Mirimir

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Novel Drought Tolerant Maize Varieties and Improved Farm Implements Promises Enhanced Food, Seed, Income and Livelihood Security

Maize, the main staple crop in Ethiopia, provides over 23% of calories; about 100 kg of per capita consumption per year and is becoming a main cash source. However, its production and productivity are low, mainly capped by abiotic and biotic stresses. Drought and low soil fertility are prominent. Especially in the Central Rift Valley, which is characterized by erratic, low, and unreliable seasonal rainfall, strong winds and high evapo-transpiration triggered by high temperatures (> 25 ^{0}C) exacerbate soil moisture stress resulting in irregular crop moisture deficit and either too low or frequent crop failures.

Research has generated a number of technologies that could solve problems facing the rural poor. A project supported by ASARECA-CGS Stream B was initiated in 2007 to address the problem by scaling up proven soil and water management (SWM) technologies and drought tolerant maize varieties in ECA countries. The main objectives were:

- To identify, document and avail proven soil-water management technologies for production of drought tolerant maize varieties to the uptake pathways;
- To develop capacity of farmers, extension workers and partners in use of improved soil-water management technologies with drought tolerant maize varieties;
- To up-scale key priority soil and water management technologies for the production of drought tolerant maize varieties, and
- To enhance availability of knowledge and information on soil-water management for the production of drought tolerant maize varieties to uptake pathways;

Contents

The project was implemented in Ethiopia under the auspices of the Ethiopian Institute of Agricultural Research, Tanzania (Selian Agricultural Research Institute) and Kenya (Kenya Agricultural Research Institute).

Main sites selected for this project in Ethiopia are Marmarssa and Dibibissa, both located in Adama Wereda of East Shewa Zone of the Oromiya Regional State at an altitude of 1488 m, and a mean annual rainfall of 756 mm. The areas receive meaningful rains in January (14 mm), and February (29 mm). Soils in the target sites are mainly of sandy loam, eroded, low in organic matter content, fertility,

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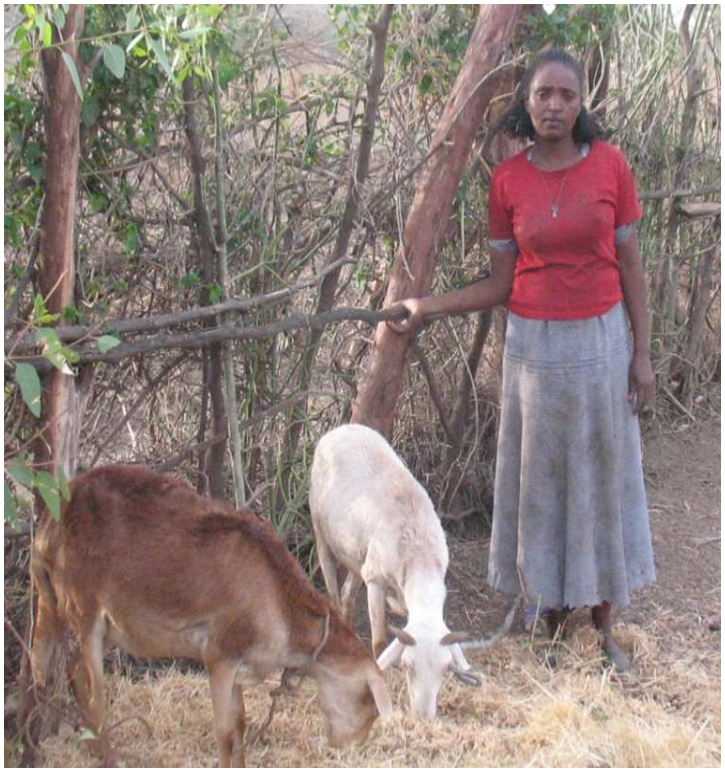

"We now have two sheep bought from sale of maize..."

and poor water holding capacity being prone to drought and resulting in periodic crop moisture deficits.

