ANNUAL PROGRESS REPORT

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

Organization Name: International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)

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Grant Amount (U.S. dollars): 18 million **Project Duration (months):** 48
Project End Date: June 2013
Has this project been granted a no-cost extension? No

Geographic Location(s) of project: Mali, Niger, Nigeria, Burkina Faso, Kenya, Uganda, Tanzania, Ethiopia, Eritrea, Southern Sudan, India

Report Prepared By: George E. Okwach **Date Submitted:** August 2011

List below all Sub-Grantees and/or Subcontractors who received funds in the last project period:

Name	Total Amount USD	Duration From/to dates	Grant or contract
Asia		1 July 2010 to 30 June 2011	Contract
- CCS Haryana Agricultural University, India	30,208		
- Directorate of Sorghum Research (DSR), India	-		
- Junagadh Agricultural University (JAU), India	7,638		
- Mahatma Phule Krishi Vidyapeeth (MPKV), India	48,650		
- Marathwada Agricultural University (MAU), India	75,650		
- Rajasthan Agricultural University (RAU), India	27,224		
- Sardarkrushinagar Dantiwada Agricultural University, India	16,420		
West and Central Africa		1 July 2010 to 30 June 2011	Contract
- Association d'Eveil au Developpement Durable (AMEDD), Mali	18,595		
- Association des Organizations des Paysans Professionels (AOPP), Mali	5,789		
- Association Minim Song Panga (AMSP), Burkina Faso	-		
- Federation des Paysans Semenciers du Burkina Faso (FePaB), Burkina Faso	-		
- Fuma Gaskiya (Federation of Farmers), Niger	24,572		
- Institut d'Economie Rurale (IER), Mali	28,427		
- Institut de l'Environement et des Recherches AGricoles (INERA), Burkina Faso	40,625		
- Institut National de Recherche Agronomique du Niger (INRAN), Niger	21,725		
- Institute for Agricultural Research (IAR), Nigeria	19,700		
- L'Union Albarka de Bokki, Niamey	4,249		
- Lake Chad Research Institute (LCRI), Nigeria	13,225		
- Union des Groupements des Producteurs pour la Commercialisation Agricole (UGPCA), Burkina Faso	6,300		
- Union FAHAMAYE de Dantchiandou, Niamey	4,249		
- Union Harey-Bane de Tera, Niamey	4,249		
- Union Made-Bane de Falwel, Niamey	2,124		
- Union of Agriculturists of the cercle of Tominian (UACT), Mali	-		

Eastern and Southern Africa		1 July 2010 to 30 June 2011	Contract
- Africa Harvest Biotech Foundation International, Inc (AHBFI), Kenya	-		
- Department of Research and Development (DRD), Tanzania	81,650		
- Eastern Africa Grain Council (EAGC), Kenya	-		
- Egerton University, Kenya	-		
- Ethiopian Institute of Agricultural Research (EIAR), Ethiopia (covering also ARARI)	39,750		
- Kenya Agricultural Research Institute (KARI), Kenya	-		
- Kenya Seed Company, Kenya	-		
- Ministry of Agriculture, Govt. of Southern Sudan (GoSS)	-		
- Namburi Seed Company, Tanzania	11,500		
- National Agricultural Advisory Services (NAADS), Uganda	3,000		
- National Agricultural Research Institute (NARI), Eritrea	33,500		
- Ugandan National Agricultural Research Organization (NARO), Uganda	18,794		
- Victoria Seeds, Uganda	9,500		
- Zanobia Seed Company, Tanzania	-		
Total	**597,313**		

Grantee Geography Reporting Request

1. Geographic Location(s) of Work

Geographic Location(s) of Work			
Location (Country and Sub-Region/State if known)	**Spent ($)**	**Yet To Be Spent ($)**	**Total Planned Spend ($)**
India (States of Andhra Pradesh, Gujarat, Haryana, Maharashtra, Rajasthan)	1,611,769	588,225	2,199,994
Burkina Faso, Mali, Niger, Nigeria	3,012,319	957,023	3,969,342
Eritrea, Ethiopia, Kenya, Southern Sudan, Tanzania, Uganda	2,445,544	350,456	2,796,000
USA	5,058	27,942	33,000
		Total Grant Amount	**$8,998,336**

2. Geographic Areas Served

Geographic Area(s) Served	
Location (Country, include States for India and China)	**Benefit ($)**
Asia – India (Andhra Pradesh, Gujarat, Haryana, Maharashtra, Rajasthan)	4,572,214
West and Central Africa -- Burkina Faso, Mali, Niger, Nigeria	7,777,380
East and Southern Africa -- Eritrea, Ethiopia, Kenya, Southern Sudan, Tanzania, Uganda	5,597,406
Global – USA	53,000
Total Grant Amount	**$18,000,000**

NARRATIVE REPORT

Executive Summary

The HOPE project successfully completed its second year of operation. The project addressed all activities designated for Year 2, which included a few activities remaining to be completed from Year 1. Some activities were also initiated, or continued, whose results (milestones and outputs) are due in Years 3 and 4. The key highlights from Year 2 include the following.

- ***Targeting***: Most of the maps on crop statistics and biophysical features of project sites have been completed. Information has been provided by sorghum, pearl millet and finger millet breeders and the development of recommendation domains is in progress. Investment options for research and development in crop improvement, crop management and market access have been developed for WCA and SA. Baseline surveys have been concluded in all planned countries. The project gender plan has been revised in line with the recommendations of the reviewers, and is being operationalised.

- ***Sorghum improvement***: Some 47 sorghum lines and one Nigerian landrace were identified in ESA and WCA as having good midge resistance. In SA, 10 B-lines and 9 R-lines were found to have good shoot fly resistance. Some 53 hybrids were obtained in ESA and are being evaluated for targeted agro-ecologies. In SA, 39 R-lines with shoot fly dead hearts were selected and are undergoing further evaluation for agronomic traits, grain quality and shoot fly resistance. Five new hybrids were selected by farmers in Mali and Tanzania. In SA, 6 hybrids showing superior traits were selected in Patancheru, 5 hybrids in MPKV Rahuri, and another 4 in MAU Parbhani. Further, farmers across the WCA region selected 3 short inter-node sorghum hybrids, 5 tall hybrids, 2 short and 4 tall new varieties for detailed farmer-evaluation trials. In SA, 2 post-rainy season varieties were preferred by farmers in both the MAU and MPKV regions for their grain quality and plant aspects, 2 varieties were preferred for their grain yield and one variety for its fodder yield. A combination of genotypes and a suitable chemical treatment was determined to be the most effective for control of shoot fly in SA. Also in SA, terminal moisture stress was identified as the major abiotic constraint in the production of post-rainy sorghum. The remedial measures recommended by the project involve the combined use of deep tillage, mulching, contour-bunding and drought tolerant cultivars.

- ***Pearl millet improvement***: Eight lines of pearl millet were identified to be resistant to all 3 pathotypes of downy mildew used in evaluating resistance in SA. Some 48 hybrids that had been constituted on the basis of 2009 rainy season selection were evaluated for their potential at 3 locations in SA during the 2010 rainy season. From this, 3 hybrids were found to be promising across all locations, and were promoted to researcher-managed, farmer participatory trials for evaluation in the current rainy season.

- ***Finger millet improvement***: A review of finger millet work in ESA was done, and new sources of resistance identified. Some 420 germplasm lines collected from Kenya (163), Tanzania (46), Uganda (105) and ICRISAT-India (80) have been phenotyped at the Kiboko station in Kenya. *Striga* endemic areas have been identified in Kenya and 48 accessions from these areas obtained for the purposes of establishing *Striga* resistance trials. These trials are now underway in Kenya, Uganda and Ethiopia. Work on varietal development is ongoing, and initial data have been analyzed and the results presented. Adaptability and yield stability trials have been initiated and are ongoing at 7 representative sites in Kenya, 5 in Tanzania, 6 in Uganda, and 9 in Ethiopia. Trials on crop management options for key constraints were conducted. Preliminary results showed that the use of fertilizers alone increased finger millet yield by 50%, while the use of improved varieties alone increased yield by 125%; and a combination of improved variety and fertilizer increased yield by 193%.

- ***Integrated Striga and soil fertility management (ISSFM):*** ISSFM was found to significantly reduce *Striga* incidence in both sorghum and pearl millet, compared to farmer practices, in WCA.

Further, the gains from ISSFM were found to be significantly higher, compared to farmer practice, in both sorghum and pearl millet fields. Data from 15 ISSFM trials in farmer field schools conducted in 3 clusters in Mali revealed that the investments for ISSFM in pearl millet were two-times higher than in farmer practice, but that the returns/profits were four times higher under ISSFM (approximating US$465/ha for ISSFM versus US$114/ha for farmer practice).

- ***Identification and development of markets***: Markets have been identified for the various commodities. Value chain survey instruments were developed and shared with national partner institutions for improvement, joint-ownership and pre-testing. Some work on estimation of seasonal commodity demands has been done, but not adequately completed across the project sites. Data from Niger shows a demand of 500 tons of pearl millet per year, while in Mali the demand is approximately 2,000 tons of both pearl millet and sorghum per year – from the 35 processors identified. In ESA, 25 processors were identified in Kenya and 25 in Tanzania. In both countries there was no distinction by processors between the two commodities. Ethiopia was found to have no medium to large-scale sorghum or millet processors. In India, it was found that 62% of pearl millet is utilized as human food, 30% as cattle feed, 5% is used in the alcohol industry and 3% as poultry feed. Nearly 90% of post-rainy season sorghum in India is used as human food. The demand for fodder from both sorghum and pearl millet is estimated to be growing annually, driven largely by some 4% increase in the annual demand for milk and meat products. The work on consumption preferences is progressing at varying pace across the three regions. Surveys have been completed and the data are being analyzed. Various models for farmer-market linkages have been identified and explored. Consultative meetings to link farmers and producers to processors, and markets have been held, though not in all countries in WCA.

- ***Enabling technology adoption***: A wide range of training manuals and brochures on production have been developed in both English and French. Translation to various vernacular/local languages is progressing in the regions. The use of mini-packs has proved to be both popular and effective with resource-poor farmers in SSA. In WCA, more than 9,000 mini-parks each of sorghum and pearl millet were sold in all four countries (Burkina Faso, Mali, Niger and Nigeria). Farmers who purchase mini-packs will be followed-up. Also in WCA, project partners produced between 300 and 1,500 kg of foundation seed of the most popular varieties of sorghum and pearl millet. In ESA, more than 4,300 kg of foundation seed and 94,500 kg of both certified and quality declared seed of six finger millet varieties was produced across four countries. Seed production in ESA comprised 26,700 kg of foundation seed and 679,800 kg of certified seed of various sorghum cultivars with Tanzania, alone, accounting for 675,000 kg of certified sorghum seed production. Several stakeholder training and consultative workshops bringing together producers and agro-dealers were held throughout the project regions. Meetings of farmer groups and other dealers along the value chain of the two crops were also held.

- ***Capacity enhancement***: ICRISAT scientists working on the HOPE project are involved in co-supervising several PhD and MSc students, whose research is aligned to the project agenda. Many training meetings were also held for the empowerment of partner institution staff, farmers, and farmer organizations. ICRISAT also provided on-the-job training to a large number of partner institution scientists.

- ***Milestones and outputs:*** A total of 379 milestones and outputs were addressed in the year under review, of which 316 (83.4%) are reported as fully achieved.

I. OBJECTIVES

(A) Activities Carried Out in the Reporting Period

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

WCA**:** A database has been collated with in-country crop statistics by region/district and maps have been generated which are available online here: (https://sites.google.com/a/cgxchange.org/hope-project/project-documents), and are being uploaded onto the project website. Data were collected at the 2nd administrative unit below region ("cercle" level) in Mali, at the department level in Niger and at the province level in Burkina Faso. Crop data were overlaid on agro-ecological zones, primary and secondary roads, and major and secondary markets (where available) to develop GIS maps for pearl millet and sorghum (**OP[1] 1.1.4**). The next step was to identify the recommendation domains for at least 3 promising sorghum and 3 pearl millet varieties identified in each project country (**MS[2] 1.1.5** and **OP 1.1.6**). This activity is on-going, as delays have been experienced by the GIS team. FAO crop statistics have been gathered in all pearl millet and sorghum producing countries in order to forecast the trends and outlook for sorghum and pearl millet in WCA. Data on demand and supply elasticities have been gathered for some countries from literature reviews. A range of policy and climate scenarios is available with the WCA scientists. However, work on regional outlook analysis has not been done due to a delay in making the necessary modifications in the IMPACT model[3]. The improved model has just been released and a trend and outlook report for sorghum and pearl millet will now be developed by November 2011 (**MS 1.1.7**, **MS 1.1.9**).

ESA: A list of 10 required crop maps has been identified after consultations with breeders. The first 3 maps include the location of 'representative' major research stations in the ESA region by zone. The remaining 7 maps are now in preparation and should be completed by October 2011 (**MS 1.1.1**). Regarding the APSIM model (**MS 1.1.4**), the project has identified three sorghum varieties (Seredo, Gadam and Kari Mtama 1) that are recommended for the region and which are currently being tested under a range of biophysical conditions across Kenya, Tanzania and Ethiopia. Key characteristics of the varieties, including days to flowering, days to maturity, total grain and dry matter yields were identified from previous and ongoing studies under this project. Gadam (duration of about 110 days) is an early maturing variety compared with Seredo and Kari Matama 1 (both 123 to 125 days). APSIM simulations were carried out using daily climate data for Katumani, Kampi ya Mawe, and Makindu locations in Kenya, Singida and Kondoa in Tanzania and Melkasa and Debre zeit in Ethiopia. The model was able to predict the performance of the three varieties fairly well with some simple adjustments to parameters, particularly during the phase between germination and the end of the juvenile stages **(MS1.1.5**). One sorghum variety (Gadam) was tested using APSIM for Tanzania and Ethiopia and one variety will be tested for Eritrea once the APSIM model is calibrated for Eritrean conditions in February 2012. Since the APSIM model for finger millet will not be developed within the life of the project, no finger millet varieties will be tested. The model was further tested for its ability to simulate the response of these varieties to small doses of fertilizer observed in the trials conducted under objective 2, to evaluate the effectiveness of application of small doses of fertilizer. The model performance at all the locations was found to be satisfactory. However, the pearl millet module of APSIM was found to be unsuitable for simulating the growth and performance of finger millet and requires major changes. Key model parameters that require adjustments include radiation use efficiency, response to temperature regimes, photosynthetic efficiency and partitioning of photosynthates and tillering. Since collection of this data requires detailed studies, we are exploring opportunities to develop a separate project that engages one or two PhD students in collaboration with the APSRU group in Australia. However, it is recognized that if this route is pursued, then this activity would fall outside the scope and timeframe of the current phase of the HOPE project. The delay in correcting the IMPACT model (by IFPRI) has negatively

[1] OP - Activity Output
[2] MS - Activity Milestone
[3] Problem first pointed out in year 1 report

impacted on the completion of **MS 1.1.7** and, to some extent, **OP 1.1.8**. IFPRI has just released an improved model and the completion of MS 1.1.7 has now been re-scheduled to October 2011. Further, on OP 1.1.8, the tables and charts for the report have been prepared for both sorghum and millet. The report for sorghum has been drafted. The report for millet is pending. The proposed new end date for this activity is October 2011.

SA: The GIS maps of macro level area, production and productivity of sorghum and millet in South Asia have been produced and can be viewed at the project online repository (**OP 1.1.2**). Key biophysical and socioeconomic characteristics have been compiled for Maharashtra state (Parbhani and Rahuri) for post-rainy season sorghum, and from Gujarat, Rajasthan and Haryana states for pearl millet and superimposed on the GIS maps. After consultation with breeders and extension workers, farmer preferred varieties for pearl millet and post-rainy season sorghum have been identified and enhanced maps of recommendation domains will be available by August 2011. IFPRI has just released a revised version of the IMPACT model in the first week of July and the sorghum and millet baseline scenario was run and calibration undertaken for South Asia. Additional scenarios will be developed and run in the model to finalize results by December 2011 (**MS 1.1.4**). Based on review of literature, primary and secondary data, interviews with key scientists, extension personnel, private players and farmers, a policy brief on future outlooks and policy options for sorghum and pearl millet has been developed and is available at both the project website and the project online document repository. The report is under review for publication (**MS 1.1.5**). Based on secondary data, the regional situation and outlook report for Asia for pearl millet and post-rainy season sorghum is being prepared and will be available in the project online document repository by the end of August 2011 (**MS 1.1.6**).

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

WCA: After reviewing the available literature, 3 groups of investment options were identified: crop improvement, soil fertility restoration and marketing strategies. Twenty (20) pearl millet and 20 sorghum varieties have been identified that are suitable for the major agro-ecological zones in the project countries, with yield potential of up to 1.5 t/ha for pearl millet and 4 t/ha for sorghum. Soil fertility restoration options include fertilizer micro-dosing and conventional fertilizer application methods. Other crop management options mostly target *Striga*. Finally, marketing strategies will focus on inventory credit schemes (**MS 1.2.3** and **OP 1.2.4**). Following the identification of technologies, data have been gathered on market prices and on-farm yields with and without micro-dosing or conventional fertilizer application. Data on adoption costs for modern varieties, economic parameters concerning supply and demand responses and discount rates have been assembled from the literature (**MS 1.2.5**). A report on the potential impact of the introduction of specific sorghum (in Nigeria) and pearl millet (in Niger) technologies has been produced and is available with the WCA scientist. The impact of R&D interventions from HOPE is likely to yield approximately USD 100 million in West Africa by 2019 (**MS 1.2.6**).

SA: A study involving a review of the literature, baseline surveys and interaction with scientists and farmers showed that local varieties were dominant in 70% of the total post-rainy season sorghum area and their replacement by improved varieties has been sluggish. In contrast, 66% of the total area under pearl millet is currently under improved varieties, with hybrids occupying more than 50 % of the pearl millet area in the states of Gujarat, Rajasthan, and Haryana. A report entitled '*Impact of Potential Technologies for Post-Rainy Season Sorghum (in Maharashtra) and Pearl Millet (in Gujarat, Haryana, and Rajasthan) in India*' is available on both the HOPE website and the project online document repository. This paper is also under review for publication in a scientific journal (**MS 1.2.1**). The ex-ante impact of available crop technologies has been estimated for post-rainy season sorghum in Maharashtra and for pearl millet in Gujarat, Haryana and Rajasthan. The introduction of improved sorghum varieties together with improved management practices including supplementary irrigation increased the net gain by Rs 14,418 (US$ 315) per ha compared to the base level, with an incremental benefit to cost ratio of 3.78. For pearl millet, the net gain increased by Rs 5,732 (US$ 125) per ha with an incremental benefit to cost ratio of 2.98. The reports are accessible through the HOPE website as well as the project online document repository and an article entitled '*Ex-ante Impacts of Rabi Sorghum Technologies in India*' and '*Ex-ante Impacts of Pearl millet Technologies in India*' has been prepared and submitted for review for publication (**MS 1.2.2**). An analysis of investment options indicated that farmer priorities for sorghum are, firstly, crop improvement followed by selective mechanization, crop management, marketing and soil and water conservation. According to scientists however, the order for sorghum is crop improvement, followed by crop management, selective mechanization, marketing and soil and water conservation. For pearl millet, the order of priority according to farmers is soil and water conservation followed by crop management, marketing, crop improvement, and selective mechanization. From the scientists' point of view, the priority for pearl millet is to increase the shelf life of grain and reduce undesirable attributes such as reducing fat content and phenol compounds, followed by improving keeping quality of the flour. This report is on the HOPE website as well as in the project online document repository (**MS 1.2.3**). The macro level ex-ante impact of potential technologies has been estimated and the expected net gain in post-rainy season sorghum is around Rs 3,164 (US$ 69) per ha. If market linkages are improved simultaneously, the economic gain will further improve by 20 %. For pearl millet, the expected net gain ranged between Rs 2,099 to 2,460 (US$ 46 to 54) per ha in all three states, with a similar 20% increase following market linkage improvement. This report is on the HOPE website as well as in the project online document repository (**MS 1.2.4**).

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

WCA: In Niger, Mali and Nigeria, sites have been selected randomly based on involvement with R&D interventions such as PVS, FFS, small pack sales, and demonstrations. Diffusion sites have been identified using matching methods from villages located between 10 and 20 km from project sites. Similarly, control sites have been selected using matching methods from villages located between 40 and 60 km from project sites (**MS 1.3.1**). Village and household survey instruments were developed in a participatory process with all partners in the three countries (**MS 1.3.2**). In addition to village profiles, data were gathered on household socio-demographic variables, economic characteristics and details of farming enterprises, including farmer perceptions of a range of issues. In Northern Nigeria, a survey of villages and households was carried out in six states (Yobe, Katsina, Kano, Jigawa, Borno and Zamfara). One hundred and thirteen (113) villages were selected and 1,105 households interviewed to collect data on pearl millet and sorghum at plot, household, and village levels. In Niger, 439 households were surveyed from 66 villages located in project, diffusion and control sites. In Mali, 744 households were surveyed from 77 project, diffusion and control villages. Data entry, exploration, cleaning and analysis are completed in Nigeria, but ongoing for both Niger and Mali (**MS 1.3.3**).

ESA: In Ethiopia, the baseline survey was successfully conducted by January 2011 (**MS 1.3.4**). In total, 390 households were interviewed in three districts (130 each in Miesso, Sirinka and Shalla districts, respectively). Miesso and Sirinka represent sorghum growing areas, while Shalla is a finger millet area. In each district, the sample was divided into two groups: the treatment (3 villages each in Miesso and Sirinka districts and 4 villages in Shalla) and a control (2 villages each in Miesso, Sirinka and Shalla districts) group. The treatment groups consist of villages where either Objective 2 or Objective 4 activities take place. Ninety households were interviewed in each treatment group and 40 households were interviewed in each control group. Hard copies of the completed questionnaires are stored at EIAR, Melkassa. In Tanzania the baseline survey was successfully conducted by November 2010 (**MS 1.3.5**). A total of 360 households were interviewed in two districts (180 in Singida and another 180 in Kondoa). In both districts farmers grew finger millet as well as sorghum.

In each district, the sample was divided into three groups: the treatment (4 villages in Kondoa and 3 villages in Singida); diffusion (5 villages in Kondoa and 3 villages in Singida); and, a control (4 villages in Kondoa and 2 villages in Singida) group. The treatment groups consist of villages in which HOPE project activities of Objectives 2 and 4 take place. Ninety households were interviewed in each treatment group and 45 households were interviewed in each diffusion and control group, respectively. Hard copies of the completed questionnaires are stored at ICRISAT in Nairobi. The completion of **MS 1.3.4** and **MS 1.3.5** implies attainment of **Output 1.3.6**. On **MS 1.3.7**, data from the baseline survey were entered and cleaned in SPSS by EIAR Melkassa in July 2011. SPSS files will now be shared with ICRISAT Nairobi for storage and EIAR will complete the report within the next five months. The Tanzanian baseline survey data were entered and cleaned by February 2011 and soft copies of the SPSS files are stored by ICRISAT Nairobi (**MS 1.3.8**). Analysis of the baseline survey data (**MS 1.3.9**) has been completed for Tanzania, but delayed for Ethiopia. The outline of the baseline report was developed by ICRISAT and partners (EIAR in Ethiopia and DRD in Tanzania) by February 2011 and ICRISAT and the respective partners have soft copies of a draft containing section headings and templates for tables. Softcopies of the draft baseline report for Tanzania, containing results of the analysis in the form of tables, were shared with DRD Tanzania and EIAR Ethiopia. This report is stored by ICRISAT Nairobi and will constitute the basis for the baseline report **(OP 1.3.10**) that is due in December 2011. For Ethiopia the data from the baseline report will be analyzed by EIAR Melkassa by September 2011 but the delay will not affect the deadline for the final output of activity 1.3, which is the baseline report indicated as **OP 1.3.10.**

<u>SA</u>: Collection of both primary and secondary baseline data from 1,080 households from 12 clusters and 36 villages in four states (Maharashtra, Gujarat, Haryana and Rajasthan) has been completed (**MS 1.3.4**). Data entry, cleaning and verification is complete for Rajasthan, Gujarat and Maharashtra but one of the originally selected districts in Haryana has been changed, hence the base line survey has to be conducted again. This will be done once the distribution of seeds to the identified farmers is completed (**MS 1.3.5**). A template has been prepared for analyzing and presenting the data and the report (**OP 1.3.6**) will be available by the due date of December 2011.

Activity 1.4 - Monitoring and evaluation of adoption and impact

<u>WCA</u>: The Gender Plan has been revised and completed in line with recommendations from the foundation (**OP 1.4.1**). The revised version is available from the project online document repository. In order to monitor progress under the project, data forms have been developed to be used by partners to gather critical information on farmer associations involved in the project, demonstrations, farmer field schools, training, inventory credit schemes, input shops, agro-dealers, information dissemination, academic training and labor costs. Furthermore, the project M&E framework was developed in Year 1 and is available with the project team in WCA (**MS 1.4.2**).

<u>ESA</u>: The Gender Plan has been revised and completed in line with recommendations from the foundation (**OP 1.4.3**). Further, in line with the recommendation of the revised project gender plan, the project in ESA convened a "Gender and Agriculture Training Workshop", held in Nairobi 27-29 June 2011, combined training in gender awareness with the development of action plans to implement the gender plan for each HOPE objective in ESA. The trainer was Ms Susan Bakesha (DELTA, Kampala). A draft Workshop Report with training materials and gender action plans for HOPE objectives is now being finalized.

<u>SA</u>: The Gender Plan has been revised and completed in line with recommendations from the foundation (**OP 1.4.3**), and is available from the project document repository. Survey instruments have been developed and pre-tested for a monitoring survey of the allocation of cultivable area, cropping pattern, management practices, status of pest and disease attack, crop characteristics, profitability of peal millet production, involvement of men and women in cultivation processes, varietal perception in relation to HOPE and control plots and constraints in the cultivation of pearl

millet (**MS 1.4.4**). Ninety households that grow pearl millet were surveyed in Rajasthan whereas only 45 households were in Gujarat (due to crop failure) and only 45 in Haryana (because the sample district was changed) (**MS 1.4.5**). Data entry, cleaning and validation are ongoing for Gujarat, Haryana and Rajasthan and the report will be available in October 2011. In Maharashtra, only 120 households were surveyed (out of the projected 540 households) because of crop failure arising from excessive rainfall (more than 1100 mm) (**MS 1.4.6**).

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

WCA: Four NARS economists from Burkina Faso (Mr Ouedraogo Matthieu), Mali (Mr Kone), Niger (Mrs Ibro Germaine) and Nigeria (Mr Jidda Umar) were trained in the use of CS-Pro (a powerful tool for survey data entry and checking), and STATA (a statistical software package for survey data processing). A brief review of basic statistical methods was also included. Participants practiced using the software with data collected in a recent baseline survey in Burkina Faso (20-25 September 2010, TVC, Niamey, Niger) (**MS 1.5.3**, **OP 1.5.4**). Mr Gambo Yahoussa, MSc student, was identified from the Universite Abdou Moumouni of Niamey, Niger, and linked to the HOPE project. His thesis, entitled "*Assessment of price and non-price factors driving the demand for sorghum and pearl millet in Niger*" has been completed and he is waiting to defend it (**MS 1.5.5**).

ESA: A graduate student from Tanzania was identified in December 2010 and mentioned in the project's January 2011 report. In Ethiopia, Mr Eremias Tesfaye from the Sirinka Agricultural Research Centre has now started his university course (**MS 1.5.4**). As reported earlier, this graduate student will be involved in the adoption survey, which is scheduled for the second half of 2012. The graduate student will therefore prepare a thesis proposal by June 2012. The graduate student from Tanzania, Mr. Muluoko, was identified, and he developed his thesis proposal by January 2011 that was approved in the same month. From February to March, Mr. Muluoko conducted his field research work. He is currently writing his Master's thesis, the first draft of which is already available (**MS 1.5.5**).

SA: Training materials on survey design and data collection have been prepared and provided to the partners and field investigators involved in data collection (**MS 1.5.1**). Arrangements are being made to upload these training materials into the project online document repository. The 16 training participants have been identified and provided with training material in advance and their feedback regarding practical difficulties with the questionnaire has been requested. There was some apprehension that farmers may not cooperate in survey work in the control villages, as they do not derive any benefit from the project. Concerns were also expressed that project beneficiaries who cultivated post-rainy sorghum during 2009 may not be willing to cultivate post-rainy season sorghum during 2010 due to good rains that enable them to plant more profitable crops like onion (**MS 1.5.2**). Five partners from each of Maharashtra, Gujarat, Haryana and Rajasthan states were trained in survey design and data collection methods. Training was given to field investigators and Co-PI's at Bikaner (on Aug 14-19 2010), at Parbhani (Sept 27-29), at Rahuri (Oct 20-23), and at SK University (Dec 13-15), Gujarat and at Hisar, Haryana (**OP 1.5.3**).

Activity 2.1 – Identify new sources of resistance/tolerance to and options for control of key biotic constraints

WCA: For midge resistance breeding in sorghum, seed of 50 entries received from India was multiplied at Sadore during the 2010/11 off-season, together with potentially superior lines from Nigeria (**MS 2.1.1**). In Niger, six sorghum varieties were tested for midge resistance under two sowing dates. A Nigerian landrace, Ribdahu, was identified as highly resistant to midge under a range of growing conditions (**M.S 2.1.2**) A literature review of midge occurrence, severity and farmer response strategies was completed by the entomologist from the Niger national program, Mr. Hame Kadi Kadi (**MS 2.1.4**). Studies on sorghum midge bio-ecology (**MS 2.1.5**) were seriously affected by travel restrictions in Niger since the application of some treatments on the trial at harvest and the survey at the farm level, required the presence and input of the scientist, who could not travel due to the security situation. Initial data were collected but additional observations could not be made. In Mali, no midge research activities were implemented due to a serious long-duration illness (covering the entire cropping season) of the key investigator, Dr. Niamoye Diarisso. For Year 3 a visiting scientist is being recruited to conduct this research.

