yields would increase, but not by much compared to the baseline.

Furthermore, increasing yields by 20% by 2050 is projected to have the following impacts: 1) the per capita intake of kilocalories would be almost the same as in the baseline scenario; 2) the area planted would increase, but by a little less than in the baseline; 3) per capita food demand would increase; 4) the net trade for both crops would decrease, but by less than in the baseline; 5) the total food supply would increase, but the number of malnourished people would not differ from the baseline, meaning that a 20% increase in yields by 2050 would not have impact on the number of malnourished people.

ESA: FAOSTAT data was collected and tables prepared for the Outlook Report on sorghum and millets in ESA. A three-day workshop was held in Dubai in May 2012 with the ICRISAT IMPACT modeler to agree on a common format for the Report and to run simulations for climate change, reduction in transaction costs, and pessimistic and optimistic scenarios for income and population growth. The draft Report is under preparation, and is expected by December 2012.

Ten GIS maps were specified for the ESA region in consultation with ICRISAT cereal breeders. These maps cover all countries in the ESA region with which ICRISAT has collaborative breeding programs for sorghum and millets. Three GIS maps have so far been produced. GIS maps are now being developed that identify the major zones for breeding sorghum and millets. Biophysical criteria were identified to demarcate these zones, and sample maps have been produced. These GIS maps of target areas for sorghum and millet plant breeding are now being circulated to NARS breeders for their feedback on the effectiveness of the criteria used for demarcating zones. It is expected that once feedback is received and biophysical criteria are confirmed, the maps will be finalized by December 2012.

Ethiopia: APSIM model simulations were performed to show the profitability of different management options for sorghum production in Ethiopia, using biophysical data for Melkassa. The cultivars modeled were Meko-1, Teshale, and Melkam. The management practices simulated were plant population, fertilizer rates, tied ridging, and mulching. Profitability analyses have not yet been completed, because data from the baseline survey on the costs of inputs and market prices were needed. Now that baseline data is available, the project work involving the APSIM model is continuing, and is expected to be finalized by December 2012.

Tanzania: APSIM model simulations for Tanzania were done to show the profitability of different management options for sorghum in Dodoma. The results identified the following management options as profitable for selected sorghum varieties: 1) Macia – under farmers' practices, with30 kg N ha; 2) Sima – under intercropping with pigeonpea, with 30 kg N ha; and 3) Pato – under intercropping with pigeonpea, with 30 kg N ha.

SA: The IFPRI IMPACT model was used to project the total demand, yield, area, production, prices and net trade of agricultural commodities under different socioeconomic and environmental conditions. For pearl millet, the IMPACT model baseline projection for India shows that in 2012, grain production would be 11.69 million tons. An increasing trend is set to continue after 2012, but at a decreasing rate. The increase in yield of millet per hectare would largely offset the decrease in the harvested area of millet. The yield of millet increases

by more than double by 2050, compared to its current level of 0.818 kg/ha (FAO data, 2009) in India. Total demand for millet increases in India at a higher rate than in any other region in Asia. Model projections depict a slight shift within the total demand by 2050 from food consumption to feed consumption in India, though more than 90% of the demand still comes from food use.

The baseline projection of harvested millet area for India is 11.07 million hectares in 2010. Production is estimated to reach 14.75 million tons by 2050 in India. Yields are projected to increase from 1003 kg/ha in 2010 to 1760 kg/ha by 2050. By 2050 supply is projected to be higher than demand, due to the decreasing trend in the direct consumption of millet in SA countries, especially India. In SA, the trends for sorghum production and consumption are negative; the projected positive trend in yield is not enough to compensate for the negative trend in area. Per capita food demand for sorghum and millets is declining in India. But per capita food demand remains high in the three top producing states (Maharashtra, Karnataka, and AP for sorghum, and Rajasthan, Gujarat, and Haryana for millets).

Except for Southeast Asia, especially Myanmar, all regions in Asia register a decrease in the millet area harvested, nevertheless the distinct upward trend in yields in Asia results in production being pushed upwards. All regions in Asia conform with the increasing global trend in demand for millet. In SA, a major portion of demand arises from India. Total demand for millet increases in India at a higher rate than in any other region in Asia. Model projections depict a slight shift in the context of total demand by 2050 from food consumption towards feed consumption in India, though more than 90% of demand still comes from food use. This shift both in sorghum and millet is observed because of high per capita income predictions, changes in food preferences of people towards livestock products, especially poultry products, and a consequent stagnation in food demand.

The IMPACT model predicts that aggregate demand for sorghum in SA will increase over the period 2000-2020. A positive trend is observed in the supply and demand for sorghum in all regions of Asia. The baseline projection of harvested area in India is 9.6 million hectares. Production is estimated to reach 10 million tons by 2050 in India. The yield projection will be from 820 kg/ha in 2010 to 1,300 kg/ha by 2050. By 2050 the supply will be higher than demand, as decreasing trend in food consumption is evident in South Asian countries especially India and an increasing trend in production.

Activity 1.2 - Analysis of investment opportunities for research and development in crop improvement (CI), crop management (CM), and market access (MA)

WCA (Mali, Niger, Nigeria and Burkina Faso): A report is available on "Ex-ante impacts of technologies and innovations in HOPE countries in WCA". Ex-ante impacts of selected sorghum- and pearl millet-based technologies in the four WCA countries were computed on selected technologies, including the use of modern sorghum and pearl millet varieties alone, the use of fertilizer micro-dosing, and a market innovation (the warrantage scheme). Results showed that the ex-ante impacts from variety improvement are estimated to be about US$ 39.75 million, the ex-ante impacts from fertilizer micro-dosing are estimated at about US$ 34 million, and the ex-ante impacts from the warrantage scheme are estimated to be about US$ 27 million. Thus from 2009 to 2019, the ex-ante estimated impact generated by HOPE project R4D interventions in West Africa is US$ 101 million in and around project sites.

ESA (Ethiopia and Tanzania): A checklist of data required for the DREAM model was prepared and sent to EIAR (in Ethiopia) and DRD (Tanzania) for data collection. Progress

was delayed in both countries because of heavy commitment by EIAR and DRD scientists in other projects and activities. Partner scientists in Ethiopia have now completed the analysis and reporting of the baseline survey, while those in Tanzania have completed the project work for the consumer preference survey and the processor surveys.

Activity 1.3 - Conduct baseline surveys for characterization of farmers, their trait preferences, input-output levels, and the profitability of dry land cereals vis-à-vis competing crops

Mali: Baseline data was collected on 530 pearl millet producers in five regions of Mali, mainly Kayes (104 households), Koulikoro (117 households), Mopti (98 households), Segou (91 households), and Sikasso (120 households). Preliminary results showed that about 52% of the farmers have been exposed to modern varieties and 39% of them have adopted modern pearl millet varieties. The major constraints to adoption of improved pearl millet varieties were found to be lack of access to seed (8% of the respondents), low yield (12%), susceptibility to drought (17%), late maturity (15%), and susceptibility to insect pests (8%). The major seed supply sources include farmers' own saved seed (38%), family members (30%), neighbors (26%), and very little from the formal seed sector. Seed exchange comprises the main type of transaction (31%), followed by seed credit (15%).

Pearl millet is an important cereal crop in Mali, contributing to about 20% of the total value of production. About 13% of the respondents reported selling pearl millet and 15% reported having bought pearl millet. However, the proportion of farmers that are net sellers of pearl millet is about 7%. It is estimated that 40% of households surveyed face food shortages, and 20% of the households are severely vulnerable (using the survival strategy index of CARE). About 95% of households in the targeted projected sites live below the poverty line of US$ 1.25/day/person.

Some 701 households of sorghum producers in five regions in Mali were selected and surveyed. In the Kayes region, 124 households were surveyed and 266 households in Koulikoro, 86 in Mopti, 88 in Segou and 137 households in the Sikasso region. Results showed about 34% of farm households have been exposed to modern sorghum varieties and that 25% of them have adopted improved seed. The major constraints to adoption of modern varieties have been reported as lack of access to seed (7% of the respondents), low yield (20%), susceptibility to drought (7%) and late maturity (39%). The major seed supply sources are saved seed (37%), family members (28%), neighbors (27%) and very little from the formal sector. The main type of transaction is seed exchange (accounting for 30%), followed by seed credit at 13%.

Sorghum is a significant cereal crop that contributes about 35% of the total value of production. About 18% of the respondents reported selling sorghum and 41% reported having bought sorghum. However, the proportion of farmers that are net sellers of the crop is estimated to be about 6%. It is estimated that 40% of the households surveyed face food shortages, and 24% of them are severely vulnerable (using the survival strategy index of CARE). The targeted project sites are among the poorest, with about 96% of households living below the poverty line of US$ 1.25/day/person.

Niger: A baseline survey was conducted that included 439 households in three regions where the HOPE project is being implemented – Dosso (99 households), Maradi (138 households), and Tillabery (202 households). Village and household data have been checked, cleaned and properly documented. Analysis has been completed and the report is under preparation by

partner scientists at INRAN. Preliminary results show that about 20% of the respondents have been exposed to improved pearl millet varieties released during the last 20 years, and 14% of households have adopted one or more of these varieties. The proportion of area occupied by improved varieties is estimated to be about 9% of the pearl millet growing area. The major constraints to adoption of modern varieties reported by farmers are lack of seed (49%), low yield (18%), late maturity (16%), and the high price of seed (7%). The major sources of seed remain seed saved by farmers from their own harvest (57% of the respondents), family members (15%), on-farm trials (11%), neighboring farmers (6%) and village markets (4%). Formal seed schemes are insignificant sources of seed; less than 2% of households buy seed from cooperatives and seed companies. It is estimated that about 75% of households are facing food shortages, and 27% of them are severely vulnerable. More than 86% of farmers surveyed are living on less than US$ 1.25 per day.

Nigeria: Some 119 villages in six states in Northern Nigeria (19 villages in Borno State, 12 villages in Yobe, 23 villages in Katsina, 29 villages in Kano, 20 villages in Jigawa, and 16 villages in Zamfara) were selected for the baseline survey. A total of 1,047 pearl millet producer households were interviewed. Preliminary results showed that 44.79% of the farmers surveyed were aware of modern varieties and 37.92% of the farmers are now using them. Improved varieties are planted in about 24.70% of the pearl millet cultivated area. Constraints to adoption of improved varieties include the unavailability of seed (42%), untimely delivery of seed (22%), low yielding varieties (11%), low market value (6%), lack of information on crop management (6%), small sized grains (6%), and the need for too much fertilizer (6%). The main sources of seed include that saved by farmers (55%), neighboring farmers (8%), extension services (30%), and on-farm trials (2%). Cash on delivery is a major type of transaction (accounting for 55%), followed by gifts (28%). Pearl millet is a major source of cash for surveyed farm households, accounting for about 20% of household crop sales. Some 80% of the surveyed households reported they were unable to satisfy their food needs. About 46% of surveyed pearl millet farmers are living on less than US$ 1.25 per day.

For sorghum, some 1,081 households were selected and interviewed. Survey results indicate that 30.16% of households have been exposed to improved sorghum varieties and 25.44% are using them. The adoption rate in terms of area cultivated is estimated to be 17.27%. Constraints to adoption of sorghum varieties include lack of seed (29%), lack of funds for purchasing it (5%), low yielding variety (18%), low market value (8%), susceptibility to pests and diseases (8%), and lack of information on management (26%). Saved seed remains the major source of seed (65%) followed by neighboring farmers (13%), relatives (13%), and extension services ADP[2] (7%). Formal seed schemes supply a small fraction of seed used by farmers. Cash on delivery remains the major transaction type, followed by gifts (50%). Sorghum is a major food and cash crop for producers. It accounts for about 17% of total cash sales. Approximately 80% of respondents reported having problems with satisfying their food needs, and experiencing on average a 2.78-month period of food shortages; about 47% of surveyed farmers live on less than US$ 1.25/ day.

Tanzania: The baseline survey report has been completed for Tanzania. A random sample of 360 households was surveyed in Singida and Kondoa districts, central Tanzania. Within each district, households were stratified into treatment, control, and diffusion groups, based on distance from HOPE on-farm trials and demonstrations. The sample size for the treatment group was 90 households, with 45 households in the diffusion group and 45 households in the

[2] Agricultural Development Project

control group in each district. Mean farm size was 2.9 ha/household and average income was $1,395 per household per year. Results showed that no farmers had adopted improved varieties of finger millet (since these had not been released) and 69% of them had adopted improved varieties of sorghum. Yields averaged 0.68 t/ha for finger millet and 0.46 t/ha for sorghum. The mean yield for improved sorghum varieties (0.49 t/ha) was not significantly different from local varieties (0.45 t/ha). Reasons given for non-adoption of improved sorghum varieties were non-availability of seeds (39%), pests and diseases (36%) and shortage of land (11%). The major sources of seed for improved sorghum were the extension service (50%), saved seed (31%), and other farmers (11%). The major sources of seed for finger millet were saved seed (48%), other farmers (32%) and the extension service (4%). Profitability analysis showed low gross margins of 45,204 Tsh/ha (US$ 28/ha) for finger millet, and 619 Tsh/ha (US$ 0.4/ha) for improved sorghum. These margins are for cash costs only and exclude the cost of family labor. Sorghum is grown primarily for subsistence, with 78% being kept for home consumption, while 14% is sold. Finger millet is primarily a cash crop, with 81% sold and only 10% consumed. Of the finger millet sold, 94% is sold as grain and 6% as flour. Fifteen percent of the finger millet that is marketed is sold directly to villagers, 77% to rural assemblers, 6% to middlemen, and 2% to urban traders.

Ethiopia: The baseline survey report has been completed for Ethiopia. A random sample of 390 households was sampled from three districts (Kobo, Miesso, and Shalla). Kobo and Miesso districts were purposively selected as centers of sorghum production, while Shalla was selected as a center of production for finger millet. In each district, 90 farmers were sampled as treatment farmers and 40 farmers as a control group. The yield of finger millets averaged 1.5 t/ha for the control group and 1.8 t/ha in the treatment areas, compared to mean sorghum yields of 1.9 t/ha and 1.8 t/ha for sorghum in treatment and control areas, respectively. The main source of seed for finger millet was that saved by farmers (39%), local traders (33%), and local markets (16%). For sorghum, the main sources (Kobo district) were local markets (29%), local seed producers (22%), farmer saved (16%), and farmer-to-farmer exchange (13%). About 80% of farmers in Miesso and 94% in Kobo districts planted improved varieties of sorghum, and 94% of farmers planted improved finger millet varieties. In both Kobo and Miess, sorghum was used primarily for home consumption (50-60%), while 30-40% was sold. Finger millet in Shalla was used primarily as a food crop (85%), with only 12% being sold. The draft report for Ethiopia is being revised to include more detailed information on adoption of improved varieties and gross margin analyses for millets, sorghum, and maize (revisions will be completed by December 2012).

SA: Baseline surveys were conducted in the primary HOPE project intervention areas where improved technologies have been introduced, and in matching control villages with comparable agro-ecological and market conditions in non-intervention areas where improved technologies have not been made available. This enabled collecting baseline data from participating and non-participating farmers that help identify comparable counterfactuals in impact evaluation. Baseline data was analysed from 270 post-rainy season sorghum farmers (180 HOPE beneficiaries and a 90 non-HOPE farmer control group) from Western Maharashtra and Marathwada region, and 180 farmers (120 HOPE beneficiaries and a control group of 60 non-HOPE farmers) from each of the pearl millet states (Rajasthan, Gujarat and Haryana). Reports have been prepared that include such indicators as the status of resource endowment, cropping patterns, the relative profitability of crop production, farmers' preferences for technology and traits, income and consumption levels, labor participation and earning, marketing channels and cost, and gender issues**.** The baseline survey shows that, in Maharashtra, 50% of the farmers are smallholders (less than 2 hectares) with 8 years of

literacy and a family size of 6. Sorghum productivity in HOPE and non-HOPE areas is 790 kg/ha and 900 kg/ha, respectively. More than 75% of farmers possess two draft animals and two milk animals. Thus, the strong livestock sector (incorporating a sorghum-buffalo-cow combination) sustains post-rainy season sorghum in Maharashtra. Further, the annual per capita income in the HOPE area is Rs. 32,039 (US$ 641) while that in Non-Hope areas is Rs. 40,669 (US$ 813). The grain yield gap[3] of post-rainy season sorghum was estimated to be 153% (as per recommendation the grain yield is 2,000 kg/ha) in both Western Maharashtra and Marathwada regions. In the HOPE project areas, farmers are receiving a net return of Rs. 3,515 (US$ 70) per hectare, compared to non-HOPE farmers of Rs. 2,528 (US$ 51) considering all costs. Farmers recognized the crucial role of women in harvesting and weeding.

For the pearl millet states, baseline survey results reveal that in **Rajasthan**, 45% of farmers had a holding size of 6 hectares. More than 60% of the sample farmers are under the age of 45 with an average family size of 6, and have completed 4-6 years of schooling. Around 35% of the area is still under local pearl millet varieties. Income from crops accounts for 74% of total average income [Rs. 163,000 (US$ 3,260)]. The average pearl millet yield is 1,700 kg/ha, compared to a potential yield of 2,200 kg/ha; the yield gap ranges from 50-100%. After accounting for production expenses of Rs. 7,900 (US$ 158), farmers realized a net return of Rs. 8,800 (US$ 176) per hectare. The integrated farming of pearl millet with a buffalo-cow combination sustains millet cultivation in Rajasthan. Farmers indicated that proprietary varieties are preferred due to their productivity, short duration, and resistance to drought, pests and diseases. Low productivity is the main constraint in public hybrids followed by their long duration, low recovery and small grain size. A shortage of labor is one of the constraints due to rising wages. These constraints are common for all three states.

In **Gujarat**, smallholder farmers comprised 80% of the total sample with literacy commensurate with 2-3 years of schooling. A majority of sample farmers (more than 85%) have two she-buffaloes, and only 5-10% of them have draft animals. The HOPE farmers realized a grain yield of 1,050 kg/ha, compared to non-HOPE farmers' average yield of 960 kg/ha. The yield gap of pearl millet with farmers practice was estimated to be 130% considering the potential yield of 2,400/ha under recommended practice and normal rainfall. After accounting for production costs of Rs. 11,000 (US$ 220), the net income per hectare of pearl millet is Rs. 4,200 (US$ 84). In both HOPE and non-HOPE areas, the crucial competing commercial crop is Castor, which fetches a three times higher return. Of the farmer-preferred traits of crop varieties, 98% preferred high productivity, 50% desired that the variety should fit into their cropping system, and 36% indicated that the variety should be of short duration.

Around 52% of farmers in **Haryana** are marginal smallholders with an average farm size of 1.3 hectare, 4-8 years of schooling, and a smaller family size of 5 members. The productivity of pearl millet in the dry spells in Haryana is 1,540 kg/ha of grain and 2,600 kg/ha of fodder, with a yield gap of 58-101%. The pearl millet-buffalo combination is practiced by more than 90% of farm families, and the average livestock value ranges from Rs. 80,000 to 95,000 (US$ 1,600 to US$ 1,900). All farmers surveyed (100%) earn an income of Rs. 93,000 to 109,000 (US$ 1,860-2,180) from crops that account for more than 90% of the total average income of Rs 120,000 (US$ 2,400). The net income per hectare of pearl millet is Rs 4,400 (US $88). Bt-cotton fetches two to three times the return from pearl millet in HOPE and non-HOPE areas.

[3]The gap between actual yield obtained under farmer practice and potential yield expected under improved production system advanced by the project

Activity 1.4 - Monitoring and evaluation of adoption and impact

Mali: Instruments to be used to monitor adoption of technologies and innovations were developed and shared with economists working in the NARS institutions implementing the HOPE project. These include gauging: the socio-demographic profile of households; ownership of physical assets (land, equipment, durables); knowledge and adoption of modern and local varieties; the use of technologies (varieties, fertilizers, pesticides, etc.) at plot levels; social capital (affiliation to associations and exposure to technology transfer activities); market transactions; food security; and income indicators.

The early adoption survey is scheduled for implementation in July and August 2012. Ten enumerators are currently being trained in Niger to administer the questionnaires at project, diffusion and control sites.

ESA (Ethiopia and Tanzania): Two students have been identified to study early adoption levels and constraints to adoption in Ethiopia and Tanzania. In Ethiopia, an MSc student is being supported by the project to study early adoption in HOPE areas. In Tanzania, a PhD student was admitted to the University of Hohenheim in June 2012. He is preparing a thesis proposal for doing fieldwork on early adoption of sorghum and millets in central Tanzania, beginning in October 2012. The findings from these academic studies will feed into the project work and will be reported by March 2013 as scheduled.

Maharashtra: A monitoring and evaluation survey was conducted during the (post-rainy) season of 2011/2012, in which 270 farmers in Marathwada and a similar number in western Maharashtra were surveyed. The sample profile comprised 180 respondents from HOPE beneficiary areas and 90 from non-HOPE areas. The data relating to adoption of improved technologies, productivity of grain and fodder, marketed surplus and the key constraints to adoption of technologies were collected and analyzed, and a draft report was prepared. The survey reveals that in Western Maharashtra, 68% of HOPE farmers indicated that the performance of post-rainy season sorghum was moderate, while 15% reported poor performance. The grain yield was 645 kg/ha and the fodder yield was 2,872 kg/ha. In Marathwada, performance was better than in western Maharashtra, where grain yield was 782 kg/ha and fodder yield 2,452 kg/ha. In western Maharashtra, 16% of farmers had fully adopted improved varieties, and 69% of them had partially adopted the new cultivars. In Marathwada, adoption of improved varieties was 100%. With respect to seed drilling with fertilizer, in western Maharashtra 71% of the HOPE farmers adopted the practice in its entirety, as did 85% of the farmers in Marathwada. Wide row spacing was adopted fully or partially by 30% of farmers, in both areas. Adoption of seed treatment technology reached 62% in western Maharashtra and 30% in Marathwada. The main constraints to post-rainy season sorghum production were identified as moisture stress during sowing and/or terminal drought, scarcity of labor, shortage of fertilizer and farmyard manure, lack of credit, lack of quality seed, and lack of appropriate machinery.

Rajasthan, Gujarat and Haryana: The M&E survey on pearl millet conducted during the 2011-12 cropping season involved 180 farmers in each of the pearl millet-producing states of Rajasthan, Gujarat and Haryana. Data collected related to adoption of improved technologies, productivity of grain and fodder, marketed surplus and the key constraints in adoption of technologies. These were analyzed and a draft report was prepared. The results indicated that overall performance[4] of pearl millet was judged to be satisfactory by 100% of farmers

[4]Farmers expressing that they have realized grain and fodder yield above their expectation relative to what they would have realized in a normal year

surveyed in the Rajasthan clusters, 80% in the Gujarat clusters, and 24% in the Haryana clusters. Low rainfall in Haryana was one of the reasons for poor performance. Average pearl millet yield among HOPE project farmers in Rajasthan was 1,850 kg/ha, while average fodder yield was 3,200 kg/ha. In Gujarat, average grain yield was 2,020 kg/ha and average fodder yield was 3,830 kg/ha. In Haryana, average grain yield was 1,900 kg/ha and average fodder yield reached 3,830 kg/ha. Farmers fully adopted all the recommended practices in Rajasthan and Haryana. In the Gujarat clusters, 98% of farmers adopted the improved varieties, 34% adopted seed and fertilizer drill technology, 39% implemented wide row spacing, and 51% partially adopted the recommended optimum depth of sowing. Scarcity of labor during harvesting, high wage rates, moisture stress, and lack of appropriate machinery were listed as the main constraints to pearl millet production in these states.

Activity 1.5 - Human resource development and policy dialogue to enhance targeting, adoption and impact of sorghum and millet technologies

WCA: All the training modules for the workshop on "Methodology for Impact Assessment and Value Chain Analysis" have been developed. The training workshop is planned for 5-11 August 2012 in Niamey, Niger. A total of 12 economists from all HOPE and TL 2 countries in WCA have been invited to participate in the training. Using the methodology learned in the workshop, economists in Mali, Nigeria and Niger will undertake studies of varietal adoption in their respective countries.

ESA: In Ethiopia, one MSc student (Ermias Tesfaye) completed fieldwork on "Early adoption of sorghum technologies in HOPE project areas". In Kenya, one MSc student (Eddie Kipnego) at Egerton University completed fieldwork on "Smallholder farming resource allocation decisions and constraints on expanding production of finger millet in Western Kenya". The two students are currently writing up their theses.

SA: Field staff of partner institutions were trained in monitoring survey methodologies and how to gauge secondary diffusion of improved technologies in the four states of Maharashtra, Rajasthan, Gujarat, and Haryana. Two MSc students were trained in research methods, data collection and analysis. A policy brief on the pearl millet and sorghum economy of India was circulated among policy makers, development departments, and crop scientists. Policy issues relating to sorghum and pearl millet were discussed in a meeting held at ICRISAT with the Agricultural Secretary and Members of the Commission on Agricultural Costs and Prices. A PowerPoint presentation on the policy bias towards dryland cereals was submitted to the ICRISAT DG for a discussion of policy recommendations for dryland agriculture, held in Delhi. Recommendations were made to include sorghum and pearl millet in the public distribution system in order to stimulate demand for these coarse grains.

PROJECT OUTPUTS REALIZED UNDER OBJECTIVE 1 TO DATE

Table 1 presents the major outputs realized in Objective 1 by end of Year 3 of the project.

Table 1: ***Major Project Outputs Realized Under Objective 1, as of June 30, 2012***

Activity 1: ***Targeting innovations for up-scaling and for reaching resource poor farmers***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	1.1.2	GIS database collated with crop statistics [Nov 2009]	GIS database has been collated with crop statistics (FAOSTAT).	Achieved	Database available
	1.1.4	GIS maps for sorghum and pearl millet based on biophysical and socioeconomic characteristics developed and made available [Nov 2010]	GIS maps for sorghum and pearl millet based on biophysical and socioeconomic characteristics have been developed	Achieved	Maps of sorghum and pearl millet areas available
	1.1.6	Maps of recommended domains for sorghum (Burkina Faso, Mali, Nigeria) and pearl millet (Burkina Faso, Mali, Niger, Nigeria) developed [Sept 2011]	Preparation of maps of recommended domains for sorghum (Burkina Faso, Mali and Nigeria) and pearl millet (Burkina Faso, Mali, Niger, Nigeria) is on-going	Delayed but on-going	Maps of recommendation domains to be available
	1.1.11	Regional situation and outlook reports developed for sorghum and pearl millet [May 2013]	*None so far*	Not commenced	
ESA	1.1.3	Target areas within the crop-growing regions in each target country and hot-spot testing sites for the project selected and defined with partners [Dec 2010]	Target areas within the crop-growing regions in each target ESA country and hot-spot testing sites for the project were selected and defined	Achieved	Maps of target areas available
	1.1.6	Profitability of selected sorghum and finger millet varieties evaluated using the APSIM model for different environments in target countries [Dec 2011]	• APSIM model simulations were done and completed for sorghum in Tanzania (January, 2012) • APSIM model simulations for sorghum in Ethiopia are awaiting economic data from baseline survey to complete (Dec 2012)	Completed for Tanzania and on-going for Ethiopia	APSIM model simulation reports to be available
	1.1.8	Regional situation and outlook reports for sorghum and finger millet developed [Oct 2011]	Completed revision to IMPACT model, completed data collection for the report, and agreement reached on format and simulations. Following this, the regional situation and outlook will be determined for sorghum and finger millet	Delayed. Completion date rescheduled to Dec 2012	Outlook Report will be made available
	1.1.10	Maps of impact target domains developed for selected varieties of sorghum (Eritrea, Ethiopia, Tanzania) and finger millet (Ethiopia, Kenya, Tanzania, Uganda) to inform technology diffusion [July 2012]	Three of 10 GIS maps completed. Awaiting feedback from plant breeders in ESA on biophysical parameters and sample maps	Ongoing. Completion rescheduled to June 2013	GIS maps will be available
SA	1.1.1	Database on post-rainy season sorghum and pearl millet updated till 2006/07 [Nov 2009]	Database on post-rainy season sorghum and pearl millet has been updated to 2008-09	Achieved	Database stored at HOPE project online document repository[5]

[5] https://sites.google.com/a/cgxchange.org/hope-project/

	1.1.2	GIS maps for post-rainy season sorghum and pearl millet areas developed based on biophysical and socioeconomic characteristics [Dec 2010]	GIS maps on area, production and productivity of post-rainy season sorghum and pearl millet have been prepared. The key biophysical and socioeconomic characteristics have been compiled for post-rainy season sorghum (Maharashtra) and for pearl millet (Gujarat, Rajasthan and Haryana), and superimposed on the GIS maps	Achieved	GIS maps in online project repository and distributed to partners
	1.1.3	Maps of recommended domains for sorghum (Maharashtra) and pearl millet (Gujarat, Haryana, and Rajasthan) developed [April 2012]	GIS maps of recommended domains have been prepared in consultation with breeders and the hot spots for post-rainy season sorghum and pearl millet have been prepared. Critical areas have been identified for targeting	Achieved	GIS maps in online project repository and distributed to partners
	1.1.6	Regional situation and outlook reports for post-rainy season sorghum and pearl millet developed and shared with partners [March 2011]	Report on regional situation and outlook for post-rainy sorghum and pearl millet is prepared.	Achieved	Report of regional situation and outlook, stored at project online document repository
Activity 2: ***Analysis of investment opportunities for research and development in crop improvement (CI), crop management (CM) and market access (MA)***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	1.2.4	A set of feasible R&D investment options identified for sorghum (Burkina Faso, Mali and Nigeria) and pearl millet (Burkina Faso, Mali and Nigeria) are prepared for economic analysis [Nov 2010]	R&D investment options have been identified in the four countries and prepared for analysis using the IMPACT model	Achieved	Database available
	1.2.7	Potential impact of the introduction of specific sorghum or pearl millet varieties estimated for sorghum (Nigeria) and pearl millet (Niger) [July 2011]	Ex-ante impacts of selected technologies and innovations have been computed	Achieved	Report on the ex-ante impacts of technologies and innovations available
ESA	1.2.5	Potential impact of promotion of available technologies estimated for finger millet in Tanzania and sorghum in Ethiopia [Dec 2011]	The baseline surveys have estimated the profitability of sorghum and finger millet in the survey areas, and APSIM models have shown profitability of improved technologies for sorghum in these areas [*Activity will not be completed during the grant period*]	On-going	
	1.2.9	Report on economic benefits from targeting research investments on alternative biotic and abiotic stresses for new variety development (supported by APSIM modeling) and market constraints for sorghum (Ethiopia and Tanzania) and finger millet (Ethiopia and Tanzania) produced [May 2012]	The baseline surveys have identified the importance of specific biotic and abiotic constraints on adoption of improved varieties. The APSIM models for sorghum in Ethiopia and Tanzania estimate the profitability of improved varieties and crop management practices that address these constraints [*Activity will not be completed during the grant period*]	On-going	
SA	1.2.2	Ex-ante impacts of available crop technologies estimated for post-rainy season sorghum in Maharashtra	Ex-ante impacts of available crop technologies have been estimated for post-rainy season sorghum in Maharashtra and	Achieved	Report uploaded at HOPE online repository

		and for pearl millet in Gujarat, Haryana, and Rajasthan assessed [Feb 2011]	pearl millet in Rajasthan. Gujarat and Haryana		
	1.2.4	Report on impact of potential crop technologies prepared for post-rainy season sorghum (Maharashtra) and pearl millet (Gujarat, Haryana, and Rajasthan) [April 2011]	Impact of potential crop technologies has been estimated at the macro level for post-rainy season sorghum in Maharashtra, and for pearl millet in Gujarat, Haryana, and Rajasthan.	Achieved	Report uploaded at HOPE online repository
Activity 3: ***Conduct baseline surveys for characterization of farmers, their trait preferences, input-output levels, and profitability of dryland cereals vis-à-vis competing crops***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	1.3.4	Household baseline data collected from target impact areas with proper counterfactuals for sorghum (Nigeria, Mali) and pearl millet (Niger) [July 2011]	Baseline survey data has been checked and fully documented. Analysis has been completed and the report is under preparation	On-going	Database available and preliminary tables available
	1.3.7	Report on socioeconomic and poverty profiles, technology preferences, etc., based on analysis of baseline household data for sorghum (Nigeria, Mali) and pearl millet (Niger) [Dec 2012]	Data cleaning and analysis is completed. The draft report (on socioeconomic and poverty profiles, technology preferences, etc.) is under preparation, and is due by December 2012.	On-going	Baseline report will be made available
ESA	1.3.6	Baseline data collected from household surveys in target areas for sorghum (Ethiopia, Tanzania) and finger millet (Ethiopia, Tanzania) [Dec 2010]	Baseline data has been collected from household surveys in target areas for sorghum and finger millet in Ethiopia and Tanzania	Achieved	Baseline survey database is available
	1.3.10	Baseline study report on socioeconomic and poverty profiles, technology preferences, etc., based on analysis of baseline household data for sorghum (Ethiopia, Tanzania) and finger millet (Ethiopia, Tanzania) produced [Dec 2011]	Baseline data processed and analyzed for Tanzania and Ethiopia and draft reports are completed. A revised report for Ethiopia is in progress and is expected December 2012.	Completed for Tanzania and on-going for Ethiopia	Baseline survey reports will be made available
SA	1.3.4	Baseline data collected from 1,080 households from target locations in Maharashtra for post-rainy season sorghum and Gujarat, Haryana, and Rajasthan for pearl millet [Dec 2010]	Collection of baseline data from 1,080 households in four states (Maharashtra, Gujarat, Haryana and Rajasthan) at 12 clusters and 36 villages has been completed. Both primary and secondary data relating to sample households and clusters has been completed, analyzed and reported	Achieved	Baseline report available
	1.3.6	Report on socioeconomic and poverty profiles, technology preferences, etc., based on analysis of baseline household data prepared for post-rainy season sorghum (Maharashtra) and for pearl millet (Gujarat, Haryana, and Rajasthan) [Dec 2011]	Five baseline reports on socioeconomic and poverty profiles, technology preferences, etc., have been prepared for post-rainy season sorghum (Maharashtra) and pearl millet (Rajasthan, Gujarat, and Haryana),and are currently under review	Achieved	Draft baseline report is available
Activity 4: ***Monitoring and evaluation of adoption and impact***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	1.4.1	Gender plan prepared for involvement and empowerment of women in the project [Oct 2010]	Gender plan has been prepared and operationalized	Achieved	Gender plan available on the HOPE online

					document repository
	1.4.4	Monitoring framework developed for selected indicators of project outcomes and impacts (productivity, production, income, vulnerability, and food and nutrition security) [Oct 2011]	Monitoring framework has been developed and operationalized for selected indicators of project outcomes and impacts	Achieved	Matrix for the logical monitoring of the project available in the HOPE online document repository
	1.4.8	Adoption surveys conducted and constraints and opportunities identified in selected project target areas/countries and shared with partners [Dec 2012]	*None so far. The studies are currently being designed*		
ESA	1.4.3	Gender plan prepared for involvement and empowerment of women in the project [Oct 2010]	Gender plan has been prepared and operationalized	Achieved	Gender Plan document available in HOPE online document repository
	1.4.6	Monitoring framework developed for selected indicators of project outcomes and impacts (productivity, production, income, vulnerability, and food and nutrition security) [June 2010]	Monitoring framework has been developed and operationalized for selected indicators of project outcomes and impacts	Achieved	M&E document available in HOPE online document repository
	1.4.9	Adoption levels monitored and report on early adoption levels and constraints documented for selected countries [March 2013]	Completed fieldwork for MSc thesis on early adoption at HOPE project sites (Ethiopia) PhD fieldwork on early adoption at HOPE project sites in Tanzania scheduled for Oct 2012	On-going	MSc thesis PhD thesis (preliminary results)
	1.4.11	Report on the evaluation of on-farm trials and demonstrations of new technologies developed (linked to objectives 2 to 4) [May 2013]	*None so far; awaiting data from Year 3 field trials*	Not commenced	
SA	1.4.2	Monitoring framework developed for selected indicators of project outcomes and impacts (productivity, production, income, vulnerability, and food and nutrition security) for post-rainy season sorghum and pearl millet [Nov 2009]	Monitoring framework has been developed and operationalized for selected indicators of project outcomes and impacts	Achieved	Matrix for the logical monitoring of the project available
	1.4.3	Gender plan prepared for involvement and empowerment of women in the project [Oct 2010]	Gender plan has been prepared and operationalized	Achieved	Gender plan available
	1.4.9	Adoption levels monitored and report on early adoption levels, impacts, and constraints documented for the target states [Dec 2012]	*None so far*	On-going and on target	
	1.4.11	Report on the evaluation of on-farm trials and demonstrations of new technologies developed and shared with NARS scientists, government officials and progressive farmers (linked to objectives 2 to 4) [March	*None so far*	On-going and on target	

		2013]			
Activity 5: ***Human resource development and policy dialogue to enhance targeting, adoption and impact of sorghum and millet technologies***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	1.5.2	One MSc student from NARS trained in marketing in Niger in local universities [March 2010]	One MSc student has graduated in agricultural marketing from the University of Niamey	Achieved	MSc thesis available
	1.5.4	Four NARS scientists (Nigeria, Mali, Burkina Faso, and Niger) will be trained in survey design, data collection methods and be involved in supervision of data collection for the project and scientific writing [April 2011]	Four NARS scientists from Nigeria, Mali, Burkina Faso, and Niger were trained in 2011 in survey design and data collection methods, and are involved in supervision of data collection and scientific writing for the project	Achieved	Report of the training available
	1.5.5	One MSc student from Niger trained in development economics in a local university [May 2011]	One MSc student has graduated in development economics from the University of Niamey, Niger.	Achieved	MSc thesis available
	1.5.7	10 scientists trained on impact assessment of technologies and innovations [Oct 2011]	*None so far. Rescheduled to 5-11 August 2012*	Delayed but on-going	
	1.5.9	Regional workshop to share findings from baseline surveys, adoption monitoring and impact studies [May 2013]	*None so far*		
ESA	1.5.3	5-8 lead socioeconomists from Ethiopia, Kenya, Tanzania and Uganda trained on survey design and data collection methods, and thereafter backstop project surveys in their respective countries [Sept 2010]	12 socioeconomists from DRD (6 women, 6 men) were trained in design and pre-testing of the baseline questionnaire for Tanzania. Similar training has not yet been done for Ethiopia, Kenya and Uganda	Delayed but on-going	HOPE training records
	1.5.7	2 MSc students from target countries supported to complete their theses on adoption and impact of sorghum and finger millet technologies in Ethiopia and Tanzania [Feb 2013]	1 MSc student from Tanzania completed thesis on adoption; 1 MSc student from Ethiopia has completed fieldwork	On-going	MSc theses
	1.5.9	In-country workshop (Ethiopia, Tanzania) and policy brief to share findings from baseline surveys, adoption monitoring, and impact studies [May 2013]	*None so far*		
SA	1.5.3	15 partners from Maharashtra, Gujarat, Haryana, and Rajasthan trained on survey design and data collection methods, and thereafter backstop project data collection [Jan 2011]	20 partners (5 each from Maharashtra, Gujarat, Haryana, and Rajasthan) have been trained in survey design and data collection methods	Achieved	Training manual available
	1.5.6	Completion of training on adoption, monitoring and impact assessment for 15 scientists [Nov 2011]	Training was imparted to 15 partners on adoption, monitoring and impact assessment at ICRISAT	Achieved	• Training manual • Pictures of participants taken during training
	1.5.7	Two MSc students, one each from Marathwada	Two students have been identified and trained on research	In progress	Draft dissertation report

		Agricultural University/MPKV, Rahuri, and GAU/RAU trained on preparing dissertations that assess the adoption and impact of sorghum and finger millet technologies [April 2012]	related topics. The research topics and thesis titles are: "Economic analysis and impact assessment of dry land technologies for post-rainy season sorghum in western Maharashtra" and "Impact of technological change (HYVs) of pearl millet on production, resource use and farm income in Rajasthan"		
	1.5.8	Organization of regional workshop to share results from baseline, adoption, monitoring and impact surveys [May 2013]	*None so far*		

OBJECTIVE 2: IMPROVE SORGHUM CULTIVARS AND MANAGEMENT OPTIONS TO INCREASE PRODUCTIVITY IN WCA, ESA, AND SA

ACTIVITIES CARRIED OUT IN THE PERIOD JULY 2011 – JUNE 2012

Activity 2.1 - Identify new sources of resistance/tolerance to end options for control

Mali: One multi-location trial with 42 potential midge resistance sources from three regions was conducted in Mali (Samanko station) and Niger (INRAN's Konni station). A local variety from northwestern Nigeria (Ribdahu) was confirmed as highly resistant at both sites.

Ethiopia: A total of 274 sorghum germplasm accessions collected from striga-infested areas and 8 local susceptible checks were planted in an artificially infested striga plot for screening at Kobo in 2011. Terminal stress conditions made it difficult to characterize striga resistance, as the drought reduced striga emergence. From 378 sorghum IBC/E accessions that were collected earlier from areas where striga is endemic, 238 lines were selected and purified. Using augmented design, 238 lines randomized with six susceptible checks were planted in an artificially infested striga plot at Kobo. The trial established well, but the later than expected on-set of rainfall and an early end of the rains led to reduced striga emergence.

Eritrea: The improved varieties ICSV111IN, Shambiko (PP290), Bushuka (ICSV 210), P9401, P9407, and Wedi Arba were identified as resistant to striga.