A baseline survey was conducted in Marmarssa and Dibibissa. The main purpose was to establish preliminary information about maize production practices adopted by farmers in the area for use to assess the impacts of the interventions beyond the project life. The surveys revealed that farmers grow three maize maturity groups, which are harvested in late October, with longer-maturity group favored by farmers because in years with better rainfall, they produce higher yields than early maturing ones. The average yields of early maturing varieties is 0.8 t ha^{-1}, 1.0 t ha^{-1} for medium maturing varieties and 1.6 t ha^{-1} for long term cultivars. Maize productivity is still very low averaging 1.2 t ha^{-1}, because of low and more importantly erratic rainfall.

The project organized an inception meeting with farmers and other stakeholders to introduce the project and identify issues and constraints impeding adoption of the technologies. Identification, documentation, and promotion of proven soil and water management technologies for production of drought tolerant maize varieties were carried out. A document describing an inventory of available soil-water management technologies and drought tolerant varieties was produced. On another stakeholders' consultative meeting, farmers and their support agents were invited to discuss the identified technologies and prioritize and select the promising ones for scaling out.

As a way to enhance farmers' knowledge about the soil and water management technologies for the production of drought tolerant maize varieties, a maize production manual describing selected maize varieties and improved farm implements was developed and used to train trainers, mainly Subject Matter Specialists (SMS). SMS then trained development workers based at each of the target locale. Development workers selected farmers who were willing to participate in the scaling out activities, and sensitized farmers with the technologies. Besides the hands-on exercises, an in-the-field training was organized for farmers on the use of improved tillage and water conservation implements. Farmers were given the implements to use on their fields. The scaling out activity was launched on 127 farmers' fields across the three target sites.

A series of participatory evaluation meetings, exchange visits and field days were organized and conducted for various stakeholders to demonstrate the benefits of improved technologies.

At maturity, crops were harvested and field measurements were carried out together with farmers. Averaged over all farms, 5.3 t of maize per hectare was produced from use of Melkassa 2 maize variety with improved small farm implements such as tie-ridger and mouldboard plow). On the other hand, an average grain yield of 6.1 t ha^{-1} was obtained from use of Melkassa 4 variety with improved small farm implements. In general, superior grain yield were realized from use of the improved management practices.

The project outcome clearly demonstrated that participating farmers were able to accrue the following economic outcomes:

- Time and labor saved from use of improved farm implements;
- Food for families;
- Additional incomes;
- New benefits (egg, milk, horse cart rental), and
- Seed for this season

The project aimed at increasing maize productivity at the agro-ecological target area through use of improved seeds and soil-water management technologies. The goal was to improve the standard of living of the target group. Indicators like number of technologies that were promoted to uptake pathway, level of awareness, incomes were documented at start of the intervention. As a result of the project, a number of households were able to improve their income levels, and housing and nutrition status.

The project was expected to reduce the impacts of rainfall related risks using improved small farm implements which enhanced availability of soil moisture to plant roots, and hence the technologies had no negative impact on the environment.

Indicators of novelty of the technologies upscale include:

- The level of awareness created;
- The level of crop yields;
- Number of farmers who accessed/adopted the technologies;
- Availability of seed for those involved and others in the communities;
- Improved availability of food at household level;
- Level of satisfaction and motivation of farmers;
- Encouraging signs of change in quality of life;
- Improved income levels, and
- Additional income and benefits - cows, sheep and chicken, and other income sourcing activities.

Lessons learnt from the scaling up activities are manifested on the following issues:

- Most often, information and resource poor farmers are blamed for not improving their situations;
- DTM can play significant role in improving farmers adaptive capacity (income and food/seed security);
- Improved small farm implements can improve productivity of water and minimize impacts of climate variability;
- Capacity development help a lot to realize outcomes;
- Improving awareness of farmers can enhances rate of adoption;
- Advancing DWs knowledge base is also crucial, and
- Strong collaboration among stakeholders increases efficiency.

