Parametric Insurance for Smallholder Farmers of Maize in Mexico

Feasibility Study

Funded by the InsuResilience Solutions Fund (ISF)

funded by KFW

on behalf of Federal Ministry for Economic Cooperation and Development

managed by Frankfurt School of Finance & Management
German Excellence. Global Relevance.

part of InsuResilience GlobalPartnership

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ABREVIATIONS

Agroasemex	Mexican Government-owned insurance company
AMIS	Mexican Association of Insurers
CADENA	National Disaster Attention Component
CADER	Rural Development Support Centers
CoDi	Digital Collection System
CONAGUA	National Water Commission
CONDUSEF	National Commission of Consumer Protection and Defence
CNBV	National Commission of Banks and Values
CHIRPS	Climate Hazards Group InfraRed Precipitation with Station
DDR	Rural Development Districts
DICONSA	Social Program Stores
ECMWF	European Centre for Medium-Range Weather Forecasts
ENA	National Agriculture Survey
ENOE	National occupation and employment survey
ENIGH	National Survey of Household Income and Expenditure
ERA5	Fifth generation ECMWF atmospheric reanalysis of the global climate
FAO	Food and Agricultural Organization
INEGI	National Institute of Statistics and Geography
MNO	Mobile Network Operator
MoF	Ministry of Finance
PROCAMPO	Program for Direct Support to the Country Side
SADER	Secretaría de Agricultura y Desarrollo Rural (former SAGARPA)
SAGARPA	Secretariat of Agriculture and Rural Development
SEL	Socieconomic Level
SIAP	Agri-food and Fisheries Information Services
SOCAPS	Cooperative Savings and Loan Societies
SOFINCO	Popular Community Financial Societies
SOFIPO	Popular Financial Societies
SPI	Standardized Precipitation Index
WB	World Bank

Executive summary

According to the terms of reference (ToR) and the contract signed by the project partners Guy Carpenter, Munich Re, Swiss Re, and AXA Climate with the Insuresilience Solutions Fund (ISF) the objective of the present feasibility study is: *to find the elements that will allow the development of a suitable insurance cover to protect smallholder farmers (owning and/or cultivating less than 5 hectares) in Mexico against extreme weather events (drought and excess rain).*

The Ministry of Finance (MoF) and Agroasemex strongly support the study as well as the foreseen following project, which main driver will be the implementation of an insurance scheme that ensure that payment of claims will reach farmers directly and rapidly to mitigate the impact of natural events.

Methodology. For the purpose of the study the team has followed different methodologies: a) review of available documents and information, especially to define the target group, risk exposure and main crops as well as the most vulnerable States; b) analysis of existing data needed for developing parametric insurance solution; b) review the CADENA experience; c) review of international case studies; d) hold meetings with the counterparts from MoF and Agroaxemex, to discuss possibilities and solutions; e) conducted interviews with different services provides that will be key for the implementation of the project, such as mobile service providers, financial institutions, and others.

Target Group. According to ENOE, there are about 5.5 million farmers in Mexico, from which around 4.4 million are smallholder farmers (80%). Smallholder farmers are mainly concentrated in the southeast States of the country. For this reason, three States (Oaxaca, Chiapas and Tabasco) were selected to conduct the study, given their large population of low-income smallholder farmers and their level of vulnerability. In these States, there are 4,560,401 adults living in rural communities in Chiapas, Oaxaca and Tabasco, from which a total of 2,973,212 are classified in the lower income segments (C to E)[1], which clearly fit in the group that the project is targeting to.

Crops. Mexico's six strategic staple crops are rice, beans, corn, wheat, soybeans and sorghum, being corn by far the main staple crop, followed by beans. Out of the 20,664,554 Ha destined to growing crops in Mexico, 7,157,587 are destined to growing corn (35%). According to ENA 2017 4 out of 10 Ha of harvested land in Mexico were corn. Therefore, it is the most relevant staple crop and subject of this study. Besides of that, corn is very relevant for smallholder farmers, because this a traditional crop for self-consumption purposes in Mexico (tortilla, tamales, and many other dishes).

Main reasons for the cancellation of CADENA. The main issue was that the State Governments were the contractors and direct beneficiaries of the insurance, meaning that they could use the resources of the compensation for priorities defined by them. Therefore, compensation did not reach the farmers systematically, especially smallholder farmers, aspect that was questioned by the current government, leading to the cancellation of the program and to look at new possibilities to distribute the benefits to the farmers without intermediation. In the meantime, farmers do not have any protection. A second aspect was that insurers placed reinsurance contracts individually, which increased their costs instead of placing a global program and accessing a better price. Furthermore, Agroasemex participated as first floor insurer and other competitors saw that as an unfair advantage.

Potential set-up

Eligibility requirements for the target group. Three eligibility requirements for smallholder producers to be beneficiaries of a potential insurance program were identified:

a) 5 or less hectares (Ha) of total land for cultivation as an adequate threshold to target the base of the income pyramid

b) <= 15USD/ PPP. Most of the adult rural population on the three states is classified under the two lower segments (D and E) of Social Economic Level (SEL) for 2019, in average 66%. Furthermore, all three states are classified among the 6 states with the highest level of poverty in Mexico.

c) Beneficiaries of the program have no access to any other insurance program

1 Income between 3 to 4 usd per day in rural communities

Distribution and Compensation. Learning from the CADENA experience, our program aims to compensate the farmers directly (avoiding intermediaries). After analyzing several options, it was identified that the most efficient way to reach and enroll farmers is using the existing national infrastructure from the Ministry of Agriculture (SADER).

For the targeted smallholder farmer segment, savings & credit cooperatives and development banks have the highest banking penetration. Nonetheless, penetration is still low, especially in rural areas and it is a challenge for banks to access and serve all producers. To be more efficient in the distribution of payouts, the best approach will be to use the existing infrastructure from ***Banco del Bienestar*** and the accounts that are tied to social programs of SADER and the Ministry of Welfare.

Crops and regions. As a result of the study and the importance of corn cultivation, especially by smallholder farmers, this will be the crop that will be covered by the insurance solution to be developed. While the aim of the IDF project's insurance scheme in Mexico will be at a national level, the Feasibility Study has focused on three states also for conducting an operational pilot in a first phase of the program.

Data Analysis. In order to carry out the study and the selection of municipalities for the pilot test, a compilation of public databases was made, ordering all the information into three large categories: I) Socio-economic information, 2) Information on services and characteristics of the housing, 3) Agricultural information and climatic risks. This with the purpose of having an order in magnitude, location and timing of all the information collected. All data are calculated by national organizations (INEGI, CONAPO, IMCO) and reviewed by international organizations such as the UN, UNECE, ECLAC, etc.

Index building methodology. Information to build a relevant index was gathered, regions and subregions growing corn in the three selected states were identified and the underwriting / compensation history from the CADENA program was analyzed. For the construction of the indexes, the Soil Moisture Index (using data from ERA5) that considers temperature impacts to yields and Standard Precipitation index using CHIRPS data is used, considering that the thresholds for each crop and region are different.

Events to be covered: An outcome of the study suggest focusing on drought and excess rain given that drought is the cause of most reported losses, and excess rain is relevant in the southeast of the country.

Parametric Insurance: Two possible parametric insurance structures were identified and will review in detail with the underwriting teams as the program move forward: Crop Moisture and Standardized Precipitation Index (SPI). Examples of the possible structure of the program will be discussed with the counterparts from the Ministry of Finance and Agroasemex to get their approval.

Considering the total exposure in the country, there are 7.1 million Ha dedicated to growing corn (about a third of the 20.7 M total Ha destined to growing crops in 2019)2. For the three states the study focused in the 1.224.056 Ha dedicated to growing corn and a potential payout of 100 USD per Ha3. In this sense, the total limit would be USD 122.405.600. We will use USD 120.000.000 to simplify the illustration below:

Linear Compensation (SPI)

Once the trigger is reached, the compensation is paid per each mm of rain above or below the trigger at an amount agreed previously. (i.e, 1% of payout per each mm of accumulated rain that is above the trigger)

Stepwise Compensation (Soil Moisture)

Pre-defined steps of soil moisture (for drought) cover are agreed with the client. It works the same way as the linear compensation, but the steps of the coverage vary according to the interests and risk appetite of the client.

One-to-one communication with producers. To create awareness and reach farmers on a one by one basis we propose we propose to use: SMS, pre-recorded audios by phone, and onsite information at SADER's regional offices.

2 Link to Total crop area in 2019 from Statista

3 The potential payout was initially aligned to what CADENA considered to account for the large number of potential beneficiaries and budget concerns from the overnment. The payout is considered as a support for first expenses, but we will have a conversation with the authorities to explore a higher individual payout.

We have identified two potential technology partners for the implementation of the front-end platform. Both have comprehensive and proved solutions specific for a program like the one we are proposing (Democrance and Raincoat)4. We are in conversations with them to prepare an RFP ahead of time to be ready in case we are invited to present a full proposal.

In case we are invited to present a full proposal, we have identified a set of success factors to observe in the implementation of the project mentioned in detail in the document.

A pilot on three states. 15 municipalities were identified for the pilot. A possible operational approach with smaller communities being in a 30 to 45-minute drive from medium locations (with at least15,000 inhabitants) to withdraw their payout, and within a 1:00 to 1:30 hour drive from larger communities where DICONSA stores could potentially offer seeds and basic food products at social cost. If a program that works in this region can be established (covering approx. 1.548.166 producers from the base of the pyramid), it won't be a problem replicating it to the rest of the country.

Availability of resources. The Insurance Unit in the Ministry of Finance is committed to develop, implement and subsidize the premium of the program for smallholder farmers, based on the (successful) results from the pilot. Assuming we are invited to present a full proposal, the pilot test can be operated during the first half of 2022, throwing first results and for analysis in Q3 2022, when the budget of the country for 2023 is decided, and thus budgeting the necessary amount for the subsidy. The pilot can finish gathering results and making the necessary adjustment to improve until the end of 2022. Given their previous experience, the scale up can be done in six months, allowing enough time in 2023 for a full scale up of the program.

Involvement of the insurance sector. The participation of insurance companies will be crucial to ensure sustainability; therefore, an official communication channel through AMIS will be asked. The current legal framework allows the offer of parametric insurance products within the boundaries of the regulation.

Project Partners. The project will be a common work between the Ministry of Finance of Mexico, Agroasemex, AXA Climate, Guy Carpenter, Swiss Re and Munich Re. Probably the Ministry of Agriculture will become a project partner as well. All partners will put all higher efforts in ensuring the success and sustainability of the project and the measures financed for its implementation.

4 They have mentioned that given that the development is already done and what is needed is to adjust it to the details of our program, the consider that a couple of months is a reasonable time for the set up (in absence of any blocking elements)

1 Developing a relevant insurance solution for smallholder farmers

The opportunity we have for structuring and implementing an insurance solution for smallholder farmers in Mexico is based on at least three dimensions: i) developing a relevant insurance solution; ii) successfully managing the distribution to reach smallholder farmers directly, and iii) developing a set up that allows for many insurers to participate. In order to answer these questions, a simple methodology was followed as described in the following section, and an analysis of the CADENA program was conducted:

1.1 Methodology followed for the development of this study

1. **Developed a clear understanding of the requirements for a parametric insurance Program** and the feasibility of a parametric coverage.
    - **Information from different sources**: SIAP Database, INEGI Database, ENA database, World Bank reference documents, FAO Reference documents, CADENA articles, Agroasemex database, best practices from other geographies.
    - **Research and review reference documents**. Reviewed all documents and generate summaries that were presented in the weekly meetings with other team members. Sections of relevant information are included portions in the Feasibility Study as reference.
    - **Interviews and weekly meetings**. Regular meetings with Agroasemex head of agricultural insurance together with Guy Carpenter and Swiss Re to learn from past experiences and brainstorm on feasible alternatives to approach the problem.
    - **Generation of internal Proposals**. We have developed different alternatives that were presented in the weekly meetings that we had with Agroasemex, Guy Carpenter and Swiss Re, to discuss the implications to the ideas, ditch the ones that did not work, and improve the ones that made sense to the group.
    - **Contacts with Service providers**. Contacts with potential suppliers for different services (i.e., MNO's, platform developers) to learn about their capabilities, coverage reach of their services, and their cost structures.
2. **Developed a Concept of the business model**. With all the collected information a concept of what we all thought could be a feasible solution was developed. The first draft of the concept was reviewed, adjusted, and challenged several times by the local IDF team and the Agroasemex team to improve its operational efficiency. An agreement on the most relevant points was reached.
3. **Started conversations with potential suppliers**. Once a first idea of a concept was developed, conversations with potential partners5 from different industries were initiated in order to better understand their requirements and business models. With their input, the idea of the concept for the program was improved. We identified that the individual sign up would be one of the most challenging operational issues for the program to be cost efficient and effectively sign up the farmers.
4. **Proposed a Pilot Test**. Reviewed all the information and challenges in detail, the team concluded that given the operational complexity of the distribution aspect, the best approach is to conduct a small pilot in the region that concentrates a large proportion of smallholder farmers.

1.2 Main lessons learned from CADENA's experience

1. **State governments as contractors.** The main issue CADENA faced was that the State Governments were the contractors and direct beneficiaries of the insurance (it was a simple structure). They could use the resources of the compensation for different priorities and the money did not reach the farmers, systematically, especially the smallholder farmers. This situation was observed as negative by the current government, leading to the cancellation of the program and to look at new possibilities to distribute the benefits to the farmers without intermediation.
2. **Individual risk placement**. Insurers placed reinsurance contracts individually and that increased their costs. They have missed the opportunity of placing a global program in the insurance market, and the opportunity to access a better price due to the larger exposure.

5 Mobile phone operators, front end developers, risk modelers, insurance related service providers, etc.

3. **First floor insurer**. Agroasemex participated as first floor insurer and the other competitors saw that as an unfair advantage. Agroasemex had the responsibility of structuring the program as well as to placing it. When other insurers saw the government insurer competing for portions of the program, they quickly got demotivated.
4. **Coarse images**. For the follow up of the damages to crops covered, satellite image definition was sometimes not accurate enough to compensate individual farmers (it was coarse). Agroasemex started developing measures with SIAP to increase the accuracy of the program6.
5. **No individual Insurance**. CADENA programs offered macro-level insurance cover to the State Governments, while usually measuring losses at the municipal level as the unit area of insurance. In other words, it was not an individual farmer insurance cover. In-field loss assessment was conducted at an area-level and not at the individual farmer level.
6. **Benefits for State Governments**. For the payment of a pre-agreed premium, the maximum liability could be quantified in advance and transferred out of the fiscal budget to local and international insurance and reinsurance markets. Insurance payouts under a weather index program went fast to State Governments and the need for in-field assessment on area-yield-based index programs was reduced. States purchased insurance to protect their budgetary allocations from natural disasters[7].

1.3 Operation of the CADENA Program

The CADENA crop insurance products were based on Macro-level Index products. Under the crop insurance programs, there were two types of index program:

1. **Weather Index Insurance products**8 which used ground-based weather stations to insure crops against key perils rainfall deficit (drought) or excess rain and other catastrophe climatic perils such as hurricane wind speeds, low temperature/freeze and floods. The main problem faced was that there were not enough weather stations and the error margin was high. They used
2. **Area-based Yield Index Insurance products**[9] which operated at a municipal / agrarian nucleus /*ejido* level and involved actual infield sampling of crop yields to establish the actual average municipal yield and, if applicable, the amount of yield loss. The problem faced was that for medium sized producers, the average yields were to low and compensation not enough.

In the event of a triggered payout on the CADENA programs, the payment was made to the State Government as the Insured, or in the case where Ministry of Agriculture and Rural Development (SAGARPA) purchased the cover (without Adhesion of the State Government), to SAGARPA. It was then the responsibility of the State Governments and SAGARPA to distribute the benefits to the farmers in the affected areas. The main drawback was that it was very time consuming to conduct farm-level loss assessment. A second method involved the a priori registration using the PROCAMPO (*Programa de Apoyos Directos al Campo*, a program that provided direct support to farmers administered by SAGARPA) lists of the targeted beneficiaries in each Municipality and establishment of the sum insured for each named farmer.

Other (more operative) lessons learned from CADENA that could be used as reference in the new program are10:

Try to do again if applicable / possible

- Eligible farmers were only those without any other form of public or private agricultural insurance and who owned and/or cultivated less than 10 hectares of rain-fed or irrigated annual crops and/or less than 5 hectares of rain-fed or irrigated perennial fruit crops
- Subsidies varied according to the marginalization index of the Municipality: High and Very High were given 90% from Federal Gov't and 10% from State Gov't, Medium and Low were given 80%

6 We have been told by the person who is responsible of agro insurance in Agroasemex, that the latest measures were more accurate, and that they may be available for our program.
7 Mexico. Agriculture Insurance Market Review June 2013. World Bank LAC
8 Seguro Agrícola de Indices Climáticos, SAIC
9 Seguro Agrícola de Índices de Producción, SAIP
10 Mexico. Agriculture Insurance Market Review June 2013. World Bank LAC

Federal Gov't and 20% State Gov't subsidies. The resources flowed from SAGARPA and the state governments to the insurance companies, which in turn ceded the premiums to the international market.