South Sudan: The 58 accessions collected in South Sudan were multiplied and 200-2,900 g of seed was produced per accession.

Tanzania: Sources of midge resistance were evaluated at Ukiriguru Mwanza. This included evaluation for the stability of midge resistance tested by stagger planting 50 lines, including susceptible checks, in two hot-spot areas – the Lake Victoria zone of Tanzania and ICRISAT's site at Alupe, Kenya. Planting was done over two seasons. During the 2011 long rainy season, 49 sorghum lines that were selected from the 186 lines in the 2010 midge nursery were evaluated at Alupe and in Ukiriguru, Tanzania, for tolerance to midge and leaf diseases. The season was fair at Alupe but poor at Ukiriguru as the rains were delayed at the start and ended early. The best lines combining midge resistance, disease resistance, and high yield were IS 8891, MR # 22x IS 8613/1/1/2/1-1, IS 8884, IS 8887, and IS 21185.

To identify new sources of striga resistance for the humid tropical zone (in Tanzania and South Sudan), 25 existing sources of striga resistance were tested in Tanzania, South Sudan, and at the Alupe site. Analysis of variance for grain yield and striga counts taken at Alupe showed 5 lines with low striga counts (<50) taken at flowering and harvesting time. The highest yielding line (IS 25395), which had a mean grain yield of 3.760 t/ha (trial mean 2.26 t/ha), had striga counts of 35 (trial mean 120) and 33 (trial mean 97) at flowering and harvesting, respectively. Other high yielding lines are Wagita with 3.760t/ha; IS33350 with 3.594t/ha; SRS1108 with 3.375t/ha; SRS3108 and SRS1208 with 3.250t/ha and 3.000t/ha, respectively. The lowest striga counts were recorded on SRN 39 (0 and 1) and IS 9830 (17 and 12), but these lines had incidences of leaf diseases and low grain yields. The striga-resistant variety N13 had low striga counts (32 and 42) at flowering and harvesting, respectively, and a low yield of 1.354t/ha. The striga-resistant varieties released in Tanzania (Wahi and Hakika) had low yields of 1.156t/ha and 1.286t/ha, and correspondingly both had high striga counts of 94 at flowering and at harvesting; Wahi had 124 striga plants and Hakika had 131.

Maharashtra: Sixty lines, including the resistant (IS 18551) and the susceptible (Swarna) checks, were tested for shoot fly resistance using the interlard fishmeal technique at ICRISAT center, Patancheru; DSR, Sholapur; MAU, Parbhani; and MPKV, Rahuri. Seventeen genotypes were identified as sources of resistance to shoot fly, suffering <25% dead-hearts compared to 7.72% in IS 18551 and 72.02% in Swarna.

Three methods of screening for resistance to aphids were compared: natural infestation under field conditions; artificial infestation under nylon netting; and no-choice cage assay. Thirty diverse sorghum lines (maintainers and restorers) were tested, with the three assays conducted in the same fields and season at Patancheru. Data analysis is on-going and a publication is under preparation.

We evaluated 90 sorghum genotypes for shoot fly resistance under field conditions during the rainy and post-rainy seasons as a part of a student's thesis research. The genotypes ICSV 25039, PS 35805, IS 2123, and Akola Kranti showed resistance to shoot fly in both the seasons. Dead-heart formation was negatively associated with trichome density, leaf glossiness, panicle exertion, number of harvestable heads, and grain yield, but positively associated with glume and grain color, and endosperm texture and color. Analysis of genetic diversity among the shoot fly-resistant lines using the un-weighted pair group method with arithmetic mean (UPGMA) placed the genotypes into four major groups, suggesting that there is considerable genetic diversity among the shoot fly-resistant sources. A set of 10 lines was also crossed in full diallel for studying the inheritance of resistance to shoot fly in 2012/13 post-rainy seasons.

Activity 2.2 - Identify options for sorghum intensification in target ecologies

Mali: Four hybrids (Fadda, Pablo, Sewa and 12A*249) and two high-yielding, open-pollinated control varieties (Tieble and Lata3) were tested in 2011 under two fertilizer treatments (high and low P) and two different planting densities – 33,000 hills per hectare (40 cm between hills, which is the common practice) and 66,000 hills per hectare (20 cm between hills) at three sites (IER Sotuba, Kolombada, and the ICRISAT Samanko stations). Grain yield trial means for Samanko (lowP), Sotuba, Kolombada and Samanko (high P) were 1.25, 1.42, 2.45, and 3.11 t/ha, respectively. Di-ammonium phosphate fertilizer application positively affected grain yield at all sites and the effect was significant in Kolombada and Samanko. Stand density and variety also affected grain yields significantly at all sites, with low stand density (40 cm between hills) producing higher yields than high stand density (20 cm between hills). The yield difference between high and low stand density tended to be smaller under lower fertilizer doses, except when fertility conditions were extremely poor, as at the Samanko low P field, and the trial at the Sotuba station. This indicates that at lower fertility, plant nutrients were just not available to allow for sufficient growth of a higher number of plants. However, under higher fertility levels, the end of season drought could have led to water shortages for the plots with higher stand densities. This is supported by the result that the one hybrid that matured significantly earlier actually had higher grain yield under higher fertility and high-density conditions, than under low-density conditions. The hybrids performed better than the open-pollinated varieties, with the hybrids Fadda, Pablo and Sewa showing very good potential at the different sites. Fadda consistently had the highest yields compared to the open-pollinated varieties and the other hybrids at all sites.

Ethiopia: Soil sample collection was completed in 2010. A set of 10 varieties was identified and tested for their performance under low soil fertility and moisture stress conditions in 2011. Data analysis is on-going.

Eritrea: Ten varieties were identified and tested for their performance under low soil fertility and moisture stress conditions. Data analysis is on-going.

Tanzania: Ten cultivars having diversity for growth rates and flowering times were evaluated at a range of latitudes to determine their photoperiod sensitivity. The sorghum varieties Macia and Sima, which have been released in Tanzania and Zambia, respectively, are being promoted in Tanzania in the 2011/2012 seasons. Another 10 improved varieties were identified and tested for their performance under low soil fertility and moisture stress conditions. Based on the performance of 100 varieties in a trial conducted at Hombolo in Tanzania (in 2010), 50 accessions were selected for further evaluation. The selection was based on yield and yield attributes.

Maharashtra: To evaluate variety adaptation to different temperatures at flowering, eight post-rainy season adapted varieties were evaluated in three locations (MAU, MPKV and ICRISAT), with three sowing dates (1 October, 15 October, and 30 October). Temperatures were recorded at all three sites. Dagadi Solapur, SPV 1411 and M 35-1 were consistently more tolerant to low temperature, showing higher seed set percentage, higher mean panicle weight, and higher panicle harvest index. They also flowered late under the first date of sowing and early under the third. This methodology clearly picked up the cultivars that have been under cultivation by farmers for several years, so any improved materials in the pipeline should use this methodology to identify the lines with high adaptability for low temperature.

Activity 2.3 - Identify new and characterize already available hybrid parents for the targeted agro-ecologies

Ethiopia: A total of 33 potential hybrid parents (A/B and R-lines) were introduced from ICRISAT-Nairobi. The parental lines were evaluated in the 2011 main season, as well as in the off-season for their morpho-agronomic traits, pest and disease reactions, height and flowering synchronization, stability of male sterility in female parents, as well as the fertility restoration ability of R-lines under Ethiopian conditions. Eight A/B and 11 R lines were found suitable for dry lowland Ethiopian conditions. Experimental hybrids have been developed for evaluation in the target ecology and the parental lines have been maintained for further evaluation.

Tanzania: Some 133 potential hybrid parental lines were genotyped at ICRISAT, Patancheru, India. Five highly polymorphic SSR markers for sorghum were used to assess variability within and between the lines. High uniformity was observed within each genotype. Thirty-five A-lines out of 36 (97.2%) were highly homozygous for all markers. A total of 32 B-lines out of 36 (89%) were highly homozygous for all markers. ICSA 89003 and ICSB 89003 showed only three events of uniformity across the markers. A total of 90 R-lines out of 97 (92.8%) were highly homozygous, but well differentiated genetically. Genotyping by sequencing (GbS) analysis for all parents is to be carried out in August 2012.

Maharashtra: Promising new B-lines (a total of 213) in early generation conversion (BC_2) were backcrossed to develop male-sterile lines. Based on grain size, grain luster, agronomic score, and plant height, 138 BC_3 progenies were selected for further backcrossing to develop potential male-sterile lines. Nine sorghum elite B-lines were evaluated along with three checks. Five promising B-lines were selected based on grain yield, grain luster, agronomic score, shoot fly resistance, and seed size. Eighty-two advanced restorer lines were evaluated along with four checks. Forty-one promising R-lines were selected based on grain yield, grain luster, agronomic score, shoot fly resistance, and seed size. All the selected R-lines

significantly out-yielded the checks SPV 1411 (3.7 t/ha) and M 35-1 (2.5 t/ha). The genetic diversity in post-rainy material increased by adding diverse Durra accessions from East Africa and Muskwari sorghums from West and Central Africa, such as IS 23891, IS 23930, IS 23986, IS 34724, IS 18551, IS 19587, IS 20583, IS 33844-5, IS 34725 and others.

Activity 2.4 - Develop hybrids with improved yielding ability and adaptation trials for specific target regions

Mali: We completed a 2-year series of evaluations of 15 hybrids in three zones (Koutiala, Dioila, and Mande – three villages per zone) where sorghum cultivation is important. The results indicate that the two best hybrids, Fadda and Sewa, have an average yield advantage of more than 35% over a wide range of growing conditions (from 900 kg/ha to 3.5 t/ha average yield). Among the 28 trials evaluated in detail, there was no case in which the hybrid yielded significantly less than the local control. The risk of using hybrid seed is thus very low, and under most circumstances farmers will gain significantly.

Burkina Faso: The one hybrid trial sent to Burkina Faso in 2011 failed due to the difficult rainfall conditions at the testing site. For 2012 a targeted multi-location trial has been distributed.

Ethiopia: Sixteen hybrids developed by ICRISAT were introduced, and their performance and adaptation examined at Melkassa. The hybrids' morphological and phenological characteristics, along with grain yield data, were collected and analyzed in 2010. Morphological and phenological data were collected in 2011, but not grain yield data because of bird damage at the milky stage of grain production. Four of the 16 hybrids in 2010 and six in 2011 out-performed the checks (ESH-2). The hybrids SDSH 90003, IESH 22023, IESH 22012, IESH 22005, SDSH 40914, ICSA276 x ICSR 38, IESH 22011, and IESH22002 had better mean grain yield performance, in a descending order. These hybrids were also found to be better in terms of their agronomic desirability. These hybrids have better biomass, a trait required by farmers for both livestock feed and other household uses.

Tanzania: A total of 25 hybrids, including a hybrid local check (SDSH409), were tested in Zimbabwe. In addition, a variety check was incorporated into a regional sorghum hybrid trial and planted in Tanzania (Ukiriguru, Miwaleni, Hombolo, and Ilonga), Ethiopia, Eritrea, and Kenya. Data from Tanzania, Eritrea, and Ethiopia are still pending. Results from Kiboko showed significant differences among the 25 entries for agronomic and yield traits. The hybrid ATX623 x IESV91104DL produced a yield of 6.683t/ha, ICSA11 x S35 had a yield of 6.535t/ha, whereas ATX623 x Macia produced 4.799t/ha; other good performers were IESH 22002 with 6.375t/ha and IESH 22010 with 5.824 t/ha. The variety check (Macia) had a yield of 3.049 t/ha. This means that the best hybrid had a 54.4% yield advantage over the check variety.

The major output here is that 15 experimental hybrids have been identified for the Dry-Lowland (DL) and Sub-Humid (SH) agro-ecologies of Tanzania and Ethiopia, and some of these will be included in Participatory Hybrid Selection trials in the coming 2013 season, targeting release in Tanzania.

Maharashtra: A total of 35 promising hybrids were selected across three locations (MAU, MPKV and ICRISAT) based on their superiority for grain yield, grain luster, agronomic score, shoot fly resistance, and seed size. The selected hybrids were significantly superior to the check SPV 1411 (3.4 t/ha). Moreover, six elite hybrids were reevaluated across four locations (ICRISAT, MAU, MPKV, and Tandur) with two checks to identify hybrids for

release for post-rainy season cultivation. The four top-performing hybrids were: Bayer-8712 (5.06 t/ha), ICSA 38 x SPV 422 (3.95 t/ha), ICSA 502 x SPV 422 (3.84 t/ha), and ICSA 84 x SPV 1411 (3.72 t/ha), which were selected based on across-location grain yield performance, grain luster, seed size, and shoot fly resistance.

Appropriate locations were identified and sowing dates standardized for seed production of hybrids in January 2012. Parents of both CSH 15R and SPH 1620 nicked well under the first and second dates of sowing (1 January and 15 January) at Rahuri. In 2011, the parents of CSH 15R generally nicked well under the first sowing date (1 January), both at Rahuri and Parbhani, and parents of SPH 1620 synchronized well under both the sowing dates (1 and 15 January) at Rahuri.

Activity 2.5 - Develop open-pollinated varieties with improved yielding ability and resistance to the predominant biotic and abiotic stresses in target ecologies

Mali: A new set of F_5lines were evaluated in two zones, in a total of two villages in the Bougoni area, in partnership with the MOBIOM network, and in two on-station testing situations, with low and high phosphorus availability. IER and national partners from other countries visited and while there they selected desirable progenies and individual panicles. Seed of those selections has been sent to them, and to some other NARS in the region.

The random mating of the second cycle of selections from the diversified Guinea population showed a very low frequency of sterile plants. All sterile plants were harvested. A set of fertile panicles that expressed the target traits (short height, open but dense panicles, open glumes at harvest, and vitreous grain) was selected as well. Another random mating of this bulk population will be done by sowing bulks of the grain harvested from sterile plants, alternating with grain from fertile plants.

IER and other national and regional partners selected panicles from the grow-out of the first random mating of this second cycle bulk population. They will use their collections to continue pedigree selection. Seed from the selected fertile panicles is being used to start pedigree selection, also at Samanko. Sets of these nurseries have been sent to Burkina Faso (two sites) and to other NARS.

Original bulk populations from the Burkina Faso program were multiplied in isolation at Samanko, as the Saria station has difficulties with isolations because of the large volume of foundation seed production at the station.

Burkina Faso: Two sets of advanced breeding lines from a diverse set of bulk populations have been evaluated on station at Saria, and in some farmers' fields. Due to difficult growing conditions, the trials failed in the driest target zone. In addition to agronomic evaluations, culinary tests were conducted with these lines at the station. None of the varieties was rejected because of quality, but three lines had significantly lower decortication yields than the local check. Four varieties were judged as having overall excellent qualities.

On station, pedigree selection in 26 S1, 234 S2, and 122 S3, and 33 S3/4s and 53 S6/S7 lines from these same bulk populations continued, in preparation for eventual releases. The single plant selection (S_1) for all those lines had been selected by farmers in the two project zones because of their adaptation to specific growing conditions. The material selected by the two groups of farmers differed substantially for earliness, grain type, and plant height. Farmers made final evaluations of the material grown on station, and jointly a total of 41 panicles were advanced from 30 different S_6 lines, for variety development.

In the Dedougou area (UGCPA[6]), six farmers evaluated 170 single plant selections, from S_2s to S_7s. The evaluations and selections were done by 20-25 farmers in each village. In total they kept 77 progenies, with a total of 128 single panicle selections. Selection criteria were: big, well-filled panicles; high grain yield; appropriate maturity date; white grain color; and green leaves and stems at grain maturity.

Among the S_7 lines, a total of 16 S_8s were retained for initial variety testing. The main criterion used was that they had to have been selected in at least two sites, including the Saria station.

In the North Central region (with AMSP[7]), a total of 213 progenies selected in previous years by the same farmers were grown out to undergo further selection. Despite the difficulties with scanty rainfall, farmers were able to select a total of 15 lines by also using the on-station results. These lines will now enter replicated variety trials, so that they can reach the dissemination stage within 2-3 years.

Ethiopia: Crosses were made between four varieties lacking the drought tolerant traits, stay-green and earliness (2001MS 7003, IESV 92084 DL, 2001 MS 7037, IESV 92146 DL), and two stay-green varieties and an early maturing sorghum (B-35, E36-1, and 76 T1 # 23). A total of 50 effective crosses were made in 2010, and from the F_2 population single seeds were picked from each head and bulked for generational advancement.

Seed of 38 lines identified during a previous project, with introgressed stay-green QTLs from B35 and 22 lines with QTLs from E36 were increased. Trials were conducted to evaluate the lines along with the recurrent and the donor parents in Kobo and Meiso. In Kobo, significant variation was obtained among all the traits measured. The entry (Meko x B-35) BC3F3 showed superior performance compared to the best recurrent parent (Meko) and other stay-green introgressed lines. A grain yield of 4,088kg/ha, a yield advantage of 10% over the high-yielding recurrent parent Meko, and the line (Teshale x E36-1) BC3F3 produced a grain yield of 4,101kg/ha. At Meiso, there was significant variation among lines for the traits measured, and three varieties performed better than the higher yielding recurrent parent in terms of grain yield.

In the 2011/2012 season, an MSc student at Alemaya University evaluated the response of 26 stay-green introgressed lines under irrigated Non-Stress (NS) and Drought Stress (DS) conditions for post-flowering drought resistance. Analysis revealed that, under both conditions, lines were significantly different ($P \leq 0.05$ or $P \leq 0.01$) for all observed traits, except total chlorophyll per area in the NS environment and panicle width in those subjected to DS. The mean grain yields under DS were 2,887.72 kg ha compared to 4,289.10 kg ha in NS environments. Based on the results, nine progenies that exhibited the combination of relatively high yield potential and drought-resistant traits appear useful for promotion in areas where post-flowering drought is a common problem. However, further verification is required across environments under rain-fed conditions to confirm the results obtained. Trait association studies indicated that at least some of the stay-green QTLs that were introgressed into recurrent parents are functional and are expressed in the genetic background of the recurrent parents. Therefore, breeding for stay-green seems to be feasible in breeding programs, given its simplicity to score on a large number of entries. The genotypic path coefficient analysis for the DS condition revealed that above-ground biomass (0.85),

[6] Union des groupement des producteurs pour la commercialisation agricole du Boucle du Mouhoun, Burkina Faso
[7] Association Minim Song Panga (AMSP), innovative farmers' network

followed by harvest index (0.77), imply that these traits could be used for indirect selection of high grain yield potential. However, further studies are required on marker-assisted introgression to transfer and capture multiple stay-green QTLs (Stg1, Stg2, Stg3, Stg4, StgA and StgB) into the genome of high-yielding sorghum varieties. Based on the results, nine progenies that exhibited the combination of relatively high yield potential and drought-resistant traits appear useful for promotion in areas where post-flowering drought is a common problem. However, further verification is required across environments under rainfed conditions to confirm the results obtained.

Eritrea: A total of 54 lines (17 lines developed locally from N13 x Hugurtay and 37 lines sent from ICRISAT (Ochuti x N13) were evaluated in striga-infested sites in Shambiko and Goluji. During the farmers' field day, three promising lines were selected. In total, 15 lines were holding up well, also in comparison with control varieties like ICSV111IN and Framida. Seed increases were done for 17 lines with confirmed presence of QTLs for striga resistance from the donor parent N13 from the previous "Fighting Striga" project, funded by BMZ and ASARECA. These materials are under evaluation in the striga hot-spot area in Goluj.

South Sudan: From the 45 Southern Sudan sorghum germplasm accessions characterized at Kiboko in 2010, a total of 93 selections were made for pure line development. These were sent back to Sudan for evaluation at Juba and Torit sites in 2011 and 2012 planting seasons. Results are yet to be reported. During the 2012 season, 22 lines from Sudan, each with at least two QTLs for striga resistance, are being evaluated along with five striga-resistant varieties in Juba and Torit in South Sudan.

Tanzania: F_2 segregating midge-tolerant populations were advanced to F_3 at Ukiriguru during the 2011/12 season. These are yet to be harvested. Three hundred and twenty segregating lines derived from crossing farmer-preferred lines and elite improved lines from Eritrea, Tanzania, and Ethiopia were advanced to the F_2stage at Kiboko and F_3stage at Miwaleni in Tanzania. The same populations have been sent to Eritrea to be planted off-season in November 2012. In the 2011/12 season, 25 best-performing midge-tolerant lines selected at Alupe and Ukiriguru from the 49 entries in the2011 midge trial done during the long rainy season were advanced at both locations. Results received from Alupe showed a better performance of the lines relative to the 2011 long rainy season. Grain yield ranged from 0.174 to 2.528 t/ha (trial mean 1.481 t/ha) with midge damage ratings ranging from a score of 1.0 to 5.3 (mean 2.2) on a 1-9 scale (with 1 being highly resistant and 9 being very susceptible). The best lines combining midge resistance, disease resistance, and high yield were IS 8891, MR # 22x IS 8613/1/1/2/1-1, IS 8884, IS 8887 and IS 21185. Data from Ukiriguru is still pending as the crop was not harvested by mid-June. Most of these lines have also been incorporated into the sub-humid sorghum trial sent to South Sudan in May 2012. Stability analysis will be done when all data are received.

Maharashtra: Fourteen elite varieties were evaluated with two checks across four locations (ICRISAT, MAU, MPKV, and ANGRAU, Tandur) to identify the best varieties for post-rainy adaptation. The top ten varieties were selected based on grain yield, grain luster, agronomic score, shoot fly resistance, and seed size. The selected varieties significantly out-yielded the best check, SPV 1411 (3.85 t/ha).

Activity 2.6 - Develop crop management options for key production constraints in target sorghum production ecologies:

Mali: Integrated Striga and Soil Fertility Management (ISSFM) practices have been tested against farmer practices (FP) for two years in three zones (Koutiala, Dioila, and Mande) in the Sudanian zone for sorghum cultivation, using the cluster-based farmer field school (CBFFS) approach. In total, 440 male and 62 female farmers from 15 different villages participated in 2010 and 2011. While sorghum grain yield under ISSFM was only marginally higher (15%, increasing from about 700 kg/ha to 820 kg/ha) than the FP averaged over 2 sites and 2 years, the ISSFM practice yielded additional cowpea grain (about 100 kg/ha) and fodder (about 1,000 bundles/ha). This additional harvest of cowpea grain and fodder generally led to higher benefits of the ISSFM practice compared to FP (in general, investment increased by about 100% while benefits increased by at least 200%). A third year of testing will allow for confirmation of results at all three sites about the profitability of ISSFM, and efforts to disseminate ISSFM have already started with sales of so-called "striga control packs". These allow farmers to apply the ISSFM practice on a small scale (500-600 m^2) in their own fields, while paying for the inputs necessary. Partners (IER and farmer organizations, USCPMD[8], Catholic Relief Services, and World Vision) used the CBFFS system for ISSFM in 2011 to experiment with and train about 400 farmers, and will use it on an even larger scale in 2012 (more details on this is given under Objective 6).

Intensified options for intercropping sorghum with groundnuts are being tested with women's groups, in 52 different women farmers' fields. The system of using narrowly spaced double rows of sorghum intercropped with 4-6 rows of peanuts has been well received by participating farmers, as sorghum yields were significantly higher (131%) than in the traditional system, with no noticeable reduction in groundnut yields.

Twelve women farmers also tested the use of wood-ash as a basal fertilizer, placed at the time of sowing. This gave an average yield advantage of 38%. The practice seems to be a recommendable for women, who tend to have fields with very poor fertility, and no other s means to access fertilizer, compost or manure. Women usually have access to ashes from cooking fires.

With 28 women from the Kita area, *Action Contre la Faim* tested the intensified intercropping, combined with a commercial organic fertilizer from Mali. They achieved an average yield advantage of 32% for sorghum.

A total of 178 farmers across the three sorghum target regions in Mali, working with IER and many local partners, farmers achieved an average of 63% yield advantage by decreasing the space between hills to 30cm, down from the usual 40-50 cm, and then thinning to two plants per hill. A small amount of fertilizer (2 g/hill) was also applied at the time of thinning. This average yield increase was achieved with 3-5 test varieties at each site. The yield advantage of the best variety with the improved practice averaged 131%.

A total of 16 farmers in four villages were involved in a full factorial experiment with 4 varieties, 2 soil fertility treatments, and 2 plant stand densities, with 2 replications. On average the improved fertility treatment produced a 60% yield advantage, the density treatment 15%, and both together 85%, indicating a small positive fertilizer x density interaction. The interaction with varieties and densities were significant in 5 of the 16 trials, indicating that there are varieties that seem to react positively. This experiment will be

[8] Union of cereal producers in Beleko, Mali

repeated in another year. The rainfall in 2011 stopped early in all places, and thus higher density treatments may have suffered more from end-of-season drought.

ESA (General): Trials were conducted at two locations, Hombolo in Tanzania and Kampi Ya Mawe in Kenya, representing slightly wet and drier areas of dry lowland environments in which sorghum is predominantly grown. The trials were conducted over a total of five seasons, which provided a good idea about the performance of different sorghum varieties under a range of moisture stress conditions. At Kampi Ya Mawe, when rainfall during the 2010-2011 short rainy season was only 150 mm, crops failed to produce any grain yield. In general, improved varieties recorded 15-20% higher grain yield with micro-dosing using 20 kg/ha of N compared to no fertilizer application. The varieties Macia (in Hombolo) and Gadam (in Kampi ya Mawe) responded to fertilizer by producing more than a 40% increase in grain yield with micro-dosing.

The response to tied ridges varied from season to season. In the seasons with prolonged dry spells of one month or more, experienced mainly in Kampi ya Mawe, no benefit from tied ridging was observed. In seasons with relatively better rainfall (≥200 mm) tied ridging increased yield by about 10% over conventional tillage. Considering the strong interaction between the amount of rainfall during the crop season and response to management, environments are now being characterized with respect to the frequency and length of dry spell occurrences using historical weather data. This will help in making management recommendations that are more appropriate to local conditions. In addition, to make more efficient use of small doses of fertilizer applied (micro-dosing), a simple fertilizer applicator is being developed that will not only reduce the labor required but also facilitate more uniform application of fertilizer at a depth that is readily accessible to roots. A prototype has been produced and will be improved with field-testing.

Ethiopia: Three treatment factors (variety, fertilizer, and soil fertility management practice) were tested in 12 treatment combinations: three sorghum varieties/hybrids (Melkam, Teshale, and ESH-2);tie-ridge and without tie ridge; two levels of fertilizer [no fertilizer and 1/3 of the recommended dose (micro-dosing)]. The trial was also planted at three sites during the 2011 main season. The trial was established at all sites, but failed at Kobo due to terminal drought. At Meiso, tie-ridging and micro-dosing (using the variety Teshale) performed best, followed by normal tillage and micro-dosing with the hybrid ESH-2. In addition, long-term weather data for three locations was collected and the same is currently being analyzed to characterize the dry spells using the Instat climate analysis tool and the APSIM crop simulation model.

Eritrea and South Sudan: Lack of weather information in Eritrea (data not available) and South Sudan (data available, but not readily accessible) has hindered the attempts to characterize the seasons and the analysis of effects of micro-dosing and water management strategies in these two countries. Efforts are now under way to construct data for selected locations in the two countries.

Tanzania: Long-term weather records for two locations in Tanzania are available and will be used to characterize the dry spells.

Maharashtra: Trials on different sowing dates, fertilizer levels, drought management and shoot fly management practices for post-rainy season sorghum were conducted by project partners on-station (at MPKV and MAU) in the target region. The first fortnight of September in Rahuri and the first fortnight of October in Parbhani were judged to be ideal for sowing. Recommendations are available for the following management options:

- Seeds of improved varieties

- Seed treatments (IPM/IDM)
- Fertilizer application (Drilling) with seed (INM)
- Wider row spacing
- Soil moisture management
- Furrow cultivation
- Shoot fly control through IPM

Activity 2.7 - Farmer participatory multi-environment testing of newly developed sorghum varieties and hybrids with crop management options in target ecologies

Mali: Using farmer managed trials with 2-4 new varieties chosen by each village, where half of each plot is managed with an agreed package for intensification [mostly modest use of fertilizer (micro-dosing with 2g/hillof DAP) with increased plant stand densities] have resulted in yield increases of 131% on average. These trials will be repeated to increase the sampling of growing conditions, especially rainfall. In 2011, the rains stopped early, which hit some low-fertility plots hard as crop development was much delayed compared to the plots under intensive management.

Twenty-nine new varieties (16 from ICRISAT, 13 from IER) and a hybrid from IER were tested in 9 villages with 36 farmers for productivity, adaptation, farmer preferences, and processing traits. The sites covered a very wide range of growing conditions, and yields ranged from 2.5 t/ha to 0.6 t/ha. All trials were fertilized (100kg/ha of DAP and 50 kg/ha of urea. Farmers chose 9 of the new varieties and one hybrid for the second stage of testing, which will be done in fully farmer-managed trials using appropriate agronomic options.

Burkina Faso: In the Boucle de Mouhoun area (with UGCPA), 4 new varieties and a local variety selected by farmers were tested in 7 villages by 14 male farmers using improved practices (100kg/ha of 'complex NPK cotton'; 50 kg/ha of urea, and with organic fertilizer if available). The new varieties out-yielded the local check in five villages by 12-26%.

In the same areas, 4 new varieties, (not all the same as for the men) were tested by a total of 27 women, in 9 villages, with the same agronomic practices described above. Grain yields were generally low, due to late sowing and drought conditions. Yield superiority of the best variety was 12% on average.

In the North-Central region of Burkina Faso (with AMSP), male farmers tested 5 new varieties, and women farmers tested a total of 7 new varieties, all with the agronomic practices described above. Grain yields of the trials were highly variable, ranging from 3t/ha in one village to complete failure in others. Three varieties were identified for release from this lot.

Ethiopia: Participatory variety selection was carried out with sorghum to identify farmers' preferred selection criteria and to select the farmers' preferred variety for wider scaling up. The sorghum variety Misikir was selected around the Kobo area, Chiro in the Chiro area, and ICSR24004 (Dekeba) and WSV-387 (Melkam) in the Mieso area.

Eritrea: The preferred varieties were identified as Seare (ICSV 111 IN), Harriray, P9401, P9407, and Bushuka (ICSV 210), all of which were evaluated with farmers during field days.

Tanzania: The varieties identified and used for evaluating three fertility and crop management options were Macia, Tegemeo, Wahi and Hakika. The evaluation was conducted with 20 farmers in each country, and associated field days attracted 310 farmers in Ethiopia, 210 in Eritrea and 750 in Tanzania.

Maharashtra: A total of four on-farm trials (Parbhani, Ahmed Nagar, Pune, and Solapur districts) were conducted with four varieties: RSV 1150, RSV 1188, SPV 1795 and SPV 1905. Farmers gave grades based on grain luster, grain color, boldness, and fodder quality. RSV 1150 was preferred due to higher grain and fodder yields, coupled with good grain quality. In farmer participatory varietal selection at three clusters of MAU, 25 men and 25 women farmers graded SPV 1411 and Phule Vasudha as the best among available varieties. In MPKV, an experiment was conducted with eight treatments (using the variety Phule Vasudha, with or without seed treatment) to identify the best suitable agronomic practices during post-rainy season cultivation. Of the treatments tested, the higher dose of fertilizer seed treated with thaimethoxam produced higher yields of grain (2.7 t/ha) and fodder (6.4 t/ha).

Activity 2.8 - Enhancing research and leadership skills of sorghum scientists:

Mali: Research partners from IER and IPR participated in a training program on the use of the plant breeding data management software Agrobase. They also participated in a one-week training course on statistical analysis of multi-environment trials, followed by a week of work with the statistician using the partners' own data. One of the sorghum breeders from IER received intensive coaching from the ICRISAT sorghum breeding team for writing his PhD dissertation. Another sorghum breeder from IER started the field research for his DEA (MSc equivalent) degree. The IER partners are now primarily using Genstat for their data analysis, following the trainings offered by the project.

The sorghum breeding team at IER is now handling the bulk of the farmer participatory variety research, including: organizing the planning meetings; planning the experiments; preparing the seeds and field books; training farmers in trial management; monitoring the trials, analyzing the data, and presenting them to farmers; and conducting culinary evaluations.

Training farmers in how to produce certified seed, especially of hybrids, has been a major endeavor. Working together with IER scientists and technicians on designing a training manual and other training materials, and gaining experience with conducting relevant training, has led to IER scientists primarily conducting these training programs(in collaboration with Objective 6).

Malian students of agriculture (Ingenieurs degree, and advanced technician training) have conducted their thesis projects on HOPE-related topics, with guidance from the ICRISAT team at Samanko. Most of these students have found meaningful employment, and several are moving into advanced degree programs based on the skills gained.

The support staff members working for partner farmer organizations have also participated in statistics training programs, focusing on data entry, management, and some graphics. They are increasingly entering data collected in their areas, and documenting other monitoring activities as well. In addition they are preparing presentations and editing photos. They have been coached together with the national sorghum-breeding scientists in managing trials and seed production plots with farmers. In addition, they have learned the basics of bookkeeping and marketing, and are supporting their organizations in multiple ways.

One video film team, who are members of our Malian partner NGOs, was trained on all aspects of filming farmer-to-farmer videos of high quality, starting with script writing and including collecting appropriate footage and capturing farmers' voices, editing video and voice, as well as doing voice-overs in other languages.

Radio teams from four partnership zones were trained in the use of digital voice recording and editing, interview techniques, and collaboration with agricultural programs, together with farmer organization support staff. This has strengthened their collaboration with technical staff of farmer organizations and with innovative farmers.

Burkina Faso: Research partners from INERA participated in a training program on statistical analysis of multi-environment trials, focusing on their own data.

The sorghum breeding team from INERA is handling the farmer participatory variety development and evaluation research, from organizing the planning meetings, planning the experiments, preparing the seeds and field books, training farmers for trial management, monitoring the trials, analyzing the data, and presenting them to farmers, conducting culinary evaluations.

One student from Burkina Faso conducted his thesis research at ICRISAT's Samanko station during the past year; he is focusing on monitoring varietal change in selected villages and households of the project area. He is presently still working with us, assisting the sorghum-breeding team with Access databases, and learning to write scientific publications. His poster was chosen for presentation at the CORAF biannual Science Week, held in Ndjamena, Tchad.

The support staff members working for partner farmer organizations have participated in statistics training programs, focusing on data entry, management, and some graphics. Two radio station programmers, along with farmer organization support staff, were trained in the use of digital recording devices.

Ethiopia: Five researchers (two from EIAR, one from ARARI, one from ORARI, and one from Ethiopian Seed Enterprise) attended training on Seed Policies and International Regulations, organized by ICRISAT and Africa Harvest in Nairobi for five days in July 2011. The same week was used to train breeders and seed specialists on testing transgenics, stewardship, risk management, and communication. In 2012, local training was given to 46 technical assistants and newly recruited researchers concerning sorghum breeding methods and crossing techniques, field management, seed production, and data management. One HOPE scientist from AARI was sponsored by the project to attend a course on molecular marker applications in crop improvement, which was held in Nairobi from May 28 to June 6, 2012. Some 150 farmers were trained on improved sorghum production techniques and food product development and utilization.

Eritrea: Five researchers from Eritrea participated in a workshop conducted in Moshi, Tanzania, on breeding and seed production.

South Sudan: Four researchers from the Ministry of Agriculture in South Sudan attended the 5-day training mentioned above on Seed Policies and International Regulations. The same week was used to train breeders and seed specialists on testing transgenics, stewardship, risk management, and communication. In early July, two persons from South Sudan participated in a field workshop conducted in Moshi, Tanzania, on breeding and seed production.

Tanzania: Eight researchers from Department of Research and Training (DRD), the Tanzania Official Seed Certification Institute (TOSCI), and Tanzania Seed Trade Association (TASTA) attended the 5-day training course on Seed Policies and International Regulations held in Nairobi. The same week was used to train breeders and seed specialists on testing transgenics, stewardship, risk management and communication. In early July, 9 researchers

participated in the field workshop conducted in Moshi, Tanzania, on breeding and seed production.

A video on variety testing in the context of integrated striga management was developed in Iramba district, in collaboration with the Malian HOPE team.

Maharashtra: A total of 10 training programs and courses were given during the 2011/2012 period to researchers, KVK staff, department of agriculture staff, and field staff at partner research stations.

PROJECT OUTPUTS REALIZED UNDER OBJECTIVE 2 TO DATE

Table 2 presents the major project outputs realized under Objective 2 by the end of Year 3 of the project.