The main challenges relate to sustenance of the efforts which could arise from lack of access of households to the improved seeds and farm implements due to lack of well-defined seed systems, as the formal seed system has already failed to meet such demands due to more focus on hybrid seed multiplication, and there are no locally trained artisans who can sustainably produce and sale small farm implements.

To ensure sustainable food and seed security, to improve farm income and livelihoods is to further activities of the project to implement the following key precursors for sustainability:

- Intensifying the initiative of scaling out of improved technologies through institutionalized scaling out (mainstreaming);
- Investing on scaling out of community based (decentralized) seed multiplication schemes;
- Linking farmers with market to ensure ready markets access and for better exploitation of market opportunities;
- Promoting better surveillance mechanisms for managing crop pests;
- Investing in mechanization of small scale agriculture;
- Re-tuning capacity of farmers, extension workers and other partners, and
- Strengthening innovation platforms and knowledge exchange/learning alliances.

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Korean Project on International Agriculture Opens an Office in Ethiopia

The Korean Project on International Agriculture (KOPIA) is working persistently to establish sustainable international cooperation in the agriculture sector through joint development of technology and resources. The project works on development of locally adaptable technologies through demonstration projects; joint development of genetic resources in KOPIA countries; and globalization of local foods; exchange of

programs for scientists and experts on foods, horticultural, bio-energy, fodder and tropical crops, livestock and genetic resources.

KOPIA has opened a new office in Ethiopia at Holleta Agricultural Research Center. As Dr Solomon Assefa, DG of EIAR, said through his representative Dr Tolossa Debele, the opening of the office has a huge role to advance the bilateral agricultural technologies exchange between the two countries. He added that it lays concrete on the already strengthened long standing relationship between Ethiopia and Korea.

Mr Nahm-Su Kim, Director General of Technology Cooperation Bureau of Rural Development Administration, as he opened the ten-day theoretical and practical training on artificial insemination and embryo transfer in cattle, expressed his appreciation to the co-hosts of the training EIAR, ILRI and Bill and Melinda Gates foundation for their relentless support, and explained that the workshop was hosted to serve as a development tool considering the dependence of 250 million African people on livestock for livelihoods, showing the grand potential of the continent in the livestock sector.

As part of its development activities, the Korean government has allocated 30 million USD to open a grand agricultural training and research center in Africa. This newly inaugurated office is expected to support the overall activities of KOPIA.

Increasing Water Availability, Access, Productivity on Degraded Lands

Funded by ASARECA (Association for Strengthening Agricultural Research in East and Central Africa), the project on *"Integrated Management of Water for Productivity and Livelihood Security under Variable and Changing Climate Conditions"* aims at improving the adaptive capacity of smallholder farmers in the semi-arid areas of East and Central Africa. It focuses on challenges of climate variability and changes through Integrated Water Management (IWM) approaches, encourages beneficial conservation and Natural Resource Management (NRM) solutions that improve response to market opportunities, competitiveness of enterprises, and ecosystem services. The methodology employs a PAR approach that facilitates joint experimentation and learning, and robust system simulation modeling tools and GIS in conjunction with innovation system approaches that draw together multi-stakeholders on strategic alliance basis.

The main objectives of the project are:

- To promote gender responsive integrated water management options to improve water productivity and to cope with impacts of climate variability and change;
- Develop capacity of stakeholders to develop and implement integrated water management options at farm and watershed scales;
- Recommend IWM policy options and institutional arrangements to minimize smallholder farmer's vulnerability to climate uncertainties , and
- Strengthen learning alliances and knowledge exchange systems for scaling up technologies and sharing information on improved water management.

Communities of the Adulala watershed, development workers and researchers planting trees, shrubs and grass species on denuded mountains

Outputs of the project are expected to facilitate innovations in policies, institutions, capacities, and technologies necessary to mainstream IWM.