- Standard sum insured of MXP 2,000/Ha for irrigated crops, perennial fruit crops and coffee and MXP 1,200/Ha for all rain fed crops
- State Governments were responsible for identifying the planted area of each crop in each Municipality
- PROCAMPO listed the targeted beneficiaries in each Municipality and established the sum insured for each named farmer for Apoyo Directo
- Almost 70% of CADENA beneficiaries managed less than 5 Ha., and over 90% were owner occupiers. Nonetheless, given the structure of the contracts and the difficulty to reach the farmers individually, the payouts did not reach them.
- 99.4% of compensated farmers returned to farming activities thanks to the program. Uses of payment were: farm improving, debt repayment, purchase agricultural inputs. (U Chapingo 2010)

Try to avoid

- High average premium rates for a program designed to cover only major catastrophe climatic events (11.9% RoL on average), review and strengthen the contract design and threshold triggers to restrict pay-outs to catastrophe only events

1.4 Assessment of possible solutions to the experiences from CADENA

Given the experience from CADENA, different options of policy contractors, structures, payout arrangements, enrollment of farmers and policy issuance were analyzed.

Structure. To solve the challenge of the distribution directly to the farmers, there are different alternatives for the contractor of the policy, and to reach the farmers directly with the payout:

1.4.1 Contractor alternatives

a. **Insurance and Pensions Unit from Hacienda**. It will be a logical option given that the Unit is collaborating closely with the team, and the Head of this unit is the person that reached out to IDF for the development of this project. They also validate the insurance programs that the states acquire to comply with Federal laws.
b. **New Federal Agency for the Comprehensive management of Public Risks**. It is what the Insurance unit from the Ministry of Finance will evolve to. The advantage of having this unit as contractor, is that they will have more faculties to enforce the inclusion of more comprehensive risk transfer programs.
c. **Ministry of Agriculture**. It will be the natural option given that they currently have several social programs in force for smallholder producers. The insurance coverage could be an extension of the benefits that they have11.
d. **Ministry of Welfare**. This ministry has numerous programs aimed at improving the resilience of people in vulnerable circumstances and therefore the proposed program is complementary. Yet, the highest correlation is with the Ministry of Agriculture.
e. **Municipal Governments**. They are also an option, but we believe that it would be complex given the high number of municipalities (2454) and the paperwork could be cumbersome.

1.4.2 Reaching out to farmers directly

This challenge has more than one angle that must be structured: a) the enrollment of beneficiaries, b) the delivery of the insurance contract, c) the update of information, and d) the direct payout functions.

f. **Alternatives for the Enrollment of Beneficiaries**.

11 This option has been suggested by the Ministry of Finance and they have offered to facilitate the conversations with them.

i. **Use the current Ministry of Agriculture and Rural Development (SADER) Infrastructure**. SADER has district and regional offices where they usually have contact with the farmers. Getting their cooperation, the project could benefit from their already deployed workforce. They also have databases with information from the farmers that could facilitate the enrollment.

ii. **Use Ministry of Welfare infrastructure**. Same as the SADER, this ministry has people in place (not as numerous) that could help us enroll the producers. Although the relationship is not as evident as in the case of SADER, it could be an option, since this is the infrastructure for social programs deployed by federal government.

iii. **Use Infrastructure from an NGO (Red Cross).** We considered the option of having the Red Cross assisting with the enrollment at least for a small operational pilot, since they have offices across the country. The project team members have a good relationship with the organization. The downside is that they Red Cross has its own priorities and the enrollment could be affected by them.

iv. **Use Civil Protection infrastructure.** They have small groups present in most municipalities, and we could reach them to see, if for the pilot they could collaborate with us. Still, we would need to evaluate their long-term participation given their priority is not fully aligned to the goals of the program.

v. **Insurance Funds**. They are mutualist organizations that have no entrance fees and are designed to group medium and large producers to access insurance coverages. We could reach out to some of them and see if they could extend their scope to include smallholder farmers.

g. **Delivery of insurance contract**.

i. **Develop a platform to deliver PDF contracts on site if possible**. The enrollment function needs to be as efficient as possible. If we can get the producers signed up and deliver the insurance certificates in the same contact, it would be very beneficial from the operational and financial perspectives. The front-end platform would need to communicate with the issuing systems of the participating insurers.

ii. **Deliver paper certificates using the infrastructure of SADER**. Given the low internet-digital usage in our target segment, paper certificates could be distributed to every producer enrolled who asks for it (otherwise they only get a PDF copy). This however is not the eco-friendliest approach, plus it also has the cost of paper to it.

h. **Periodic update of information**.

i. **Use one of the enrollment options presented before**. If relying on the infrastructure from SADER or Welfare Ministries, it would also be needed to develop a process for endorsements and policy maintenance.

ii. **Use online platform**. The cleanest approach would be to develop a front-end platform that allows collecting all information needed for sign up of the producers and share it with the insurance company(ies) operating the program. This option implies the purchase/ development of the solution, and maintenance costs.

iii. **Develop/use call center infrastructure**. Another option could be to hire and train call center positions that could handle remotely all endorsements from the producers. For this option, it would be needed to develop a communication array between the enrolment systems from the call center (front end) and the issuing systems from the participating insurers. Although being an efficient solution, it might work even better as part of a more integrated solution.

i. **Payout of claims**.

i. **Use Banco del Bienestar Infrastructure**. Producers who are registered in the social programs from the SADER and/or the Ministry of Welfare have a debit cards from *Banco del Bienestar* to use funds received from those institutions. Ensuring a collaboration with any of those government entities, could allow access to the accounts of farmers using their programs.

ii. **Issue dormant debit cards**. Another alternative is to partner with a micro finance institution or bank specialized in our segment that targets the potential beneficiaries, and in case of a claim, issue 'dormant debit cards' that are activated by the beneficiaries with a phone call and used afterwards.

iii. **Use mobile phone infrastructure**. To send unique reference numbers from a participating bank. This alternative calls for a previous agreement with a bank that helps us disperse the funds to selected accounts and/or issue reference numbers linked to the ID of the producers. These references are shared with the producers via text or mail, and they must go to a bank branch to cash the money with a valid ID.

1.5 Different set up alternatives

The setup of the program must allow for the largest number of insurers to be interested in participating, it must also help the project to have a clear leader in the setup, and proper updating of the technical details every year. In this sense the following alternatives were analyzed:

1. **Agroasemex working as an insurer**. AgroAsemex can act as an insurer like the rest of the participants. They compete for different portions of the risk under the same rules as the rest of the insurers. The operational implications of this arrangement are that we must set up a front-end platform that is open to manage the connectivity with a few potential participating insurers. The downside of this alternative is that other participating companies might perceive an unfair advantage from Agroasemex in the assignment of the portions of the program and feel discouraged to participate.
2. **Agroasemex working as insurer and reinsurer**. Agroasemex has as well the capacity to act as a reinsurer and back up the insurance companies who are interested in fronting a portion of the risk in some states. This is something they explored with CADENA: they were reinsurers providing capacity for the program, but when insurance companies did not present their quotes they had to participate as well as insurance companies. The downside is the same as in the first case, other insurance companies get discouraged to participate.
3. **Agroasemex as Technical Administrator of the program**. In this set up, using all its experience Agroasemex develops the program rules for the participation of insurance companies and manages the technical requirements of the program, updates indexes so they remain relevant, and places the program in the reinsurance market. They do not participate as insurers and allow other companies to openly compete for portions of the program. We believe this one to be the better approach in the long run12.

1.6 Critical success factors from the CADENA experience that we aim to include in the proposal

There are important points to be observed in the proposal that will be submitted in order to be efficient, functional and accepted by the local and international markets. Here a short list of the main learnings from the CADENA experience that can be include in the proposal to ISF.

1. The **states cannot be the contractors and/or direct beneficiaries** of the coverage. Discussions with the Ministry of Finance on the possibility that they could act as contractor are on-going. In any case, it is foreseen that the beneficiaries must be the individual farmers.
2. Structure a reinsurance **a pool to access to better costs** for the participating insurers.

12 Agroasemex has kindly accepted to help us structure the operational details of the pilot test using their systems and infrastructure, and once the program is operational, step back and only participate as a reinsurer.

3. Provide complete transparency that **Agroasemex will be an administrator of the program**, not participating of the risk as an insurer (will only help us structure the pilot and then step back).
4. **A clear structure and operational model** must be set up. The rules of the program must be very clear to make sure that many insurers are interested and motivated in participating.
5. **Develop a plug and play operational model** that is open to the different needs that the participating insurance companies may have, to be as inclusive as possible.
6. Even though the target segment has almost uniform low production, we will **start simple with a parametric drought and excess rain coverage** across the country for the crop of corn. Yield will not be included as an option for the duration of the project.
7. **Understand and improve one on one signup/enrollment model** that will be tested in the pilot, to make the program more efficient.
8. Establish a **candid conversation with SADER and the Ministry of Welfare, and other government entities** involved to secure their active participation in the enrollment and in the follow up of the program.
9. Validate that the **image and radar resolution** from participating the calculation agent is granular enough to distinguish individual producers to properly pay claims and lower basis risk. This should be tested during the pilot.
10. **Other success factors.** We have identified a first list of success factors to consider as we move forward with the concept of the program along four dimensions: Impact, Sustainability, Efficiency and Effectiveness. Please see Box below:

Impact	Sustainability	Efficiency	Effectiveness
Reach as many smallholder producers as possible	Secure subsidy from Ministry of Finance	Target compensation to help farmers cultivate a larger area next year	Use **government resources** (PROCAMPO, DICONSA) when available to control costs
Achieve proper mutualization of risk	Develop an inclusive insurance model that enrolls the people that really need it	Access technologies that allow for a total coverage cost-effectively	Regularly **update** beneficiaries and crop **census**
↑ smalholder farmer resilience	Identify and address the needs of the target group with the designed compensation	Each farmer knows what to do **to** maintain an updated profile and to receive compensation	Identify and develop a network of **community leaders** to support the program
Achieve a repeatable and scalable model	Train beneficiaries to manage their information in the selected platform	Proper maintenance/update of beneficiaries DataMart	Be as cost efficient as possible before **scaling up**
Develop a profitable business case for all stakeholders involved while fulfilling the social need (Create shared value)	Foster gender parity and use local languages	Enrollment and follow up timely communicated to each stakeholder	Properly use **satellite imagery** to follow up and compensate (no delays and claim handling costs)
Check that the compensation received is sufficient and meaningful for our target group	Identify and properly address the political context around smallholder producers	Reach the allies that grant more capillarity with beneficiaries	Choose **simple, cost effective communication technology**
↑ Productivity (vol/Ha), ↑ #Ha sown ↑Ha/ Producer	Empower producers to manage Kiosks and to be more independent	Target 100% of farmers to return to farming after compensation	Identify and share best practices to **decrease risk exposure**
Improve producers resilience measures	Generate agreements with Farmer Unions to reach more producers	Design contact to be simple, relevant, and inclusive	Generate/maintain a **relevant stakeholder map** including their interests
		Simplify geographic interaction for beneficiaries	

Chart 1: Other success factors for smallholder insurance program

2 Brief description of the main requirements/necessary changes to be fulfilled by a new scheme to successfully address challenges

Some of the most relevant requirements for the program are presented for the technical design of the product, in the selection of the target group, for distribution and other relevant issues for the government and facilitate the participation of other insurance companies.

2.1 List of main requirements/necessary changes to be fulfilled by a new scheme to successfully address the challenges

1. **Technical product design**
   - **Design an index with high correlation to losses** in the selected regions. To benefit as many farmers as possible, pricing will be accurate and accessible.
   - **Select return period of events long enough** to filter frequency events and allow for more accessible pricing. One of the lessons learned from CADENA is that we need to filter frequent events and find a complementary solution for those events. This way parametric insurance cover will be relevant for the events that cannot be handled through other measures. Yet, this point shall be agreed with Agroasemex and the Ministry of Finance (MoF).
   - **Start simple and sophisticate as the program evolves**. Although we have found many 'nice to have elements' for the program (i.e., development of online markets for producers) we want to start with the minimum requirements to have the program up and running and delayer the complexity of additional functions. For the scale up of the program, we will design a program that simplifies the pricing at a municipality level (2,457 municipalities in the country).
   - **Develop a Plug and Play approach**. In order to facilitate the participation of as many insurers as possible, all technical and operational details of the program need to be as simple as possible for them to join the program. If we have guidelines, coaching for IT teams, readily available technical indexes, a front-end that is easy to hook up to, etc., more companies will be interested in joining.
   - **Validate quality/resolution of satellite imagery**. To lower the basis risk, we need to be able to adequately separate the portion of crop land that is affected by a weather event, and we need to calibrate the available tools and processes to compensate the affected beneficiaries. Agroasemex has shared with us that SIAP is their preferred option for Calculation Agent, and that they have complimentary analyses to satellite imagery to gain access to higher resolution. We will test these capabilities during the pilot test.
2. **Target group**
   - **Correct identification and enrollment**. We are structuring a social program, and it needs to reach the people it is designed for. It is vital for the success of the initiative to get in contact and enroll only the producers at the bottom of the pyramid, and maintaining their information updated for the program to properly function. The project counts on the support of government agencies for this task13. Moreover, we have developed a complementary solution that can help registering them and geolocating them during enrollment.14
   - **Correct identification at payout**. It must be guaranteed that the people receiving the payout are the same beneficiaries that were signed up, that they are legally bound to the crop land, and that there will be only one payout per crop. National ID cards at both ends of the process will required to present. The contacted vendors have shared that there are mechanisms to automatically check online the veracity of ID information. This aspect will be validated during the pilot test.
   - **Quick payout delivered directly to beneficiaries**. Resilience means being able to bounce back faster and mitigating the effects of the disaster for the people affected. The sooner they can retake their producing activities, the better equipped they will be to withstand the economical

13 We already have conversations with the Insurance and Pensions Unit from the Ministry of Finance. They have weekly meetings with us to collaborate in the structure of the product, but also to discuss the potential collaboration from the Ministry of Agriculture, Ministry of Welfare, and with Agroasemex. The Head of the mentioned unit in the Ministry of Finance is personally helping us get in contact with the other institutions.

14 We explain in the document that our team has created a georeferenced dataset that can be linked to the information captured in the enrollment process (including coordinates) to build a georeferenced beneficiary list

aftershock of the event. Parametric insurance can offer the simplicity and rapidity needed. As we further structure the operational details of the program, we will include checkpoints to guarantee an expedite process.

- **Identification of infrastructure needed to reach all beneficiaries**. The existing SADER infrastructure and personnel to enroll and communicate (primarily) with the beneficiaries of the program will be used. If during the pilot we observe that an additional enrollment channel needs to be in place, we will (managed by Agroasemex) get access to the also already existing network of Mutualist Insurance Funds that today operate for medium producers by selectively inviting some of them to our program.
- **Collaborate with the Ministries of Agriculture and Welfare.** In order to better identify or target beneficiaries within existing social government programs, we must facilitate the interactions and flow of information with our public partners. With the help of the Ministry of Finance (MoF), we are initiating contact with them to explore operational collaboration.
- **Develop contacts with local governments.** In order to facilitate the operation of the program, we are approaching the local government offices and ensure their support. The Ministry of Finance is helping us with the connection.

3. **Distribution**
   - **Operational cost efficiency**. Given that the program is oriented to the people living in the rural communities with less access to telecommunications and other services, we are structuring a program that reaches them in a cost-effective way through the collaboration with the SADER and the MoF.
   - **Enrollment program**. Given the low use of electronic and digital resources within the target group, we are counting on the support from SADER regional offices and personnel for the enrollment. The objective is to generate an agreement to provide access to each regional office to our front-end screen in a simple way. We also aim to structure a condensed training using scripts and visual aids to onboard the personnel that will support us with this function.
   - **Effective use of Technological Platform**. The enrollers need a very intuitive interface, with as few questions as possible to be answered and as many validations as possible (to avoid grammatical mistakes, typos, etc.). The interface must be able to interact with all devices and to work offline. To help enrollers, as many aids messages as possible will be included in the tool. **Democrance and Raincoat** are potential allies to provide a solution for the project, and both solutions fit the criteria.
   - **Simplicity in communication**. Our target group is normally not concerned about insurance or financial tools. Thus, for our message to be relevant to them, we will include the main messages in a very simple but impactful way (using behavioral economics if possible).
   - **Inclusion measures to reach more people**. We must also address the issue of local languages and be prepared to enroll people who are illiterate. A large proportion of the target beneficiaries have low school level. Our network of enrollers will be trained to communicate effectively and will have the tools they need to include everyone. We want our program to help women become empowered through the protection and tools we provide; therefore, we will put special attention to deliver messages properly to this group.
   - **Facilitate inputs and tool purchasing at fair prices**. It also may allow to sell the harvest at better prices and increase productivity of smallholder farmers. Helping producers get access to fair replacement seed and tools at fair price is not absolutely required for the insurance program to work. However, if we want the program to really benefit the producers, we could help them get to access seeds and tools at better prices after a disaster, to increase their productivity in the long run. We would like to develop an ecosystem around the needs of the farmers, since it may allow them to purchase seed at fair prices, to sell their produce, and to use financial tools more often. For this purpose, through the SADER, we can reach the **DICONSA** stores that provide smallholder farmers with fair priced seeds and tools. Although we believe that this is a very important components of the program, it will be included on a later stage, to first focus efforts in properly structure a simple distribution operating model.