Table 2: ***Major Project Outputs Realized under Objective 2 as of June 30, 2012***

Activity 1: ***Identify new sources of resistance/tolerance to and options for control of key biotic constraints***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	2.1.3	Sources of midge resistance validated [March 2013]	Second year of multi-location trials is being sown	On-going and on-track	Field trial results, and report
	2.1.7	Epidemiology of sorghum midge better understood [March 2013]	Second year of observation is planned for the harvesting period 2012, in Niger	On-going and on-track	Fellowship report, and lab observation reports
ESA	2.1.4	Two new sources of sorghum striga resistance identified and existing sources validated [May 2013]	The two sources of striga resistance identified based on assessment of the number of striga plants emerged over time	On-going and on-track	Project reports from the collaborating partners
	2.1.8	Sources of midge resistance validated [May 2013]	Based on trial results from Alupe and Ukiriguru, the best lines combining midge resistance, disease resistance and high yield were IS 8891, MR # 22x IS 8613/1/1/2/1-1, IS 8884, IS 8887 and IS 21185	On-going and on-track	Project reports from the collaborating partners
SA	2.1.5	Sources of aphid resistance (6) identified [March 2013]	Six B-lines and eight R-lines resistant to aphids for use in sorghum improvement have been identified and shared with NARS	Achieved	Research paper
	2.1.10	Sources of shoot fly resistance identified (10-12 lines) and mechanisms of resistance delineated [March 2013]	Seventeen sources of resistance to shoot fly for use in sorghum improvement were identified and shared with NARS. A set of 30 genotypes has been characterized for resistance mechanisms and genetic diversity	Achieved	Conference paper; PhD thesis planned
Activity 2: ***Identify options for sorghum intensification in target ecologies***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	2.2.3	Response of new photoperiod sensitive sorghum hybrids to a wide a range of production conditions, including women's fields (low to high input) understood [May 2013]	Farmer managed tests attract a lot of attention from other villagers and development agents. Yield superiorities, especially with hybrids are stunning. On station trials conducted under high and low P conditions at Samanko, and 2 IER stations are exploring in more detail variety by management interactions, second year of testing under way.	On-going and On-track	Database in Access available, and queries can be made; shall be made publically available
	2.2.6	Productivity and stover quality of new dwarf plant type varieties characterized and discussed with farmers [April 2013]	Stover quality of the new hybrids has been analyzed. Farmers are exploring the options for using stover of those varieties and hybrids which have significantly higher stover quality for animal nutrition.	On-going and On-track	Report, and feedback from farmer evaluations.
ESA	2.2.3	A set of 10 cultivars diverse for growth and flowering, evaluated in a range of latitudes to	Ten cultivars were evaluated in a range of latitudes for flowering and other traits. The early flowering varieties	Achieved	Partners' project report

		determine response to photoperiod to provide knowledge for development of improved and adaptable photosensitive varieties [May 2012]	Sima and Macia re being used in the crossing programs with local materials to introduce earliness.		
	2.2.7	10 varieties identified and tested for their performance under low soil fertility and moisture stress conditions in Ethiopia, Eritrea and Tanzania [May 2013]	Based on the evaluation of 36-50 sorghum lines under different levels of land degradation at selected sites, each of the three countries has identified 10 varieties that will be tested under low soil fertility condition	On-going and On-track	Partners' project report
SA	2.2.4	Possible mechanisms of tolerance to low temperature on crop growth and economic yields documented [May 2012]	Mechanisms of tolerance to low temperature on crop growth and economic yields have been documents, and the report is in final stage of preparation	Achieved	Report (under preparation)
	2.2.7	Role of temperature on seed setting (to help in avoiding areas with low temperatures and select locations for crop production and seed multiplication) documented [April 2013]	The role of temperature on seed setting has been documented	Achieved	Agrobase records
Activity 3: ***Identify new and characterize already available hybrid parents for the targeted agro ecologies***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
ESA	2.3.3	Morpho-agronomic data, disease and pest reactions of the commonly used and available hybrid parents analysed/ synthesized and documented for future use by national DUS test guidelines descriptors [Dec 2012]	A PhD student has evaluated 121 (85Rs, 36A/B pairs) hybrid parents for morpho-agronomic traits, disease and pest reactions. The data has been analysed and will be used detailed description of the parental for form a descriptor for DUS testing.	On-going and On-track	Students draft thesis
	2.3.9	A post graduate student advised and genetic diversity of the 15 inbred lines determined using morphological and molecular markers [May 2013]	A PhD student is being advised and supervised as he works on this project activity. He used 121 inbred lines for morphological genetic diversity studies and is currently working on molecular characterization of these lines.	On-going and On-track	Draft thesis
SA	2.3.5	New maintainers (25) under conversion in BC4 stage identified [March 2013]	138 promising new maintainers are now in BC_3 stage.	On-going and On-track	Agrobase records
	2.3.9	New A-/B-lines (6) developed for agronomic traits, grain traits, seed setting and charcoal rot tolerance and shoot fly resistance for further utilization in hybrid programs in target agro eco regions [March 2012]	Six promising B-lines were selected based on agronomic traits, grain traits, seed setting and charcoal rot tolerance and shoot fly resistance for further utilization in hybrid programs, and are available for use by partners	Achieved	Agrobase records
	2.3.13	Promising new R-lines (20) identified for agronomic traits, grain traits, seed setting and charcoal rot tolerance and shoot fly resistance under receding soil moisture conditions identified for further utilization in hybrid programs [March 2012]	Forty one promising R- lines were identified for agronomic traits, grain traits; seed setting and charcoal rot tolerance and shoot fly resistance under receding soil moisture conditions for further utilization in hybrid programs. The genetic diversity in postrainy material was increased by	Achieved	Agrobase records

			crossing with diverse durra accessions from East and West Africa.		
Activity 4: ***Develop hybrids with improved yielding ability and adaptation traits for specific target regions***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	2.4.3	Three hybrids identified for large scale dissemination with private sector in Mali [May 2011]	During the past two years the private sector has been disseminating 5 new sorghum hybrids (Fadda, Sewa, Pablo, Caufa, and Niakafa) successfully, and has been expanding the sales volumes tremendously.	Achieved	Seed production, and sales records kept
	2.4.10	Six new hybrids produced for large-scale evaluation in Sudanian zone in Mali and Burkina Faso [Dec 2011]	15 new hybrids have been evaluated thoroughly, with on average 35% yield advantage in Mali. Trials in Burkina Faso are on-going	Achieved	Publication under preparation, presentations
	2.4.12	Hybrid seed production techniques developed for specific parental combinations and growing conditions in Mali [April 2012]	Seed production techniques have been developed for all 5 preferred hybrids; farmers have been trained to use them, and success rate of seed production, and certification is very high	Achieved	Records available
ESA	2.4.4	12 experimental hybrids for the Dry Lowland (DL) and Sub Humid (SH) agro-ecologies identified in Tanzania and Ethiopia [May 2013]	Ethiopian partners identified 10 hybrids for the Dry lowlands and Tanzania identified 15 experimental hybrids for the dry Lowlands (8) and Sub- Humid (7) agro ecologies	Achieved	Project reports and a publication on GxE for sorghum hybrids under preparation
	2.4.7	Hybrid seed production feasibility tested for specific parental combinations and growing conditions in Ethiopia and Tanzania [May 2012]	A hybrid seed production field was grown successfully for three hybrids that have a common R –line (Macia). Another set using KARI Mtama 1 is progressing in Tanzania. Ethiopia is initiating the activity this season starting July 2012	Delayed but on going	Partners Project report
SA	2.4.5	Eight promising new hybrids developed for on-farm trials in the target areas [March 2013]	Eight hybrids were developed and assessed for their yield potential during postrainy season 2011 across four locations and we found six promising hybrids across the locations.	Achieved	Manuscript is in final stage of preparation
	2.4.10	Two hybrids multiplied for large scale testing in target areas [March 2013]	Seed production undertaken and seeds are ready for large scale multiplication. At ICRISAT six promising hybrids, at MPKV five promising hybrids and at MAU three promising hybrids were multiplied for large scale testing.	Achieved	Seed production, and dissemination records kept at every station
	2.4.14	Hybrid seed production technology standardized for the selected hybrids [Aug 2012]	Hybrid seed production technology was standardized and we identified new locations for postrainy season seed production.	Achieved	Flyer on hybrid seed production under preparation for use by seed companies and seed producers
Activity 5: ***Develop open-pollinated varieties with improved yielding ability, and resistance to the predominant biotic and abiotic stresses in target ecologies***					

Region	Output #	Targeted Outputs & Delivery Date	Realized Outputs as of June 30, 2013	Status	Means of Verification
WCA	2.5.6	15-30 varieties created for multi-location testing across the S. Sudanian [April 2011] and N. Sudanian [Apr 2013] zones, including some with high Fe and Zn content	30 new varieties were created and entered into initial on-farm evaluation in 2011 rainy season for the southern Soudanian zone. A wide range of material is under selection in Burkina Faso and in Mali in the Northern Sudanian zone, as reported above.	Achieved	Database of results
	2.5.9	Second cycle of recurrent selection in Guinea race dwarf population for S. Sudanian zone completed in WCA [May 2013]	Bulks for second random-mating by open-pollination will be sown in July 2012, to complete the second random mating of this population.	On-going and on track	Field records and availability of seed
ESA	2.5.4	Segregating breeding populations for the dry lowlands and the sub-humid ecologies created [May 2012]	In each country 4 Elite Prents were crossed with sources of resistance to midge and Striga to generate new segregating materials for various maturity groups.	Achieved	Project reports
	2.5.8	Stay-green QTL introgressed materials field tested in the dry lowlands in Ethiopia [May 2012]	A Msc student registered at Alemaya University has evaluated 20 Stay Green QTL introgressed lines at Kobo in Sirinka under drought stress (DS) and irrigated conditions.	Achieved	MSc thesis and draft publication under preparation
	2.5.11	5 varieties identified for participatory evaluation of variety by management options for the sub-humid areas of Tanzania [March 2012]	Starting with 47 lines in Yr 2 the following 6 varieties IESV 94105 SH, IS 21185, IESV 94114 SH, IS 8891, IS 8887 and IS 94103 SH) with stable midge resistance and good grain yield across two seasons were identified for participatory evaluations with management options.	Achieved	Partners' project progress reports
	2.5.14	5 varieties identified for participatory evaluation of variety by management options for the dry lowlands areas of Tanzania, Ethiopia and Eritrea [May 2013]	Progressive screening of 80-100 lines and further evaluation of 25 varieties in multi-locational trials resulted in the identification of five varieties each for Tanzania, Ethiopia and Eritrea for participatory variety evaluations with crop management options for the dry lowlands.	On-going and on track	Partners' project progress report
	2.5.19	30 lines identified for detailed evaluation and/or purification for higher rainfall areas of Southern Sudan [Dec 2012]	From 310 germplasm and breeding lines 81 lines were selected based on grain yield, disease reaction and other field observations. They were tested at two sites (Rejaf and Torit) in the July 2011 season. The best lines combining midge resistance, disease resistance and high yield were IS 8891, MR # 22x IS 8613/1/1/2/1-1, IS 8884, IS 8887 and IS 21185 have also been incorporated into the sub-humid sorghum trial sent to southern Sudan in May 2012.	On-going and on track	Partners' project progress report
SA	2.5.6	Fifty F5 progenies obtained for agronomic and grain traits, shoot fly resistance, tolerance to charcoal rot and terminal drought [March 2013]	218 F_4s were advanced based on panicle size, grain luster, grain color, agronomic score and seed size. The selected progenies will be evaluated for postrainy season adaptation	On-going and on track	Agrobase records

			and productivity.		
	2.5.10	Third random mated ms7/3 post rainy season population developed for initiating recurrent selection [March 2013]	23 sterile plants and 10 fertile plants from B- population bulk were selected to make the next generation B-population bulk. 14 sterile plants and 12 fertile plants from R- population bulk along with 16 F_2 R-population cross bulks were selected to make R- population bulk based on agronomic desirability.	On-going and on track	Breeding records
	2.5.14	Eight lines with good grain appearance, superior grain and stover yield, terminal drought and charcoal rot tolerance and shoot fly resistance identified [March 2013]	Ten varieties were developed for good grain appearance, improved grain yield, stover yield, charcoal rot tolerance and shoot fly resistance.	Achieved	Agrobase records
Activity 6: ***Develop crop management options for key productions constraints in target sorghum production ecologies***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	2.6.5	Integrated practices for Striga and soil fertility management tested with farmers in the Sudanian zone in Mali [March 2013]	Two years of testing integrated components for sorghum production systems in the Sudanian zone has led to the identification of useful combination practices (tolerant variety, intercropping with forage cowpea, placement of organic manure, and possibly DAP) for large scale dissemination. 10 Farmer to farmer videos were produced for large scale dissemination of these experiences	Achieved	Reports, publications under preparation
	2.6.10	Options for sustainably improving sorghum productivity with a focus on women's fields assessed in Mali [May 2013]	Intensified intercropping options, adapted from experiences in Nigeria are generating very striking results in terms of yield superiority. Confirmation under more diverse rainfall conditions is required.	On-going and on track	Database
ESA	2.6.5	Recommendations of integrated soil fertility and water management practices developed and validated in Eritrea, Ethiopia ,Southern Sudan and Tanzania [May 2013]	Integrated soil fertility (microdosing for the three countries) and water management (tied ridges for Ethiopia and Tanzania and *fanya juu* for Eritrea) have demonstrated interactive effects of moisture and fertility, with approx. 45% yield advantage for the improved varieties.	On-going and on track	Draft publications and partners' project progress reports
	2.6.10	Integrated Striga and weed management options developed, tested and documented for / in Eritrea and Tanzania [May 2013]	On-farm trials were conducted in Iramba and Singida districts in Tanzania to assess performance of improved varieties for their tolerance to Striga under different management practices. The improved varieties tested include Macia, Hakika and Wahi along with a local check. In all the fields the Striga incidence was found to be very	On-going and on track	Partners' Project progress

			low this year and Striga appeared late in the season. In general, the three improved varieties out -performed the local variety by 50-80% Hakika performed better compared to Macia and Wahi.		
SA	2.6.3	Integrated shoot fly management options fine-tuned for various production areas [April 2012]	Seed treatment with thaimethoxam or seed treatment + deltamethrin sprays were more effective for shoot fly control on Akola Kranti, Phule Vasudha and M 35-1 than on Parbhani Moti. and information shared with NARS	Achieved	Flyer under preparation
	2.6.6	Cultural practices to manage terminal drought identified [March 2011]	Cultural practices to manage terminal drought were identified and ready for dissemination	Achieved	Flyer under preparation
	2.6.9	Crop production practices (fertilizer requirements, spacing and time of sowing) for enhanced productivity validated [March 2013]	Crop production practices (fertilizer requirements, spacing and time of sowing) for enhanced productivity validated across the Maharashtra	Achieved	Flyer under preparation, along with above
Activity 7: ***Farmer participatory multi-environment testing of newly developed sorghum varieties and hybrids with crop management options in target ecologies***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	2.7.7	Three varieties identified for detailed farmer evaluation in each target area [Apr 2010, 2011, 2012, 2013]	A total of 28 improved varieties are presently being evaluated by different farmer groups in different adaptation zones. In 2012 10 new varieties were added to the tests.	On-going and on track	Database available
	2.7.21	Three varieties characterized for their adaptation to specific growing conditions, GxE interactions and marketing potential in eight partnership areas, and at least one sorghum variety identified for delivery in each target areas [May 2012]	Over the past 2 years a total of 20 varieties, including 5 hybrids) have been evaluated in farmer managed trials with and without agronomic components. The results have been used to publish 'Fiches Techniques' for these varieties, in close interaction with IER.	On-going	Database available
	2.7.25	Lessons learned and best practices for effective large-scale farmer participatory trial management for integrating variety and crop management options published [May 2012]	A folder with sturdy 'practical Guides' for farmer managed trial implementation has been published and distributed widely	Achieved	The Practical Guides are available on the HOPE online document repository
ESA	2.7.5	Four varieties evaluated with 3 fertility and crop management options in the dry lowlands of Eritrea, Tanzania, Ethiopia [May 2013]	Each country identified 4-5 varieties e.g. Tanzania identified Macia, Tegemeo, Wahi and Hakika; Eritrea had Seare (ICSV 111 IN), Harriray, P9401, P9407, Bushuka (ICSV 210) and Ethiopia Misikir , Chiro ,ICSR24004 (Dekeba) and WSV-387 (Melkam) and four fertility options (microdosing) , and normal tillage vs. tied ridges	On-going and on track	Project progress
	2.7.8	Three varieties evaluated with 3 fertility and crop management options in the sub-humid areas of Tanzania and 1 variety recommended for release and 20kgs of seed produced for further seed increase	Based on three years of evaluation in Ukiriguru and on farm at Bunda the varieties IESV93041SH, IS8193 and Wagita are proposed for release There is more than 20kgs of seed for each variety available	Achieved	Variety release proposal

		[May 2013]			
SA	2.7.5	Most promising cultivars (two varieties) identified with the help of farmers for cultivation by farmers [March 2013]	In three clusters monitored by MAU, 25 men and 25 women farmers graded SPV 1411 and Phule Vasudha as the best among available varieties. AT 4 MPKV managed locations 26 men and 11 women farmers graded the genotypes and they selected RSV 1188 and RSV 1150 as the best.	Achieved	Partners' Hope reports 2011
	2.7.8	Best bet practices for enhanced productivity identified with the help of farmers in target areas [March 2012]	Best bet practices for enhanced productivity were identified in target areas, as early deep plowing, and wider row spacing.	Achieved	Partners' Hope reports 2011
	2.7.11	Selected women and men farmers knowledge in assessing the cultivars and management practices enhanced [May 2013]	Training to farmers and staff's conducted under various crop production aspects.	Achieved	Partners' Hope reports 2011
Activity 8: ***Enhancing research and leadership skills of sorghum scientists***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	2.8.3	Graduate students advised in sorghum breeding, genetic and natural resource management research, including integrated Striga management [May 2013]	A long list of students has been trained, see "Big Picture Summary of Results"	On-going and on track	Lists of students available
	2.8.8	NARS partners trained in statistical analysis and recurrent selection for population improvement and variety development [Feb 2013]	Courses on statistical analysis have been held every year using Genstat. Now many NARS partner scientists are well familiar with it, and use it regularly.	On-going and on track	Partner reports, and participant lists
ESA	2.8.4	Post graduate students identified, TOR for consultants to provide training on MET and GXE agreed on and case study data sets compiled [March 2011]	Case study data sets identified and analysis on GxE were done; 2 post graduate students (PhD from Tanzania and Msc from Ethiopia) were identified and 2 resource persons were identified from ICRISAT India	Achieved	Draft manuscript on GGE
	2.8.7	Capacity of breeders for product development and deployment of African Biofortified Sorghum enhanced in ESA [March 2012]	Training course held in July 2011 and attended by 21 participants (17 men and 4 women)	Achieved	List of course participants and training materials
	2.8.10	15 NARS, and interested private sector breeders and technicians trained in all steps of sorghum hybrid parent and product development, seed production and marketing [Dec 2011]	Training on steps of sorghum hybrid parent and product development, seed production and marketing was held at ICRISAT India, attended by 10 NARS staff. Those trained have since organized a similar course in their countries for a total of 36 participants (mainly technicians)	Achieved	List of training participant and training materials
	2.8.13	12 NARS and extension staff who are project partners trained in implementation of large-scale farmer managed trials and facilitation of Farmer Learning Centers in target areas (linked to objective	The training course was completed and 20 participants (including 5 women) were trained in July 2011 and the trained staff have organized in country courses on the	Achieved	List of training participant and training materials

		6) [May 2012]	same		
	2.8.16	12 NARS and partner breeders in Eritrea, Ethiopia, Tanzania and Southern Sudan trained in conducting Multi Environment Trials and data analyses and manuscript developed [Dec 2012]	25 NARS breeders (5 of whom were women) attended a training on GXE and MET in Nairobi Kenya in June 2010. The trained staff have organised their data , analysed and a manuscript prepared and under review	Achieved	Draft Manuscript of GGE
	2.8.19	Two post graduate trainings-one on sorghum improvement and another in integrating crop varieties /management and crop modeling techniques advised and draft thesis available [May 2013]	One PhD student (Justin Ringo) working on hybrid parent characterisation, development and evaluation of hybrids Another student (Aemiro Bezabih) working on evaluation of stay green QTLs introression sorghum lines for post flowering drought at Kobo, North Eastern Ethiopia.	On-going and on track	Theses
SA	2.8.3	Training materials developed and master trainers trained on improved crop cultivars, agronomic practices and integrated pest management and drought management [Aug 2011]	Training materials (4) were developed and master trainers trained on improved crop cultivars, agronomic practices and integrated pest management and drought management across the target locations	Achieved	Flyers developed on: *-Post-rainy season* sorghum seed production technology and storage
	2.8.8	Training material developed in local language and researchers, field staff and farmers trained on seed production aspects and village seed systems and visual documentation of seed production aspects [April 2013]	Training material (4) were developed in the local language, *marathi* and training programs were conducted on various aspects of seed production, village seed systems and visual documentation of seed production aspects for researchers, field staff and farmers	Achieved	Flyers and leaflets As above in local language (Marathi)

OBJECTIVE 3: IMPROVE PEARL MILLET CULTIVARS AND MANAGEMENT OPTIONS TO INCREASE PRODUCTIVITY IN ESA

ACTIVITIES CARRIED OUT IN THE PERIOD JULY 2011 – JUNE 2012

Activity 3.1 - Identify new sources of resistance to key biotic constraints, validate these resistance sources, determine resistance inheritance and where necessary identify markers as a selection aid

Mali: From 200 Set #1 FS progenies of the current cycle of the ICRISAT Striga-Resistance Genepool, which were evaluated in a heavily infested farmer's field near the IER-Cinzana Research Station during the 2011 rainy season, 10 superior FS progenies were identified that combine low striga emergence and low downy mildew incidence with high grain yield performance. These were recombined to produce an experimental OPV, as well as FS progenies to be evaluated during the 2012 rainy season

Niger: A replacement pearl millet mapping population targeting host-plant resistance to *Striga hermonthica* was advanced two generations, and sets of multi-locational trials prepared and distributed for evaluation of >200 F_3 progenies under striga-infested conditions during the 2012 rainy season.

From 200 Set #1 FS progenies of the current cycle of the ICRISAT Striga-Resistance Genepool evaluated in an artificially infested field at ISC during the 2011 rainy season, 19 superior FS progenies combining low striga emergence and low downy mildew incidence with high grain yield performance were identified and recombined to produce an experimental OPV.

From 200 Set #2 FS progenies of the current cycle of the ICRISAT Striga-Resistance Genepool evaluated in a second artificially infested field at ISC during the 2011 rainy season, 19 superior FS progenies combining low striga emergence and low downy mildew incidence with high grain yield performance were identified for generation of an experimental OPV and for recombination to generate FS progenies for testing during the 2012 rainy season.

Across Mali and Niger: Following evaluation of 200 Set #1 FS progenies of the current cycle of the ICRISAT Striga-Resistance Genepool across both sites, 28 FS were recombined to produce FS progenies for evaluation during the 2012 rainy season.

SA (Rajasthan, Gujarat and Haryana): A total of 84 lines that are parents of various mapping populations available at ICRISAT, Patancheru, were screened against three newly identified virulent downy mildew pathotypes – Sg445 (Gujarat), Sg526 (Rajasthan), and Sg519 (Haryana). The F_6 RIL mapping population of the cross ICMB 841-P3 × 863B-P2 comprising 106 plants was used to map the QTLs for resistance against these virulent downy mildew isolates. A total of 21 SSRs were used to genotype the RIL mapping population. Data about 16 of these markers were combined with the earlier available genotypic data comprising 305 markers for linkage map construction. An augmented linkage map was generated, consisting of 287 markers on the expected seven linkage groups (LGs) with a total map length of 1750.1 cM (Haldane units). Major QTLs were detected on LG1 for Sg445 (R^2= 53.8%, LOD=19.63), LG6A for Sg526 (R^2=44.1%, LOD=8.21) and LG6B for Sg519 (R^2= 34.0%, LOD=9.91) with DM resistance from the 863B allele. The linked flanking markers IPES0017 and P12900 (LG1), P6383 and P10371 (LG6A), PSMP2213 and P7507 (LG6B) can be employed, respectively, for introgression of resistance to Sg445 (Gujarat), Sg526 (Rajasthan), and Sg512 (Haryana) downy mildew isolates in pearl millet. Pathogenic variation was studied among 25 *M. grisea* (blast disease) isolates collected from four major

pearl millet growing states in India – Rajasthan, Haryana, Maharashtra, and Uttar Pradesh – on ten pearl millet genotypes grown in the greenhouse. The 25 isolates were grouped into five different pathotypes based on their reaction types, viz., Pg118, Pg119, Pg56, Pg53, and Pg45. For the identification of resistance sources, a pearl millet mini-core comprising 238 accessions was evaluated under greenhouse conditions against five isolates representing the five pathotypes. Of 238 accessions, 32 were found resistant to at least one pathotype. Resistance to multiple pathotypes (2 or more) was recorded for several accessions, while three accessions – IP 7846, IP 11036, and IP 21187 – exhibited resistance to four of the five pathotypes. These resistance sources to multiple pathotypes could be used for developing blast-resistant pearl millet hybrids in India. Isolates Pg118, Pg119, Pg56, Pg53, and Pg45, which represent the five pathotypes, have been selected for greenhouse screening of pearl millet breeding lines for blast resistance.

Activity 3.2 - Identify integrated control options for pearl millet insect pests:

Niger: Field trials conducted during the 2010-11 crop year were analyzed and repeated in 2011-12, but results obtained were inconclusive.

***Activity 3.3 - Identify options for pearl millet intensification in target ecologies for effective implementation of IGNRM*:**

Niger: On-farm trials in Niger showed that mineral fertilizer micro-dosing, combined with spot application of organic manure (farmers preferred 100 to 200 g per pocket, varying across sites), was more beneficial to the plants than organic manure alone; micro-dosing of DAP at sowing, plus urea at the stem elongation stage, produced better yields than both rates of NPK (15-15-15) tested; improved pearl millet varieties ICMV-IS 89305 and Mil de Siaka were selected by farmers across sites, while SOSAT-C88 was selected at sites where millet head miner incidence did not reach seriously damaging levels during 2011. In the farmer field schools in western Niger, the effects of micro-dosing mineral fertilizer (DAP), organic fertilizer (manure), and the combination of mineral and organic fertilizer were evaluated for agronomic and economic feasibility in a participatory manner in four clusters. The highest agronomic performance (grain yield) was consistently obtained with the combination of DAP and manure, but the best economic performance (net benefits, and especially the return to investment) was highest for DAP micro-dosing only. It was concluded by farmers that if one has to pay for manure, it is too expensive as an investment and that if one chooses to micro-dose manure, it is best to combine it with DAP fertilizer. All trials will be repeated in 2012 and a treatment without any fertilizer added to the treatments as a control and to enable the calculation of marginal benefits of using fertilizer at all.

Niger on-station results: Initial evaluation of the response of pearl millet varieties ICMV-IS 89305 and Sadoré Local to micronutrient fertilization in 4-rep factorial trials conducted on-station at ISC during the 2011 rainy season demonstrated statistically significant and practically important favorable grain yield responses of both varieties to the application of ZnSO4 at rates of 2.5 and 5.0 kg/ha, with or without the basal application of NPK macronutrient fertilizer. This trial will be repeated during the 2012 rainy season, following which the best-bet treatments will be identified for on-farm validation.

Burkina Faso: Pearl millet varieties (improved OPVs or introduced landrace accessions from other regions) identified by farm union partners for more widespread on-farm assessment (and mini-packet seed dissemination) during the 2012 rainy season included SOSAT-C88, IKMP 5 and IKMV 8201 for FEPAD-Nayala; PE00576, PE06001, Toronio (from Mali) and IKMP 1 for UGCPA; and SOSAT-C88 and PE00576for AMSP-Kaya. It is

proposed that some of these materials be identified for addition to the national catalog of recommended pearl millet varieties following the 2012 rainy season. In addition, AMSP-Kaya partners recommended the use of the systemic fungicide seed dressing, ApronStar, for control of pearl millet downy mildew (a 10 g sachet costs FCFA 1000, or about US$2, and is enough to treat 5 kg of seed).

Rajasthan: A micronutrient fertilization response trial was conducted with three locally adapted hybrids (RHB 121, RHB 173 and RHB 177) at Durgapura during the 2011 rainy season. The results indicated that application of ZnSO4 at a basal dose rate of 10 kg/ha' combined with one foliar spray of ZnSO4 (0.5%) 30 days after sowing was found to be better than the basal application of ZnSO4 alone.

Gujarat: A micronutrient fertilization response trial was conducted with three locally adapted hybrids (GHB 538, GHB 732 and GHB 744) at Jamnagar during the 2011 rainy season. The results indicated that a basal application of ZnSO4 at a rate of 20 kg/ha is better in terms of grain yield than a combination of basal and foliar applications.

Haryana: A micronutrient fertilization response trial was conducted with three locally adapted hybrids (HHB 94, HHB 197 and HHB 223) at Hisar during the 2011 rainy season. Analysis of data for two years (2010 and 2011) indicated that the basal application of ZnSO4 at 20 kg/ha is comparatively better than combining basal and foliar applications.

Activity 3.4 - Strengthen national program capabilities for screening for resistance to key biotic constraints

WCA: One representative each from IER-Cinzana (Mali), INRAN-Maradi (Niger), LCRI-Maiduguri (Nigeria), and INERA-Gampela (Burkina Faso), along with a female PhD student from Ahmadu Bello University (Zaria, Nigeria), received training (a 3-day practical course conducted in September 2011) in the use of the newly established facilities at ISC-Sadoré for greenhouse screening pot-grown seedlings of pearl millet against downy mildew.

Following the training course, a set of 100 pearl millet improved varieties and landrace accessions from INRAN (Niger) was then screened against the ISC-Sadoré isolate of pearl millet downy mildew using this facility, and the data were provided to INRAN-Maradi pathologist Issa Karimou.

SA: Pathologists from Rajasthan, Gujarat and Haryana were trained in field screening for downy mildew in pearl millet. Training was held on 8 October 2011, at ICRISAT-Patancheru. ICRISAT pathologists also helped partner scientists to identify sick plots in their state institutes for establishing downy mildew disease nurseries for screening pearl millet lines, using the field screening technique standardized at ICRISAT. The efficacy of the field-screening protocol for selection of downy mildew-resistant pearl millet breeding lines developed by partner universities will be monitored during the 2012 rainy season.

Activity 3.5 - Identify and/or develop pearl millet breeding lines and hybrid parents for target ecologies

SA: A breeding line nursery constituting 200 lines was tested at four locations in Rajasthan and at two locations each in Gujarat and Haryana during the 2011 rainy season, from which 24, 18, and 10 breeding lines were found promising for agronomic performance in Rajasthan, Gujarat, and Haryana, respectively. Also, a nursery of 64 potential hybrid parents was tested at three locations in Rajasthan, two locations in Gujarat, and three locations in Haryana, from which 10, 20, and 9 promising hybrid parents were selected in Rajasthan, Gujarat and Haryana, respectively. In addition, 46 breeding lines in the Early B-Line Trial (EBLT) and 40

lines in the Early R-line Trial (ERLT) were evaluated in all three states, from which 17, 11, and 5 B-lines and 10, 10, and 8 R-lines were selected by Rajasthan, Gujarat and Haryana, respectively. Selections were made from ICRISAT-supplied segregating breeding materials and arid-type pollinator composites to derive promising restorer lines in all three states. Seed of about 200 breeding lines and 75 potential hybrid parents was produced at Patancheru, ICRISAT, during the 2012summer season (February to May).

Single QTL introgression into the backgroundsofJ2340 and H 77/833-2-202 (=ICMR 01004*)* was completed at ICRISAT, Patancheru. Five introgression lines having the J2340background and nine having the ICMR 01004background were found promising on the basis of first year testcross performance in MLT. Seed production of 48 testcross hybrids for J2340, and 40 testcross hybrids for ICMR 01004background hybrids was done during summer of 2012, and they will be evaluated during the 2012 rainy season. Single QTL introgression lines in BC_3F_4 generations carrying three different sources of DM resistance QTLs (P310-17, P7-3, and 863B-P2-P7) were inter-mated to generate F_1s carrying double QTL heterozygotes, which were planted in the field during the summer of 2012, and these double QTL heterozygotes will again be sown in the field during the 2012rainy season.

Activity 3.6 - Develop pearl millet hybrids with improved yielding ability and the necessary adaptation and market-required traits for specific target regions

SA: A trial comprising 218 testcross hybrids was evaluated at three locations in Rajasthan, and at two locations each in Gujarat and Haryana during the 2011 rainy season, from which 25 entries were selected and promoted to advanced trial evaluation in 2012. The hybrids found promising in 2010 were tested in an advanced trial comprising 68 entries evaluated at four locations in Rajasthan, three in Gujarat, and four in Haryana, from which 29, 16, and 27 promising entries were selected by Rajasthan, Gujarat and Haryana states, respectively. The selections were promoted to testing in advanced trials in 2012. In Rajasthan, the checks (HHB-67-2, ICMH-356, GHB-538 and RHB 121) produced yield levels of 1,200-2,000 kg/ha, while the selected entries produced grain yield levels of about 2,500-3,000 kg/ha. In Gujarat, the check GHB 538 had a grain yield of 1,795 kg/ha, while the selected entries produced grain yield levels in the range of 2,610-2,890 kg/ha. In Haryana, the check HHB-67-Improved had a grain yield of 1,400-1,600 kg/ha, while the selected entries showed grain yields in the range of 2,000-2,250 kg/ha. Rajasthan, Gujarat, and Haryana contributed one, one and three hybrids respectively for testing during the 2012 rainy season national trials in northwestern India (early maturity group). Further, the seed of 225 testcrosses and 70 hybrids was multiplied in the summer of 2012 for testing in the 2012 rainy season (July to September) at ICRISAT, Patancheru.

Activity 3.7 - Create diversified populations, perform recurrent population improvement for priority traits, and generate new pearl millet OPVs adapted to specific target environments:

Mali: Ten full-sib (FS) progenies (selected from 200 FS of the ICRISAT Striga-Resistance Genepool were evaluated in a striga-infested farmer's field near the IER-Cinzana Research Station) and 13 C_0 FS progenies from the newly formed Burkina Yellow-grained Diversified Population were selected for recombination based on their performance in Mali during the 2011 rainy season. Experimental varieties and FS progenies for evaluation during the 2012 rainy season were produced at ISC-Sadoré by recombining the FS progenies selected from within each base population during the 2011/12 off-season. Reasonable progress was thus achieved towards the 2013 major output for Mali.

Niger: FS progenies of eight populations were evaluated at ISC-Sadoré and FS progenies of an additional two populations were evaluated at INRAN-Tara during the 2011 rainy season. Head bug damage to early-flowering populations at Sadoré prevented effective evaluation of yield performance, so selection of progenies for advance was based on visual selection. Experimental varieties and FS progenies for evaluation during the 2012 rainy season were produced at ISC-Sadoré by recombining the selected progenies from each base population during the 2011/12 off-season. Thus, reasonable progress towards the 2013 major output for Niger was also achieved.

Burkina Faso: Based on evaluations during the 2011 rainy season of 71 C_0 FS progenies of the newly formed Bristled Population, which were done at ISC-Sadoré (Niger) and INERA-Gampela (Burkina Faso), 15 early maturing and 6 medium- to late-maturing FS progenies were recombined at ISC-Sadoré to produce an early maturing and a later-maturing experimental variety, and 94 C_1 FS progenies were generated for evaluation during the 2012 rainy season. Based on 2011 rainy season evaluations of nearly 300 FS progenies of the newly formed Burkina Yellow-grained Diversified Population, 26 early, 2 × 13 medium-, and 18 late-maturing C_0 FS progenies were selected for recombination to produce four experimental OPVs (one E, two M and one L) and 415+110+149 = 684 FS progenies of three C_1 populations (E-M, M and L) for assessment during the 2012 rainy season. Based on evaluations during the 2011 rainy season 202 C_1 FS progenies of the SOSAT × Burkina Ecotypes-based population, 7 C_1 FS progenies were selected for recombination to generate 64 C_2 FS progenies at ISC-Sadoré during the 2011/12 off-season. Finally, 327 C_2 FS progenies generated from crosses of released varieties ICMV-IS 92222 and Kapelga were evaluated during the 2011 rainy season at INERA-Gampela. Based on this, 15 C_2 FS progenies were selected for recombination to produce an experimental variety. Experimental varieties and the full-sib progenies for evaluation during the 2012 rainy season were produced at ISC-Sadoré by recombining the selected progenies from each base population during the 2011/12 off-season. Thus, reasonable progress was also made towards the 2013 major output for Burkina Faso.

Nigeria: Based on evaluations during the 2011 rainy season of 126 FS C_0 progenies of the Dual-Purpose Population at ISC-Sadoré (Niger) and LCRI-Maiduguri (Nigeria), 24 selected FS progenies were recombined at ISC-Sadoré during the 2011/12 off-season to produce 181 FS C_1 progenies that will be assessed during the 2012 rainy season. Similarly, based on evaluations during the 2011 rainy season of 126 FS C_0 progenies of the newly formed Medium-Maturity Genepool at ISC-Sadoré (Niger) and LCRI-Maiduguri (Nigeria), 23 selected FS progenies were recombined at ISC-Sadoré during the 2011/12 off-season to produce 249 FS C_1 progenies that will be assessed during the 2012 rainy season. Based on evaluation during the 2011 rainy season of C_1 FS progenies of the Niger-Nigeria Population at ISC-Sadoré (Niger) and LCRI-Maiduguri (Nigeria), 16 selected FS progenies were recombined at ISC-Sadoré during the 2011/12 off-season to produce 118 FS C_1 progenies that will be assessed during the 2012 rainy season. Experimental varieties and the full-sib progenies for evaluation during the 2012 rainy season were produced at ISC-Sadoré by recombining the selected progenies from each base population during the 2011/12 off-season. Reasonable progress was thus made towards the 2013 major output for Nigeria.

Activity 3.8 - Evaluate the potential of newly developed pearl millet varieties and hybrids, and crop management practices, using large-scale, gender-specific, farmer-participatory multi-location testing approach

Mali: Since 2009, ICRISAT, IER and the Aga Khan Foundation have implemented farmer field schools (FFS) on integrated striga and soil fertility management, crop management (ISSFM) and variety trials in 30 different villages in Mopti and Djenne district in Mopti region. In a total of 5 FFS clusters (covering over 30 villages), 8 field agents and 4,000 farmers (of which at least 10% were women) were trained in ISSFM and component technologies. Although 2011 was a difficult year, most of the trials executed in the Mopti region of Mali produced satisfactory results. In comparing ISSFM and the farmer practice, ISSFM yielded quantities of pearl millet grain that were similar to the farmer practice, but the ISSFM approach produced additional grain and fodder from the cowpea or groundnut intercrop. The net benefit from ISSFM was about 30% higher than from the farmer practice in 2011. Pearl millet varieties preferred by farmers in Mopti and Djenne district in Mali were Toronio and Syn0006, both varieties stemming from IER pearl millet breeding program and registered in the national catalog for over 10 years. Toronio especially often showed superior performance compared to the local varieties, both in low- and high-potential environments, for three consecutive years, confirming its high potential and broad adaptability. The variety SOSAT-C88 was dismissed by farmers in these areas after three years, because despite good yield potential in high-potential environments, it performed poorly in low-potential areas and showed unacceptable levels of susceptibility and sensitivity to striga and millet head miner. PEO6001 was dismissed, despite showing good resistance to striga, because it matured too late. In 2011, 16 demonstrations of different crop management practices (Zai techniques, intercropping pearl millet with cowpea in alternating rows, micro-dosing, and farmer practice) were installed in four different villages. Although not conclusive, micro-dosing showed potential for increasing yield. Micro-dosing trials with different doses of DAP showed that, in general, micro-dosing increased yields, but the results were too variable to select and recommend a "best-bet" micro-dose practice. Trials are continuing in 2012 and with a "normal" year, we expect to collect more conclusive results on the effectiveness of crop management options in agronomic and economic terms.

Niger: In 2011, Farmer Field Schools in Niger conducted a second year of evaluation of ISSFM practices, and on a larger scale in more than 25 villages in 7 clusters in western Niger (Tera, Falwel, Bokki, Dantchiandou) and south-central Niger (Sae Saboua, Serkin Haoussa, El Kolta). These activities provided training for about 20 field agents (of which 4 are women) and 665 farmers (of which 288 are women). In this second year of Farmer Field Schools in Niger, improved pearl millet varieties ICMV-IS 89305 and Mil de Siaka were selected by farmers across sites, while earlier-maturing SOSAT-C88 was selected at sites where millet head miner incidence did not reach seriously damaging levels during 2011. Further, the early maturing, high-tillering variety ICRI-Tabi, which has superior grain densities of mineral micronutrients Fe and Zn, and is based on the Malian landrace accession B9-Tabi, proved to be very resistant to millet head miner and was popular (particularly with women) from Tera in the west to Serkin Haoussa in the south-central part of the country. Along with later-maturing, head miner-resistant Mil de Siaka, ICRI-Tabi will be considered for addition to the national catalog of varieties for Niger following the 2012 rainy season. Results from western Niger showed increased pearl millet yields and profitability of the ISSFM practices compared to the farmer practice, while results from south-central Niger are not conclusive (due in part to use of a cowpea variety that was susceptible to local populations of *Striga gesneroides*, and therefore failed to provide all of the expected advantages) and the ISSFM practice needs to be

adapted, as the ISSFM practice is agronomically superior but is less profitable than the farmer practice.

Burkina Faso: Pearl millet varieties (improved OPVs or introduced landrace accessions from other regions) identified by farm union partners for more widespread on-farm assessment (and mini-packet seed dissemination) during the 2012 rainy season included SOSAT-C88, IKMP 5 and IKMV 8201 for FEPAD-Nayala; PE00576, PE06001, Toronio (from Mali) and IKMP 1 for UGCPA; and SOSAT-C88 and PE00576 for AMSP-Kaya.

Nigeria:PE05578 was preferred by >90% of farmers (both male and female) who evaluated it in on-farm trials in Nigeria during the 2011 rainy season, and was officially released for cultivation as SUPERSOSAT in December 2011 by the Nigerian National Variety Release Committee. During the 2011 rainy season, this variety was evaluated by at least 200 farm families in each demonstration site across six states in northern Nigeria (one each in Sokoto, Zanfara, Katsina, Borno, Yobe, and Jigawa states). Thus, 200 × 6 =1,200 farm families evaluated it in 2011 alone. It provides a 20-35% improvement in grain yields compared to the farmer practice (typically using the previously released and widely adopted earlymaturing variety SOSAT-C88).

Rajasthan: In the 2011 rainy season, 30 hybrid entries were tested in Researcher-Managed Farmer Participatory Trials (RMFPT-1) at six locations in target village clusters in Jodhpur and Nagaur districts in Rajasthan. The order of preference of hybrids by farmers was GHB 939, VVBH-3087 and 86M76 in Jodhpur and HHB-67-2, HMS47A x H77-833-2-202 and 86M76 in Nagaur. Other farmer-preferred hybrids were Bio-8141 and Bio-8494. The hybrid GHB 939 will be tested in Farmer-Managed Participatory Trials (RMFPT-2), while the hybrids VBBH 3087, Bio-8141 and Bio-8494 will be tested in large-scale adoption trials in Rajasthan during the 2012 rainy season. Also, four hybrid entries (RHB-185, GHB-719, GHB-905 and Bio-8141) were tested in Farmer-Managed Participatory Trials (RMFPT-2) in target village clusters during the 2011 rainy season; GHB 719 was highest yielder (2.24 t/ha in Jodhpur and 2.53 t/ha in Nagaur), followed by GHB 905 (2.0 t/ha in Jodhpur and 2.2 t/ha in Nagaur).

Gujarat: In the 2011 rainy season, 30 hybrid entries were tested in Researcher-Managed Farmer Participatory Trials (RMFPT-1) at five locations in target village clusters in Banaskantha and Pattan districts in Gujarat. The farmer-preferred hybrids were Bio-8141, GHB 939 and GHB 941. The hybrid GHB 939 will be tested in Farmer-Managed Participatory Trials (RMFPT-2), while the hybrids Bio-8141 and GHB 719 will be tested at large-scale adoption trials in Gujarat during the 2012 rainy season. Also, three hybrid entries were tested in Farmer-Managed Participatory Trials in target village clusters during the 2011 rainy season, and the hybrids preferred by farmer were GHB 719, GHB 905 and GHB 908, in that order.

Haryana: In the 2011 rainy season, 30 hybrid entries were tested in Researcher-Managed Farmer Participatory Trials (RMFPT-1) at four locations in target village clusters in Haryana. The order of farmer preference for hybrids was GHB 538, 86M01, GHB 941 and Hybrid No.3 (ICMA 88004 x MRC HS-225-3-5-2-B-B-B-1). Other farmer-preferred hybrids were VBBH -3115, JKBH 676, HHB-262 and GHB-941. The hybrids GHB 538, GHB 941 and Hope hybrid No.3 (ICMA 88004 x MRC HS-225-3-5-2-B-B-B-1) will be tested in Farmer-Managed Participatory Trials (RMFPT-2) during the 2012 rainy season, while the hybrids VBBH 3115 and JKBH 676 will be tested in large-scale adoption trials in Haryana during the 2012 rainy season. Also, three hybrid entries (HHB 256, HHB 271 and HHB 263) were tested, along with four check hybrids in Farmer Managed Participatory Trials in target village

clusters during the 2011 rainy season; HHB 256 was highest yielder (2.9 t/ha), followed by HHB 263 (2.7 t/ha). The check hybrid HHB-67-Improved produced a grain yield of 2.01 t/ha.

Activity 3.9 - Strengthen research-for-development capacity:

Mali: One technician from IER-Cinzana received training in the use of the newly established facilities at ISC-Sadoré for greenhouse screening of pot-grown seedlings of pearl millet against downy mildew.

Niger: The pearl millet pathologist from INRAN-Maradi received training in the use of these new facilities as well.

Burkina Faso: One technician from INERA-Gampela also received training at the new ISC-Sadoré facilities.

Nigeria: One technician from LCRI-Maiduguri and one woman PhD student from Ahmadu Bello University (Zaria) also received training at the new ISC-Sadoré facilities.