The project main outcome is to develop a model watershed which will serve as a field school for the ten ASARECA member countries. The project was launched in June 2011, and is being implemented in Ethiopia, Kenya, Madagascar, and Rwanda. In Ethiopia, one of the project sites under the auspices of Melkassa Research Center (MRC) of the Ethiopian Institute of Agricultural Research (EIAR) is the Adulala-Batu-Roge Watershed including Adulala Hate, Haroreti, Batu and Roge localities. The watershed covers an area of about 1000 hectares. The areas suffer from frequent and severe droughts induced by the impacts of local and global climate variability and change. As a result, crop and livestock productivity are low. Denuded mountains within the watershed are Gara Game, Gara Gerbu, Gara Sori, Gara Gobu, Amsalu, and Abajifar. The project mobilized communities to fully engage in rehabilitation of the natural resources. The floods from these mountains have been devastating the farmlands, Wenji Sugar Estate, and MRC. There are a number of huge gullies formed because of deforestation on the mountains.

To support smallholders to adapt to the impacts of climate variability and change, the project mobilized communities to undertake massive natural resource management activities to be able to increase water availability in the degraded systems. From June to August 2011, about 5000 community members of the watershed were mobilized over the weekends and holydays to rehabilitate the degraded lands of the watershed focusing on mountain ranges. Farmers built over 16 km of soil conservation structures and planted over 250,000 tree seedlings, shrubs and grasses. They have set out a bylaw, agreed, and excluded human activities and livestock from the protected areas for a faster recovery of the system.

In addition to such community-driven actions, farmers within the watershed are actively involved in participatory testing of various water productivity enhancing interventions adopting PAR approach. So far, they have actively tested new maize, teff, haricot bean, wheat, barley, cassava, and various forage species.

Commodity	No. of participating farmers
Maize	346
Tef	92
Haricot bean	78
Barley	10
Wheat	10
Cassava	500
Forage	250
NRM	5000
Total	6046

In this project, the communities are regarded as drivers of their development agenda, while researchers assume a position of facilitators together with development workers from bureaus of agriculture. Researchers facilitate the process of change by supplying technologies, new knowledge, and training. The overall approach is called PAR, which involves learning while doing. The project also adopts an innovation platform that facilitates management of scarce water resources more efficiently and productively, protects ecosystems, increase food security, reduce poverty, and adapt to future changes in climate.

PhD Theses on Frankincense Tree

Abeje Eshete Wassie and Tefera Mengistu Woldie, from and Forestry Research Center (FRC) of EIAR and Wendo Genet Colleague of Forestry and Natural Resources (WGCF-NR) respectively, defended their PhD theses on July 15, 2011 at Wageningen University, The Netherlands. Abeje and Tefera have been working in the Forest Ecology and Management Group within the FRAME project,

which is a multidisciplinary project on sustainable use of dry woodland resources in Ethiopia. In this project, the main focus is on the tree species Boswellia papyrifera, providing frankincense, a resin highly valued on the local and international market.

Tefera studied the carbon balance of the frankincense tree and showed how photosynthesis products are distributed between growths sinks (e.g. growth, fruits, respiration, resin). Based on large field protocols, he scaled annual whole tree carbon gain from leaf and crown traits. He demonstrated that tapping of resin causes a major loss of carbon during dry seasons when trees are without leaves and deplete their carbon storage pools. He also shows that trees cannot refill their storage pools during the wet season, which implies that tapping depletes the carbon available to trees also in the long run. He found that tapping caused losses in total leaf area and reproduction, particularly in climates with less favourable conditions. Based on these findings, he came up with recommendations for the management of the frankincense resource, and emphasized that tapping intensities should be controlled below a threshold level, and also in relation to actual tree size and structure.

Abeje studied frankincense trees at the whole population level. He established an unprecedented large scale population study for dry woodlands, covering 19 different 2 ha plots. He showed that the production was remarkably similar between populations in different climates, and on contrasting soils. He related resin production to tree size and resin harvest intensities, and showed the limits of intensive tapping for the resin yield. He showed that most populations are in serious decline because successful regeneration is scarce or even absent and adult tree mortality is very high. Based on these findings, he sketched the possible objectives of frankincense woodland management, with a major focus on the protection of natural regeneration and adult trees.

Books on the Shelf

- Mitigating Crop Technologies and Seed Gaps