4. **Others factors relevant for the government, insurance industry, etc**.
   - **Participation of insurers and reinsurers** to allow competition and improved market conditions for the beneficiaries. Once the high-level program is drafted and is ready to be operational, all insurance companies will be invited to join the program, given that it will help us mutualize the risks, and allow for healthy competition. We will reach out to them though the Mexican Insurers

Association (AMIS) once the project is approved. We understand that the distribution and operation of the program will be a key feature for all participants to be part of. Our plan is to develop the IT platform and allow all companies to use it.

- **Share information candidly with participating insurers/reinsurers** to foster development of a market around the needs of the beneficiaries. The better informed all the participants are about the benefits and potential risks of the program, the more help we will get structuring an actionable implementation plan and reaching the project's goal.
- **Registering the Product.** We have confirmation from the Insurance Unit of the Ministry of Finance that a parametric product that can be used for our program with only small adjustments has already been registered. We believe that this previous register will allow us to shorten the preparations for the pilot test.
- **Structure a pool of reinsurers.** Agroasemex could play the role of lead reinsurer and use the combined program reach to access better conditions from international markets.

2.2 Operational best practices that could be used from cases in other countries where they have been successfully implemented

Some of the most widely examples of banking, insurance and mobile telephone for vulnerable people in Africa and India were analyzed and a brief summary of the main findings that might be useful as ideas to explore for structuring a program for smallholder farmers in Mexico was written. From the experiences researched we concluded that for the program in Mexico it would be feasible to:

- Use technology available as much as possible to gain capillarity with the producers and simplify the operations;
- Use the most basic technologies available to increase outreach and communication;
- Develop a multichannel approach and be inclusive;
- Develop an economic ecosystem around the producers' needs (second stage).

Main best practices that could be useful for structuring the program in Mexico

- **BIMA**
  - **Uses mobile phone to reach clients**, integrating the insurance program to the MNO's15 systems allowing BIMA to deduct premiums in small increments from airtime balances. We will use mobile phones as one of our communication channels.
  - **Uses digital signatures to sign up customers**. We have shared this idea with Democrance and Raincoat to explore a feasible solution for our program.
  - **Communication with beneficiaries via SMS**. We are exploring costs and operational needs of SMS communication.
- **ACRE**
  - **Insurance information in bags of seeds** or related farming products. We want to include this practice in a second stage of the program.
  - **Pays claims into mobile wallet or as a discount on the next seed or fertilizer purchase** without any actions required by the farmer. This alternative can be explored during the pilot with local SADER offices and Banco del Bienestar branches.
  - **Text messages for further benefits.** The use of mobile technology allows ACRE beneficiaries an opportunity to extend their benefits via text messages. Would like to explore this option in a second stage, since this would be a value added to the insurance product, which will awake more interest from farmers.
- **Choupal**
  - **e-market place for online products**. It helps increasing the resilience of producers. We believe it adds value, but given the operational complexity, either we find a partner willing to do it on a stand-alone basis, or we include it on a later stage.
  - **Empowers beneficiaries through small local self-help groups** around kiosks managed by farmers themselves. We are interested in including this function through the Ministry of Agriculture offices (or other allies from them), so we will talk to them about the idea.
- **Reuters Market Light**
  - **Platform for interaction of producers and agricultural communities**. We will test if the front end we are to develop, allows for interaction with the producers on a regular basis (Raincoat does).

15 Mobile Network Operator

    - **Works with content partners** to provide personalized information on farming techniques, crop recommendations, weather forecasts, and various other pieces of agricultural information. There are options that we have identified already, but it is a second priority given that we want to implement a complete basic operation first.
    - Producers selling directly to traders increase their price realization by 9% (income of producers increased by 15-25%). The possibility of using this interesting feature, will be explored on the second stage of the program.
- **MobiLife**
    - **Policies issued and managed via mobile services** (no paper). We are targeting for this feature on our front-end as one of our communication channels.
    - **Social media content to market its product to beneficiaries**. We would like to include this feature in the second stage of the program.
    - **Weekly grocery vouchers** are sent via text message and can be redeemed at lending supermarkets. This could be a very good push towards increasing bank usage in the segment, yet we will concentrate on the basics of insurance first and leave It for a second stage.

2.3 A platform / information system that transparently shares information on all beneficiaries, claims, and payments

In order to sign up farmers for the program, there will be a need of having a team of enrollers, which can be the staff of SADER. The enrollers from SADER that currently manage other social programs will need the support of a system/platform to effectively communicate with the insurance companies. On the one hand, the mentioned platform needs to allow for all personal, crop, and risk accumulation information to be properly updated; on the other it must be a simple and clear tool to get the message through to the farmers to understand the program, requirements, operation, etc.

For the farmers to update their personal and crop information, a communication tool is needed to store and share the data to the insurer. If such a platform would not be in place, the complexity of enrolling new beneficiaries to the program and uploading that information into the systems of the insurance companies would endanger the efficacy of the whole array.

After analyzing several alternatives (Democrance, Luxelare, Biosnet, Raincoat, White label Telcel), the proposals that are most aligned to the needs of the project in Mexico are the ones from Democrance and Raincoat.

- **Raincoat** has experience in developing a complete end to end platform solution for agriculture in different geographies, including the following functionality: Support for risk evaluation, Key customer (farmer) development, development of touch points and IT integration, automating the full cycle of the policy, seamless experience, connectivity with enrollers, payout mechanisms, providing feedback for scaling up operations, support with trigger management, report management, communication with clients in the event of a claim, etc.
- **Democrance** has experience as well with omni-channel, fast to market, plug and play distribution and policy support. The have operations similar to the proposal being structured for Mexico, in other geographies. Their solution also includes a fully digitalized customer journey with fully automated back end connectivity to insurance companies with capacity to handle multiple insurance companies, management of digital MKT campaigns, quick structure for digital distribution, easiness to configure products in their front-end platform, report management, payment management, multi-user access management, etc.

If invited to present a full proposal, the team is already working on the RFP to select one of these potential partners to join the project. Both are willing to be part of the consortium if invited.

3 Results of the assessment for the target group definition to assess whether the ISF (target group) criteria can be fulfilled

In this section we verify that 5 Ha of total crop land is an adequate threshold and that most producers are below the 15usd PPP/day threshold for the project. Although there are variations across the country, the Southeast region presents a higher concentration or potential beneficiaries, particularly the States of Oaxaca, Tabasco and Chiapas. We estimate that there are around 1,935,000 producers in all three states. Around 1,530,000 meet our eligibility criteria and grow corn with 1,224,056 Ha dedicated to growing corn. Therefore, there is an average of 0,8-1,0 Ha per small holder producer aprox. We learn that most people concentrate in D+, D and E SEL's. Low income is a barrier for technology adoption[16].

3.1 Suitable threshold for the most vulnerable smallholder farmers

According to FAO, the structure of the Sustenance Family Agriculture segment (Smallholder farmers who use their produce for self-consumption mostly) is aligned to the beneficiary profile we are targeting[17]

- Average Crop Surface: 3.4 Ha (compared to 24.7 Ha national avg.)
- Gross yearly income[18]: USD 867 (compared to USD 6,692)
- Productive Assets: USD 340 (compared to USD 6,607 national avg.)
- Family members participating in agriculture: 2.6 (compared to 1.5 national avg.)

Approx. 9.92 million Crop Ha belong to this segment in Mexico (8.8% of total crop surface)

The five hectares threshold. Former CADENA Program set the smallholder farmer threshold at 10 Ha per farmer, and later increased it to 20 Ha or less. Below 5 Ha. We find the bottom of the pyramid, the most vulnerable farmers with lower access to technology and lower production per Ha. . The IDF Group developed a database at a municipality level, and cross referenced it with other databases.

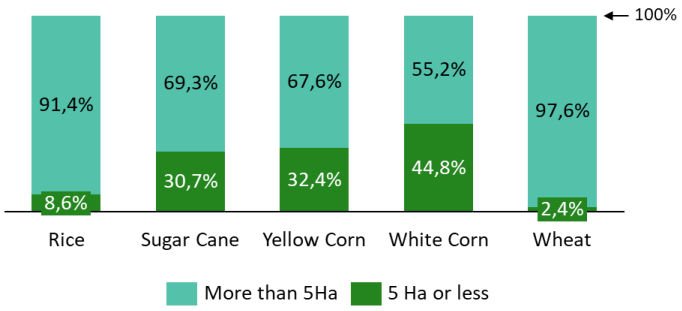

Chart 2 .: % of surface sown by size of crops
Source: ENA 2019

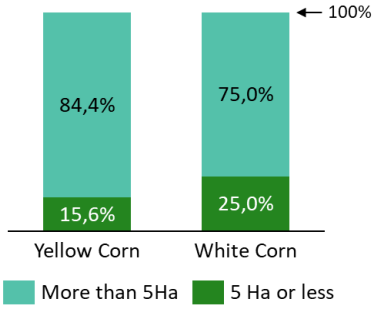

Chart 3. % of corn production segmented by size of crops
Source: ENA 2019

From the graphs above, we see that for case white corn, it occupies 44.8% of the crop land for farmers with 5 Ha. or less, but only generates 25% of the production. Thus, we can see that the productivity of smallholder farmers is lower than that of larger producers.

[16] We selected three states for the in-depth development of the Feasibility Study (Oaxaca, Tabasco and Chiapas) to focus efforts in structuring a repeatable methodology. These three states belong to the Southeastern part of the country, where most of the smallholder producers are located. They are heavily exposed to excess of rainfall and drought as main perils and the most relevant crop is corn. This selection simplifies a couple of variables for the study and allows us to focus on the structuring of the potential program and its implications, before taking on more perils, locations, crops, etc.

[17] http://www.fao.org/3/bc944s/bc944s.pdf

[18] FAO Data source link

3.2 Census of the target population by state, yield production, degree of technification, hectares, type of crop, access to irrigation, access to credit, etc.

According to the information from *Servicio de Informacion Agroalimentaria y Pesquera* (SIAP), there are 29.5 million people living in rural communities in Mexico, and 87.4million in urban settlements

- The North region has a higher concentration in SEL's A/B compared to the rest of the country.
- Although the Central regions have a somewhat larger proportion of people living in rural communities in lower SEL's, most of the population in these regions live in urban communities.
- The Southeast region comparatively has the larger concentration of people living in rural communities and in SEL's D to E.
- The information suggests that a larger proportion of smallholder farmers that meet the 15 USD PPP per day can be found in the Southeast region.

	Rural	Urbano
Centro	**10,567,692**	**32,251,890**
A/B	4,590,724	20,505,697
C	2,723,783	5,623,561
D	1,331,832	2,474,468
D+	1,550,529	2,730,181
E	370,824	917,983
Centro Occidente	**7,439,438**	**20,194,098**
A/B	2,791,262	12,209,519
C	3,135,441	4,456,026
D	177,778	868,191
D+	1,299,455	2,555,353
E	35,501	105,010
Norte	**4,556,923**	**20,470,255**
A/B	3,211,802	17,971,718
C	858,601	1,513,828
D	125,793	214,690
D+	278,613	603,228
E	82,112	166,791
Sureste	**6,883,096**	**14,449,562**
A/B	1,167,239	4,941,850
C	1,976,884	2,563,507
D	1,819,953	3,543,617
D+	1,372,807	2,280,469
E	543,441	1,076,269
Total	29,447,149	87,365,805

Table 1 Adult population in Mexico distributed by SEL and type of community (2019). *Source: INEGI, ENIGH 2018, AMAI.*

Also, with information from SIAP we **confirmed that most of the people in the rural areas** (we do not have the number of farmers per municipality) **in the three selected states belong to the lower Socioeconomic Level (SEL), i.e. the D and E categories[19].** Although Oaxaca has a predominantly rural population, it is not the case in Tabasco, where most of the people live in urban communities.

There are 4,560,401 adults living in rural communities in Chiapas, Oaxaca and Tabasco, from which a total of 2,973,212 are classified in the lower income segments (C to E).

SEL	Oaxaca		Tabasco		Chiapas	
	Rural	Urban	Rural	Urban	Rural	Urban
A/B			0	612,228		465,046
C+	1,095,266	133,384				
C-	441,407	275,239			50,516	419,212
C	29,668		24,230	654,080		
D+	35,171		52,991	499,293	114,241	323,324
D	1,017,800	576,339			823,201	697,000
E	459,491				416,418	486,684
Total	**3,078,803**	**984,962**	**77,222**	**1,765,601**	**1,404,376**	**2,391,266**

Table 2. Adult population in Oaxaca, Tabasco and Chiapas distributed by SEL and type of community (2019). *Source: INEGI, ENIGH 2018, AMAI.*

19 incomes between 3 to 4 usd per day in rural communities

Our analysis confirmed that almost all corn growing in Oaxaca is done by producers in living in municipalities where the predominant SEL's are D+, D and E in rainfed land in the spring summer cycle. For Tabasco the sowing of corn is done across both cycles by people of the same SEL´s (D+, D and E). Chiapas also concentrates its sowing in the spring summer cycle within SELs D and E. **In 2019, the total number of Ha of corn sown during all cycles was 1,224,056 for all three states** (in Tabasco was 82,265, 464,444 for Chiapas, and 677,347 for Oaxaca). The number of **Ha of corn sown for the year was 79%** of all the crops sown[20]**.**

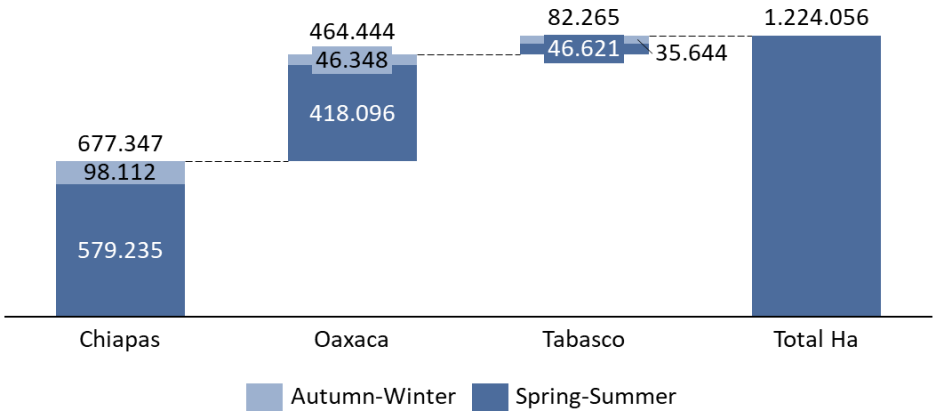

Chart 4. Total number of corn Ha sown (2019).

Source: SIAP

Most of the corn-producing areas are in municipalities where the predominant SEL's are E and D (average incomes from 3 to 14 USD per day).21 This is consistent with reports and news about the situation of agriculture in these states. There is a total of 2,764,493 people living rural communities in the three states, classified under D and E SEL's. (28.5% of the total population). If we assume that 70% of the rural population in those states are producers and that 79% of the producers grow corn (in line with the number of Ha dedicated to corn in the three states) we can estimate that there are around 1,528,000 producers in the three states and almost all of them meet our eligibility criteria.

3.3 Degree of technology adoption (and main barriers) in the target segment

The average value of the total assets of smallholder families is comparatively low compared to more established larger producers. It is therefore more difficult for these producers to purchase productivity tools.

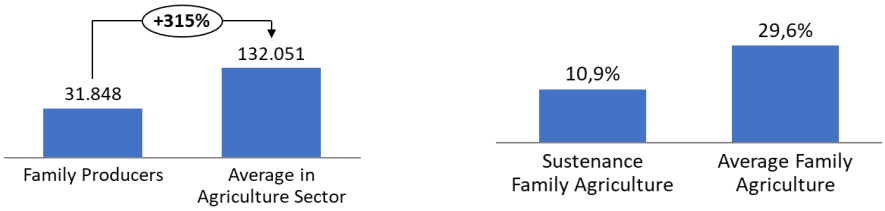

Chart 5 : . Average value of Total Assets mxn (left), and % of producers whose operations are profitable (right)

Source: FAO22

20 We considered only rainfed crops.

21 There are people above this SEL's within these regions, however with the information at hand it is not possible to separate

22 http://www.fao.org/3/bc944s/bc944s.pdf

Historically, the proportion of sustenance family agriculture in Mexico (smallholder producers) whose operations are profitable is small (10.9%), which becomes a barrier for them to improve their productivity through the acquisition of better tools and equipment.