PROJECT OUTPUTS REALIZED UNDER OBJECTIVE 3 TO DATE

Table 3 presents the major project outputs realized under Objective 3 by the end of June 2012.

Table 3: ***Major Project Outputs Realized in Objective 3 as of June 30, 2012***

Activity 1: ***Identify new sources of resistance to key biotic constraints, validate these resistance sources, determine resistance inheritance and where necessary identify markers as a selection aid***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	3.1.2	Flanking markers for pearl millet striga resistance QTLs identified [May 2013]	Population remade and available for evaluation during 2012 rainy season	On-going and on-track	Trial sets received by partners in Mali and Nigeria
SA	3.1.4	Newly emerging downy mildew strains identified from portion of target region where single-cross hybrids are cultivated [Oct 2010]	New isolates identified: Sg526 for Rajasthan, Sg519 for Haryana and Sg445 for Gujarat state	Achieved	Isolates being maintained at ICRISAT greenhouse
	3.1.5	Sources of resistance to newly emerging downy mildew strains identified [March 2011]	8 lines found resistant to the 3 new pathotypes, and 7 lines found resistant to 2 of the 3 pathotypes	Achieved	HOPE Annual Report for Y2; Pearl Millet Hybrid Parents Research Consortium (PMHPRC) Annual Report-2012
	3.1.7	Flanking markers identified for major genes contributing to resistance to newly emerging down mildew strains [March 2012]	Major QTLs detected on LG1 for Sg445, LG6A for Sg526 and LG6B for Sg519 with DM resistance from 863B allele. Linked flanking markers identified for introgression of resistance to newly identified downy mildew isolates	Achieved	HOPE Project annual report for Y 3 Manuscript under preparation
Activity 2: ***Identify integrated control options for pearl millet insect pests***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	3.2.5	Impact of various crop residue and soil management techniques on MHM (*Heliocheilus*) and associated natural enemies and other macro fauna documented [March 2012]	Results obtained were inconclusive as they were not consistent across sites and years. The differences in numbers of diapausing stem borer larvae detected in the different cropping system (with or without cowpea intercrop) and pearl millet straw management treatments evaluated were statistically significant, but not large enough to have practical consequences. Further, levels of millet head miner infestation were not consistently high enough at the trial sites to permit effective assessment. Results are being prepared for publication	Achieved	HOPE Y2 Annual Report and trip reports for data collection from trials conducted at INRAN-Konni during 2010/11 and 2011/12
	3.2.7	Impact of improved integrated soil, nutrient and pest management techniques on MHM infestation and damage assessed in Niger [March 2013]	Results obtained to date are inconclusive, as above. Analysis of available data sets is in progress	On-going	HOPE Y2 Annual Report and trip reports for trials conducted at INRAN-Konni during 2010/11

					and 2011/12
Activity 3: ***Identify options for pearl millet intensification in target ecologies for effective implementation of IGNRM***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	3.3.5	Best-bet soil fertility management options and their interactions with genotype identified for Sahelian zone in Niger [April 2013]	Farmer-preferred options for combining organic and mineral fertilizers were identified. No repeatable, significant genotype × fertility management interactions have been identified to date	On-going and on-target	Trip reports following sharing of 2011 rainy season trial results with participating groups of farmers
SA	3.3.7	Report on pearl millet response to micronutrient (Zn, B, and S) fertilization, with recommendations of treatments to test on-farm [March 2012]	Report on pearl millet response to micronutrient (Zn, B, and S) fertilization has been prepared. The recommendations of treatments are described in the text in this report	Achieved	Report available with CCSHAU-Hisar who compiled the results and with Objective 3 Global-Coordinator
Activity 4: ***Strengthen national program capabilities for screening for resistance to key biotic constraints***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	3.4.3	Potted seedling downy mildew resistance screening facilities established at ICRISAT-Sadoré for use in recurrent selection [Feb 2012]	Facilities established during Y2 and screening protocol validated during early Y3 were used in a training course in September 2011; They subsequently are being used in screening FS progeny sets, germplasm accessions, and experimental varieties	Achieved	HOPE Annual Reports for Y2 and Y3
SA	3.4.6	Field screening for downy mildew resistance strengthened at three sites (one each in Gujarat, Haryana and Rajasthan), and partners trained in their use [Dec 2011]	• Efficacy of field screening protocol for selection of downy mildew resistant pearl millet breeding lines was developed by partner universities • 4 Pathologists from partner institutes were trained on field screening systems, sick plots identified in each state.	Achieved	HOPE Annual Report for Y3
Activity 5: ***Identify and/or develop pearl millet breeding lines and hybrid parents for target ecologies***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
SA	3.5.3	New breeding lines with both downy mildew resistance and drought adaptation in good agronomic backgrounds [May 2012, 2013]	About 120 promising lines identified by partners, and were used in their breeding programs. The identified lines were also used to generate new testcrosses in the project for testing in the targeted ecology. An arid-type pollinator composite was used by partners to develop drought-tolerant restorer lines, and about 60 B-lines were initiated for A-line conversion	On-going and on-target	• Breeding programs of partner institutions, • Hybrids developed in project • Breeding material at ICRISAT
	3.5.6	New hybrid parents identified with good grain appearance, superior grain and stover yield, drought adaptation, and downy mildew resistance [May 2012]	80 promising lines were identified based on superior grain and stover yield, drought adaptation, and DM resistance. These are being used by partners in their breeding programs	Delayed but on-going	Breeding programs of partner institutes

	3.5.9	First cycle downy mildew resistance improvement of two elite hybrid parents (J 2340 and H 77/833-2-202) by marker-assisted backcrossing completed [April 2011, 2012]	Single QTL introgression in J2340 and H 77/833-2-202 (=ICMR 01004)-background completed. 5 introgression lines were found promising in J2340-background, and 9 for ICMR 01004-background. Second season data will be generated in the 2012 rainy season for revalidation	Achieved	HOPE Annual Report for Y3
	3.5.11	Second-cycle downy mildew resistance improvement of elite pollinator J 2340 completed, pyramiding resistances using marker-assisted selection [April 2012]	Single QTL introgression lines in BC_3F_4 generations carrying three (P310-17, P7-3, and 863B-P2-P7) different sources of DM resistance QTLs inter-mated to generate F_1s carrying double QTL heterozygotes, and were planted in field during summer (February-May), 2012. Double QTL heterozygotes to be sown in field during the late rainy season in2012. To be completed in March 2013	Delayed but on-going	HOPE Annual Report for Y3
Activity 6: ***Develop pearl millet hybrids with improved yielding ability and necessary adaptation and market-required traits for specific target regions***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
SA	3.6.4	60 hybrids evaluated in multi-locational trials in northwest India during rainy season [Dec 2010, 2011, 2012]	650 test crosses and 180 hybrids evaluated in multi-location trials in 3-12 locations in different years, of which promising hybrids were identified and promoted to advanced testing.	On-going and on Track	HOPE Annual Report for Y3
	3.6.5	3 hybrids selected for seed increase and future inclusion in state and national trials in north-western India [Feb 2012, 2013]	5 hybrids were identified and multiplied for seed increase and included in national trials in northwestern India for 2012 evaluation	On-going and on-track	HOPE Annual Report for Y3
Activity 7: ***Create diversified populations, perform recurrent population improvement for priority traits, and generate new pearl millet OPVs adapted to specific target environments***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	3.7.5	At least two new, farmer-preferred downy-mildew resistant experimental cultivars derived from recurrent population improvement developed per country for large-scale on-farm testing [April 2013]	Experimental varieties derived by recombining selected full-sib progenies have been produced from at least two different base populations per target country and are being evaluated in on-station trials during rainy season 2012	On-going and on-target	Field books of multi-locational full-sib progeny trials and preliminary variety trial
	3.7.8	At least 2 new breeding populations based on farmer-preferred, trait- or adaptation-specific pearl millet germplasm groups for WCA developed per participating country [April 2013]	New populations have been created and, following an initial cycle of full-sib progeny-based recurrent selection, are being evaluated during the 2012 rainy season in population-specific full-sib progeny trials and compared with each other and derived experimental varieties and appropriate controls in a 72-entry preliminary variety trial	On-going and on-target	Field books of multi-locational full-sib progeny trials and preliminary variety trial
Activity 8: ***Evaluate the potential of newly developed pearl millet varieties and hybrids, and crop management practices, using large-scale, gender-specific, farmer-participatory multi-locational testing approaches***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	3.8.3	Varieties and their on-farm response to management options characterized in participatory	Farmer-preferred pearl millet varieties (all four target countries), seed dressings (Burkina Faso), soil fertility	On-going and on-target	HOPE Annual Report for Y2 and Y3

		trials [Feb 2011, 2012, 2013]	management practices (Niger), and striga management practices (Niger and Nigeria) have been identified; validation work is ongoing		
	3.8.6	At least one pearl millet variety identified by farmers for larger-scale dissemination in each target area [March 2012, 2013]	SUPERSOSAT variety was released in Nigeria (Dec 2011); ICRI-Tabi, Mil de Siaka, and ICMV-IS 89305 selected for wider dissemination in Niger; striga-resistant landrace PE06001 and several improved OPVs were identified for wider testing in Burkina Faso and Mali. Validation on-going; large-scale seed multiplication of ICMV-IS 89305 and SUPERSOSAT was initiated in the current rainy season 2012	On-going and on-target	ICRISAT Happenings article (Jan 2012) and HOPE Annual Report for Y3
	3.8.10	200 farmers participate in Farmers Field Schools (FFS) on integrated striga and soil fertility/water management (ISSFM/ISFWM) methods in one target area each in Mali and Niger [Dec 2010; 2011]	With additional support from the Aga Khan Foundation in Mali since 2009 and from the PROMISO II project during rainy season 2011, it has been possible to involve more than 4,000 farmers in Mali, 650 farmers in Niger and 1,000 farmers Nigeria in these ISSF/WM farmer field schools; most of these FFSs will continue (albeit with less active ICRISAT involvement) in the 2012 rainy season	On-going and on-target	HOPE Annual Reports for Y2 and Y3; Lists of participants in the Farmer Field Schools
	3.8.12	Lessons learned and best practices for effective large-scale participatory trial management published jointly with sorghum [April 2013]	Farmers want to use more organic manure than is presently available, so introduction of composting technology appears to be promising; a forage cowpea intercrop is an excellent source of cash income provided that the variety used is resistant to local populations of *Striga gesneroides* and sufficient good quality seed is available; there are opportunities for improving striga resistance and bruchid resistance of long-duration forage cowpea varieties, and this could improve income from and adoption of integrated striga management practices for both pearl millet and sorghum	On-going and on-track	HOPE Annual Reports; Technical Manuscript (in preparation)
SA	3.8.15	Hybrids and their on-farm response to management options characterized on-farm [Feb 2011, 2012, 2013]	30 hybrid entries, including selections from the previous year's evaluation, and some entries contributed by partners and private sector companies, were tested on-farm in 3 states; farmer–preferred hybrids were identified for each state	On-going and on-track	HOPE Project Annual Report for Y3
	3.8.20	2 farmer-preferred hybrids and a management option identified by farmers for larger-scale dissemination in each target area [March 2012, 2013]	4 farmer preferred hybrids for Rajasthan, 3 hybrids for Gujarat, and 5 hybrids for Haryana; plus management options were identified for dissemination for each state. Verification trials are on-going in the current season	On-going and on-track	HOPE Project Annual Report for Y3
	3.8.21	Lessons learned and best practices for effective large-scale participatory trial management published [April 2013]	The publication is planned, to be delivered in April 2013	On-going and On-going	Publication on Lessons learnt (in preparation)

Activity 9: ***Strengthen research-for-development capacity***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	3.9.2	At least 6 partner organizations (2 per country) trained in farmer-participatory trial implementation [March 2010]	"Animateurs" from partner organizations (farm unions) in Mali (>10), Niger (>4) and Nigeria (2) were trained in Farmer Field Schools and Participatory Trial Implementation	Achieved	HOPE Annual Report for Y1 & Y2
	3.9.7	NARS partners trained in IGNRM, downy mildew screening techniques, statistical analysis, and recurrent selection methods [March 2012]	National program pearl millet scientists and/or technical staff from LCRI (Nigeria), INRAN (Niger), INERA (Burkina Faso) and IER (Mali) provided short-course training programs in IGNRM, use of pot-grown seedlings for downy mildew screening, striga screening techniques, recurrent selection methods, and/or statistical analysis (especially combined analysis of multi-environment trials);a second DM screening course is scheduled for August 2012	Achieved	HOPE Annual Report for Y1, Y2 & Y3
SA	3.9.8	2 NARS partners trained in application of molecular markers in pearl millet improvement [Dec 2009]	2 Indian pearl millet national program scientists (including 1 woman) participated in a 3-week training course on application of molecular marker-based tools for crop improvement	Achieved	HOPE Annual Report for Y1
	3.9.9	3 NARS partners trained in greenhouse screening for resistance to downy mildew [March 2010]	4 Indian national program staff and 1 ICRISAT-Niger research officer trained in India (4 weeks) in the screening of potted pearl millet seedlings against downy mildew	Achieved	HOPE Annual Report for Y1
	3.9.12	At least 6 partner organizations (2 per state) trained in farmer-participatory trial implementation [Aug 2010]	All collaborating partner institutions (5) had their staff trained in farmer-participatory trial implementation in Gujarat, Rajasthan, and Haryana	Achieved	HOPE Supplementary Report for Y1 (Feb 2010)

OBJECTIVE 4: IMPROVE FINGER MILLET VARIETIES AND MANAGEMENT OPTIONS TO INCREASE PRODUCTIVITY IN ESA

ACTIVITIES CARRIED OUT IN THE PERIOD JULY 2011 – JUNE 2012

Activity 4.1 - Assemble finger millet genetic resources and use it to identify new sources of resistance to key biotic stresses in ESA

Ethiopia: A total 81 landraces collected from four administrative zones in Oromia and Benisgangul Gumz regional states were characterized. The collected materials included 26 landraces that were white in color, 32 that were red, and 23 that were black. These landraces were grouped into three sets and are being evaluated for agronomic traits and major biotic stresses in regional variety trials.

About 100 accessions collected from the Institute of Biodiversity Conservation (IBC) were planted at Adet to evaluate their performance in high-potential areas. Another 150 accessions collected from IBC were planted at Merawi, with the objective of assessing and identifying blast resistance; 44 of these accessions were promoted to preliminary yield trials in the 2011 cropping season (June-November). The remaining 106 accessions were planted at Adet for seed increase and for screening against other stresses.

Kenya: Some 340 finger millet lines collected from diverse agro-ecological zones in Kenya (154), Uganda (105), and Tanzania (81) were phenotyped at the KARI centers in Kiboko, Mtwapa, and Lanet. These sites represent the agro-ecologies in which finger millet production takes place in HOPE project target countries. The data showed that the accessions had high variability in days to flower (48-136 days), grain yield (0.01-6.08 t/ha), plant height (38.8-138.8cm), finger length (3.3-18.2cm), finger width (0.5-1.52cm), number of fingers per panicle (4-13), peduncle length (6.3-43.2cm), and number of productive tillers (0-14). Principal component analysis (PCA) showed that the first four PCs accounted for 53% of the total diversity in the germplasm. Much of the variability was contributed by panicle exertion, peduncle length, plant height, grain yield, and finger width. The germplasm was also evaluated for blast disease reaction, and 14 accessions [GBK 029649A, Acc# 98, GBK 011136A, GBK - 011119A (from Kenya); Okhale 1 (from Nepal); Kahulunge, Acc# 32, IE 6613 (RW 127) (from Tanzania); and Acc# 23, Acc# 1, Acc# 42, Ent 3 Uganda, Uganda 56-Kal, Uganda 65 - Ekemo (from Uganda)] had blast scores of<3.0 and were selected for use in breeding. Based on field observation and data analysis, 76 accessions (the best performers) were selected from across the four tests sites and these are being evaluated further for adaptation and productivity to identify accessions suitable for farmer use. Also, 20 best performers were selected for fast tracking in variety development.

These accessions and 44 mini-core varieties were also genotyped using the 30 best markers; this generated 10,200 data points. Five major groups were detected using a weighted neighbor joining clustering-based dendrogram that was generated using simple matching dissimilarity indices. Group 1 is characterized by a long maturity period, high mean finger and peduncle length, high mean number of grains per spikelet, and low mean blast scores; Group 2 by high mean grain yields, high mean 1,000 seed mass, and high mean plant height; Group 3 by high mean grain yields, high mean 1,000 seed mass, and high mean plant height; Group 4 by high mean grains per spikelet, and the shortest accessions; and Group 5 by tall accessions, and the longest panicle exertion and peduncle lengths.

Uganda: Collection of land races from major finger millet-producing areas was done in 2010. A total of 102 finger millet landraces were collected, mainly from the project area (eastern

and northern Uganda) and 22 landraces from western Uganda were added to the collection. The 124 land races were planted out for seed increase and observation at the NaSARRI-Serere station during the first 2011 rainy season (April-July). These were evaluated for morphological, blast and other agronomic traits. Data sets collected have been synthesized and are currently being statistically analyzed.

Tanzania: Germplasm collection was done in June 2010in the southern highlands zone in Mbozi and Sumbawanga districts. Some 37 accessions were collected and taken to the National Plant Genetic Resources Centre at Arusha for conservation and seed multiplication. However, the collection did not cover all the main locations targeted, as such areas as Kigoma, Mtwara and Ruvuma regions were not reached. Seed increase and characterization of the accessions started in 2012 at Miwaleni.

Evaluation of the finger millet materials started at Uyole, Mbeya in 2010. ICRISAT provided 100 unique finger millet accessions from the ICRISAT, NARS and regional gene banks in order to evaluate their general behavior in Tanzania. The selected materials were advanced in the regional variety trial, which is ongoing. Evaluation for striga resistance started in 2011 at Uyole. Unfortunately, the expected striga infestation did not occur and therefore in 2012 the trial was transferred to Singida in the central zone where striga is an endemic problem. The trial continues and a report will be provided in December 2012.

Activity 4.2 - Identify sources of resistance to the key abiotic stresses, adaptation and quality traits in ESA

Ethiopia: A total of 87 finger millet collections obtained from the Institute of Biodiversity were evaluated at Bako and Pawe, where blast is a major constraint to production. Fifteen promising blast-tolerant and/or resistant finger millet lines were identified and advanced to the Finger Millet National BlastResistance Trial. Two candidate lines were selected for further verification.

Regional finger millet variety trials that included ICRISAT accessions were grown in lowland areas (Melkassa and Meiso), and 29 varieties and a standard local check (Taddesse) were evaluated.

Kenya: Finger millet accessions from the core collection were planted at Kiboko in three different maturity groups: Group 1(63 accessions), Group 2(363 accessions), and Group 3(195 accessions). The accessions were planted in single 4 m rows. The Groups were planted using an augmented design, with material exposed to terminal drought by stopping irrigation when 50% of the treatments/entries from each group attained 50% heading. In Group 1, days to 50% flowering (DAF) ranged from 52-88 days in accessions 5736 and 7500, with a mean of 63.9. In Group 2, DAF ranged from 53-88 days in accessions 2264 and 4826, with a mean of 75. Group 3 had DAF ranging from 65 days in accessions 6922 and 4287 to 107 days in accessions 4842 and 2586, with a mean of 84. Accession 7500 had the largest number of green leaves (9) at 5 weeks, followed by accessions 2322 and 4755 (with 8 leaves). In Group 2, the highest number of green leaves (9) at 5 weeks was in accessions 2535 and 5173, while accession 6541 had the largest number (5) in Group 3. Accessions 5390, 2030, and 5584 had the highest chlorophyll content in Group 1 at 5 weeks, followed by accessions 5239, 4817, and 7366 in Group 2 and 3694 in Group 3. Simple correlation analysis showed DAF was positively correlated to the number of green leaves remaining at 5 weeks and negatively correlated to chlorophyll content at 5 weeks. Yield was positively correlated to the number of green leaves and to chlorophyll content. Further analyses are ongoing to determine the effects of the different parameters on yield and to select promising accessions for drought tolerance.

Tanzania: Three maturity groups of finger millet were identified to determine drought tolerance: Group 1 was composed of 9 early maturing lines and a check, U15; Group 2 was composed of 63 medium-maturing lines, with P224 as check: and Group 3 was composed of 63 late-maturing lines, and UFM 149 as check. The three Groups were planted at Uyole in January 2012. The overall aim was to identify 25 superior finger millet varieties for drought resistance and desired head and grain characteristics. The 25 superior germplasm sources will be for direct use or for incorporation into breeding activities. The selected lines identified in 2012 will be evaluated for biotic stresses at different locations and quality traits in 2013.

Activity 4.3 - Develop breeding and mapping populations for improving finger millet resistance to blast, drought and adaptation to different agro-ecologies in ESA:

Kenya: The F_2 seed from the finger millet blast crosses made during the 2009/2010 short rainy season was planted at Kiboko field station during the 2010/2011 short rains. No selections were made from the F_2s because Kiboko is not a blast disease hot-spot. The harvested seed was divided into four parts and distributed for planting during the 2012 long rainy season at Kiboko[9] in Kenya and at Miwaleni in Tanzania for screening against drought tolerance. Seed was also planted at KARI-Alupe (Kenya) and NaSSARI-Serere (Uganda) to undergo selection for blast resistance. The crop grown at KARI-Kiboko was subjected to dry conditions (irrigation was withdrawn as soon as the crop properly established). This crop is still in the field at the time of this reporting. Selection will be done at physiological maturity within families for drought tolerance-related traits, and high-potential plants will be selected. In KARI-Alupe, a susceptible check (KNE 471) was planted around the plots and crop debris spread inside the plots to build up inoculum. The crop is now at physiological maturity. Selection will be done within families, and promising plants for blast resistance will be selected. All selected plants will be advanced as F_4 using the head-to-row method.

Uganda: F_3 families received from the F_2 generation from KARI-Kiboko the previous year (see above) were planted at NaSSARI-Serere during the 2012 long rains (same months as in Kenya). The station has conditions favorable for blast development (high humidity, high rainfall), and is also a major finger millet-growing area with a prevalence of blast inoculum. Here, too, a blast-susceptible check (KNE 471) was planted around the plot and finger millet crop residues were spread inside the plots to help build up inoculum. The crop is currently heading. At physiological maturity selection will be done within families for blast resistance.

Tanzania: F_3 families derived from the F_2 generation material provided by KARI-Kiboko the previous year were planted at Miwaleni during the 2012 long rains (April-August). The plants were subjected to irrigation only once after establishment until maturity. At physiological maturity selection was done within families for agronomic (plant aspect, lodging) and yield parameters (head size, shape, seed size, and shattering ability). Individual plants selected for drought tolerance will be used to form F_4 lines.

Activity 4.4 - Identify and develop varieties with improved yielding ability, resistant to key biotic and abiotic stresses for the targeted agro ecologies and end uses in ESA:

Ethiopia: Two sets of Finger Millet National Variety Trials using accessions obtained from the IBC were grown at Arsi Negele, Bako, Pawe, and Assosa. A red and brown finger millet variety trial consisted of 34 genotypes along with Tadesse and Padet as checks. A white finger millet variety trial contained ten varieties, and Tadesse and Padet as checks. Promising

[9]Long Rains season at Kiboko are usually less reliable than the Short Rains seasons, and supplementary irrigation is often required to sustain a crop.

varieties were identified and the trial will be advanced for verification. Eleven white finger millet varieties and 34 red and brown accessions were evaluated for different agronomic traits at Arsi Negele, Bako, and Assosa. Two promising varieties that performed better than the checks were selected from each set. These promising varieties were proposed for variety verification in 2012.

Kenya: Accessions selected from the phenotyping trial conducted during the 2011 long rains (April-July) were constituted into 9 x 9 lattice trials and established at KARI-Kiboko and KARI-Alupe during the 2011 short rains (August-November). Genotype was highly significant (P=0.001) for most of the traits, except for insect damage and seedling vigor. In KARI-Kiboko, days to maturity ranged from 98.5-126.5 days for KNE 479 to 126.5 days for Kaulunge. Other accessions with short maturity periods were GBK-011110A, GBK-011111A and GBK-011129A (100 days). The improved variety with the least days to maturity was U15 (103 days). Kaulunge, Kal Atari and KNE 814all had the lowest blast score (1.75). The Kafumbata/Sanzamula mix produced the lowest yield (0.5 t/ha) and Emiroit/Engeny the highest (2.60 t/ha). Etiyo-brown expressed the best threshability (94.47%), followed by GBK-011111A (82.98%) and Nakuru FM 1 (78.63%). All these are landraces and may be useful as parents for improving threshability, which is cited as one of the key factors limiting finger millet production. In KARI-Kiboko, all traits were highly significant (P=0.001), except 1,000 grain weight (P=0.022) and threshability (P= 0.09) comomcomo and KNE 479 had the fewest days to flowering (59 and 60) and Acc 2954 and KNE 1034 the most (100 and 101). Data collected from the two trials were used to select accessions for three regional duration trials (low, medium, and high), along with other elite materials from previous trials. These trials were planted in four locations during the 2012 long rains (April-August).

Uganda: A regional finger millet trial comprising 30 entries (29 test lines and a local check) was planted in Serere during the 2011 short rains (August-October). Data was taken on blast disease damage, insect damage, days to flowering, plant height, tillering, lodging, and grain yield. Genotype was not significantly different ($P \leq 0.05$) for all traits, except days to flowering (P=0.001).This indicated that a completely different kit for testing was needed in this location, which has been provided for testing during the 2012 long rains (April-August). KNE 741 and Engeny had the lowest days to flowering of 56 and 63.7, respectively.

Tanzania: A kit of 29 entries was tested against a local check (Moshi) for adaptation in Miwaleni, during the 2011 short rains (April-July). Twenty-five of the entries expressed resistance to moderately resistant reaction (≤ 3.0) to finger millet blast, with four entries (KNE 1063, KNE 434, KNE 628, and KNE 814) scoring 1.3, and the worst (Engeny) scoring 9. KNE 741, Engeny and KNE 1034 recorded the lowest DAF: 60, 61.3, and 62 days, respectively. The local check required the most days to reach maturity (75.3). The best yielders were KNE 669 (1.7 t/ha) and Engeny (1.43 t/ha), with the check producing 1.1 t/ha. These yields amount to a 55% and 30% yield increase over the local, respectively.

Activity 4.5 - Determine adaptability and yield stability of improved varieties for the targeted agro-ecologies and end use in ESA

Ethiopia: Nine testing sites (Bako, Gungua, Adet, Dibate, Pawe, Assosa, Arsi Negele, Axum, and Mystemri) in finger millet-growing areas were selected for Multi Environment Trials. Seven already released and pipeline finger millet varieties (Tadesse, Padet, Boneya, Bareda, Gute, Wama, and Bereda) were tested at the nine sites. Participatory variety selection for the best-adapted materials was conducted, and based on this process; only eight lines were selected for the 2012 Multi-Environment Trial.

Tanzania: The regional finger millet variety trials (MET) at Uyole and Miwaleni started in 2011 with 36 entries. These trials continued at the same sites in 2012, with 30 entries. Uyole is a highlands site (1800 masl), with 900-1,000mm of rainfall and low temperatures (21^0C mean). The Miwaleni agro-ecology is high altitude (1660 masl), low rainfall (700mm) and high temperatures (26^0C mean). Trial results will be reported after harvest in August 2012.

Activity 4.6 - Develop and assess crop management options for key constraints in the targeted finger millet production ecologies to enhance productivity in ESA

Ethiopia: Trials were done at Arsi Negele, Bako, and Adet during the 2011 season (July-November) to develop and assess crop management options for key constraints to finger millet production. Three levels of spacing between rows (20cm, 40cm, and 60cm), two levels of farmyard manure (2.5t/ha and 5t/ha), and four levels of inorganic fertilizer (0/0, 12.5/12.5, 25/25, 50/50 kg/ha of NP_2O_5 were investigated. Pooled analysis revealed that maximum grain yield was obtained using the combination of 40cm spacing between rows, 5 ton/ha of farmyard manure, and 30/30 kg/ha NP_2O_5.. This study is ongoing, and it is expected that an economically and ecologically feasible treatment combination will be identified based on the price of inorganic fertilizer and availability of farmyard manure.

Uganda: A striga management trial was carried out during the first rains (April-August) of 2011 at three different sites located in Kumi, Bukedea, and Bukedea districts. The sites selected are known for high striga incidence. The experiment was of a factorial nature with three factors: finger millet variety, intercropping, and fertilizer application. Four finger millet varieties (PESE1, SEREMI2, SEC915 and the farmers' local variety); two intercrops [cowpea and *Celosia argentea* ('Striga chaser')], and nitrogen fertilizer (CAN) at three levels (40, 20, and 0 kgN/ha) were tested. The treatments were applied both singly and in various combinations and arranged in a completely randomized block design. The individual sites represented replications. The results can be summarized as:

- The local farmers' variety and the improved variety SEC915 had low striga emergence, while PESE1 and SEREMI2 supported more striga emergence. Treatments where *Celosia argentea* was intercropped with finger millet, and nitrogen fertilizer was applied at 20 kg N/ha had the lowest striga emergence, and those in which nitrogen fertilizer alone was applied to millet had the highest striga emergence.
- Intercropping finger millet with *Celosia argentea* alone produced the highest grain yield, followed by the application of nitrogen fertilizer. The local farmers' variety and SEC915 were the highest yielding varieties, while PESE1 was the lowest yielding variety under striga infestation. Generally, finger millet yields in this trial were low (483-1,100 kg/ha) compared to the potential yield of 3,000 kg/ha for improved varieties under good management; this was mainly due to the high striga infestation.

Tanzania: Soil samples were collected from farmers' fields in five districts, four in Central Tanzania and one in Rombo district. These samples were analyzed at Selian Agricultural Research Institute for different nutrients to determine the soil fertility status. In general, most farmer fields have very low fertility. More than 80% of the fields had very low, to low (<1.5%) organic carbon, plant-available phosphorus, and exchangeable potassium. Zinc is emerging as one of the micronutrients constraining crop production, with more than 70% of the fields containing medium to low levels of plant-available zinc. The widespread potassium deficiency and the emerging micronutrient deficiencies, (especially zinc and copper) have so far received little or no attention in the region.

Trials on herbicide-based weed management options (pre- and post-emergence) for cost efficiency and weed control effectiveness were initiated during the 2011 short rains (August-November) at Miwaleni. Determination of options for integrated striga and weed management started at Uyole in 2011, but no striga was observed in the field. In 2012, the trial was shifted to Singida, where striga infestation occurs. Different rates of fertilizer (macronutrients) were tested at Miwaleni in 2012 by evaluating the performance of three finger millet varieties in degraded soil and testing different levels of N and P. A report for the above trials will be produced after harvest (July).

Activity 4.7 - Participatory validation of integrated improved varieties with crop and fertility management options to enhance productivity in ESA

Ethiopia: Evaluation of released varieties using post-emergence herbicides (2,4-D and Tomb) for effective control of weeds and determination of optimum plant population were conducted at Bako. Three levels of intra-row spacing (20cm, 25cm, and 30cm), two different herbicides (Anthrazine and 2,4-D) and three finger millet varieties (Tadesse and Padet and one pipeline variety) were combined. No grain was harvested from plots that received no fertilizer and no weeding treatment. All varieties reacted the same to weed infestation.

Kenya: An on-farm trial using four improved varieties (U-15, GULU-E, P224 and SEREMI 1), and having micro-dosing and no micro-dosing as treatments, was conducted during the 2011 long rains (April-July). A Participatory Variety Selection (PVS) trial was also conducted, which contained seven improved varieties (SEREMI 1, U-15, KNE 648, P224, GULU-E, OKHALE-1, IE 4115 and a local check, Nakuru FM1). Participating farmers (mostly women) were trained on the improved technologies before the trials were established. During the farmer field days, participants learned to appreciate the importance of row planting, good husbandry practices, and timeliness of operations.

Tanzania: On-farm PVS trials were conducted in ten villages each in Mbozi, Singida, and Kondoa districts. Eight finger millet varieties/lines (P224, U 15, KNE 814, KNE 688, UFM 149, ACC 14, ACC 32,and a local variety as a check) were included in the trials. Farmers observed the eight varieties in the field before selecting. The varieties were evaluated using absolute, matrix, and pair-wise rankings. Results for absolute ranking at three districts showed that Acc 14, P224, U15, and UFM 149 were the preferred varieties, in that order. The variety Acc14 was the best at Mbozi, P224 at Kondoa, and UFM149 at Singida. The comparison of the three assessment tools at Singida and Kondoa indicated a similar trend. Farmers' selections were not limited to grain yield, but also included such qualities as disease resistance, grain color, head size and shape, resistance to lodging, and other general plant aspects.

The finger millet varieties U15 and P224 were officially released in 2011 based on the results obtained from these trials and demonstrations. UFM149 did not qualify for release because of its late maturity. U15 and P224 are currently being multiplied to produce breeders' seed.

Activity 4.8 - Capacity building, knowledge and information sharing for pursuance of finger millet crop improvement and management in ESA

Tanzania:A field workshop on breeding and seed production was conducted in Arusha, Tanzania, in July 2011 and attended by researchers from Ethiopia (4), Uganda (3), Kenya (4) and Tanzania (6). Brochures and manuals on finger millet agronomy and production have been produced in the different countries. In Ethiopia, brochures in three different languages (Amharic, Afan oromo, and Tigrigna) are in the process of being developed. Uganda has a manual and brochure on finger millet production and agronomy in the final stages of

production. In Kenya, a brochure on finger millet husbandry has been produced and translated to Kiswahili, while a manual on striga management is in the final stages of production and translation. Tanzania has extension leaflets on finger millet cultivation and management under production, and they should be completed by October 2012. One PhD student each is undergoing training in Ethiopia and Kenya.

PROJECT OUTPUTS REALIZED UNDER OBJECTIVE 4 TO DATE

Table 4 presents the major project outputs realized under Objective 4 by the end of June 2012.

Table 4: ***Major Project Outputs Realized Under Objective 4 as of June 30, 2012***

Activity 1: ***Assemble finger millet genetic resources and use it to identify new sources of resistance to key biotic stresses***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
ESA	4.1.4	Reference collection of finger millet assembled and evaluated [Dec 2010]	Finger millet core collections and collections from the four countries have been characterized	Achieved	Annual reports, data in database, accessions in cold room and field
	4.1.10	The finger millet core collection at ICRISAT augmented for improving chances of identifying useful materials [June 2011]	Lines with potential for high yield, farmer-preferred qualities, and resistance to blast and striga have been identified	Achieved	Annual reports, data in database accessions in cold room and field
	4.1.15	150-200 finger millet accessions characterized and genetic diversity information enhanced using molecular technology [May 2013]	384 finger millet accessions have been genotyped with SSR markers and their genetic diversity in the region enhanced	Achieved	Annual reports, SSR markers, data in database
	4.1.17	Stable sources of blast resistance identified [June 2012]	76 blast resistant lines have been identified	Achieved	Annual reports, data in the database, lines
	4.1.20	8 new sources of striga resistance identified [Dec 2012]	14 new striga resistant lines have been identified for breeding	Achieved	Annual reports, data in the database, lines
Activity 2: ***Identify sources of resistance to the key abiotic stresses, adaptation and quality traits***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
ESA	4.2.3	80 finger millet varieties identified for drought resistant and desired head and grain characteristics [Sept 2011]	120 drought tolerant finger millet lines with desired agronomic characteristics have been identified	Achieved	Annual reports, raw data in the database, lines
	4.2.6	Initial identification of 40-50 superior germplasm sources for direct use or for incorporation into breeding activities [Dec 2012]	76 Lines with high yield, good tolerance to drought, and good agronomic traits have been produced for further evaluation of adaptation and for incorporation into the breeding program	Achieved	Annual reports, data in the database, lines
	4.2.9	25 superior germplasm sources identified for direct use or for incorporation into breeding activities [Dec 2012]	34 lines superior in yield, grain quality, and resistance to blast and striga have been identified for inclusion in the crossing block; some have been fast tracked for variety release	Achieved	Reports, raw data in the database, lines
	4.2.13	20-25 finger millet lines identified that have expressed good levels of resistance to drought and are also resistant to striga and blast [May 2013]	49 Lines with resistance to striga and blast have been identified and are being tested for drought tolerance	On-going and on-target	
	4.2.15	Agronomic, head, grain and end use characteristics determined for 45-50 lines selected based on their biotic stress resistance and abiotic stress tolerance	80 lines with good biotic and abiotic stress resistance/tolerance and good agronomic traits are under evaluation in Kenya, Uganda, Tanzania, and Ethiopia	On-going and on-target	

		[May 2013]			
Activity 3: ***Develop breeding and mapping populations for improving finger millet resistance to blast, drought and adaptation to different agro-ecologies***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
ESA	4.3.3	Efficient finger millet emasculation techniques developed for use in hybridization activities [Dec 2010]	2 finger millet emasculation techniques (hot water and polythene bag techniques) were determined to be most effective	Achieved	Annual reports
	4.3.6	Segregating populations developed for sharing with 2 targeted NARS (who were in off-season) for further selection [Aug 2011]	14 crosses were made between blast-resistant and susceptible parents. The crosses have been advanced to F_3 and distributed to Uganda, Kenya, and Tanzania for further selection	Achieved	Annual reports, crosses, data in the database
	4.3.9	F_2s advanced to produce F_3 seed using SSD and pooled to generate the F_2-derived F_3 generation ($F_{2:3}$) and F_4 [June 2012]	F_3 seed was produced and shared with breeders in Uganda, Kenya, Tanzania, and Uganda	Achieved	Reports, crosses, database
	4.3.12	Breeding populations and lines developed based on crosses between blast, drought- and striga-resistant lines with farmer-preferred and adaptable varieties [Dec 2012]	Families developed for multiple traits are under observation in the field to identify true F_1 plants	On-going and on-target	Database
	4.3.14	Mapping population development using parental lines identified with diverse reaction to blast (a blast-resistant and a susceptible source) initiated [May 2013]	F_3 lines developed for blast mapping are in the field in KARI-Kiboko and being advanced to at least F_4 for mapping	On-going and on-target	Database
Activity 4: ***Identify and develop varieties with improved yielding ability, resistant to key biotic and abiotic stresses for the targeted agro ecologies and end uses***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
ESA	4.4.3	Superior lines that combine blast resistance, adaptation, preferred grain yield, and high levels of micronutrient identified to feed into on-station Multi-Environment Trials (MET) and Participatory Variety Selection (PVS) [Dec 2011]	20 superior lines that were fast tracked from the diversity studies, plus elite varieties from the NARS, were placed in a MET trial for evaluation in the four ESA countries. 4 lines selected from previous MET trials have been advanced to PVS trials in farmers' fields	Achieved	Reports, data
	4.4.8	Superior lines developed from farmer-preferred local varieties (identified for each country) using mass selection, supplemented with purity procedures [March 2013]	Lines derived from cleaning the farmer-preferred varieties are under observation in the field where they are undergoing further cleaning for uniformity	On-going and on-target	Database
	4.4.10	50 improved blast-resistant and drought-tolerant lines selected from the developed breeding populations available for preliminary yield evaluations [May 2013]	49 blast-resistant and drought-tolerant lines and checks are under evaluation in four countries	On-going and on-target	Database
Activity 5: ***Determine adaptability and yield stability of improved varieties for the targeted agro-ecologies and end use***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of**

					Verification
ESA	4.5.5	Sites for multi-location testing identified and described and materials contributed by partners multiplied [May 2011]	Multi-locational sites in each country have been identified. Materials from different NARS have been collated and evaluated as a regional finger millet trial	Achieved	Reports, data, lines
	4.5.9	25 high-yielding varieties tested in regional multi-environment trials (MET) at sites representative of the targeted agro-ecologies of the 4 ESA target countries and data shared [June 2012]	25 high-yielding varieties collected from NARS tested in representative agro-ecologies in the 4 countries	Achieved	Reports, data, lines
	4.5.13	MET data collated for joint analysis and interpretation by breeders trained on MET data analysis under the capacity building activity, 4.8 milestone 2 [March 2013]	MET data for 3 years is being collated and will be ready by end of August 2012 when the data from field trials will be finalized. A MET analysis training course is planned for September 2012 when this data will be analyzed	On-going and on-target	Database
	4.5.16	Grain quality characteristics and nutritional attributes of 5 varieties determined and documented [May 2013]	*None so far*	Not commenced	
Activity 6: ***Develop and assess crop management options for key constraints in the targeted finger millet production ecologies to enhance productivity***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
ESA	4.6.5	Herbicide-based weed management (pre- and post-emergence) options tested for cost efficiency and weed control effectiveness [April 2013]	Herbicide-based weed control options were found not to be effective for finger millet	Achieved	Annual report
	4.6.11	Options for integrated striga and weed management option availed [May 2013]	Use of resistant finger millet varieties together with fertilizer application and proper weeding regime was found to be the best option for striga management. Verification process is on-going in all countries. Row planting for easy weeding found to be best. Since manual planting is very tiresome, simple planting machines (animal drawn where possible) seem the solution, prototypes being tested	On-going and on-target	Database
	4.6.16	Different rates of fertilizer (macronutrients) tested in each country to determine the most feasible and economic rates [May 2013]	Trials are under observation in Kenya, Tanzania and Ethiopia. Report expected by May 2013	On-going and on-target	-
Activity 7: ***Participatory validation of integrated improved varieties with crop and fertility management options to enhance productivity***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
ESA	4.7.3	Effectiveness and economics of integrated variety, fertilizer, and weed management options validated with 120 farmers (40% of whom are women) in Ethiopia, Kenya, Uganda, and Tanzania [Dec 2011]	None so far. This work has not commenced due to current heavy commitment of economists. It is proposed to be re-scheduled for completion by May 2013	Not commenced	
	4.7.8	Variety Release Regulatory-compliant information	Two finger millet varieties were released in Tanzania. Several	On-going	Reports

		compiled and 4 varieties (1 each for Kenya, Ethiopia, Tanzania, and Uganda) become ready for moving into the release systems through each country's regulatory system [May 2013]	varieties are in the pipeline for release in other countries	and on-target	
Activity 8: ***Capacity building, knowledge and information sharing for pursuance of finger millet crop improvement and management***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
ESA	4.8.6	Short-term training provided to 35 NARS partners and information materials developed and shared with partners in Ethiopia, Kenya, Tanzania, and Uganda [May 2013]	1) Short training course in Multi-Environmental Trials (MET) data analysis and G x E results interpretation in Nairobi, June 2011, involving 30 participants from NARS institutions 2) Information sharing materials produced: a. Kenya - 2 brochure, 1 manual, 1 flyer b. Uganda - 1 brochure, 1 manual c. Ethiopia - 3 manuals d. Tanzania - 1 brochure 1 manual	Achieved	Reports, list of attendance, webpage (being loaded)
	4.8.10	Two MSc students advised on plant breeding and pathology covering conventional and molecular technology and one HOPE project-supported student on crop management and crop intensification [May 2013]	Two PhD students (Eric Manyasa at Kwa Zulu Natal University and Dagnachew Lule at Addis Ababa University) are being advised on plant breeding and supported by the project	On-going and on-target	Reports, PhD proposals, trials

OBJECTIVE 5: DISCOVER AND DEVELOP STRATEGIES FOR IMPROVING MARKETS FOR SORGHUM, PEARL MILLET, AND FINGER MILLET TO STIMULATE ADOPTION OF IMPROVED TECHNOLOGIES BY SMALLHOLDER FARMERS IN WCA, ESA, AND SA

ACTIVITIES CARRIED OUT IN THE PERIOD JULY 2011 – JUNE 2012

Activity 5.1 - Map marketing channels and measure transaction costs for selected value chains (food, feed, fodder) including competing crops (maize)

Mali: Market studies were conducted for pearl millet and sorghum grains. Forty-three traders were interviewed from nine major grain markets in Mali. For each crop, the marketing channels were mapped, and the marketing margins (net of transportation and storage costs) were measured along each marketing channel identified.

