

Report: Assessment of identified CLCA alternatives in Oaxaca, Mexico

Component 1: Participatory adaptive research with integrated capacity development of farmers and other key partners to fully implement and evaluate CLCA systems.



Subcomponent 1.1: CLCA system optimization

Diagnostic and Interventions in Oaxaca

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The project, 'Use of conservation agriculture in Crop-livestock systems (CLCA)' focuses on the growing challenges of food security, climate change, and land and natural resource degradation encountered by mixed smallholder farmers in dry areas. Considering the focus of the project, we are working in the high lands of Bolivia and in the state of Oaxaca (Mexico). In Oaxaca, the project domain is popularly known as *Mixteca*. The project activities were concentrated in the highlands of *Mixteca* called *Mixteca alta*. The *Mixteca alta* is in the northwestern part of the Oaxaca city, this region is characterized by multi-ethnic panorama, each of the communities with their own language, customs, and traditions. The panorama that exists in the region is one of a predominant marginalization, poverty, in the large semi-desert areas, lacking water and subsistence agriculture. This region has an altitude between 1700-2300 msl with eroded soils and extended maize fields mosaiced with pastures and forest ecologies. On an average the holding size is quarter hectare, therefore strengthening agricultural systems at scale is challenging.



Pictures: General erosion and eroded agricultural lands are common in *Mixteca alta*

The climate of project domain is characterized by semi-arid to sub humid in nature with erratic and patchy summer rains. Rainfall in the *Mixteca* is unpredictable in amounts and timing, even if the total rainfall is between 800-1200 mm, dry spells can almost kill maize during August-September. The rainy season lasts from mid-May through the beginning of October, with a dry spell occurring in August. This dry spell may last for two to six weeks which greatly affects maize crop. Farmers reported that changes in rainfall events in recent decades; later rains and more drought, have made crop growing conditions challenging for traditional farmers. Temperatures in *Mixteca* can be extreme from one season to the next, from subzero in winter months and hitting 40°C in the summers. It is pertinent to mention that about ninety per cent agriculture in *Mixteca alta* is rainfed with an average maize yield of 1.1. t/ha in a mix crop livestock type with presence of small ruminants.

1. **Challenges:** The main challenges for crop livestock production system in the region were identified as,
 - 1.1 Rainfed agriculture with erratic rainfall, prolonged dry spells,
 1. 2 Soil erosion, poor soils that cannot hold water or nutrients,
 - 1.3. Mono cropping of maize, or beans.

- 1.4. Weeds, pest and diseases, mainly chemical control which is not very effective.
- 1.5. High cost of production, fertilizers contribute to about 26% costs, soil preparation (12%) and harvesting (10%)
- 1.6. Use of crop residues for fodder.
- 1.7. Paucity of fodder and feed availability for livestock especially small ruminants

Considering these production constraints and food and fodder requirements interventions were designed in consultation with local stakeholders in a project meeting and subsequent field visits held in Oaxaca city in February 2020. The core foundation of the interventions was based on conservation agriculture-based management practices, sustainable diversification and intensification for crop and fodder production. In our desk studies, field visits and stakeholder consultations, we noticed that the famers are small and maize and beans are very important component of their diet. The project activities were implemented in eight municipalities of Oaxaca including, Heroica Ciudad de Tlaxiaco, San Andrés Sinaxtla, San Bartolo Soyaltepec, San Francisco Chindúa, San Juan Sayultepec, Santa Catarina Tayata, Santo Domingo Yanhuitlán, and Villa Chilapa de Díaz (Fig.1).