Oaxaca

2010-2019		CORN				CORN GRAIN			
		Irrigation		Temporary		Irrigation		Temporary	
Socioeconomic leve	Productive cycle	Ha Sown	%	Ha Sown	%	Ha Sown	%	Ha Sown	%
E	Autumn-Winter	1,636	1%	17,991	5%	161,352	10%	550,336	6%
	spring-summer	12,710	7%	65,192	20%	231,522	14%	2,292,708	27%
	Perennial	5,256	3%	11,485	3%	287,580	17%	307,394	4%
D	Autumn-Winter	7,588	4%	18,857	6%	220,234	13%	626,056	7%
	spring-summer	22,760	12%	54,040	16%	122,527	7%	2,027,949	24%
	Perennial	9,115	5%	7,962	2%	122,376	7%	279,481	3%
D+	Autumn-Winter	29,481	16%	26,944	8%	135,663	8%	465,459	5%
	spring-summer	87,168	47%	102,934	31%	160,319	10%	1,230,235	14%
	Perennial	6,925	4%	22,799	7%	181,596	11%	279,481	3%
C-	Autumn-Winter	-	0%	-	0%	-	0%	26,670	0%
	spring-summer	-	0%	-	0%	3,312	0%	13,356	0%
	Perennial	-	0%	-	0%	310	0%	6,980	0%
C	Autumn-Winter	956	1%	576	0%	13,514	1%	104,919	1%
	spring-summer	919	0%	253	0%	15,631	1%	238,221	3%
	Perennial	168	0%	206	0%	1,745	0%	36,893	0%
C+	Autumn-Winter	-	0%	-	0%	-	0%	-	0%
	spring-summer	-	0%	-	0%	-	0%	-	0%
	Perennial	-	0%	-	0%	-	0%	-	0%
A/B	Autumn-Winter	24	0%	-	0%	3,799	0%	29,771	0%
	spring-summer	-	0%	-	0%	8,299	0%	36,407	0%
	Perennial	-	0%	-	0%	2,042	0%	12,687	0%
Total		184,704	100%	329,240	100%	1,671,822	100%	8,565,001	100%

Tabasco

2010-2019		CORN			
SEL	Productive cycle	Temporary Ha Sown	%	Irrigation Ha Sown	%
E	Otoño-Invierno	266,810	32%	0	0%
	Primavera-Verano	359,289	43%	0	0%
	Perennes	0	0%	0	0%
D	Otoño-Invierno	81,753	10%	25	50%
	Primavera-Verano	96,592	12%	25	50%
	Perennes	0	0%	0	0%
D+	Otoño-Invierno	14,811	2%	0	0%
	Primavera-Verano	16,341	2%	0	0%
	Perennes	0	0%	0	0%
Total		835,595	100%	50	100%

Chiapas

SEL	2010-2019	CORN			
		Irrigation		Temporary	
	Productive Cycle	Ha Sown	%	Ha Sown	%
E	Autumn-Winter	1,967	2%	539,908	8%
	Spring-Summer	6,998	6%	1,964,411	29%
D	Autumn-Winter	91,393	76%	403,307	6%
	Spring-Summer	5,114	4%	3,301,945	48%
D+	Autumn-Winter	8,734	7%	18,371	0%
	Spring-Summer		0%	415,751	6%
C	Autumn-Winter	5,363	4%	37,851	1%
	Spring-Summer	267	0%	113,665	2%
A/B	Autumn-Winter	125	0%		0%
	Spring-Summer		0%	32,769	0%
	Total	119,961	100%	6,827,978	100%

Table 3 . Corn Ha sown (irrigation modality, productive cycle and SEL) 2010-2019.

Source: SIAP.

Table 2 also shows that across states, most of the sown land does not have irrigation systems (included as 'Temporary') and is therefore more vulnerable to weather conditions. The cost of implementing irrigation systems could be the most relevant cause for its little usage.

3.4 Characterization of the target group by income level that allows to clearly distinguish people with income of less than 15 USD PPP per day (ISF target) and align the program to understand/attend their different needs

We have identified that almost all producers live in municipalities where people on average make less than 15 PPP USD per day. In order to make sure that all participants in the program belong to the target SEL, we will include filtering questions in the enrollment process.

To provide an income per day profile, we associated it to the predominant Socioeconomic Level (SEL) in each Municipality, and the type of community (rural, urban) where people live. Moreover, we also used the degree of vulnerability/marginalization to characterize each group.

Marginalization	Socioeconomic level	Income per day (USD)	
		Urban	Rural23
+	E	4	3
	D	7	4
	D+	10	5
	C-	12	7
	C-	17	9
	C+	26	14
-	A/B	57	33

Table 4. Income and vulnerability of target group

Source: CONAPO, AMAI and ENIGH 2018.

Within each Municipality there is however a distribution of people in the different SEL's. The smaller the community, the more predominant the lower SEL's are. Since the rural communities where most of the smallholder producers are located are the smallest ones, we provide the current SEL distribution for communities with 2,500 to 15,000 inhabitants, and lower than 2,500. Table 3 shows the current distribution of SEL's given the number of people in each community.

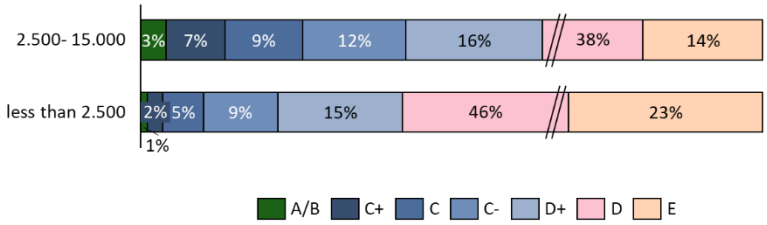

Chart 6. SEL distribution for people in communities given the number of inhabitants

Source: AMAI 2020[24]

Across the country, 32 states were divided into four regions (North, Center, Center-west, and south-east). Within each state there is a number of municipalities, and in each municipality, there are several communities, which have decreasing average incomes as the size of the population decreases. We chose rural communities for the study and separated them from the urban ones, finding that people living in rural municipalities and belonging to SEL's D+, D, and E, earning less than 15USD PPP per day. Also, the total number of Ha dedicated to sowing corn in the country is 7.1million distributed across the four regions as shown in the next chart.

23 For the study we have simplified Mexican communities in two kinds: Urban with more than 15,000 inhabitants (Metropolis, semimetropolis, urban) and Rural with less than 15,000 inhabitants (rural, transition, quasi-urban), given that they observe similar demographic characteristics.

24 https://nse.amai.org/data/

Region/SEL	#Municipalities	# Rural Municipalities	# Urban Municipalities	Total Sown (Ha, All Crops)	Total Sown (Ha, Corn Grain)
Centre	**1,186**	**753**	**433**	**4,765,426**	**2,376,221**
A/B	124	22	102	939,789	531,775
C	174	75	99	741,996	298,539
D	480	382	98	1,879,415	922,777
D+	212	125	87	1,027,362	536,811
E	196	149	47	176,864	86,318
Centre West	**459**	**149**	**310**	**6,204,364**	**1,856,299**
A/B	68	4	64	985,859	324,497
C	166	55	111	2,495,389	659,185
D	70	28	42	569,470	190,980
D+	145	57	88	1,939,985	594,541
E	10	5	5	213,662	87,096
North	**338**	**179**	**159**	**5,404,019**	**12,184,227**
A/B	131	43	88	2,219,158	4,724,705
C	117	80	37	2,050,500	3,713,539
D	27	20	7	266,918	1,137,695
D+	52	32	20	823,923	2,456,189
E	11	4	7	43,521	152,099
South East	**480**	**199**	**281**	**4,297,380**	**17,315,887**
A/B	19		19	700,771	3,969,633
C	36	3	33	363,582	867,010
D	252	118	134	2,238,700	9,505,302
D+	98	42	56	893,149	2,706,003
E	75	36	39	101,179	267,939

Table 5. Total Ha of corn sown per Region and SEL in Mexico
Source: ENIGH 2018

We can see that the higher concentration of lower income rural municipalities is in the southeast and central regions, whereas the north has a higher concentration in the upper SEL's. We therefore confirm that starting a pilot test in the southeast selected states is adequate.

Region	SEL	Adult Population (Men)	Adult Population (Women)	Average Daily Wage (USD)	Average Internet Penetration (%)	Average Cellphone Penetration (%)	Total Corresponsals
Centre	A/B	9,770,198	10,893,595	53.57	46%	57%	29,589
	C	2,869,345	3,188,906	15.18	38%	40%	4,903
	D	1,736,553	1,937,440	5.13	21%	15%	1,507
	D+	1,501,166	1,670,196	8.76	31%	23%	1,881
	E	651,732	737,376	2.90	12%	10%	334
Centre-West	A/B	5,829,008	6,422,365	73.00	57%	58%	19,230
	C	2,276,549	2,500,811	19.12	54%	39%	4,329
	D	491,361	534,981	9.09	39%	18%	449
	D+	1,369,484	1,541,631	11.94	49%	28%	1,774
	E	71,793	74,128	5.55	28%	11%	39
North	A/B	8,877,761	9,300,225	67.33	65%	51%	33,153
	C	888,040	905,719	17.53	66%	29%	1,775
	D	155,715	155,207	7.79	49%	14%	150
	D+	370,607	368,108	9.90	57%	24%	580
	E	92,990	95,803	2.65	28%	8%	52
South-East	A/B	2,356,707	2,585,143	42.20	40%	58%	10,120
	C	1,230,116	1,353,351	17.25	31%	43%	3,071
	D	2,016,369	2,134,551	6.33	18%	19%	2,171
	D+	1,195,999	1,279,573	9.39	24%	30%	1,962
	E	614,820	660,268	3.53	8%	7%	247

Table 6. Concentration of people by SEL across regions in Mexico
Source: ENIGH 2018

Likewise, the southeast and central regions have a higher concentration of people in the lower SEL's compared to the north.

To focus on the states for operational pilot, with the information available, we characterized each municipality as belonging to a predominant SEL. In Oaxaca, 567 municipalities are rural and only 3 are urban, which means that approximately 99% of them are rural, and 1% or less are urban[25]. The opposite is shown in Tabasco, where most of the municipalities (10) are urban, having yet an average income of 9 USD/day.

Oaxaca

Income per day (USD)	% municipalities in the bracket	# of urban municipalities	Urban municipali represented	# of rural municipalities	% Rural municipalities represented
3	38%	0	0%	214	100%
4	29%	0	0%	168	100%
5	27%	0	0%	152	100%
7	0%	0	0%	2	100%
7	0%	2	100%	0	0%
9	4%	0	0%	21	100%
10	0%	1	100%	0	0%
33	1%	0	0%	5	100%

Chiapas

Income Per Day (Dolars)	% Municipalities in the Bracket	# Of Rural Municipalities	% Of Rural Municipalities	# Of Urban Municipalities	% Of Urban Municipalities
2	35%	18	45%	0	0%
4	53%	19	48%	0	0%
5	7%	3	8%	0	0%
6	0%	0	0%	0	0%
15	3%	0	0%	4	80%
21	0%	0	0%	0	0%
22	1%	0	0%	1	20%

Tabasco

Income per day (dls)	% of income respect total	# of urban municipalities	% Urban locality respect total municipalities	# of rural municipalities	% Rural locality respect total municipalities
4	18%	3	100%	0	0%
6	29%	5	100%	0	0%
7	41%	5	71%	2	29%
8	12%	1	50%	1	50%

Table 7. Percentage of income per day and income by type of locality

Source: ENIGH 2018

Most of the people in the selected states belong to SEL's D+ to E and are found in rural communities. Thus, we confirm that for the purpose of the program across the country, the population that belongs to SEL D+, D and E, are below the 15 USD per day bracket. There is a higher concentration of lower SEL rural communities in the southeast and central regions. Thus, we expect to find also a higher concentration of beneficiaries of the program. We will use the additional filter of 5 Ha or less to make sure we filter any potential exceptions to the rule.

25 For the purpose of our study, within 'rural' Municipalities, we included : rural, 'transition' and semi-urban'

Oaxaca

Income per day (USD)	SEL	# people urban community	% in urban community	# people rural community	% in rural community
3	E	0	0%	752,812	25%
4	E	0	0%	1,159,644	39%
5	D+	0	0%	587,968	20%
7	D	0	0%	21,506	0.70%
7.5	C-	46,300	2%	0	0%
9	C-	0	0%	355,209	12%
10	D+	891	0.03%	0	0%
33	A/B	0	0%	36,073	1.20%

Tabasco

Income / day (USD)	SEL	# People Urban Location	% Urban	# People Rural Location	% Rural
4	E	242,707	13%	0	0%
6	D	648,300	35%	0	0%
7	D	829,649	45%	52,991	3%
8	D+	44,945	2%	24,230	1%

Chiapas

SEL	Income / day (USD)	# People Rural Location	% Rural	# People Urban Location	% Urban
E	2	715,738	34%	956,022	28%
D	4	936,486	44%	1,178,888	34%
D+	5	174,496	8%	287,909	8%
C-	6	-	0%	-	0%
C	15	172,499	8%	497,463	14%
C+	21	-	0%	-	0%
A/B	22	108,191	5%	540,956	16%

Table 8. Percentage of income per day and income by type of locality
Source: ENIGH 2018

3.5 Relevance of local language (and other inclusion components) for the successful adoption of the program

Given that there is a high concentration of rural communities in the southeast of Mexico (the region where

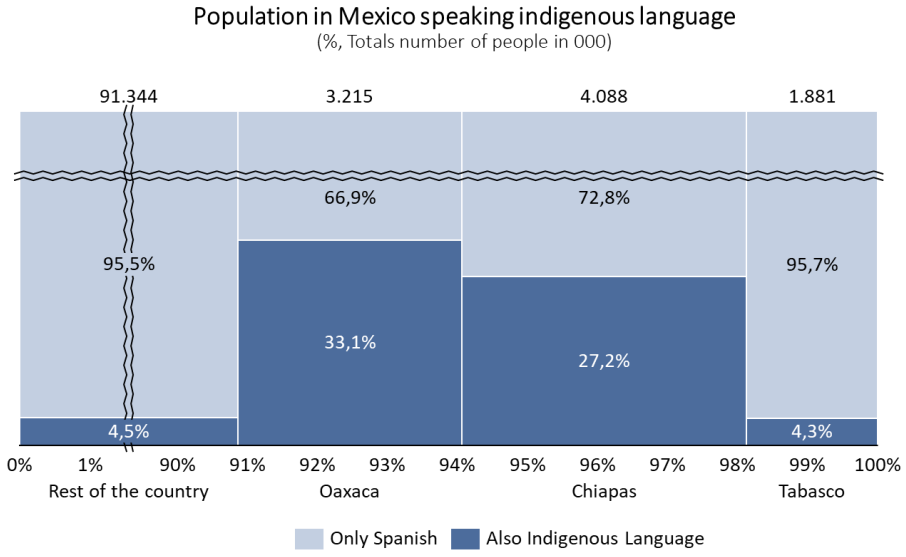

Chart 7 Population in Mexico speaking indigenous languages

Oaxaca, Tabasco and Chiapas are), we have reviewed the number of municipalities that have local languages. The following table shows the number of municipalities in which the population speaks a certain percentage of the indigenous language.

We see the topic of local language in these three states not as a barrier, but as an opportunity to reach more people inclusively, explaining them the program and its benefits in their local language. Given the high iliteracy rates in rural communities, we will try different ways to approach them to be more efficient (for example using pre-recorded messages instead of SMS written texts, or local radio messages).

% of people speaking a local language	municipalities (Oaxaca)	municipalities (Chiapas)	municipalities (Tabasco)
0%-30%	298	73	17
30%-50%	45	10	-
50%-70%	56	5	-
More than 70%	171	30	-

Table 9. Percentage people speaking a local language in selected states
Source: ENIGH 2018

Having support from local SADER offices for the enrollment, we expect to have people who already speak the local languages being part of their team. Our goal is to prepare MKT materials and scripts in the most representative languages to reach a larger number of producers through these personnel.

Although the target population segment is producers who earn less than 15 USD per day, we have found that most of them (in all three states) earn between 3 USD and 9 USD a day. This segment of the population is associated with socioeconomic levels (E and D-). Another measure of inclusiveness is the relative higher proportion of women to men in the lower SEL's. It is true that there are consistently more women across all income brackets, yet the larger proportion of women is found within the 3-5 USD per day segment. We will address this topic together with SADER to find ways in which we can pair our program to their existing gender initiatives.

Oaxaca

Income per day (dls)	% adult population within bracket	of which adult women	of which adult men
3	25%	14%	12%
4	39%	21%	18%
5	19%	10%	9%
7	0.70%	0.40%	0.30%
7	2%	1%	1%
9	12%	6%	5%
10	0.03%	0.02%	0.01%
33	1.20%	0.70%	0.60%

Chiapas

Income Per Day (Dolars)	% Adult Pop. within bracket	Of which adult women	Of which adult men
2	23.8%	12.3%	11.5%
4	40.1%	20.6%	19.4%
5	10.4%	5.4%	5.0%
6	0.0%	0.0%	0.0%
15	12.4%	6.6%	5.8%
21	0.0%	0.0%	0.0%
22	12.3%	6.6%	5.7%

Tabasco

Income per day (dls)	Adult population within bracket	Of which adult women	Of which adult men
4	13%	7%	6%
6	35%	18%	17%
7	48%	25%	23%
8	4%	2%	2%

Table 10. Percentage of income per day and income by adult population (Tabasco, Oaxaca, Chiapas)

Source: ENIGH 2018

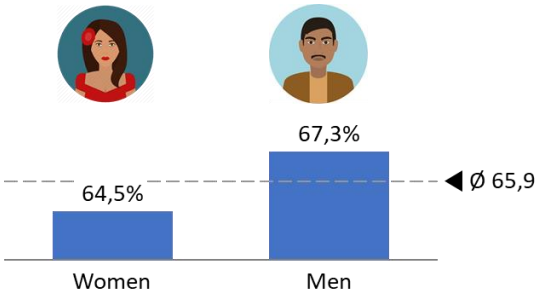

Chart 8. Probability of internet usage per gender in Mexico[26]

Source: IFT, EDUITIH 2018

This information is very relevant considering the 6.3% national average (6.4 million people[27]) that speaks a local language. In order to reach our target group and ensuring they understand the requirements and benefits of the program, we need to include the most dominant regional languages in the communication (written and oral). Although it is true that the most vulnerable segments of people also concentrate the higher proportion of analphabets, besides sharing pre-recorded messages over the phone and in local radios, we believe that the program needs to address in written (with simple messages and illustrations possibly using behavioral economics) to provide the enrollers with the tools they need to get people interested in the program and going to their (SADER) offices.