ESA: For 374 lines collected in *Striga* endemic areas in Ethiopia seed was increased at Melkassa in Ethiopia during the June to October 2010 cropping season. The same season was used to increase seed in Eritrea at Halhale and in Juba, Southern Sudan. In Ethiopia, 238 lines were selfed and seed dispatched for screening in the 2011 main season. In Eritrea, the 58 collected accessions were multiplied to produce between 200 g and 2,900 g of seed per accession. In Eritrea, the improved varieties ICSV111IN, Shambiko (PP290), Bushuka (ICSV 210), P9401, P9407 and Wedi Arba showed *Striga* resistance and were also multiplied (50 kg each) (**MS2.1.2**). During the 2010 long rainy season, 186 sorghum lines were evaluated at Alupe (Kenya) for tolerance to midge and to leaf diseases. These lines were selected from breeding materials developed at ICRISAT-Nairobi and introductions from ICRISAT-India. The area received average rainfall and since the trial was planted 2 weeks later than the normal sowing time, to ensure adequate midge pressure, the second planting performed poorly due to terminal drought. Some lines introduced from India were not adapted and many failed to set seed. Forty-seven lines attained good midge scores with grain yields ranging from 0.70-1.21 t/ha (trial mean 0.57 t/ha) (**MS 2.1.5**).

SA: The major biotic factors (shoot fly and aphids) constraining post-rainy sorghum production in India were targeted through crop improvement and management options. Screening techniques for aphid resistance were fine-tuned using a net house, and clip cage methods and the protocol is available on the HOPE project repository. A total of 190 B and R-lines were evaluated for shoot fly resistance under diverse environmental conditions at ICRISAT-Patancheru, MAU-Parbhani and MPKV-Rahuri during the 2010-11 post-rainy season. From this, 10 B-lines and 9 R-lines with lower shoot fly dead hearts at 21 DAE than the local, resistant check IS 18551 were selected. Another 2 B-lines were also included among the selections from Rahuri. Seed of the entries tested at the above locations was multiplied for future use (**MS 2.1.3**). This experiment indicated that the aphid screening technique developed was efficient for the identification of aphid resistance from the germplasm (**MS 2.1.7**).

Activity 2.2 – Identify options for sorghum intensification in target ecologies

WCA: The performance of sorghum hybrids was tested in two different sets of experiments, on-station and on-farm, during the 2010 cropping season. On station, two hybrids and three varieties were evaluated in intercropping trials with maize. For on-farm testing, farmers chose hybrids from advanced yield trials for inclusion in their own variety tests managed in their own fields during 2010. Each village zone (total of three zones, plus two new partnership zones with NGOs) chose a set of agronomic treatments to test with the 2-4 varieties. The agronomic treatments chosen were: DAP microdose (2 g per hill) with increased plant density, and thinning to 2 plants per hill; DAP microdose only; and fertilization with commercial inorganic fertilizer (Sabuniyman) (**MS 2.2.1**). In the on-station advanced hybrid trials, stover yields were assessed under high fertility conditions. An initial analysis of the farmer-managed trials, where half the variety plot was 'treated' with the improved management practice, and the other half was grown using the traditional practice, showed that, with DAP as microdose, the hybrids achieved yields over 2.5 t/ha, whereas the local checks yielded only around 1.5 t/ha when sowing was done before the 15 July. On the unfertilized plots, the yield advantage of the hybrids was around 30%. More detailed analysis of these results is underway. On station, two hybrids, and three varieties were tested in an association with maize. The sorghum hybrids clearly outperformed the sorghum varieties (average 4.5 t/ha), and the maize varieties as well. Under field conditions at the Samanko station, managed for sorghum cultivation, the two most popular improved maize varieties averaged 3.6 t/ha. (**MS 2.2.4**). However to be useful for farmers, these trials should be conducted in fields managed for maize, with sorghum as an intercrop, possibly in unfertilized, or less fertilized, rows.

ESA: Data on morphological and vegetative growth characteristics were collected and analyzed to determine response to photoperiod. The Kiboko data indicated that Macia took a longer time to flower (75 days after seeding) than Sima (66 days after seeding). The other materials collected from southern Tanzania (IBS19, IBS30, IBS 40 and IBS582) flowered between 89 and 91 days. Data from WCA and ESA are being integrated to draw conclusions (**MS 2.2.2**). Soil samples that had been collected (as reported earlier) across four districts (Kondoa, Kishapu, Iramba and Singida) in Tanzania, were analyzed at the Selian Agricultural Research Institute. Significant differences in the fertility status of soils across the four districts were observed. In general, the soils are neutral to acidic in pH and more than 75% of the soils recorded low to very low levels of phosphorus, zinc and copper. Surveys to elicit farmers' perceptions about abiotic constraints in sorghum cultivation were also carried out. The abiotic constraints to sorghum and millet production in Eastern Africa were identified by farmers as follows: high cost of inputs such as fertilizer, seeds, etc. (92%); climate factors such as drought (62%); low output prices (62%); lack of varieties (46%); soil fertility (33%); major pests such as cutworms (27%); and *Striga* incidence (8%) (**MS 2.2.4**). The survey reports are currently being finalized.

SA: Post-rainy season sorghum requires photoperiod sensitivity and temperature insensitivity (cold tolerance) to optimize productivity. Ten sorghum genotypes were grown in an Alfisol under optimally irrigated conditions using three dates of sowing (sowing at fifteen-day intervals starting from 1 October 2010) at ICRISAT-Patancheru. The lowest temperatures were recorded during January 5-11, 2011 that coincided with the flowering stage at the second sowing date. Among the 10 genotypes, Dagadi Solapur, SPV 1411 and M 35-1 were not affected by the cold, as indicated by higher percentage seed set, mean panicle weight and panicle harvest index. The genotypes ICSB 52, Phule Anuradha and ICSR 149 were sensitive to cold as expressed by variable lengths of flowering period with different dates of sowing. The grain yield data for different dates of sowing confirm the above results. Differences in delay in flowering in later dates of planting versus early dates, female sterility (as reflected by poor seed setting) and grain yield, all suggest that temperature insensitivity and photoperiod sensitivity are critical requirements that contribute to higher grain yields in post-rainy season sorghum and crop breeding though selection of progenies in the rainy season does not facilitate retention of these traits (**MS 2.2.2**). From this work, genotypes with photoperiod sensitivity and temperature insensitivity were identified that can be used for enhancing yields in post-rainy season sorghum areas.

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

ESA: A PhD student registered with Moi University in Kenya, and attached to the HOPE project, Mr Justin Ringo, has evaluated 354 testcrosses for fertility restoration at two locations (Kiboko-Kenya and Miwaleni-Tanzania). One hundred and sixteen hybrids with more than 95% seed set have been identified for further evaluation at three locations (Kiboko and Miwaleni - dry low land and Ukiriguru – sub-humid). Data compilation and analysis is in progress. The student has taken samples from 121 parental lines (85Rs, 36A/B pairs) for molecular genetic diversity analysis (**MS 2.3.4**). Twenty four hybrid parents (12 A/B - pairs and 12 restorer lines) were identified and a crossing block established at Kiboko field station in the short rains season of 2010/11 (November 2010 to March 2011). Fifty-three hybrids were obtained. Some of the common A lines used are ATx623, ICSA12, ICSA15, ICSA44, ICSA8806 and IESA2. The R-lines are mostly ESA adapted varieties and already released and include Gadam el Hamam, Macia and IESV91063DL (**MS 2.3.5**).

SA: A total of 458 BC_1 progenies along with their maintainer lines were evaluated in the 2010 post-rainy season. The sterile plants' progenies were tagged and backcrossed by taking pollen from the maintainer progenies. Based on grain size, grain lustre, agronomic score and plant height, 380 progenies were selected and further backcrossed (BC_2) (**M.S. 2.3.2**). Twenty-one sorghum advanced B-lines were evaluated in three replicated RCBD trials in the 2010 post-rainy season with three checks (ICSB 52, 296 B and M 35-1) at ICRISAT-Patancheru. Promising B-lines (SPs 22442, 14844, 14836, 22440, 22434, 14828, 14826, 22406 and 14852) were selected based on significantly higher grain yield (t/ha), grain lustre score, seed size (g/100 seed), seed set % in comparison with the checks ICSB 52, 296 B and M 35-1, and for shoot fly resistance in comparison to the resistant check (IS 18551). All the traits showed highly significant differences among the B-lines except for plant aspect score and seed set %. Among the selected B-lines, four lines with shoot fly dead hearts (SFDH %) ranging from 40 to 67% were numerically superior for shoot fly resistance compared to the resistant check, IS 18551 (SFDH%: 70). Of the twenty-one sorghum advanced B-lines screened for charcoal rot tolerance, two B-lines, namely SPs 22434 and 22412, were free from charcoal rot. The selected lines were further backcrossed (**MSs 2.3.6** and **MS 2.3.7**). A total of 530 preliminary R-lines were evaluated in an augmented block design with two checks, M 35-1 and SPV 1411, at ICRISAT-Patancheru in the 2010 post-rainy season. Ninety restorers were selected from this based on higher grain yield, grain lustre score, seed size, and shoot fly resistance. Grain yield ranged from 3.26 to 6.23 t/ha; grain lustre from 1 to 2 (1=highly lustrous and 3=dim or non-lustrous) and grain size from 2.90 to 3.77 g/100 seed in these lines. The check M 35-1 recorded 3.25 t/ha of grain yield with 2.94 g 100 seed grain size and a lustre score of 1. The other check, SPV 1411, produced 3.10 t/ha of grain yield with 3.40 g/100 seed grain size and a lustre score of 1. The selected R-lines were advanced for further testing. Thirty-nine lines with shoot fly dead hearts (SFDH %) ranging from 0 to 44% were superior to, or on par with, the resistant check, IS 18551 (SFDH %: 44) and were selected (**MS 2.3.11**). These will be further evaluated for agronomic traits, grain quality and shoot fly resistance. We further studied the molecular diversity among the lines adapted to the post-rainy season, released varieties, hybrid parents and *durra* lines from East Africa. Forty-eight accessions involving 6 post-rainy season landrace collections including M 35-1, 8 improved post-rainy season OPVs, 27 *durra* accessions from East Africa and post-rainy season parents were used in molecular diversity analysis. Genotyping was done with 36 polymorphic SSRs (converted to 267 allelic data points) and 485 polymorphic DArT clones well distributed across the genome. Using the Dice dissimilarity index with 10,000 bootstrap, a dissimilarity matrix was generated. Clustering was performed using a weighted Neighbor-Joining method with 10,000 bootstrap. All of the post-rainy season landraces and released varieties grouped in to one cluster and were distinct from the *durras* from East Africa. This result shows that there is substantial diversity available in *durra* accessions from East Africa for improving post-rainy season sorghum material. All these lines were used in the crossing program at ICRISAT-Patancheru and new F_3s were generated from this material.

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

WCA: Fourteen hybrids were evaluated in pre-release variety trials in three on-station conditions, and in three villages in each of three sorghum production zones of Mali (**MS 2.4.1**). The seven shorter hybrids yielded on-farm an average (over 2 years, and 9 villages) 35% more than a common local check, Tieble (CSM 335). The farmer evaluation scores for the hybrids, as well as individual selections, were not uniformly positive. Some hybrids were rejected because of their poor glume opening, and thus poor threshability, or because of grain discoloration (**MS 2.4.2**). During the final evaluation workshop held in each zone, farmers chose five of the tested hybrids for seed production and for large scale village-managed demonstration plots (**OP 2.4.3**). All five hybrids, and their parental lines, are listed now in the Malian variety catalog which will facilitate economic evaluation on a more representative scale. Hybrid seed production is being taken up by two farmer seed cooperatives and by a total of 27 farmers and this will allow for economic assessments of hybrid seed production. The advanced varieties and hybrids were also evaluated under artificial *Striga* infestation on the research station at Samanko (**MS 2.4.1**). Extremely high levels of *Striga* emergence were achieved, and thus there was good differentiation among the varieties and hybrids tested. All of the best performing hybrids showed sensitivity to *Striga* but their grain yields remained significantly superior to the resistant checks. Twenty-eight new hybrids developed by IER and ICRISAT were tested at the Samanko, Sotuba and Kolombda stations under high and low P conditions (**MS 2.4.9**). Selected hybrids are being tested in multi-location trials, including on-farm trials.

ESA: The five best performing hybrids (IESH 22019, IESH 22023, IESH 22002, IESH 22006, IESH 22012) were identified based on two years of testing at Ukiriguru (Tanzania) research station representing the sub humid (SH) environment and Miwaleni (Tanzania) representing dry lowlands (DL). Days to flowering for the A lines (A2DN55, ATX623, ICSA15 ICSA88006, ICSA4) ranged from 70 to 73 days while that for the R lines (AIHR91075, Gadam Hamam, IESV92136DL, Macia and IESV 92151) ranged from 58 days for Gadam to 72 days for Macia. The above hybrids have been used as checks when conducting on-station regional hybrid trials and in preliminary evaluations of newly developed hybrids as well as in hybrid parents' characterization (**MS 2.4.5**). Preliminary hybrid evaluation for 121 hybrids was conducted at Alupe (Kenya), Miwaleni (Tanzania) and Kiboko (Kenya) in 2010/2011 to assess their adaptation, time to flowering, resistance to insect pests and disease reaction. The Miwaleni data for the 2010/2011 season indicated significant differences in all agronomic traits as well as the grain yield amongst the hybrids tested. The mean grain yield for the trial was 4.03 t/ha and the best hybrid was from ATX 623 X KARI Mtama 1 with a yield of 5.87 t/ha followed by ATX 623 X IESV 91131 DL with a yield of 5.71 t/ha. The yields for the above five best performing hybrids were between 4.29 t/ha and 5.44 t/ha. In a regional hybrid trial with 25 entries at Miwaleni and Kiboko there was significant difference for grain yield, days to 50% flowering, plant height and lodging score. Nine of the hybrids yielded above the mean (4.0 t/ha) and the hybrid IESH 22019 had a mean grain yield of 3.84 t/ha whereas the check SDSH409 yielded only 3.25 t/ha and the best hybrid ICSA 15 X IESV 23005 DL had a mean yield of 4.8 t/ha. Because there has not been a release of a hybrid in Tanzania, Gadam (OPV) was included as a check and it had a yield of 2.29 t/ha. The yields of the hybrids were significantly different from that of the check variety. The best A lines when evaluated in testcrosses with a common R (Macia) have been planted in Miwaleni to test the practicality of hybrid seed production. The five best-performing hybrids will be taken for on-farm PVS in the 2011/2012 season.

SA: A total of 279 preliminary hybrids were evaluated in ICRISAT, Patancheru and MAU, Parbhani. In MPKV, Rahuri, 64 hybrids were evaluated using an augmented block design with three checks, CSH 15R, M35-1 and SPV 1411, during the 2010 post-rainy season (**MS 2.4.2**). Three hybrids were selected in common at Patancheru and Parbhani.

- *At ICRISAT, Patancheru*: There was statistically significant variation for days to 50% flowering, plant height, seed size, % seed set and grain yield and forty hybrids were selected based on significantly superior grain yield, grain lustre, % seed set, seed mass and shoot fly resistance. Grain yield ranged from 3.98 t/ha to 7.4 t/ha compared to 4 t/ha in the control (CSH 15 R). For shoot fly resistance, none of the tested entries was superior to the shoot fly resistant check, IS 18551 (SFDH: 40%) but 16 hybrids with SFDH ranging from 60% to 84% were superior to the susceptible check Swarna (SFDH %= 89) were selected.
- *At MAU, Parbhani*: The results indicated that the hybrids ICSA 29 × RVRT 2, ICSA 91004 × ICSR 161, ICSA 88006 × Gidda Maldandi, 185A × RSV 1026 and 104A × RSV 1059 performed well for grain yield along with maximum seed setting percentage. The hybrid 104 A × RSV 1059 and ICSA 29 × RVRT 2 were best for both grain and fodder yield per plot.
- *At MPKV, Rahuri*: Sixty-four new hybrids (produced in Year 1) were evaluated for agronomic traits, shoot fly resistance and charcoal rot tolerance in three RCBD trials in the 2010 post-rainy season. Statistically significant differences were observed for grain and fodder yields in the hybrids tested. The hybrids RSH1075 (3.6 t/ha), RSH1076 (2.9 t/ha), RSH1034 (2.8 t/ha),

RSH1011 (2.4 t/ha), RSH 1014 (2.3 t/ha), RSH1126 (2.2 t/ha), RSH1133 (2.1 t/ha), SPH 1620 (2.2 t/ha) and RSH 1015 (2.2 t/ha) produced significantly higher grain yield compared to the check CSH 15 (1.7 t/ha).

A sorghum advanced hybrid trial was conducted in the 2010 post-rainy season, with twelve hybrids at ICRISAT (Patancheru) and with ten hybrids each at MAU, Parbhani and MPKV, Rahuri, with three checks (CSH 15R, M 35-1 and SPV 1411) (MS 2.4.7). The results are:

- *ICRISAT, Patancheru*: Statistically significant differences were observed among the hybrids tested for grain yield. Six promising hybrids (XSR 401, ICSA 88001 x M 35-1-19, ICSA 88001 × IS 33844-5, ICSA 502 × SPV 422, ICSA 38 × SPV 422 and 8712) were selected based on grain yield, grain lustre, seed size and shoot fly resistance in comparison with the checks CSH 15R, SPV 1411 and M 35-1. The grain yields in these hybrids ranged from 3.5 to 4.4 t/ha. Four hybrids with shoot fly dead hearts (SFDH %) ranging from 66% to 80% were superior to the resistant check, IS 18551 (SFDH: 81%). The charcoal rot infection in the test hybrids ranged from 0.3 internodes (ICSA 84 x SPV 1411) to 3.4 internodes (ICSA 20 x ICSR 93009) and the soft rot ranged from 6% (ICSA 675 x SPV 1411) to 100% (ICSA 20 x ICSR 93009). Based on the number of nodes infected, infection length and per cent softening, two hybrids (ICSA 675 x SPV 1411 and ICSA 675 x ICSV 700) appeared to be tolerant to charcoal rot, with <1 internode infection, length of infection <5 cm and <10% soft rot.
- *At MPKV, Rahuri*: Five hybrids: ICSA 84 × SPV 1411 (2.6 t/ha), 8712 (2.0 t/ha), ICSA 675 × ICSV 700 (1.9 t/ha), ICSA 502 × SPV 422 (1.8/ha), ICSA 38 × SPV 422 (1.5 t/ha) showed significantly higher grain yield than the check CSH 15 R (1.1 t/ha). The hybrid 8712 recorded a lower SFDH % (61%) compared to the check CSH 15R (77%).
- *At MAU, Parbhani*: The best four hybrids (ICSA 38 × SPV 422, ICSA 502 × SPV 422, ICSA 702 × SPV 1411 and ICSA 84 × SPV 1411) were selected based on significantly superior grain yield, grain lustre, seed size and shoot fly resistance in comparison with the checks CSH 15R, SPV 1411 and M 35-1. For shoot fly resistance, all the selected hybrids showed low dead heart values ranging from 38.5% to 50.8%.
- *Pooled analysis results for ICRISAT, MAU and MPKV*: Overall, hybrids significantly superior for grain yield across the three locations were ICSA 502 × SPV 422 (2.4 t/ha), 8712 (2.1 t/ha), ICSA 38 × SPV 422 (2.1 t/ha), ICSA 84 × SPV 1411(2.1 t/ha) and XSR 401 (2.1 t/ha) compared to the checks CSH 15R (1.8 t/ha), SPV 1411 (1.5 t/ha), and M 35-1 (1.5 t/ha) **(MS 2.4.7)**.
- Based on meteorological data, Pune and Rahuri in Western Maharashtra and Parbhani and Badnapur in Marathwada region were identified for hybrid parent and hybrid seed production in the summer season **(MS 2.4.11).** These locations do not experience temperatures below 12^0C during germination and early crop growth and do not have extremely high temperatures (>40^0C) during flowering and seed setting. Earlier sorghum seed production attempts, planted in early January, were successful in these locations.
- Parental lines of hybrids CSH 15R and SPH 1620 were multiplied for growing in the selected locations for studies of flowering synchronization in the summer season **(MS 2.4.12)**
- Flowering period synchronization studies were implemented by planting the parental lines of released hybrids on two sowing dates at MPKV-Rahuri and MAU-Parbhani during the summer season of 2011. The parents of hybrid CSH 15R sown on 15 January, had no synchronization problem, although delay in sowing by 10 days (24^{th} Jan), resulted in the male parent flowering 3 days earlier than the female parent MS 104. Planting of the parental lines of CSH 15R in the first fortnight of January is thus recommended for hybrid seed production in the Marathwada. In Western Maharashtra, parents of CSH 15R generally nicked well for the first sowing date (1 January) and parents of the hybrid SPH 1620 synchronized well for both the sowing dates (1 and 15^t January) **(MS 2.4.13)**.

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

WCA: Field trials were conducted for *Striga* resistance and agronomic performance with backcross-lines of 2 Malian and 3 East African recurrent parents in Samanko and Cinzana stations in Mali (100 entries), and of all Malian lines in Sotuba (49 entries, year 2). In addition, we hand-crossed the best 4 BC-2 lines from Mali, and 2 lines from Eritrea, to create backcross-generation 3 (BC3F1) to improve yield and plan-type while maintaining *Striga* resistance **(MS 2.5.4).** Results showed that Tiemarifing is the more *Striga* resistant, but lower yielding, recurrent parent. The 5 most *Striga*-resistant lines exhibit a 60% reduction in *Striga* incidence compared to the original parent (equal level of resistance to the resistant parent N13), and reach 77% of the yield of the original parent. Of the CSM335 (Tieble) derived lines, CSM335 was found the higher yielding, but more *Striga* susceptible, recurrent parent. The 5 most *Striga*-resistant lines had a 76% reduction in *Striga* incidence in comparison with the original parent (9% more *Striga* than resistant parent N13), and reach 69% of the yield of the original parent, a 31% yield penalty (**MS 2.5.4**). We conducted yield assessments of 150 S2 progenies from the diversified dwarf guinea population, both on-farm and on-station, with the specific objectives of (1) population improvement for grain yield of grain- and dual-purpose sorghums with shorter stature (reduced stem internodes), acceptable grain quality and threshability, (2) developing an effective methodology for multi-environment, early generation yield testing of large numbers of progenies that effectively samples the target environments and (3) development of new, higher yielding varieties that combine short-intermediate plant height with the grain and panicle characteristics required for farmer adoption, exploiting the progenies developed and tested for population improvement. We selected a set of 25 entries for variety development, and 30 for recombination for the second cycle of the population **(OP 2.5.6)**.

ESA: The same progenies described for WCA were used for the evaluation of *Striga* resistance using molecular markers tightly linked to the five *Striga* resistance quantitative trait loci (QTL) from N13 and introgressed into farmer-preferred varieties for Kenya, Ethiopia, Eritrea and Sudan. In Eritrea, the Hugurtay and Hariray varieties were crossed with N13 to produce F1 (N13 x Hugurtay). Backcrosses with Hugurtay were continued and advanced. 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 in Eritrea. During the farmers' day, three promising lines were selected. Introgression lines from Sudan (22) are the furthest advanced, each with at least two QTLs present. They were evaluated together with five *Striga*-resistant varieties in Juba and Torit in South Sudan. In total, 15 lines were holding up well, also in comparison with control varieties like ICSV111IN and Framida (**MS 2.5.1**). From the previous back crossing program with two stay-green sources, 33 lines (26 from B35 and 7 from E36 donor parents) were maintained. The recurrent parents were 76T1#23, Meko, Gambella and Teshale. The introgressed lines, along with the recurrent and donor parents, were evaluated in two phenotyping trials at Melkassa and Mieso research stations in Ethiopia. One trial was done at the end of 2010 in Melkassa, and two more are planned. Each treatment was replicated four times and each plot consisted of three rows with 0.75 m and 0.2 m between and within row spacing, respectively. Two sets of trials were conducted and grouped according to the donor parent. From both sets, some promising lines were selected that performed better than the recurrent parents with a yield advantage of 400–1,000 kg/ha. The highest yield of 6.09 t/ha was obtained at Melkasa from the one introgression line of (Teshale X E36-1) BC3F3, whereas the (Meko X B-35) BC3F3 and (Gambella X B-35) BC3F3 yields were 6.54 t/ha and 6.81 t/ha, respectively. It was expected that the B35 introgression progeny would perform better than the donor parent, which is a dwarf, low yielding variety. Overall, results showed that GxE variances are significant across the two locations so that it is not currently possible to merge the data across locations, so another season's data will be needed to finalize the study and allow for publication in a peer-reviewed journal. This is planned for the upcoming 2011/2012 season (**MS 2.5.6**). During the 2010 long rains season, 186 sorghum lines were evaluated at Alupe, Kenya (a midge hot spot) for tolerance to midge and leaf diseases. These lines were selected from breeding materials developed at ICRISAT-Nairobi and introductions from ICRISAT-India. The season received less rainfall than normal and because the trial was planted two weeks after the normal sowing time (to ensure adequate pest pressure) the entries performed poorly due to terminal drought. Some lines introduced from India were also not adapted resulting in many failing to set seed. In spite of the poor season 47 lines attained good disease, stem borer and midge scores with grain yield ranging from 0.70 to 1.21 t/ha (trial mean 0.57 t/ha). The best 10 lines were IESV 94114 SH, IS 21881, IS 21185, AF 28, IS 7005, IS 8887, IS 8891, IESV 94103 SH and IESV 95005/3. The selected lines (47 plus 2 checks) were put into an Advanced Yield Trial and planted at Alupe (2010 short rainy season) and at Ukiriguru in Tanzania (Jan 2011). Results from Alupe showed five lines (IS 21185, IESV 94114 SH, IS 8891, IS 8887 and IS 94103 SH) had stable midge resistance and good grain yield across the two seasons. These lines had mean grain yields ranging from 1.36 to 1.71 t/ha (trial mean 0.945 t/ha) and midge damage score < 4.0 (on a 1-9 scale). The best line, IESV 94105 SH, had a mean grain yield of 2.06 t/ha and a midge damage score of 2.0. The local check IS 8193 had a mean grain yield of 0.84 t/ha and a midge score of 4.3. Results from Ukiriguru are expected in July 2011. The 10 best lines have been selected for on-farm evaluation in midge hot spot areas during the next season (**MS 2.5.9**). Three hundred and ten (310) germplasm and breeding lines, 185 from ESA and 125 from WCA programs were evaluated for adaptation at Torit in the Republic of Southern Sudan in the 2010 season. The lines showed varied reactions to climatic conditions at the site. Most performed poorly and had low grain yields (<0.5 t/ha) and high incidences of leaf diseases. Based on grain yield and disease reaction data and field observations, 81 lines were selected and these will be planted in a replicated trial at two sites (Rejaf and Torit) in the July 2011 season (**MS 2.5.17**).

SA: A total of 290 F_1s were made from the parents from highland Eritrea, bold grain Yemen, Muskwari and new promising post-rainy season varieties, and the released and popular post-rainy season varietal groups at ICRISAT-Patancheru during the 2009 post-rainy season. Two hundred and sixty-two (262) were advanced to F_2 (**MS 2.5.2**). From 262 segregating F_2s, 325 were selected based on grain lustre, seed size and plant height and advanced to F_3 (**MS 2.5.3**), during the 2010 - 11 post-rainy season. In the first stage of random crossing with an *ms* 7/3 population, 16 IS lines and two post-rainy season varieties were introgressed in open pollination and simultaneously we made 18 crosses using the pollen from the parents. The F_1s thus obtained were grown along with the population. From this, 117 steriles and 35 fertiles were harvested from the population along with 35 F_2s from 18 crosses (**MS 2.5.7**). A total of 37 advanced varieties were evaluated in an RCBD trial with two checks (SPV 1411 and M 35-1) at ICRISAT-Patancheru during the 2010 post-rainy season. The 14 best performing varieties were selected based on their significantly superior grain yield, grain lustre, seed size and shoot fly resistance compared with the checks SPV 1411 and M 35-1. Twelve varieties with shoot fly dead hearts (SFDH %) ranging from 31 to 47% were superior to the resistant check, IS 18551 (SFDH: 48%). Of the 37 advanced varieties screened for charcoal rot resistance, four varieties (PVT 09 R 15524, 15534, 15539 and 15639) were completely free from charcoal rot and seven varieties (15516, 15538, 15540, 15553, 15610, 15654 and 15656) were found to be resistant with <1 internode infection, length of infection <5 cm and <10% soft rot (**MS 2.5.11**).