For pearl millet, ten marketing channels were mapped. The channels that provided the lowest marketing margins, net of transaction costs, were:

- Producers groups and Cooperatives – Assemblers – Wholesalers – Exporters
- Producers groups and Cooperatives – Assemblers – Wholesalers – Retailers – Consumers.

For sorghum, nine marketing channels were mapped. The channels with the lowest marketing margins, net of transaction costs, were:

- Individual producers and rural Assemblers – Retailers – Consumers
- Producers' groups and Cooperatives – Assemblers – Wholesalers – Exporters
- Producers' groups and Cooperatives – Assemblers – Wholesalers – Retailers – Consumers.

As expected, collective marketing appeared to be the best marketing strategy. Farmers selling pearl millet collectively gain an average of 10 FCFA per kg more than farmers selling individually. On average, farmers receive about 57% of the pearl millet consumer price. Rural assemblers gain 12% of the consumer price, while wholesalers gain 10% and retailers 21%. For farmers selling sorghum, on average farmers' groups earn 9 FCFA per kg more than selling individually. On average, farmers capture 71% of the consumer price, rural assemblers earn 13%, wholesalers 8%, and retailers 8%. Transportation accounts for a larger share of transaction costs. In Mali, quality traits sought by traders include grain homogeneity in size and color, and the absence of physical impurities such as sand.

Niger: Market studies were conducted for pearl millet and sorghum, and the report is available. Eighty-nine traders (brokers, rural assemblers, semi-wholesalers, wholesalers, and retailers) were interviewed from 10 markets. For each crop, the marketing channels were mapped, and marketing margins, net of transportation and storage costs, were measured along each marketing channel identified.

For pearl millet, seven marketing channels were mapped, and the lowest marketing margins, net of transaction costs, were provided by the Producer groups-Retailers-Consumers channel. As in the case of Mali, producers gain about 10 FCFA/kg by selling collectively rather than individually. Farmers earn a relatively larger share of the consumer price in Niger, accounting for 75%. Rural assemblers earned 12% of the consumer price, wholesalers 5%, and retailers 7%. Quality traits sought by traders include the absence of physical impurities such as sand, and grain homogeneity in size and color (red for pearl millet grain and white for

sorghum grain are preferred). In general, processors pay a premium of 4 to 14 FCFA per kg for good quality grain relative to poorer quality grain.

For sorghum, four marketing channels were mapped. The Producer groups-Retailers-Consumers channel provided the lowest marketing margins, net of transaction costs. Farmer groups earn 4 FCFA/kg more if they sell grain to retailers directly. On average, farmers get 74% of the consumer price, while rural assemblers receive 15%, wholesalers 11%, and retailers 2%. Quality traits required by the market include grain size and homogeneity, color (white grain color is preferred), and the absence of physical impurities such as sand.

Nigeria: Market studies have been carried out by partners LCRI (for pearl millet) and IAR (sorghum). Major marketing channels have been identified and mapped. Transaction costs along each channel have been estimated, and though the survey was carried out long ago, results from partners are still pending.

Ethiopia: A reconnaissance survey was conducted in five districts to identify relevant marketplaces. Based on this survey, market channels were mapped and markets for the market study were selected. The study was conducted in two districts for sorghum and in three districts for finger millet. In each district, data was collected from sorghum/finger millet retailers and wholesalers along the mapped market channel. One to three marketplaces were included at each level of the market channel (village markets in areas of production, markets in the next bigger cities, and final markets in urban centers). The collected data included information about grain purchases (from whom and where, prices, etc.), quality issues (grades and standards), and grain marketing (to whom and where, prices, etc.). Market survey data were entered, cleaned, and analyzed by EIAR partner scientists. The report on the survey is still pending from EIAR.

Tanzania: A reconnaissance survey of marketing channels was made in Tanzania in preparation for the processor survey. This was used to identify the processors included in the survey and to formulate the research design for the MSc thesis that studied the value chain for finger millet. For the MSc study, 77 finger millet farmers and 43 finger millet traders were interviewed in central Tanzania and Dar es Salaam, which is one of the most important final markets for finger millet from central Tanzania. The MSc student mapped and described finger millet market channels and estimated profit margins for different actors (farmers, rural assemblers, wholesalers, retailers) along the value chain. Results show that farmers have only restricted access to markets, as they often rely on either rural assemblers in their villages or traders that pass by the village. For rural assemblers and wholesalers, profit margins per kg of finger millet are lower than for farmers. However, as the turnover of those traders is usually higher than the harvest of a single farmer, they have higher total profits. Urban retailers have higher profit margins than rural retailers, because they can add a higher mark-up. As expected, profit margins are highest for processors, who produce finger millet flour. To increase farmers' profit margins and total profits, they need to be directly linked to traders in nearby markets. However, this normally requires collective action, as individual farmers often don't harvest enough to supply nearby markets. Moreover, selling individually increases transaction costs, which reduces profit margins.

SA (Maharashtra, Rajasthan, and Gujarat): Market surveys were conducted to determine the sorghum and pearl millet value chains and map the market channels both for grain and fodder. The two most widely observed marketing channels for grain (both for sorghum and pearl millet in Maharashtra, Gujarat and Rajasthan) are:

- Farmer – Primary market trader – Local retailer – Consumer
- Farmer – Primary market trader – Secondary market trader – Retailer – Consumer

The trade in both channels is facilitated through commission agents who charge 2-4% on the value of the produce. For post-rainy season sorghum in Maharashtra, physical value addition (cleaning, grading, bagging, packing, and branding) is primarily done by traders in the major markets. For pearl millet grain, while cleaning and grading is done, there is no branding.

For post-rainy season sorghum fodder the most prominent channels observed were:

- Farmer– Wholesaler– Consumer
- Farmer– Wholesaler – Processor – Consumer
- Farmer – Consumer (mostly dairy farms).

There are no formal channels for pearl millet fodder in Gujarat and Rajasthan. However, millet fodder is sold or exchanged within villages, based on existing demand and supply. Small quantities of pearl millet fodder find their way to urban centers through informal channels.

Activity 5.2 - Establish existing seasonal demand, quality characteristics, prices, and relative competitiveness of sorghum and millets in alternative uses (food, feed, fodder)

Mali: Demand for sorghum and pearl millet grain followed a seasonal supply in the market. The supply of grain in the cereal markets is high from October to March and low from April to September. Focus group meetings with processors indicated an annual demand of 1,375 tons for pearl millet and 1,325 tons for sorghum. The demand is a function of characteristics of millet grain. Focus group meetings with traders in Mali revealed that a physical impurity is a major quality indicator. For processors, the major quality characteristics include the rate of physical impurities, the size of the grains, and their homogeneity.

Some poultry farms were reported to use less sorghum because of its higher price. From 2006 to 2010, the price of sorghum was 10% higher than the price of maize, while the price of millet was 18% higher than maize.

Niger: As in Mali, the demand for sorghum and millet grain in Niger follows a seasonal trend. Focus group meetings with processors and poultry farmers showed that the annual demand from processors is about 200 tons for pearl millet and 100 tons for sorghum. The demand from poultry farmers is estimated to be about 174 tons for sorghum. Traders have reported the major pearl millet quality characteristics to be the color, especially the red color (Hainkire) very much appreciated by consumers, and the level of impurities. Traders pay on average 15-20 FCFA per kg more for color, i.e., the variety Hainkire. Similarly, sorghum traders prefer the yellowish color highly demanded in the market. Traders pay on average 7.5-10 FCFA more per kg for the yellow color. In addition to the color of the grain and physical impurities, emphasis is placed on the size of the grain and its homogeneity. Quality indicators are linked to the source of supply. Pearl millet coming from Mali and Burkina Faso, for example, is known to be of poor quality because of a high percentage of impurities (especially sand). Within the country, it is reported by traders that pearl millet originating from Dogondoutchi, Tillabery, and Maradi are of good quality. Pearl millet from Zinder in Niger and from Nigeria is often of poor quality. Farmers' organizations reported a number of quality characteristics as being very important. These include the level of impurities, the size of the grains, grain homogeneity, bag filling, and color linked to variety. However, apart from the color of the grain, i.e., the variety, the characteristics listed are not readily translated into a price premium.

There is limited demand for pearl millet for feed. Demand for sorghum as feed is growing, but is largely dependent on the relative price between sorghum and maize. Poultry raisers switch to sorghum if maize becomes comparatively more expensive.

Nigeria: Focus group meetings with representatives from GUINNESS, Nigerian Breweries, presidents of poultry farmers' associations, DALA foods, etc., revealed a high demand for sorghum in the malting and feed industries. It is estimated that during the last three years, the demand for sorghum was about 500,000 tons, of which 150,000 tons was used in the feed industry. Quality characteristics focused more on varieties likely to provide good malt. GUINNESS expressed a preference for SK 5912 (called "Short Kaura") for its good malting properties. An average premium of 5 Naira per bag is paid on SK 5912 over other varieties.

The use of sorghum in the poultry industry is growing, which is explained primarily by the limited supply of maize in the market, making its price relatively higher than sorghum.

Kenya: With partners EAGC and KARI, a sample of 13 major processors was identified in Nairobi, Kisumu, Nakuru, and Eldoret. A questionnaire was developed by EAGC and ICRISAT, and ICRISAT and KARI conducted the interviews. The processor survey for Kenya showed that the three main quality requirements were cleanliness, moisture content, and brown color. Only half the sample was satisfied with grain quality, but only three applied grades, and then only for finger millet. Eight were willing to pay a price premium for quality. High-season prices were paid between December and May. Seasonal price fluctuations averaged 57% for millet and 123% for sorghum.

Uganda: The processor survey for Uganda (15 processors) showed that the three main quality requirements for millets were cleanliness, no stones, and brown/red color. Less than half were satisfied with quality, but only two applied grades. Ninety percent were willing to pay a price premium for quality. Prices in the high season (August-January) were 21% lower than during the low season (May-August).

Tanzania: The processor survey for Tanzania (25 processors) showed that the three main quality requirements were cleanliness, freedom from pest damage, and color. Only half the sample was satisfied with quality, and less than half actually applied grades. One-quarter was willing to pay a price premium for higher quality. The difference in price between first and second grade grain was 25-28% for millet and sorghum. High-season was December-May, when prices were 40% lower for millet and 50% lower for sorghum. Finger millet was competitive with maize for local brews and cakes, and sorghum for cakes and bread. All processors stated that their demand for sorghum and finger millet has increased in the past 5 years and planned to expand production in the future. Figures supplied by processors on the expected increase in demand appear to be exaggerated, so no exact figures are quoted here.

Ethiopia: A processor survey has not been carried out in Ethiopia, due to a lack of clear sorghum and millet processors in the country. However, negotiations are currently in progress with the Ethiopian Institute of Development Studies to conduct a survey to determine the actual situation on the ground. This activity is expected to be completed by June 2013, and to provide information on potential strategies to reduce transaction costs and improve quality.

SA: Survey instruments were developed and market surveys were carried out in eight markets in Maharashtra for post-rainy season sorghum, and five markets in Rajasthan and six in Gujarat for pearl millet. Surveys were carried out to understand the quality specifications, price premiums and volume of trade of the grain for different end uses.

Maharashtra: Survey results revealed that there is a wide variation in prices of sorghum grain, ranging from Rs. 1,900 per 100kg to 3,200 per 100 kg. The variation is primarily due to varieties and the grading that exists within a variety. Jute, Maldhandi and Dagdi are the three most popular varieties traded in Maharashtra markets. Seed size, luster, color, and taste of the grain are the key quality parameters that determine the price. The grading within a variety is also based on its size and luster. The highest price variation of Rs. 2,400-3,500 per 100 kg within a variety is observed for Jute with 3 grades, followed by Maldhandi (Rs.2,700-

3000 per 100 kg) and Dagdi(Rs.2,500-3,000 per 100 kg). Quantitative estimations using regression analyses corroborate the survey findings.

Gujarat: For pearl millet in Gujarat, summer pearl millet (SPM) arrivals are increasing over time as the bulk of the produce is marketed and traded over long distances, including exports. Kharif pearl millet arrivals are variable and declining, depending on production/rainfall. Larger seed size, hexagonal shape, and uniformity of seed were significant quality parameters for export to Gulf countries. Kharif pearl millet and yellow-colored SPM are preferred for domestic food consumption. SMP prices are in the range of Rs. 1,200-1,250 per 100 kg and are Rs. 150-200 per 100 kg higher than KPM prices.

Rajasthan: In Rajasthan, the most preferred quality traits for food use are small-sized grain, round, uniform in shape, yellow/cream in color, hard, and sweet in taste. Grades I and II are mainly used as food, while grade III (blackened grain, rain touch, shriveled seed, old grain) is mainly used for cattle feed. The price difference between grades I and II is in the range of Rs. 50-75 per 100 kg, and between grades I and III it is Rs. 100-150 per 100 kg. With hybrids grown under irrigation, the grains are greyish yellow and medium to bold in size. Grade I of hybrids is used for food, grade II is supplied to flour mills and to hotels, and grade III is mainly used as cattle and poultry feed (exported to eastern Rajasthan, Punjab, Haryana, and Saudi Arabia). Hybrids fetch about Rs. 100 per 100 kg lower price compared to Desitypes.

Activity 5.3 - Identify consumer preferences, perceptions, and price- and non-price factors that determine the demand for sorghum and millet in human diets

Mali: Data from household consumption surveys was purchased from the Institut National de la Statistique (INSTAT) du Mali. Therefore, it was not necessary to carry out a consumer survey. These data were used to compute the drivers of consumer demand for sorghum and pearl millet. Data comprises a sample of 4,453 consumers, where 65% are rural consumers and 40% are poor. Factors driving the demand for sorghum include the price of sorghum (-), the price of rice (-), millet (+), expenditures (+), location (0=urban, 1=rural) [+], poverty (0,1=poor) [+], gender (0=male, 1=female)[-], illiterate (0,1=illiterate) [+]. Factors driving the demand for pearl millet include the price of sorghum (+), the price of maize (+), pearl millet (-), expenditures (+), location (+), poverty (+), illiteracy (-), etc.

In Mali, for all crops, the own-price elasticities were negative and sorghum, cowpea, maize, and pearl millet were price elastic. Cowpea and sorghum behave as complements, but sorghum and maize behave as substitutes. Rice behaves as a substitute for cowpea. Maize, local rice and imported rice are substitutes for sorghum and pearl millet. Sorghum, cowpea, maize, and millet have expenditure elasticities above 1 (signaling that these crops behave like luxury goods). In Mali rice behaves like a normal good.

Niger: Data from a household consumer survey was provided by the Institut national de la Statistique du Niger. Nationally representative data from ENBC in Niger include 4,000 consumers, of which 48% live in rural areas and 47% are poor. In Niger, factors driving the demand for sorghum are the price of rice (+), cowpea prices (+), maize prices (+), millet prices (-) and total expenditures (+). Consumers living in rural areas and poor households demand more sorghum. Surprisingly, households with more adult equivalents demand less sorghum. Factors driving the demand for pearl millet include sorghum prices (-), cowpea prices (-), maize prices (-), millet prices (-) and total expenditures (+). Consumers located in rural areas or in poor households demand more pearl millet. Surprisingly, illiteracy and households having more adult equivalents are negatively correlated with the demand for millet.

In Niger, for all crops, the own-price elasticities are negative, and imported rice and cowpea are found to be price elastic. Imported rice and sorghum behave as substitutes, and millet and sorghum as complements. Cowpea behaves as a complement to pearl millet. Sorghum, maize and millet behave as luxury goods, while cowpea is an inferior good and both local and imported rice behave as normal goods.

Nigeria: Drivers of demand for cereals were computed by Akinleye and May Rahji (2006)[10] using the most comprehensive dataset of 8,676 consumers from the national consumer survey (NCS) of the Federal Office of Statistics (FOS). Results showed that for low-income farmers, rice is a luxury food item. Own price elasticities show that sorghum and millet are the price elastic food items, while other foods are price inelastic. Cross-price relationships show that millet is a substitute for rice, guinea corn, yam, and maize, and that maize is a substitute for millet, sorghum corn, garri, and beans. For middle-income households in Nigeria, rice, yam, and pearl millet are the luxury food items, while guinea corn and maize are the essential foods. Sorghum is price elastic and other food items are price inelastic. Rice would substitute for millet, yam, and maize; sorghum would complement rice, millet, garri, beans, and maize; and maize is a substitute for rice, millet, sorghum, and garri.

Income elasticities for high-income households showed garri, beans, and maize to be inferior foods. The other food items are considered essential. Sorghum is price elastic, while the other food items areprice inelastic. Cross-price relationships show that pearl millet would substitute for sorghum, yam, and maize; and that yam would substitute for every other food item.

Kenya: A consumer preference survey was conducted at open air markets, retail outlets, and supermarkets in Kenya (sample size 454 consumers). Most sorghum and finger millet are bought at open air markets. About two-thirds of high income urban consumers buy finger millet in supermarkets, compared to one-third for sorghum. Results show higher share of consumers buying finger millet (78%) compared to sorghum (65%), greater volume purchased by higher-income urban consumers. Both are generally eaten as blended not as pure porridge.

The Kenya Bureau of Statistics gave ICRISAT access to the Household Expenditure Survey (2004/05)[11] data involving a nationally representative sample of 13,430 households. Results showed that 54% of households consumed millet and 5% of households consumed sorghum. The average quantity of millet consumed was 33 kg/AE/yr compared to 3 kg/AE/yr for sorghum. Consumption was higher in urban than in rural areas and higher among the non-poor relative to the poor. Results suggest high consumer demand for finger millet flour and grain in Kenya, but low demand for sorghum. The main commercial opportunity for sorghum is for beer (opaque home-brews and clear beer).

Uganda: Because of a limited capacity for socioeconomic research in NARO, which delayed the processor survey, it was decided to not conduct a consumer preference survey in Uganda. Information about consumer demand will be obtained from the ongoing analysis of the Uganda National Household Survey (NHS) that was conducted by the Uganda Bureau of Statistics in 2005/06.

Tanzania: A consumer preference survey (involving 400 consumers) was conducted in central Tanzania, the coastal area, and northern Tanzania. Data were obtained from open

[10] Akinleye and May Rahji (2006)[10]. Nutrient elasticities among Nigerian Households differentiated by income, *Agrekon*, Vol. 46 (2):274-288

[11]The project was not given access to more recent data, but it is postulated that the relative pattern of consumption will not have changed dramatically between this date and now.

markets, small retail outlets, and supermarkets. The analysis of consumer preference is ongoing and is expected to be completed by the end of July 2012.

Data from the Tanzania Household Expenditure Survey (2007) has recently become available. If ICRISAT were granted access to this data, it would be possible to make a study of consumer demand for sorghum and millets in Tanzania using the same template used for Kenya, Uganda, and Tanzania. The project will work with DRD and request access to the raw data. If available, a report on consumer demand in Tanzania would be completed by June 2013.

SA: The data on household consumption of sorghum and pearl millet collected under HOPE clusters during Year 2 was analyzed to understand the factors influencing consumption. Household size and household production were found to be the significant factors influencing higher consumption, while education and occupation (business/employed) were significant factors contributing to a decline in consumption. Consumption of sorghum as *roties* in restaurants is increasing in Maharashtra. Dry *roties* (that can be stored for some days) are also popular among consumers.

Pearl millet comprises a significant proportion of cereal consumption in project locations in Rajasthan and Gujarat, although its use is declining in both in urban and rural areas (albeit more slowly in rural areas). Some of the reasons for this decline are: availability of wheat from the Public Distribution System (PDS); longer cooking/preparation time; non-storability of flour, even for 1-2 weeks; non-availability/affordability of complementary commodities like ghee, curd; consumption being restricted to winter months; and changing food habits in urban India.

Activity 5.4 - Evaluate and identify effective grain and fodder marketing strategies for reducing transaction costs, and develop strategies for introducing grades and standards

Mali: A consultative meeting was organized in August 2011 at the CRES in Bamako, Mali. It was attended by 34 participants from 20 institutions [Financial institutions (KAFO Jiginew, FENATRA), IFDC, ORIAM, ECOFIL, AOPP, UACT, ULCP, WFP/P4P, UCODAL, DADO, FAO, WASA, Douceur sahelienne, Promo Avi Mali, Madia, Damanda, Afrique Verte, and AMEDD]. Direct value chain actors were involved, as were actors in the policy and institutional environment, and from the business development services. This consultative meeting between all value chain actors has permitted assessment of the existing marketing linkages between them, and the opportunities and constraints for value chain development. It was observed that the linkage between farmers and processors was weak, whereas it presented some opportunities for better payments to the farmers, and better quality of grain with more marketable processed products to the processors. Twenty-five representatives of farmers' organizations and processors were trained in small-scale business and marketing skills. A report on the training is available. Based on the results of the market study, establishing contractual arrangements for the transaction of improved pearl millet and sorghum varieties between farmers' organizations and processors was suggested as an effective marketing strategy. A report on the linkages between farmers' organizations and warehouse receipt systems is also available.

Niger: A consultative meeting was held in June 2012 at the ICRISAT TVC in Niamey, Niger. This was attended by 37 participants from institutions such as IFDC, 1000+, INRAN, ICRISAT, PFP/N, processors, traders, seed producers, extension services, MINAGRI, SIMA, Direction of Export at MINAGRI, NGOs (AGAPE, the Prime Ministry etc.). As in Mali, direct value chain actors, actors in the policy and institutional environment, and actors representing business development services were involved. The meeting permitted assessment of existing marketing linkages between the actors, as well as opportunities for and

constraints to development of the value chain. Seventy-three farmers' organizations and processors were trained in small-scale business and marketing skills. Implementing contractual arrangements for the transaction of improved pearl millet and sorghum varieties between farmers' organizations and processors was suggested as an effective marketing strategy. A report on the linkages between farmers' organizations and warehouse receipt systems is available.

Nigeria: A consultative meeting was held in August 2011 at the TAHIR Hotel in Kano, Nigeria, which was attended by 44 participants from such institutions as IAR, LCRI, NOWAIDA, WASA, ICRISAT, MOA, NAFDAC, GSARDI, IFAD/CBADP, NOTORE, ADPs of Kano, Katsina, Jigawa, GUINESS, farmers' associations, processors, Dala Foods, Celsian Mills, FURA processor, IFDC, WOFAN, Agricultural Bank, MAINA seeds, USAID-markets, WDI, UNION Bank, Bank of Industry, Agricultural Bank, GOLDEN, etc.). As in Mali and Niger, the meeting between all value chain actors permitted assessment of existing marketing linkages between the actors, and the opportunities for and constraints to development of the value chain.

ESA (Kenya, Uganda, Tanzania): The processor report for Kenya, Uganda and Tanzania (July 2012) identified three major strategies (for each country) to reduce transaction costs and improve quality. These included 1) training in post-harvest processing for farmers, 2) bulk buying from farmer groups, and 3) credit to allow processors to make bulk purchases. With respect to the first strategy, processors were willing to pay a price premium for higher-quality grain. All processors interviewed had a minimum quality standard they used in fixing a buying price, and rejected grain below this minimum quality standard. Regarding strategy 2, processors were willing to buy directly from farmer groups, but only through a buying agent. And regarding 3, credit would allow processors to contract for supply in bulk and reduce the higher transaction costs that come with small orders. The introduction of formal grades for grain may be premature at this stage in the industry's development, and a preferable strategy would be to focus on processors' willingness to pay for higher quality grain. All processors were aware of the need to meet industry standards for processed products.

Maharashtra: Interventions to facilitate improved marketing of sorghum (such as bulk marketing, direct selling, etc.) for higher returns to farmers were facilitated through direct selling of sorghum grain by farmers to end consumers at a "Food Grain Mahotsav", held at Nagar in May 2012. Farmers realized a higher price for their produce due to physical processing (cleaning, grading, and packing) and selling directly to the end users. However, scaling up such linkages will depend on good production and marketable surpluses.

Rajasthan and Gujarat: For pearl millet, output markets, retail market chains, wholesalers, livestock feed producers, alcohol distilleries, and poultry feed manufacturers were identified within and outside of the project clusters. In each of the cluster, farmers' associations (SHGs) were formed to directly link farmers' groups with all stakeholders in the value chain, including banks, retail chains, wholesalers, and processors. Farmers and stakeholders (industrial users/bankers) were brought into a common platform to facilitate linkages. Though linkages with industrial users were promising, they could not be formalized due to erratic production and uncertain availability of marketable surpluses. Also, the industrial users are located further away from the project clusters, particularly in Rajasthan for alcohol and poultry.

Activity 5.5 - Develop appropriate models for farmer-market linkages using alternative formal and informal arrangements with buyers to improve market access:

From the consultative stakeholder meetings referred to under Activity 5.4, and from the market surveys conducted in Mali, Niger, and Nigeria, two models for farmer-market

linkages were identified. These models, which are currently being monitored, include collective marketing, with farmers' groups supplying grain to processors and other institutions such as P4P, government, and/or selling to traders and making use of warrantage schemes (warehouse receipts).

Mali: Arising from the consultative stakeholder meetings referred to earlier, linkages were established between the farmer cooperative COPROSEM and Faso Kaba seed company, and contracts between them have been formalized. The ULPC farmer union established three contracts with P4P/PAM. This activity is linked to Objective 6.

Burkina Faso: Farmer cooperatives in Burkina Faso favor contracts with the government to sell most of their certified seed (due to prices that are higher than the market value). The farmer union FEPAB-Nayala, established in 2010/2011, contracted with P4P/WFP to supply 179 tons of sorghum grain and 154 tons of pearl millet grain to an NGO (CRS). This, too, is linked to Objective 6.

Niger: In Niger, a follow-up meeting (to the consultative stakeholder meeting) involving processors and farmer association grain producers was held on 16 February 2012 at the Stade Seyni Kountche in Niamey. The type of contracts and contract attributes preferred by both parties were discussed. Contracts to supply a total of 31 tons of grain were signed between farmers' associations (in Ouallam, Dantiandou, Falwel, and Tera) with processors (Groupement Bani-Bani, Boro tarey, Marietout, Unions DiGAbedje, and Feba) in Niamey, Niger. These contracts are available for review.

Nigeria: Due to insecurity, arrangements between farmers' organizations and buyers in Nigeria have not been initiated to study their efficiency and appropriateness.

Ethiopia: The project partner in Ethiopia (EIAR) has not identified any innovative business models for the supply of sorghum and millet, and they will assess the models developed in Uganda and Kenya (see below).

Kenya: A study is planned to review experiences with innovative business models to link farmers with markets, which will include the business model used by Smart Logistic to link sorghum growers with East African Breweries Limited (Kenya). This study will be completed by the end of December 2012.

Uganda: A study is planned to review experiences with innovative business models to link farmers with markets, to be completed by the end December 2012. This will include the business model used by the LEAD Project, Uganda, to link finger millet rowers with Unga Mills Limited (Kenya).

Tanzania: INTSORMIL has funded a PhD student's study of the business model used to link sorghum growers with breweries in Tanzania, and key findings will be summarized in the report on innovative business models to be completed by the end of December 2012.

SA: Available effective models for linking grain and fodder producers of sorghum and pearl millet with buyers/end users were reviewed and case studies were documented in the training manual on value chain analysis. Additionally, a brief paper on linking farmers to markets, which is in an advanced stage of completion, will identify a few relevant models for sorghum and pearl millet. The training manual on value chain analysis can be accessed via the HOPE website.

Activity 5.6 - Determine opportunities for small-to medium-scale agro-enterprise development, local processing, and value addition to stimulate markets and expand consumption demand

Mali: During the same consultative stakeholders' meeting held in August 2011 in Bamako (referred above), agri-business opportunities were identified along the value chain and especially in the sub-sector of processing. Small-scale businesses were identified around the investments n de-stoners, milling machines, and/or threshers. In the project, interventions focused on the supply of the milling machine, which was ranked first by stakeholders. Consequently, three pilot villages and three small-scale processors were equipped with milling machines. The operation and impact of these machines are currently being monitored for their profitability and the labor saved by women at the village level. Village committees were formed and trained in machine operation, maintenance, and information gathering.

Niger: During the consultative stakeholders' meeting held in June 2012 in Niger, agri-business opportunities were identified along the value chain, and especially in the sub-sector of processing. As in Mali, three pilot villages and six small-scale processors in urban Niamey were equipped with milling machines by the HOPE project. These investments are currently being monitored for their profitability and laborsaving characteristics. An MSc student from the University of Niamey has started his fieldwork on the effects of milling machines on labor use by women in the three selected villages.

Nigeria: During the consultative meeting held in Nigeria, agri-business opportunities were identified along the value chain, and especially in the sub-sector of processing. Investments on such equipment as milling machines, de-stoners, and threshers were preferred. In addition, specific products were targeted, including weaning foods, FURA and flour, and malt. In the GUMEL local government, a woman entrepreneur famous for processing FURA, and a flour processor have been targeted, as well as three women's groups engaged in processing weaning/baby foods. These groups were trained and equipped with milling machines and other small equipment. The profitability of such enterprises is currently being monitored.

Kenya: A processor survey conducted in Kenya did not identify any new products or new opportunities for value addition. The consumer market in the country is mostly for flour. The consumer market for finger millet flour is highly differentiated, with many different brands targeting distinct consumer segments.

Uganda: A processor survey for Uganda did not identify any new products or new opportunities for value addition. See the reasons given for Kenya above.

Tanzania: A processor survey for Tanzania identified opportunities for five value-added products for millet and sorghum. The most promising are local brews, cakes and cookies (using millets), and cakes, cookies, and bread (using sorghum). These opportunities are not new, but do represent opportunities. However, processors reported a lack of knowledge about the specifications for these products.

SA: Opportunities for value addition to sorghum and pearl millet grain were identified through reconnaissance market surveys. As a follow up on this, extensive discussions were held with small-scale machinery manufacturers, nutritionists, processors and feed manufacturers. Suitable, cost-effective, small-scale machinery for cleaning, sorting, and grading of sorghum and pearl millet grain and chopping machine to add value to fodder were identified. Small-scale equipment for developing value-added products (flakes/flour/popped products) were also identified. The testing of these value chain interventions is not possible as there is no provision for doing so under the project.

Activity 5.7 - Strengthen local capacity for value chain and policy analysis and market projection:

WCA: Training was carried out in Mali, Niger, and Nigeria for selected value chain actors – seed producers, farmers' associations, processors, and individual farmers. They were trained in small-scale business and marketing skills. A joint regional training on value chain analysis and impact assessment is planned for 5-11 August 2012.

ESA: Training was given in the design of consumer preference and processor surveys to four staff from KARI (Kenya), two from EAGC (Kenya), and three from DRD (Tanzania). One MSc student completed his thesis on "Analysis of finger millet profitability and the marketing chain in the central zone of Tanzania", which was submitted to Sokoine University.

SA: A training manual on value chain analysis was completed that also includes cases studies on linking farmers to buyers. Additionally, a brief on strategies for linking farmers to buyers is in the advanced stage of completion.

PROJECT OUTPUTS REALIZED UNDER OBJECTIVE 5 TO DATE

Table 5 presents the major outputs realized under Objective 5 by the end of June 2012.

Table 5: ***Major Project Outputs Realized in Objective 5 as of June 30, 2012***

Activity 1: ***Map marketing channels and measure transaction costs for selected value chains (food, feed, fodder) including competing crops (maize)***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	5.1.3	Market and value chain surveys conducted for sorghum (Nigeria and Mali) and pearl millet (Niger) [Dec 2010]	Market and value chain surveys have been conducted for sorghum (Nigeria and Mali) and pearl millet (Niger)	Achieved	Reports for Niger, Mali and Nigeria available at ICRISAT Niamey
	5.1.5	Marketing channels identified and mapped for selected value chains in Nigeria, Niger, and Mali [Sept 2011]	Market channels have been identified and mapped for pearl millet and sorghum grain in Nigeria, Niger, and Mali	Achieved	Reports for Niger, Mali and Nigeria available at ICRISAT Niamey
	5.1.6	Transaction costs and distribution of marketing margins estimated for selected value chains for sorghum (Nigeria, Mali) and pearl millet (Niger) [Dec 2012]	Transaction costs from grain markets have been estimated. The work is ongoing	On-going and on-target	Reports on value chains are under preparation
ESA	5.1.5	Market and value chain surveys conducted for sorghum and finger millet in Tanzania and Ethiopia using trained enumerators [May 2011]	Rapid market surveys have been conducted for sorghum and finger millet in Tanzania and Ethiopia. An in-depth market survey was conducted for finger millet in Tanzania by an MSc student. The thesis is submitted. This work experienced delay in Ethiopia due to over-commitment of EIAR scientists. Final report is now under preparation by EIAR, and is expected Dec 2012	Delayed but on-going	Market survey report in preparation by EIAR
	5.1.7	Marketing channels for finger millet and sorghum defined and value chains mapped in Ethiopia and Tanzania [May 2012]	Market channel report for finger millet available for Tanzania (MSc thesis), and market channel data for Ethiopia collected but not yet analyzed by EIAR. New completion date estimated to be Dec 2012	Delayed: Completed for Tanzania but on-going for Ethiopia	MSc thesis on market channel for finger millet in Tanzania, market channel report in Ethiopia, in preparation by EIAR (ready Dec 2012)
	5.1.9	Transaction costs and distribution of marketing margins estimated for selected value chains in Ethiopia and Tanzania [March 2013]	Transaction costs and distribution of marketing margins have been estimated for finger millet in Tanzania (MSc thesis). Analysis of selected value chains in Ethiopia will be completed by June 2013	Delayed: Completed for Tanzania and on-going for Ethiopia	MSc thesis (Tanzania)
SA	5.1.5	Grain and fodder market and value chain surveys conducted for sorghum (Maharashtra) and pearl millet (Gujarat and Rajasthan) [April 2011]	Grain and fodder market and value chain surveys were conducted for sorghum (Maharashtra) and pearl millet (Gujarat and Rajasthan)	Achieved	Notes on reconnaissance surveys of grain and fodder markets for sorghum and pearl millet
	5.1.8	Marketing channels for sorghum (Maharashtra) and pearl millet grain and fodder (Gujarat and Rajasthan) defined and value chains mapped [April	Marketing channels for sorghum (Maharashtra) and pearl millet grain and fodder (Gujarat and Rajasthan) have been	Achieved	Spreadsheet files with inputted data are available, (draft) journal article on

		2012]	defined and value chains have been mapped		marketing of pearl millet grain in Rajasthan
	5.1.10	Transaction costs and distribution of marketing margins estimated for selected value chains for sorghum (Maharashtra) and pearl millet grain and fodder (Gujarat and Rajasthan) [March 2013]	None so far	Not commenced	-
Activity 2:*Establish the existing seasonal demand, quality characteristics, prices and relative competitiveness of sorghum and millets in alternative uses (food, feed, fodder, etc.)*					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	5.2.6	Potential demand for grains and processed products targeting processors of flour, weaning foods, and other processed products estimated [April 2011]	Potential demand for grains and processed products targeting processors of flour, weaning foods, and other processed products have been estimated	Achieved	Report available for Mali, Niger, and Nigeria
	5.2.7	Product characteristics, quality requirements and price premiums for different end-users identified and mapped for sorghum (Burkina Faso, Nigeria, Mali) and pearl millet (Niger, Mali) [Aug 2011]	Product characteristics, quality requirements and price premiums for different end-users have been identified for Niger (pearl millet) and Mali (pearl millet and sorghum)	Achieved	Consultative meeting reports, MSc thesis(for Niger)
ESA	5.2.2	Demand for food processing industries for finger millet estimated in Kenya, Uganda, Ethiopia, and Tanzania [Aug 2011]	Report on processor survey has been written for Kenya, Uganda, and Tanzania. Processor survey for Ethiopia (requested by Yilma) pending, currently hiring a consultant. Report expected June 2013	Delayed: Completed for Kenya, Uganda, and Tanzania and on-going for Ethiopia	Processor Survey Report for Kenya, Tanzania, Uganda
	5.2.5	Potential demand for use of sorghum as food and feed and its competitiveness estimated in Ethiopia and Tanzania [Dec 2011]	Processor survey completed for Kenya, Uganda, and Tanzania and report available. Ethiopia Processor Survey (contract now being negotiated) will examine food-feed profitability. INTSORMIL has conducted a study on use of sorghum for feed in Tanzania, so the project will not duplicate that work (i.e., this activity has been dropped)	Delayed: Completed for Kenya, Uganda, and Tanzania, and on-going for Ethiopia	Processor Survey Report for Kenya, Tanzania, Uganda
	5.2.8	Product characteristics, quality requirements and price premiums for different end-users identified [April 2012]	Product characteristics, quality requirements and price premiums for different end-users have been identified for Kenya, Tanzania, and Uganda. For Ethiopia, a processor survey has not been conducted, and is rescheduled for completion in June 2013.	Delayed: Completed for Kenya, Uganda, and Tanzania and on-going for Ethiopia	Processor Survey Report for Kenya, Tanzania, Uganda (July 2012).
	5.2.11	Options identified to improve consistency of supply in meeting end-user needs for quality and quantity [Aug 2012]	Options to improve consistency of supply in meeting end-user needs for quality and quantity have been identified for Kenya, Uganda, and Tanzania. Work on Ethiopia has commenced and is expected to be delivered by June 2013	Delayed: Completed for Kenya, Uganda, and Tanzania and on-going for Ethiopia	Processor Survey Report for Kenya, Tanzania, Uganda
SA	5.2.2	Potential demand for food and other uses of	Potential demand for food and other uses of sorghum grain	Achieved	Reports of

		sorghum grain (Maharashtra) and pearl millet (Gujarat and Rajasthan) estimated [Dec 2010]	(Maharashtra) and pearl millet (Gujarat and Rajasthan) have been estimated		reconnaissance survey, SAT e-journal, Food Security journal, and a working paper series (also available from the HOPE online repository).journal article on demand and supply of pearl millet grain in Rajasthan (submitted)
	5.2.4	Potential demand for fodder from sorghum (Maharashtra) and pearl millet (Gujarat and Rajasthan) estimated [April 2011]	Potential demand for fodder from sorghum (Maharashtra) and pearl millet (Gujarat and Rajasthan) has been estimated	Achieved	Reports of reconnaissance surveys of fodder markets
	5.2.7	Product characteristics, quality requirements and price premiums for different end-users grain and fodder for sorghum (Maharashtra) and pearl millet (Gujarat and Rajasthan) identified [May 2012]	Product characteristics, quality requirements, and price premiums for different end-users of grain and fodder for sorghum (Maharashtra) and pearl millet (Gujarat and Rajasthan) have been identified	Achieved	Reconnaissance surveys notes and data available. A report is under preparation
	5.2.10	Options to improve consistency of supply in meeting end-user needs for quality and quantity of grain and fodder of for sorghum (Maharashtra) and pearl millet (Gujarat and Rajasthan) identified [March 2012]	None so far	Not commenced	
Activity 3:*Identify consumer preferences, perceptions and price and non-price factors that determine the demand for sorghum and millet in human diets*					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	5.3.3	Consumer surveys conducted in selected regions for pearl millet (Niger and Mali) (May 2010) and sorghum (Nigeria and Mali) conducted [Jan 2011]	Consumer surveys conducted in selected regions for pearl millet (Niger and Mali) and sorghum (Nigeria and Mali) have been conducted	Achieved	Report on consumer demand and factors driving demand for coarse grain available at ICRISAT-Niamey
	5.3.6	Drivers of consumer demand for sorghum and pearl millet as food identified in Mali, Niger, and Nigeria [Aug 2012]	Drivers of consumer demand for sorghum and pearl millet as food have been identified in Mali, Niger, and Nigeria	Achieved	Report on consumer demand and factors driving demand for coarse grain available at ICRISAT-Niamey
	5.3.7	Policy brief on Strategies for improving consumer demand for sorghum and pearl millet as human foods in WCA developed [March 2013]	None so far	Not commenced	