3.6 Towards building a database of the beneficiaries

We don´t have a list of potential beneficiaries at this stage, but we believe that as we move on with the implementation of the project, the Ministries of Agriculture and Finance will help us get access to existing lists. Nonetheless, the team has worked to develop a Database for the IDF Project. Today the database contains the following information:

1. **Geographical information**
    a. All municipalities, with coordinates and in geojson format
    b. Location of Banco del Bienestar, OXXO, Telecomm, etc., locations with coordinates and distance they have to the center of the municipality (to calculate how far it is for each beneficiary to walk to one of them and cash a potential payout)
    c. People living in each community/municipality and their living conditions (access to water, type of households, public services, etc.)

2. **Insurance information**
    a. Crop areas (sown, harvested, damaged) for two different production cycles and type of irrigation (rainfed or artificial) from 2010 to date, together with yield, prices and production per staple crop for the whole country
    b. CADENA underwriting and claims data sets for Oaxaca, Tabasco and Chiapas. (but information on the rest of the states is also available upon request)

3. **Accessibility information**
    a. Bank branches
    b. Number of mobile phone contracts per Municipality
    c. SEL's and marginalization indexes per Municipality

The team has developed the database in R coding software, so it is ready to merge with the information we collect from the beneficiaries during the enrollment process (ex. the exact location of each producer). We will include in the deliverables of the project a link to access the database because we consider it to be a valuable byproduct of the analysis.

26 http://www.ift.org.mx/sites/default/files/contenidogeneral/estadisticas/usodeinternetenmexico.pdf
27 INEGI, 2020 Census of Population and Housing

4 Overview of existing data and data sources, including comments on quality and applicability for the foreseen product and scheme/program

In this section a brief summary of the data sources used for the study is presented. CHIRPS and ERA5 are validated as reliable sources of satellite/weather information. Corn is the main staple crop for smallholder farmers in the region (82,4% of the crop land). *Banco del Bienestar* has an array of allied cooperatives and MFI's in his 'Network of the People', and that there are local cooperatives that may help establishing/extend our communication/cash exchange network.

4.1 Overview of Data used for this study and its sources

i. **SIAP Database (2010-2019):** The information provided by the Agrifood and Fisheries Information Service (SIAP) is made up of figures for the area to be sown, production to be obtained and expected yield. The objective of the information published by the SIAP is to provide the data that show the cyclical moments and the level of seasonal fluctuations. It covers the 64 follow-up crops and considers cyclical fall-winter and spring-summer crops, as well as perennials. By water modality, it includes information for irrigation, temporary, as well as the aggregation of both production technologies. Geographic coverage is at the level of the federal entity; data refer to absolute averages of production volume. The data are compiled by the State Delegations of SADER, Rural Development Districts (DDR) and Rural Development Support Centers (CADER), under the *Technical Regulations for the Generation of Basic Agricultural Statistics*; It consists of a set of procedures, criteria, guidelines and tools through which the integration of the productive statistics of the agricultural and livestock subsectors is carried out.

ii. **Financial Inclusion Databases, (2010-2020):** The General Directorate for Access to Financial Services makes the Financial Inclusion Databases available to the public with state and municipal level statistics, with information about the access and use of financial services of banking institutions, cooperative savings and loan societies and popular financial societies. This database is based on the information registered in the regulatory trimestral reports by the entities subject to the supervision of the CNBV (National Banking and Securities Commission).

iii. **INEGI, Population and Housing Census (2020,2010):** The census is responsible for producing information on the volume, structure and spatial distribution of the population, as well as its main demographic, socioeconomic and cultural characteristics; in addition to obtaining the account of the homes and their characteristics such as construction materials, services and equipment, among others. By complying with the principle of universality, it counts all the habitual residents of the dwellings in the national territory, in addition, it includes the personnel of the Mexican Foreign Service who carry out their functions abroad, the homeless population and those who reside in collective housing. The quality of the information is considered good, since from the design of the questionnaire to the operational part, it was carried out with recommendations and follow-up from international organizations such as the United Nations (UN), the United Nations Economic Commission for Europe. (UNECE), the Economic Commission for Latin America and the Caribbean (ECLAC), the International Labor Organization (ILO), the Organization for Economic Cooperation and Development (OECD).

iv. **CONAPO, Marginalization Index Database (2015):** The information shows the intensity of marginalization and includes socioeconomic indicators calculated every five years for each geographic unit. Marginalization indexes are calculated from 1990 to date and refer to federal entities, municipalities, localities and basic geostatistical urban areas.

v. **INEGI, National Survey of Household Income and Expenditure, 2018 (ENIGH):** The purpose of this database is to provide a statistical overview of the behavior of household income and expenses in terms of their amount, origin and distribution; additionally, it offers information on the occupational and sociodemographic characteristics of the household members, as well as the characteristics of the housing infrastructure and the household equipment.

4.2 Satellite data to use for the parametric temperature, drought and excess rainfall product (or other peril if that is the case)

Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) has got enough satellite data for the participating companies to underwrite the risk and to follow up the evolution of the crops. CHIRPS gets daily images with resolution at Municipality level that will allow a good monitoring of the program.

CHIRPS is a dataset that can be used to meet the goal of building a parametric drought and excess rainfall product. In fact, the platform provides daily precipitations from 1981 to near-present at a 0.05° resolution for the whole world.28.

Another dataset that can be used is the dataset ERA5 provided by the European Centre for Medium-Range Weather Forecasts. It is a dataset based on reanalysis, meaning that it combines model data with observations from across the world. It provides a consistent view of the evolution of hourly weather estimates, such as the precipitations, the temperature, or the water content of the soil at different depths. The data is available from 1979 to near-present and at a 0.25° x 0.25° geographical resolution for the whole world.

ERA5-Land is a global land-surface dataset at 9 km resolution, consistent with atmospheric data from the ERA5 reanalysis from 1950 onward.29 ERA5-Land is a reanalysis dataset providing a consistent view of the evolution of land variables over several decades at an enhanced resolution compared to ERA5. For our analysis, the relevant information from ERA5 is:[40b]

1. Volumetric soil water layer 1. (m3 m-3). Volume of water in soil layer 1 (0 - 7 cm) of the ECMWF Integrated Forecasting System. The surface is at 0 cm. The volumetric soil water is associated with the soil texture (or classification), soil depth, and the underlying groundwater level.
2. Volumetric soil water layer 2. (m3 m-3). Volume of water in soil layer 2 (7 -28 cm) of the ECMWF Integrated Forecasting System.
3. Volumetric soil water layer 3 (m3 m-3). Volume of water in soil layer 3 (28-100 cm) of the ECMWF Integrated Forecasting System.
4. Volumetric soil water layer 4 (m3 m-3). Volume of water in soil layer 4 (100-289 cm) of the ECMWF Integrated Forecasting System.

For the illustrative Index that we share later for the Soil Moisture Index, the data to construct the correlation that we used was from ERA5.

28 SIAP (which is the calculation agent of CADENA, and possibly could be for the new program we propose as well) has developed methods to increase the accuracy of radar observations. We will get in contact with them if we continue advancing towards a Full Proposal

29 [40b] https://climate.copernicus.eu/climate-reanalysis

4.3 Weather station data available (historic time series and actual measurement)

There is a network of georeferenced weather stations available from National Water Commission (CONAGUA)30. There is also a network of Automated Climatological Weather Stations. The number of these automated stations is low; therefore, we consider that for our project we will use this weather station data as support for the satellite imagery only in case necessary, but our analysis will not include this data as a source.

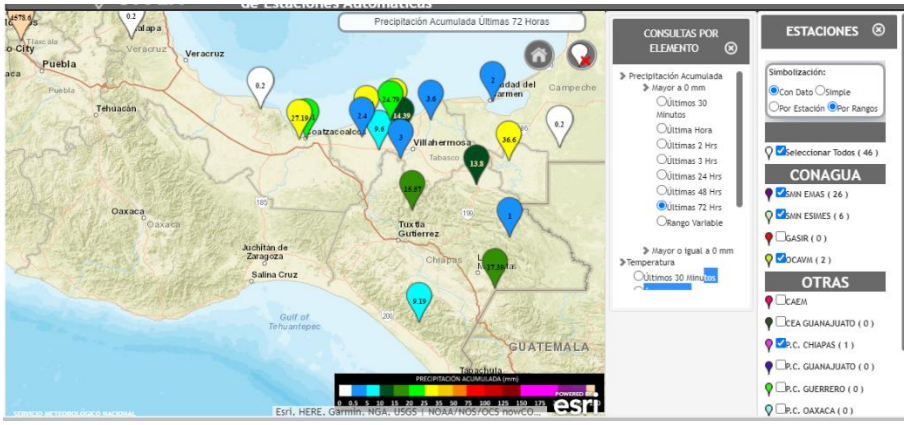

Chart 9. Weather Stations in Mexico

Source: (CONAGUA31)

4.4 Sub-regions/climatic zones in scope covering the target population

SADER has divided the country in 191 Rural Development Districts (DDR) and 713 Rural Development Support Centers (CADER) to increase the communication among producers, Municipal and State Governments. Its purpose is to provide guidelines, different programs and services for producers to become more productive32.

30 National Water Commission

31 https://smn.conagua.gob.mx/es/observando-el-tiempo/estaciones-meteorologicas-automaticas-ema-s

32 Since 2012 SIAP database is arranged in DDR's and CADER's to share statistical information. (SIAP: Agri-food and Fisheries Information Service is SAGARPA decentralized administrative body in charge of generating statistics and geographic information on agri-food matters)

4.4.1 Oaxaca.

The current political division of Oaxaca State is made of eight geographical and cultural Rural Development Districts (DDR), with 570 municipalities. The DDR's are: Cañada (4,400 km^2), Costa (11,600 km^2), Istmo (20,760 km^2), Mixteca (15,670 km^2), Papaloapan (8,500 km^2), Sierra Sur (14,750 km^2), Sierra Norte (8,970 km^2), and Valles Centrales (9,480 km^2). Within each DDR there are several CADER's that in turn enclose all municipalities. On the figure below, we have the historic production and yield for the period of 2010-2019 for Oaxaca across DDR's and CADER's.

DDR/CADER		Sown (Ha)	Harvested (Ha)	Damaged (Ha)	Production (Ton)	Yield (Ton/Ha)
Cañada		**29,901**	**29,901**	**-**	**40,433**	**1.35**
	Cuicatlán	11,471	11,471	-	15,640	1.36
	Huautla	14,890	14,890	-	19,766	1.33
	Teotitlán	3,541	3,541	-	5,027	1.42
Costa		**50,695**	**30,276**	**20,419**	**43,921**	**1.45**
	Pinotepa Nacional	30,249	18,662	11,587	31,516	1.69
	Pochutla	5,291	3,517	1,774	3,699	1.05
	Río Grande	8,585	4,915	3,670	5,401	1.10
	Santos Reyes	6,571	3,183	3,388	3,306	1.04
Huajuapan de León		**100,558**	**86,531**	**14,027**	**84,008**	**0.97**
	Huajuapan	27,910	25,315	2,595	28,435	1.12
	Nochixtlán	18,090	8,569	9,521	8,299	0.97
	Tamazulapan	8,028	7,043	985	3,256	0.46
	Tlaxiaco	46,530	45,604	926	44,019	0.97
Istmo		**76,911**	**76,911**	**-**	**106,576**	**1.39**
	Juchitán	29,260	29,260	-	46,522	1.59
	Matías Romero	17,649	17,649	-	26,238	1.49
	Niltepec	7,055	7,055	-	9,024	1.28
	Tapanatepec	10,574	10,574	-	13,084	1.24
	Tequisistlán	12,373	12,373	-	11,708	0.95
Sierra Juárez		**21,805**	**21,784**	**22**	**28,514**	**1.31**
	Ayutla/Mixe	11,099	11,099	-	14,094	1.27
	Ixtlán	5,098	5,098	-	7,136	1.40
	Villa Alta	5,609	5,587	22	7,284	1.30
Tuxtepec		**62,022**	**62,022**	**-**	**159,512**	**2.57**
	Cihualtepec	5,354	5,354	-	18,476	3.45
	Ojitlán	18,163	18,163	-	25,898	1.43
	San Juan del Río	14,860	14,860	-	44,546	3.00
	Temascal	7,850	7,850	-	13,170	1.68
	Tuxtepec	15,795	15,795	-	57,422	3.64
Valles Centrales		**155,841**	**155,841**	**-**	**170,833**	**1.10**
	Etla	64,865	64,865	-	66,762	1.03
	Miahuatlán	47,080	47,080	-	50,351	1.07
	Sola de Vega	21,981	21,981	-	24,155	1.10
	Tlacolula	21,915	21,915	-	29,566	1.35
	Total	**497,732**	**463,266**	**34,467**	**633,798**	**1.37**

As shown in *Chart 10*, 47% of the surface of the state has a warm sub humid climate that is located throughout the coastal area and to the east, 22% has a warm humid climate located mainly in the north region, 16% has a temperate humid climate in the upper parts east of the Volcán Prieto and Humo Grande hills, 11% have a dry and semi-dry climate in the central-south and northwest region, the remaining 4% have a temperate sub humid climate towards the south and northwest of the state.

Chart 10. Climate in regions of Oaxaca
Source: (Service, s.f.)

DDR/CADER		Sown (Ha)	Harvested (Ha)	Damaged (Ha)	Production (Ton)	Yield (Ton/Ha)
Cañada		**29,901**	**29,901**	**-**	**40,433**	**1.35**
	Cuicatlán	11,471	11,471	-	15,640	1.36
	Huautla	14,890	14,890	-	19,766	1.33
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	Santos Reyes	6,571	3,183	3,388	3,306	1.04
Huajuapan de León		**100,558**	**86,531**	**14,027**	**84,008**	**0.97**
	Huajuapan	27,910	25,315	2,595	28,435	1.12
	Nochixtlán	18,090	8,569	9,521	8,299	0.97
	Tamazulapan	8,028	7,043	985	3,256	0.46
	Tlaxiaco	46,530	45,604	926	44,019	0.97
Istmo		**76,911**	**76,911**	**-**	**106,576**	**1.39**
	Juchitán	29,260	29,260	-	46,522	1.59
	Matías Romero	17,649	17,649	-	26,238	1.49
	Niltepec	7,055	7,055	-	9,024	1.28
	Tapanatepec	10,574	10,574	-	13,084	1.24
	Tequisistlán	12,373	12,373	-	11,708	0.95
Sierra Juárez		**21,805**	**21,784**	**22**	**28,514**	**1.31**
	Ayutla/Mixe	11,099	11,099	-	14,094	1.27
	Ixtlán	5,098	5,098	-	7,136	1.40
	Villa Alta	5,609	5,587	22	7,284	1.30
Tuxtepec		**62,022**	**62,022**	**-**	**159,512**	**2.57**
	Cihualtepec	5,354	5,354	-	18,476	3.45
	Ojitlán	18,163	18,163	-	25,898	1.43
	San Juan del Río	14,860	14,860	-	44,546	3.00
	Temascal	7,850	7,850	-	13,170	1.68
	Tuxtepec	15,795	15,795	-	57,422	3.64
Valles Centrales		**155,841**	**155,841**	**-**	**170,833**	**1.10**
	Etla	64,865	64,865	-	66,762	1.03
	Miahuatlán	47,080	47,080	-	50,351	1.07
	Sola de Vega	21,981	21,981	-	24,155	1.10
	Tlacolula	21,915	21,915	-	29,566	1.35
	Total	**497,732**	**463,266**	**34,467**	**633,798**	**1.37**

Table 11. Number of Ha for crop use in Oaxaca by DDR and CADER **for CORN** (regions)
Source: Internal study with data from SIAP

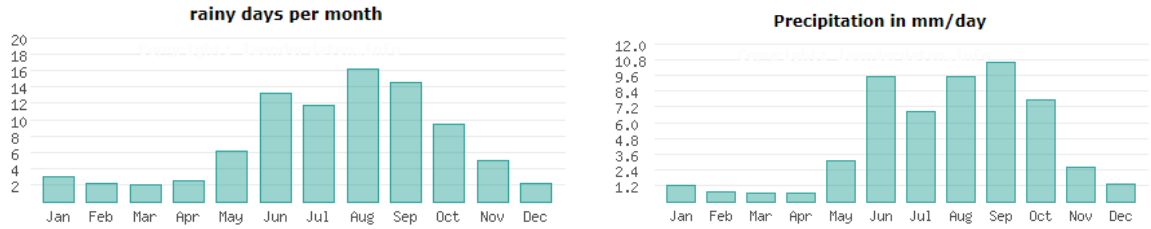


Chart 11. Rainy days and precipitation in Oaxaca[33]

Source: (Service, s.f.)

Oaxaca has its rainy season from June to September.

4.4.2 Tabasco.

Tabasco is exposed to almost yearly flood events that cause substantial damage. The State is organized in three Rural Development Districts: Cárdenas, Emiliano Zapata and Villahermosa. and 21 CADER's. On the next page figure, we present the historic production and yield for the period of 2010-2019 for Oaxaca across DDR's and CADER's.