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

WCA: In 2010 the project implemented Cluster Based Farmer Field Schools (CBFFS) for integrated *Striga*- and soil fertility management (ISSFM) in sorghum in three zones in Mali. In total, 322 male and 55 female farmers from 16 different villages participated. Farmers in each zone determined the 'farmer practice' (FP), as the typical activities in that zone for sorghum cultivation under poor soil fertility conditions and, in discussion with researchers, developed a protocol for the ISSFM practice for testing during the season. In addition, five improved varieties and a set of fertilizer treatments were tested by farmers in all farmer field schools. Training sessions were conducted every two weeks, allowing farmers to observe and learn about the development of crops, biotic and abiotic factors. At all sites, ISSFM reduced the number of *Striga* plants emerged in comparison with FP. This has long-term yield and economic advantages to farmers. In all zones the additional net economic benefit from the ISSFM treatment came from the value of the intercrop, mostly cowpea hay. Generally, the gains, in monetary terms, from the ISSFM were significantly higher than under farmer practice, except in cases where the farmer practice did not include manure application. However, total benefits were significantly higher in all cases of ISSFM **(MS 2.6.3).** On station, we tested the effect on *Striga* emergence and crop development and yield of the interaction between three varieties of sorghum (DouaG, CGM19 and Lina3) with different reactions to *Striga*, three levels of DAP fertilization as a microdose and three levels of *Striga* infestation. DAP microdose level and sorghum variety affected *Striga* emergence significantly. *Striga* emergence increased with increasing levels of infestation and decreased with increasing levels of DAP microdose fertilization. DouaG and Lina 3 had significantly lower numbers of emerged *Striga* than CGM19. Increasing Striga infestation level delayed time to flowering in sorghum whereas application of DAP as a microdose shortened it. Grain and stover yield were higher with DAP microdosing than without fertilizer. Increasing *Striga* infestation level tended to decrease grain and stover yield in sorghum, but this trend was not significant **(MS 2.6.4)**. A second trial studied the effects of six *Striga* control treatments (representing single and combined control options for *Striga*) under artificial *Striga* infestation. Sorghum grain yield was highest in the treatment that combined a resistant sorghum variety with microdosing, and in a treatment that combined resistance with micro-dosing, intercropping with cowpea and application of compost. It was lowest for a treatment that combined resistance with intercropping. *Striga* emergence was low under treatments that included a sorghum-cowpea intercrop and high in the pure sorghum crop treatments. The trial quantifies the potential for intercropping to reduce *Striga* and achieve superior cereal yields in comparison to pure sorghum crops, provided that extra fertilizer is used **(MS 2.6.6)**. Sorghum varieties were tested in groundnut-sorghum intercrops that are commonly cultivated by women in Mali. Twenty trials with two or four sorghum varieties, with and without phosphorus fertilizer application (microdose) applied to the sorghum, were sown by women farmers in the Siby area, near Bamako. Sorghum responded very well to the phosphorus application, with an average of 59% grain yield improvement. No significant effect on groundnut yield could be observed, despite positive trends **(MS 2.6.6)**.

SA: Shoot fly management methods, involving a combination of host plant resistance (four sorghum genotypes possessing varying levels of shoot fly resistance) and cultural practices (three dates of planting and seed treatment with systemic insecticides), were evaluated at ICRISAT- Patancheru, MAU- Parbhani and MPKV- Rahuri during the 2010 post-rainy season (**MS 2.6.1**; **MS 2.6.2**, & **OP 2.6.3).**

- *ICRISAT, Patancheru:* Thaimethoxam as a seed treatment in combination with deltamethrin was quite effective in controlling shoot fly. Shoot fly-resistant genotypes in combination with deltamethrin and thiamethoxam kept the shoot fly damage under check (5 to 14% dead hearts compared to 54% in the susceptible check). These chemicals can be used as a component of integrated management of shoot fly.
- *MAU, Parbhani:* The trial consisting of 3 treatment along with one control and 4 varieties evaluated against shoot fly at 21 and 28 days after planting indicated that the treatment Thiamethoxam 35 FS + Deltamethrin 2.8% EC was most effective against shoot fly.
- *MPKV, Rahuri:* **S**eed treatment with thiamethoxam 35 FS at 10 ml/kg seed followed by a spray of deltamethrin at 1.25 ml/liter water 15 days after crop emergence was significantly superior to other treatments in recording the lowest shoot fly deadhearts (13%) at 28 DAE. The grain yield/plot was significantly highest in variety Phule Vasudha (6.6 kg/plot) and M-35-1 (6.5 kg/plot) followed by Akola Kranti (5.79 kg/plot).

Terminal moisture stress was identified as the major abiotic constraint in the production of post-rainy season sorghum in India. Use of deep plowing with mulching and contour bunding in combination with drought tolerant landrace OPVs are recommended for achieving higher yields under terminal moisture stress. An experiment on deep ploughing with thrice mulching (hoeing) was undertaken at MAU, Parbhani and showed that deep ploughing followed by thrice mulching gave the highest grain yield (1.5 t/ha) and fodder yield (4.4 t/ha) followed by deep ploughing and mulching twice **(MS 2.6.5** and **OP 2.6.6**). Fertilizer assessment trials were conducted in MPKV, Rahuri and MAU, Parbhani with five genotypes, 100 % Recommended Dose of Fertilizer (RDF), 50% RDF and two different dates of sowing **(MS 2.6.7)**. Non-significant differences were found between fertilizer treatments at MPKV, Rahuri. The RDF (100:50:50 NPK kg/ha) recorded maximum grain (2.4 t/ha) and fodder (6.3 t/ha) yield. Phule Vasudha recorded significantly higher grain and fodder yield than the other genotypes and the first fortnight of September in Rahuri was the best time for sowing. No significant difference in grain and fodder yield between 100% and 50% recommended dose of fertilizer at MAU, Parbhani. Proagro-8712 (SPH 1449) recorded higher grain and fodder yields than other genotypes and the first fortnight in October was the best sowing date.

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

<u>WCA</u>: The series of trials leading to **output 2.7.7** was conducted in three villages in each of three target zones (one new- and two existing ones) in Mali. Eight short hybrids and six short varieties were combined with two checks in one set, and six tall hybrids and nine tall varieties were combined with one check in another set (**MS 2.7.2** and **MS 2.7.5**) All trials were evaluated by 2-60 farmers from the same villages with an average of 30% women contributing (**MS 2.7.3**) accompanied by local extension officers and radio programmers. The hybrids clearly outperformed the varieties for grain yield over the whole range of growing conditions, and particularly under poorer conditions. All steps of the evaluation process were carried out, with an increasing number of women participating in the evaluations. As a result, three new hybrids were prepared for registration in the Malian variety catalogue, along with their parents (**MS 2.7.6**). These three hybrids and other varieties were chosen by farmers for detailed evaluation in specific target areas **(MS 2.7.7**). With coordination by IER scientists, a similar experiment with 32 entries was conducted in one new partnership area, in Tominian (**MS 2.7.5**). In Burkina Faso, experimental sorghum varieties, derived from populations selected by farmers, were evaluated in two partnership areas (**MS 2.7.5**). Plans are underway to upload the reports of this activity to the project document repository. To achieve the output **2.7.21** (due May 2012), we included one set of agronomic treatments in the variety testing. Trials were only conducted in villages where women also conducted their own experimentation. Farmers chose the varieties to include in the test during meetings conducted around the culinary tests of the new varieties. Across the three regions in the southern Sudanian zone farmers chose three short-internode hybrids, five tall hybrids, two short new- and four tall new varieties from the 29 new varieties introduced during the previous season. Sufficient seed of all these varieties had been produced by IER and ICRISAT to respond to these requests **(MS 2.7.9)**. The agronomic treatments chosen were: increased sowing density, with thinning and early fertilizer application, as a microdose of DAP; a microdose with DAP, Profeba (commercial compost) with urea; intercropping with groundnuts; intercropping with maize; and two different sowing dates **(MS 2.7.10)**. In total 250 farmers (131 men and 119 women) received seed and other inputs for testing, in a total of 49 villages in the three target zones, Mande, Dioila and Koutiala. Results from the new target zones, i.e. collaboration with ACF in KITA, and with Mobiom in Bougouni, Yorosso, Banamba and Bla are reported under objective 6 (**MS 2.7.16** and **MS 2.7.17**). IER (in Mali) conducted similar trials with five test entries plus a check, but without the agronomic treatments in two other target zones, Sikasso and Tominian (**MS 2.7.16** and **MS 2.6.17**). INERA (in Burkina Faso) conducted such trials in the Boucle du Mouhoun, and the Centre Nord region, with 48 women farmers in 15 villages. The release procedure for Burkina Faso has been changed, and another year of testing is required before the varieties can be registered formally, but certified seed production has already started **(MS. 2.7.19)**. Some key results are:

- In Mali the fertilizer treatment with DAP microdose improved sorghum yield on average by 500 kg/ha. The advantage became smaller with later sowing dates.
- With and without fertilizer, the hybrids Fada, Caufa, Omba, and in some cases Sewa, and Yamassa, out-performed the local check varieties significantly, and were preferred by farmers for the stability of their performance **(MS 2.7.10).**
- Sorghum productivity in men's fields was on average 14% higher than in women's trials fields.
- Caufa, Omba, Pablo, Sewa and Fada were the most preferred hybrids, with variations between the zones.
- Feedback from women conducting trials was extremely positive. Men were generally very supportive **(M.S. 2.7.13)**.

To facilitate data analysis by all partners, a database was created with all the results of these trials, quantitative observations and scores, as well as qualitative feedback. We are presently exploring options for generating standard types of queries, so that partners can search the database for useful results to specific questions **(MS 2.7.22).** Sufficient seed was produced for varieties requested for future experimentation and for future seed production, often exceeding the planned 10 kg per variety **(MS 2.7.20).**

SA: Farmers participatory varietal trials were conducted with four pipeline varieties each contributed by MAU and MPKV during the 2010 post-rainy season. In MPKV, Rahuri, varieties Phule Revati and RSV 1150 were preferred by farmers among the eight cultivars tested for their grain quality and plant aspect. In MAU, Parbhani, SPV 1905 (1.3 t/ha), SPV 1795 (1.3 t/ha) and Parbhani Moti (1.2 t/ha) recorded high grain yields and were preferred by farmers. SPV 1905 recorded the highest fodder yield (4.0 t/ha) **(MS 2.7.2)**. The selected crop management trial was conducted with a combination of fertilizer level, spacing, shoot fly management and drought management in four locations at MAU, Parbhani. Deep ploughing (60 cm) + 100% RDF + seed treatment resulted in the highest grain yield (1.4 t/ha) and stover yield (4.3 t/ha), followed by deep ploughing + 50% RDF + seed treatment with grain yield of 1.2 t/ha and stover yield of 3.8 t/ha. Farmers also preferred these treatments over the others in their evaluations **(MS 2.7.6)**.

Activity 2.8 – *Enhancing research and leadership skills of sorghum scientists*:

WCA: The HOPE objective 2 team in WCA supervised a number of graduate students and interns during Year 2. Mr Abdoulaye Diallo of IER is finalizing his PhD thesis, on combining ability of sets sorghum breeding materials, at the University of Bamako. Mr. Peter Muth is conducting the third year of PhD research, assessing the QTL-mediated transfer of *Striga* resistance into farmer-preferred varieties at the University of Hohenheim. Mr Chiaka Diallo of IER and IP ISFRA finalised his DEA degree at the University of Bamako. Mr. Ferry Lapeube (Tchad), Mr, Papa Moctar Kante (Senegal), Gatien Falconnier (France), and Hermann Some (Burkina Faso) spent 4-6 months at Samanko, or in partner villages in Mali, to collect the data for theses, equivalent to MSc degrees. The team also trained several technicians, who spent 3-4 months, and others who have just started in May 2011, with the sorghum team at Samanko to learn technical skills for field experimentation and report writing: Gakou Hamady, Diakaridia Goita, Diawari Traore, Moriba Keita, Yacouba Kane, and Massama Doumbia (**MS 2.8.1** and **MS 2.8.2**). In addition, two postdoctoral fellows spent time at ICRISAT – Bamako for writing publications. These were Dr. D. Yonli on *Striga* management, and Dr. Marthe Diallo on seed system issues. Three short training courses were organized on planning and implementing participatory variety evaluation trials. The first, held in Sep 2010, with scientists, technical and farmer partners from all project regions and partners in Mali, focused on options for conducting farmer evaluations of variety trials. One of the results of the workshop was an agreed approach and protocol for the trials managed under HOPE. A similar training was held in English in

December 2010 with the HOPE partners from Nigeria and one HOPE participant from Maharashtra, India. In April 2010, partners from all francophone HOPE countries were trained in tools for planning variety trials with farmers. At this meeting, training materials newly translated into French were tested and improved by the participants (**MS 2.8.4** and **MS 2.8.5**). A statistics training course was held early in 2010, during Y1. Further, in March 2011, the McKnight Foundation organized another statistics training course in which several HOPE scientists participated. Hence there was no need for another course (**MS 2.8.6**). The course on efficient recurrent selection methods is planned for September/October 2011 (**MS 2.8.7**). The entomologist from the Niger National Program, Mr. Hame Kadi Kadi, spent three months in India to learn techniques for midge screening and epidemiological observations.

<u>ESA</u>: A training workshop was held at Egerton University, Kenya from 31 May 2010 to 4 June 2010 attended by breeders from NARS institutions. The objective of the training was to improve the capacity of the breeders in ESA to analyze and interpret historical meteorological data and to determine genotype by environment (GXE) interactions. Historical meteorological data for sorghum and pearl millet was analyzed and manuscripts were developed (**MS 2.8.3**). Two PhD students and one MSc student joined to work In the HOPE project research agenda. The PhD students are Phylis Muturi and Caroline Mwongera. Phylis is registered at Makerere University, partially funded by RUFORUM and is working on "*Enhancing resistance to* Busseola fusca *and* Chilo partellus *in sorghum for improved food security and livelihoods*". Caroline, whose studies are co-funded by CIRAD, is registered at Montpellier University, and is working on "*Predictability of the climate to reduce tropical agriculture vulnerability*". An MSc student, Aemiro Bezabih of Haramaya University, Ethiopia, is working on "*Evaluation of Stay-green QTL Introgression Sorghum Lines for Post flowering Drought at Kobo, North Eastern Ethiopia*" (**OP 2.8.4**). A training course on 'Seeds Policies and International Regulations' was organized from 4-8 July 2011 in Nairobi, Kenya, with 22 participants (including five women) from Ethiopia, Eritrea, Sudan, Tanzania and Kenya, and eight resource persons from the Kenya Plant Health Inspectorate Service (KEPHIS), African Agricultural Technology Foundation (AATF), Africa Harvest, ICRISAT, Africa Seed Trade Association (AFSTA) and KARI–Kenya. The training covered: National and International Regulations Governing Genetically Modified Organisms and Conventional Seeds; Principles of Confined Experimentation and practice of ABS at KARI, Kenya; Developing applications for Permits for Confined Experimentation; Confined Experimentation; Seed movement and seed release though National Performance Trials; Harmonization of seed policies and relationship to COMESA; and a communication strategy for contained- and confined field trials of sorghum. The fifth day was devoted to a field visit to the ABS–CFT facility at KARI-Kiboko (**MS 2.8.5**). A training course was organized for breeders on sorghum hybrid parents and product development and seed systems at ICRISAT-India from 4 to 8 February 2011. The ESA HOPE project supported five participants (one from the private sector in Tanzania and two each from Ethiopia and Tanzania NARS). Another participant was supported by Suba Agro Seed Company from Tanzania and three breeders from ESA (giving a total of nine participants from ESA). The course provided a broad overview of seed production and breeding (**MS 2.8.8**).

<u>SA</u>: Focus in South Asia centered on enhancing stakeholder capacities for technology development, through nine training programs organized during the year, and the publishing of flyers on various issues. MPKV and MAU each produced three flyers on improved cultivars and production technology, integrated pest management and drought management practices **(MS 2.8.1).** The project also conducted training programs (two each) on improved crop cultivars, agronomic practices and integrated pest management and drought management (soil moisture conservation) for six researchers, 10 university field staff and 30 KVK and agriculture department staff (**MS 2.8.4**).

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

WCA**:** A wild donor parent (115_199) carrying four putative quantitative trait loci (QTLs) for *Striga* resistance was crossed plant-by-plant to a SOSAT-derived inbred line at ICRISAT- Sadoré during the off-season of 2010/11, and six triplets (F_1 seed and selfed seed from both parental plants) were obtained. One of these new crosses will be used for marker validation during the 2012 rainy season using F_2-derived F_3 and BC_1F_1-derived BC_1F_2 progenies to identify targets for marker-assisted backcrossing of *Striga* resistance QTLs into the SOSAT-derived line. As a second back-up strategy, full-sib progenies for phenotyping and genotyping in a marker-assisted population improvement (MAPI) scheme using a pearl millet *Striga*-resistance genepool were produced at ICRISAT-Sadoré during the off-season of 2010/11 as basic genetic material for field and pot trials to be conducted during the 2011 rainy season**.** The MAPI activity is co-funded by the McKnight Foundation. A PhD student from Niger, holding a stipend from IRD-Montpellier, is involved in this work. [No MS or OP due in Y2.]

SA: Sixteen isolates of the downy mildew pathogen were collected from different hybrids during surveys of farmers' fields in the target region where single cross hybrids are cultivated (Haryana, Rajasthan and Gujarat states) in the rainy seasons of 2009 and 2010 and were evaluated for their virulence on seven host differential lines. Three pathotypes (Sg 139, -212 and -384) from Rajasthan, one pathotype each from Haryana (Sg 334) and Gujarat (Sg 445) were also included as reference pathotypes for comparison of virulence. The higher virulence (downy mildew incidence) of new pathotypes compared to the earlier pathotypes collected during 1997-2003 indicated a change in the pathogen population in both Rajasthan and Haryana. Isolate Sg 526 from Osiyana in Jodhpur district was found to be more virulent than the old pathotype-Sg 384 from Barmer in Rajasthan, isolate Sg 519 from Rewari was found to be more virulent than the old pathotype-Sg 334 from Bhiwani in Haryana, while Sg 445 remained the most virulent for Gujarat (**OP 3.1.4**). Eighty-four parents involved in different QTL mapping populations available at ICRISAT were tested against these most-virulent pathotypes (Sg 526, Sg 519, and Sg 445) and four lines were found to be resistant with ≤10% incidence to all the three pathotypes, while two parents were found resistant to two of the three pathotypes. The mapping populations involving these identified parents will be used to identify flanking markers for major genes contributing to resistance to these newly emerging downy mildew pathotypes. To identify sources of resistance against them, 103 parental lines were evaluated for downy mildew resistance and eight lines were found to be resistant (≤10% incidence) to all the 3 pathotypes while seven parents were resistant to two of the three pathotypes (**OP 3.1.5**).

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

WCA: Based on a preliminary survey of INRAN research stations and seed multiplication centres in Niger during the 2009 rainy season (limited to the "secure" area of the country at that time), INRAN's Doukoudoukou Seed Multiplication Centre was identified as a millet head miner (MHM) hotspot location. During the 2010 rainy season, the millet stem residue management study first conducted at ICRISAT-Sadoré during the 2009 rainy season was repeated at both ICRISAT-Sadoré and at Doukoudoukou, in collaboration with INRAN. During the rainy season of 2010, MHM incidence was high (mean of 80%) and evenly distributed across the field at Sadoré, while it was low (2%), with significant differences between treatments at Doukoudoukou. Stem borer incidence (MSB) was evenly distributed at both locations, but much higher at Sadoré (66%) than at Doukoudoukou (13%). Analyses of the 2010 results are still underway, but those for survival of diapausing *Coniesta* larvae (MSB) have been completed. Infestation level and the number of surviving *Coniesta* larvae per stem was much higher at Sadoré than at Doukoudoukou. The treatments effects were consistent across both locations in 2010. At Sadoré in 2010/11, despite higher MSB incidence, there were no significant differences in survival of diapausing larvae between the treatments where stems were not exported. This was ascribed to the fact that strong winds during the dry season laid down the stems on treatments where they were expected to have remained upright for some period following grain harvest. Similar results were observed at Doukoudoukou in 2010/2011, but at this location the lack of significant differences between stem management treatments where stems were not exported was attributed to the low overall stem borer incidence. The final conclusion of both the first and the second year trial on millet stem residue management will appear in the next report. The preliminary results provide limited support to observations from a 2009 trial at ICRISAT-Sadore, in which the treatment with millet stems cut at the end of the dry season (supposedly the most effective treatment against wind erosion because the most critical period for wind erosion is at the shift from the dry season to the rainy season), was unfortunately favourable for *Coniesta* (MSB) carry-over. However, the 2010 study shows that this carry-over is even more favoured by the storage of millet stems on elevated platforms, as the highest MSB mortality was achieved with stems cut at harvest or 2 months later (**MS 3.2.1**).

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

WCA: An integrated genetic and natural resource management (IGNRM) trial of 16 soil fertility management options (combinations of organic manure with inorganic fertilizers) with 10 different pearl millet cultivars was conducted on-station at ICRISAT-Sadoré, INRAN-Kollo and INRAN-Maradi during the 2010 rainy season. Mean grain yield was considerably lower at Maradi (206 kg/ha), compared to 953 kg/ha at Sadoré. There was no significant effect of mineral or organic fertilizer application at Sadoré and Kollo although a significant effect of mineral fertilizer was observed at the lower-yielding Maradi site. The lack of response to the fertilization at Sadoré and Kollo is most probably due to the fact that at these sites long-term fallow fields were used, which had relatively high soil organic matter contents and hence higher inherent soil fertility levels. No statistically significant interaction effect between mineral and organic fertilizer was observed; however, the combination of 6g of NPK and 300g of cow manure produced the highest yields across all locations. There were no significant genotype × fertility treatment interactions (**MS 3.3.2**). After discussions and agreement with partners, on-farm trials were conducted in 2010 in the form of demonstrations (covering eight genotypes and three farmer-chosen soil fertilization options) with 66 farmers at 26 villages in Niger. In the participatory evaluations, farmers selected the combination of micro-dosing with 6g NPK and 200g organic manure per hill for more wide-spread testing in 2011. According to farmers' perceptions, hill application of manure requires additional work although it is a good practice that increases crop yield. Among the tested varieties, "Mil de Siaka", ICRI-Tabi, and ICMV IS 89305 confirmed their potential to adapt to diverse environmental conditions. For the 2011 rainy season, the intensification treatments including $ZnS0_4$ and two proprietary micronutrient products, in various combinations with organic manure and inorganic macronutrient fertilizers are being assessed in the current rainy season of 2011 at Sadore **(MS 3.3.1**).

SA: A micronutrient fertilization response trial was conducted with three locally adapted hybrids at three locations (Hisar, Durgapura and Jamnagar) during the rainy season in 2010 (**MS 3.3.6**). Trials at Durgapura and Jamnagar were damaged due to heavy rains, while results of trial conducted at Hisar (with hybrids HHB 94, HHB 197 and HHB 223) showed that basal application of $ZnSO_4$ at 20 kg/ha had significantly increased grain and forage yield in comparison to the control and other micro-nutrient treatments. This result was supported by a recently concluded multi-year and multi-location study at JAU, Jamnagar which also reported that basal application of $ZnSO_4$ at 20 kg/ha leads to higher grain yield in pearl millet. The results of this experiment will now be validated in the rainy season of 2011 at the same three locations (Hisar, Durgapura and Jamnagar).

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

WCA: Suitable greenhouses at ICRISAT-Sadoré were identified and repaired, and a misting system was installed to ensure uniform favorable conditions for screening pot-grown pearl millet seedlings against downy mildew. Additional facilities developed include an inoculation room and air-conditioned incubation chamber. Initial establishment of inoculum for the local strain of the pearl millet downy mildew pathogen under greenhouse conditions has been successfully completed, and preliminary evaluation of the screening system is on-going (**MS 3.4.1**). An ICRISAT-Sadoré research assistant Harouna Dodo received four weeks training in the use of potted seedling screens for pearl millet downy mildew resistance assessment at ICRISAT-India during Y1 (Feb 2010). The training was very successful and Harouna is now independently performing a preliminary screen of 16 pearl millet lines to optimize the procedure (**MS 3.4.2**). In addition, screening of >300 FS progenies of "ICRI-Tabi" and up to 100 breeding lines each from national programs in Burkina Faso, Mali, Niger and Nigeria is now planned using these facilities in the rainy season in 2011.

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

SA: A trial of 216 breeding lines was evaluated for adaptation and productivity in the target environment at three locations in the rainy season in 2010 (**MS 3.5.2**), of which 24, 10 and 15 promising breeding lines were selected in Gujarat, Haryana and Rajasthan, respectively. Seed of these and other new breeding lines (total of 200) was produced in the summer of 2011 (February-May) and sent for evaluation in the rainy season of 2011 at seven locations (three NARS and four private sector seed companies) in target environments (**MS 3.5.1**). In addition, nine progenies from ICRISAT-CAZRI B- Composite and 16 early-flowering B-lines were selected based on 2010 rainy season evaluation and initiated for A-line conversion. Twenty-two IC-CZBC progenies which were selected in 2009 reached BC_2 conversion stage and 56 promising B- lines which were initiated for A-line conversion in the rainy season of 2010 reached BC_1 stage. Based on the 2010 evaluation at four locations, three of the 24 stay-green and six of the 40 early R-lines were identified for future use. A trial of 74 potential hybrid parents was evaluated at Haryana, Gujarat and Rajasthan locations in the rainy season of 2010 (**MS 3.5.5**), of which 13, 10, and 13 promising parents were selected in terms of adaptation and productivity by respective state partners. These selected lines were used to generate new crosses which were entered for test-cross evaluations in the rainy season 2011. Seed of potential hybrid parents selected by partners in 2010 (36 B- and R- lines) and 28 new B- and R- lines was produced in the summer season and sent to nine locations (three NARS and six private sector seed companies) for evaluation in the rainy-season in 2011. Also, seed of 86 new potential hybrid parents (46 B-lines and 40 R-lines) was produced in the summer season and sent to seven NARS locations for evaluation in the rainy season, 2011 (**MS 3.5.4**). Integrated marker-assisted and conventional backcrossing to improve DM resistance of elite pollinator lines ICMR 01004 (male parent of early-maturing released hybrid HHB 67 Improved) and J 2340 (male parent of early-maturing released hybrid GHB 538) was further advanced during Y2. A total of 1124 progenies of ICMR 01004 in BC_4F_2 and BC_5F_1 generations along with their respective donor and recurrent parents were planted in the field during the summer of 2011. Selected plants were selfed and backcrossed with their respective recurrent parents (**MS 3.5.8 & OP 3.5.9**). A total of 64 test crosses were made with selected ICMR 01004 pollinator progenies on seed parent 843-22A to produce "HHB 67 Improved-like" hybrids during summer, 2011. On the basis of their downy mildew reaction (resistant to moderately resistant disease reaction), 36 test crosses were selected for multi-location evaluation along with check hybrids during the rainy season, 2011. BC_3F_4 progenies of J2340 were grown during summer 2011 and 23 improved J2340-background introgression lines were used as pollinators to develop "GHB 538 (ICMA 95444 × J 2340) -like hybrids". These hybrids, along with the original GHB 538 hybrid, will be tested during rainy season 2011 in multi-location trials in the targeted region (**OP 3.5.9**).

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

SA: During summer of 2011, seed of 218 testcross hybrids[4] was produced and sent for evaluation to seven locations (three NARS and four private sector seed companies) in north-western India as an Observational Nursery (**MS 3.6.1**). The seed of 31, 40 and 16 testcrosses was contributed by Haryana, Gujarat and Rajasthan, respectively. An Observational Nursery of 236 testcrosses was evaluated at Hisar, Durgapura and Jamnagar in the rainy season, 2010 (**MS 3.6.2**), of which 27 were found to be promising in at least two locations. These were multiplied for seed in summer 2011 and promoted for testing in a Hybrid Trial in the rainy season of 2011. Seed of 68 hybrids (selected on the basis of a rainy season 2010 evaluation) was produced during summer 2011 and sent for Hybrid Trial evaluation at 12 locations (six NARS and six private sector seed companies) during rainy season, 2011 (**MS 3.6.3**). A Hybrid Trial of 48 hybrids (constituted on the basis of rainy season, 2009 selection) was evaluated at Hisar, Jamnagar and Durgapura (**OP 3.6.4**) along with standard checks, and three hybrids considered promising across all the locations were promoted to Researcher Managed Farmer Participatory Trial for evaluation in rainy season, 2011. The hybrids found to be promising at a minimum of 2 locations in a Hybrid Trial were multiplied for seed in summer 2011 and will be re-tested in Hybrid Trial in rainy season, 2011[5].

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

WCA: Full-sib families from 8 new farmer-preferred pearl millet populations were evaluated with NARS partners (IER, INRAN, LCRI and INERA) for development of new varieties during the 2010 rainy season. The best families of each population, identified with partners from replicated full-sib progeny trials, were recombined at ICRISAT-Niger during the 2010-11 off-season to create Breeder Seed of new varieties/experimental cultivars for evaluation and use during the 2011 rainy season (**MS 3.7.2**). Due to high downy mildew infestation of the whole PE05572 FS trial at Cinzana, this farmer-preferred population requires a second cycle of selection for downy mildew resistance under sick-plot conditions at IER-Cinzana, and new full-sib progenies were produced for this purpose during the 2010-11 off-season. With the aim to develop and improve new trait-specific diversified pearl millet populations for future variety development, full-sib progenies from 10 populations were evaluated with partners during the rainy season, 2010. The best families were identified with partners for each population. Full-sib seeds were produced during the 2010-11 off-season by recombining the identified best families for evaluation during the next recurrent selection cycle in the 2011 rainy season. So the first selection cycle was successfully completed for each of these populations (**MS 3.7.2**). The LCIC-diversified population was so diverse that it was partitioned into three subpopulations: one early-maturing, one medium-maturing, and one later-maturing stay-green dual-purpose type. In addition, to serve farmers in the Southern Sudanian zone, two late-maturing populations were created in the off-season for use in farmer-participatory improvement in southern Mali (this activity is co-funded by the McKnight Foundation).

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

[4] In 2010, we had tested 236 test crosses (11 more than the projected 225), while in 2011 for the same trial we could multiply seed of only 218 test crosses (7 less than the projected 225 test crosses).
[5] A hybrid trial was re-constituted in 2010 to evaluate the selections made in observational nursery in 2009. As the rainy season in 2009 was the first year of the project and the targets were not clear, we had a fewer number of entries in observational nursery in2009 (188 hybrid against the projected target of 225). The seed of these entries was produced in the summer of 2009 when project was not in place. This led to fewer selections in 2009 and eventually to 48 hybrids (12 less than the projected target of 60) for testing in the hybrid trial 2010. This was reported in year 1. We now tried to fill this deficit and are testing 68 hybrids in hybrid trial of 2011 (against the target of 60 in 2011).