ESA	5.3.5	Consumer surveys in selected markets for finger millet (Kenya) and sorghum (Tanzania and Ethiopia) conducted [Sept 2011]	Consumer preference surveys completed in Tanzania and Kenya, and now being analyzed. Report on consumer preference surveys for Tanzania and Kenya available by August 2012. Household consumer expenditure survey has been analyzed for Kenya. Household consumer expenditure survey now being analyzed for Ethiopia and Uganda. Draft reports available end of August 2012. Final report due Dec 2012	Delayed but on-going	Reports on consumer preference survey and household consumer expenditures – as these become available in the revised time frame
	5.3.9	Strategies for improving consumer demand for sorghum (Ethiopia, Tanzania) and finger millet (Kenya) as human foods developed [Oct 2012]	None so far. This activity awaits the completion of analysis of household expenditure studies for Uganda and Ethiopia in August 2012.	On-going and on-track	
SA	5.3.4	Factors that influence consumption of sorghum (Maharashtra) and pearl millet (Gujarat and Rajasthan) for food identified and documented [Feb 2012]	Factors that influence consumption of sorghum (Maharashtra) and pearl millet (Gujarat and Rajasthan) for food have been identified and documented	Achieved	Reconnaissance survey reports and paper on demand and supply of pearl millet.
	5.3.6	Strategies for improving consumer demand for sorghum (Maharashtra) and pearl millet (Gujarat and Rajasthan) as human foods developed [Dec 2012]	None so far	On-going and on-target	
Activity 4:*Evaluate and identify effective grain and fodder marketing strategies for reducing transaction costs and develop strategies for introducing grades and standards*					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	5.4.4	Farmers' associations/organizations developed/strengthened for collective marketing (e.g., agro-dealers and producer marketing groups) for pearl millet (Mali, Niger) and sorghum (Mali, Nigeria) [Jan 2012]	Selected farmers' associations/organizations have been trained in small-scale business and marketing skills in Niger and in Mali. Work in Nigeria is pending due to insecurity	Delayed: Completed for Mali and Niger and on-going for Nigeria	Report on the training available for Niger and Mali at ICRISAT-Niamey
	5.4.7	Grain collection points for sorghum (Mali) and pearl millet (Mali and Niger) established or reinforced [July 2011]	Established grain collection points have been identified in Mali and Niger. Work on this activity is on-going	Delayed but on-going	Report on market baselines available at ICRISAT Niamey
	5.4.10	Warrantage system (warehouse receipt system) tested for sorghum (Mali) and pearl millet (Niger) [March 2013]	None so far	Not commenced	
	5.4.11	Grades and standards associated with corresponding price premiums for sorghum (Mali) and pearl millet (Mali and Niger) identified and promoted [May 2013]	None so far	Not commenced	
ESA	5.4.2	Good business practices and price premiums needed for grades and standards established and	Information on grades and standards and price premiums was collected in the processor surveys for Kenya, Tanzania, and	Achieved	Processor Survey Report for Kenya, Tanzania,

		documented (Ethiopia, Tanzania) [Sept 2011]	Ethiopia and presented in processor survey report. Results will be contained in report with processor surveys, available July 2012)		Uganda (July 2012)?
	5.4.5	Marketing through farmer organizations (e.g., agro-dealers and producer marketing groups) tested for sorghum (Ethiopia, Tanzania) and finger millet (Kenya, Ethiopia, Tanzania) [Sept 2011]	Innovative business models have been identified for study in Uganda and Kenya, and preliminary visits made to establish contacts. Research and report will be completed by end of Dec 2012.	Delayed but on-going	Report on business models for sorghum and finger millet (Dec 2012)
	5.4.8	Grain collection centers tested and evaluated for sorghum (Ethiopia, Tanzania) and finger millet (Ethiopia, Tanzania) (link with P4P of WFP) [May 2012]	Innovative business models, including Warehouse Receipt Systems, have been identified for study in Uganda and Kenya. Research and report will be completed by Dec 2012.	Delayed but on-going	Report on business models for sorghum and finger millet (Dec 2012)
	5.4.10	Warehouse receipt systems tested for sorghum marketing (Ethiopia, Tanzania) (link with P4P of WFP) [May 2013]	Innovative business models have been identified for study in Uganda and Kenya, and preliminary visits made to establish contacts. Research and report will be completed by end of 2012.	On-going and on-target	Report on business models for sorghum and finger millet (Dec 2012)
SA	5.4.2	Marketing of grain through farmer organizations (e.g., agro-dealers and producer marketing groups) linked with supermarkets, processors and wholesalers tested in India for sorghum (Maharashtra) and pearl millet (Gujarat, and Rajasthan) [Dec 2011]	Facilitated linkage through direct selling of sorghum grain by farmers to end users at a "*Food Grain Mahotsav*" held at Ahmednagar, Maharashtra. Linkages could not be established for pearl millet due to erratic production	Delayed but on-going	Short notes and photos
	5.4.4	Marketing of fodder through farmer organizations linked with feed processors and wholesalers tested in India for sorghum (Maharashtra) and pearl millet (Gujarat and Rajasthan) [Feb 2013]	None so far	Not commenced	
Activity 5:*Develop appropriate models for farmer-market linkages using alternative formal and informal arrangements with buyers to improve market access*					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	5.5.3	Options (radio, mobile phones, other existing market information systems) for delivering timely and relevant market information to farmers tested and identified for sorghum (Nigeria, Mali) and pearl millet (Niger and Mali) [Dec 2011]	Formal contracts between rural radio providers and the project established for the supply of information in Niger and being finalized in Mali	Delayed: Completed for Niger and on-going for Mali and Nigeria	Contracts with rural radios available for Niger
	5.5.8	Formal and informal contractual arrangements between producers and food/feed processors tested and best practices identified for sorghum (Mali) and pearl millet (Niger) [Aug 2012]	Contractual arrangements established for the 2012/13 growing season in Niger and Mali (linked to Objective 6)	Achieved	Contract between producers and food processors available for Niger and Mali
ESA	5.5.1	Options (radio, mobile phones, internet, etc.) for delivering timely and relevant market information	Options for delivering timely and relevant market information to farmers were tested and identified for sorghum (Ethiopia,	Achieved	Julius J. Okello and David J. Otieno (2012).

		to farmers tested and identified for sorghum (Ethiopia, Tanzania) and finger millet (Kenya, Tanzania) [Sept 2011]	Tanzania) and finger millet (Kenya, Tanzania)		Market Information Systems in Eastern Africa: A Review of Services Provided, Performance and Challenges (EAGC)
	5.5.3	Effective best business practices for linking producers with food processing industry tested and identified for finger millet (Kenya, Tanzania) [April 2012]	Innovative business models, including Warehouse Receipt Systems, have been identified for study in Uganda and Kenya. Research and report will be completed by Dec 2012	Delayed but on-going	Report on business models for sorghum and finger millet (Dec 2012)
	5.5.5	Formal and informal contracting methods with food and feed processing industry tested and best practices identified for sorghum (Tanzania, Ethiopia) [May 2013]	Innovative business models have been identified for study in Uganda and Kenya. Research and report will be completed by end of 2012	On-going and on-target	Report available Dec 2012
SA	5.5.3	Options (radio, mobile phones, internet, etc.) for delivering timely and relevant market information to farmers tested and identified for sorghum (Maharashtra) and pearl millet (Gujarat and Rajasthan) [March 2011]	Options for delivering timely and relevant market information to farmers have been identified and tested for sorghum (Maharashtra) and pearl millet (Gujarat and Rajasthan)	Achieved	Findings from the survey available. Documentation of radio talks and newspaper articles delivered by partners on marketing of sorghum and millet
	5.5.6	Effective models for linking producers with food/feed processing industry for grain and fodder documented for sorghum (Maharashtra) and pearl millet (Gujarat, and Rajasthan) [April 2013]	None so far	Not commenced	
Activity 6: ***Determine opportunities for small-to-medium scale agro-enterprise development, local processing and value addition to stimulate markets and expand consumption demand***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	5.6.2	Agribusiness opportunities for sorghum (Mali, Nigeria) and pearl millet (Mali, Niger) in processing, transport, storage, wholesale and retailing activities identified and models developed through consultation and meetings with value chain actors [Aug 2011]	Agribusiness opportunities have been identified and models developed through consultative stakeholder meetings in Niger, Mali, and Nigeria	Achieved	Stakeholder workshop reports
	5.6.5	Labour-saving and low-cost options for household processing and utilization of sorghum (Mali) and pearl millet (Niger) by targeting women tested [Sept 2011]	Milling machines supplied to farmers in Ouallam, Dantiandou, and Tera (in Niger) to serve for pilot testing time utilization by women and the profitability of such machines for private entrepreneurship. Same in 3 villages of Mali	Achieved	Milling machines established in 3 rural villages of Niger and Mali which can be visited

	5.6.7	Agro-enterprise opportunities in production and marketing of foundation and certified seed identified and models developed for sorghum (Mali, Nigeria) and pearl millet (Niger, Mali) [March 2012]	This work is in progress, linked to Objective 6	Delayed but on-going	
	5.6.10	Equip and enhance the capacity of food processing unit in Niger for supplying good quality sorghum and pearl millet processed products in the market (linked to the private sector) [May 2013]	None so far	Not commenced	
ESA	5.6.3	Agribusiness opportunities for sorghum (Ethiopia, Tanzania) and finger millet (Tanzania, Kenya, Uganda) in processing, transport, storage, wholesale and retailing activities identified and models developed through discussions with stakeholders [Oct 2011]	Processor surveys for Uganda, Kenya, and Tanzania were conducted and companies identified agribusiness opportunities. Innovative business models have been identified for study in Uganda and Kenya, and preliminary visits made to establish contacts. Research and report will be completed by end of 2012.	Delayed but on-going	Report on business models for sorghum and finger millet (Dec 2012)
	5.6.5	Agro-enterprise opportunities in production and marketing of foundation and certified seed identified and models developed [Feb 2012]	None under Objective 5. Seed model analysis being done under Objective 6	Transferred to be carried out under Objective 6	
	5.6.8	Labour-saving and low-cost options for household processing and utilization of sorghum and finger millets tested [May 2013]	None so far	Not commenced	
SA	5.6.3	Low-cost options for household processing and utilization of sorghum (Maharashtra) and pearl millet grain (Gujarat) tested [Sept 2011]	Low-cost options for household processing and utilization of sorghum (Maharashtra) and pearl millet (Rajasthan and Gujarat) grain were identified. Testing of the options could not be carried out due to delay in installing the equipment in the villages	Partially completed, delayed but on-going	Details of the low-cost equipment and value added products available
	5.6.6	Low-cost options for household-level processing and utilization of sorghum(Maharashtra) and pearl millet(Gujarat) fodder tested [April 2013]	None so far	Not commenced	
Activity 7:*Strengthen local capacity for value chain and policy analysis and projection of markets for dryland cereals*					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	5.7.3	Regional short-term training courses or research workshop for partners on agribusiness skills and enterprise opportunities in sorghum and pearl millet organized and proceedings available [Aug 2011]	Farmers' organizations and processors trained in agribusiness skills in Niger in Mali. Regional training on value chain analysis and impact assessment planned for 7-13 August 2012 in Niger	Delayed but on-going	Proceedings will be available by October 2012
	5.7.5	2 MSc students from Niger and Mali trained in	1 student has been trained in Niger, and MSc thesis completed	Partially completed,	1 MSc thesis available

		local universities on marketing [April 2013]		on-going	
	5.7.6	Technical brief on improving market linkages and manual for processing and agribusiness development developed and available [May 2013]	None so far	Not commenced	
ESA	5.7.2	Support and supervise 3 MSc students from the target countries in the region for their research on improving markets for sorghum and finger millet [Sept 2010]	3 MSc students are being supported and supervised		1 MSc thesis completed.
	5.7.7	Regional short-term training for partners conducted in value chain analyses methods; strategies for linking farmers with buyers; and agribusiness skills and enterprise opportunities in sorghum and finger millets [Nov 2012]	Training in value chain analysis has been provided to 14 EIAR staff. Work is on-going	On-going	List of EIAR trainees
	5.7.8	3 master thesis completed by MSc students and seminars presented for project partners [Feb 2013]	1 MSc thesis completed (Tanzania). Fieldwork for 2 MSc theses completed (Uganda and Ethiopia)	On-going and on-target	1 MSc thesis completed
	5.7.9	Policy brief on improving markets and toolkits for processing and agribusiness development, especially for women [May 2013]	None so far	Not commenced	
SA	5.7.2	Support 2 MSc students from India for research on improving markets for sorghum and pearl millet [April 2010]	2 MSc students from India were supported by the project for research on improving markets for sorghum and pearl millet	Achieved	MSc thesis on fodder markets for sorghum available, a PhD thesis on pearl millet grain marketing is in draft form
	5.7.7	Regional short-term training courses prepared and research workshops conducted for partners in value chain analyses methods and strategies for linking farmers with buyers and improving agri-business skills [Nov 2012]	One training program on value chain analysis has been completed and more are planned and will be completed before the due date	On-going and on-track	Training reports
	5.7.8	Policy briefs on improving markets and toolkits for processing, especially for women [April 2013]	Work on this activity has commenced. Results from the market surveys are being complied to develop a policy brief, to be completed by due date	On-going and on-target	

OBJECTIVE 6: ENABLE TECHNOLOGY ADOPTION OF SORGHUM, PEARL MILLET, AND FINGER MILLET BY IMPROVING ACCESS TO SEEDS, MARKETS, INPUTS, KNOW-HOW, AND FINANCE IN WCA, ESA, AND SA

ACTIVITIES CARRIED OUT IN THE PERIOD JULY 2011 – JUNE 2012

Activity 6.1 - Increase farmers' access and use of know-how about the use and benefits of profitable crop management technologies and improved cultivars

Mali: Training and awareness-building activities on the use and profitability of integrated striga and soil fertility management technologies and improved cultivars were carried out. At least 440 men and 62 women from 15 villages in Koulikoro and Sikasso region were trained. Additionally, training and awareness work was done to reach 3,950 farmers (10% of which were women) in 30 villages in Mopti.

Farmer exchange visits, video projections, and interactive radio programs at five local stations, as well as television broadcasts, have all been used to train and inform farmers on the use and profitability of integrated striga and soil fertility management technologies and improved cultivars. Some 1,600 men and women farmers from Koulikoro and Sikasso region and 1,200 farmers from 15 villages in the Segou region were reached with improved technology. In the Mopti region, the Aga Khan Foundation estimated that approximately 15,240 farmers were indirectly reached through radio programs. Furthermore, some 1,083 farmers in the Diola region participated in radio programs by calling in during the shows. More than 500 telephone calls were registered by the ULPC, and 177 at radio Diédougou, during 38 broadcasts. In Tominian, the local radio network Moutian provided 35 broadcasts in collaboration with UACT, in which 765 farmers participated and 295 telephone calls were registered during the programs. ULPC and UACT received co-funding from EU/IFAD for these activities. Contracts have been signed between ICRISAT and rural radios to supply information on such technologies as improved varieties and market information (current prices, demand, and supply) with the radio networks Kayira and Yeredon in Koutiala, Mouintan and Taresi in the Tominian zone, and Tilibo and Balinko in Dioila.

Niger: Training and awareness building were carried out (in collaboration with Mooriben and Fuma Gaskia farmer organisations) on the use and profitability of integrated striga and soil fertility management technologies, as well as improved cultivars. A total of 330 women and 269 men from 22 villages in central Niger were trained.

Training was conducted through video projections of DVDs produced in Year 2 and Year 3 on integrated striga and soil fertility management technologies for the benefit of approximately 150 farmers in western Niger. Four local radio stations (Bokki, Say, Aguié, and Tera) aired 11 broadcasts on crop management, improved pearl millet varieties, and seed production. A study conducted by a student in 2012 (Kristal Jones) revealed that 60% of mini-pack buyers in Bokki region listen to Say radio, which broadcasts information on seed and improved varieties. Rural radio programs have been adapted to include information on prices of major commodities, as well as the demand and supply of different grains. The rural radio networks Falwel, Dantiandou, Ouallam, Bokki, and Tera are all involved.

Burkina Faso: Four local radio networks broadcasted four different programs each on varietal and crop management issues. The translation of the seed production manual for sorghum was finalized, and it will be published in Year 4.

Nigeria: Some 150 farmers were trained in the use and profitability of integrated striga and soil fertility management technologies and improved cultivars. The ICRISAT/WASA pearl

millet seed production manual (produced in 2009 and 2010) was translated into Haussa and 700 copies were printed for circulation (of which half will be distributed in Niger). One hundred and ten (110) seed production manuals for pearl millet in the Haussa language and 136 sorghum seed production manuals in English were distributed during April-June 2012.

Ethiopia: A total of 61 on-farm participatory demonstrations were carried out for sorghum and finger millet. In Mieso, sorghum varieties MI5093 and Melkam were demonstrated on the fields of seven farmers, while the Chelenko and Chiro varieties were demonstrated on five farmers' fields in the Chiro district. Three on-farm micro-dosing demonstrations using the sorghum variety Misikir were conducted in Kobo district. Farmer field days featuring sorghum were organized in November 2011 at Kobo and Mieso districts, which was attended by 230 farmers (17 of them women), and 89 experts and administrators from different organizations participated.

On-farm demonstrations of finger millet varieties were conducted on 20 farmers' fields. A total of 14 micro-dosing and weed management demonstrations were conducted in Shalla and Guangua districts, with each hosting 7 demonstrations. Seven improved varieties and one local cultivar were planted on six farmers' fields for PVS in Guangua district, and the evaluations and selections by farmers were completed. A total of eight field days were organized in different locations for both crops. Participants included farmers, Bureau of Agriculture staff, district administrators, researchers and NGO representatives. Field days on finger millet were organized at Shala/MARC and Diga/BARC, where 110 farmers (11 of them women) and 55 experts and administrators from different organizations participated.

Eritrea: There was no work planned for Eritrea under Activity 6.1. However, the training manual on "Integrated Striga Management and Micro-dosing" was translated into the Eritrean language, Tigrinya, and was used for training conducted in Asmara in February 2012, involving 26 researchers and extension staff who qualified as trainers to provide training to other research and extension staff, as well as to farmers.

South Sudan: There was no work planned for South Sudan under Activity 6.1. However, because of the importance of striga in the country, training on Integrated Striga Management and Micro-dosing was conducted alongside other trainings. Field days were conducted in Torit and Juba in March 2012, which were attended by 66 farmers, 29 of them women.

Kenya: Thirty-eight farmer participatory on-farm demonstrations were organized in the Rift Valley [Bomet (12), Koibatek (11) and Kerio Valley (15)] on integrated blast and weed management. The treatments included a locally adapted blast-resistant finger millet variety (NFM1) and micro-dosing at 20 kg N/ha. Five field days were held and attended by a total of 248 farmers (61of them women). In western Kenya (Western and Nyanza Provinces), 60 on-farm demonstrations were organized and each contained three promising, one released and one local finger millet varieties. Twenty demonstrations on integrated blast and weed management and micro-dosing in finger millet were also organized. A total of eight field days were held on selected demonstration sites with a recorded attendance of 393 female and 500 male farmers.

Uganda: In the eastern part of Uganda, 30 farmer participatory on-farm demonstrations were set up in Serere, Ngora, and Kumi districts. The demonstrations on integrated blast and weed management included the locally adapted blast-resistant finger millet varieties Pese 1 and Seremi 2, as well as micro-dosing fertilizer [(CAN) at 20 kgN/ha and a control that received no fertilizer]. Farmers participated in variety selection and Seremi 2 was observed to be most resistant to blast. It also responded well to fertilizer application, giving a yield advantage of 37%.

As a follow up, two field days in each of the three districts were organized and attended by 230 farmers (102 of them women). In northern Uganda (Gulu, Oyam, Apac, Lira, and Pader districts), 50 technology demonstrations were conducted using the same treatments as in eastern Uganda. Four finger millet varieties (Pese 1, Seremi 1, Seremi 2, and SEC915 were demonstrated, and the varieties Seremi2 and SEC915 were the varieties most preferred by farmers. Field days were organized in June 2012 and attended by 1,300 farmers. Field trainings on blast management and improved varieties were conducted for 50 farmer groups (which included 13 women farmers' groups) from the five districts

Tanzania: Training of farmers on integrated striga management and micro-dosing for sorghum was conducted in Iramba, Singida Rural, and Kondoa districts. In Singida Rural and Iramba, 36 farmer participatory on-farm demonstrations on integrated striga management were conducted. The demonstrations included locally adapted striga-resistant sorghum varieties (Wahi and Hakika) and micro-dosing (20kg N/ha). In addition, 43 farmer participatory on-farm demonstrations were organized on integrated blast and weed management, using a locally adapted blast-resistant finger millet variety (U15) and micro-dosing (20kg N/ha); these were conducted at Singida Rural (12 demonstrations), Iramba (22) and Kondoa (9) from mid-April 2012 to the end of the month. Each district organized one major farmers' field day, while each ward in the district organized smaller field days. The total number of field day participants in 2012 so far is 453 farmers, which includes 158 women.

Maharashtra: A total of 8,050 new farmers (4,050 in MAU and 4,000 in MPKV regions) were supplied with improved sorghum cultivars – Parbhani Moti, Parbhani Jyoti, Akola Kranti, Phule Vasudha, Phule Chitra and Phule Anuradha and M 35-1 – along with such improved production technologies as seed treatment (70 WS Thiomethaxam), wide spacing (45 cm between rows), fertilizer application, inter-cultivation, and drought management by furrow opening/bunding. Most of these farmers were selected from adjoining villages in each cluster (six clusters in total) so that there is a better spread of HOPE project activities. Women accounted for 30% of the selected farmers. The project also followed up with the farmers that have been involved in previous years so as to learn about the extent of adoption of HOPE interventions after the project's exit. Yield data from 100 or more farmers in each cluster who cultivated sorghum this year using saved seed was recorded, and the adoption of HOPE interventions was found to be up to 70%. Farmers are realizing higher yields (up to 30%) over their base levels (0.5 to 0.6 t/ha) before the advent of HOPE interventions.

Rajasthan: Discussions were held with farmers regarding pearl millet hybrids suited to their ecology, use of both N and P fertilizer (in which the soils are deficient), and crop management practices such as weed control.Some3,040 households directly benefited from the technology demonstrations (seed + fertilizer) provided to them. In addition, trials on crop management practices, such as use of micronutrient applications and chemical control of insect pests also enhanced farmers' awareness about improved technologies. Lists of farmers likely to benefit (1,800 farmers/cluster) from the 2012 demonstration trials were prepared.

Gujarat: Some 2,892 households in the Jandi and Radhanpur clusters benefited from the demonstration trials (seed + fertilizer) provided to them. Farmers also learned procedures for collecting soil samples for chemical analysis. Results of soil test reports were shared with farmers; they were advised to use phosphate in addition to nitrogen in their fields. Farmers also benefited from the demonstrations on chemical weed control. Most fields in the Kamalpur cluster were found to be low-lying, thus a new cluster (Adiya in Patan) was selected for trials in 2012. Lists of farmers likely to benefit (1,800 farmers/cluster) from the 2012 demonstration trials were prepared.

Haryana: Discussions were held with farmers in the Sundrah and Siwani clusters regarding pearl millet hybrids suited to rainfed agro-ecologies, as well as the use of both N and P fertilizer for which the soils in the target villages are deficient. Crop management practices, such as use of chemicals for weed control, were also discussed. Some 2,950 households benefited directly from the technology demonstration trials (seed + fertilizer) provided to them. Trials on crop management practices, such as use of micronutrient applications and chemical control of insect pests, were demonstrated, which led to significant yield increments. Lists of farmers expected to benefit (1,800 farmers/cluster) from the 2012 demonstration trials were prepared. Flyers on crop management practices were distributed at the time of seed distribution to the farmers in the three states (in the relevant local language) to provide technical know-how for producing a good crop of pearl millet.

Activity 6.2 - Increase availability and use of quality seeds of improved varieties

Mali: Some 1.2 tons of foundation seed of four varieties of sorghum, and 1.4 tons of five varieties of pearl millet were produced at IER station at Cizana and by selected farmers. In addition, 214kg of breeder seed was produced by IER and ICRISAT for 24 sorghum varieties being disseminated. Certified (R1) seed production in Year 3 doubled compared to Year 2, with 22 tons of 11 sorghum OPVs and hybrids obtained from ULPC and the Coprosem farmer union. These two cooperatives together produced 4.02 tons of certified seed of the seven new ICRISAT/IER sorghum hybrids (Fadda, Pablo, Yamassa, Niakafa, Omba, Sewa, and Caufa). In addition, the number of members of the Coprosem union, as well as the number of seed producers, increased during the 2012-13 seasons from 25 to 60. A seed cooperative collaborating with IER in the Segou region produced a total of six tons of pearl millet seed. All certified seed produced in 2012 has been sold to farmers, a private seed enterprise (Faso Kaba), and to NGOs (Afrique Verte and the Aga Khan Foundation).

A total of 7,158 sorghum mini-packs were sold to some 1,500 farmers (estimated number of farmers is based on the assumption that each farmer purchased 5 mini-packs) and 2,926 mini-packs of pearl millet were sold to 850 farmers (3 packs/farmer) in the Mandé, Dioila, Tominian, and Koutiala regions. These mini-packs contained between 100g and 500g of seed/pack. Partnerships with Catholic Relief Services, CARITAS, and ADL-SAHEL allowed dissemination of 1,000 mini-packs of pearl millet to 375 farmers in Douentza, Koro, and Mopti regions. Surveys conducted in the Mandé region indicated that the vast majority of mini-packs sold contained seeds of new or improved varieties (81%), with the buyers originating from villages that had no previous experience with improved varieties. It was also observed that the number of female buyers in this region increased by about 13% compared to Year 2 (Siby report by K. Jones, 2012). Seed sharing from mini-packs among the farmers sampled decreased from 15% in 2011 (Year 2) to 7% in 2012 (Year 3). This could be related to a poor rainy season and limited seed availability. It could also be related to the increasing familiarity of farmers with "buying seed" and not asking for seed presents for testing, as reflected in the increased mini-pack production and purchase in Year 3 compared to Year 2 in the Dioila region. A study carried out in Year 3 by ICRISAT on Year 2 mini-pack sales indicates that there are differences in the preferences for varieties by gender. While men prefer Bobodje, Tieble, and Jakunbe, women prefer Grinkan, Jakumbe, and Latta. Profitability analyses could not be performed due to lack of data on transaction costs.

A total of 339 test-kit trials (one test per farmer, 66 of them women) were conducted in collaboration with two farmer organizations and three NGOs. Altogether, 23 OPVs and hybrids were tested. Due to the extensive testing of existing varieties in the first two years, 15 farmers associated with the AMEDD started hybrid seed production in the Koutiala region in 2012.

Regular training programs on seed production were carried out. Some 104 men and 35 women were trained in seed production and issues relating to improved varieties. Additionally, 229 men and 96 women participated in variety evaluations in Koutiala, Mandé, and Dioila regions.

Niger: In collaboration with ACH, 16 pilot farmers were contracted to produce certified seed of at least two strongly demanded pearl millet varieties (Sosat, ICVIS 99001). Together with Moriben, Fumar Gaskia, and Agdel Fahamey Seed Enterprise, a total of 27 tons of certified millet seed of five different varieties were produced. Foundation seed production was 9.6 tons (ICRISAT and Alheri) and breeder seed production in Niger was 8.7 tons (seven varieties).

Some 15,826 pearl millet mini-packs were sold in 2011/12 to 2,500 farmers (in Niger each farmer bought 6.3 mini-packs on average). A study done by K. Jones (2012) indicates that the number of women buying the mini-packs in 2011 increased by 14% over 2010. Aside from the mini-packs, a total of 136 women and 64 men conducted variety demonstrations involving four pearl millet varieties (0.1ha/variety). The Falwel Union of Mooriben organized their first seed fair on 29 April 2012; the event was considered a great success, as the demand for seed outstripped supply.

ACH is supporting and supervising 16 pilot farmers to produce SOSAT and IMV 99001 in Mayahi (8ha) and six villages in Keita (total of 10.9ha). Due to climatic constraints, striga infestation, and rodent attacks, only 20-30% of the fields were harvested. ACH, together with the farmers, discussed and made recommendations for future seed production activities.

Burkina Faso: Certified seed production by 39 seed producers from AMSP, UGCPA, and FEPAB resulted in about 100 tons of certified sorghum seed, of which 95% is a local improved variety of tan plant color (Kapelga), and 15 tons of certified pearl millet seed. Two improved local varieties strongly preferred by farmers (Gnossiconi and Flagnon) have been officially released, with farmers keen to produce them in 2012. Foundation seed production in Burkina Faso is mainly managed by the general farm program on the research station of INERA at Saria. Even though this program is not receiving HOPE funds, the project contributed indirectly to the production of more than 80 tons of sorghum foundation seed (five varieties), as the breeder seed of the collaborating INERA breeders was used to produce it. The HOPE project further contributed directly (UGCPA receives project funds) to the production of 470kg (three varieties) of foundation seed produced by the UGCPA farmer union and 3 tons of pearl millet foundation seed (four varieties).

About 4,787 sorghum mini-packs were sold to 1,500 farmers in Burkina Faso during the 2011/12 season, while 1,520 pearl millet mini-packs were sold to 506 farmers (on average, a single farmer buys three mini-packs). Seed purchased by women in the Boucle du Mouhoun region increased from 5% in 2010 to 10% in 2011 (K. Jones, internal Dedougou report, 2012). The AMSP farmer union sold 90% of its seed production to the FAO and State seed operation program, which distributes seed to farmers with the double objective of improving use of modern varieties and helping farmers in need of seed. AMSP farmers sold 25 tons of sorghum (three varieties) and 15 tons of millet (three varieties) to the state/FAO program and PICOFAR (850kg) in Year 3.

Training on seed production was given to 41 farmers (27 men and 14 women) in Sanmatenga (AMSP) and Boulsa (FEPAB), with an additional financial contribution of EU/IFAD funds.

Nigeria: Three farmers were contracted in Jigawa state to produce seed of SOSAT-C88, as well as an unspecified sorghum variety on 20ha of land. At Yobe, one farmer successfully produced sees of SOSAT-C88 on 11ha, as certified by the National Seed Inspection Agency

of Nigeria. Breeder seed production was 926 kg and foundation seed 5.3 tons of four pearl millet varieties.

Some 1,555 sorghum mini-packs (seven varieties) were distributed by project partners in five states. IAR and collaborating institutions conducted 20 sorghum variety demonstrations comparing improved varieties to local varieties in five states. LCRI and CBARDP together conducted 174 variety demonstrations involving three millet varieties in five states. Demonstration of the variety SUPERSOSAT reached at least 200 farming families for each demonstration site across six states (200 x 6 =1,200). SUPERSOSAT is presently in the release phase for Nigeria.

Ethiopia: A total of 391 farmers (35 of them women) were reached with small seed packs of improved finger millet varieties. In Diga district, 304 farmers (23 women), received seed of finger millet varieties Bonya (230 kg), Wama (262 kg), Bereda (253 kg), and Gute (30 kg). In Guangua district, 10 farmers (all men) received 30 kg of Necho and Wama finger millet varieties, while in Shala district, a total of 79 farmers (12 women) received 25 kg of the finger millet variety Tadesse. A total of 830 kg of improved finger millet seed were distributed to farmers.

In terms of finger millet seed production, some 3.7 tons of basic seed and 3.0 tons of certified seed of four varieties (Tadesse, Necho, Wama, and Degu) were produced. For sorghum, seed of varieties Melkam, Teshale, and Meko were distributed to 450 farmers in Mieso. Some 500 farmers received seed of Misikir, Girana-1 and Hormat. Some 950 farmers were reached with seed of improved sorghum varieties. A total of 7 tons of improved sorghum varieties were produced and distributed for the June 2012 planting season.

Eritrea: The sorghum varieties of choice in Eritrea are Seare (ICSV 111 IN), Harriray, P9401, P9407 and Bushuka (ICSV 210). In March of 2012, NARI[12] distributed 19,600 kg of seed of these varieties to 3,920 farmers in Sheib, Goluj, and Laelay Gash in preparation for the June 2012 planting. In addition, NARI purchased 22,600 kg of seed of these varieties and distributed it to farmers in the HOPE target regions of Goluj, Shambuko, and Sheib for the June 2012 planting season.

South Sudan: The Republic of South Sudan was not part of Activity 6.2, but after the release of KARI Mtama 1 and Macia in August 2011, the World Bank, through the South Sudan Ministry of Agriculture, bought 1.6 tons of basic seed (produced by ICRISAT in Tanzania) of each of the two varieties for distribution to farmers in Juba and Torit for the March/April 2012 planting.

Kenya: A total of 1,100 kg (of which 150 kg was produced at the Koibatek FTC and 950 kg produced on-farm, by farmers) of finger millet seed of varieties NFM1, KNE629, KNE 1034, U15 and P224 were distributed to 600 farmers (each receiving 0.5 kg) and 800 farmers (each receiving 1.0 kg) in the districts of Bomet, Koibatek, Nakuru, and Kerio valley. The small packs were sold through agro-dealers and distributors to Koibatek SACCOs, AGROSOY, and KENFAP. It is expected that in 2012, an estimated 20-30 tons of finger millet seed will be available for distribution through agro-dealers. A necrotic disease is currently attacking maize in Kenya, and this has increased need for finger millet seed, especially in the Rift Valley where the maize disease is most prevalent.

In Nyanza province, 500 kg of seed of U15 finger millet variety was produced on-farm. This was distributed in 0.5 kg packs to 1,000 farmers in four districts. In addition, 3 tons of certified seed of P224 was sold through agro-dealers. Agro-dealers sold 1.5 tons of the improved varieties U15 and Okhale1 to farmers in Siaya in Nyanza province, and in the

[12]National Agricultural Research Institute (NARI)

Busia, Teso, and Mumias districts of Western Province. The variety Okhale 1 was the most preferred in Mumias, while U15 was preferred in Busia, Butula, Teso and Siaya. Kenya Seed Company, through their agro-dealer networks, sold to farmers about 2 tons of P224certified seed. Farmer groups in all these locations were made aware (through various meetings) of the availability of the mini-packs in agro-vet shops. One farmer group in Teso district, previously trained in seed production techniques, currently supplies quality (informal seed) to local farmers and organizations, such as the Kenya prisons in Busia, which bought 20kg of U15 for planting in the 2012 long rains. Farmer-to-farmer transactions involving seed of improved finger millet varieties in Nyanza and Western Provinces for 2012 planting is estimated to be more than 10 tons.

Uganda: In the northern zone, promotion of improved finger millet for adoption focuses on ten districts: Lira, Apac, Kole, Oyam, Amolatar, Dokolo, Gulu, Nwoya, Kitgum, and Pader. The finger millet varieties being promoted are Seremi1, Seremi 2, Pese1, Seremi3, Gulu E and Sec915. A total of 600kg of pre-basic seed and 5,000 kg of basic seed of Pese1, Seremi 3 and Gule E were produced. The Victoria Seed Company produced 23,379 kg of certified seed, mainly of Seremi 2 and Pese 1 in the 2011/2012 season. A total of 2,206 farmers were aware of improved varieties that were accessed as small 500g packs distributed in 2012, and 1,667 accessed improved varieties by purchasing them from agro-dealers.

In October 2011, 676 farmers were trained on finger millet technologies, whereas in 2012 it was 436 farmers. In the eastern zone, 130 farmers belonging to the Soroti Sorghum Producers and Processors Association (SOSPPA) of Kyere/Serere acquired seed of U15 from NASARRI and produced 12 tons of seed of Seremi 2 in July 2011. Of that 12 tons, 1,000 kg were bought from the group by Victoria Seed Ltd to distribute to 60 farmer groups in northern Uganda participating in the HOPE project. In the first season of 2012, it is estimated that about 5 tons of informal seed (Seremi1) was produced by groups and purchased by other farmers in the six HOPE target districts in the eastern zone of Uganda.

Tanzania: Seed production and marketing is done through both formal and informal systems. In the formal seed sector, the Agricultural Seed Agency (ASA) produces basic seed, and in 2010 it was the only source of sorghum seed; they produced and marketed 200 tons of the sorghum variety Macia. In 2012, ASA produced and marketed 300 tons of basic seed of the sorghum varieties Macia, Tegemeo, Wahi, Hakika and Pato. Seed production and marketing of improved varieties in the 2011/2012 season indicated that farmers and NGOs purchased 300 tons and 100 tons, respectively, at commercial price, while subsidized seed amounted to 400 tons, with 800 tons being carried over. Sorghum seed demanded by various regions in Tanzania through the subsidy scheme for the 2012/2013 season is 3,243 tons. The demand for subsidized sorghum seed is higher than supply because of the lower prices offered to farmers.

The semi-informal seed sector mainly focuses on Quality Declared Seed (QDS), i.e., seed produced by trained farmers and NGOs using basic or certified seed from ASA. The production and marketing of this seed class is restricted to within the producing district. In 2012, the four HOPE target districts (Singida, Iramba, Kondoa, and Kishapu/Misungwi) produced 200 tons of QDS sorghum seed, mainly of Macia and Tegemeo. Two finger millet varieties (U15 and P224) were released in Tanzania in January 2012 and basic seed production of U15 is ongoing at Miwaleni, where approximately 4-5 tons of seed will be harvested. Multiplication of P224 will be done at Miwaleni during the July 2012 off-season.

Maharashtra: Each partner university in Maharashtra needed a minimum of 16 tons of seed of improved post-rainy season sorghum varieties to supply to the 4000 HOPE farmers in their respective regions in the 2012-13 season. However, both universities produced more seeds (MAU 32.2 tons and MPKV 31.2 tons) to enable coverage of more farmers.

Rajasthan: Some 4,170 kg of seed of ten pearl millet hybrids (HHB 67-I, RHB-177, RHB-121, B 70, MP 7792, 86M66, 9444, Tejas, VBBH-3115, and Bio-8494) were distributed to farmers during the 2011 rainy season. In addition, 3,040 demonstration trials were conducted (1,550 in Kherapa and 1,490 in the Gotan cluster). Trials that produced a good crop stand were considered successful and data on grain and fodder yield were recorded. Fields with poor plant stands at harvest were considered failures. Some 3,040 trials were conducted, of which 2,763 were successful. Of the 10 hybrids tested, RHB 177 was found promising and produced the highest grain yield (1,950 kg/ha). In addition, a high-yielding private sector hybrid B 8494 was also selected for large-scale testing in 2012. Some 5,370 kg of seed of 11 hybrids RHB 177, RHB 173, GHB 538, HHB 67-2, B8494, B 8141, JKBH 676, VBBH 3115, Vibha 3087, MP 7888, and PB 106 were produced for planting in the 2012 trials.

Gujarat: Some 3,900 kg of seed of six hybrids (GHB 538, GHB 744, MP 7792, 86M66, 9444 and 8494) was distributed to farmers during the 2011cropping season. A total of 2,950 demonstration trials were conducted (1,492 in eight villages of the Janadi cluster and 1,458 in eight villages of the Kamalpur cluster). Among the test hybrids, 86M66 (a private sector hybrid), was found best both for grain and fodder yield, and has been selected for large-scale testing in 2012. Furthermore, some 5,400 kg of seed of GHB 744, GHB 538, GHB 719, 86M66, JKBH 676, MP 7888, VBBH 3115, and B 8141have been produced for trials in 2012.

Haryana: Seed (3,915 kg) of nine hybrids (HHB 67-2, HHB 223, HHB 197, B 70, MP 7792, 86M66, 9444, Tejas, and VBBH 3115) were distributed in Haryana during the 2011 rainy season. A total of 2,892 demonstration trials were conducted (1,442 in seven villages of the Siwani cluster and 1,450 in five villages of the Sundrah cluster). Of these, 2,316 trials (80.1%) were deemed successful. Comparatively, more trials failed in the Siwani cluster (76.1% were successful) than in the Sundrah cluster (where 84.0% were successful). The failure of trials was due to either crust formation and/or drought stress after sowing. The average grain yield with improved practices in both clusters showed an increase of about 23.4% (in Siwani) to 36.4% (in Sundrah) over the control (farmers' practices). Based on the results obtained, the private sector hybrid Tejas was selected for large-scale testing in 2012. Some 5,400 kg of seed of eight hybrids (HHB 197, HHB 223, HHB 226, Tejas, JKBH 676, VBBH 3115, Kaveri, and MP 7888) was produced and distributed to farmers in readiness for the 2012 cropping season.