Chart 12. Inundation maps for 10- and 1000-yr return period riverine floods under current climate conditions

Source: Scielo

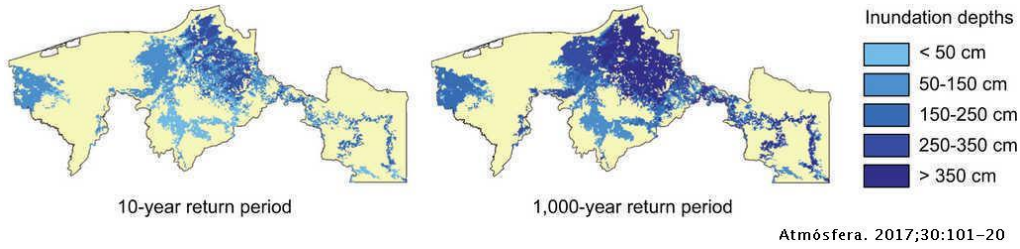


Chart 13 Inundation maps for 10- and 1000-yr return period coastal floods under current climate conditions

Source: Scielo

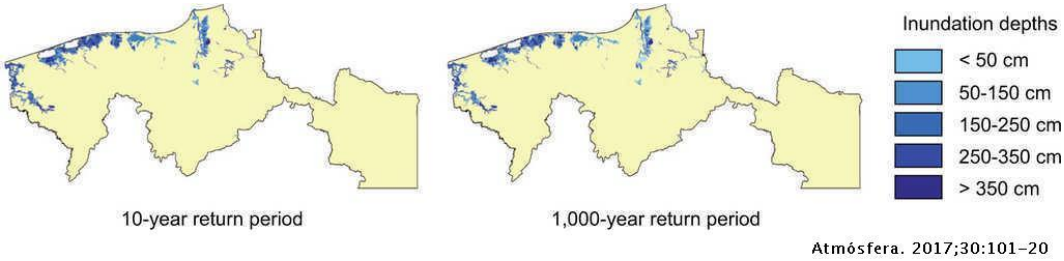


Figure 12 (upper) shows two examples of inundation maps for different return periods of river flooding[34]. Note that these maps do not show the extent of one flood, but rather that the chance of flooding in these areas is one in 10 (left) and one in 1000 (right), respectively. Figure 13 (lower) presents two examples of inundation maps for coastal flooding as well.

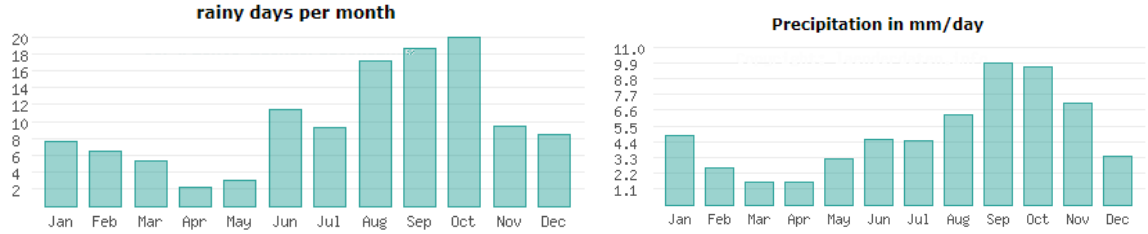


Chart 14. Rainy days and precipitation in Tabasco[35]

Source: (Service, s.f.)

33 https://www.worlddata.info/america/mexico/climate-Oaxaca.php

34 Economic evaluation of climate risk adaptation strategies: Cost-benefit analysis of flood protection in Tabasco, Mexico (link)

35 https://www.worlddata.info/america/mexico/climate-Tabasco.php

Tabasco has a slightly longer rainy season from June to October

Tabasco

DDR/CADER		Sown (Ha)	Harvested (Ha)	Damaged (Ha)	Production (Ton)	Yield (Ton/Ha)
Cárdenas		**26,846**	**26,306**	**540**	**45,462**	**1.73**
	Benito Juárez	3,619	3,619	-	5,971	1.65
	Cárdenas	3,596	3,596	-	5,882	1.64
	Comalcalco	3,485	3,035	450	4,780	1.57
	Cunduacán	2,780	2,780	-	4,617	1.66
	Huimanguillo	9,348	9,348	-	18,633	1.99
	Jalpa de Méndez	806	806	-	981	1.22
	Lic. Fco. Trujillo	2,163	2,163	-	3,552	1.64
	Nacajuca	810	810	-	848	1.05
	Paraíso	239	149	90	198	1.33
Emiliano Zapata		**33,386**	**28,841**	**4,546**	**59,019**	**2.05**
	Balancán	8,311	7,123	1,188	19,983	2.81
	Emiliano Zapata	2,545	1,343	1,203	2,587	1.93
	Jonuta	5,515	5,106	409	9,151	1.79
	Sur 18	5,181	4,604	577	7,622	1.66
	Tenosique	4,509	4,110	399	7,334	1.78
	Villa Quetzalcóatl	7,325	6,555	770	12,343	1.88
Villahermosa		**22,033**	**22,033**	**-**	**42,516**	**1.93**
	Centla	5,718	5,718	-	10,674	1.87
	Centro	2,828	2,828	-	5,785	2.05
	Jalapa	1,177	1,177	-	2,244	1.91
	Macuspana	2,954	2,954	-	5,352	1.81
	Tacotalpa	8,472	8,472	-	16,957	2.00
	Teapa	884	884	-	1,502	1.70
	Total	**82,265**	**77,180**	**5,086**	**146,997**	**1.90**

Table 12. Number of Ha for crop use in Tabasco by DDR and CADER **for CORN** (regions)
Source: Internal study with data from SIAP

4.4.3 Chiapas.

The State is organized in ten Rural Development Districts (Comitán, Motozintla, Palenque, Pichucalco, San Cristóbal de las Casas, Selva Lacandona, Tapachula, Tonalá, Tuxtla Gutiérrez and Villa Flores) and 32 CADER's. On the figure below, we present the historic production and yield for the period of 2010-2019 for Chiapas across DDR's and CADER's.

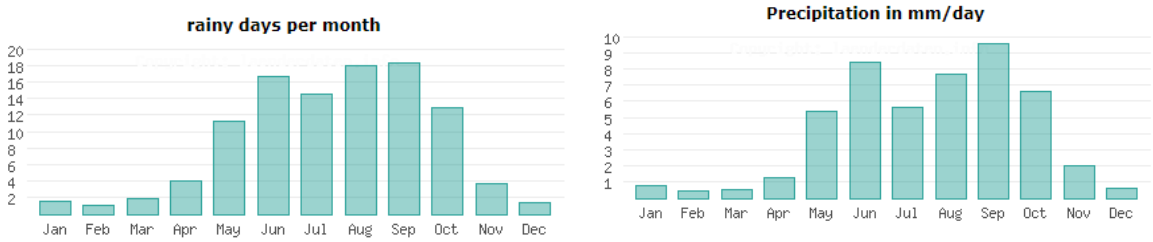


Chart 15. Rainy days and precipitation in Chiapas[36]
Source: (Service, s.f.)

Chiapas also concentrates most of its rains from June to October

36 https://www.worlddata.info/america/mexico/climate-Chiapas.php

Chiapas

DDR/CADER		Sown (Ha)	Harvested (Ha)	Damaged (Ha)	Production (Ton)	Yield (Ton/Ha)
Comitán		**99,322**	**99,322**	**-**	**213,966**	**46.3**
	Margaritas	37,810	37,810	-	61,517	1.6
	San Gregorio	22,998	22,998	-	86,338	3.8
	Trinitaria	38,514	38,514	-	66,111	1.7
Motozintla		**35,723**	**35,723**	**-**	**55,855**	**1.6**
	Amatenango	21,433	21,433	-	35,687	1.7
	Porvenir	14,290	14,290	-	20,168	1.4
Palenque		**148,255**	**148,255**	**-**	**188,465**	**1.3**
	Ocosingo	17,984	17,984	-	24,668	1.4
	Palenque	79,551	79,551	-	100,299	1.3
	Yajalon	50,720	50,720	-	63,498	1.3
Pichucalco		**66,858**	**66,858**	**-**	**89,965**	**1.3**
	Bochil	16,825	16,825	-	24,586	1.5
	Juárez	14,057	14,057	-	18,077	1.3
	Pichucalco	6,192	6,192	-	7,321	1.2
	Simojovel	25,383	25,383	-	34,145	1.3
	Tapilula	4,401	4,401	-	5,837	1.3
San Cristóbal		**81,336**	**81,336**	**-**	**101,531**	**1.2**
	Altamirano	22,888	22,888	-	28,150	1.2
	Chenalhó	15,759	15,759	-	19,063	1.2
	San Cristóbal	42,688	42,688	-	54,318	1.3
Selva Lacandona		**37,440**	**37,440**	**-**	**37,643**	**1.0**
	Frontera	15,488	15,488	-	15,488	1.0
	Nuevo Orizaba	12,885	12,885	-	12,747	1.0
	San Quintín	9,067	9,067	-	9,408	1.0
Tapachula		**30,023**	**30,023**	**-**	**73,776**	**2.5**
	Acapetahua	9,529	9,529	-	20,756	2.2
	Huixtla	5,051	5,051	-	9,979	2.0
	Suchiate	999	999	-	3,334	3.3
	Tapachula	14,445	14,445	-	39,707	2.7
Tonalá		**7,420**	**7,420**	**-**	**15,006**	**2.0**
	Pijijiapan	4,420	4,420	-	9,893	2.2
	Tonalá	3,000	3,000	-	5,114	1.7
Tuxtla Gutiérrez		**122,081**	**105,071**	**17,010**	**273,642**	**2.6**
	Cintalapa	13,389	11,495	1,894	29,517	2.6
	Tecpatán	10,649	9,337	1,312	14,871	1.6
	Tuxtla Gutiérrez	78,514	66,815	11,699	181,198	2.7
	V Carranza	19,529	17,424	2,105	48,056	2.8
Villa Flores		**61,366**	**61,366**	**-**	**205,570**	**3.3**
	Independencia	24,870	24,870	-	71,838	2.9
	Villa Corzo	13,438	13,438	-	52,782	3.9
	Villaflores	23,058	23,058	-	80,950	3.5
	Total	**689,822**	**672,812**	**17,010**	**1,255,420**	**1.9**

Table 13. Number of Ha for crop use in Chiapas by DDR and CADER **for CORN** (regions)
Source: Internal study with data from SIAP

4.5 Main staple crop for the target population in each relevant sub-region / climatic zone

Mexico's six strategic staple crops are rice, beans, corn, wheat, soybeans and sorghum[37]. Chart 18 shows that corn is by far the main staple crop in the country.

One of the most documented impacts of Climate Change is droughts, which are becoming more frequent, and have caused losses in agriculture in the past and livestock that have reached up to 50%, with significant damage to the **corn crop** —which occupies most of the cultivated area— together with beans [23b]

[37] Sixth National Communication and Second Biennial Report of Update for the Convention United Nations Framework on Climate Change, MEXICO. 2018

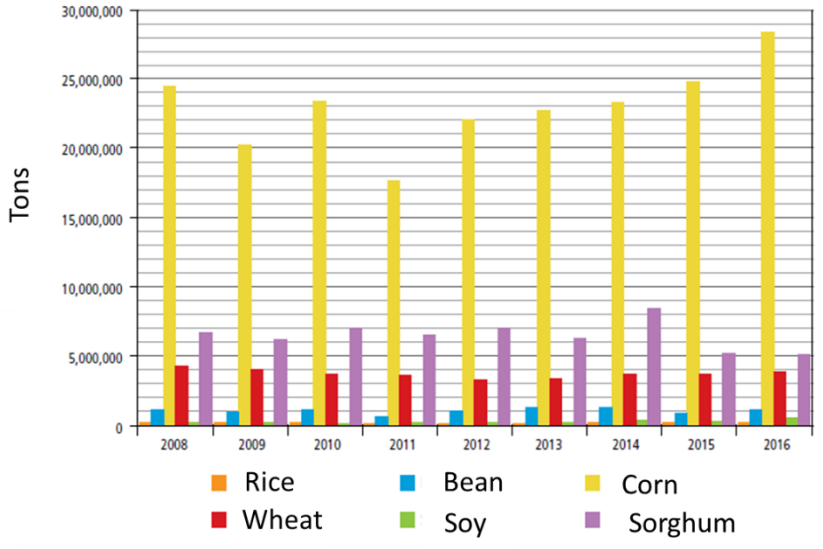


Chart 16 : . Strategic Basic Staple Crops in Mexico (2006 – 2016).

Source: Sectorial Development Program Agriculture, Fisheries and Food 2013-2018.

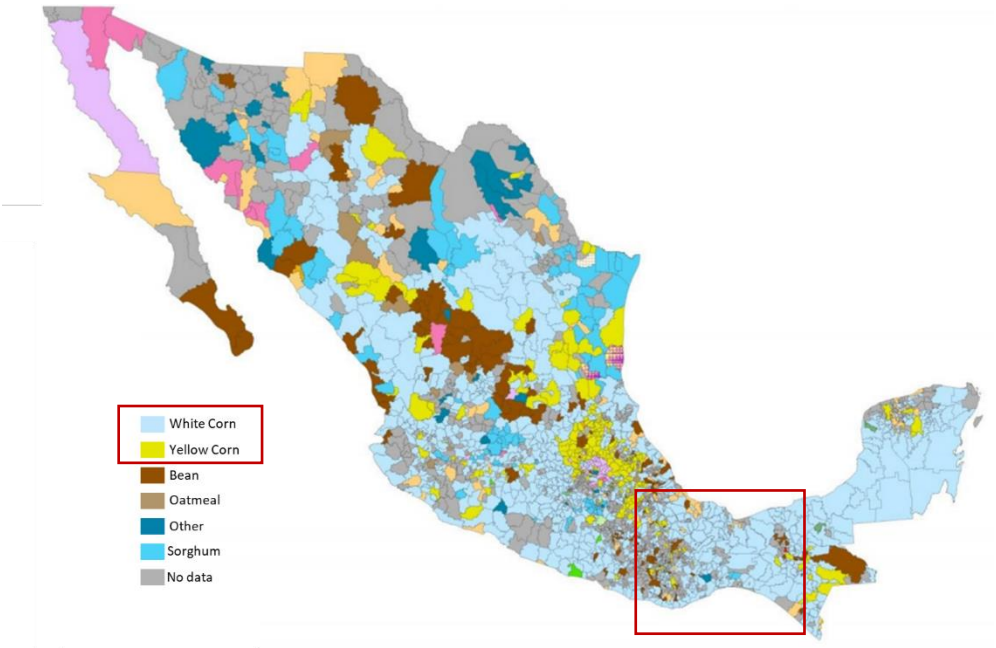


Chart 17. Distribution of Main Staple cyclical crops predominant per Municipality for Family agriculture.

Source: FAO38

According to ENA 2017 4 out of 10 Ha of harvested land in Mexico were corn. There was a 31.2 million Ton total production of grain corn (28.6% of the total agriculture production of the country)39. 23.1 million Ton were of white corn, and 8.1 million Ton of yellow corn. 48.3% was sold to intermediaries, and 38.6% was sold directly to the consumer.

38 http://www.fao.org/3/bc944s/bc944s.pdf

39 https://www.inegi.org.mx/contenidos/programas/ena/2017/doc/inf_Maiz17.pdf

4.6 Main “staple crops” and states selected for the project pilot

The top five staple crops in Oaxaca (Corn, Lemon, Papaya, Pasture and Sugar Cane) account for roughly 65% of the total production of the State. We have learned from Agroasemex, that the initial interest for the program would be to protect the corn production.

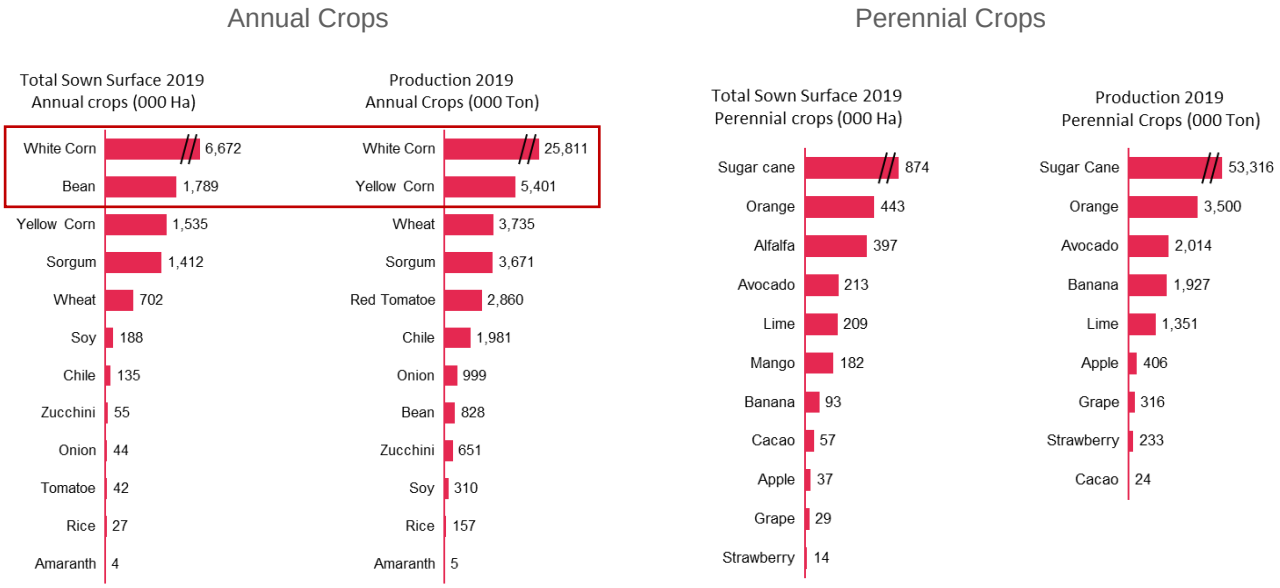


Chart 18. Top crops in Mexico 2019 (Total surface in Ha, Total Production in tons)

Source: (INEGI)

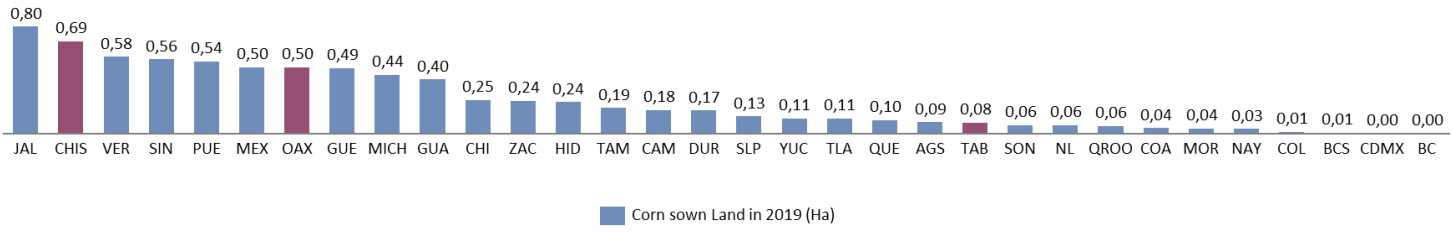


Chart 19. Corn sown land by State 2019 (Total surface in Ha)

Source: (SIAP)

Chiapas, Oaxaca and Tabasco accounted for 1,270,367 Ha of Corn sown in 2019, or 16.5% of the total area destined to corn in the country.