WCA: At the beginning of the 2011 rainy season, 14.4 tons of seed of 12 different cultivars were produced/procured at ICRISAT-Sadoré, 10.3 tons in Burkina Faso and 1.5 tons in Mali for participatory evaluation and seed production activities (**MS 3.8.1**). Another 16 experimental cultivars were multiplied by manual sibbing, due to lack of further isolation plots at ICRISAT-Sadore. In Niger, 66 on-farm researcher-managed PVS trials were conducted involving eight new pearl millet cultivar options evaluated under three soil fertility management regimes. In Nigeria, on-farm researcher-managed PVS trials were conducted during the 2010 rainy season with three pearl millet varieties using 6g NPK fertilizer per hill as a micro-dose. In Burkina Faso, on-farm researcher managed PVS trials were conducted at Kaya, Boulsa and Toma with farmer organizations AMPS (in Centre Nord), FEBAB (in Centre Nord and Mouhoun), and UGCPA (in Mouhoun). In Mali, on-farm researcher managed PVS trials were conducted involving four improved varieties: CzSyn 00-06, Nko × TC1, Indiana 05, and CzSyn 03-11 (**MS 3.8.2**). In Niger, farmers selected the combination of micro-dosing with 6 g NPK and 200 g organic manure per hill for future testing. Among the tested varieties, "Mil de Siaka", ICRI-Tabi, and ICMV IS 89305 confirmed their potential to adapt to diverse environmental conditions. Out of three varieties tested in Nigeria, farmers identified pearl millet variety PE05532, otherwise known as "Super-SOSAT", with yield potential of 3.5 t/ha that represents a 30% grain yield superiority over the improved check. This variety is being documented for the national variety release process in Nigeria. In Burkina Faso, pearl millet variety IKMV 8201 was most preferred by farmers, followed by SOSAT C88 **(OP 3.8.3** and **MS 3.8.4**). In Mali, through the collaboration with the Aga Khan Foundation and IER, 27 FFS for ISSFM were installed in four Training of Trainer (TOT) clusters and 23 villages, in which 1400 participants (of which 120 were women) were trained directly in 2010. In Niger, through collaboration with the Mooriben farmers unions, FUMA-Gaskiya and INRAN, seven FFS for ISSFM were installed in which 155 participants (15% of which were women) were trained in 2010. In Nigeria, LCRI and CBARDP Yobe state installed two TOT site clusters with five FFS trials, training 50 farmers (**MS 3.8.8** and **OP 3.8.10**). Data analysis from ISSFM trials of the farmer field schools in Mali (three clusters and 15 trials) revealed that investments for ISSFM were about twice as high as for FP, but that profits were four times as high (US$ 465/ha for ISSFM, versus US$ 114/ha for FP). The return to investment for ISSFM was 1.6 while this value was 1.1 for FP. This means the ISSFM practice may be acceptable to farmers and that it may be desirable to start scaling-up the practice. This is currently being done through printed, radio and video messages, farmer exchange visits and the sale of "integrated *Striga* control packs". More information could be obtained from the project website at: http://hope.icrisat.org/from-variety-tests-and-farmer-field-schools-to-the-sale-of-seed-packs-and-integrated-striga-control-packs/. In Niger, analysis of trials at four Mooriben sites revealed that investments for ISSFM were about three and a half times higher than for FP, and that profits were similar (US$ 171/ha for ISSFM, versus US$ 147/ha for FP). As a result, the return to investment for FP was much higher than for ISSFM, which means that the ISSFM practice in the tested form requires too much investment relative to the increase in profit. Steps have been taken to adapt the ISSFM practice to reduce the costs of investment and to increase profitability. In Nigeria in Yobe state, partial budget analysis of the trials revealed that investments for ISSFM were about three times higher than for FP, and that the profit from ISSFM was about two times that of FP (US$ 594/ha for ISSFM, versus US$ 267/ha for FP). The return to investment for ISSFM was 1.81 while this value was 2.19 for FP. This means the ISSFM practice in its current form may be acceptable to farmers, but that it is not necessarily preferred over FP. If the ISSFM practice leads to stable yield increases over the years, coupled with more profit than the farmer practice, it may be desirable to start scaling-up the practice (**MS 3.8.9**).

SA: Seed of 24 hybrids (comprising three best hybrids from the hybrid trial of 2010 + nine pipeline hybrids contributed by partner states + 12 hybrids contributed by private sector seed companies) was produced/procured and sent for rainy season 2011 evaluation along with standard checks in a researcher–managed participatory trial in the target ecology (**MS 3.8.13**). A researcher–managed participatory trial comprised of 19 pipeline hybrids was evaluated in the farmers' fields in two village clusters each in Gujarat, Haryana and Rajasthan. This activity was coupled with Objective 6 farmer-participatory technology demonstration/evaluation activities (five trials in each village cluster x two clusters/state x three states= 30 trials) along with the respective state standard checks for evaluation in the 2010 rainy season (**MS 3.8.14**). The trials were conducted successfully in Gujarat and Rajasthan but not in Haryana. Scientist-farmer's days were organized at the trial sites in Gujarat and Rajasthan and farmers' feedback was collected to identify the hybrids of their choice. Based on the farmers' feedback, the three best hybrids were selected for each of Gujarat and Rajasthan states (**OP 3.8.15, MS 3.8.16**, and **MS 3.8.17**). Their seed was multiplied during summer 2011 and has been sent for evaluation in farmer–managed trials during rainy season 2011, on bigger plots along with best management options identified in activity **3.3.6** from on-station trials. Haryana will conduct farmer- managed trials with their three best pipeline hybrids from their state program in rainy season 2011.

Activity 3.9 - Strengthen research-for-development capacity

WCA: In Niger, 210 farmers were trained from various farmer organizations to conduct FFS, Mini-pack production and IGRNM trials in April 2011 (**MS 3.9.4**). Training for members of the FAMEYE farmer union of the MOORIBEN was conducted for 30 farmers (21 men and nine women) from 4-5 April 2011. At Bokki, the training was conducted for members of the ALBARKA farmer union of the MOORIBEN for 30 farmers (24 men and six women) from 15-16 April 2011. Training was conducted at Tera for the HARABEN farmer union of the MOORIBEN and AMPTI from 16-17 April for 30 farmers (27 men and three women) drawn from six villages. At Falwel, training for members of MADABEN farmer union of the MOORIBEN, was conducted from 18–19 April 2011 for 28 farmers (21 men and 9 women). From 24-30 April, training was conducted for 90 farmers (40 men and 50 women) of the FUMA Gaskiya farmer organization involving unions at Sarkin Houssa, Sayi-Saboua and Elkolta of the Maradi region. Training on *Striga* resistance screening methodology in pearl millet and sorghum, was conducted from October 27 to 29 2010, at the ICRISAT-Sadoré station in Niger (eight participants from Mali, Burkina Faso, Niger and Nigeria) (**MS 3.9.5**). Activities leading to **MS 3.9.6** were not completed, and the attainment of this milestone is postponed to September 2011. The process of optimizing the greenhouse screening facilities at ICRISAT-Sadoré is on-going. Training of partners (three days, at ICRISAT-Sadoré) will be carried out once the screening procedure is optimized.

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

The finger millet core collection (540 accessions) characterization data was used to compose a subset of 144 lines that expressed variability in morphological traits and blast reaction and the lines were planted at Alupe, Kenya during the 2010 long rains (March to July). Days to flowering, days to heading, plant height, number of tillers, panicle size and shape and reaction to different biotic stresses were measured. The data were used to select 64 lines resistant to blast and these are under evaluation in Alupe this season. ICRISAT, in collaboration with Tanzanian and Ugandan NARs, conducted collection missions in June-July 2010 to fill gaps, and accessions were also collected from the Kenya gene bank. Unique finger millet accessions were collected from Kenya (154), Uganda (105) and Tanzania (45) and multiplied for distribution to the different countries. Accessions could not be obtained from Ethiopia due to their strict germplasm movement regulations, but they made a selection that will be collated with accessions from other countries for them to screen within the country (**MS 4.1.4)**.

A review of work on finger millet blast in the region has been completed and new resistance sources have been identified. The review revealed that most cultivated landraces are susceptible to finger millet blast that causes grain yield losses of up to 60%. The disease was first recorded in East Africa in Uganda in 1933. Previous research at Serere (Uganda), Kakamega (Kenya) and Uyole (Tanzania) through germplasm screening has identified several accessions with significant blast tolerance and good agronomic and grain quality traits. The full report of this review is ready and available at ICRISAT – Nairobi (**MS 4.1.6**).

In late June to early July 2010, the National Agricultural Research Organisation (NARO), Uganda and ICRISAT undertook a joint finger millet collection mission in Uganda. The objective was to fill finger millet collection gaps in Uganda and share the germplasm according to agreed country germplasm sharing regulations (**MS 4:1.7** and **MS 4.1.9**).

All the germplasm collected (105 accessions) was divided into two sets and one left at SAARI, Uganda together with the passport data. Collections were made in areas with altitude between 1018 masl in Pader district to 1179 masl in Mbale district. These are in mid-altitude areas, which is the main finger millet growing agro-ecology in Uganda. In the eastern (Serere, Kumi, Bukedea, MbaleKibuku, Katakwi and Amuria) and northern districts (Dokolo, Lira, Apac, Oyam and Apac), the crop was in the field where the samples were collected. Samples from the western districts of Masindi, Hoima, Kasalisi, Kiryandongo, were collected from the market. The naming of finger millet varieties was mainly based on variety characteristics i.e. Purple, Okwangapel (white), Ebati (white), Obeet (egg, referring to the color of egg yolk) all given in respect to the color of the plant, and Engenyi (stubborn), Emoru (rock), Emorumoru (rock), regarding the hardness of the crop. Another criterion was origin, as in KalLango (millet from Lango), Ochom and OtimCherigar (persons who introduced the variety). In Ethiopia, the Bako research center collected 81 finger millet accessions from Oromiya and Benisangul regions in the 2010 crop season. Four administrative zones (East Wollega, West Wollega, Illubabor and Asosa) were addressed in this collection. Biophysical data of the collection sites and crop-related information were also collected. The Ethiopian Institute of Agricultural Research (EIAR) is not mandated to carry out germplasm transfers and it is only through the involvement of the Institute of Biodiversity Conservation (IBC) that any transfer of indigenous germplasm can be possible. Sharing of released finger millet varieties could be possible but the process is very long and tedious. Nevertheless, this is being pursed (**MS 4.1.7**).

Eighty one (81) accessions from Tanzania and 158 accessions from Kenya were planted at ICRISAT KARI-Kiboko field station in 4 m row single plots using an augmented trial design in the 2010/11 SR season (November 2010 to April 2011). This served to multiply the seed and for characterization of the germplasm. 400 g of each accession was harvested. The germplasm is being conserved in the ICRISAT-Nairobi gene bank (**MS 4.1.8**).

One hundred and five accessions from Ugandawere were planted at ICRISAT KARI-Kiboko field station in 4 m row single plots using an augmented trial design in the 2010/11 SR season (November 2010 to April 2011). This served to multiply the seed and for characterization of the germplasm. 400 g of each accession was harvested. The germplasm has been conserved in the ICRISAT-Nairobi gene bank. The germplasm from Ethiopia will be multiplied and characterized this season, as they do not have irrigation facilities to grow an off-season crop. Harvesting of the current crop is expected in November (**MS 4.1.9**).

A collection of 420 germplasm lines, including 163 collections from Kenya, 46 from Tanzania, 105 from Uganda and 80 from the ICRISAT-India minicore collection, were constituted and phenotyped at Kiboko during the 2010/11 short rains season. Data were taken for 30 quantitative traits. Preliminary results indicate diversity in the germplasm with PCA analysis showing the first four PCs capturing 58% of the variability. The highest loadings on the first PC were contributed by days to 50% flowering, panicle exsertion, finger length, number of leaves and peduncle length. In the Kenyan germplasm, materials from Nyanza Province had the longest finger (8.6 cm, panicle exsertion (9.9 cm) and peduncle (20.6 cm) and were also earliest to flower (44 days to 50% flowering). The latest lines to flower, with a mean of 50 days to 50% flowering, were from Western Province (in Kenya) and also had the highest mean number of leaves per plant (17). Among the collections from Uganda, the earliest lines to flower (mean 40 days) were from Dokolo (Eastern Uganda) and the latest (mean 50 days) were collected from Hoima (Western Uganda). The Dokolo lines also had the longest peduncles (22.2 cm) and longest exsertion (11.9 cm). Among the Tanzania collections, lines from

Mtwara were the latest to flower (66 days) whereas lines from Tarime had the lowest panicle exsertion (4.2 cm) and longest peduncles (23.4 cm). Overall materials from Uganda had lowest mean days to flowering (40 days) with the longest mean peduncle length (21.2 cm) whereas Tanzania material had the latest lines (56 mean days to flowering). The rest of the data are being processed for full analysis (**OP 4.1.10**).

Marker details were obtained from ICRISAT-India and published literature and primers were synthesized. These consisted of the 20 markers previously developed at UGA and recommended by the GCP for finger millet genetic diversity assessment. However, five of these markers proved to be monomorphic, i.e. they did not distinguish between the genotypes being evaluated and thereby limited the discrimination power of the marker set. We therefore supplemented the GCP set with more markers from published reports up to a total of 82. These are currently being optimized using a small collection of 10 diverse genotypes selected from the regional collection of 340. A set of the 20 most polymorphic markers that work well in finger millet will be selected for genotyping the full set of genotypes collected in this study in a follow-up study to be reported on later. In addition to evaluating SSR markers for genetic diversity assessment, we evaluated the eight potential mapping population parents selected (KNE479, KNE1124 and KNE755 susceptible and KNE796, P224, KNE1015, KNE814 and U15 resistant) to determine which parental combination is most diverse (exhibits the largest amount of polymorphism) and used the results to decide which mapping populations to develop RIL populations for future blast resistance QTL mapping. The best parental combination was KNE755(S) x U15(R) followed by KNE755(S) x KNE1015(R), KNE755(S) x KNE796(R) and KNE755(S) x P224(R). At least four populations are being advanced for this purpose and will be adequately inbred (F_4 generation) by mid-2012. (**MS 4.1.11**). Further, the diverse collection of finger millet varieties that will be genotyped has been assembled and delivered to ICRISAT-Nairobi for DNA extraction and genotyping. This activity is due for completion, as **MS 4.1.12**, in December 2011.

A total of 64 selections were made from the preliminary finger millet trial planted in 2010 **(MS 4.1.2**). These selections were put into a regional trial and planted at KARI-Alupe station in the 2010 short rains (SR) season, Serere-Uganda (2010 SR) and Uyol-Tanzania (Jan 2011) using four rows x 2 m length plots with two replications in a lattice square design. Data were taken on days to 50% flowering, grain yield, blast reaction (1-9 scale), plant height, agronomic score and 1000 grain weight. At the Alupe (Kenya) site 19 lines (out of 64) attained mean grain yield of 1.2 -2.2 t/ha with an overall blast rating score $\geq$ 4.0 (1-9 scale) with the susceptible check KNE 479 having a score of 8.0. These 19 best-performing lines flowered between 66 and 95 days and attained plant heights of 69-99 cm. The highest yielding line, KNE 629, had a mean grain yield of 2.2 t/ha and a blast score of 3.5.The line with best blast tolerance (score 2.0) was KNE 814 with mean grain yield of 1.56 t/ha. The released/pre-released lines in Uganda and Kenya (U 15 and P 224) both had blast scores of 3.5 and grain yields of 1.72 and 1.59 t/ha, respectively. Blast was highly correlated to agronomic score (r=0.50), correlated to 1000 grain weight (r=0.23) and number of tillers (r=0.15). Highly significant negative correlation was expressed between blast and plant height (r=-0.48) and days to 50% flowering (r=-0.46), while blast was negatively correlated to yield (r=-0.17) and lodging (r=-0.15). Very weak correlation was observed between blast and insect reaction (r=-0.05). Analysis of variance showed significant differences for blast disease damage, insect damage, days to flowering, number of panicles harvested and plant height (P<0.001) and grain weight (P<0.05). At physiological maturity farmers were invited to the stations to participate in selection. In all instances, farmers were aware of the blast disease but selected mainly released or pre-released varieties from other countries. Favourites across the three sites were U15, P224 and Gulu E (**MS 4.1.16**).

Finger millet *Striga* endemic areas were identified as Busia, Siaya, South Nyanza, Kuria and Homa Bay districts of western Kenya. Cross checking with the Kenya gene bank revealed that extensive collections have already been made in these areas and so it was felt that there was no need to do additional collections. Germplasm from these districts was sought from the gene bank, and a total of 48 accessions were received for the purpose of establishing a *Striga* experiment. These accessions are now being tested in Kenya (at Alupe), Uganda (Serere) and Ethiopia to establish their resistance status. *Striga* was not reported as a problem in the millet growing areas of Tanzania, so collection was not necessary there (**MS 4.1.18**).

A *Striga* experiment was carried out with 48 varieties collected from *Striga* hot spots and major finger millet growing districts plus a local check, to form a seven x seven lattice square design with two replications, two rows per plot of 4 m length and a spacing of 0.4 m between rows and 0.1 m within rows. Trials were planted at the ICRISAT KARI-Alupe station in western Kenya in March 2011, at Uyole, Tanzania in March 2011, and are to be planted in Ethiopia in July 2011 and Uganda in August/September 2011. Data collected will include plant stand, days to 50% flowering, plant height, disease score, agronomic score, panicles harvested, dry panicle weight, grain weight and weight of 1000 grains. In addition data on days to first *Striga* emergence, days to onset of *Striga* flowering, *Striga* vigour, number of *Striga* plants that flower, number of *Striga* plants at flowering and at physiological maturity. Data for Alupe and Tanzania are at their final stages of completion and only preliminary data for Alupe are shown. In Alupe, the local check used was Okhale 1 which is believed to be resistant to *Striga*. Days to flowering ranged from 56 in GBK-0296808A to 103 in GBK-029667A, with a mean of 46.4 and 75.0 recorded for the check. Days to first *Striga* emergence ranged from 35 to 61 in GBK-029767A and GBK-000399A, respectively with a mean of 44.6 and the check having 49. Simple ANOVA revealed that accessions differed significantly for agronomic score, reaction to blast disease, days to flowering (P<0.001), damage by *Striga* (P<0.002) and plant height (P<0.003). Accessions were not significantly different for days to first *Striga* onset, days to onset of *Striga* flowering, number of panicles harvested, or *Striga* count at flowering or at harvest. Correlation analysis among the agronomic and disease traits revealed that plant damage due to *Striga* was highly correlated to agronomic score (r=0.60), days to flowering (r=0.56) and *Striga* count at flowering (r=0.31). It was negatively correlated to panicles harvested (r=-0.55), dates to onset of *Striga* flowering (r=-0.32), first *Striga* emergence (r=-0.30) and plant vigor (r=-0.25). Number of panicles harvested (the nearest estimate to yield) was negatively and highly correlated to days to flowering (r=-0.66), *Striga* count at flowering (r=-0.31) and was correlated to days to onset of *Striga* flowering (r=0.40) and plant height (r=0.36). Blast was highly and negatively correlated to days to flowering (r=-0.36), but was not significantly related to the *Striga* traits (**MS 4.1.19**).

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

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) in single rows of 4 m length each using an augmented design in the 2010/11 SR season (Nov 2010 to April 2011). The materials were exposed to terminal drought by stopping irrigation when 50% of the treatments/entries from each group attained 50% heading. Data were collected weekly from heading to maturity on days to 50% flowering, number of green leaves and the chlorophyll content of the 4th leaf from the top of the plant. Data collection and entry is complete. The seed multiplication of the same accessions was done in the same season and approximately 100 g of each accession was harvested. From the harvested grains, 25 g of each accession was sent for nutritional analysis in Nairobi. Unfortunately, the rains came earlier than anticipated and we could not expose the later-maturing accessions (groups 2 and 3) to terminal drought. Consequently, the trial has been repeated at Kiboko in the 2011 LR season (April to September) to expose the trial to terminal drought (**MS 4.2.1**).

Activity **4.2.2** was combined with **4.8.4**, which is reported later. Nine breeders and seed company representatives from Uganda, Kenya, Tanzania and Ethiopia were invited to the ICRISAT-DRD trial station in Miwaleni Tanzania for a field day. They were exposed to different germplasm at different levels of development, including varieties from other countries collated by ICRISAT. The breeders were able to make selections for their respective programs, and these materials will be sent to them when it is ready and the necessary paperwork done. Apart from selection, the breeders exchanged experiences about processes, desired traits and farmers' expectations during a two-day planning meeting (**MS 4.2.2**).

Output **4.2.3** relied on the attainment of **MS 4.2.1**. As reported earlier, activity **4.2.1** was not completed in time due to an early onset of the rains at our KARI-Kiboko station. Activity **4.2.1** will now be repeated in the period June to October 2011, when the varieties with drought resistance and desirable characteristics will be identified (**Activity 4.2.3**) by October 2011 (**MS 4.2.3**).

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

Crosses were made in 2009/10 SR using susceptible lines (KAT FM 1, KNE 1124, KNE 479, KNE 744 and KNE 755) as the females and tolerant/resistant lines (KNE 1034, KNE 796, KNE 814, P224 and U15) as the pollen donors. Seed from the crosses was planted at Kiboko (Kenya) on 17th November 2010 in 2010/11SR season. The 14 crosses from resistant and susceptible lines were planted to establish the true F1's and 193 finger millet heads that looked like the true crosses were selected and harvested as F1 seed. The F1 seed was planted at Kiboko field station as head-to-row in the 2011 LR season and the F2 plants are at the booting stage. Six of the crosses have more than 300 plants. The F2 seed will be harvested by August and then planted at Alupe/Kakamega (Kenya) and at a blast hot spot in Tanzania to screen for blast and at KARI-Kiboko to screen for drought (**MS 4.3.5**).

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

Varieties from different countries, together with elite materials from ICRISAT, were evaluated in a regional finger millet variety trial of 36 treatments/varieties in rows of 4 m length plots with three replications using a lattice trial design. Trials were planted at KARI-Alupe field station (Kenya) during the 2010/2011 season and at Miwaleni (Tanzania) and Serere (Uganda) during the 2011 long rains season. Data were taken on blast disease damage, insect damage, days to flowering, plant height, tillering attitude, lodging and the grain yield. KARI-Alupe trial data are ready and have been analyzed and will be reported here, while the Tanzania and Uganda trials are still ongoing. At Alupe, blast reaction ranged from 2.8 in KNE 688 to 7.7 in KNE 741 on a scale of 1-9, with a grand mean of 4.4 and with the local having a score of 4.0. Most of the commonly cultivated varieties and the released materials, such as Engeny (7.0), Gulu E (5.3), Nakuru FM (5.3) and U15 (5.0), had higher scores than the local, confirming the conclusion from the literature that most of the cultivated varieties are susceptible to blast. Eighteen of the 36 varieties expressed moderate reaction to blast ($\leq$4.0), in particular Okhale 1 and P 224 with a score of 3.3. Varieties also showed some tolerance to insect damage and most of the commonly cultivated varieties (Nakuru FM 1 (1.3), U15 (2.0), Engeny (2.3), Gulu E (2.3), Okhale 1 (2.3), Ending (2.7) and P 224 (3.0) expressed a resistant reaction (<3.0 on a scale of 1-9), but were not significantly different from the local check (2.3). Days to 50% flowering ranged from 59.0 to 96.7 in KNE 741 and UFM 260, respectively, with the local taking 78.0 days. All varieties tillered well with KNE 629 (3.3) showing the least amount of tillering and Engeny (7.0) the most. Lodging was rare, with only UFM 260, Engeny, KNE 814, Ending, KNE 648, KNE 624 having scores of 1 (scale 1-10). The trials mean grain yield was 1.07 t/ha with the highest and lowest yielding varieties being KNE 392 (1.81 t/ha) and UFM 260(0.53 t/ha), respectively. Two thirds of the varieties yielded lower than the local check (1.24 t/ha), indicating that little work has so far been done in breeding for higher yield potential in the East African varieties. The varieties showed significant differences in blast disease damage, insect damage, days to flowering, lodging and the grain yield (**MS 4.4.4**).

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

Using MET data, the following sites were identified as being representative test sites in Kenya: Alupe, Kakamega, Kisii, Bomet, Baringo, Nakuru, and Kerio-Valley. In Tanzania: Miwaleni, Uyole, Maruku, Singida and Sumbawanga were identified and in Uganda: Serere, Kumi, Pallisa, Lira, Gulu, Ngetta. In Ethiopia, nine testing sites (Bako, Gungua, Adet, Dibate, Pawe, Assosa, ArsiNegele, Axume and Mystemri) from areas growing finger millet were selected for the multi environment variety evaluation. Biophysical characteristics of the test sites are awaited from the implementing centers (**MS 4.5.3**).

Sites were grouped based on their agro-ecologies in the region and agro-ecologies with the largest number of sites were selected. The two predominant production agro-ecologies identified are mid-altitude and sub-humid, represented by Alupe and Kakamega sites in Kenya, Serere in Uganda and Uyole in Tanzania and high altitude low rainfall represented by Bomet and Nakuru in Kenya, Singida and Miwaleni in Tanzania and Kumi in Uganda the sites were suitable for MET implementation because most had research centers, rendering it easy for monitoring and evaluation of the trials. Trials have been established in most of those centers (**MS 4.5.4**).

Sites for multi-location testing were identified in activity **4.5.3**, and have been described. Materials were multiplied by ICRISAT and distributed to the different NARS for evaluation in the regional finger millet trial (**OP 4.5.5**).

One hundred kg of breeder seed of each of five varieties (Pese 1, Seremi 1, Seremi 2, Seremi 3, and Gulu E) was produced between May and August 2010. In Uganda 3,000 kg of foundation seed of improved varieties was produced during the reporting period and was made available to farmers during the first planting season 2011. Some 200 kg of Seremi 2 seeds were multiplied by Pearl Seeds Ltd in collaboration with farmers in Okoboi. The NASECO seed company is multiplying SEC 915 in Uganda. Victoria Seeds of Uganda received up to 30 kg of seed of improved varieties from the project for their trials and multiplication during this reporting period. Currently 10 tonnes of Seremi 2 and 1 tonne of Pese 1 are expected this season. Similar quantities have been supplied by Kenya Seed in Kenya and DRD in Tanzania to farmers for on-farm trials (details available in **Objective 6** report to avoid repetition). Some 520 finger millet accessions and elite materials in the region, core germplasm and other promising materials to be released were submitted for nutrient analysis. Results are expected within August 2011 (**MS 4.5.14**).

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

Experiments to compare the use of herbicides and hand weeding operations in the management of weeds in finger millet were established in Uganda, Kenya and Tanzania during the 2011 season. The treatments applied in a factorial experiment at Serere (Uganda) were: herbicides (2,4,D & Roundup); application time (3 and 6 weeks after sowing); hand weeding (3 & 6 weeks after sowing); farmer practice (one weeding, 3 weeks after sowing). The trial is under evaluation in the field. Similar trials are ongoing at Miwaleni, Tanzania and KARI-Alupe, in Kenya. One of the main constraints is the non-availability of selective pre-emergence herbicides. Through the market survey we have identified three possibilities, i.e. Sencor, Guardian Max and Farmuron and we have pre- tested them in a trial at Kabete research station of the University of Nairobi. The results indicated that the germination of finger millet was adversely affected by the use of herbicides with plant stand reduced to less than 10%. Consequently, we tested the feasibility of localized application of post-emergence herbicide with limited or no effect on finger millet. We designed two different pieces of equipment to limit the area sprayed to the inter-row spaces. These were found helpful in reducing the damage but were not fully effective. Further work on modifying them to enhance their effectiveness is in progress (**MS 4.6.2**).

An experiment to determine the main and interactive effects of variety, nitrogenous fertilizer and intercropping on *Striga* incidence and finger millet performance was established at three sites (farmers' fields heavily infested with *Striga hermonthica*) in Uganda during the first rains of 2011 (April to July)**.** The sites were Malera and Bukedea, in Bukedea district, and Kumi, in Kumi district. A factorial design consisting of varieties Pese 1 (P224), Seremi 2 (U15), SEC 915, local check, fertilizer (CAN at 20 kg N/ha and 40 kg N/ha) and intercropping with cowpea (Celosia was used). The trial is in its final evaluation stages (**MS 4.6.6**).

Areas with limiting soils have been identified in the three countries. Soil samples were taken from Singida rural, Kondoa, Iramba and Rombo finger millet districts of Tanzania. Soils were analysed at Selian Agricultural Research Institute, Tanzania and the results are yet to be interpreted. Uganda, Kenya and Ethiopia are waiting for the harvest period (July to Nov 2011) to collect soils for analysis (**MS 4.6.12**).

In Uganda, the performance of released varieties U 15, P 224 (Pese 1), Seremi 2, Seremi 3, SEC 915 and Gulu E was evaluated with complementary fertility management practices (fertilizer application and time of fertilizer application) in 6 villages in Kaberamaido District in the 2010/11 season. Data analysis has not yet been completed. In NaSARRI, Uganda, seed of these varieties was increased on-station in a 10 ha field. In Tanzania, U15, ACC 14, UFM 149, P224, KNE 688 were evaluated in Kondoa, Singida rural, Iramba and Rombo, with and without micro dosing, ridge planting and weeding. The trials at Rombo were adversely affected by drought, but those at Kondoa, Singida Rural and Iramba performed relatively well. Farmers' assessments in Kondoa and Singida rural districts ranked U 15 first and UFM 149 second although, based on farmers' preferences in all rankings, ACC 14, P 224, U15, KNE 688 and UFM 149 were superior to the local varieties and hence should be considered for release. Planting on ridges, with micro dosing and water conservation produced the highest yield. In Ethiopia a trial was established on-farm at ArsiNegele and on-station at Bako to test land and water conservation practices (with and without tied ridges) as the main plot, two fertility levels (recommended rate and without fertilizer) and weed management options (one- and two hand weedings) as sub-plots. Two released varieties (Tadesse and Padet) and on-pipe line varieties were used for the evaluation. Before planting and after planting soil samples were taken based on the fertility management of the experimental plots. Data obtained from ArsiNegele is being analyzed. At Bako, plots without fertilizer and weeding did not yield grain. In Kenya, the continuation of the McKnight Complementary project titled "*Genetic Improvement, technology dissemination and seed systems development in African Chloridoidea Cereals*" contributed to the achievement of this milestone. In this project demonstrations of improved varieties, together with recommended fertility management (20 kg each of N and P_2O_5/ha in contrast with farmers' fertility practices - mostly no fertilizer applied), were implemented on 115 farms during the four-year period 2006-2010 in Siaya, Busia, Teso and Mumias Districts. This work established that farmers preferred planting with fertilizer, adopted row planting, and selected the improved varieties U-15, Gulu-E, and Okhale-1. This work also showed that farmers' adoption of fertilizer alone improved yields by about 50%, adoption of improved varieties alone increased yields by about 125% and adoption of the best variety and recommended fertilizer improved yields by about 193%. Additional trials to demonstrate to farmers the feasibility and benefits of applying minimal quantities of fertilizer to improve finger millet production are being conducted in Uganda, Kenya, Tanzania and Ethiopia. In Uganda, demonstrations were planted in 30 farmers' fields with two farmer groups in Kumi district in May. Treatments included two varieties (Pese1 [late] and Seremi 2 [early]) and fertilizer (with and without CAN at 20 kg N/ha). In Kenya, 45 farmers had plots of U15, Seremi 1, P224 and local varieties with and without fertilizer (20 kg N/ha) as treatments (**MS 4.6.13**).