Activity 6.3 - Increase availability and use of fertilizer and other crop management technologies

Mali: Some 400 striga control packs (consisting of a small amount of pearl millet seed, cowpea seed, and DAP and Urea fertilizer) were sold in the Segou and Mopti regions during the year under review, with 320 sales being documented. The approach is being expanded this year to include sorghum-growing areas and a total of 1,000 packs will be distributed in 2012. Involving agro-dealers in the mini-pack dissemination favors the creation of farmer links to input shops and their products. In the Dioila region, the farmer cooperatives have strengthened their links with the agro-dealer networks, as reflected in the fact that purchases of mini-packs from agro-dealers increased by about 14%. Mini-packs of pearl millet (1,000 packs) disseminated through the Catholic Relief Services, CARITAS, and ADL-SAHEL also contained a dose of fertilizer. About 165 farmers bought mini-packs in input shops belonging to the agro-dealer network of CNFA.

Niger: About 300 striga control packs have so far been distributed for sale in Niger in 2012. Some 16 farmers (7 of them women) received four days of training in integrated head miner management in August 2011. Then in January 2012, a total of 100 farmers (20 of them

women) benefited from a 3-day training on improved composting techniques and economic analysis of trials.

Nigeria: For pearl millet, 14 Training of Trainers (TOT) and 27 Farmer Field Schools (FFR) on integrated striga management were undertaken across four states (Yobe, Jigawa, Sokoto, and Borno) with 38 villages by CBARDP, Green Sahel Gumel, and farmer organizations. Treatment combinations involving use of farmyard manure, NPK micro-dose applications, and sesame as a trap crop in a field planted toSOSAT-C88 yielded significantly more (80% better) than the farmers' practice. A total of 1,200 farmers from 38 villages participated in the training.

For sorghum integrated striga management, (improved practice versus local practice) small trials consisting of 625m² were conducted in 25 villages in five states involving a total of 125 farmers. The integrated striga management technology consisted of improved varieties intercropped with cowpea (1 kg of Samsorg14, 1.53 kg of IT277) and fertilizer application (Urea and NPK). The improved practices recorded significantly lower striga counts in all trial sites, as well as heavier stalk weight and grain yields, when compared with the farmers' practices. In three of five states, the farmers recorded increased revenue (12-47%) from the improved practices when compared with their local practices.

Ten large sorghum varieties x management demonstration plots were conducted in five states by IAR. The improved variety x improved management or local variety x improved management trials in general resulted in higher income (an average of 20-50%) compared to the local practices.

Ethiopia: Currently, the government of Ethiopia is encouraging farmers to purchase inputs without credit if they can afford to do so. For those farmers who cannot afford to purchase inputs, credit is given through rural financial institutions (savings and credit institutions). Discussions were held with stakeholders on improving smallholder/poor farmers' access to inputs and linking them with savings and credit intuitions. The Bureau of Agriculture and cooperatives/unions took the responsibility in their respective districts to facilitate the availability and use of fertilizer, as well as improved crop production technologies. Subsequent discussions will be organized in 2012, starting in the July cropping season.

Kenya: Timing of fertilizer delivery and its availability at wholesale outlets is the responsibility of government ministries. Fertilizers, as well as seed, are often delivered late in the season. Packaging into small packs can only be done after wholesale deliveries are accomplished. To address the issue of timely availability of appropriate fertilizers for finger millet in Kenya, 10 agro-dealers were identified in Rift Valley, Nyanza, and Western provinces and trained on fertilizer micro-dosing. Information is being packaged to draw the attention of policy makers to the need for timely delivery and application of fertilizers for maximum benefits. Profitability or benefits from marketing fertilizer in small packs will be assessed in September 2012 and shared with suppliers and retailers by December 2012.

Tanzania: Farmers have indicated that they prefer 5 kg packages of Ammonium Sulphate or CAN, which is mainly for top-dressing. In the central zone of Tanzania (Kondoa, Singida Rural, Iramba, and Kishapu districts), 416 farmers indicated that they use fertilizer micro-dosing for improving soil fertility and tied ridges for water harvesting and conserving soil moisture. For finger millet production, farmers mainly use manure, broadcasted before planting, and the actual application rate was not clearly indicated. Timing of fertilizer delivery and availability at wholesale outlets is in the realm of government ministries, and fertilizers as well as seed are usually delivered late in the season. To address the issue on the timely availability of appropriate fertilizers for finger millet and sorghum farmers in Tanzania, each district identified and enlisted several agro-dealers for closer collaboration

with HOPE, as follows: Rombo (8 agro-dealers), Singida (4), Iramba (4), and Kondoa (5). Other enlisted agro-vets are located in the HOPE project spillover districts of Same (8) and Mwanga (8). The agro-dealers that were brought in were trained in fertilizer micro-dosing in February 2012 for districts in central Tanzania (Dodoma and Singida) and Rombo district in May 2012.

Uganda: Although not targeted under this activity, it should be reported that 63 farmer groups involving 1,890 farmers in northern Uganda (of which 23 are women groups) were sensitized on the use of fertilizers and such crop protection products as pesticides and herbicides. A total of 1,500 farmers from nine districts in northern Uganda were linked to agro-dealers who sell appropriate fertilizers at slightly lower prices.

Maharashtra: At least 100 soil samples were collected from six clusters in Maharashtra. Farmers were trained in collecting soil samples, and soil test analysis reports were disseminated to the respective farmers that provided them with recommended fertilizer applications. Each cluster was supplied with two "ferti-cum-seed drills" (6 drills in total) to ensure maintenance of recommended row spacing (45 cm) for having optimum plant population in the field and for drilling of fertilizer along with seed. This mechanism also facilitated mechanical inter-cultivation. Frontline demonstrations (10 per cluster) were conducted on farmers' fields to demonstrate the superiority of the improved package of practices.

Rajasthan: Some 120,000 kg of SSP fertilizer were distributed to farmers for technology demonstration trials in the 2011 season. For 2012, 75,000 kg of NPS fertilizer has been procured for distribution to farmers.

Thirty crop management trials (weed control, insect pest management, and micronutrient application) were conducted in two clusters in Rajasthan. Application of the insecticide chloropyriphos at the time of land preparation had a noticeable effect on pearl millet grain yield in both Jodhpur and Nagaur districts. Grain yield increased by 14.6% and 12.5% with the chloropyriphos application in Jodhpur and Nagaur districts, respectively.

Weed management through two hand-weedings at 25 and 45 days after sowing also had a significant effect on pearl millet productivity. In Jodhpur and Nagaur districts, the mean grain yields were 1,660 kg/ha and 1,625 kg/ha in the control plots, compared to 2,040 kg/ha and 2,013 kg/ha under weed control, respectively. Weed management increased grain yield by 23% compared to the control.

Grain yield also increased by 18% and 19% with zinc application in Jodhpur and Nagaur districts, respectively.

Gujarat: Some 60,000 kg of DAP fertilizer was distributed to farmers for technology demonstration trials in the 2011 cropping season. Further, 72,000 kg of DAP was procured for distribution to farmers for the 2012 season. Thirty crop management trials (weed control, insect pest management, and micronutrient application) were conducted in two clusters in Gujarat during 2011.The application of Atrazine (1.0 kg/ha at sowing) resulted in a 5.8% yield increase in GHB 744 and 6.4% in GHB 538. Micronutrient application also showed good results. There was a 7.5% yield increase in GHB 744 and a 6.8% in GHB 538with the application of 10 kg/ha of zinc sulphate. A higher dose of zinc sulphate (20 kg/ha) resulted in a 10-11% grain yield increase. Application of Parathion dust at10 kg/ha at the time of sowing resulted in a 6.58% and 6.20% yield increase in GHB 744 and GHB 538, respectively.

Haryana: During 2011, 60,000 kg of DAP fertilizer was distributed to farmers for technology demonstration trials. For 2012, 72,000 kg of DAP has been procured for distribution to farmers. Application of Atrazine (1.0 kg/ha) at 7-14 days after sowing had a

significant effect on pearl millet productivity in Haryana. The grain yield increased by 14.9% and 19.8% over the control, and fodder yields increased by 8.13% and 24.9% with the Atrazine application in Mahendergarh and Bhiwani districts, respectively.

Activity 6.4 - Improve access to output markets to increase technology adoption and cash incomes for farmers

Mali: As in Year 1 and 2, ULPC contracted PAM to deliver of 400 tons of sorghum grain. In Year 3, members of the ULPC used all the seed of the new IER/ICRISAT hybrids to implement the contract. The AMEDD sold 264 tons of millet grain, of which 200 tons were bought by the P4P program, and 1,930 tons of sorghum grain, of which 1,800 tons were bought by P4P. In contrast to ULPC, only 30 tons of the production was grain of improved varieties while the majority was grain of local varieties.

Niger: In Niger, a follow-up meeting between processors and farmers' association grain producers was held in February 2012 at the Stade Seyni Kountche. The type of contracts and contract attributes preferred by both parties were discussed. Then contracts to supply a total of 31 tons of grain were signed between farmers' associations of Ouallam, Dantiandou, Falwel, and Tera with processors (Groupement Bani-Bani, Boro tarey, Marietout, Unions DiGAbedje, and Feba) in Niamey, Niger.

Burkina Faso: The farmers' unions FEPAB and UGCPA have contracts with P4P to sell grain to private vendors. UGCPA supports its members with internal warrantage systems to access fertilizers and seed. They use certified seed produced at by the union. In Year 3, more than 670 tons of sorghum grain was sold by the UGCPA, mainly of two improved varieties (Flagnon and Kapelga). Of this, 200 tons were sold to P4P.

Nigeria: A consultative meeting between value chain actors was organized in November 2011 at Tahir Palace in Kano, Nigeria. This involved farmers' organizations, traders and processors, and consumers, as well as actors from the policy and institutional environment. The objectives were to: 1) share information on opportunities and constraints facing the actors; 2) link the various stakeholders through the exchange of ideas and other information that will improve value chain efficiency; 3) identify and discuss the strengths, weaknesses and opportunities that limit performance; and 4) identify opportunities for financing agricultural value chains. A SWOT analysis was also undertaken that will help actors to create linkages in the coming months.

Ethiopia: Linking sorghum farmer groups with P4P did not materialize, since P4P facilitating organizations could not go beyond their mandate/intervention areas. It is clear that linking sorghum and millet farmers to markets outside their villages is still a challenge that will required some concerted effort, including aspects of policy review and changes for organizations such as P4P and other potential buyers. This output target needs to be revised, or Ethiopia needs to be dropped with respect to this particular target.

Tanzania: A total of 25 farmers' groups were identified in Year 2 (2011) and briefed on existing sorghum grain marketing opportunities with breweries, food processors, and feed industries. Of the 25 groups, 20 from Singida, Iramba, and Kondoa were linked to the P4P market of the World Food Program, beginning in March 2012. A group of 36 farmers of the Kwamtoro SACCOs in Kondoa have entered into a forward contract with Dunia Trust Ltd, which is contracted by East Africa Malting Limited (EAML/Serengeti) to supply 8,000 tons of sorghum grain in 2012. Dunia trust has contracted farmer groups in eight other districts for grain collection. To facilitate and initiate group farming at Kwamtoro SACCOs, an amount of 2,510 kgs of Macia was made available (purchased by the district and the HOPE project) and 700 farmers accessed seed for this pilot initiative. Agri-business training was offered in

September 2011 and an input supplier within Kwamtoro [the Rural Urban Development Initiative (RUDI)] was identified to be the source of seed and fertilizer. RUDI will continue to provide the Kwamtoro SACCO members with training on business planning and marketing. The provision of entrepreneurs and farmer groups with technical and business support as part of a business incubation plan was achieved in Tanzania, where Kwamtoro SACCO farmers were provided with a set of post-harvest handling equipment (a thresher and a de-huller) as a demonstration of post-harvest technologies available in the country to minimize drudgery and improve grain quality and cleanliness standards. An artisan in Moshi town (Samuel Engineering Co.) has been provided with a prototype of a thresher and contracted to manufacture eight grain threshers, which will be provided to eight districts [four of these (Same, Mwanga, Serengeti, and Moshirural) are spillover districts that are contracted to produce sorghum for EAML/Serengeti].

SA: During Year 3**,** an interactive meeting with about 40 farmers, including 10 women, in Siwani sub-division was held on 27 September 2011 regarding pearl millet cultivation practices and marketing aspects.

Activity 6.5 - Improve farmers' access to finance to increase adoption of purchased inputs, production of seed, and surplus grain for marketing

Mali: A stakeholder meeting was held in August 2011 in which a group session focused on issues related to financing the sorghum and pearl millet value chains. The agricultural bank (BNDA) was actively involved in these discussions. One major bottleneck to contracting was the information asymmetry between value chain actors and BNDA and the lack of business plans that could convince financial institutions of the viability of value chain activities. Therefore, this was to be followed up with the development of business plans for selected processors. Due to political instability in Mali, however, these activities were postponed to a later, as yet to be determined, date.

Niger: During the stakeholder meeting organized for 22-23 June 2011 (Year 2 report) with all value chain actors, the Agricultural Bank (BAGRI), the Banque Régionale de Solidarité (BRS), and the Micro-Finance Institution (ASUSU) were closely involved. This was followed by the development of business plans for selected processors in Niger. A meeting is planned between processors and financial institutions for early October 2012 to discuss potential financing needs in order to build grain stocks and to cover other operating costs of processors.

Nigeria: One result of the consultative meeting in November 2011 was that the Agricultural Bank of Nigeria and commercial banks have a strong interest in financing agricultural activities. According to financial institutions, the lack of information about the sector may lead to costly monitoring and a higher cost of lending, which in turn may lead to unprofitable investments by value chain actors. Tools that can be developed to ease monitoring and convince financial institutions were suggested. These include the development of business plans by value chain actors. Follow-up meetings scheduled with value chain actors did not happen because of travel bans to northern Nigeria.

Ethiopia: The EIAR, in partnership with ICRISAT, organized a training workshop on agricultural business planning, management of farmer organizations, product marketing, and credit access. Twenty people representing the various stakeholders from research, extension, farmer cooperatives, seed enterprises, and credit institutions involved in the sorghum and finger millet value chains in HOPE target districts attended the training. Participants were provided with basic and practical skills in farm planning, keeping of financial records, managing farmer organizations, product marketing strategies and the principles and practices involved in mobilizing financial resources by farmer organizations for improved agricultural

production and marketing. The training was held at Melkassa Agricultural Research Centre in Nazareth, Ethiopia, during 8-9 December 2011. This was part of a training of trainers (TOTs) effort to train farmer organizations to be able to access finance to support for production and to purchase of surplus finger millet and sorghum. Awareness on the part of financial institutions about business opportunities in the sorghum and finger millet value chains was therefore achieved. More training should be directed at cooperative unions in every HOPE target district, as these organizations actively engage farmers in input supply and product marketing activities. Linkages between financial institutions and farmer organizations to access finance for input supply and output marketing were not established because of WFO limitations placed on P4P regarding going beyond current mandate areas.

Researchers observed that credit was available in rural areas, especially with credit and savings associations where collateral is not a prerequisite. However, membership in savings and credit associations and a business plan is required for accessing credit. Therefore, future effort needs to focus on improving farmers' know-how and awareness of service providers to assist in business plan development and identifying business opportunities relating to sorghum and finger millet. The warehouse receipt system and credit organizations will be visited in August 2012, in collaboration with EAGC and a finance expert, to discuss opportunities relating to sorghum and millets. Outcomes of these discussions will be reported in September and December 2012. A pilot contractual arrangement between farmer groups and traders for both sorghum and finger millet will be organized in September/October 2012 (before harvest) and will be monitored in Year 4.

During training sessions, other strategies were developed to strengthen farmers' access to finance:

- Training farmers to prepare business budgets, including break-even budgets, to enable them negotiate grain prices more objectively with traders;
- Training farmer groups in better group management and improved post-harvest handling of sorghum and finger millet grain;
- Stakeholder forums (farmer and financial institutions) at Guungua, Kobo, Bahirdar,Melkassa, Bako, Diga, Mieso, Shala, and Gisangu have developed plans to identify during this season specific areas of linkage with finance.

Kenya: The capacity of farmer organizations in Kenya to access finance was strengthened through training in agri-business skills. The training was given to 30 participants, 16 of them women. Participants were from farmer groups, extension, grain processors, researchers, agro-input dealers, and credit agencies that participate in the finger millet value chain. These participants were drawn from the Nyanza, Rift Valley, and Western provinces of Kenya. This training strengthened the capacity of farmer organizations to access credit and also instilled awareness in financial institutions about business opportunities in the finger millet value chain. Further consultation forums for farmers and credit agents have shown that the Cooperative bank of Kenya has much interest in the Rift Valley and Western Kenya. Local NGOs with interest in credit and input supply linkages to farmers will also be invited to participate. Eastcom Foods, a CBO operating in Western Kenya, currently accesses credit from Equity Bank and KWFT to purchase finger millet grain before cleaning and milling it to make composite flour of soya bean and amaranthus, which is then sold to supermarkets, hospitals, and children's institutions.

Tanzania: In May 2011, training was provided to 19 collaborators in agri-business planning, finance and marketing, as well as the benefits of peer-monitoring and the timely payment of loans from financial institutions. This training strengthened the capacity of farmer organizations to access finances. Another training was organized in September 2011in Arusha, and attended by 8 participants from financial institutions – KCB Bank in Tanzania,

NMB Bank, and Stanbic Bank of Tanzania – and attended also by 14 farmers from three districts (Kondoa, Iramba, and Singida). Financial stakeholders were sensitized to business opportunities along the finger millet and sorghum value chains. Linkages were created between the above financial institutions and farmer organizations to facilitate access to credit for input supply and output marketing. In addition, Dunia Trust is linking with Namburi Seeds Co., which has 40 hectares of Macia seed crop and anticipates a harvest of 40 tons by August 2012. This seed will be provided for the November 2012 planting as credit to 12 farmer groups (in Singida, Iramba, and Misungwi/Kishapu) contracted to produce grain for food and nonfood industrial uses. Training on contractual arrangements between Kwamtoro farmers' SACCOs in Kondoa and Dunia Trust (the grain buyer) was held 17-18 April and attended by 22 SACCO members. The contractual arrangement is being monitored and the most recent visit was in May 2012. The farmers' group was provided with a thresher and a de-huller purchased by the HOPE project to pilot production of clean grain for the market.

Uganda: Uganda is not targeted under Activity 6.5. However, five farmer groups in northern Uganda are already linked to banks in order to access loans. Furthermore, seed loans were made available to 13 farmers' groups (of which 9 are women's groups). The HOPE project is working to encourage farmers to form well-organized groups with good governance to meet the requirements of finance institutions. One of the groups is constructing storage facilities with a capacity of 150 tons to boost farmers' production, and the HOPE project is supporting construction of three concrete threshing grounds, each worth US$1,500.

Maharashtra: Training sessions were conducted for 100 selected farmers (50 women and 50 men) from the farmers' associations in the MPKV region. The farmers were trained in good business practices related to accessing finance from alternative sources. Other trainings given to farmers were on various market opportunities for post-rainy season sorghum seed, grain, and stover. Farmers were educated about obtaining crop loans and negotiating loans from banks using stored seed/grain in warehouses as collateral by pledging receipts.

In the MAU region, 100 farmers (40 women and 60 men) from the farmers' associations were trained in good business practices for accessing finance from alternative sources, and how to access the Kisan credit card system, using the loan for designated purposes, timely repayment, etc. One training program per cluster was organized (three in total) in villages that involved 200 farmers (women and men); the focus was on market opportunities for post-rainy season sorghum seed, grain, and stover.

Activity 6.6 - Enhance capacity of partners (e.g., NGOs, farmer organizations, private-sector, extension) to deliver appropriate cereal technology options to farmers and increase alternative uses of dryland cereals

WCA: Tools have been developed for use by partners to deliver appropriate cereal technology options to farmers. This is well exemplified by the farmer-to-farmer instructional videos on integrated striga and soil fertility management, entitled "*Fighting Striga*", which was produced in French, English, and six major West African languages. The production of this video was a joint effort between the HOPE and PROMISO II projects. Some 20,500 copies of the striga DVD have been produced and 4,000 of these dispatched to partners across the project-implementing countries in SSA. Other efforts include radio programs and picture books in local languages.

Mali: About 50 field agents of partners (NGOs, FOs, and national agricultural research institutions) have been trained in the use of tools for scaling up integrated striga and soil fertility management and improved varieties through printed documents, radio programs, and video messages, in addition to the mini-pack approach. About 300 copies of the OPV seed production manual in Bambara, as well as 400 copies in French, were distributed in Mali.

More than 200 manuals about hybrid seed production were also distributed. More than 1,180 farmers in Dioila participated in video viewings about integrated soil fertility measures.

Niger: About 20 field agents of farmer organizations trained in the use of tools for scaling up integrated striga and soil fertility management and improved varieties (print, radio, and video messages, plus the mini-pack approach).

Burkina Faso: Forty folders containing 12 practical 1-page guides on variety testing and evaluation were distributed at a 7-8 June 2012 workshop in Dedougou that was focused on data analysis of variety trials (25 participants). In addition, videos were used to train about 30 members and agents of farmer organizations.

Nigeria: Altogether, 36 participants partook in the pre-season training of CBARDP partners in preparation for the 2011/2012 season of the HOPE project. The training captured the basic agronomic practices of managing trials, the socioeconomics of marketing, and expectations regarding the HOPE project, especially in regard to types of data collection, as well as when and how to collect it. Attendance at the training is shown in Table 6. The workshop was held in Katsin from 8-11 June 2011 (this was not reported in Year 2).

Ethiopia: The capacity of sorghum extension staff, and seed producers and distributors was enhanced in preparation for product deployment of African biofortified sorghum was achieved through a training course conducted at Melkasa in December 2011. The 20 participants (including 2 women) represented the various stakeholders from research, extension, farmer cooperatives, seed enterprises, and credit institutions that are involved in the sorghum and finger millet value chains in the HOPE target districts. They were equipped with basic practical skills in farm planning, keeping of financial records, managing farmer organizations, and product marketing strategies. Another training and technical support program about finger millet and sorghum seed production for seed companies and seed growers, which was due in March 2011, was reported on in Year 2.

The five breeders and extension service personnel participating in the seed policy and regulations training course conducted in mid-July 2011 were also trained in how to establish and strengthen farmer feedback to breeders and to encourage women farmer groups to provide feedback. A total of 31 trainees drawn from farmers, researchers, and agricultural service providers (e.g., extension, agro-dealers, and farmer associations) were trained in integrated striga management and control at Melkasa research station (this was also reported in Year 2) and contributes to achieving output target 6.6.15. Participants in the TOT training began training others as indicated below.

Training sessions on different topics were organized for farmers, experts from the Bureau of Agriculture, and other partners. More than 500 farmers and 168 experts have participated in various training courses. Specifically, sessions included: 1) Training of Trainers, conducted in November 2011(42 participants) and covering ISM and improved sorghum production technologies; 2) finger millet production and micro-dosing at Shala, done in December 2011 (28 participants); 3) processing and utilization of finger millet, done at Bako in December 2011 (10 farmers participated); 4) blast management for finger millet (25 participants); and 5) agribusiness and group lending (25 participants), held in December 2011. In October 2012,a training of trainers course in post-harvest handling will be organized at Adet, Ethiopia, where appropriate post-harvest equipment is located. The participants will learn how to train women entrepreneurs and organized women's groups on better post-harvest handling and processing techniques; this will be reported in May 2013.

Eritrea: As for Ethiopia, the three Eritrean breeders and extension service personnel participating in the seed policy and regulations training conducted in mid-July 2011 also learned how to establish and strengthen farmer feedback to breeders and to encourage women

farmer groups in providing feedback. In February 2012, training was organized for 30 participants on sorghum/legume intensification as an approach for integrated striga management, using such legumes as lablab bean, cowpeas, and green gram. The same group was also given training on sorghum seed production for seed growers from the three zobas – Goluj, Shambuko, and Sheib. In March 2012, the trained trainers provided instruction for 75 farmers on improved sorghum production techniques, including integrated striga management, micro-dosing, and utilization. Training of trainers in post-harvest handling will be organized at Asmara in September 2012 (during field days). The trained trainers will instruct women entrepreneurs and organized women's groups on better post-harvest handling and processing techniques; this, too, will be reported in May 2013.

Kenya: Training to enhance agribusiness, grain marketing and the managerial skills of farmers' organizations was done in March 2011 and reported in Year 2. A total 120 farmers (including 65 women) from western Kenya (Nyanza and Western Provinces) were trained on 11-12 August 2011 in on-farm seed production, while 1,200 farmers and 8 agro-dealers were trained on finger millet agronomy, including fertility, striga, blast, and weed management. The latter sessions were held at Siaya, Busia, Teso, and Kakamega in November 2011.

In Rift Valley, 50 farmers were trained in seed production at Bomet (8-9 August 2011), while 750 farmers were trained on finger millet agronomy at Koibatek (15-17 August), Keriyo Valley (18-20 August 2011), and Bomet (22-23 August 2011). The other short course for participating stakeholders was on agri-business; 34 persons attended and the training session was conducted at Nakuru/Egerton (29-31 August). Training on PVS and seed-delivery channels was held at Egerton (6-7 September 2011) and attended by 40 participants (12 of them women).

Uganda: Training of trainers in post-harvest handling is planned for artisans in September 2012 at Moshi, and will be done by the Samuel Engineering Company (participants will also come from Tanzania). The trained trainers will then implement short courses and workshops aimed at strengthening the skills of women entrepreneurs and organized women's groups.

Tanzania: In December 2011, training on sorghum/legume intensification as an approach for integrated striga management using legumes was done (26 participants from Uganda, Ethiopia, Eritrea, Tanzania, and Sudan). Seven sorghum breeders, extension staff, and seed producers and distributors from Tanzania were trained on seed regulations, communications, and biosafety regulations in July 2011 in Nairobi; they were also trained on how to establish and strengthen farmer feedback to breeders. Three women's groups participated in feedback provision during the field day on 3 July 2012 at the Miwaleni research station.

With respect to post-harvest handling and processing techniques, training was provided to SACCO members of Kwamtoro in April 2012 on repairing and regular maintenance of the thresher and de-huller. An artisan was identified at Moshi and has adapted a prototype of a thresher. At least eight of these machines will be manufactured and made available this year, and the artisan will provide the recipients of the equipment (including at least two women groups) with training focused on repairing and regularly maintaining it. This training will be provided by March 2013.

Maharashtra: Trainings (six groups of 50 farmers each) were conducted on soil sample collection, post-rainy season sorghum crop management, purity maintenance in seed production plots, and grain and stover marketing. One women farmers' rally was organized at MAU headquarters in Parbhani. A training program was organized for women's self-help groups (40 participants) and KVK field staff (7 participants). Information regarding seed storage warehouse management and bookkeeping was given to farmers and IEC material was

distributed. Farmers' rallies (one per cluster), field days, and exposure visits were also organized.

Rajasthan: Meetings were held with the partner scientists prior to the crop season to ensure better delivery of the proposed technology to farmers. Flyers on crop management were distributed to farmers at the time of seed distribution. Two field days were organized on 1-2 October 2011 in which 200 farmers participated. A home science specialist was invited to provide information on value addition in pearl millet.

Gujarat: Flyers on crop management were distributed to project farmers. Partner scientists also trained field staff to further guide the farmers. Meetings were held with partner scientists prior to the crop season to ensure better delivery of the proposed technology to farmers. Field days were organized on 26 September and 26 August 2011. Radio and TV programs were aired in which various scientists of SAUs in Gujarat, as well as government officials, delivered talks on integrated pest management and seed production in pearl millet, and on grading, packing, and value addition in cereals in general.

Haryana: As in Gujarat, flyers on crop management were distributed for the benefit of project farmers in Haryana. Partner scientists also trained field staff to further guide the farmers. Meetings were held with the partner scientists prior to crop season to ensure better delivery of the proposed technology. An awareness campaign on value-added products of pearl millet was organized at two different locations (Gate No. 4 of CCS HAU and in Town Park) in Hisar on 15 and 21 December 2011. Pearl millet products such as biscuits, cakes, etc., were displayed, along with posters related to value addition in pearl millet. About 500 farmers and the general public visited the campaign stalls and showed keen interest in the products. An awareness campaign was also carried out during Farm Darshan, held on 21-22 September 2011, at CCS HAU, Hisar. About 20,000 farmers from various districts of Haryana, Rajasthan, and Punjab participated in the event.

PROJECT OUTPUTS REALIZED UNDER OBJECTIVE 6 TO DATE

Table 6 presents the major outputs realized under Objective 6 by the end of June 2012.

Table 6: ***Major Project Outputs Realized Under Objective 6 as of June 30, 2012***

Activity 1: ***Increase farmers' access and use of know-how about the use and benefits of profitable crop management technologies and improved cultivars***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	6.1.5	Training manuals in two languages on integrated striga management for pearl millet-based systems in the Sahelian zone of Mali and Nigeria published and distributed [May 2012]	Manual and templates for field books (tables for data entry for observations, etc.) on integrated striga and soil fertility management for cluster-based farmer field schools have been published. During the project period, the French and English versions of the manual were used in training workshops in Y2 and Y3 in Nigeria, Niger, and Mali. A series of technical 12 guides on striga management were extracted and distributed for farmer trainers in French and Bamanan	Achieved	Manuals in the HOPE online repository, printed technical guides
	6.1.11	Radio programs broadcasted in two languages on variety characteristics, ISM and crop management options, and market information [March 2013]	Radio messages and scripts have been developed and broadcasted in the four countries.Altogether, 15 rural radio networks broadcasted 7 to 60 programs in 7 different languages in Y2. In Y3, 12 radio networks and two TV stations broadcasted 60 programs.	Achieved	Scripts written by the farmer organizations, DVD and videos on TV programs
ESA	6.1.5	Training manuals in five languages on integrated striga management and micro-dosing for sorghum-based systems developed [May 2011]	A training manual on "*Integrated striga management and micro-dosing*" for sorghum has been developed, and is available in English, Swahili, Oromifa, Amharic, and Tigrinya. The manual has been used in crop management training courses in the ESA target countries	Achieved	Printed manuals and training materials in the HOPE online repository
	6.1.9	Training manuals on integrated blast and weed management and micro-dosing for finger millet developed in three languages [May 2011]	An English version of the manual on "*Integrated blast and weed management and micro-dosing for finger millet*" was developed and edited in February 2011. This manual has been translated into Amharic and Swahili; final editing is pending	Achieved	Printed manuals in HOPE online repository
	6.1.13	Awareness and know-how of farmers on integrated striga management and micro-dosing for sorghum increased through participatory on-farm demonstrations in three countries [March 2013]	Training was conducted for TOT in Eritrea, Ethiopia, and Tanzania on integrated striga management and micro-dosing for sorghum. On-farm demonstrations were established and field days held in collaboration with farmers	Achieved	List of names of participants in the training
	6.1.18	Awareness and know-how of farmers on integrated blast and weed management for finger millet increased through participatory on-farm demonstrations in four countries [May 2013]	Training on integrated blast management (IBM) and weed management was conducted to TOT who established on farm demonstrations with farmers. Farmer field days were organized in Kenya and Uganda, and back-to-back with ISM in Ethiopia and Tanzania	Achieved	List of names of participants in the training
SA	6.1.4	3 clusters of 5 villages established in each of Parbhani and Rahuri regions (6 clusters total) and secondary diffusion areas identified [Dec 2009]	**MPKV**: 3 clusters, each with 5-6 villages were identified and primary and secondary diffusion areas established **MAU:**3 clusters, each with 5-6 villages were identified and primary and secondary diffusion areas established	Achieved	Objective 6 Annual Report - Sorghum in SA; Document submitted by ICRISAT

					for 'Partnership Award'
	6.1.7	Farmers' associations established in each cluster [Aug 2010]	Farmers' clubs were established with the help of National Bank for Agriculture and Rural Development (NABARD) in each cluster village of Parbhani in the MAU region Farmer's associations were established and organizing committees formed in each cluster in the MPKV region	Achieved	Objective 6 Annual Report - Sorghum in SA and documents of FAs
	6.1.10	Outreach strategy developed to create awareness about improved varieties and profitable crop management technologies and market opportunities developed and communicated [June 2010]	Outreach strategy has been developed and implemented across clusters. Awareness has been created about improved varieties and crop management technologies, as well as market opportunities, helping to ensure their use by farmers	Achieved	HOPE Annual Report Outreach materials, e.g., flyers and brochures developed and distributed
	6.1.14	2 clusters of target villages (4 in each cluster) established in Rajasthan, Gujarat, and Haryana (6 clusters total) [Nov 2009]	2 clusters of target village were established in each state: • Rajasthan - Kherapa (6 villages) and Gotan (6 vllages) • Haryana - Siwani (7villages) and Sundrah (5 villages) • Gujarat - Jandi (8 villages) and Kamalpur (7 villages)	Achieved	Lists of farmers in the selected clusters
	6.1.17	Farmers' associations/self-help groups strengthened in each village cluster [Feb 2010]	Farmers' associations and SHGs have been strengthened by linking them to financial institutions (banks) in selected village clusters. Bank accounts were opened and funds generated through the sale of test kits deposited	Completed for all previous villages and on-going for new villages	Bank accounts
	6.1.22	Outreach strategy to create awareness about improved varieties and profitable crop management technologies developed and implemented [May 2010]	Outreach strategies have been developed and implemented. Technology demonstration trials were conducted to disseminate information about improved varieties and crop management technologies. Seed of best-suited hybrids were provided through test kits, along with fertilizer (N and P). Field days and exposure visits were organized to demonstrate the potential of improved technology	Achieved	List of farmers, information, , educational, and communication (IEC) materials distributed
Activity 2: ***Increase availability and use of quality seeds of improved varieties***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	6.2.5	4,500 farmer variety kits containing pearl millet suited to the Sahelian zone distributed by farmer associations, private sector, or extension services groups in Niger, Mali, and Nigeria [Dec 2012]	More than 30,000 mini-packs of pearl millet seed were sold in Niger, Nigeria, Burkina Faso, and Mali in Y1-Y3 (18 varieties). Mini-packs reached about 6,590 households directly and 3,042 indirectly through seed exchange. Additionally, 430 pearl millet variety test-kit trials and demonstrations were conducted in Nigeria and Mali in Y2 and Y3.	Achieved	Mini-pack database developed; PhD thesis of Kristal Jones and MSc thesis of Anna Niccoleau, SATrends article
	6.2.9	5,000 farmer variety kits containing sorghum	A total of 23,190 sorghum mini-packs (32 varieties and hybrids)	Achieved	Mini-pack database

		distributed by farmers' associations, the private sector, and extension services in Mali, Burkina Faso, and Nigeria [Dec 2012]	were sold by agro-dealers, farmers' unions and seed enterprises, NGOs, and state departments in Mali, Burkina Faso, and Nigeria by the end of Y3. Mini-packs reached about 5,373 households directly and 1,643 indirectly through seed exchange. 279 variety test kits involving 9 different varieties were conducted in 12 zones in Mali, Burkina Faso, and in three Nigerian states.		developed; PhD thesis and reports of Kristal Jones and MSc thesis of Anna Niccoleau (2011), SATrends article
	6.2.20	Seed production training manuals for open-pollinated varieties of pearl millet and sorghum published in English and French in Mali, Niger, and Nigeria [Sept 2012]	Sorghum OPV seed production manual in French and Bambara is done, as is the sorghum hybrid manual in French. The pearl millet manual in French, Zerma, and Haoussa is complete. English manuals are available from IITA. Manuals are used in trainings and have been distributed in Burkina Faso, Niger, Nigeria, and Mali. The existing OPV seed production manual for Burkina Faso was translated into Moré and Dioila (draft available).	Achieved	Printed manuals available from ICRISAT and partner organizations
	6.2.25	Ten farmer associations and individual members trained in seed marketing and business skills [March 2012]	13 farmer associations were trained in Burkina Faso by INERA and AMSP in the areas of seed production and marketing. In Niger ICRISAT, WASA and INRAN provided training in seed production and marketing. Similar training was done in Mali by ICRISAT and IER. Regional meeting of seed producers' cooperatives and others was held in Dedougou, BF to exchange know-how on seed marketing	Achieved	Internal reports of training, training database, article submitted (vom Brocke, et al., experiences in BF)
	6.2.30	Ten tons of certified and QDS millet and sorghum seed disseminated through farmers' organizations and agro-dealers in Mali, Niger, Burkina Faso, and Nigeria [May 2012]	888 tons of pearl millet and 282 tons of sorghum commercial certified seed have been produced in WCA HOPE countries since 2009. About 6,500 buyers in Mali and Burkina Faso are registered, however, not all organizations are registering their sales. In 2011, seed corporations in Mali and Burkina Faso sold all their seed production stocks	Achieved	Databases of seed cooperatives
	6.2.33	Profitability of seed sales and initial adoption of sorghum varieties as a result of commercialization of farmer variety kits assessed [May 2012]	Data form was distributed this year to be used to better monitor seed sales profitability. Data on the number of packs, variety sold, period of sales, pack size, location of sales, etc., were collected in 2010 and 2011. A report is available of these. Due to missing data on profits, it was not possible to compute the profitability of selling small seed packs	Delayed but on-going	Data sheets prepared
	6.2.36	Profitability of seed sales assessed, along with the increase in demand for quality seed of improved pearl millet varieties as a result of commercialization of farmer variety kits in Mali and Niger [May 2012]	As for sorghum, a data form was distributed this year to be used to better monitor seed sales profitability. The same data has been collected on pearl millet. A report is available of these. Due to missing data on profits, it was not possible to compute the profitability of selling small seed packs.	Delayed but on-going	Data sheets prepared
	6.2.38	Country reports on farmer-preferred varieties and	Results and information on new technologies have been published	On-going and	HOPE Website

		new crop management options with potential for more wide-spread adoption published on-line, on a yearly basis [April 2011, 2012. 2013]	on different online websites: • HOPE website (for striga packs): http://hope.icrisat.org/from-variety-tests-and-farmer-field-schools-to-the-sale-of-seed-packs-and-integrated-striga-control-packs/ • Facebook: http://www.facebook.com/home.php#!/pages/Striga-research-and-control-Recherche-sur-la-lutte-contre-le-Striga/205932102756790 • Youtube (educational videos on crop management): http://www.youtube.com/watch?v=hlpN-aVYsgY • ICRISAT online journal SATrends (mini-pack strategy).	on target	
ESA	6.2.3	Handbook for production of quality seed of improved finger millet and sorghum varieties developed and distributed to seed companies, farmers' associations, and other interested parties [May 2011]	The seed production handbook has been developed and used in various training sessions on seed production, and especially targeting producers of QDS as well as contract seed growers	Achieved	Soft copy of handbook is available
	6.2.7	Quality seed of improved finger millet varieties produced and distributed through agro-dealers, NGOs, extension services, and farmers' associations and cooperatives [May 2013]	Various classes of improved finger millet varieties were produced and distributed through channels appropriate for each target country	Achieved	HOPE Annual Report for Y2 and Y3
	6.2.11	Quality seed of improved sorghum varieties produced and distributed through agro-dealers, NGOs, extension services, and farmers' associations and cooperatives [May 2013]	Various classes of improved sorghum varieties were produced and distributed through channels appropriate for each target country	Achieved	HOPE Annual Report for Y2 and Y3
	6.2.16	Availability of seed of improved finger millet and sorghum varieties increased [May 2013]	Availability of seeds of improved finger millet and sorghum varieties has been enhanced through 1) the release of two finger millet varieties P224 and U15 in Tanzania, Kenya, and Uganda, and 2) increased access to quality seed through various channels, including small-scale agro-dealers	Achieved	HOPE Annual Report for Y3
	6.2.22	Country reports on farmer-preferred varieties and seed dissemination experiences targeting policy makers completed [May 2013]	Farmer-preferred traits were determined during PVS assessments and on-farm demonstrations. Country reports are under preparation	On-going and on-target	-
SA	6.2.4	Breeder/foundation seed of promoted varieties produced to feed seed supply chain [April 2011]	250 kg of breeder seed of preferred OPVs was produced to complete the seed chain in order to meet seed requirements in the next year	Achieved	Objective 6 Annual Report; foundation seed produced using this breeder seed; extent of area covered using this

					seed
	6.2.7	1 warehouse for post-rainy season sorghum seed storage established in MAU region [Dec 2011]	1 seed warehouse was constructed and operationalized in the MAU region	Achieved	Objective 6 Annual Report; warehouse - physical structure and operations in MAU
	6.2.10	Progressive farmers and KVKs identified and trained in post-rainy season sorghum seed production, storage, and marketing [Dec 2010]	Training sessions were held at University, regional, KVK, and village levels to more than 100 progressive farmers and KVK and SAU field staff (>20) in post-rainy season sorghum seed production, storage, and marketing. Women farmers (25) were trained in collecting seed for their own use and to share with other farmers	Achieved	Project annual reports
	6.2.16	Seed of promoted post-rainy season sorghum varieties produced, stored, and distributed to cover 12,000 ha over three years [June 2010, 2011, 2012]	Seed of released varieties (Parbhani Moti, Parbhani Jyoti, Phule Vasudha, Phule Chitra and Akola Kranti) was distributed for cultivation to cover 10,180 ha, involving 25,200 farmers, in the first 3 years of the project. Beneficiary farmers were trained on the use of improved cultivars and management practices.	Achieved	Annual reports; Partnership Award nomination; Messages in ICRISAT Happenings
	6.2.19	State seed corporations and private-sector seed agencies encouraged to produce and market seed of farmer-preferred hybrids [Nov 2009, 2010, 2011, 2012]	State seed corporation (APSSDC) and private sector companies such as Bioseeds, Metahelix, JK Agri, Bayer, Vibha, and Pioneer are being encouraged to produce seed of hybrids suited to target agro-ecologies	On-going and on-target	Records of APSSDC and Companies; SA Annual Report
	6.2.20	Seed of promoted hybrids purchased in bulk and delivered to target villages [June 2010, 2011, 2012]	10,710 kg of seed of promoted hybrids was procured from APPSDC and delivered to target clusters during 2011. Private seed companies contributed an additional 1,275 kg of free seed for use in demonstrations in farmers' fields during 2011. About 6,100 kg of seed was distributed during 2010. During 2012, 16,170 kg seed has been produced by APSSDC, private sector companies, and the State Agricultural University (SDAU) in Gujarat for distribution to project farmers in target clusters and villages	Achieved	Records of APSSDC and seed companies; SA Annual Report
	6.2.22	Promoted hybrids demonstrated using test kits marketed in target villages by self-help groups and/or local agro-dealers [July 2010, 2011, 2012]	1,288, 1,618 and 1,613 test kits were distributed in Gujarat, Haryana, and Rajasthan, respectively, in 2010. In the period June-July 2011, 2,892, 2,950 and 3,040 test-kits were distributed. In June 2012, 5,370 test kits were distributed in Rajasthan, and 5,400 kits distributed each in Haryana and Gujarat	Achieved	Data sheets, SA Annual Report
	6.2.23	Self-help group revolving funds established/strengthened for future input marketing with proceeds from test kit sales [Aug 2010, 2011, 2012]	In 2010 test kits were distributed free of charge. In 2011, US$1.10/kit was charged for public sector hybrids; however, there was reluctance by some farmers to pay for the kit and thus money could not be collected in some villages	On-going	Banks accounts of SHGs, SA Annual Report