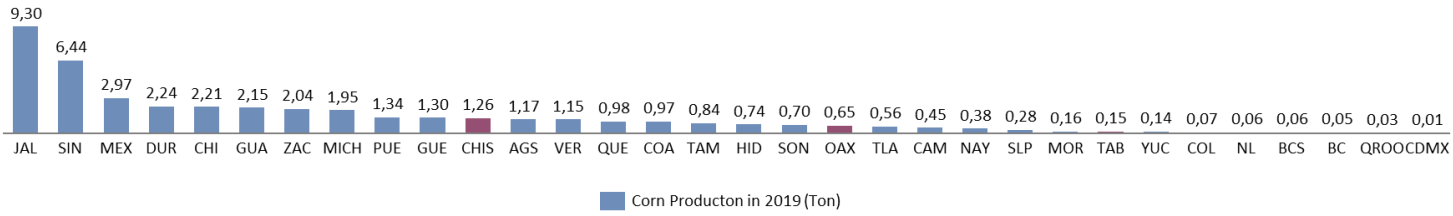


Chart 20. Corn Production by State 2019 (Total surface in Ha)

Source: (SIAP)

However, Chiapas, Oaxaca and Tabasco accounted for only 2,056,339 Tons of corn produced, roughly 4,8% of the corn in the country. Thus, we see that the productivity in the region is lower than in other states. We assume it is due to poor access to resources and best practices. During our pilot test, we will provide access to best practices and record the impact in the overall productivity.

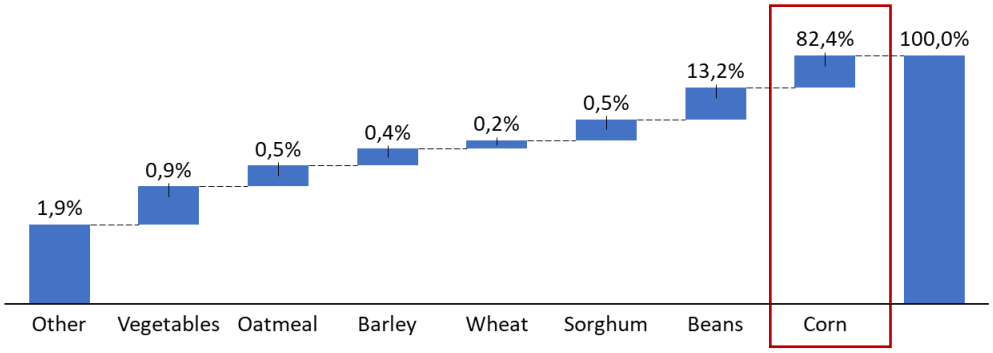


Chart 21. % of total surface of main staple Crops in Family Agriculture)

Source: FAO40

82,4% of the total surface that smallholder (family) producers cultivate is destined to corn, and most of the time is used for self-consumption by the bottom of the pyramid producers. It is thus pivotal for the sustenance of the families. Protecting corn is therefore key to contribute to the resilience of households.

The following tables show a summary of the experience the CADENA program had in Oaxaca, Tabasco and Chiapas on two products (parametric and traditional insurance). The parametric experience was for green corn used as livestock food (its indexes and information are thus not relevant for our study)

Tabasco

	PARAMETRIC			PRODUCTION GUARANTEES		
	Insured area (Ha)	insured sum (MXN)	GWP (MXN)	Insured area (Ha)	insured sum (MXN)	GWP (MXN)
2010	17,191	19,514	33,042	13,236	14,804	17,967
2011	4,410	5,855	8,729	34,426	37,048	32,187
2012	7,396	6,485	13,709	35,631	33,205	39,794
2013	4,862	5,537	11,553	35,611	33,180	38,799
2014	-	-	-	35,611	34,882	40,033
2015	-	-	-	-	-	-
2016	-	-	-	-	-	-
2017	-	-	-	-	-	-
2018	-	-	-	-	-	-

		PARAMETRIC		MULTICROP (SATELLITE)		TRADITIONAL	
		Compensated area (Ha)	Compensation (MXN)	Compensated area (Ha)	Compensation (MXN)	Compensated area (Ha)	Compensation (MXN)
Excess Rain	2010	17,883	12,770,325	-	-	-	-
	2011	-	-	-	-	9,334	11,200,200
	2012	-	-	-	-	564	733,200
	2013	-	-	-	-	8,543	11,105,900
	2017	-	-	1,650	2,475,000	-	-
Drought	2012	-	-	-	-	215	279,175
	2017	-	-	2,394	3,590,625	-	-
Hail	2017	-	-	31	46,875	-	-

Oaxaca

YEAR	PARAMETRIC			PRODUCTION GUARANTEES			TRADITIONAL		
	Insured area (Ha)	Insured sum (MXN)	GWP (MXN)	Insured area (Ha)	Insured sum (MXN)	GWP (MXN)	Insured area (Ha)	Insured sum (MXN)	GWP (MXN)
2010	-	-	-	510,467	835,269	1,772,576	-	-	-
2011	121,836	188,755	424,604	22,008	32,968	81,946	993,331	1,573,403	2,893,066
2012	11,869	20,807	76,021	-	-	-	1,006,357	1,625,204	3,329,552
2013	137,270	223,106	470,451	-	-	-	1,064,688	1,668,325	3,424,028
2014	140,706	217,873	486,662	-	-	-	1,060,332	1,673,364	3,381,884
2015	211,215	319,953	720,756	-	-	-	1,058,393	1,670,335	3,441,390
2016	265,487	413,691	921,936	1,063,360	1,671,730	3,364,583	-	-	-
2017	135,327	211,326	476,294	1,055,001	1,663,009	3,525,705	-	-	-
2018	135,327	211,326	482,377	-	-	-	1,055,001	1,663,009	3,545,664

40 http://www.fao.org/3/bc944s/bc944s.pdf

Chiapas

YEAR	PARAMETRIC Insured area (Ha)	PARAMETRIC Insured sum (MXN)	PARAMETRIC GWP (MXN)	TRADITIONAL Insured area (Ha)	TRADITIONAL Insured sum (MXN)	TRADITIONAL GWP (MXN)
2010	-	-	-	141,233	166,400	217,127
2011	114,364	138,124	180,144	114,218	139,472	192,593
2012	-	-	-	134,053	171,423	202,962
2013	504	813	5,419	152,424	175,404	223,597
2015	30,375	36,084	38,346	149,527	196,245	218,788
2016	-	-	-	149,527	196,245	218,498
2017	-	-	-	-	-	-
2018	27,700	32,029	42,016	157,196	180,205	238,738

		PARAMETRIC Compensated area (Ha)	PARAMETRIC Compensation (MXN)	TRADITIONAL Compensated area (Ha)	TRADITIONAL Compensation (MXN)
Excess Rain	2013	-	-	10,794	19,150,827
	2016	-	-	1,000	-
Rain & Drought	2016	-	-	2,040	-
Excess Rain	2010	-	-	1,136	1,022,400
Drought	2015	163	220,050	2,697	40,050,000
	2016	-	-	13,028	525,000
Wind & Drought	2016	-	-	600	-
Other Risks	2010	-	-	5,813	5,231,673
	2011	77,856	82,635,480	7,480	8,975,652
	2012	-	-	7,457	13,699,064
	2014	-	-	20,085	33,208,200

		PARAMETRIC Compensated area (Ha)	PARAMETRIC Compensation (MXN)	AGRICULTURAL FIELD Compensated area (Ha)	AGRICULTURAL FIELD Compensation (MXN)	TRADITIONAL Compensated area (Ha)	TRADITIONAL Compensation (MXN)
Excess Rain	2005	-	-	-	-	200	300,000
	2006	-	-	-	-	920	3,135,000
	2007	-	-	-	-	4,937	6,047,217
	2009	-	-	3,407	3,066,300	-	-
	2011	-	-	1,156	1,040,400	-	-
	2012	-	-	961	864,900	-	-
	2013	-	-	22,480	26,916,400	-	-
	2015	-	-	14,171	17,067,800	-	-
	2016	1,955	1,231,650	-	-	8,850	12,810,734
	2018	7,886	10,251,800	-	-	-	-
Hail	2006	-	-	-	-	195	292,500
	2007	-	-	-	-	230	345,000
Frost	2013	-	-	1,376	1,652,500	-	-
	2015	-	-	1,812	2,174,400	-	-
Flood	2009	-	-	537	483,300	-	-
	2011	-	-	15,433	13,889,250	-	-
	2012	-	-	5,768	5,191,200	-	-
	2013	-	-	450	405,000	-	-
Other Risk	2008	-	-	-	-	150	183,720
	2016	11,715	11,415,420	-	-	17,458	25,738,400
	2017	-	-	-	-	17,949	26,958,334
	2018	-	-	-	-	15,449	24,282,479
Drought	2004	-	-	-	-	555	382,500
	2005	-	-	-	-	7,241	10,951,500
	2006	-	-	-	-	14,625	19,391,715
	2007	-	-	-	-	23,057	28,937,852
	2008	-	-	-	-	26,478	32,429,642
	2009	-	-	-	-	2,321	2,842,698
	2015	-	-	6,358	5,210,670	-	-
	2016	33,356	25,768,795	917	742,770	11,385	16,923,012
	2017			4,960	3,720,645	-	-
	2018	3,278	1,933,360	544	380,880	-	-
Wind	2005	-	-	-	-	55	82,500
	2006	-	-	-	-	10	15,000
	2013	-	-	120	144,000	-	-
	2015	-	-	170	204,000	-	-

Chart 22 Summary of experience from CADENA in the three states

According to the information shared by Agroasemex, the experience across the three states for the green corn livestock parametric program was limited because the covered area was small, and because the imagery and data was coarse the first years making its use difficult. Later the data accuracy was refined but the program was stopped.

5 Proposed perils, outreach (regional, national)

We confirm that the thresholds for each type of crop and region are different. We find that June and November are the months of sowing for corn. We discover that the most climate-sensitive period for corn development is from days 27 to 76 (depending on temperature). We share yield data per region and subregion (DDR and CADER). Standard Precipitation Index and Crop Moisture are the indexes recommended by underwriting teams to develop.

5.1 Thresholds for all types of crops of a selected State equally vulnerable to changes in temperature and availability of water

Considering our target group, we have selected corn as the most relevant crop and because its vulnerability to temperature and the availability of water is the same across states. However, information on all main staple crops in the country was collected as well.

In fact, all the crops do not depend on the water in the same way, and therefore, it will be needed to build custom indices and thresholds for each crop we would want to ensure. For example, we found out that the water content of the soil is the best indicator to determine how the corn will develop, but we may have to choose another indicator, based for example on rain or temperature, that will have a bigger impact on the growth of another crop. Also, the risk period, which is the period when the plant is the most sensitive to drought, can be different from one crop to another, depending on its growing cycle41. For instance, for the corn crop that is planted in the spring-summer cycle, we look at the climatological variables during the 3 months of July, August and September only.

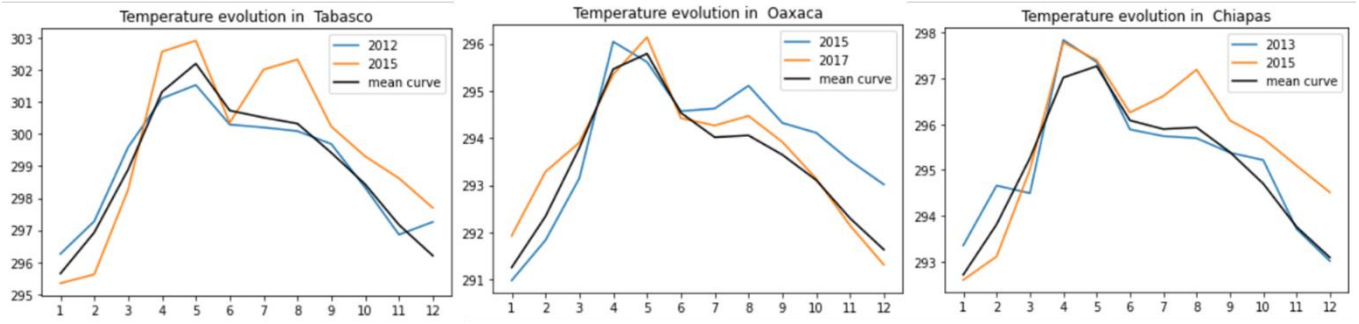


Chart 23. Temperature evolution in Tabasco, Oaxaca and Chiapas (2013 and 2015)

Source: (SIAP,internal research AXA Climate Data Science Team)

5.2 Crop growing periods (per sub-region/climatic zone if possible) and target crop sensitivity to temperature, drought/excess rainfall

SIAP shares information across Mexico for two agricultural cycles: autumn-winter and spring-summer. The largest sown area of corn in Mexico in the autumn-winter cycle occurs in **November**, while in spring-summer it is in **June**42.

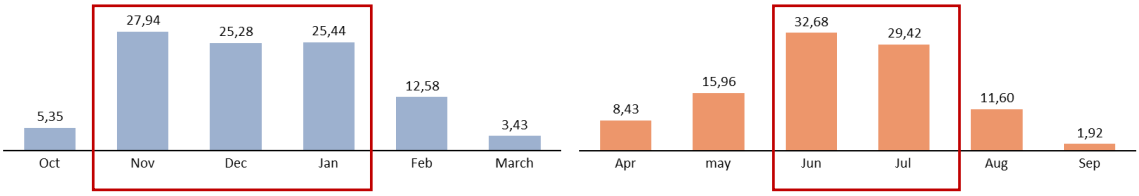


Chart 24. % Area of Corn sown by month in two periods (spring-summer in blue, autumn-winter in orange).

41 For the purpose of this study we will assess the risks associated to white corn, which is the predominant variety sown by smallholder farmers. Yellow corn is mostly sown by large farmers to be exported (its sweet taste is not popular for tortillas and other dishes in MExico).

42 https://www.gob.mx/siap/articulos/fecha-de-siembras-y-cosechas-en-mexico?idiom=es

Source: (SIAP, Datasets from Agrifood and Fisheries Information Service)

Corn is particularly vulnerable to changes in the availability of water and temperature near the flowering period: 20 to 30 days before it, and 21 days after. If (considering the first day of the period the day of sowing) the flowering happens around day 57, then the period of higher risk should be around the period from day 27 to 76.

	Potential Damage	Stages at risk
Excess rain	Yellowing or reddening of the leaves Leaf necrosis Growth and development affected depending on the duration of the flooding	At sowing and emergence
Drought	Before flowering: leaf curl, "blue" leaf coloring At flowering: delayed female flowering, fertilization problem After flowering: grain abortion, scalding of grains from the top of the ear	Maximum sensitivity stage between 20 and 30 days before flowering and three weeks after

Table 14. Potential damage to corn development from changes in the availability of water.
Source: (Internal AXA Climate)

	Stage	Days	Characteristics
	VE	5	The coleoptile emerges from the soil surface
	V1	9	The neck of the first leaf is visible.
	V2	12	The neck of the second leaf is visible.
Period of higher risk of damage from climate events	**Vn**		The neck of blade number "n" is visible. ("n" is equal to the final number of leaves that the plant has; "n" generally fluctuates between 16 and 22, but by flowering the 4 to 5 leaves below will have been lost.)
	VT	55	The last branch of the panicle is completely visible.
	R0	57	**Anthesis or male flowering**. Pollen begins to shed.
	R1	59	The stigmata are visible.
	R2	71	**Blister stage.** The grains are filled with a clear liquid and the embryo can be seen.
	R3	80	**Milky stage.** The grains are filled with a white milky liquid.
	R4	90	**Massive stage.** The grains are filled with a white paste. The embryo is about half the width of the grain.
	R5	102	**Toothed stage**. The tops of the kernels are filled with solid starch, and when the genotype is serrated, the grains take on the serrated shape. In both crystalline and serrated types, a "milk line" is visible when the grain is viewed from the side.
	R6	112	**Physiological maturity**. A black coating is visible at the base of the grain. The moisture of the grain is generally around 35%.