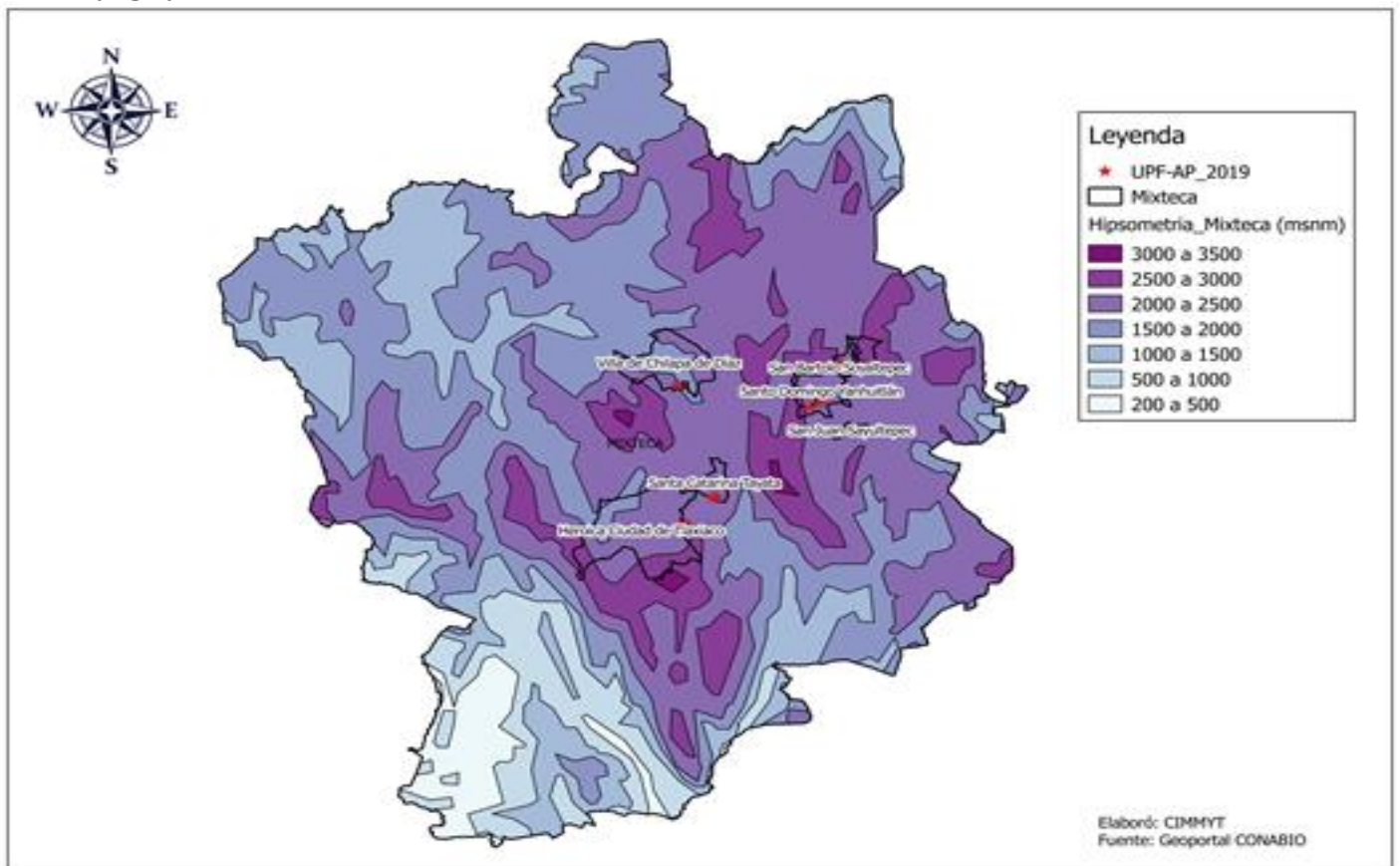


Fig1: Map of selected municipalities for project operations in Mixteca alta

2. Project interventions:

Considering the mix crop livestock production system, its constraints, the past CIMMYT experiences in the region, interventions were designed for sustainable system that the Project envision. The project aims at creating systems in which food and feed production can go on indefinitely, while at the same time improving the soil, environment, and farmer livelihood. the objective is to reduce the environmental impact, the production costs, ensure profitability, produce healthy food and maintain valuable ecosystem services.

Appropriate soil management and its ecology are essential for a productive and sustainable system.

Following interventions were identified for implementation in the project domains

CA-based maize and fodder production systems,

Introduction of improved and appropriate varieties of diversified crops.