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

A protocol for the evaluation of at least four varieties across countries in ESA is being developed. [No OP or MS due in Year 2]

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

A five-day training workshop on multi-environment trial (MET) data analysis was organized from 31 May to 4 June 2010 at Egerton University, Njoro, Kenya. Twenty-five ICRISAT-ESA HOPE-implementing scientists and NARS breeders from Kenya, Uganda, Eritrea, Ethiopia, Tanzania and southern Sudan attended. The workshop aimed at equipping scientists with tools that would help them identify stable genotypes suitable for cultivation in several locations, and to identify testing sites representative of different agro-ecologies to reduce the costs of testing at numerous sites. The training covered basic statistics, design of experiments and the use of single and multisite analysis, understanding genotype-by-environment interaction (G X E) and stability (Eberhart and Russel, AMMI, GGE and Factorial regression) and hands-on practice with users' data (**MS 4.8.2**).

ICRISAT scientists developed a training manual/brochure on integrated blast- and *Striga* management and microdosing in finger millet and a leaflet on finger millet husbandry. These are being translated into local languages for Ethiopia and Tanzania. Two brochures and leaflets on finger millet production and blast management in Uganda have been developed and are under review by the editorial committee of the institute (**MS 4.8.3**).

ICRISAT, in collaboration with its Tanzanian NARS partners, organised a field workshop and planning meeting for their HOPE collaborators in the regions between 30 May and June 2 2011. The objectives of the field day/workshop were:-

- To expose partners (along the value chain) to different sorghum-, finger millet- and pearl millet breeding finished- and semi-finished materials for various end uses in drought prone environments.
- To enable breeders to select and identify materials for further evaluation in their countries – responding to two milestones in **Objective 4**.
- To act as a forum for NARS partners along the value chain to interact and share ideas across countries.

The event attracted nine finger millet partners and eleven sorghum partners with at least one breeder and one seed agent from all the ESA countries, and saw them interact with other partners from Tanzania including processors and the main beneficiaries, the farmers. In the field, participants were able to see materials at various stages of development and the breeders and seed agents were able to select for their different countries and also discuss which were the most important attributes and best technologies for delivering seed. There was a wrap up session graced by Professor Lewis Mughogho, a member of the HOPE Project Advisory Board who commended ICRISAT and its national partners for the project's strong food security focus, involvement of public-private partnerships and the commitment to the participatory varietal selection (PVS) approach. He was particularly impressed by the level of ownership by the national program as indicated by their participation (**MS 4.8.4**).

ICRISAT and her national partners have held more than 20 field days and awareness meetings where politicians (policy makers) and other stakeholders such as HOPE-farmers, extension staff, agro dealers, school children and the general public attended. During these meetings the participants are educated on the health benefits of finger millet food products, especially for pregnant and breast-feeding women, children, the sick e.g. diabetics, and the general public. In such meetings the media is usually present and these meetings end up on air on the radio and television or are printed in the newspapers, thus giving them a larger coverage. For example, in Tanzania meetings held between March and June 2011 with the local district and regional officials in the sorghum and finger millet districts of Singida and Iramba resulted in the inclusion of two crops in the seed subsidy program through which district funds are allocated for purchase of seeds which are then given to farmers free or at a subsidized price. Field days and meetings have also been held in Kenya, Uganda and Ethiopia (**MS 4.8.5**).

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

WCA**:** Nine markets were identified in Niger (Tera, Naimey Haini Habou, Dantiandou, Say, Falwel, Elkolta, Maradi, Tchadoua, and Serkin Haoussa) and 10 markets in Mali (San, Koutiala, Dioila, Fangasso, Youdiou, Madiama, Segou, Banagabougou, Niarela and Siby). In Nigeria, six markets were identified in Jigawa state (Maigatari, Gujungu, Jahun, Shuwari, Gumel, and Dutse), five in Yobe state (Gashua, Potiskum, Buni yadi, Damaturu and Ngalda) and four in Borno state (Damboa, Maiduguri, Konduga and Kawuri) together with an additional 16 markets in Kano state (Dawanau, Konadangora, Gezawa and Dariki), Katsina state (Jibia, Bakori, Dutsema and Batsari), Zamfara state (Gusau, Tsafe, Shikafi and Talata Mafara) and Kebbi state (Tsamiya, Bagudi, Ribah and Sakaba). Markets and value chain surveys and analyses have been conducted in three countries. In Mali, 50 value chain actors where surveyed. In Niger, 74 value chain actors and in Nigeria some 199 respondents (processors, marketers, producers, wholesale dealers, and retailers) have been interviewed (**OP 5.1.3**). Data have been collected, entered, explored and analyzed for sorghum (in Nigeria and Mali) and pearl millet (in Niger) (**MS 5.1.4**).

ESA: The pending identification of target markets in northern Tanzania was conducted by February 2011 (**MS 5.1.1**). A rapid market appraisal was undertaken in Moshi and Arusha by ICRISAT and Dr. Mafuru (DRD) (**MS 5.1.1**). Standardized market survey instruments in the form of trader- and small-scale processor questionnaires were developed by February 2011 by ICRISAT, KARI and EAGC. The questionnaires were shared with partners in Ethiopia (EIAR), Tanzania (DRD) and Uganda (NASSARI) for comments and pre-testing and our partners adapted the questionnaires according to local needs (**MS 5.1.2** & **MS 5.1.3**). Soft copies of the questionnaires are held by ICRISAT and the respective partners. In Tanzania, the MSc student, Mr. Alfred, conducted the market and value chain survey by May 2011 in Singida district. His sample consisted of 45 farmers, 65 traders and 10 processors. Hard copies of the filled questionnaires are currently with the student who will forward them for storage to ICRISAT Nairobi once his thesis is complete (**MS 5.1.5**). The rapid market appraisal (RMA) that was conducted in November 2011 by ICRISAT and Mrs. Hussein (DRD) in Singida and Kondoa districts revealed that market structures are very similar for the two districts (**MS 5.1.5**). We therefore decided to conduct the in-depth study in only one district (Singida). In Ethiopia, enumerators (socio-economists from EIAR) were trained in January 2011 in Melkassa, Ethiopia (**MS 5.1.4**). A market and value chain survey was conducted in four areas by June 2011 (Kobo and Miesso district for sorghum and Guanga and Shalla district for finger millet). RMAs in Ethiopia revealed that market structures in the different sorghum and finger millet areas vary to some extent (**OP 5.1.5**). We therefore decided to conduct market and value chain surveys in all four districts. Hard copies of the filled questionnaires are stored at the Research Stations that conducted the value chain survey (Sirinka Research Station for Kobo data, Adet Research Station for Guanga, and Melkassa Research Station for Miesso and Shalla).

SA: Enumerators were identified, trained and the survey instruments pre-tested in Gujarat and Rajasthan for pearl millet. Data were collected from 48 producers, 48 commission agents, 48 traders and 12 processors of pearl millet grain in Gujarat and Rajasthan. For pearl millet fodder markets, data were collected from 16 farmers, four middlemen, 14 commission agents, 14 traders and eight retailers (**MS 5.1.4**). Similar value chain surveys for grain and fodder markets for post-rainy season sorghum were completed for two regions (Marathwada and Western) of Maharashtra (**MS 5.1.5**). The most common grain marketing channel identified was the producer-commission agent/middlemen-wholesaler-retailer-consumer. The most widely used marketing channel for fodder is farmer-trader-commission agent-cattle shed owner. Currently, the entered data is being validated for analysis and value chain mapping for post-rainy season sorghum.

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

WCA**:** Literature has been reviewed in consultation with partners working along the value chain in Niger, Mali and Nigeria. The results of work done by ICRISAT, INTSORMIL, the West and Central Millet Research Network (WCAMRN), and the West and Central Sorghum Research Network (WCASRN) have been gathered (**MS 5.2.1**). The literature review was included in the report on the potential demand for sorghum as feed and its competitiveness in the poultry sector. There is insignificant use of sorghum and pearl millet in the poultry sector and some utilization (less than 1% of total production) especially by women processors in the food processing industry. The competitiveness of pearl millet and sorghum is limited by high relative prices compared to maize and rice. These are due to low productivity and use of high cost technology. There are prospects in the brewery industries in Nigeria and potential large demands in the poultry sector provided productivity of sorghum increases significantly. Prospects for pearl millet are limited with small market niches for weaning food. Focus group interviews with poultry raisers in peri-urban Niamey and Bamako indicated very little use of sorghum and pearl millet grain for poultry feed (**MS 5.2.4**). A report is available that combines **MS 5.2.1** and **MS 5.2.4**. A report on potential demand for sorghum and pearl millet in food processing industries is available. This was based on focus group interviews carried out with food processors (mainly women) and bakeries in the urban areas of Mali and Niger. A total of 22 processors have been identified in Niger, in Niamey and in the Maradi and Zinder regions. Fifteen of these processors are in the capital city, Niamey. There are dominant processors in the industry. In Niger, for example, the processing unit of Mrs Lyman processes on average three tons of sorghum and pearl millet per month, i.e. 36 tons per year. The current demand by processors is estimated to about 500 tons of pearl millet and sorghum of which 80% is pearl millet. In Mali, demand is estimated to be about 2,000 tons of pearl millet and sorghum from 35 processors identified. These quantities are small, largely explained by the range of constraints such as lack of access to working capital, lack of access to appropriate equipment and market outlets (**MS 5.2.5**). Output **5.2.6** arises from activities related to **MS 5.2.5**. Potential demand for grains and processed products targeting processors of flour, weaning foods and other processed products has been estimated (**OP 5.2.6**).

ESA: The rapid market assessments conducted in Tanzania and Ethiopia (**Activity 5.1**) revealed that there is no clear differentiation between sorghum and finger millet processors. Processors of sorghum might as well process finger millet. Therefore only one list of processors was produced for these two countries. In Kenya, 25 processors were identified (**MS 5.2.1**). They are located in Nairobi, Eldoret, Kisumu and Nakuru. In Tanzania, 25 processors were also identified in Dar es Salaam, Arusha and Moshi (**MS 5.2.1**). However, most processors in Tanzania are small- to medium size processors, while in Kenya many medium to large-scale processors are found. In Uganda, we focused, as planned, only on finger millet processors. Fifteen processors were identified, all in Kampala (**MS 5.2.1**). In Ethiopia, there are no medium- to large-scale sorghum and/or finger millet processors. Small-scale processors such as local milling shops and informal brewers of local alcoholic drinks were therefore included in the market and value-chain survey. Lists of major processors in the other three countries were prepared by ICRISAT and partners (**MS 5.2.1**). Soft copies of these lists are held by ICRISAT as well as by the respective partner. In Tanzania, processors were interviewed by two staff members of DRD by May 2011 and annual demand was estimated by ICRISAT by June 2011 (**MS 5.2.2**). Hard copies of the filled questionnaires are stored at ICRISAT Nairobi. We focused on processors of food because INTSORMIL has already conducted a study on sorghum and millet utilization for feed processing in Tanzania and the Association of Kenya Feed Manufacturers has conducted a survey on the feed processing industry in Kenya. Reports from both studies have been shared with ICRISAT. In Kenya, food processors were interviewed by KARI by June 2011 (**MS 5.2.2**). Hard copies of the filled questionnaires are currently stored at KARI Nairobi. Annual demand will be estimated by ICRISAT by July 2011 (**MS 5.2.2**). In Uganda, processors will be consulted by NASSARI within July 2011 and potential demand will be estimated by ICRISAT by August 2011 (**MS 5.2.2**). In Ethiopia, EIAR will interview selected food and feed processors of wheat and maize by September 2011 to identify potential future demand for sorghum and finger millet (**MS 5.2.2**).

SA: Major users of post-rainy season sorghum and pearl millet grain were identified and their annual demand estimated (**MS 5.2.1**). Post-rainy season sorghum grain in Maharashtra is mainly (90%) used for food consumption and only a small proportion goes to the processed food sector. Overall, in western India 62% of production of pearl millet grain goes to food, 30% goes to cattle feed, 3% goes to poultry feed and only 5% goes to the alcohol industry. Potential demand for food and other uses of sorghum and pearl millet grain were estimated (**MS 5.2.2**). The household demand for post-rainy season sorghum in Maharashtra is expected to be between 2.95 and 3.5 million tons by 2020. However, non-household food consumption (*dhabas*, restaurants) and alternative uses (food processing) would drive the future demand for post-rainy season sorghum. For pearl millet grain, while food use is projected to increase, demand from industrial uses will increase faster. The major users of sorghum fodder were identified in Maharashtra and for pearl millet fodder in Gujarat and Rajasthan and interviewed to estimate their potential demand (**MS 5.2.3**). Sorghum and pearl millet fodder demand is the derived demand for milk and meat products, which are growing by more than 4% driven by income growth and urbanization (**MS 5.2.4**). Accordingly, it is estimated that the total demand for sorghum fodder would be 14-15 million tons by 2020. It is estimated that the demand for pearl millet fodder will increase by more than 5% per year and there will be a deficit in the main demand centers.

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

WCA: As previously explained in earlier reports, after consultations with the Directorate of Statistics in Niger and Mali, we decided to purchase data sets that they have collected in their previous national consumption surveys. In Niger, data were collected from 4000 consumers based on poverty level and location (rural *versus* urban areas). One thousand two hundred and forty-seven (1247) consumers were non-poor living in urban areas, 669 consumers were poor living in urban areas; 883 consumers were urban non-poor and finally 1201 consumers were rural poor. In Mali, consumer survey data were collected from 4453 households of which 1266 are non-poor living in urban areas, 292 consumers are urban poor, 1435 are rural non-poor and finally 1460 are rural poor. A similar consumer survey was carried out in Nigeria on 14951 consumers and drivers of consumer preferences were published by Akinleye and May (2007)[6] (**OP 5.3.3**). Data have been (further) cleaned and analysis done in collaboration with the Directorates of Statistics in Mali and Niger (**MS 5.3.4**).

ESA: Most ESA countries already collect consumption data through regular household expenditure surveys at national level. Access to this data would obviate the need for separate consumption surveys by the project, so ESA has identified, and is seeking access to, these surveys for Kenya, Ethiopia, Uganda, and Tanzania. In Kenya, data were collected through an '*Integrated Household Budget Survey*' in 2004/2005 by the Kenyan Bureau of Statistics (KNBS). KNBS shared this data with ICRISAT Nairobi in March 2011. In Uganda, data were collected through the '*National Household Survey 2005/2006'* by the Ugandan National Bureau of Statistics (UNBS). ICRISAT is in touch with UNBS to get the data from this survey. In Ethiopia, a '*Consumption and Expenditure Survey*' was conducted by the Central Statistic Authority in 2004 and the dataset has been shared with ICRISAT.

[6] Akinleye SO and May Rahji (2007). Nutrient elasticities among Nigerian households differentiated by income. *Agrekon, Vol 46, No 2 (June 2007)*

All three datasets contain valuable information about consumption of sorghum and finger millet and drivers of consumption. In Tanzania, DRD is in touch with the National Bureau of Statistics (NBS) to ask for a similar dataset (**MS 5.3.1, MS 5.3.2, MS 5.3.4 and MS 5.3.5**). The project also seeks to collect information on the potential future demand for sorghum and finger millet through interviews with consumers. Interviews will be held in selected urban and rural areas in Tanzania, Kenya and Uganda **(MS 5.3.1).** A questionnaire for the surveys was developed by ICRISAT Nairobi by March 2011. It was then shared with partners for comments (**MS 5.3.2**). The questionnaire was finalized by April 2011 and the survey will be implemented in the next months. Pre-testing in the respective countries will be done during the enumerator training. Soft copies of the questionnaire are held by partners and ICRISAT Nairobi.

SA: Both primary and secondary data were collected on consumption of pearl millet grain to estimate demand. Data entry, cleaning, exploration and analysis for pearl millet (Gujarat and Rajasthan) have been completed (**MS 5.3.2**). Preliminary findings indicate that the three important variables which influence human consumption are (i) rural/urban, (ii) household income, and (iii) season. Per capita consumption of the rural population is almost thrice that of the urban population. There is no significant difference between men and women in consumption of pearl millet. Both primary and secondary data were collected on consumption of post-rainy season sorghum grain in Maharashtra to estimate demand. Data entry, cleaning, exploration and analysis for post-rainy season sorghum grain have been completed (**MS 5.3.3**). In urban areas of both the regions, sorghum consumption is less than in rural areas and it is also consumed less frequently than in rural areas. The gender-disaggregated data on consumption has shown that women consume sorghum less frequently than men.

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

WCA**:** In Niger, three producer marketing groups have been identified, i.e. the Dinie Koyan (SirfiKoira)/ Union Harey Ban of Tera, the Fahmey (Darie) farmer group of Ouallam and the Sambou Gaka (Yerimadey Gorou)/Union Fahmey of Dantiandou. Three groups have been identified in Wacoro, Ngolobougou and Hanekuy villages in Mali. (**MS 5.4.1**). Committees from these groups have been trained in seed production, small business management and marketing skills and similar training in Mali is scheduled for the last week of July 2011 (**MS 5.4.2**). This has not been done in Nigeria. Given that the WASA group is phasing out in Nigeria, we are now looking at alternative ways to provide the training in Nigeria (**MS 5.4.3**). Grain collection points have been identified in the respective markets where farmers' associations are located (**MS 5.4.5**). A meeting, gathering all value chain actors (producers, processors, traders, supermarkets owners, input suppliers, etc), was organized from 22-23 June 2011 to assess the strengths, weaknesses, opportunities and threats limiting the efficiency of sorghum and pearl millet value chains (**MS 5.4.6**).

SA: Reconnaissance surveys were conducted to identify bulk buyers, marketing groups, processors and wholesalers of post-rainy season sorghum and pearl millet for possible linkages. For post-rainy season sorghum, the data show that since most of the grain is used directly for food consumption at household level, there are not many channels for bulk buying and marketing. For pearl millet, a large traders' group (Gujarat Grain Market Dealers Association) and an input supplier (IFFCO) were identified. The Bhanas cattle feed processing unit and other small-scale feed manufacturers were identified for purchasing grain directly from the cluster farmers (**MS 5.4.1**).

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

WCA**:** Twelve rural radio stations have been identified in the project sites, six in Niger (Tera, Dantchiandou, Falwel, Keita, Ouallam and Serkin Haoussa) and six in Mali (Kita, Madiama, San, Koutiala, Dioila and Kati). Information on market prices and supply and demand is being offered to producers at project sites with data provided by the Market Information Systems in Mali and Niger (**MS 5.5.1**). The first information pathway has been established but the second is currently being established. The use of cell phones to market information to farmers in selected sites started in Niger and Mali only in January 2011. Because this was still at an experimental stage, it was proposed, by the Head of MIS, to wait for at least six months before monitoring the experiment. Discussions were held in June 2011, and agreements reached with the Head of MIS to commence monitoring the effects of information dissemination through the two pathways (**MS 5.5.2**). Consultative meetings were held from 22-23 June 2011 between producers, processors, supermarkets and retailers to identify potential contractual arrangements that could be tested in Niger. Similar meetings had been scheduled in Mali, but the sudden demise of the AOPP key contact derailed the planned meetings. These have now been re-scheduled for the end of August 2011 (**MS 5.5.4**). During the consultative meeting organized on 22-23 June 2011, group meetings were focused on links between producers and traders as well as producers and processors and a number of potential contracts emerge. A subsequent meeting together with financial institutions in Niger is scheduled for 3 August 2011 to formalize few contracts between parties (**MS 5.5.5**).

SA: Focus group meetings and surveys were conducted in each of the selected clusters of the HOPE project on existing and preferred sources of information dissemination for post-rainy season sorghum and pearl millet production and marketing (**MS 5.2.2**). Scoring of the data for information dissemination shows input suppliers, Agricultural Universities and newspapers are the top three priorities for information on farming practices and inputs while market middlemen and traders are the top information sources for post-harvest activities. Farmers preferred mobile phones for information delivery, particularly related to prices, followed by agro call centers and TV. Under the project, alternative options for delivering timely and relevant market information to farmers through the internet are being tested in the Marathwada region of Maharashtra for sorghum and in Gujarat and Rajasthan for pearl millet. Radio talks on the economics of post-rainy season sorghum and a credit and pledge finance scheme were delivered by partners of the HOPE project in Marathwada and Western Maharashtra. Additionally, two newspaper articles were published on marketing of post-rainy season sorghum in a local newspaper *"AGRO ONE"***.** Two radio talks (on 1 April 2011 and 8 July 2011) and three TV shows (2 June 2010, 15 December 2010, 30 March 2011) were conducted in Gujarat and one radio talk in Rajasthan was delivered on various aspects of the value chain of pearl millet. Television and community leaders were also identified as important sources of information. New models were tested in the village, included the internet, e-choupal, etc. Government of India marketing department provides all information on prices across all markets. These are posted in the website www.agmarknet.nic.in. (**OP 5.5.3**)

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

WCA: Agri-business opportunities in Niger were identified through a consultative meeting organized on 22-23 June 2011 at ICRISAT's TVC in Niamey. This meeting determined opportunities for both small-to-medium scale agro-enterprise development, local processing and value addition (**MS 5.6.1**) and for processing, transport, storage, wholesale and retailing activities (**OP 5.6.2**). A similar meeting could not be held in Mali due to the demise of a key AOPP contact person collaborating in the study. The Mali meeting is now scheduled for the second week of August 2011. In Mali and Niger, Three villages in Mali (WACORO, Ngolobougou and Hanekuy) and three in Niger (Groupement Djine Koyan (Sirfikoira)/Union Harey-Ban ; Ouallam with the Groupement fahmey (Darié) and Dantchandou :

Groupement Sambou Gaka (Yerimadey Gorou)/Union Fahmey) were selected and equipped with milling machines (**MS 5.6.3**). Due to budget limitations, these villages could not be equipped with threshers for now. Proposals are being considered for budget re-allocation to avail more funds to meet the shortfall for this activity. After the assessment of the needs of small-scale processors, six women processors have been equipped with small-scale milling units in Niamey, Niger. They are Mrs Salaou Safiatou (Quartier recasement/Niamey Groupement EDEN/Union FEBA), Mrs Hamidou Fati (Quartier Dar-Eslam/Niamey Groupement Lakalkaney/Union FEBA), Mrs Hountondji Ursile (Route Filingué Groupement Homothu Madon/Union FEBA), Mrs Fati Guirmey (Quartier aéroport/Niamey Groupement multi-métier/ Union FEBA), and Mrs Haoua Hamani (Quartier Gaweye (Rive droite) Groupement Halal/Union Di GA Bédjé). Based on needs assessment, Mrs Liman (Quartier recasement/Niamey Union FEBA) was equipped with small-scale milling machine in addition to a decorticator and a solar panel. Three women processors in Bamako, Mali, (Mrs Nantene Coulibali, Mrs Zouboye Fatimatou and Mrs Tata Keita) have been equipped with milling machines (**MS 5.6.4**).

ESA: The previous rescheduling of activities 5.1 and 5.2 affected activity 5.6. However, this was overlooked when scheduling new deadlines for activities last October. Information on agribusiness opportunities will be provided by the market and value chain surveys and the processor interviews (MS 5.1.5, 5.2.2, 5.2.5). The data from these two activities (5.1 and 5.2) will be analyzed by September 2011. Results for activity **MS 5.6.1** and **5.6.2** are therefore also expected by September 2011. Based on the results, stakeholder workshops will be held in September and October 2011.

SA: Low cost equipment for processing, cleaning and grading of post-rainy season sorghum and pearl millet grain and chopper equipment for fodder value addition were identified **(MS 5.6.1).** Exposure visits were undertaken to sensitize farmers of HOPE clusters for processing and value addition (**MS 5.6.2**). Similar equipment was displayed during Kisan Melas (farmer exhibitions) and at farmer group meetings and farmer training programs in Gujarat.

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

WCA: Training modules for value chain analyses are available. This training will be given back-to-back with one on impact assessment of agricultural technologies and innovations in West Africa (**MS 5.7.1**). A student (Mr Abass Malam Yaou) from the Université Abdou Moumouni of Niamey in Niger has been identified and his thesis will focus on marketing of processed products in urban Niamey, Niger (**MS 5.7.4**).

ESA: The previously identified graduate student from Ethiopia dropped out and EIAR is currently seeking to identify a new student. A third graduate student (Mr. Bushoborozi) was identified in Uganda. His research proposal was approved by April 2011 and he is currently pre-testing the questionnaire (**MS 5.7.1**). Mr. Alfred, a student from Tanzania, has completed his fieldwork by May 2011 and is currently writing his thesis. A first draft is expected in July 2011 (**OP 5.7.2**). Training materials for market and value chain analysis methods were prepared by November 2010 (**MS 5.7.3**). In Ethiopia, training on value chain analysis was conducted with 11 socio-economists from EIAR in January 2011. Soft and hard copies of the training manual were shared with the participants. Soft copies of the training materials are stored by ICRISAT Nairobi. The training materials developed in ESA were also shared with SA to assist preparation of a similar training course to be conducted under Objective 5. Training materials on market linkage models and agribusiness development have not been prepared yet (**MS 5.7.4**). Related activities were not fully undertaken and training on these topics is only planned for 2012. There was, therefore, no need to prepare a training manual this early, especially given the many activities scheduled in Year 2 that were competing for attention.

SA: Training materials on market and value chain analysis methods have been compiled. However, these will be uploaded in the project document repository only after the training program is completed since some changes are being made in the light of comments being received (**MS 5.7.3**). A regional on-the-job training (**MS 5.7.4**) has not yet been carried out. Training was provided for investigators involved in data collection for the market surveys. What is pending is training for scientists and researchers from partner and stakeholder institutions involved in socioeconomics components of the project. The reason for the postponement was that it was considered both a saving of time and funds to combine this training with that of impact assessment under Objective 1.

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

WCA**:** A draft training manual on integrated *Striga*- and soil fertility management for pearl millet-based systems in the Sahelian zone of Mali was reviewed and edited by a communication specialist. The English version is held at the HOPE project document repository. Arrangements are in place to have these manuals accessible through the revamped project website. One field guide (20 pages + 33 pages of appendix) was developed and is ready to be published for use by agents and scientists in training programs for pearl millet systems. The principal information was extracted to produce 11 practical guides (1-2 pages) in the French language **(MS 6.1.1** and **MS 6.1.2).** A training manual in English on integrated *Striga*- and soil fertility management for pearl millet based systems in the Sahelian zone of Nigeria was reviewed and edited by a communication specialist. The English version is held at the HOPE project document repository (**MS 6.1.3**). The principal information from this manual was extracted to produce 11 practical guides in French which are also held at the document repository site, and will also be uploaded to the project website. In addition Rural Radio programs on availability of new seed in each of the six target areas were broadcast. Seed cooperatives in Mali (COPROSEM, ULCP) have contracts with radio stations to regularly broadcast messages or documentation about seed- and variety tests. Radio messages were developed and broadcast in the four countries in about 20 regions/states in Mali (Tominian, Dioila, Mandé, Kita), Niger (Bokki, Falwel, Tera, Maradi, Serkin Houssa), Nigeria (in Kebbi, Katsina, Zamfara, Yobe, Kano State) and Burkina Faso (Sanmatenga, Boucle du Mouhoun, Namatenga, Nayala) (**MS 6.1.6**). Radio messages on integrated *Striga* management practices have been developed during farmer exchange visits in Mopti, Tominian and Dioila in September, October and November in 2010. These have been broadcast several times on the local radio in Djenne and Dioila (Bambara) and Tominian (Bomu). The local radio in Tahoua broadcast a documentation of training in Konni village in September 2010 on biological treatments against headminer attacks in millet in Niger (**MS 6.1.7**). Five modules for ISM and soil management options have been produced in French and await translation by partners into Bambara, Bomu (Mali) and Haussa (Niger). In the Tahoua region the rural radio reported about head miner control options. Radio programs on integrated *Striga* management, integrated headminer management and soil fertility management were tested in appropriate target areas and radio program on ISM were broadcast in four target areas in Bambara. More informative radio programs will be developed during the 2011 growing season when field demonstrations and experiments are being performed. These will be broadcast in Koutiala, Tominian and Mopti (Mali), and Serkin Haussa (Niger) (**MS 6.1.8** and **MS 6.1.9**).

ESA: The English version of the training manual on "Striga *management and microdosing*" was completed and uploaded into the HOPE project document repository. The translation of the manual into Tigrinya was done, and is soon to be uploaded into the HOPE project document repository (**MS 6.1.2***).* The manual was also translated into Amharic and Oromifa. The Swahili version of the training manual has been completed and further training in Tanzania and Kenya will be conducted using Swahili (**MS 6.1.4**). The *Striga* management and microdosing training manual has now been developed in English, Swahili, Oromifa, Amharic and Tigrinya (**OP 6.1.5**) and uploaded to the project online document repository. The English version of the manual on "I*ntegrated blast and weed management and micro-dosing for finger millet*" was developed and edited in February 2011. The manual is held at the project online document repository and is queuing for printing by the ICRISAT publication unit (**MS 6.1.6**). This manual has been translated into Amharic (**MS 6.1.7)** and Swahili (**MS 6.1.8**) and awaits final editing before uploading to the project online document repository.