Activity 3: ***Increase availability and use of fertilizer and other crop management technologies***					
Region	**Output #**	**Targeted Outputs**	**Realized Outputs as of June 30, 2012**	**Status**	**Means of Verification**
WCA	6.3.3	Input providers linked to other projects, to facilitate access to training in appropriate use of specific types of fertilizers, seed treatments, herbicides, pest control products, and business skills in Mali and Niger [Oct 2012]	A total of 35 agro-dealers were included in different training workshops and sessions on varieties and marketing topics in Mali, Burkina Faso, and Niger in 2010/2011. CNFA and AGRA projects (EUCORD NGO) were approached. Collaboration agreements were signed in Mali; agro-dealers were included in training about seed marketing in the Dedougou and Sanmatenga regions in Burkina Faso(August 2011)	Completed for Mali and on-going in other countries	Different internal reports on marketing, MSc thesis of Anna Niccoleau, striga control packs documentation
	6.3.8	Farmer field schools for integrated striga management for pearl millet-based systems scaled up to reach 5,000 farmers in Mali and Nigeria using a range of tools for farmer training [Dec 2011]	At least 5,600 farmers have been reached with technologies on integrated striga management for pearl millet in Mali and Nigeria, through FFS, videos, field demonstrations, and information booklets	Achieved	Annual reports for Y2 and Y3, materials stored online
	6.3.11	Impact of MHM biological control technique extended by INRAN/Maradi quantified on storage moth (Corcyra) in millet granaries at 3 locations in 3 countries [May 2012]	A study was conducted in Y2, resulting in a better understanding of impacts	Achieved	Results presented at the 2011 national HOPE meeting in Niamey and are available from the HOPE online depository, training program reports, GIMEM project documentation
	6.3.14	Potential for extending use of integrated pearl millet head-miner control techniques into new areas understood [July 2011]	Integrated pearl millet head-miner control was extended: **Burkina Faso:** new releases in 10 different villages in the Sahel zone (department Falagounptou) and 2 farmer field schools on integrated head miner management in the Arginda region in the Sahel zone of Burkina **Niger:** new villages in the Téra region now collaborating with GIMEM. 4 farmers trained and 150 release backs produced for10 villages. In Y3, training programs in Maradi for releases in new villages were conducted for 9 male and 7 female farmers	Achieved	Information from GIMEM project documentation
ESA	6.3.3	Timely availability of appropriate fertilizers for finger millet and sorghum farmers in Ethiopia, Kenya, and Tanzania increased through agro-dealers [March 2012]	Agro-dealers in HOPE target areas in Kenya and Tanzania were identified within 5 km and were trained in PVS, participatory technology delivery systems, and micro-dosing for finger millet and sorghum. They were also trained in packaging fertilizer into small packs and given information on farmer-preferred fertilizers, rates	Delayed but on-going	HOPE annual report for Y2

			and time of application. In Ethiopia, fertilizer access and the high cost, as well as farmers' inability to access credit, has been a challenge. Fertilizer delivery to agro-dealers and timing is a national task and is beyond the project authority		
	6.3.6	Input suppliers, agro-dealers and farmer cooperatives provided information and technical support in marketing fertilizer in affordable packs to small-scale farmers. [March 2013]	In Tanzania, farmers preferred 5 kg packages of ammonium sulphate or CAN, mainly for top-dressing. In Kenya, although most types of fertilizer are packaged in 10, 20, and 50 kg sizes, fertilizer sellers legally sell even 1 kg packs. A brochure on fertilizer preference and marketing in small affordable packs is under development	On-going and on-target	HOPE annual report for Y2 and Y3
SA	6.3.4	Farmer groups in cluster villages linked to soil testing facilities and input suppliers (fertilizers and pesticides) [Dec 2010]	Six farmers' associations were linked with the soil testing labs in the cluster areas. The farmers were trained in the soil sample collection and submission of samples to the nearby soil-testing lab for analysis. The results were taken back to the farmers and fertilizer recommendations were given as per the soil test results. The project keeps track of this process. Six farmers' associations were linked to input suppliers in target areas and ensured that there is no shortfall in fertilizer or pesticide availability. All input suppliers in the area were informed about the project and the farmers' associations were supplied with the list of input agencies available in the area. The farmers had access to fertilizers, pesticides without any shortfall	Achieved	No. of soil samples collected and reports distributed, no. of farmers trained in soil sample collection, Objective 6 Annual Report
	6.3.7	Crop management demonstrations conducted in each village cluster (10 per cluster across years) [March 2013]	Frontline demonstrations (FLDs) on crop management were conducted in 10 villages in each cluster (10/cluster).	Achieved	Demonstration notes and reports, HOPE annual reports
	6.3.11	Farmer groups in cluster villages linked to soil-testing facilities and fertilizer suppliers [Sept 2010]	Farmers in the cluster villages were linked to the soil-testing facilities and fertilizer suppliers in each selected district in Gujarat, Rajasthan, and Haryana through representatives from soil-testing laboratories and fertilizer suppliers. Farmer representatives visited the labs and suppliers.	Achieved	Names of laboratories and fertilizer suppliers; SA Annual Report
	6.3.15	Self-help group revolving funds strengthened with proceeds from test kit sales [Aug 2010, 2011, 2012]	In 2010, test kits were distributed free of charge. In 2011, US$ 1.10/kit was charged for public sector hybrids. However, there was reluctance by some farmers to pay for the kit and thus money could not be collected in some villages	On-going and on-target	Bank accounts of SHGs, SA Annual Report
	6.3.16	Crop management demonstration superimposed on hybrid demonstrations conducted in target villages [Aug 2010, 2011, 2012]	Crop management practices have been identified and 30 demonstration trials were conducted in Rajasthan, Gujarat, and Haryana during 2010 and 2011.	On-going and on-target	Data sheets, SA Annual Report
Activity 4: ***Improve access to output markets to increase technology adoption and cash incomes for farmers***					

Region	Output #	Targeted Outputs & Delivery Date	Realized Outputs as of June 30, 2013	Status	Means of Verification
WCA	6.4.3	Link at least two farmer organizations to WFP's P4P program in Mali [May 2010]	Links have been formed and contracts signed by farmers' organizations ULPC, UACT, and AMEDD with the P4P program	Achieved	Signed contracts
	6.4.8	Strengthen 10 farmers' unions for collective marketing of dryland cereals in Burkina Faso, Mali, Niger [May 2013]	Six farmers' associations, 2 associations of FEPAB, and 4 associations of Fumar Gaskiya and Moriben farmer organizations have been trained in small-scale business and marketing skills in Mali and Niger. Contracts have been negotiated and signed between the FUs, P4P, and different cereal grain agencies in Burkina Faso, Mali and Niger	On-going	Results of analysis of strengths, weaknesses, signed contracts, training reports
	6.4.12	Improve availability of information on prices, supply and demand for actors along the value chain (producer, traders, processor) in Mali, Niger, and Burkina Faso [May 2013]	Information on prices, and supply and demand of sorghum and pearl millet are currently being provided by the Systeme d'Information sur les Marches Agricoles (SIMA) in Niger and the Office des Marches Agricoles (OMA) in Mali in project sites. In Burkina Faso, 'Afrique Vert' distributes market information through a monthly newsletter. As these systems are functioning very efficiently (gap in information dissemination is only about 2 days and information cannot be provided much earlier than that), there is no need for setting up more contracts with market information systems. However, contracts have been established between ICRISAT and rural radio outlets for the supply of information on new technologies, supply and demand, and prices in Niger and Mali to farmers in and around the project sites	Achieved	Existing information systems and contracts signed
ESA	6.4.3	3-5 organized farmer groups growing finger millet in Kenya, Tanzania, and Uganda linked to Unga Ltd and/or other millers to market their surplus grain [May 2011]	In **Uganda**, 6 groups from the 6 project districts have been linked to Family Diet and to Maganjo Grain Millers and other smaller local processors In **Kenya**, 15 groups were linked to Unga Ltd, Eastcom Foods, and other smaller processors In **Tanzania**, 25 farmer groups in Kondoa, Singida, Kishapu, Iramba, and Rombo are linked to P4P, Nyire Farm, and Dunia Trust/Serengeti breweries	Achieved	HOPE annual report for Y2
	6.4.6	2-4 organized farmers' groups growing sorghum in Ethiopia and Tanzania linked to P4P and to food and feed processors to market their surplus grain [May 2012]	In Tanzania, more than 20 farmers' groups from central and northern zones were linked to P4P, Nyirefami, EAML/Serengeti breweries, and TBL. They were briefed on other existing grain business opportunities and are marketing their surplus grain. In Ethiopia there are no food processors and linkage to P4P was not possible because of the restrictions imposed on P4P disallowing them linkage to local markets there	Completed for Tanzania, not feasible for Ethiopia	HOPE annual reports for Y2 and Y3

	6.4.10	Information (prices, supply and demand) on finger millet and sorghum integrated into the existing regional market information system managed by East Africa Grain Council [March 2011]	The EAGC is integrating this information into the existing regional market information system and the information is being posted on their website since the end of 2011. Price information is already available on the Regional Agricultural Trade Intelligence Network (RATIN) for the major markets in Kenya, Tanzania, Uganda, Rwanda, and Burundi Weekly reports are made on supply and demand and are also available through the RATIN portal and can be downloaded	Achieved (this is a continuous activity)	HOPE annual report for Y2, RATIN portal
	6.4.14	Appropriate post-harvest handling and processing equipment (e.g., dehullers, and grain threshers and cleaners) demonstrated to farmer groups, women's groups, and entrepreneurs for reducing drudgery and providing business opportunities at the local level [Jan 2013]	HOPE project in Tanzania purchased one set of a thresher and a de-huller and provided it to the Kwamtoro SACCOs. Proper operation was demonstrated to farmers' groups by Intermech Engineering Equipment Ethiopia is being helped to purchase a similar set of equipments, but this has not been finalized	Completed in Tanzania On-going in Ethiopia	Receipts of purchase of the equipment, new equipment purchased by groups, list of participants present during the demonstration
SA	6.4.3	Farmers' groups in cluster villages linked to retail chains and grain wholesalers [Nov 2010]	Six farmers' associations have been linked to identified retail market chains and grain wholesalers in the target areas in both the MPKV and MAU regions	Achieved	HOPE annual report for Y2
	6.4.6	Farmers' groups in cluster villages linked to fodder wholesalers and processors [Nov 2010]	Farmers' associations were linked to selected fodder wholesalers and processors (one each in the MPKV and MAU regions)	Achieved	HOPE annual report for Y2
	6.4.9	Farmers' groups in cluster villages linked to retail chains, grain wholesalers, and/or livestock feed producers [Sept 2010]	Farmers in cluster villages were linked to selected retail market chains, wholesalers, and feed manufacturers in Gujarat, Haryana, and Rajasthan through market representatives and commission agents	Achieved	List of markets selected, HOPE annual report for Y2
	6.4.12	Farmers' groups in selected village clusters linked to fodder wholesalers and processors [Sept 2010]	Farmers' groups in the clusters were appraised and linked to fodder markets and kept abreast of fodder price differences between the village and in the informal fodder market in a nearby town	Achieved	List of markets selected, HOPE annual report for Y2
Activity 5: ***Improve farmers' access to finance to increase adoption of purchased inputs, production of seed, and surplus grain for marketing***					
Region	**Output #**	**Targeted Outputs & Delivery Date**	**Realized Outputs as of June 30, 2013**	**Status**	**Means of Verification**
WCA	6.5.3	Farmer organizations strengthened in bookkeeping, (cash flow, profit and loss account) in Burkina Faso, Mali, and Niger [Dec 2012]	Farmers' organizations in Niger, Burkina Faso, and Mali were strengthened through training in proper bookkeeping	Achieved	Internal reports in HOPE online repository
	6.5.7	Linkages established between financial institutions and farmers' organizations to access credit for input supply and output marketing in Mali and Niger [Sept 2011]	Linkages between farmers' organizations and processors have been initiated and the process is on-going. A consultant has been identified to develop business plans for processors that will be used as basis for discussions with banks to have access to loans	Delayed but on-going	Country reports, consultative meetings, business plans under development

	6.5.10	Warrantage and credit guarantees strengthened with partners to increase farmer access to input finance for dryland cereals (link with CNFA and AGRA initiatives) in Mali and Niger [April 2013]	In Niger, 5 warrantage schemes were identified with the farmers' union MOORIBEN. Efforts to strengthen warrantage schemes have been limited in Niger. A study is underway to understand why some farmers' associations are dis-adopting and why others are still using warrantage systems	On-going	
ESA	6.5.3	Capacity of farmer organizations in Ethiopia, Kenya, and Tanzania to access finance strengthened [May 2012]	Training in agribusiness and basic business planning was provided to farmers and farmers' organizations in Ethiopia (22 participants), Kenya (30), and Tanzania (29) to be able to access finance to support purchase of surplus finger millet and sorghum	Achieved	HOPE annual report-Y2, agribusiness training manual
	6.5.6	Awareness of financial institutions about business opportunities in sorghum and finger millet value chains in Ethiopia, Kenya, and Tanzania enhanced [Dec 2011]	4 financial institutions in Kenya and 2 in Tanzania were sensitized about business opportunities in sorghum and finger millet value chains during agribusiness training workshops held in March and June 2011, respectively. In Ethiopia, credit is available in rural areas from savings and credit associations and collateral is not required	Achieved	HOPE annual report for Y2, agribusiness training manual
	6.5.8	Linkages established between financial institutions and farmers' organizations to access finance for input supply and output marketing in Ethiopia, Kenya, and Tanzania [Feb 2012]	In Tanzania, farmers and 3 banks were sensitized to business opportunities along the finger millet and sorghum value chains. In Kenya, linkage and business opportunities were discussed with Kenya Women Finance Trust (KWFT). In Ethiopia, awareness of financial institutions about business opportunities in sorghum and finger millet value chain was achieved during the agribusiness training	Achieved	HOPE annual report for Y2, agribusiness training manual
	6.5.11	Monitor contractual arrangements between farmer unions and traders [Dec 2011; May 2012; 2013]	**Tanzania:** Monitoring of contractual farming is on-going, and being done between Dunia Trust and WFP/P4P, with SACCOs in Kwamtoro Dodoma, as well as Habiba SACCOs in Singida **Kenya:** Warehouse operators in Koibatek, Bomet, Nakuru, Kakamega, Eldoret, Kisii, Busia, and Kisumu were identified and the warehouse receipt system is being promoted **Ethiopia:** Still pending, since such financial institutions are not in operation in the sorghum and finger millet growing areas	On-going (this is a continuous exercise)	HOPE annual report for Y3
SA	6.5.3	Financial institutions informed about business opportunities along the value chain [July 2010]	Financial institutions were identified in the MPKV and MAU regions in 2010; flyers were developed and distributed to these intuitions on the post-rainy season sorghum value chain and opportunities for financing it. Interactive meetings were organized to network the financial institutions and farmers' associations, so as to facilitate increased flow of credit to post-rainy sorghum. A brochure has been developed on good business practices in accessing finance from alternative sources for use by farmers	Achieved	Brochure developed on good business practices, HOPE annual report for Y2

	6.5.6	Farmers' organizations in cluster villages strengthened and educated about good business practices in accessing finance from alternative sources [Aug 2012]	Some 150 farmers (50 women and 100 men) from farmers' associations were trained in good business practices in accessing finance from alternative sources. Training was given (60 men and 40 women) on various market opportunities for post-rainy season sorghum seed, grain, and stover to get higher profits	Achieved	Training records
	6.5.10	Increased farmer access to input finance for input supply and output marketing for post-rainy season sorghum production promoted through warehouse receipts and other schemes [May 2013]	The seed warehouse is constructed and is operational. Opportunities have been reviewed for access to credit with the banks through storage of the farmers produce in the constructed seed warehouse	Achieved	Existence of constructed warehouse, HOPE annual report for Y2
	6.5.13	Financial institutions informed about business opportunities along the value chain [Aug 2010]	Three financial institutions were identified in Haryana, 3 in Rajasthan, and 4 in Gujarat and informed of business opportunities along the pearl millet value chain	Achieved	List of banks
	6.5.16	Farmers' organizations in cluster villages strengthened and educated about good business practices in accessing finance from alternative sources [Aug 2012]	Representatives of local financial institutions have been trained in workshops that included representatives of farmer organizations. Bankers explained various financial products and services (crop loans, farmers credit cards, crop insurance, Bank-SHG linkage program, etc.) provided by the banks and how farmers can benefit from them	Achieved	No. of trainings conducted, list of financial institutions
	6.5.19	Increased farmer access to input finance for input supply and output marketing for pearl millet production promoted through warehouse receipts and other schemes [Aug 2012]	Brochure on "*Providing access to credit for HOPE project farmers to enhance pearl millet productivity*" was developed and translated into local languages for the benefit of farmers in Rajasthan, Haryana, and Gujarat. Use of warehouse receipts is not prevalent. Benefits from the system were explained to the farmers. Information was provided by bankers on various schemes for accessing finance. Linkage with grain, feed and fodder markets have been established	Achieved	Copies of brochure

Activity 6: ***Enhance capacity of partners (e.g., NGOs, farmer organizations, private-sector, extension) to deliver appropriate cereal technology options to farmers and increase alternative use of dryland cereals***

Region	Output #	Targeted Outputs & Delivery Date	Realized Outputs as of June 30, 2013	Status	Means of Verification
WCA	6.6.2	ICRISAT and NARS scientists and other partners trained in participatory approaches [April 2010]	Several training workshops and in-field sessions were organized for partners in Mali, Burkina Faso, Niger, and Nigeria, either locally or as a regional workshop	Achieved	Internal training reports, technical guides printed in French and English, technical guides
	6.6.4	Experiences with integrating delivery of seed, crop management techniques, inputs, and market linkages exchanged among project partners in WCA [Feb 2013]	A workshop to exchange experiences among partners was organized in Bamako in April 2011. HOPE partners were also invited to the ICRISAT open house day in October 2010, where mini-packs and seed were on display. An exchange workshop on	On-going and on-target	Report on exchange of experiences, stored in the HOPE online document repository

			seed and variety issues with participants from WCA was conducted at Dédougou in February 2012 with the participation of agro-dealers, seed producers, farmer organization representatives, and agents.		
	6.6.5	1 MSc student per country trained in technology change (Mali, Niger, Burkina Faso, and Nigeria) [Jan 2012]	5 MSc students from Mali (2), Burkina Faso (1), Nigeria (1), and Niger (1) in WCA were trained and supervised – training of 2 were co-hosted by Objective 2	Achieved	Training database
ESA	6.6.2	Capacity of scientists enhanced to facilitate choice by partners of appropriate technology for widespread adoption in Eritrea, Ethiopia, Kenya, South Sudan, Tanzania, and Uganda [Sept 2010]	Training on participatory technology development and delivery techniques was carried out for researchers, extension, lead farmers, and seed production agencies from HOPE project target districts in all HOPE countries (Eritrea, Ethiopia, Kenya. Uganda, Tanzania, and South Sudan	Achieved	List of trainees,HOPE annual report for Y2
	6.6.8	Capacity of sorghum extension staff, seed producers, and distributors enhanced in preparation for product deployment of African biofortified sorghum anticipating that regulatory systems will be in place [May 2012]	Training on biosafety, communication, and risk management was carried out in July 2011 in Nairobi, attended by 25 participants (21 men and 4 women) drawn from research (breeders), extension, private seed companies, and seed certification and plant health institutions from the 6 HOPE ESA target countries	Achieved	Training database, HOPE annual report for Y2
	6.6.11	Training provided to enhance the agribusiness, grain marketing, and managerial skills of farmer organizations in Ethiopia, Kenya, and Tanzania [Sept 2011]	Training on agribusiness was conducted in Tanzania, Kenya, and Ethiopia with a total of 81 participants (60 men and 21 women)	Achieved	Training manual and a brochure are available, training database
	6.6.13	Training and technical support in finger millet and sorghum seed production for seed companies and seed growers completed in Eritrea, Ethiopia, Kenya, Tanzania, and Uganda [Dec 2011]	Training and technical support in finger millet and sorghum seed production for seed companies and seed growers was completed in Eritrea (25 participants), Kenya (34), Tanzania (35), Uganda (26) and Ethiopia (22)	Achieved	Seed production training manual, training database
	6.6.15	Training and technical support in integrated striga management for sorghum provided to agricultural service providers, e.g., extension, agro-dealers, and farmers' associations in Eritrea, Ethiopia, Tanzania, and Uganda [March 2012]	187 farmers, extension agents and researchers were trained in integrated striga management and control in Tanzania (41 participants), Ethiopia (31), Sudan (26), Eritrea (30), Kenya (34), and Uganda (26)	Achieved	Integrated Striga Management Manual, list of trainees and training database
	6.6.17	Training and technical support in integrated blast management for finger millet provided to agricultural service providers, e.g., extension, agro-dealers, and farmers' associations in Ethiopia, Kenya, Tanzania, and Uganda [Sept 2011]	132 farmers, extension agents, and researchers were trained in integrated blast management in Tanzania (41 participants), Ethiopia (31), Kenya (34), and Uganda (26). This was carried out during PVS TOT training, and those trained are becoming trainers of others	Achieved	Integrated blast and weed management manual, list of trainees, training database
	6.6.19	Training provided to farmers' groups (especially women) on better post-harvest handling and processing techniques in Eritrea, Ethiopia, Kenya,	Training being organized in Tanzania for artisans from the other countries, for subsequent training of farmers in respective countries	On-going and on-target	

		Tanzania, and Uganda [May 2013]			
SA	6.6.3	Farmers' groups, women's self help groups, and KVK field staff trained in post-rainy season sorghum crop management, variety seed production, village seed systems, and grain and stover marketing [Sept 2012]	Six farmers' groups (with 60 members each), women's self-help groups (2 in each region, 50 members in each) and 8 KVK field staff were trained in soil sample collection and post-rainy season sorghum crop management, purity maintenance in seed production, and grain and stover marketing.3 information, education and communication (IEC) documents were developed in the Marathi language on post-rainy season sorghum value chain development for grain and stover production and value addition for marketing stover	Achieved	List of persons trained, publications developed and circulated, HOPE annual report for Y2
	6.6.7	Farmers' groups trained in seed storage warehouse management and bookkeeping [April 2012]	Developed training material (1 brochure) on seed storage warehouse management and warehouse bookkeeping in the local language (Marathi). Training was given to selected farmers (30 in each cluster) on seed storage warehouse management and bookkeeping in the MAU area	Achieved	No. of persons trained, publications developed and circulated, HOPE annual report for Y2
	6.6.10	Field days and exposure visits organized for technology demonstration and dissemination for project farmers material [Oct 2012]	Trained project farmers (400 each from western Maharashtra and the Marathwada region) by conducting field days (2 in each region) and exposure visits (3 in each region), and distributed the IEC material	Achieved	Field day records, training records, IEC materials, HOPE annual reports for Y1 and Y2
	6.6.13	Farmers' groups, women's self-help groups, and KVK field staff trained in pearl millet crop management and marketing [Sept 2012]	A training program was conducted in each state (Rajasthan, Gujarat, and Haryana) to illustrate pearl millet crop management practices that increase yields. The location of markets (both regulated and informal markets) and the prevailing prices, seasonal variation in prices, and quality premiums for each grade were explained to participants	On-going and on-target	No. of persons trained, IEC materials
	6.6.16	Field days and exposure visits organized for technology demonstration and dissemination for project farmers [Sept 2012]	One field day and exposure visit organized in each state (Rajasthan, Gujarat, and Haryana) every year	On-going and on-target	Report of field days, HOPE annual report for Y2 and Y3

DEVIATION FROM PROPOSAL

Following the planning and mid-term review meeting held in Addis Ababa in October 2011:

- Activity 3.4 (SA) was restructured, and a new activity (3.1.8) implemented and accomplished in Year 3. Activity 3.1.8 (SA) involved the characterization of blast isolates and identification of the sources of resistance to blast pathotypes;
- In WCA, Activity 3.1 was restructured and is now on track with a revised time line.

MEASURABLE OUTPUTS AND OUTCOMES

The status of the major project outputs, as of June 30, 2012, was presented in Tables 1 to 6 in this narrative report. A summary picture of these outputs across the project objectives is shown below in Table 7.

Table 7: Summary of status of major project outputs across objectives as of June 30, 2012

Objectives	Total of project outputs	Number of major outputs as of June 30, 2012			
		Achieved	Delayed	On-going and on-target	Unattainable by June 2013
1	47	25	10	10	2
2	60	34	2	24	0
3	30	9	2	19	0
4	29	16	0	13	0
5	62	19	21	22	0
6	83	63	4	16	0
Total	**311**	**166**	**39**	**104**	**2**
Percentage		53.4	12.5	33.4	0.6

In addition, a summary of "big picture" results arising from three years of project activities is being prepared, and will be presented separately, as an Annex to this report.

KNOWLEDGE GENERATED

Targeting

- Status of socioeconomic profile of farmers, adoption levels, yield gaps, input-output levels and the profitability of crop production, income and consumption levels, marketing channels, gender participation, and crop livestock status in SA and selected countries in SSA.
- Forecast of supply and demand scenarios of sorghum and pearl millet production using the IMPACT model in WCA and SA.
- Early information on adoption levels, yield, and critical constraints relating to dissemination of post-rainy season sorghum and pearl millet technologies in SA.
- Changes in production, productivity, cost of production and overall profitability over baseline in SA.

Sorghum improvement

- Transfer of striga tolerance QTLs, using marker-assisted selection is working. In Mali the levels of striga tolerance found in BC_2lines has reached the level of the donor parent.
- Yield superiority of photoperiod-sensitive sorghum hybrids is high and consistent over a wide range of growing conditions in the Sudanian zone in Mali. This yield superiority renders fertilizer application to sorghum more profitable. The yield superiority of hybrids is also consistently observed under low-productivity conditions.
- The identified integrated striga management practices for sorghum in the Sudanian zone of West Africa show satisfactory levels of returns on investment, to enable farmers to adopt them.
- For post-rainy season sorghum of SA the knowledge generated in terms of low temperature tolerance adaptation is unique and will help to develop genotypes better adapted to post-rainy season conditions.
- Several hybrid parents have been developed for producing hybrids for the targeted agro-ecologies with improved shoot fly and charcoal rot resistance. This may facilitate the breakthrough for hybrids for post-rainy season sorghum, a market that has so far been dominated by reselected landrace varieties.
- The screening techniques for identifying lines tolerant to aphids will help the breeding programs to develop new parental lines and hybrids that can produce higher and more stable yields.
- Best management practices were identified across locations for fertilizer, spacing, sowing time, and seed treatment and these were disseminated via rigorous extension activities to farmers to help reduce the cost of cultivation and increase productivity.

Pearl millet improvement

- Major QTLs identified for resistance to most virulent downy mildew pathotypes, and their flanking markers identified.
- Hybrid parents and hybrids with high yield potential under drought adaptation were identified.
- Improved hybrid parents with newly introgressed DM-resistant QTLs were developed.

Finger millet improvement

- Existence of great finger millet germplasm diversity in ESA, which could be exploited for different traits including rare ones like “snapping trait”.
- High potential for increasing finger millet grain yield above the present average of 0.6 t/ha.

Markets

- In Mali, the marketing channels that provided the lowest marketing margins, net of transaction costs, for pearl millet were: 1) Producers groups and cooperatives – Assemblers – Wholesalers – Exporters; and 2) Producers groups and cooperatives – Assemblers – Wholesalers – Retailers – Consumers; and for sorghum they were: 1) Individual producers and rural assemblers – Retailers – Consumers; 2) Producer groups and cooperatives – Assemblers – Wholesalers – Exporters; and 3) Producers groups and cooperatives – Assemblers – Wholesalers – Retailers – Consumers.
- The demand for sorghum and millets by processors outstrips supply in ESA.

- There is high demand for finger millet in Kenya by both urban and rural consumers.
- The two most widely observed marketing channels for grain (both for sorghum and pearl millet in Maharashtra, Gujarat and Rajasthan) are: Farmer – Primary market trader – Local retailer – Consumer; and Farmer– Primary market trader – Secondary market trader – Retailer – Consumer.

ACTIVITIES THAT CANNOT BE COMPLETED IN GRANT PERIOD

In ESA, activities 1.2.5 and 1.2.9 will probably not be completed during the grant period due to heavy commitments by DRD and EIAR partner scientists that are causing delays in the completion of the planned tasks. There is very little that ICRISAT can do to speed up these activities.

MANAGEMENT UPDATES

The project management structure remains unchanged, and is shown below:

Principal Investigator: Dr. Said N. Silim

Project Manager/Coordinator: Dr. George E. Okwach

Objective Leaders & Regional Objective Coordinators

Objective 1: Dr. Nareppa Nagaraj

WCA: Dr. Jupiter Ndjeunga
ESA: Dr. Alastair Orr
SA: Dr. Nareppa Nagaraj

Objective 2: Dr. Eva Weltzien-Rattunde

WCA: Dr. Eva Weltzien-Rattunde
ESA: Dr. Mary Mgonja
SA: Dr. Belum Reddy

Objective 3: Dr. SK Gupta

WCA: Dr. C. Tom Hash
SA: Dr S.K. Gupta

Objective 4: Dr. Henry Ojulong

ESA: Dr. Henry Ojulong

Objective 5: Dr. Alastair Orr

WCA: Dr. Jupiter Ndjeunga
ESA: Dr. Alastair Orr
SA: Dr. Parthasarathy Rao

Objective 6: Dr. Mary Mgonja

WCA: Dr. Kirsten Vom Brocke
ESA: Dr. Mary Mgonja
SA: Dr. Belum Reddy/Dr. Rajan Sharma

LESSONS LEARNED

Overall

Commitment to project activities by partners continues to be a critical challenge in some countries, especially in Africa. This may be due, at least in part, to heavy involvement by national partner scientists in different (and sometimes competing) projects, and lack of appropriate incentives from the HOPE project.

Targeting – SA

- Dryland farmers tend to under invest in improved capital-intensive technologies because of risk and uncertainty, including the vagaries of the monsoon rains and scarcity of labor.
- Farmer's response to investment in soil and moisture conservation technologies is poor due to the large investments required, lack of capital ownership, small holdings, and limited crop choices.
- Farmer response is good with regard to mechanical threshing.
- Farmers hardly follow the recommended spacing. The demand for fodder often drives out the desire to maintain higher plant populations than is recommended.
- In case of pearl millet, public hybrids are more popular in harsh agro-climatic ecologies, while private hybrids are more popular in irrigated areas.
- With respect to post-rainy sorghum, farmers tend to prefer local varieties to improved varieties due to the quality of its fodder.
- A strong livestock economy is the driving force for adopting improved varieties/hybrids of sorghum as well as pearl millet

Sorghum improvement – SA

- Project implementation over three years has helped to identify new hybrid parents, varieties, and hybrids. More efforts are required, over another three to four years, to take these improved cultivars to farmers through on-farm testing and seed production activities.
- New material generated as a result of crossing *maldandi* Indian materials with bold grain African lines needs further selection/backcrossing to produce them as useful hybrids.
- A long-term approach of population improvement using genic male-sterility should be maintained to sustain male-sterile line development and support new hybrid breeding.

Sorghum improvement – WCA

- Combining variety and crop management options in the same experiments managed by farmers, and focusing on farmers' main interests is very powerful in triggering experimentation with new technologies.
- Hybrid seed production can be well integrated with food grain production of households, which are mainly oriented towards self-sufficiency.

Pearl millet improvement

- There was a need to expand the private sector seed companies base for scaling up the hybrids identified in the project, hence three more seed companies than planned were involved.
- The incidence of blast has increased in the last two to three years; hence, breeding material was screened for blast resistance
- Long-duration forage cowpea is an excellent intercrop for use in integrated *Striga hermonthica* and soil fertility management for pearl millet, but there is a dearth of farmer-preferred forage genotypes resistant to *Striga gesneroides* (a parasite of cowpea) and bruchids (a serious storage pest of cowpea seed and grain).

Marketing – SA

- It is recognized for most of the development-related interventions, awareness and demonstrations play an important role. This also holds for the proposed value chain interventions. Discussions with HOPE farmers and experiences from field surveys show that piloting some of the proposed value chain interventions (development of value-added products and value addition through installation of small-scale equipment) would have made higher impacts on development outcomes. Also, these interventions need to be tested for their economics and scalability.

Enabling technology adoption – WCA

- Through diversification of technology dissemination practices (mini-packs, demonstration plots, radio messages, DVDs) combined with strong farmer organizations and dynamic NGOs, it is possible to boost the use of modern technologies in WCA zones where farmers are traditionally reluctant to adopt new technologies.
- Participatory cost-benefit analysis of new crop technologies can help farmers with their decision-making.
- New Guinea hybrids possess high potential for increasing productivity and adoption of varieties in West Africa. They combine the farmers' preferred plant type and quality with high yield and stability.

Enabling technology Adoption – SA

- There is critical need for efforts to a) popularize the use of seed drills to maintain the required row spacing of 45 cm; b) demonstrate the productivity and utility of fodder from improved sorghum varieties; c) fine tune the "women champion" concept; and d) acquire and test mechanical harvesters.

With the benefit of hindsight, the following would have been done differently if the project was re-designed:

- Provide more incentives and motivation to national partner staff.
- Refocus the project scope to derive fewer but more successful pilot locations that can be replicated. The strategy would be to target one or two locations and focus the interventions to attain maximum benefits, then scale out and up at later stages of the project.
- Reduce the number of activities, and sequence targeting and market activities and outputs.

- Redefine the reporting procedure to focus on broader output target areas, and thus allow for the description of processes and results in an analytical manner that is more geared toward joint learning.
- Integrate documentation, data management and user-friendly management tools and interfaces.
- On pearl millet improvement, leave out head miner and stem borer activities related to assessing soil, stover, and intercrop management options and their effects on these insect pests. Instead the project should have focused millet entomology efforts on assessment of head miner resistance in early-maturing genetic backgrounds, and on use of natural enemies in control of millet head miners, as these appear to be much more promising.
- Plan for supplying two seed drills to each cluster among collaborating farmers in Maharashtra, so that farmers can maintain the required sorghum row spacing of 45 cm.
- Monitoring and planning for impact assessments should have been integrated with the technology and crop production objectives.
- Involve home science faculty and agro-processors in the project to develop and promote novel products, such as multigrain flour or gluten-free products using sorghum and millets.
- Involve Self-Help-Groups to enhance the participation of women farmers in the value chain.
- Research on and options for making improved small implements available, especially to women, to reduce drudgery and to enhance productivity should receive more attention. This should also include mechanical methods for harvesting sorghum and processing fodder (chaffing, pellets).

Potential for scale/impact/sustainability

- The potential for scaling up technologies such as the promotion of varieties, seed production, or fertilizer micro-dosing application is high. Large investments are needed. Government commitment to promote technologies and innovations remains a challenge.
- Use of videos depicting farmers' use of improved technology is very effective, as shown by the use of striga control DVDs in WCA. The fact that the videos are based on showing farmers' experiences triggers farmers who are watching to think immediately about their own practices, and how they are different. It leads immediately to profound discussions on practices that individual farmers could change.
- Use of rural radio in programs that involve farmers is a fast and effective method for reaching large numbers of farmers.
- There is need to increase pearl millet breeder seed production at least 10-fold and/or move breeder seed and foundation seed multiplication to off-season irrigated environments if we are to meet potential demand for improved seed of pearl millet OPVs in WCA.

- Collaboration with strong and well-run farmers' organizations can assure sustainability of interventions and provide a wide reach to those low-input farmers who stand to benefit most from such collaboration.

CHANGES

There have been no institutional changes in ICRISAT that could jeopardize or negatively affect the implementation of HOPE project activities. However, outside of ICRISAT a number of countries in which the project is implemented have, during the year under review, either fallen into, or continued to experience political and national upheavals that have had a negative bearing on certain aspects of project activities. This has been most notable in Nigeria and Mali in West Africa. In addition, parts of Niger remain insecure.

The effects of these incidents of insecurity have, so far, been limited to delaying the implementation of planned activities. The March 2012 coup d'etat in Mali had the effect of delaying activities in nearly all objectives. Further, the deteriorating security situation in northern Nigeria over the past year has necessitated an ICRISAT travel ban for this region, thus reducing the project's ability to link effectively with national programs in Nigeria for effective implementation of the project agenda.

RISKS

- Unpredictability of climatic and weather conditions, as well as political upheavals remain the two key risks the project faces in many countries. The political uncertainties in Mali, Niger, and northern Nigeria could compromise a number of contractual arrangements that have been made for economic activities in WCA. They could also hinder, or at least delay, progress in many planned activities.
- One of the major consequences of the Mali political situation has been a severe reduction of Mali government and donor funding to the national agricultural research body, IER. Several donors suspended their support to government institutions in Mali immediately following the coup. If this leads to cuts in the breeding program itself, it will have serious long-term consequences for the sorghum improvement program in the country.

Measures taken to deal with these challenges

The project took the following steps to counter or prevent serious repercussions to prevailing insecurity in some project countries in West Africa:

- We have taken sub-samples of our breeding material and collection in Mali, and put them into medium-term storage in the Niamey genebank. Some of the materials that have been backed up for safe custody belong to the IER sorghum-breeding program.
- We have intensified our collaboration in Burkina Faso, working with another research station in the southern Sudanian zone (FarakoBa).
- We have intensified the use of Internet-based storage and information sharing services for data backup. Facilities such as Drop Box are proving useful for data sharing with partners, and scientists who had to leave Bamako following the political problems in Mali.
- We have intensified our efforts to empower national partners and encourage them to take greater responsibility for project activities in their countries. In countries where local nationals are ICRISAT staff, such as in Nigeria, we have mandated them to manage key processes and activities, in cases where the scientists cannot be on site.

- Efforts are underway by ICRISAT scientists to identify alternative sources of funds to help support IER's sorghum-breeding program.

OTHER SOURCES OF PROJECT SUPPORT

Table 8 provides information on other bilateral-funded projects that are considered complementary to HOPE project activities. It is important to recognize that these funds and the complementary activities they support are directly managed by the respective projects and/or organizations. They do not represent funds given to ICRISAT for use in the HOPE Project.

Table 8: ***Other Sources of Project Support***

Funding Sources	Amount (USD)	Target activities	HOPE Objective	Committed or Potential
McKnight Foundation - Seed project	30,000	Variety testing – Sorghum [Mali, Burkina Faso, Niger]	2	Committed and on going
	20,000	Variety testing – Pearl millet [Mali, Burkina Faso, Niger]	3	Committed and on going
	103,000	Seed production and distribution, study on mini packs and seed networks [Mali, Burkina Faso, Niger]	6	Committed and on going
PROMISO2	100,000	Support to partners for variety development and testing [Mali, Burkina Faso, Niger]	2	Committed and on going
	100,000	Support to variety testing and agronomy [Mali, Burkina Faso, Niger]	3	Committed and on going
	300,000	Support to partners for seed production, storage and marketing and FFS [Mali, Burkina Faso, Niger]	6	Committed and on going
Aga Khan Foundation	35,000	Farmer field schools and variety testing [Mali]	6	Committed and on going
Mobiom	5,000	Variety testing [Mali]	6	Committed and on going
FFEM2 project	5,000	Population improvement [Mali]	2	Committed and on going
	5,000	Training and variety testing [Mali]	6	Committed and on going
Africa Rising (USAID)	15,000	Variety development and agronomy [Mali]	2	Committed and on going
	30,000	Seed production; agronomy [Mali]	6	Committed and on going
AGRA	240,000	Sorghum breeding [Ethiopia]	2	Committed and on going
IFAD/EC	Euro 1,500,000	Sorghum for Multiple Uses [ESA]	2	Committed and on going
ASARECA	1,400,000	Sorghum and legume intensification [ESA]	2	Committed and on going

Note: The funds indicated for AGRA, IFAD/EC, and ASARECA projects are lump sums, and do not reflect the amounts dedicated to HOPE-relevant activities