Intercropping (rainy cycle) and relay cropping or of the fodder mix.

Multi species windbreaks to reduce erosion and to strengthen food and feed production.

Use of crop residues, cover crops and animal manure for improving soil health.

Controlled grazing of crop residue and cover crops.

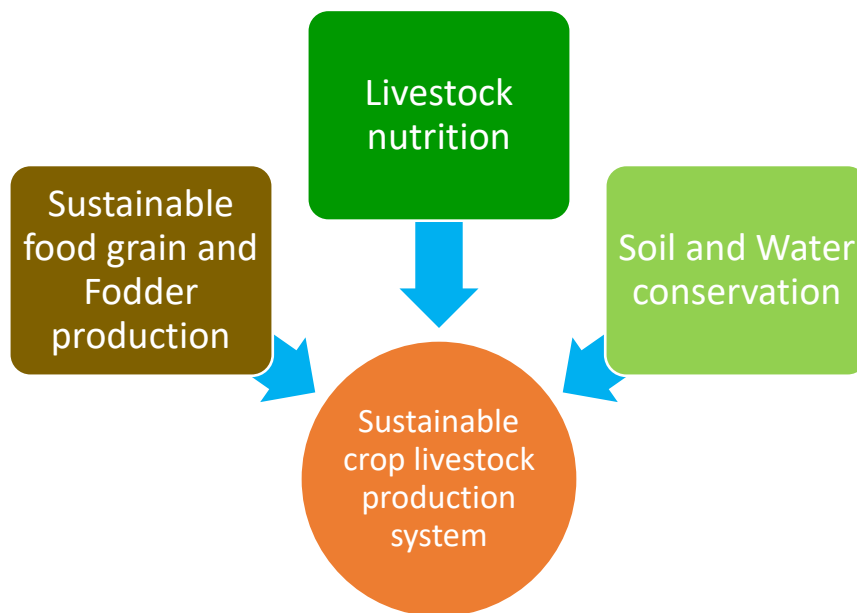


Fig. 2 Project interventions for crop livestock production system

3. Methodology

The project field activities were kept in three categories.

- i) farmer participatory adaptive trial, wherein we side by side evaluated project intervention with farmer practice, this was called “modules”.
- ii) The best bet practices were demonstrated in farmer field, with or without side-by-side comparison called ‘extension area’ and
- iii) progressive farmers trying best bet practices called ‘extension area’.

The best bet practice included:

- a) Maize planting at the optimum time (first fortnight of June) under CA.

- b) Relay intercropping of fodder mixture in rainy cycle following a dry season relay planting of forage mixture in September/October 2020.
- c) Peripheral multi species wind barrier using perennial runner beans and perennial forage grass, to reduce erosion and conserve soil and soil moisture.

Two main fodder mixtures were tested during the 3rd Cropping season of CLCA Project depending on “rainy-dry” cropping seasons. In rainy season the fodder mixture included VCaScI (Vetch, Canola, Sunflowers, Clover) and GRClCaO (Grasspea, Radish, Clover, Canola, Oats) in dry/winter cycle. The objective is to harvest fodder mixture at an early stage (V7-V8 stage of maize) so that maize crop did not suffer moisture or nutrient stress in its grand growth phase. The region of intercropping of fodder was also decided as farmers were not interested in sacrificing land for fodder on cost of maize crop. Fodder mixtures also provided ground cover to reduce runoff of the soil sediments, besides providing green fodder. With these sustainable soil conserving practices, we saw an evident reduction of soil erosion, improved water and nutrient availability to the crop plants resulting higher crop and fodder yields. In modules best bet practices were evaluates against traditional practice which was limited to conventional tillage (CT) and planting of maize during summer cycle only. However, in best bet practice intercropping of fodder mixture with was planted under CA. The lay out of the module is presented in Figure 2.