Training manuals on "*Integrated blast and weed management and micro-dosing for finger millet*" are already in 3 languages --English, Swahili and Amharic (**OP 6.1.9**). Thirty farmer-participatory on-farm demonstrations were held in Tanzania (six each in Rombo, Singinda, Kondoa, Kishapu and Iramba) as well as 37 demonstrations in Eritrea (12 in Shambuko, 17 in Goluj and eight in Leilaigash). In addition, three farmer field days on integrated *Striga* management and micro-dosing in sorghum were held, together with training on *Striga* management, seed production and conduct of PVS, and attended by 40 people in Goluj and 57 in Shambuko (**MS 6.1.10**). More demonstrations have been planted in Eritrea this season and field days will be scheduled in September 2011. In Kobo district, Ethiopia, the three most *Striga*-prone areas were identified and 20 participatory ISM demonstrations each in Zobil and Ayub were implemented. Subsequently, a farmers' field day (attended by 100 farmers, 20% of whom were women) was held in Kobo in Nov 2010 and another smaller field day with 33 people was held in Sirinka. Two other field days were organized at Diga and 129 farmers and representatives of different institutions attended (**MS 6.1.11**). The field day was covered by the media in Afan Ormo. In Ethiopia, the demonstrations have been planted again in the targeted areas and also in Bako and field days will be held in September 2011

SA: Farmers' clubs were established with the help of NABARD in each cluster village of Parbhani, Beed & Jalna districts under MAU. Farmers' Associations were established (**MS 6.1.6**) and organizing committees formed in each cluster under MPKV (**OP 6.1.7**).

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

WCA**:** A total of 9372 mini-packs (50-200g seed packs containing certified seed of one variety) of millet were sold and documented for 2010/2011 in Niger, Nigeria, Burkina Faso and Mali. The sale or distribution was done by farmer seed cooperatives (MOORIBEN, FUMA GASKIA, AMSP, UACT) in Burkina, Mali and Niger and by the extension service (CBARDP) in Nigeria. Additionally, 247 pearl millet variety test-kit trials (2 to 5 improved varieties) were conducted in collaboration with the AKF and EUCORD NGOs in Mali (**MS 6.2.2**). The names of 260 farmers from 129 villages were documented in Mali and 1037 farmers in 219 villages in Niger. The farmer cooperative Mooriben documented 33 women buyers (from a total of 260 buyers) in the regions of Tera, Falwel, Dantchiandou and Bokki. The cooperative Fumar Gaskia documented 210 women buyers (from a total of 777 buyers) in Elkolta, Serkin Haussa and Sae Saboua. The FEPAB organization in Burkia (who sold 1500 mini-packs of millet) documented 112 farmers from 12 villages in 5 communes. The names of farmers are being documented by CBARDP in Yobe state in Nigeria for the sale of 900 mini packs of pearl millet (particularly SOSAT-C88) (**MS 6.2.3**). In all countries, samples of 51-140 farmers who bought mini-packs were visited with a similar questionnaire on the appreciation and performance of sorghum and millet varieties and on the appreciation of the distribution strategy. In Niger, 51 millet producers were interviewed in Serkin Haoussa. The 247 test-kit trials conducted by AKF, EUCORD and MOBIOM were all evaluated for yield performance. (**MS 6.2.4**). A total of 9884 sorghum mini-packs were sold by agro-dealers, farmer unions, NGOs and state departments in Mali, Burkina Faso and Nigeria. In Mali and Nigeria, 279 variety test kit trials involving 9 different varieties were conducted in collaboration with AKF, ACF, EUCORD and MOBIOM NGOs in 12 zones in Mali and three states in Nigeria (**MS 6.2.6**). Through distribution lists more than 2500 buyers were documented in the four countries. However, actual numbers of farmers who bought mini-packs will be higher as distribution lists were not always complete. About 48% of mini-packs were distributed by agro-dealers (five input shops). In Nigeria the names of 286 farmers from 29 villages were documented for mini-pack sales of sorghum at Kebbi, Zanfara and Katsina states Community Based Agricultural and Rural Development project (CBARDP) (**MS 6.2.7**). In Nigeria, a monitoring visit was performed by the HOPE team in IAR on the 28– 29 September 2010 to Kebbi state. Four sites of the large plot demonstration were visited (12 plots). Further, some of the farmers who purchased mini-packs were visited to assess the performance of the sorghum varieties. The areas where the demonstrations were conducted, the layout and management practices and yield data from the demonstration plots were monitored. In Mali: The NGO MOBIOM, ACF, AKF and EUCORD evaluated yield and preferences for all sites in November 2010 with variety test kit trials. Mini-pack buyers in Mali, Burkina and Niger were surveyed during November 2010 and April 2011. Some 500 mini-pack buyers were surveyed in Mali, Burkina and Nigeria. The results of these surveys are contained in various reports, such as the IAR report on the 286 mini-pack buyers), a thesis in preparation by a PhD student (Kristal Jones), and a Diploma dissertation by another student (Anna Nicolleau). These reports give details of surveys of mini-packs and MOBIOM, ACF, AKF and EUCORD reports on test-kit performance. As a result, seed production of three varieties released in Burkina will be started in Mali for the Mopti and Tominian region (**MS 6.2.8**). To support the seed availability and use of quality seed a training manual in Haoussa on seed production for pearl millet OPV's in the Sahelian zone of Nigeria and Niger was to be published (**MS 6.2.14**). However, this milestone has not been achieved yet. Translation agencies were identified in Niger and the French language training manuals were sent for translation. Initially planned for publication by February 2011, the revised plan is to have the manuals published by December 2011. The training manual in French on seed production for pearl millet OPV's in the Sahelian zone has been published (**MS 6.2.15**) and is held at the project online document repository. This manual has also been translated into Bambara for pearl millet OPV's in the Sahelian zone of Mali (**MS 6.2.16**). The manual on seed production for sorghum OPV's in Mali has been published in French (**MS 6.2.18**). The same manual was also adapted to Nigerian conditions and translated into English. A training manual for sorghum and pearl millet seed production was produced in Nigeria by IITA in 2009 and recently published. We were not aware of this during the writing of the HOPE project proposal. This manual will be used in training workshops and diffused also by the HOPE project. The project proposes that this IITA manual be used, rather than duplicate the work already done, and come up with a similar product (**MS 6.2.19**). Two 2- and 3-day training workshops were carried out in Niger (from 31 March to 1 April 2011 and from 18 to 19 May 2011) with the technical backup of the WASA-SEEDS project on seed production, storage and marketing, respectively, in Niamey and in the Maradi region of Niger. Thirty-one seed producers from six farmer unions (Mooriben and Fuma Gaskia farmer organisations), seed processors and 20 agro-dealers attended the two workshops (**MS 6.2.21**). Extensive training on seed production and storage has been conducted. Marketing training was scheduled for May 2011, but due to the passing away of the major focal contact at AOPP organization, the event could not be organized in time (**MS 6.2.22**), and was therefore re-scheduled to August to September 2011. In Burkina Faso, training in seed production and storage has been conducted and was reported in May 2010 (**MS 6.2.23**) and contained in the Year 1 project report. Training will be organized in collaboration with the PROMISO2 project in two regions in Burkina Faso. The activity to deliver on **MS 6.2.24** (Business and marketing plans reviewed with previously trained associations) is planned with the backstopping from one of the financial institution SINERGI that has developed expertise in developing business and marketing plans with small investors. This is now expected to be done by November 2011. On seed quantities, 500 kg of foundation seed of at least five open-pollinated pearl millet varieties under dissemination were produced by ICRISAT and collaborating NARS in Niger, Nigeria, Mali and Burkina Faso (**MS 6.2.28**). On monitoring yearly profitability of sorghum seed sales with farmer organizations (**MS 6.2.31**), a data form has been distributed this year to better monitor seed sales profitability as available data with farmer organizations and agro-dealers were not sufficient to assess the sales and profits from Y1 production. First reporting of this milestone will be in September 2011. For Mali, a report and manual were published in 2010 on the potential gain from cereal commercialization by farmer groups. The document has been distributed to farmer organizations and can be used in training workshops. The same data form has been developed to assess profitability of pearl millet seed sales yearly with agro-dealers, and farmer organizations (**MS 6.2.34**). However, the profitability analysis has not been conducted. The Year 2 component of this milestone was, therefore, not achieved, and the first reporting of this activity will be in September 2011 (Year 3). Country reports on farmer-preferred varieties and new crop management options with potential for more widespread adoption have been prepared, and this will be on a yearly basis (**OP 6.2.38**). Plans are underway to upload this information and the annual reports in the project online document repository. **OP 6.2.5** and **OP 6.2.9** (both due December 2012), on sorghum and pearl millet variety kits and mini-pack diffusion, have both been achieved already after the first diffusion year, with more than 9000 mini-packs sold and documented for each crop millet and sorghum. This diffusion involved 12 varieties for pearl millet and 29 for sorghum. More detailed statistics about the commercialization of the mini-packs and the appreciation of the varieties and the strategy has been analyzed based on distribution lists collected and surveys and technical visits conducted. Furthermore, databases of mini-packs have been developed in each country and they will be brought together in the following months by a database specialist in Mali. Technical reports about more than 200 test-kit trials (small trials of two to five varieties) have been produced by the collaborating partners (NGOs who do not receive funds through HOPE). This information is available on the project online depository site. Project partners produced between 300 kg and 1.5 t of foundation seed of the most popular varieties for both cereals.

ESA: Marketing of sorghum and millet seed is governed and regulated through seed certification standards that differ across countries. To get a better understanding of the variations, seed certification standards were reviewed in a seed policy workshop held in Nairobi from July 4-8 and attended by 22 participants from COMESA countries. Hence, more countries in the COMESA region will be following the harmonized seed policy that advocates a uniform and regionalized variety release system as well as observing the same ISTA standard for seed testing and quality control and harmonized sanitary and phytosanitary measures (**MS 6.2.2**). A handbook for production of quality seed of improved finger millet and sorghum varieties has been drafted and reviewed by Dr M.B Jumbo of ICRISAT as well as by the CEO of the Tanzania Seed Trade Association (TASTA) (**OP 6.2.3**). The handbook will be uploaded in the project online document repository for sharing. On foundation seed production, the following seed quantities were produced by country and by seed class category:

- In Kenya, a total of 500 kg of foundation seed of Nakuru FMI (NFM1), Gulu E, U15 and P224 varieties were produced and distributed to farmers in Rift valley, Nyanza and Western provinces for on-farm seed production and informal seed distribution. An additional 400 packets each of 250 g (total 100 kg) of four improved varieties (P224, U15, Enaikuro, NFM1) were distributed to farmer groups through the Kenya National Federation of Agricultural Producers (KENFAP) in the Rift Valley. It is expected that at least 2500 kg of seed will be harvested by the end of the current season (July 2011) in Rift valley alone, while Nyanza and Western provinces expect an estimated finger millet seed production of about 3000 kg for informal seed distribution. Further, 5000 kg of certified seed of improved finger millet P224 was produced by Kenya Seed and sold through their agro-dealer outlets in the three HOPE project provinces.
- In Ethiopia, three kg of breeder seed per finger millet variety (Gute, Bonya, Degu and Taddesse) were multiplied and these were further increased so that 840 kg of foundation seed of the four listed varieties was produced and available for the 2011/12 planting season.
- In Tanzania, 1000 kg of UFM149 foundation seed was produced by DRD.
- In Uganda, Serere Research Centre produced 3000 kg of foundation seed of Pese 1, Seremi1, and Seremi 2.

In total, more than 4300 kg of foundation seed of the six finger millet varieties was produced across the four countries (**MS 6.2.5**). Further:

- In Uganda, Victoria Seed produced 6,000 kg of certified seed of Pese 1 and Seremi 1 and Seremi 2 from foundation seed produced by Serere Research Centre.
- In Ethiopia, 1000 kg of certified seed of finger millet cultivars was produced.
- In Tanzania, Zanobia Seed Co. produced 70,000 kg of Quality Declared Seed of a finger millet local variety that is highly preferred by industry.

- In Ethiopia, the second season has just started and their year 2 field work ongoing.

In total 94,500 kg of finger millet seed of both certified and QDS was produced in Year 2 (**MS 6.2.6**). On Sorghum seed production:

- In Tanzania, the Agricultural Seed Agency (ASA) in Tanzania produced 20,000 kg of foundation seed of Macia and this was supplemented by 1000 kg of seed of Tegemeo, Pato, Wahi and Hakika produced by Namburi Seed Co and Zanobia and distributed to farmers in Kondoa, Singida, Iramba and Kishapu for informal seed production.
- In Ethiopia, 2700 kg of foundation seed of four varieties (Melkam, Teshale, Mashiya and Gubiye) were produced and distributed for informal seed production and marketing.
- In Eritrea, 3000 kg of foundation/basic seed of ICSV111 IN was produced by NARI Eritrea.

The total amount of foundation seed produced in Year 2 was 26,700 kg (**MS 6.2.9**). On certified seed:

- In Tanzania**,** the following seed companies produced certified seed for Macia/ Pato/ Tegemeo: Suba Agro - 200 tons; ASA - 100 tons; Krishna - 50 tons; Meru Agro - 120 tons and Seed.Co - 200 tons. In addition 5,800 kg of Macia was distributed by the Suba Agro Company to farmers in Southern Highlands districts who were contracted by Tanzania Breweries Ltd to produce grain. More than 5,000 kg of QDS has been produced by farmers with the supervision of extension staff in the four sorghum mandate districts in Tanzania in 2010. Tanzania produced a total of 675,000 kg of certified sorghum seed in Y2.
- In Ethiopia, 1800 kg of Chiro seed was produced on a Farmers' Training Centre field. But due to the early ending of rain in the area the seed quality was low and it can't be used as seed. The 2700 kg pre/basic seeds of Melkam, Teshale, Mashiya and Gubiye varieties produced by MARC were distributed.
- In Eritrea, the 3000 kg of basic seed (from **MS 6.2.9**) has been planted in the current season.

A total amount of 679,800 kg of certified sorghum seed was produced in Ethiopia, Tanzania and Eritrea (**MS 6.2.10**). On small seed packs of certified finger millet (Kenya and Uganda) and sorghum (Tanzania) promoted through agro-dealers (**MS 6.2.12**):

- In Kenya, over 250 250g seed packets of finger millet were distributed to over 300 farmers in the country. In addition 2500 2kg packs of certified finger millet seed of P224 were distributed by Kenya Seed Company through their agro-dealer outlets in Rift Valley, Nyanza and Western provinces.
- In Uganda, Victoria Seeds in collaboration with NAADS distributed 1200 250g packs of Seremi 1 and Seremi 2 millet varieties to farmers in Oyam, Gulu, Apac, Pader and Lira districts.

In Tanzania, 3000 1kg packs of certified sorghum seed of Macia, Tegemeo, Pato and Sila were distributed in October 2010 to four districts. Further, more than 1000 kg of certified sorghum seed of Macia and Tegemeo were sold through agro-dealer outlets in the project targeted districts. On small seed packs of certified finger millet and sorghum made available to members of farmer unions in Ethiopia, some 300 small seed packs of finger millet were produced and distributed to farmers in June 2011. An attempt was made to produce more than 2500 seed packs of sorghum seed in Melkassa alone, but due to the failure by the company that won the tender to abide by the due date and low quality of the packaging materials, it could not be achieved (**MS 6.2.13**). Further, in Ethiopia, a total of 580 kg of foundation seed of Teshale (150 kg), Chiro (130 kg), Melkam (200 kg) and Hormat (100 kg) varieties were distributed in 2300 250g packs (**MS 6.2.14**). A total of 6,800 small packs of sorghum certified seed were distributed in Tanzania, Eritrea and Ethiopia. Similarly, some 5,250 small packs of finger millet were distributed in Ethiopia, Kenya, Uganda and Tanzania.

SA: On sorghum, some 250 kg of breeder seed of identified OPVs was produced to complete the seed chain to meet the requirements in the next season (**MS 6.2.3** & **OP 6.2.4**). One seed warehouse was constructed and operationalized in the MAU region (**MS 6.2.6** & **OP 6.2.7**). Trainings were given at University, regional, KVK and village level to more than 100 progressive farmers and more than 20 KVK and SAU field staff in post-rainy season sorghum seed production, storage and marketing (**MS 6.2.9** and **OP 6.2.10**). Women farmers (25) were trained in collecting seed for their own use and to share with other farmers. More than 25 tons of commercial seed of selected varieties by each University was produced for supplying to the farmers in target areas (**MS 6.2.14**). More than 7000 ha were covered through seed supply and management interventions in the last two years, and some 17,000 farmers directly benefited from project interventions (**MS 6.2.16**). On pearl millet, indents were placed with seed production agencies for supply of the promoted hybrids GHB 744, GHB 538, HHB 67-2, HHB 197, HHB 223, RHB 121 and RHB 177. Some 129 kg seed of parental lines was produced (**MS 6.2.17**) and supplied to a seed agency (APPSDC: Andhra Pradesh State Seed Development Corporation) to produce and supply hybrid seed for 2011 hybrid demonstration trials (**MS 6.2.18**). Meetings were conducted with the officials of APPSDC and the seed agency was encouraged to produce seed of these hybrids in 2010-11 that will be evaluated in 2011 rainy season. In addition to the seed quantity required for HOPE trials, APSSDC has produced 700,000 kg seed of HHB 67-2 (promoted through HOPE) for Rajasthan. Based on the performance of promoted hybrids in different states, private-sector seed companies were also encouraged to produce and market seed of identified farmer-preferred hybrids (**OP 6.2.19).** Seed of promoted hybrids (10,710 kg) was procured from APPSDC and delivered to target clusters in Rajasthan, Gujarat and Haryana. In addition, private seed companies also provided 1,275 kg seed free of cost for demonstration trials on farmers' fields (**OP 6.2.20)**. Farmers' Associations/Self-Help Groups produced test kits (hybrid seed + fertilizer) of promoted technology inputs. The fertilizer (DAP and SSP) was procured and test–kits (seed for 0.4 ha plot + 25 kg DAP or 50 kg SSP) were developed with the help of farmer organizations and provided to farmers in the cluster villages (**MS 6.2.21)**. On promotion of hybrids demonstrated via test kits marketed in target villages by self-help groups and/or local agro-dealers, it was decided in the work-plan meeting that trials of private-sector hybrids will be given to selected farmers in addition to the public-bred hybrid trials. The group agreed to reduce the total number of trials and area under these hybrids in order to give more importance to the public sector hybrids better suited to these areas. The distribution of a particular hybrid to farmers in hybrid demonstration technology trials will be on the basis of its maturity duration and the availability of irrigation facilities with the farmer (**OP 6.2.22).** Test kits (excluding private sector hybrids) were sold to farmers at a subsidized price of Rs 50/kit (US$ 1.10/kit) through SHGs and a revolving fund was established by depositing this amount in the bank accounts of SHGs in each village of the clusters (**OP 6.2.23*)***. The number of test kits by state and the amount of seed as well as area for each trial is available.

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

<u>WCA</u>**:** Agro-dealers operating in the project target areas participated in several training programs conducted by other projects. Altogether, 35 agro-dealers were involved in different training workshops and sessions on varietal and marketing topics in Mali, Burkina Faso and Niger. In Burkina Faso, five agro-dealers were trained together with HOPE seed producers in varietal issues in May 2010. Five agro-dealers participated in variety demonstrations in collaboration with CNFA. They received training and protocols for conducting variety trials and five other agro-dealers have been identified for training during the coming season. One agro-dealer in the Kati region in Mali received training on hybrid seed production from IER. Four Agro-dealers who were involved in mini-pack distribution in the Mopti region in Mali participated in project activities of the AGRA microdose project. Twenty agro-dealers participated in marketing training conducted by WASA-SP/ICRISAT (**MS 6.3.1**). In Burkina Faso, 5 agro-dealers were invited to the evaluation in October 2010 of variety trials in the Sanmatenga region. In Mali, two farmer union representatives (UACT, Tominian) participated in farmer exchange visits to integrated *Striga* management trials in Mopti and Djenné region. In the Kati region (Mali), agricultural extension agents participated in field visits of IER/ICRISAT to demonstration plots organized by CNFA in November 2010. Television and radio broadcasts were

also produced which featured the CNFA agro-dealer program, ICRISAT/IER demonstrations, the mini-pack strategy of the HOPE project and the importance of new varieties and hybrids. Two agents of the AMEDD NGO in Koutiala (Mali) participated in variety evaluations in the Dioila region in November 2010. Local radios in Mali participated in two annual evaluations of variety and crop management trials in Mandé and Dioila region. Every communal representative participated in the same evaluation (**MS 6.3.2**). Planning meetings with farmer facilitators have been executed and decisions taken on strategies for making ISM technologies available on a large scale. Altogether, about 3600 farmers were trained in Mali and Nigeria (**MS 6.3.4**) and altogether 66 FFS groups gained access to inputs, tools and training. In the Mopti and Segou regions in Mali, more than 60 FFS groups will have access to inputs, observation tools and training materials through funding from partners with whom ICRISAT collaborates (but do not have subcontracts), such as AKF (30 groups), World Vision (10 groups) and Catholic Relief Services (20 groups). In Jigawa state in Nigeria, six FFS groups will gain access to inputs, observation tools and training materials through a partner who started CBFFS on ISSFM on its own initiative and with its own funds (Green Sahel and Development Initiative) (**MS 6.3.5**). The **MS 6.3.9** on the MHM biological control technique extended to three new areas in each of Niger, Burkina Faso and Mali was not completed. A study on the impact of releases of *H. hebetor* in granaries was carried out in Niger to test the hypothesis that the released bugs could let escape the adult *C. cephalonica* and could infest millet stored in farmers' granaries. Results were presented at the 2011 national HOPE meeting in Niamey and are available in the depository (**MS 6.3.13**).

<u>ESA</u>: Twenty-five agro-dealers operating in HOPE mandate areas in Kenya and Tanzania participated in stakeholder workshops for participatory variety selection (PVS) and participatory technology delivery systems held in Busia (Kenya) and Singida (Tanzania), where micro-dosing for finger millet and sorghum was one of the topics addressed (**MS 6.6.1**). As follow up to this, these input suppliers were trained during several field days in which demonstrations on micro-dosing for finger millet and sorghum were displayed. The details of the training will form HOPE annual report for year three (**MS 6.3.2**). In the Central Zone of Tanzania (Kondoa, Singida Rural, Iramba and Kishapu districts) 300 farmers participating in field days during the 2010/11 cropping season and indicated that they used improved varieties of sorghum such as Macia, Tegemeo and Pato. They also used fertilizer micro-dosing for improving soil fertility and tied ridges for water harvesting and conserving soil moisture. The farmers indicated that they preferred 5 kg packages of Ammonium Sulphate or CAN and this is 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 - whatever the amount of fertilizer the farmer needs. Results of agro-dealer focus group discussions during the PVS workshop held in Busia, Kenya, in December 2010, showed that traders get a gross profit of 100 Kshs (US$ 1.10) and 250 Kshs (US$ 2.80) from sales of 50 kg and 1 kg of CAN fertilizer packages, respectively. According to agro-dealers in Kenya, they preferred to market fertilizers in 1 kg pack sizes as this earned them higher profit margins. However, although the 1 kg pack sizes make fertilizer more accessible to farmers in Kenya, these smaller packs are more expensive for farmers per unit of fertilizer. Fertilizer pack size preferences of farmers will be assessed during this current cropping season in Ethiopia (**MS 6.3.4**).

<u>SA</u>: For sorghum, soil samples were collected in the MAU region (125 samples) and MPKV region (300 samples), analyzed, and the results disseminated to farmers with fertilizer recommendations based on the results (**MS 6.3.2**). Six farmers' associations were linked with the input suppliers in target areas to ensure that there is no shortfall in the availability of fertilizer or pesticides (**MS 6.3.3** and **OP 6.3.4**). In addition, 10 Frontline Demonstrations (FLDs) were conducted per cluster, with fertilizer application rates based on soil analysis. Eight new cultivars from MAU (PVR 631, SPV 1795, 183, 1905) and from MPKV (RSV-1130, 1150, 1161, 1188) were used in farmer-participatory varietal selections. Newly released varieties like Phule Revati, Phule Uttara and Phule Panchami were demonstrated (five trials/variety/cluster) in all three clusters in the MPKV region (**MS 6.3.6**). For pearl millet, farmers were trained to collect soil samples for analysis and 20 soil samples from each cluster were collected from the farmers' fields in Haryana, Rajasthan and Gujarat. The samples were

analyzed in the soil testing laboratories identified for each district/state (**MS 6.3.9**). The results were discussed with the farmers when seed and fertilizer were distributed. Most of the soils were deficient in nitrogen and phosphorus and only medium in potassium and micronutrients such as sulphur were also deficient. For these areas, suggestions have been made for balanced nutrition with the use of DAP and urea along with $ZnSO_4$ at 20 kg/ha (**MS 6.3.10**). A total of 60,000 kg fertilizer (DAP) was purchased in bulk each in Haryana and Gujarat, whereas 120,000 kg SSP was purchased in Rajasthan because DAP was not available, and was distributed to farmers in the target villages through SHGs (**MS 6.3.12**). Fertilizer (DAP and SSP) and seed of the hybrids selected for the target villages was procured and test–kits (seed for 0.4 ha plot + 25 kg DAP or 50 kg SSP) were developed with the help of farmer organizations (**MS 6.3.13**) and were marketed in target villages by self-help groups (**MS 6.3.14**). Test kits were sold to farmers at a subsidised rate of Rs 50/kit (US$ 1.10/kit) through SHGs and revolving funds were established by depositing this amount in the bank accounts of SHGs in each village of the clusters (**OP 6.3.15**). Demonstrations plots were planted for the 2011–2012 cropping season in target villages in Haryana, Rajasthan and Gujarat. The demonstrations involved agronomic and crop management practices superimposed on pearl millet cultivars (**OP 6.3.16**). The details of the treatments demonstrated are with the scientists and the project coordinator.

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

WCA: Consultative meetings were organized in Niger by members of farmers' unions and traders as well as other partners along the value chains from 22-23 June 2011. Options for work on collective marketing around collection points defined by farmers' associations were discussed. In Burkina Faso, AGRODIA (an association of agro-dealers) and the farmers' union AMSP held consultative meetings on input supply and sale of seed. (**6.4.5**). Contracts in Mali have been established between the farmer cooperative COPROSEM and the FASOKABA seed company for the sale of more than 1.5 t of certified seed (at CFA 400/kg). The ULPC farmers' union established two contracts with the P4P/PAM program for a total of 430 t of sorghum grain and 90 t of pearl millet grain. In Burkina Faso, farmer cooperatives favor contracts with the government to sell most of their certified seed (due to prices higher than market value). The farmer Union FEPAB-Nayala arranged the commercialization of 179 t of sorghum grain (costing CFA 156,000 (US$ 340) per tonne) to P4P/PAM project and 154 t of millet grain (at CFA 160,000 (US$ 351) per tonne) to Catholic Relief Services. Contracts for pearl millet between farmer unions and collectors and processors have been initiated, although not formalized, during a meeting 22-23 June 2011 in Niger and a report of the meeting is available on the project depository site (**MS 6.4.6).** Although the milestone has been achieved in Year 2, the results of discussions for Niger are due in Year 3. Information on prices, 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 for project sites. 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 to set up more contracts with Market Information Systems (**MS 6.4.9**). Two information pathways were identified as (1) rural radios and (2) the market information system (MIS). Information on prices, supply and demand has been supplied via rural radio for more than four years now **MS 6.4.10**).

ESA: In Kenya, three farmer groups from each of the three regions (Nakuru, Bomet and Koibatek) were trained by Unga Ltd to provide technical support in production and postharvest handling to their members. Additionally, 30 farmer group representatives from Rift Valley, Nyanza and Western provinces were briefed on finger millet postharvest handling, grain quality requirements and modalities for market linkages by Eastcom Foods and Unga Ltd during an agri-business training workshop held in Nakuru, Kenya in March 2011. Additionally, a group in Busia called Wamama Tuamue started value addition activities to process finger millet products for the supermarkets under the brand name Eastcom foods. Fifteen farmer groups in Western province have asked to learn from the group's experiences about selling finger millet grain to Eastcom Foods. It is anticipated during this year's harvesting season, that at least 10 organized groups in Rift Valley will provide finger millet for sale to millers (Unga Ltd) through their umbrella organization KENFAP and five groups in Western province will sell finger millet grain to Eastcom Foods. Small processors and millers in Nakuru such as Menengai Processors were indentified and will be involved in the purchase of farmers' outputs this year. In Uganda, six farmers representing six farmer groups from Kumi, Soroti, Palissa, Soroti, Apac and Gulu districts were briefed by Family Diet during a training workshop in Lira, Uganda on their finger millet grain quality standards and related improved post-harvest handling strategies. In Tanzania, farmers in Kondoa were also introduced to post-harvest handling techniques and finger millet grain quality standards by the P4P. Nyirefam, a major sorghum and finger millet grain food processor based in Arusha, provided technical support and information to farmers who supply grain to this processing plant (**MS 6.4.2**). Finger millet farmers were linked to millers (**OP 6.4.3**) as follows:

- In Tanzania, more than 20 farmer groups from Central and Northern zones were linked to P4P, Nyirefam and TBL and were briefed on other existing finger millet business opportunities. An agri-business training session was held in Arusha.
- In Uganda, six groups from the six project districts of Kumi, Palissa, Apac, Lira, Soroti and Gulu have been linked to Family Diet and Maganja Grain Millers and other smaller local processors.
- In Kenya, 15 groups were sensitized on improved postharvest handling and grain quality standards and linked to Unga Ltd, Eastcom Foods and other smaller processors.

