CIMMYT MR
International Maize and Wheat Improvement Center

MasAgro: CIMMYT and Mexico's partnership for sustainable maize production

Abstract: The CIMMYT-led project MasAgro develops farmers' ability to adopt the product of research on maize conservation and improvement, agronomy, machinery, ICTs and postharvest solutions. MasAgro has developed 49 improved maize varieties adapted to small scale farming in Mexico. Farmers and breeders collaborate to improve native maize yield potential and its resistance to diseases. Improved seeds and conservation agriculture have helped farmers increase yields and keep them above the national average. Participant farmers achieved, on average, a 25% increase in both yields and annual revenue. More than 30 local seed companies sold 1.1 million bags of improved seed in 2017, a combined market share of 21%. For every dollar invested participant farmers make $7. This strategy can be replicated in trainings, participatory maize improvement, or more ambitious breeding and capacity building projects.

Environmental challenge

Agriculture contributes significantly to greenhouse gas (GHG) emissions. Conservation agriculture (CA) based on minimal soil disturbance, permanent ground cover and crop rotations reduce GHG emissions. CA improves water infiltration and moisture retention in the ground, conserves soil fertility and health, and increases farmers' productivity and income. In Mexico's highlands, where CIMMYT runs a field trial since 1991, CA has had a lower global warming potential (GWP) compared to conventional tillage (CT). During the last drought in the region (2009), the GWP (including soil carbon sequestration, GHG emissions, fuel use and fertilizer) of maize grown under CA was -7,729 kg CO2 per hectare compared to 1,327 kg CO2 per hectare of maize grown under CT. Soil water content stayed above or near wilting point during the whole dry period under CA, whereas soil water values were below wilting point for three weeks under CT. Yields were up to 4.7 tons per hectare higher under CA than under CT.

Context

Maize production is key to Mexico's food security, nutrition and sustainable rural development. Mexico produces approximately 25 million tons of maize (90% white and 10% yellow) per year. White grain is used for human consumption and yellow grain for livestock feeding and industrial purposes. Mexico consumes over 35 million tons of maize (64% white and 36% yellow) per year and imports over 10 million tons of yellow maize mainly from the U.S. Most farmers grow maize under rain-fed conditions on 6 million hectares. Their productivity remains low at an average of 2.3 tons per hectare. Farmers growing maize on 1.5 million hectares of irrigated land in Western Mexico harvest an average of 8 tons per hectare. The groundwater stress of the aquifers feeding irrigated lands ranks among the highest in the world. Mexico must increase

maize yields to meet its demand for grain. However, a study published by Scientific American expects Mexico's agricultural output to fall by 26% in 2080 as a consequence of global warming.

MasAgro's sustainable intensification strategy

CIMMYT and Mexico's Agriculture Department (SAGARPA) are currently implementing the MasAgro project to help address maize production, biodiversity conservation, food security and sustainable rural development challenges. MasAgro is in its seventh year of implementation developing a sustainable intensification strategy of maize production systems based on conservation agriculture, and on the development and transfer of improved, high-yielding, climate ready maize seeds to farmers' fields. MasAgro develops small farmers' ability to adopt the product of CIMMYT's research on maize conservation and improvement, agronomy, farming machinery, information and communication technologies (ICTs), and postharvest storage solutions. CIMMYT has developed innovation networks or hubs between maize farmers, researchers, service providers, extension agents, authorities, local seed producers and industry representatives in 12 regions of Mexico that have specific agronomic, ecological, weather, infrastructure and market conditions relevant to maize production. Each hub is formed by research platforms, demonstration modules, extension and impact areas where improved seeds, management systems, farming machinery and ICTs are developed, tested and adapted to farmers' needs. MasAgro offers training to extension agents, technicians and farmers who maintain an ongoing exchange of information that has been key to achieve resource conservation and use efficiency, productivity gains and income increases.

Implementation

CIMMYT and more than 150 local and international partners from the public and private sectors participate in MasAgro's research and development (R&D) activities and contribute to its implementation in the 12 hubs mentioned before. Each year MasAgro's research infrastructure and impact areas depend on the different type and number of participants, although SAGARPA provides core funding and CIMMYT leads on most R&D activities. CIMMYT and Mexico's agricultural research system (INIFAP) have bred and released 49 improved varieties of white maize and yellow maize that are adapted to small scale and rain-fed farming conditions in central, south and southeastern Mexico. CIMMYT has also offered specialized training to more than 50 Mexican seed companies that reproduce and commercialize the improved seed in MasAgro's target areas. To help farmers adopt and achieve the yield potential of the improved maize varieties CIMMYT implements the sustainable intensification strategy described above.

Only in 2017, project partners and participants set up 52 research platforms, 1,468 demonstration modules of sustainable farming practices and 9,053 extension areas in 30 states of Mexico. MasAgro experts organized 2,099 field days to promote sustainable farming in the 12 hubs.

33,348 farmers participated in these demonstration events. Furthermore, 5,935 technicians and extension agents attended MasAgro trainings. 40 technicians also completed a one year certification program and joined the 360 experts that CIMMYT has certified in sustainable agriculture since 2011. These technicians monitored sustainable farming practices in 1,390 demonstration modules and in 9,673 extension areas covering over 28,000 hectares. Information collected from the field was registered in MasAgro's electronic logbook and added to the six-year (2011-2017) project database.