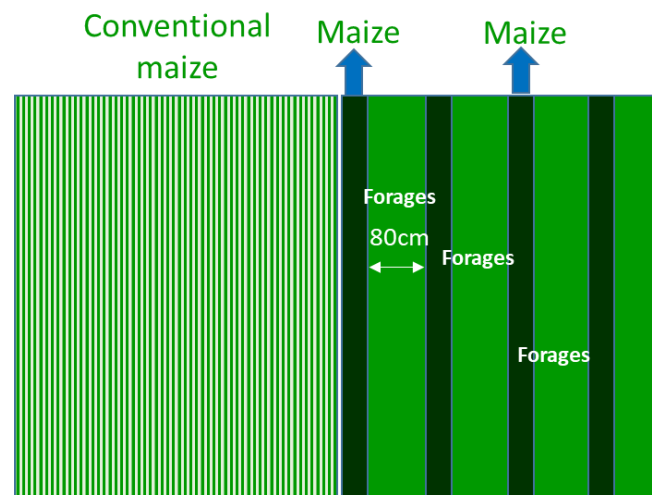


Figure 2. Lay out of a module

Overall, 13 adaptive trials (Modules), 9 demonstrations (Impact areas) and 108 adoption plots (Extension area) were laid down – in total, 130 farmer participatory field trials were conducted during the Project cropping season 2020-21. The geographical distribution of the field activities is mapped in figure 3.

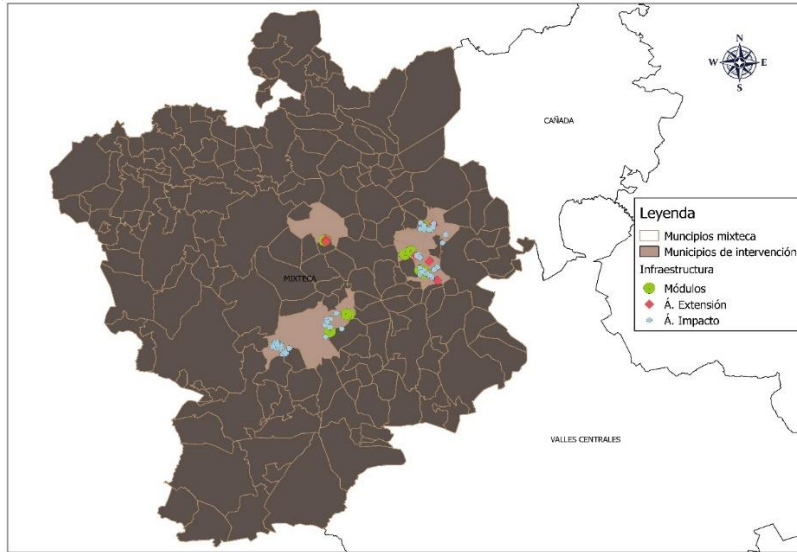


Figure 3. Modules, Extension area, and Impact area under CLCA systems in selected municipalities of *Mixteca alta*, Mexico

The farmer participatory trials were laid out in highlands (2000 to 2245 MSL) in semi-arid ecologies (precipitation 500 to 700mm, Fig. 5), with erratic precipitation pattern. The soils were variable mostly clayey, although there are sandy loam and clay-loam soils.

The best bet package on an average produced a fodder yield of 2.2 t/ha and maize grain yield of 1.43 t/ha while in control the maize grain yield was 1.48 t/ha. In improved practices plots farmers also harvested a limited quantity of ayocote beans for their household consumption. One of the major problems realized was presence of weeds which had a detrimental effect of crop yields under CT as well as best bet practices. On an average approximately 6.5 t/ha of fresh weed biomass was recorded in test plots, which is a great concern for us. Sound weed management in an appropriate way, can further fush maize yield by half a ton/ha. Consequently, in Year-IV, the Project team is planning to further strengthen CLCA agronomical packages to control weeds and include integrated weed and pest management practices in CLCA technological bundles.

. Nevertheless, we have observed that improved practices were able reduce soil erosion, which we were not able to measure due restriction of COVID protocols in communities. The improved agronomic practices were also found economically viable due to fodder production. In *Mixteca alta* the livestock component has much larger contribution to household income therefore enhance fodder availability con significantly raise their household income. The Project has further planned for scaling up CA and soil water conservation practices in the region, aiming a large-scale adoption.