For farmer groups growing sorghum (**MS 6.4.4**):

- In Tanzania, 25 farmer groups identified from Kondoa, Singida, Kishapu, Iramba and Rombo were briefed on existing sorghum grain marketing opportunities and necessary grain quality standards with P4P and Nyire Farm. Improved postharvest handling techniques were identified as essential in a meeting on grain quality requirements for Nyirefam. Tanzania Breweries Ltd (TBL) also briefed farmer groups on existing sorghum business opportunities.
- For Ethiopia, the cropping season is underway and this activity will be implemented before the harvesting of the finger millet and the sorghum from the current season.

Thirty (30) farmer groups working with the HOPE project in Kenya, Tanzania and Uganda have been briefed on grain quality requirements for finger millet and sorghum. Farmers in Kenya and Tanzania were also introduced to postharvest handling techniques by the P4P. Postharvest handling equipment and training will be provided before October 2011. Also in Tanzania, the Tanzanian Agriculture Evolution (TAE) Co. Ltd hired combine harvesters using loans to improve quality and gave them to farmers for use. Nyirefam introduced to farmers in Singida the use of animal-powered threshers to improve quality. This exposed farmers to improved sorghum post-harvest handling techniques (**MS 6.4.5**). On information (for prices, supply and demand), finger millet daily grain market prices and supply information for Kisumu, Nakuru, Eldoret, Nairobi and Mombasa were collected by the Kenya Ministry of Agriculture (MoA) and Kenya Agricultural Commodity Exchange (KACE) and were compiled and trend graphs produced. This information is posted on the HOPE project website. In Ethiopia, Uganda and Tanzania price and supply information on finger millet have been compiled and trend graphs posted on the HOPE project website (**MS 6.4.7**). In Ethiopia and Tanzania price and supply information for sorghum were compiled and trend graphs posted on the HOPE project website (**MS 6.4.8**). In addition, meetings were held with the East Africa Grain Council (EAGC) to discuss the possibility of integrating information on prices, supply and demand for finger millet and sorghum into the existing regional market information system. The EAGC has agreed to integrate the information into existing regional market information system and the information will be posted on their website before the end of the year 2011 (**OP 6.4.10**).

SA: For sorghum, retail market chains were identified for each cluster and grain wholesalers were also identified. A post-rainy season sorghum grain 'Mahostava' (Grand Festival) was organized at Pune for three days. At this festival, the farmers sold their grain directly to consumers from the city area. Six farmers associations were linked to the identified retail market chains and grain wholesalers in the target areas in both regions (**MS 6.4.2** & **OP 6.4.3**). Farmers associations were linked with the fodder wholesalers and processors (one in each region) in the target regions by introducing the wholesalers and processors to the farmers' association members and giving them information on the project activities and areas. Two meetings were conducted at Parbhani and Hyderabad to link sorghum farmers and fodder wholesalers. Hyderabad is an important market for sorghum fodder and every year large quantities of stover are transported from the Parbhani area to meet the fodder needs of Hyderabad market (**MS 6.4.5** & **OP 6.4.6**). For pearl millet, retail market chains, wholesalers, livestock feed producers and poultry feed manufacturers were identified in Guajrat, Rajasthan and Haryana states for pearl millet marketing. Cattle feed manufacturers in Pipad and Nagaur were identified in Rajasthan and Mahadev Poultry Feed manufacturing unit was identified in Mahendragarh district of Haryana. Some manufacturing plants of the Banas Dairy Cooperative were identified in Gujarat state and Associated Distilleries Limited, Hisar, with a large capacity to manufacture wine from pearl millet grain, was also identified. An alcohol distillery (Distt. Sikar, Rajasthan) was identified in Reengas Ajitgrah (**MS 6.4.7**). The farmers associations (including existing associations like dairy cooperatives) were linked to identified retail market chains, wholesalers and feed manufacturing plants in Gujarat, Haryana and Rajasthan clusters. In each 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 (**MS 6.4.8**). Farmers groups were linked to identified retail market chains, wholesalers and feed manufacturing plants in Gujarat, Haryana and Rajasthan. Training programs were conducted by SKRAU, SDAU and HAU in Rajasthan, Gujarat and Haryana, respectively, involving all stakeholders including market committee members and commission agents. The market committee members explained price trends in the last three years (**OP 6.4.9)**. Formal and informal fodder markets in each cluster in Gujarat, Haryana and Rajasthan were identified. These markets were Jodhpur and Nagaur in Rajasthan, Mahendragarh and Kanina in Haryana and two fodder markets in Sidhpur block of Bhanaskanta district in Gujarat (MS **6.4.10)**. Most farmers were unaware of the existence of fodder markets in peri-urban areas, so farmers groups in the clusters were linked to fodder markets and informed of the fodder price differences between the villages and informal fodder markets in nearby town (MS **6.4.11)** Training programs were conducted by SKRAU, SDAU and HAU in Rajasthan, Gujarat and Haryana, respectively, involving all stakeholders including market committee members and commission agents. The market committee members explained about prospects of fodder markets and price trends in the last three years. They also suggested selling chapped fodder for realizing higher price and storage methods for selling fodder in off-season (**OP 6.4.12**).

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

WCA**:** Training needs of farmer organizations in Niger were identified and training in bookkeeping done in partnership with the USAID-funded WASA-Seeds Project from 31 March to 1 April 2011. Training was organized in partnership with AOPP in July 2011 in Mali and Burkina Faso in July 2011 with an experienced agency based in Ouagadougou in collaboration with the PROMISO 2 project (IFAD/EC) (**MS 6.5.1**). The major sources of capital for farmer organizations have been identified through focus group meetings with farmers' groups in Niger. Credit for input purchase (seed and fertilizers) and inventory credit needs are the main financial needs. In Burkina Faso, especially in the Sanmatenga region, farmers sell seed to the state initiatives and use some of the money to buy inputs. However, as the state payments are often delayed, farmers need interim credit for those inputs (**MS 6.5.4**).

Financial institutions were identified in Niger (BAGRI, SINERGI, ASUSU,) and options for lending to farmers' groups have been explored during a meeting held at TVC on 22-23 June 2011. The AOPP farmer union in Mali has different "fonds de grantie" with the BNS bank for seed production of cereals and cowpeas and is discussing how to organize one single fund for all the activities of AOPP (**MS 6.5.5**). There are commitments from BAGRI and SINERGI in Niger pending for the development of business plans for farmer organizations. Contracts will be initiated between producers and processors, facilitated by financial institutions, in August 2011 (**MS 6.5.6**). Four warrantage schemes have been identified in the project sites at Falwel, Dantiandou, Ouallam and Tera. Farmers Associations were involved in the meeting of value chain actors in Niamey (Niger). Links between farmers' associations and BAGRI (agricultural bank) have been initiated to increase the value of stocks that can be put in the inventory credit scheme. This would enable more credit being available to farmers using warrantage schemes. Contracts will be firmed up in September 2011 before the sorghum and pearl millet harvests. (**MS 6.5.8**).

<u>ESA</u>: In Kenya 10 lead farmers (representing 30 farmer groups), 10 extension staff, four agro-vet suppliers, four credit institution staff, two grain processors and two CBO staff from Rift Valley, Western and Nyanza provinces were trained in basic business planning to be able to access finance to support purchase of surplus finger millet and sorghum. During the training, credit institutions such as Cooperative bank, Equity Bank, Wakenya Pamoja and Kenya Women Finance Trust (KWFT) who lend to farmers also briefed the agri-business trainees on available credit opportunities for farm production, product- and input marketing. Collective marketing, with appropriate peer monitoring and group guarantee systems, was agreed as one way to encourage financial institutions to lend money to farmers. In Tanzania, 18 farmers, five agro-dealers and five extension staff from Rombo, Kondoa, Singida, Iramba and Kishapu districts and two processors from Arusha were trained in agri-business planning, finance and marketing. Further follow-up discussions with at least three financial institutions are planned for September 2011. The training for Ethiopia is planned for August 2011 because facilitator for the training was not available (**MS 6.5.1**). In Tanzania, 18 farmers from Rombo, Kondoa, Singida, Iramba and Kishapu districts and two processors from Arusha were trained in good business practices and the benefits of peer-monitoring and timely payment of loans from financial institutions (**MS 6.5.2**). A training session was held in Tanzania involving financial institutions (KCB Bank in Tanzania, NMB Bank, Stanbic Bank of Tanzania) and farmers in Arusha, in June 2011, where stakeholders were sensitized on business opportunities along the finger millet and sorghum value chains. The financial institutions indicated that they have schemes for group loans targeted at farmers that would benefit sorghum and finger millet farmers in the targeted districts. Also, the issue of liberalizing foundation seed production and surplus grain for sorghum and millet growing farmers was put before the Agriculture Minister during a Seed Stakeholders workshop held at Arusha in June 2011, during which he promised support from government. Further, in Tanzania, Nyirefarms got a loan from ADB for Tsh 300 million (US$ 200,000) and KCB Bank for Tshs 230 million (US$ 146,000) for threshers to assist farmers to improve grain quality. In Kenya, training was held in Nakuru on 29-30 March 2011 involving financial institutions such as Cooperative Bank, Equity Bank, Wakenya Pamoja and Kenya Women Finance Trust (KWFT) where stakeholders were sensitized on business opportunities along the finger millet and sorghum value chains (**MS 6.5.4**). In Kenya, the strategies for encouraging financial institutions to provide loans to farmer groups with promising business plans were discussed with Kenya Women Finance Trust (KWFT). It was agreed that KWFT would lend to willing farmers in the coming season in Nyanza (**MS 6.5.5**). Financial institutions in Kenya and Tanzania were sensitized about business opportunities in sorghum and finger millet value chains during agribusiness training workshops held in March and June 2011, respectively (**OP 6.5.6**). Contractual arrangements between farmer unions or groups and traders were completed with groups in Tanzania, where the marketing period is now at its peak and this will be done in Kenya when the grain marketing period commences in early August, 2011 (**OP 6.5.11**). In Ethiopia, these milestones have not yet been accomplished due to the under-development of the rural financial credit service, especially for sorghum and finger millet, and needs further assessment.

SA: For sorghum, both collaborating universities (MPKV and MAU) have identified financial institutions in their respective project areas during Year 1 and in Year 2. Flyers were developed and distributed to these institutions with details of the post-rainy season sorghum value chain and opportunities for financing it. Further, interactive meetings were organized to network the financial institutions and farmers associations to enable an increased flow of credit for post-rainy season sorghum (**MS 6.5.2** and **OP 6.5.3**). A brochure for use by farmers was developed on good business practices in accessing finance from alternative sources and it will be uploaded to the HOPE project document repository (**MS 6.5.4**). Some 150 farmers (50 women and 100 men) were selected from the farmer associations in target areas and trained in good business practices and in accessing finance from alternative sources during June 2011 at both MAU and MPKV (**MS 6.5.5**). Training was given during June 2011 at both MAU and MPKV to 100 farmers (60 men + 40 women) on various market opportunities for post-rainy season sorghum seed, grain and stover to obtain higher profits (**MS 6.5.8**): The seed warehouse was operationalized and institutional arrangements for providing credit-based warehouse receipts were discussed with the credit agencies (**MS 6.5.9**). Because of the heavy demand for sorghum this year, produce was rushed to market with practically no seed stored in the warehouse. For pearl millet, a flyer on the pearl millet value chain was developed and translated into local languages (Hindi for Rajasthan and Haryana and Gujarati for Gujarat farmers) to create awareness among farmers, especially women (**MS 6.5.11**). The financial institutions Gurgaon Gramina Bank, State Bank of India and Punjab National Bank were identified in Haryana, Jaipur Thar Gramin Bank, UCO Bank and State Bank of India were identified in Rajasthan, and Deena Bank, Dena Gujarat Gramin Bank (DGGB), Banas Bank and State Bank of India were identified in Gujarat. These banks were all informed of business opportunities along the pearl millet value chain. SHGs (including women SHGs) were formed and linked to the banks by opening accounts with banks on behalf of the SHGs (**MS 6.5.12).** Representatives of local financial institutions (public sector banks, regional rural banks, cooperatives) were invited for training programs, meetings and interaction with farmers organized by the HOPE project team. The HOPE project team explained the project and the needs of the farmers (e.g. loans required for various investment options of farmers) to the bankers. Bankers explained various financial products and services (crop loans, farmer's credit cards, crop insurance, Bank-SHG linkage program, etc) provided by the banks and how farmers can benefit from them (**OP 6.5.13**). A brochure on 'providing access to credit for the HOPE project farmers to enhance pearl millet productivity in western India' was developed and translated into local languages for the benefit of farmers in Rajasthan, Haryana and Gujarat. Information regarding types of loan available and the interest rates was provided in the brochure (**MS 6.5.14**). Training programs were conducted in each state during which farmers were informed about financial services provided by the banks and how they can increase access to financial services (credit/crop insurance, etc). More than 100 farmers (40% women and 60% men) were trained in good business practices for accessing finance from different banks in each state. Training programs were held on 10 May 2011 in Haryana, 1 June 2011 in Rajasthan and 23 June 2011 in Gujarat. Information about various government schemes such as Kisan Credit Cards, Crop Loans and Crop Insurance was given to farmers. Best practices for record keeping, financial discipline, regular meetings of members of SHGs and resolving conflicts were explained by bankers and faculty (**MS 6.5.15).** A flyer on market opportunities for pearl millet grain and fodder/stover was developed and translated into local languages for the benefit of farmers (**MS 6.5.17**). Three training programs were organized by the HOPE project team in collaboration with local Krishi Vignan Kendras (KVKs) on on 10 May 2011 in Haryana, 1 June 2011 in Rajasthan, and 23 June 11 in Gujarat. In these training programs local market committee members were invited to give advice/present market opportunities to farmers on pearl millet grain, fodder and various value added products. They explained the local market price trends and suggested good marketing practices like sorting, cleaning and grading the grain and fodder before selling in the market so as to fetch higher prices. They also explained that in Haryana there is increasing demand for grain from poultry farms, while in Gujarat and Rajasthan the demand is mainly for human consumption. They also explained that there is an increasing trend in prices for pearl millet stover in the coming years due to a shortage of fodder. Even though use of warehouse receipts is not prevalent, they explained the benefits of the system to the farmers (**MS 6.5.18**).

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 use of dryland cereals

WCA: A one-day meeting was convened at IER Sotuba station in Bamako, on 14 April 2011, following the WCA regional HOPE review and planning, for current and potential future partners to exchange ideas on how to integrate delivery of seed, crop management techniques, inputs, and market linkages for improving sorghum and pearl millet production. A report of this meeting is available at the project online depository site. HOPE project partners were also invited to the ICRISAT open–house day in October 2010, where mini-packs and seed were demonstrated. These fora enabled partners in technology delivery from each target area to meet and exchange experiences (**MS 6.6.3**).

ESA: The HOPE project organized training in participatory technology development and delivery techniques for researchers, extension, lead farmers and seed production agencies from the project mandate districts in all project mandate countries in ESA. In Kenya, 34 participants (19 men and 15 women) consisting of farmers (10), extension (10), researchers (six), stockists (six) and seed producers (two) were trained. During the training, three focus discussion groups were formed, representing the Nyanza, Western and Rift Valley provinces that had been identified as finger millet technology recommendation domains for the HOPE project in Kenya. In Tanzania, 41 participants (13 women and 28 men) comprising extension staff, farmer seed producers, seed stockists and farmer group leaders, attended a training session held at the Department of Social Services Training Institute, Singida. The participants were drawn from the HOPE project districts of Singida, Rombo, Iramba, Sumbawanga, Kishapu and Kondoa. In Uganda, a training workshop on PVS and technology delivery was organized by NARO and ICRISAT-ESA and attended by 25 participants (10 women and 15 men) including research and extension staff, farmer group officials, innovative farmers and input suppliers from Kumi, Palissa, Gulu, Lira, Apac, Oyam and Kibaale Districts of Uganda. These participants were trained to be able to train others on PVS and technology delivery of finger millet-based improved production technologies**.** Two zones, Eastern and Northern, were defined as HOPE project finger millet mandate zones in Uganda. In Eritrea, 30 participants consisting of 21 people from National Agricultural Research Institute (NARI), six from the extension service and three from seed agencies were trained in Asmara on PVS and participatory technology delivery mechanisms. The participants divided Eritrea into three different production zones consisting of Eastern Lowlands, Highland and Western Lowlands for the purpose of implementing HOPE project activities. In South Sudan, a training workshop on variety testing, evaluation and technology delivery was organized in Torit by the Ministry of Agriculture, Government of Sudan in collaboration with ICRISAT. In attendance were 26 participants (10 of which were women) including research and extension staff, innovative farmers and community-based farmer groups from Central and Eastern Equatoria who were trained to be able to train others in testing, evaluation and dissemination of sorghum-based improved production technologies. HOPE project activities are based in Western and Eastern Equatoria States. In Ethiopia, the EIAR in partnership with ICRISAT organized training in PVS and participatory technology delivery mechanisms for 31 participants drawn from research (15), extension (10), seed agencies (four) and cooperative unions (two). This output target is complete in all six HOPE project mandate countries. The researchers, extension workers, lead farmers, seed agents and agro-input dealers were trained to effectively participate in suitable technology development, evaluation and exchange (**OP 6.6.2**). Gaps and challenges for sorghum and finger millet seed supply and adoption in Kenya were identified as: high levels of poverty; unavailability of seed of adapted varieties; inappropriate packaging; high prices; inadequate information on available seed; and long distances to seed sources. For Uganda and Ethiopia, additional challenges are improper packaging and for Ethiopia, the main seed problems listed by stakeholders were high prices, improper packaging and lack of information on available seed types (**MS 6.6.4**). Sorghum seed producers and distributors in Eritrea, Ethiopia and Tanzania were trained in seed policies and international seed regulations including biosafety issues, to facilitate seed movement and knowledge and also to effectively contribute in seed policy debates (**MS 6.6.5**). This activity (**6.6.5**) is due December 2011 but has already been achieved. Sorghum breeders in Tanzania were linked with Zanobia and Suba Agro. The Ethiopia breeders were linked with the Ethiopian Seed Enterprise. The Eritrea sorghum breeders were linked with the NARI seed unit as there is not much private sector activity currently in Eritrea (**MS 6.6.6**). In Kenya, 34 participants attended a training-of-trainers session held in Nakuru in March 2011. These consisted of farmer group officials, extension agents and agro-input dealers who were trained by a consultant hired from Enterprise Institute, Nairobi by the project. The officials of farmer groups and extension workers have been facilitated to train members of 30 farmer groups (average membership of 25) working with the HOPE project in Western Kenya and Rift Valley. In Tanzania, 35 participants consisting of farmer group officials, extension agents and agro-input dealers were trained by the same consultant. The officials of farmer groups and extension workers have been facilitated to train members of 25 farmer groups working with the HOPE project in Kondoa, Singinda, Rombo, Kishapu and Iramba**.** The activity will be done in Ethiopia in August 2011, since it is usually linked with the presence of a crop in the field (**MS 6.6.10**). 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 participants), Tanzania (35 participants) and Uganda (26 participants), linked to the PVS training. The same training will be provided in Ethiopia during this cropping season (**OP 6.6.13**). A total of 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). This was carried out during PVS TOT training and those trained will start training others in the next season (**MS 6.6.14**).

<u>SA</u>: For sorghum, six farmer groups (each with 60 members), two women's self-help groups (in each region, 50 members in each) and eight KVK field staff were trained by university and KVK scientists in soil sample collection and post-rainy season sorghum crop management, purity maintenance in seed production and grain and stover marketing (**MS 6.6.2**). A brochure on seed storage warehouse management and warehouse book-keeping in the local language (Marathi) was developed and sent to the HOPE project repository (**MS 6.6.4**) Training was given to selected farmers (30 in each cluster) in seed storage warehouse management and book-keeping in the MAU area (**MS 6.6.5**) as the warehouse is present only in MAU. Information, education and communication (IEC) materials (3) in the Marathi language on post rainy season sorghum value chain development for grain and stover production and value addition for marketing stover were developed (**MS 6.6.8**). These are being uploaded into the HOPE project document repository. The project farmers (400 from each region) were trained during field days (two in each region) and exposure visits (three in each region) and the IEC material was distributed during the crop harvesting period (**MS 6.6.9**). Government officials from the Department of Agriculture participated in these field days and helped in mobilizing farmers. For pearl millet, flyers on crop management, and grain and stover marketing were developed and translated into local languages for better understanding by farmers in the target areas. **(MS 6.6.11).** A training program was conducted in each state to promote pearl millet crop management practices to increase yields and acreage under pearl millet. More than 100 farmers (one group from each cluster) including women farmers (about 40-50%) were trained. A training program was held on 10 May 2011 in Haryana, 1 June 2011 in Rajasthan, and 23 June 2011 in Gujarat. The locations of identified markets (both regulated and informal markets) and prevailing prices, seasonal variation in prices and the quality premium appropriate to each grade were explained to the farmers. Farmers also learned about the potential gains available by selling fodder in fodder markets rather than selling in the village itself and were encouraged to do this during 2011 season. KVK field staff were also trained in the three states in pearl millet crop management, and grain and stover marketing, in order to disseminate the information in the target villages **(MS 6.6.12**). Education and communication (IEC) materials (flyers and brochures) on pearl millet value chain for grain and stover

production and value addition in pearl millet for marketing were developed and translated into the local languages Hindi and Gujarati (**MS 6.6.14).** Farmers were trained in pearl millet crop management during field days that were organized in each state. In Rajasthan, field days were held on 13 September 2010 in Kherapa cluster and on 3 October at Gotan. Two hundred and seventy farmers participated. In Haryana, a field day was held on 15 September in Sundrah and in Gujarat it was held on 28 September in Jandi cluster. About 150-200 farmers attended the field days. Flyers in the local language on crop management were distributed. Flyers on pearl millet value chain, markets and credits have been developed and will be distributed to the farmers during field days and exposure visits during 2011 season (**MS 6.6.15).**

(B) Outputs and Milestones

The status of Year 2 outputs and milestones as at 30 June 2011 is summarized in Table 1.

(C) Deviations from Proposal

- It is planned to include modification of the APSIM model to enable it to correctly simulate pearl millet (see section F for details).
- As reported in January 2011, the student to be identified in Ethiopia, under Activity 1.5 in ESA, will be involved in adoption studies.
- Some additional work was completed to achieve diversification of breeding materials.
- The milestones/outputs 3.4.4, 3.4.5, and 3.4.6 in SA have been revised. A formal request for the approval of these revisions will be sent to the foundation together with this report. The new milestones/outputs area as follows:
    - **MS 3.4.4.** Field screening technique developed/refined for downy mildew resistance at one national program site (Y3) (Dec 2011)
    - **MS 3.4.5.** Field screening technique developed/refined for downy mildew resistance at two national program sites (Y3) (Dec 2011)
    - **OP 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).
- The finger millet genotyping component of the project (in ESA) has been expanded slightly to include the full diversity collection (384 varieties). This is possible through linkage with a recently funded BioInnovate project on which ICRISAT is a partner, which has complementary goals of genotyping genetically diverse cultivated and wild germplasm from the region, including Ethiopia. The BioInnovate project also aims to develop additional molecular markers for finger millet. The results and resources from HOPE and BioInnovate are being shared to ensure the maximum benefit for both projects.
- The proposal states that 'finger millet and sorghum processors are consulted in Ethiopia' (**MS 5.2.2**). However, no major processors for these two crops exist in Ethiopia. We will therefore identify and consult a selected number of processors of wheat and maize (e.g. bakeries, millers) in Addis Ababa and Nazareth to assess potential future demand for finger millet and sorghum.
- According to the proposal, a consumer survey should also be conducted in Ethiopia. (**MS 5.3.5**). However, we did not fix a date for this activity yet. Objective 5 has many activities in Ethiopia, but capacities of EIAR are limited. We therefore decided to first focus on activities for which data is not available from other sources. These are the market and processor surveys. Once these activities and the respective reports are completed, and the existing data from the national 'Consumption and Expenditure Survey' from Ethiopia is analyzed, we will discuss the need of

conducting additional interviews with consumers in Ethiopia (**MS 5.3.5**). The original timeframe for this activity was July 2011. A new timeframe for this activity will be provided when this activity becomes necessary.

- The MSc student from Uganda will work on production and competitiveness of finger millet. His results will therefore feed primarily into Objective 1 and provide baseline information on finger millet production in our target areas. This deviates from the proposal which specified that MSc theses in Objective 5 focus on 'improving markets for sorghum and finger millet (**MS 5.7.2**). However, Objective 1 does not have activities in Uganda, although the country is the leading producer of finger millet in ESA, and is a major supplier for Nairobi millers. This information gap was important enough to justify collection of farm level data on production and competitiveness of finger millet in Uganda. Sufficient information on markets for finger millet, processing, and consumption in Uganda will be collected through activities 5.1 and 5.2.

Table 1: *Status of Year 1 Outputs and Milestones as at End of Year 2*

Region	100% Achieved	50-100% Achieved	<50% Achieved	Comments
Objective 1				
WCA	1.1.4, 1.1.7, 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.3.1, 1.3.2, 1.3.3, 1.4.1, 1.4.2, 1.5.3, 1.5.4, 1.5.5 **[14]**	1.1.5, 1.1.6 **[2]**	1.1.9 **[1]**	• 1.1.5 & 1.1.6 – delays in the GIS map generation process • 1.1.9 – Delay in necessary changes in the IMPACT model. The improved model has just been released, and the completion date is now re-scheduled to November 2011
ESA	1.3.4, 1.3.5, 1.3.6, 1.3.7, 1.3.8, 1.4.3, 1.5.4, 1.5.5 **[8]**	1.1.1, 1.1.4, 1.1.5, 1.1.6, 1.1.7, 1.1.8, 1.1.9, 1.3.9 **[8]**	Nil	• 1.1.1 – heavy demands on GIS resources at ICRAF, Nairobi • 1.1.4, 1.1.5 – difficulty in obtaining daily climatic data in Eritrea for use with APSIM/Also inability of APSIM to correctly simulate finger millet (see text for details) • 1.1.6 – delay in obtaining profitability data from baseline surveys in Ethiopia • 1.1.7 - Delay in necessary changes in the IMPACT model. The improved model has just been released, and the new end date is now re-scheduled to October 2011 • 1.1.8 – delay in completing 1.1.7. New end date is October 2011 • 1.1.9 & 1.3.9 – delay in data entry and cleaning due to limited human resource at EIAR, Ethiopia
SA	1.1.2, 1.1.5, 1.1.6, 1.2.1, 1.2.2, 1.2.3, 1.2.4, 1.3.4, 1.4.3, 1.4.4, 1.4.5, 1.4.6, 1.5.1, 1.5.2, 1.5.3 **[15]**	1.1.4, 1.3.5 **[2]**	Nil	• 1.1.4 - Delay in necessary changes in the IMPACT model. The improved model has just been released by IFPRI, and work is expected to be completed in December 2011 • 1.3.5 – delay in entry and cleaning of Haryana data due to late change of survey district in this state
Objective 2				
WCA	2.1.1, 2.1.4, 2.2.1, 2.2.4, 2.4.1, 2.4.2, 2.4.3, 2.4.9, 2.5.4, 2.5.6, 2.6.3, 2.6.4, 2.6.6, 2.7.1, 2.7.2, 2.7.3, 2.7.5, 2.7.6, 2.7.7, 2.7.9, 2.7.10, 2.7.12, 2.7.13, 2.7.16, 2.7.17, 2.7.19, 2.7.20, 2.7.22, 2.8.5, 2.8.6 **[30]**	Nil	2.1.5, 2.8.7 **[2]**	• 2.1.5 – This study was not concluded in Niger due to insecurity (and hence travel advisory) in parts of the target study area. It was also not carried out in Mali due to long-duration illness of the responsible national program scientist during the 2010 cropping season. It should be noted that this is a running, annual activity, and the next reporting is due in Y3, from the work carried out in the 2011 cropping season. • 2.8.7 – There were too many events between March and June 2011 for the scientists in WCA, hence the postponement of this training to Oct 2011
ESA	2.1.2, 2.1.5, 2.2.2, 2.2.4, 2.3.4, 2.3.5, 2.4.5, 2.5.1, 2.5.6, 2.5.9, 2.5.17, 2.8.3, 2.8.4, 2.8.5, 2.8.8 **[15]**	Nil	Nil	
SA	2.1.3, 2.1.7, 2.2.2, 2.3.2, 2.3.6, 2.3.7, 2.3.11, 2.4.2, 2.4.7, 2.4.11, 2.4.12, 2.5.2, 2.5.3, 2.5.7, 2.5.11, 2.6.1, 2.6.5, 2.6.6, 2.6.7, 2.7.2, 2.7.6, 2.8.1, 2.8.4 **[23]**	Nil	2.6.2, 2.6.3 **[2]**	• 2.6.2 - This is a follow-up activity after 2.6.1, and should have been revised to March 2012 following the Oct 2010 revision of 2.6.1 from March 2010 to March 2011 • 2.6.3 – Delay follows the rescheduling of 2.6.1 and 2.6.2. These changes have now been marked in Appendix B.
Objective 3				
WCA	3.3.1, 3.3.2, 3.4.1, 3.4.2, 3.7.2, 3.8.1, 3.8.2, 3.8.3, 3.8.4, 3.8.8, 3.8.9, 3.8.10, 3.9.4, 3.9.5, **[14]**	3.2.1, 3.9.6 **[2]**	Nil	• 3.2.1 - Activities completed but sample analysis and result compilation pending. Completion is postponed to March 2012. • 3.9.6 – Delays in completing the optimization of the screening facilities at ICRISAT – Niamey, now estimated to be completed in Sept 2011.