Key partners and stakeholders engaged

MasAgro is a bilateral collaboration project between CIMMYT and Mexico (SAGARPA) that involves over 150 partners including Mexico's agricultural research system (INIFAP and universities), local seed companies, multinational agri-food companies, farmer associations, local machinery workshops and several non-governmental organizations (NGOs). INIFAP, Mexico's agricultural universities and the local seed companies develop, test, release and commercialize improved maize varieties for small scale farming in the tropical, subtropical and temperate regions of Mexico. The multinational companies support MasAgro by rewarding farmers, researchers and opinion leaders for promoting sustainable farming (Cargill), offering training in the safe use of agrochemicals (Syngenta), and developing local supply capacities for responsible sourcing schemes (Bimbo, Kellogg, Nestlé). Farmer associations promote wider participation and offer plots to set up demonstration modules that show the advantages of conservation agriculture. Local blacksmiths produce different models of precision machinery following the advice and blueprints provided by MasAgro's mechanization team. Field workers and technicians of local and international NGOs collaborate in trainings, give farmers access to new local and international markets, and advocate for environmental conservation. The state-sponsored loan agency for agriculture (FIRA) also gives priority to farmers that receive training and assistance from MasAgro.

Biodiversity conservation and use

CIMMYT conserves and improves biodiversity in communities of Oaxaca and the Yucatan Peninsula where subsistence farmers grow native maize. In 2017, MasAgro conducted 38 participatory native maize breeding trials in 12 indigenous communities of Oaxaca. Local farmers, CIMMYT and INIFAP breeders collaborated to improve native maize yield potential and its resistance to prevalent diseases, such as the tar spot complex which causes yield losses of up to 90%. CIMMYT is also repatriating maize landraces at risk in the Yucatan Peninsula where farmers in search of better opportunities stop growing native varieties. CIMMYT partnered the Mérida-based Mayan World States Foundation to help farmers realize a better price for their produce in established and new markets. Top chefs in Mexico, Europe and the

U.S. have sourced grain from small farmers in Oaxaca and the Yucatan Peninsula including Enrique Olvera (Cosme, NYC, and Pujol, Mexico City) and Rene Redzepi (noma, Copenhagen).

MasAgro has had a positive impact in the lives of more than 300,000 farmers who have adopted conservation agriculture and sustainable farming technologies. Participant farmers grow 49 maize varieties bred for small scale and rain-fed farming conditions on more than 1.3 million hectares. MasAgro brought about stronger collaboration in Mexico's maize value chain. Researchers have developed seeds of high nutritional and industrial quality that farmers sell to different markets including food processing companies.

CA increases infiltration, reduces evaporation and erosion by run-offs especially between the harvest and the next growing season. Soil covered by crop residues can absorb 100% of the water poured by a 60mm rainfall. Bare soils only absorb 20%. MasAgro has made heat and drought tolerant maize seeds available to farmers in tropical and subtropical lands. Improved seeds and CA have helped farmers increase yields and keep them above the national average under rain-fed conditions.

MasAgro farmers strengthen food security by supplying local markets part of the grain that Mexico imports for livestock feeding and industry uses. SAGARPA records show that maize imports grew at an average annual rate of 6.5% between 2005 and 2014. The MasAgro yellow maize varieties available for participant farmers meet the highest industry standards in terms of processing quality and nutritious content. MasAgro facilitates contract farming and actively promotes responsible sourcing practices.

The latest data available shows that the productivity and income of participant farmers growing maize under rain-fed conditions was 92% and 105% higher, respectively, than average yields and income achieved by other farmers in Mexico. On average, rain-fed plots managed with MasAgro's sustainable intensification practices yielded 25% more grain and revenue to maize farmers than plots managed with conventional practices on the same farm. Similarly, Mexican seed companies have increased 70% their sales of improved seed since 2011. More than 30 small and medium-sized local companies sold 1.1 million bags of improved seed in 2017, which represents a 21% share of Mexico's improved seed market.

In addition to the heat and drought tolerant maize seed for tropical and subtropical regions, MasAgro is developing an information service that helps farmers mitigate the effects of extreme weather events. MasAgro Movil sent more than 45,000 text messages to farmers and technicians with climate alerts and agronomic recommendations in 2017. The information comes from meteorological stations across Mexico, technicians and partners on the field.

International acknowledgement and replicability

MasAgro has been acknowledged as, “the most original program so far to target the most vulnerable sector of agriculture in the world” (Bill & Melinda Gates Foundation); a “Mexican experience that could be used as a model for coordinating research, development, innovation, technology transfer activities and public private partnerships in the agri-food sector” (G20 Agriculture Vice Ministers 2012 Report); and, a success story of technology development and transfer to the field (The Next Global Breadbasket Report 2014). CIMMYT has replicated MasAgro on a smaller scale in Guatemala with funding from USAID. The Buena Milpa project is focused on making traditional farming practices more sustainable and on participatory maize improvement. CIMMYT seeks funding for similar projects in Central America and the Caribbean. Modest training work is underway in Haiti. The strategy can be adapted to local needs and budget sizes. Implementation may take the form of trainings, participatory maize improvement, or more ambitious breeding and capacity building projects.