Region	100% Achieved	50-100% Achieved	<50% Achieved	Comments
SA	3.1.4, 3.1.5, 3.3.6, 3.5.1, 3.5.2, 3.5.4, 3.5.5, 3.5.8, 3.5.9, 3.6.1, 3.6.2, 3.6.3, 3.6.4, 3.8.13, 3.8.14, 3.8.15, 3.8.16, 3.8.17 **[18]**	Nil	Nil	
Objective 4				
ESA	4.1.4, 4.1.6, 4.1.7, 4.1.8, 4.1.9, 4.1.10, 4.1.11, 4.1.18, 4.1.19, 4.2.2, 4.3.5, 4.4.4, 4.5.4, 4.5.5, 4.5.14, 4.6.2, 4.6.6 4.6.13, 4.8.2, 4.8.3, 4.8.4, 4.8.5 **[22]**	4.1.16, 4.2.1, 4.2.3, 4.5.3 **[4]**	4.6.12 **[1]**	• 4.1.16 - Differences in season and late arrival of rains this season, the trial is in the final stages of evaluation in Uganda (harvest August 2011) and Tanzania (July 2011) • 4.2.1 – change of rainfall pattern prevented realization of the right (dry) conditions for the trial, to be achieved in Sept 2011 • 4.2.3 – Follows from 4.2.1 • 4.5.3 – Lack of biophysical information of the test sites of Ethiopia, despite repeated requests by ICRISAT scientists • 4.6.12 – Lack of synchrony between the cropping season in Kenya, Uganda and Ethiopia and reporting schedule – Samples are being collected this season (July to October). The new date will be December 2011
Objective 5				
WCA	5.1.3, 5.1.4, 5.2.1, 5.2.4, 5.2.5, 5.2.6, 5.3.3, 5.3.4, 5.4.1, 5.4.2, 5.4.5, 5.4.6, 5.5.1, 5.7.1, 5.7.4 **[15]**	5.5.2, 5.5.4, 5.5.5, 5.6.1, 5.6.3, 5.6.4 **[6]**	5.4.3, 5.6.2 [**2**]	• 5.4.3 – Training in Nigeria was postponed due to the winding up of WASA in that country. Another partner is being sought • 5.5.2 – Use of cellphones in Niger and Mali, as agricultural information pathway was new – starting only in Jan 2011. Time was needed before effects could show. A delay of 6 months was agreed between partners • 5.5.4 – Consultation meeting scheduled for Mali was postponed after the sudden demise of a key AOPP contact person. This has been re-scheduled to Aug. 2011 • 5.5.5 – It had not been possible to finalize contracts in the June meetings due to heavy agenda at the convened consultative meetings. This work involves many partners. Agreement made between partners to re-convene 3rd August to finalize contracts. • 5.6.1 – Death of AOPP contact forced postponement of activities • 5.6.2 – Same as for 5.6.1 • 5.6.3 – budget limitation prevented equipping of Mali villages with threshers. Funds will be re-located to enable achievement of this activity. • 5.6.4 – Activity not yet carried out in Mali due to pressure of work/time constraint. This is planned for August 2011
ESA	5.1.1, 5.1.2, 5.1.3, 5.1.4, 5.1.5, 5.3.2, 5.7.2, 5.7.3 **[8]**	5.2.1, 5.2.3, 5.7.1 **[3]**	5.6.1, 5.6.2, 5.7.4 **[3]**	• 5.2.1 – Activity pending for Uganda; delay caused by NAADS being slow to execute activities • 5.2.3 – Completed for Tanzania but not for Ethiopia. No major sorghum (and millet) processors exist in Ethiopia • 5.6.1 & 5.6.2 – Delayed by linkage to 5.4.5 and 5.5.2 which were rescheduled October 2010 to September 2011. This linkage was over-looked while rescheduling 5.4.5 and 5.5.2. Consequently,

Region	100% Achieved	50-100% Achieved	<50% Achieved	Comments
				activities 5.6.1 & 5.6.2 are also rescheduled to October 2011. These changes will not affect the overall project outcome. • 5.7.1 – Dropout of student from Ethiopia affected overall performance of this milestone. However, 5.7.2 is considered achieved as supervision of identified students is ongoing. • 5.7.4 – Training on these topics is planned for 2012, and related activities were not fully undertaken. There was, therefore, no need in early preparation of training manuals.
SA	5.1.4, 5.1.5, 5.2.1, 5.2.2, 5.2.3, 5.2.4, 5.3.2, 5.3.3, 5.4.1, 5.5.2, 5.5.3, 5.6.1, 5.6.2, 5.7.3 **[14]**	5.7.4 **[1]**	Nil	• 5.7.4 – Training was conducted for investigators involved in data collection for market survey. What is pending is training for scientists and researchers. Training for this cadre will be combined with that on impact assessment under Obj 1, in August 2011
Objective 6				
WCA	6.1.1, 6.1.2, 6.1.3, 6.1.6, 6.1.7, 6.1.8, 6.1.9, 6.2.2, 6.2.3, 6.2.4, 6.2.6, 6.2.7, 6.2.8, 6.2.15, 6.2.18, 6.2.19, 6.2.21, 6.2.28, 6.2.37, 6.2.38, 6.3.1, 6.3.2, 6.3.4, 6.3.5, 6.3.9, 6.3.13, 6.4.9, 6.6.3 **[28]**	6.2.14, 6.2.16, 6.4.10, 6.5.1, 6.5.4, 6.5.5, 6.5.7, 6.5.8, **[8]**	6.2.22, 6.2.23, 6.2.24, 6.2.31, 6.2.34, 6.4.4, 6.4.5, 6.4.6, 6.5.6 **[9]**	• 6.2.14, 6.2.16 - Translation of training manual on pearl millet seed production from French into Haousa (6.2.14) and Bambara (6.2.16) is delayed, but ongoing • 6.2.22 – delayed in Mali due to death of AOPP contact person. Now re-scheduled to August 15 and 16 2011 • 6.2.23 – This activity was delayed by insecurity in Burkina Faso and is now scheduled for September 2011 • 6.2.24 – These activities (originally scheduled in March 2011 to 2012) immediately following training in marketing and agribusiness and will be implemented in December 2011 for the three countries just after the harvest • 6.2.31 & 6.2.34 – The full information set needed to do the analysis was not available by January 2011. These analyses have been done for Niger together with the sale of mini packets. The report is in progress and will be finished in August 2011 for Mali and September 2011 for Nigeria and Burkina Faso. • 6.4.4 - SWOT analysis has been conducted in Niger and is reported in the consultative meeting report organized from 22-23 June 2011. This analysis will be done during the consultation meeting between the players in Mali in August 2011 • 6.4.5 - The consultation meeting was held for Niger from 22 to 23 June and the report has been shared. In Mali it will be held in August 2011, and Burkina Faso in September 2011 • 6.4.6 – Work in Mali and Burkina Faso will be done in Sept 2011 • 6.4.10 – Done for Niger and Mali but not for Nigeria due to insecurity. Rescheduled to Sept 2011 • 6.5.1 – Training for Mali is scheduled to late Aug 2011, to be coupled with the "training in agri-business management and marketing" in Mali. This was postponed for Mali due to demise of AOPP contact person. • 6.5.4 – To be concluded after the consultative meetings in Mali expected in August 2011 – postponed due to demise of AOPP contact person. • 6.5.5 – Consultative meetings were rescheduled to Burkina Faso to Sept 2011 • 6.5.6 – To be done in Burkina Faso in Sept 2011 • 6.5.7 – Consultative meetings are already held for Niger, and will be done for Mali late August 2011 – Mali meetings postponed due to demise of AOPP contact person

Region	100% Achieved	50-100% Achieved	<50% Achieved	Comments
				• 6.5.8 – Slow-down of activities due to insecurity in northern Nigeria. Re-scheduled to Sept 2011
ESA	6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.1.6, 6.1.7, 6.1.8, 6.1.9, 6.1.10, 6.1.11, 6.2.2, 6.2.3, 6.2.5, 6.2.6, 6.2.9, 6.2.10, 6.2.12, 6.2.13, 6.4.2, 6.4.3, 6.4.4, 6.4.5, 6.4.7, 6.4.8, 6.4.10, 6.6.2, 6.6.4, 6.6.6, 6.6.10, 6.6.14 **[30]**	6.3.4, 6.5.1, 6.5.2, 6.6.13 **[4]**	6.5.4, 6.5.5, 6.5.6, 6.5.11 **[4]**	• 6.3.4 – The only data missing is for Ethiopia, and this is being collected in the current cropping season • 6.5.1 – Completed in Kenya and Tanzania. Agri-business training in Ethiopia is scheduled for August 2011 • 6.5.2 – Completed in Kenya and Tanzania. Training to be done in Ethiopia in August 2011 • 6.5.4 – Completed in Kenya, but to be done in Tanzania and Ethiopia by December 2011 • 6.5.5 - Completed in Kenya, but to be done in Ethiopia (Aug 2011) and Tanzania (Sept 2011) • 6.5.6 – Completed in Kenya, but to be done in Ethiopia and Tanzania by December 2011 • 6.5.11 – Not done, due date to be reschedule to December 2011 • 6.6.13 – Training in Ethiopia delayed to current cropping season. This will be done in December 2011
SA	6.1.6, 6.1.7, 6.2.3, 6.2.4, 6.2.6, 6.2.7, 6.2.9, 6.2.10, 6.2.14, 6.2.16, 6.2.17, 6.2.18, 6.2.19, 6.2.20, 6.2.21, 6.2.22, 6.2.23, 6.3.2, 6.3.3, 6.3.4, 6.3.5, 6.3.6, 6.3.9, 6.3.10, 6.3.12, 6.3.13, 6.3.14, 6.3.15, 6.3.16, 6.4.2, 6.4.3, 6.4.5, 6.4.6, 6.4.7, 6.4.8, 6.4.9, 6.4.10, 6.4.11, 6.4.12, 6.5.2, 6.5.3, 6.5.4, 6.5.5, 6.5.8, 6.5.9, 6.5.11, 6.5.12, 6.5.13, 6.5.14, 6.5.15, 6.5.17, 6.5.18, 6.6.2, 6.6.4, 6.6.5, 6.6.8, 6.6.9, 6.6.11, 6.6.12, 6.6.14, 6.6.15 **[61]**	Nil	Nil	• 6.2.15 – The "**April 2011**" listed as due date for the first part of this milestone is a typographical error. It should have been "**April 2012**" since this activity follows after 6.2.14 which was scheduled for completion in April 2011. This correction has now been proposed in Appendix B.
TOTAL	**315 / 83.1%**	**40 / 10.6%**	**24 / 6.3%**	

(D) Measurable Outputs and Outcomes

Measurable outputs and outcomes are presented in Appendix A.

(E) Knowledge Generated

- A large body of baseline and experimental/scientific data.
- Information on adoption rates of improved sorghum and finger millet varieties in Tanzania and Ethiopia, and reasons for (non)adoption.
- The Nigerian sorghum landrace *Ribdahu* has a high level of midge resistance, and high grain yield, when grown with an early sowing date in Niger.
- Screening protocol for aphid resistance was developed in SA, and sources of tolerance identified.
- High yielding ability of sorghum hybrids in West Africa is very encouraging. The hybrid superiority over local and improved varieties in the Sudanian zone in Mali is stable at 30%, also on-farm.
- Promising sorghum hybrids and parental lines were identified with good grain and fodder yield potentials, when tested on station in SA.
- Varietal differentiation between temperature and photoperiod sensitivity under post-rainy season growing conditions was useful.
- The genetic base of post-rainy sorghum (in India) is limited and no information was available on the actual diversity available in the post-rainy sorghum material currently in use. The information generated [in this project] on molecular diversity of post-rainy material may prove useful for enhancing the diversity of breeding material for improving the post-rainy sorghum.
- Appropriate locations and time of sowing were standardized for hybrid seed production in the summer season in Western Maharashtra and Marathwada regions to have minimum time lag between seed production and seed distribution (marketing). Public and private sector seed producing agencies can make use of this information to produce and distribute the hybrid seed.
- High frequency of S2 progenies coming through progeny testing among selections. High frequency of Fatido (and Ronido) entries, value of bulk population based on progeny index selection.
- Genotype alone is not sufficient for boosting the yields in post-rainy season sorghum in India. Managing the nutrients, drought and shoot fly is critical for enhancing the post-rainy sorghum yields in India.
- Farmer interest in the farmer field schools approach is very encouraging, and seems linked to the opportunities provided to find solutions to a widespread problem, and to the opportunities for thematic interactions with other farmers in Mali.
- Protocols for conducting participatory trials in sorghum developed for all three regions, with positive feedback from partners.
- Yield increases from combinations of new varieties with affordable crop management practices give consistent grain yield advantages.
- A combination of organic manure with inorganic fertilizers (the combination of 6g of NPK and 300g of cow manure) was identified as very effective both on-station and on-farm. This will now be up-scaled for increasing the efficiency of pearl millet IGNRM in SSA region.
- Reference collection of finger millet germplasm has given insight into the general diversity available in the region for breeding purposes. Specific evaluation has shown diversity of main biotic stresses - blast and *Striga*. Literature search reveals that very little has been done on breeding of finger millet. This is also confirmed by data. Knowledge of number of individuals to genotype in order to capture the full genetic diversity of a variety as well as if and/or how such samples can be bulked for cost-effective SSR genotyping.
- The germplasm movement agreement across countries in the region is not harmonized.

- Differences in agronomic and other traits of individuals in different finger millet maturity periods. This will help in understanding and breeding for escape, tolerance and/or resistance to the key biotic and biotic stresses.
- Method of screening finger millet F_1 from selfs after emasculation has been mastered. Choice of morphological markers to be used in screening F_1s is very important for success. A number of morphological markers` inheritance is not as perceived by most breeders as being simply inherited.
- Adaptability of finger millet varieties in different environments, and the interaction of varieties with management options.
- Knowledge about trade flows, traded quantities and qualities and market needs for sorghum and finger millet, especially for Tanzania and (partly) Ethiopia. Information on this is increasing as more countries are covered.
- Information gained on the demand (in regard to quantity and quality) of processors for sorghum and finger millet in ESA countries. We learned that there is a high interest in the two crops and an increasing demand. However, the demand cannot be met by the market. Reasons for this are poor infrastructure (roads, collection points, etc.), low level of organization of farmers, high quality requirements of the market. Further analysis of data from the baseline, market and processor surveys will provide more information about reasons for the unaccomplished demand.
- The protocols for participatory varietal selection for post-rainy sorghum in India were developed and farmers' preferences noted.

(F) Activities that cannot be completed in grant period

- Activity 1.1: In ESA, the millet module of APSIM was found to be unsuitable to simulate the growth and performance of finger millet. The Project is proposing work on the model to enable it to simulate pearl millet growth. This will require the collection of a large body of data which may run over several seasons, and which constitute a set of activities that are not within the current planned activities. It is proposed that one or more PhD students be identified and engaged to conduct this exercise. Such a route would take the work beyond the scope and timeframe of the current phase of the HOPE project.
- The identification of one hot spot for screening Millet Head Miner in WCA seems to be difficult, due to security reasons there are not many locations to test this hypothesis. Moreover, the 2010/11 results question the relevance of having Doukoudoukou as an additional site as it provided no comparative advantage compared to Sadoré, where an unexpectedly high MHM infestation was observed.

II. MANAGEMENT UPDATES

The project management structure is currently as follows.

Principal Investigator: Dr. Said N. Silim
Project Manager/Coordinator: Dr. George E. Okwach
Objective Leaders & Regional Objective Coordinators

- Objective 1: Dr. Nareppa Nagaraj (based in India)
  - WCA: Dr. Jupiter Ndjeunga
  - ESA: Dr. Alastair Orr
  - SA: Dr. Nareppa Nagaraj
- Objective 2: Dr. Eva Weltzien-Rattunde (based in Mali)
  - WCA: Dr. Eva Weltzien-Rattunde
  - ESA: Dr. Mary Mgonja
  - SA: Dr. Belum Reddy
- Objective 3: Dr. SK Gupta (based in India)
  - WCA: Dr. C. Tom Hash
  - SA: Dr S.K. Gupta
- Objective 4: Dr. Henry Ojulong (based in Kenya)
  - ESA: Dr. Henry Ojulong
- Objective 5: Dr. Alastair Orr (based in Kenya)
  - WCA: Dr. Jupiter Ndjeunga
  - ESA: Dr. Alastair Orr
  - SA: Dr. Parthasarathy Rao
- Objective 6: Dr. Mary Mgonja (based in Kenya)
  - WCA: Dr. Kirsten Vom Brocke
  - ESA: Dr. Mary Mgonja
  - SA: Dr. Belum Reddy/Dr. Rajan Sharma

III. LESSONS LEARNED

Sorghum improvement

- PVS trials very effective for identifying varieties for dissemination and seed production, as well as for readjusting selection priorities.
- Sorghum hybrids in Mali show good, stable yield superiority across years and sites.
- Hybrid seed production can be integrated with grain production on smallholder farms.
- Integrated *Striga* and soil fertility management options are of key interest to farmers, and demand for support from development partners is increasing.
- Marker assisted transfer of *Striga* resistance was successful, but requires optimization
- Soil fertility status of women's fields in West Africa is extremely low, especially for phosphorus. Even small inputs of P have strong effects.
- Integrated *Striga* management increases economic gain, and reduces *Striga* emergence.
- Post-rainy sorghum cultivars with additional resistance to biotic (aphid, leaf diseases) and abiotic stresses are needed.
- There is need to explore the possibility for mechanical harvesting of sorghum crop and processing of fodder (chaffing, pelleting, etc) in India.
- Hybrid seed production in the summer season helps to fill the post-rainy sorghum markets in SA.

Pearl millet improvement in WCA

- Useful genetic variability was created with the new diversified populations and breeders were quite excited especially about the Yellow Grain Genepool for Burkina Faso and the LCIC diversified population targeting Nigeria. Both populations exhibit tremendous genetic variability and therefore opportunity for genetic gains.

- The agronomy research is a special challenge as the high inter-annual climate variability affects the results and needs to be taken into account before making final conclusions. As weather data are being collected at all sites, including on-farm sites where the project has distributed rain gauges and trained farmers in data collection, special climatic data analysis will be performed to assess representativeness of rainy season conditions in a given year.
- High involvement of farmer-participatory approaches in on-farm trials leads to the fact that recommendations may not always be uniform across and even within one site. While this seems unsatisfactory initially, farmers confirmed that it is important to include their views in trial design.
- Partner NARS continue to show high interest in pearl millet hybrid research. It would have been good to include this aspect also for HOPE Objective 3 activities in WCA, and not only in Asia. If HOPE management agrees then some activities on hybrid research for WCA can be initiated from Y3.
- The FFS activities show initial very encouraging opportunities for impact: Partner institutions are planning the implementation of CBFFS for ISSFM in 2011 on their own initiative and with their own funds, with the use of the manual and technical support from ICRISAT and the national partners in Mali (World Vision, Segou region, 2 clusters, 10 villages and Catholic Relief Services, Mopti Region, more than 8 clusters in over 40 villages) and Nigeria (Green Sahel and Rural Development Initiative, 1 cluster in 6 villages). All these activities together have the potential to train about 1,500 farmers in ISSFM.

Pearl millet improvement in India

- The number of locations for testing the trials has been increased from 2011 to generate reliable data so as to mitigate climate fluctuations. This should help in providing reliable data from an optimum number of locations for different trials under adverse climatic conditions.
- The private seed sector is the main vehicle of delivering hybrid technology at the ground level; hence the seed companies interested in working with the HOPE project were invited and given a chance to test their pipeline hybrids suitable for HOPE regions. These companies were also involved in testing different trials that provides more testing locations for the project and simultaneously encourages the private sector to increase their interest/funding towards project outcomes.
- The breeding material generated by NARS partners working in different states may be adopted in adjoining states due to similar ecologies. Thus, breeding materials of project NARS partner states have been used in the development of test-crosses for testing across the regions. This should increase the probability of delivering suitable hybrids for the targeted regions.

Capacity building of partners

- Focusing on capacity building during the first half of the project has been useful in enhancing partners' ability to implement project activities.
- The capacities of our partners are not equal in all countries. In Ethiopia, human resources to implement all project activities on time and at the expected quality level are not available. The project is making unrealistic demands on this partner, and activities will need to be reduced in order that the partner can produce quality outputs within the project time period (with specific reference to MS 5.6.1 and 5.6.5).
- Funding for MSc. students in HOPE is not very attractive because other scholarships are available that include university fees and other expenses. There are difficulties in finding highly-qualified students (MS 5.7.1).
- Capacity enhancement of partners needs to be a continuous process as they are dynamic.

- The demand and needs for capacity are very high for the project.
- Participation of women in capacity building activities is still minimal, especially in Ethiopia and Eritrea.
- The success of many development projects in North India is slow due to historical and socio-economic conditions and restrictions on participation of women. However, selecting the right partners at every stage of the project is important for success.

Seed production and distribution

- Mini-packs in WCA
  - The mini-pack strategy seems to be successful to reach various categories of farmers and the strategy is welcomed by farmers. Farmers view the prices charged as affordable, although there are requests to increase the size of packs.
  - In several regions of WCA, women have less access to mini-packs.
  - Documentation of mini-packs is challenging, as it necessary for the salespersons (such as agro-dealers) to invest time and effort to note the information. Also up to 25% of names couldn't be found in the villages indicated on the distribution lists in Niger. Simple notebooks were distributed to avoid having loose papers and distribution lists were simplified.
  - Visiting mini-pack buyers during the growing season was difficult (time constrains) therefore surveys were conducted in the off-season (March/April).
- Seed production manuals and manuals on ISM and FFS are extensively used in training workshops. The beneficiaries of the training manual and the training sessions conducted with the help of the manual are farmers from all four countries and also farmers who work in collaboration with other projects and NGOs.
- Production of foundation seed on research stations is becoming more difficult with an increasing number of varieties under dissemination, due to limited isolation areas on the research stations. In WCA, some local solutions to the problem in 2010/11 involved collaboration with the Alheri seed enterprise in Niger or with private and expert farmers in Mali. In Burkina Faso the UGCPA seed cooperative is producing foundation seed in collaboration with INERA.
- The establishment of a seed warehouse in the WAU region of India for storing seed produced in the off-season (summer) to distribute in the post-rainy season and the provision of institutional credit linkages to seed farmers through warehouse receipts is an important and useful innovation.
- Strategies for effective and sufficient foundation seed production need to be strengthened as research stations are at the limit for physical isolation requirements.
- When promoting improved varieties through small seed packs, it is more effective to deal with small seed companies that view the small seed pack production as a profitable venture. The larger seed companies such as Kenya Seed Company view production of small seed packs as not profitable as it involves a change to the production line.
- Seed production is a skilled job and training farmers in seed production storage and marketing helps in sustaining the project outcomes in the longer term. Adding the Mahabeej and National Seeds Corporation in India for seed supply further strengthens the seed chain.
- Agro-dealers operating in the project target areas are very interested in variety issues. They need more information on hybrids and variety characteristics to better inform their clients. The trained agro-dealers are an important source of information for farmers. In the Samantenga region in Burkina Faso about 48% of mini-pack seed is sold and promoted by agro-dealers. In Mali the agro-dealer involved in hybrid production is educating other farmers via radio messages about hybrids. Five new agro dealers collaborating with CNFA demanded mini-pack seed for the upcoming season. As a result of the different awareness building activities (training of agro-

dealers, field visits etc) the demand for seed and variety demonstrations increased this year: The AMEDD NGOs included two new varieties their program; AKF extended FFS activities and also engages in seed production and mini-pack sale; CNFA demanded hybrid seed to start a specific awareness building program with agro-dealers for hybrid varieties; Agro-dealers in Burkina and Mali contributing to the promotion of new varieties as they are now aware of specific traits and benefits of these varieties. *Striga* control packs are being successfully diffused (see http://hope.icrisat.org/from-variety-tests-and-farmer-field-schools-to-the-sale-of-seed-packs-and-integrated-striga-control-packs/).

Farmer involvement and awareness

- Farmers are aware of the productivity enhancement from micro-dosing fertilizer as a top dressing. We learned that farmers in ESA have not yet appreciated basal application of fertilizers such as DAP.
- Increasingly farmers are getting to know that there are market opportunities for sorghum and finger millet.
- The impact of climate change and the need to grow drought tolerant crops is becoming a reality to farmers and many stakeholders.
- Marketing groups of various forms will help in shortening the long supply chain and reduce the number of intermediaries.
- In India, fodder is a critical component in the post-rainy sorghum value chain. The surplus stover is transported from project areas (Parbhani) to Hyderabad. Linking of project farmers with the fodder wholesalers helps in sustaining the project interventions. The project has documented the entire process for use by stakeholders.
- Following the different awareness building activities in WCA, the demand for seed and variety demonstrations increased significantly this year. Four new NGOs (Sahel 21, Stopsahel, CRS, World Vision) are now using new millet and sorghum seed for variety testing and FFS trials in their zones of intervention. The organizations IICEM, ACDI-VOCA, CMDT Holding, PAM in Mali and Burkina are seeking collaboration for commercialization of cereals and in cereal value chain development. EUCORD, AGAF GALE and KILABO NGOs (collaborating with HOPE/AGRA microdose) as well as CNFA are increasing collaboration with ICRISAT for sorghum hybrid promotion (approximately 10 kg of hybrid seed of different varieties for demonstrations).
- Local radio is a very important source of information for farmers however radio messages have to be improved in some areas.
- In some areas farmers are confusing modern variety seed (especially hybrid seed) with GMOs, especially in areas where ICRISAT and its partners had little experience. Efforts need to be increased to build more awareness, e.g. through specific radio programs or demonstrations and field visits (planned by e.g. CNFA in Mali)

IV. CHANGES

There have been no institutional changes in ICRISAT that could jeopardize or negatively affect the implementation of the HOPE Project agenda.

V. RISKS

- Unpredictable weather patterns, leading to crop failures in some countries (by floods or drought) or changes in timeliness of operations.
- Insecurity and/or political instability in certain project sites, especially in West Africa, is preventing the implementation of planned activities, and causing delays in achieving results.

VI. OTHER SOURCES OF PROJECT SUPPORT

Table 2 provides details regarding other bilateral-funded projects that are considered collaborative to the HOPE project. It should be noted that these represent mainly collaborative efforts, rather than funds given to ICRISAT for use in the HOPE Project. In addition to those listed, in WCA, the Aga Khan Foundation (AKF) project collaborates with HOPE in supporting the implementation of farmer-field schools in the Mopti region of Mali.

Table 2: *Other Sources of Project Support*

Funding Sources	Amount (USD)	Type of Funding	% of Project	Committed or Potential
Action contre la Faim (ACF)	In kind contribution	Support to farmers in 3 “communes” in the Kita district of Mali to facilitate farmer experimentation, and seed dissemination. ACF conducts its own M&E activities, as well as grain marketing and fertilizer access.	-	Ongoing
AGRA	$240,000	Breeding sorghum for improved productivity and resistance to biotic and abiotic stresses [Activities 2.2; 2.5 in ESA]	-	Ongoing in Ethiopia
ASARECA	$99,000	Making the best of climate - Adapting agriculture to climate variability [Activity 2.2 in ESA]	-	Ongoing (Jan 2009-Dec 2010), no cost extension until Dec 2011
ASARECA	$1,200,000	Pearl millet and legume intensification in ECA	-	Aug 2011-Jun 2014
ASARECA	$1,400,000	Sorghum and legume intensification in ECA	-	Aug 2011-Jul 2014
ASARECA	$111,699	Integrated technology for drought mitigation in Ethiopia [Activity 2.2 in ESA]	-	Ongoing (2007-2010), continuation to Dec 2011
ASARECA	$27,660	Integrated *Striga* management in Ethiopia [Activity 2.2 in ESA]	-	Ongoing (2008-2011)
BMZ/GTZ	Ug: $24,000 Ken: $30,000 Tz: $28,000	Sustainable conservation and utilization of genetic resources of finger millet and foxtail millet, participatory variety selection and seed systems. Targets sites different from HOPE [Objectives 4 and 6 in ESA]	-	Ongoing (Jan 2007-Dec 2011)
BMZ/GTZ	$170,000	Fighting *Striga* using resistance genes deployed to boost sorghum productivity integrating MAB and conventional breeding [Activity 2.1 in ESA]	-	Ongoing (Jan 2009-Dec 2011)
Generation Challenge Program	$15,300	Screening sorghum for drought resistance and renovation of irrigation facility in Tanzania [Activity 2. 2, 6.3 in ESA]	-	Ongoing (2008 -2011)
IAEA (Eritrea)	$160,000	Improving sorghum productivity in Eritrea through application of N^{15} [Activity 2.6 in ESA]	-	Ongoing (2008 -2012)
McKnight Foundation, West Africa Community of Practice (Anbe Jigi project)	$145,000	To aid ICRISAT and farmer organization partners in Mali for targeting Fe and Zn nutrition of young children, Action research, variety screening for Fe and Zn, variety trails with women	-	Committed (2011-2014)
McKnight Foundation, West Africa Community of Practice (Germplasm project)	$432,000	Support to NARS and Farmers Organizations for participatory variety improvement, using recurrent selection of sorghum in Burkina Faso and Mali, and pearl millet in Mali	-	Ongoing (2011-2013)
McKnight Foundation, West Africa Community of Practice (seed project)	$567,270	Field activities, student training, including social science PhD student, support to Farmer Organizations	-	Ongoing (2010-2014)
Mobiom Association, Mali (via Helvetas)	$6,000/year	Support for farmer meetings, local supervision, and exchange visits for experimentation with new varieties of sorghum and pearl millet. Mobiom has approx. 2500 members, of which at least 50% are women. [Activities 2.6 and 6.1]	-	Ongoing

Funding Sources	Amount (USD)	Type of Funding	% of Project	Committed or Potential
NARI, Eritrea EIAR, Ethiopia DRD, Tanzania NARO, Uganda KARI, Kenya	$60,000 $74,400 $30,000 $20,000 $13,000	Sorghum and millet improvement [Objectives 2, 4 and 6 in ESA]	-	Ongoing
Promiso2 project (EC)	$5,025,000	Co-financing for training workshops, increasing numbers of Farmer Field schools, producing training materials, producing breeders' seed, conducting variety evaluations, and research and dissemination of related technologies in WCA.	-	Ongoing (2011-2013)

VII. BUDGET VARIANCES

See budget sheet.

VIII. OTHER

N/A

APPENDICES

Appendix A: Project Objectives and Outcomes

- Attached.

Appendix B: Timeline

- Attached.

Appendix C. Budget Spreadsheet

- Attached.

PRIVACY AND CONFIDENTIALITY NOTICE

Nil