Table 15. Period of higher risk of damage to corn crops

5.3 Historic crop yield data at the sub-regional level to calibrate the products

The study does not only consider the existing historic crop yield data but also the possibility to create area yield triggers for sub regions as well as climatic zones with robust yield data (historic time series and actual measurements). In the following tables the historic corn yield (Ton/Ha) is presented for both production cycles (autumn-winter and spring-summer) per DDR and CADER.

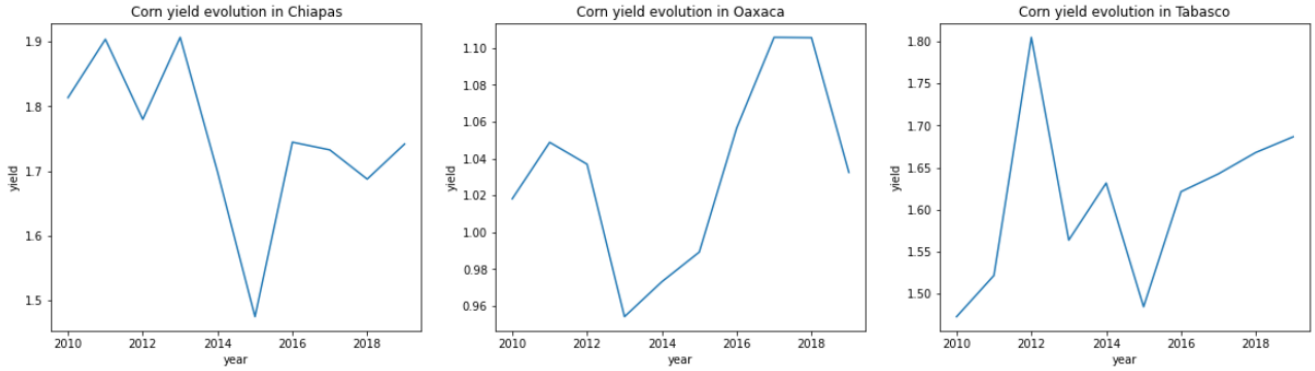


Chart 25. Corn yield evolution for Chiapas, Oaxaca and Tabasco.
Source: (Internal AXA Climate with data from SIAP)

Maize Yield (Ton/Ha)		Autum Winter										Spring Summer									
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Cañada		**2.26**	**2.33**	**2.28**	**2.18**	**2.23**	**2.30**	**2.22**	**2.18**	**2.22**	**2.27**	**1.61**	**1.69**	**1.57**	**1.50**	**1.56**	**1.55**	**1.62**	**1.60**	**1.66**	**1.69**
	Cuicatlán	2.33	2.36	2.27	2.15	2.25	2.30	2.23	2.19	2.25	2.28	1.58	1.74	1.63	1.53	1.57	1.60	1.65	1.67	1.69	1.73
	Huautla de Jiménez	1.81	1.83	1.81	1.73	1.74	1.83	1.77	1.71	1.78	1.79	1.33	1.36	1.32	1.36	1.44	1.37	1.45	1.34	1.48	1.51
	Teotitlán de Flores Magón	2.88	3.15	3.14	3.03	3.05	3.13	2.97	2.96	2.95	3.10	1.97	1.93	1.72	1.61	1.68	1.66	1.74	1.76	1.78	1.80
Costa		**2.00**	**2.00**	**2.22**	**2.08**	**2.07**	**2.30**	**2.38**	**2.48**	**2.50**	**2.59**	**1.08**	**1.15**	**1.07**	**0.95**	**0.89**	**0.97**	**1.23**	**1.36**	**1.26**	**0.93**
	Pinotepa Nacional	2.04	1.92	2.30	2.06	2.09	2.48	2.59	2.70	2.77	2.79	1.12	1.24	0.89	0.85	0.84	0.91	1.20	1.25	1.24	0.95
	Pochutla/San Pedro Pochutla	1.94	2.07	2.10	2.14	2.11	2.09	2.04	2.05	2.23	2.23	0.94	1.03	0.95	0.85	0.76	0.83	1.10	1.21	1.09	0.92
	Río Grande	1.94	2.31	2.25	2.36	2.11	1.96	2.03	2.31	1.96	2.44	1.67	1.11	1.94	1.62	1.49	1.30	1.68	2.30	1.99	0.88
	Santos Reyes Nopala	1.95	2.09	1.83	1.80	1.83	1.75	1.82	1.85	1.91	1.98	0.80	1.08	1.12	0.89	0.83	1.09	1.17	1.23	1.05	0.95
Huajuapan de León		**2.22**	**2.15**	**2.17**	**2.14**	**2.18**	**2.17**	**2.17**	**2.11**	**2.34**	**2.54**	**1.03**	**1.15**	**1.12**	**0.99**	**1.12**	**1.13**	**1.11**	**1.16**	**1.17**	**1.15**
	Huajuapan	2.40	2.61	2.53	2.52	2.56	2.47	2.44	2.32	2.65	2.93	0.92	1.10	1.03	1.04	1.08	1.05	1.03	1.13	1.22	1.17
	Nochixtlán	2.64	1.88	1.72	1.98	2.02	2.20	2.33	2.24	2.41	2.56	1.12	1.57	1.53	1.25	1.65	1.62	1.58	1.60	1.54	1.53
	Tamazulapan	1.98	0.76	2.03	1.68	1.38	1.40	1.43	1.51	1.56	1.78	0.99	0.67	0.67	0.31	0.49	0.59	0.57	0.60	0.54	0.46
	Tlaxiaco	1.64	1.65	1.71	1.59	1.63	1.67	1.66	1.70	1.79	1.83	1.11	1.11	1.11	1.08	1.06	1.10	1.11	1.11	1.14	1.18
Istmo		**1.51**	**1.60**	**1.58**	**1.54**	**1.48**	**1.51**	**1.60**	**1.60**	**1.68**	**1.73**	**0.74**	**0.98**	**1.13**	**0.85**	**0.92**	**1.00**	**1.20**	**1.32**	**1.30**	**1.27**
	Juchitán	1.75	1.56	1.65	1.59	1.56	1.67	1.74	1.66	1.75	1.87	0.81	0.93	1.21	0.93	1.04	1.11	1.29	1.41	1.39	1.40
	Matías Romero	1.59	2.50	2.05	2.00	1.65	1.55	1.60	1.70	1.80	1.74	1.26	0.98	1.40	1.30	1.27	1.24	1.54	1.69	1.67	1.34
	Niltepec	1.10	1.01	1.05	1.17	1.14	1.13	1.26	1.20	1.31	1.33	0.40	0.89	1.02	-	0.60	0.71	0.88	1.22	1.24	1.30
	Tapanatepec	0.50	1.06	1.02	1.10	1.17	1.08	1.13	1.41	1.44	1.45	0.30	1.69	1.08	0.88	0.91	1.06	1.33	1.36	1.36	1.22
	Tequisistlán	1.50	1.62	1.49	1.25	1.45	1.43	1.58	1.68	1.72	1.70	0.57	0.85	0.84	0.69	0.49	0.65	0.80	0.84	0.82	0.91
Sierra Juárez		**1.94**	**1.90**	**1.89**	**1.79**	**1.74**	**1.69**	**1.69**	**1.76**	**1.66**	**1.70**	**1.32**	**1.32**	**1.36**	**1.35**	**1.23**	**1.21**	**1.35**	**1.39**	**1.37**	**1.38**
	Ayutla/Mixe	1.22	1.10	1.09	1.15	1.25	1.09	1.21	1.24	1.21	1.23	1.13	1.21	1.20	1.12	1.03	1.05	1.18	1.31	1.25	1.28
	Ixtlán	2.13	2.11	2.09	2.08	1.87	1.83	1.87	1.92	1.82	1.91	1.48	1.46	1.55	1.52	1.41	1.38	1.52	1.54	1.53	1.52
	Villa Alta	2.13	2.12	2.11	1.88	1.87	1.87	1.81	1.90	1.77	1.78	1.22	1.20	1.18	1.24	1.10	1.08	1.23	1.24	1.23	1.24
Tuxtepec		**1.71**	**1.65**	**1.76**	**2.13**	**2.18**	**2.31**	**2.52**	**2.53**	**2.72**	**2.73**	**1.57**	**1.77**	**1.73**	**1.78**	**1.71**	**1.73**	**2.00**	**2.11**	**2.26**	**2.41**
	Cihualtepec	2.12	2.53	4.35	4.48	4.25	4.40	4.70	4.80	4.95	4.90	1.85	2.10	1.59	1.73	1.83	1.93	1.93	2.15	2.60	2.77
	Ojitlán/San Lucas	1.18	1.04	1.36	1.44	1.39	1.17	1.26	1.33	1.37	1.38	1.23	1.18	1.21	1.24	1.35	0.86	1.31	1.34	1.39	1.42
	San Juan del Río	1.86	1.99	2.02	2.46	2.51	2.72	2.58	2.75	2.80	2.77	1.96	2.67	2.61	2.49	2.24	2.33	2.34	2.39	2.68	2.82
	Temascal	1.31	0.80	0.96	0.96	0.96	1.18	1.68	1.77	1.85	1.83	1.15	1.04	1.01	1.14	0.91	1.12	1.09	1.12	1.18	1.24
	Tuxtepec	2.10	2.04	1.36	2.29	2.58	2.82	3.27	2.92	3.52	3.63	1.60	1.64	1.71	1.89	1.97	2.13	2.91	3.18	3.17	3.50
Valles Centrales		**2.64**	**2.52**	**2.62**	**2.65**	**2.71**	**2.74**	**2.72**	**2.81**	**2.82**	**2.91**	**1.68**	**1.61**	**1.70**	**1.64**	**1.63**	**1.65**	**1.62**	**1.68**	**1.72**	**1.65**
	Etla	2.79	2.59	2.74	2.69	2.78	2.81	2.78	2.91	2.93	2.96	1.84	1.70	1.85	1.75	1.73	1.75	1.72	1.74	1.79	1.74
	Miahuatlán	2.64	2.58	2.47	2.56	2.51	2.49	2.45	2.44	2.40	2.84	1.44	1.45	1.47	1.48	1.44	1.44	1.43	1.50	1.59	1.44
	Sola de Vega	1.95	2.14	2.13	2.48	2.49	2.62	2.65	2.71	2.76	2.79	1.41	1.52	1.47	1.55	1.55	1.55	1.53	1.58	1.59	1.55
	Tlacolula	2.46	2.43	2.65	2.74	2.81	2.82	2.84	2.86	2.88	2.89	1.63	1.58	1.58	1.51	1.60	1.63	1.65	1.77	1.72	1.74
	Total	**2.16**	**2.13**	**2.20**	**2.17**	**2.19**	**2.25**	**2.27**	**2.31**	**2.36**	**2.45**	**1.34**	**1.38**	**1.40**	**1.30**	**1.33**	**1.35**	**1.39**	**1.45**	**1.47**	**1.42**

Table 16. Historic Corn Crop Yield in Oaxaca per DDR / CADER (Ton/Ha)
Source: (Datasets from Agrifood and Fisheries Information Service)

Maize Yield (Ton/Ha)		Autumn - Winter										Spring - Summer									
		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Comitán		**2.1**	**3.0**	**2.5**	**2.6**	**2.6**	**2.5**	**3.1**	**2.8**	**3.0**	**2.9**	**2.2**	**2.6**	**2.2**	**2.8**	**1.7**	**1.6**	**1.9**	**1.9**	**1.8**	**2.0**
	Margaritas	1.2	2.0	1.9	2.0	2.1	2.1	2.0	2.2	2.0	2.1	2.1	2.6	2.2	2.7	1.5	1.3	1.7	1.7	1.6	1.6
	San Gregorio	4.1	5.5	5.0	4.4	3.0	3.5	3.9	4.3	4.2	5.0	2.7	2.5	3.0	3.0	2.4	2.2	2.4	2.3	2.4	3.0
	Trinitaria	2.2	2.7	2.5	2.7	2.8	2.5	3.5	2.8	3.2	2.9	2.0	2.7	1.9	2.8	1.6	1.6	1.9	1.8	1.7	1.7
Motozintla												**1.4**	**1.5**	**1.5**	**1.4**	**1.5**	**1.6**	**1.5**	**1.5**	**1.5**	**1.5**
	Amatenango/Motozintla											1.5	1.6	1.6	1.5	1.6	1.7	1.6	1.6	1.6	1.6
	Porvenir											1.3	1.3	1.3	1.3	1.3	1.4	1.4	1.4	1.4	1.4
Palenque		**1.2**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.2**	**1.3**	**1.3**	**1.3**	**1.4**	**1.2**	**1.3**	**1.3**	**1.3**	**1.3**	**1.4**	**1.2**	**1.2**	**1.3**
	Ocosingo	1.2	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.3	1.3	1.8	1.7	1.7	1.7	1.7	1.7	1.6	1.3	1.2	1.4
	Palenque	1.0	1.3	1.3	1.3	1.3	1.3	1.1	1.2	1.3	1.3	1.6	1.1	1.5	1.3	1.4	1.4	1.4	1.2	1.2	1.3
	Yajalon	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.4	1.3	1.1	1.1	1.2	1.1	1.2	1.2	1.4	1.2	1.3	1.2
Pichucalco		**1.0**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.1**	**1.2**	**1.3**	**1.2**	**1.2**	**1.2**	**1.2**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**
	Bochil	1.2	1.5	1.4	1.4	1.3	1.4	1.5	1.4	1.4	1.5	1.4	1.3	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.5
	Juárez	1.0	1.0	1.1	1.1	1.0	1.0	1.0	1.1	1.1	1.1	1.3	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4
	Pichucalco	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.0	1.1	1.1	1.2	1.2	1.2	1.2	1.2
	Simojovel	1.0	1.1	1.1	1.2	1.2	1.1	1.2	1.2	1.2	1.2	1.6	1.2	1.3	1.3	1.3	1.3	1.2	1.2	1.3	1.4
	Tapilula	0.9	1.0	0.9	1.0	0.9	0.9	1.0	1.0	1.0	1.1	1.3	1.2	1.1	1.1	1.1	1.3	1.3	1.3	1.3	1.4
San Cristóbal de las Casas		**1.3**	**1.3**	**1.2**	**1.3**	**1.3**	**1.3**	**1.4**	**1.3**	**1.3**	**1.3**	**1.7**	**1.7**	**1.6**	**1.6**	**1.6**	**1.6**	**1.6**	**1.6**	**1.5**	**1.6**
	Altamirano/Oxchuc	1.3	1.2	1.2	1.2	1.3	1.3	1.2	1.3	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2	1.2
	Chenalhó	1.2	1.2	1.2	1.2	1.2	1.2	1.4	1.3	1.2	1.3	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.2
	San Cristóbal de Las Casas	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	2.0	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.8	1.9
Selva Lacandona		**0.8**	**0.8**	**0.9**	**0.8**	**0.9**	**0.9**	**0.7**	**0.7**	**0.9**	**1.1**	**1.0**	**1.2**	**0.9**	**0.9**	**0.8**	**0.8**	**0.9**	**0.9**	**1.0**	**1.0**
	Frontera Corozal/Echeverría	0.7	0.7	0.7	0.8	0.7	0.7	0.6	0.7	0.9	1.8	0.9	0.8	0.8	0.9	0.8	0.6	0.8	0.8	0.8	0.8
	Nuevo Orizaba	1.0	1.0	1.0	0.9	1.0	1.0	0.8	0.8	0.9	0.9	1.1	1.5	1.0	0.9	0.9	0.8	0.9	1.0	1.1	1.0
	San Quintín/Tacitas	0.6	0.8	0.7	0.7	0.7	0.8	0.6	0.6	0.7	0.8	0.9	0.8	0.8	0.9	0.8	0.8	0.9	0.9	1.2	1.1
Tapachula		**2.6**	**2.3**	**3.3**	**2.2**	**2.4**	**2.6**	**2.7**	**2.7**	**2.9**	**2.9**	**2.1**	**2.3**	**2.0**	**2.3**	**2.2**	**1.7**	**2.3**	**2.1**	**2.2**	**2.2**
	Acapetahua	1.8	1.3	1.3	1.3	1.6	1.7	1.7	1.9	2.0	1.9	1.6	2.0	1.9	2.1	2.2	1.7	2.1	2.2	2.3	2.2
	Huixtla	2.0	2.0	3.1	1.9	2.4	2.2	2.2	2.2	2.7	2.5	2.3	2.0	1.8	2.2	2.0	1.4	2.1	2.0	2.0	2.0
	Suchiate	4.0	4.0	4.0	2.7	2.8	3.4	3.7	3.5	3.7	3.9	1.8	2.0	2.5	3.3	1.8	1.9	2.8	2.6	2.6	2.6
	Tapachula	3.4	2.9	4.4	2.9	2.8	3.0	3.1	3.1	3.2	3.3	2.3	2.8	2.2	2.2	2.4	1.7	2.3	2.1	2.3	2.3
Tonalá		**1.6**	**1.7**	**1.6**	**1.6**	**1.9**	**1.7**	**1.5**	**1.9**	**1.6**	**1.8**	**1.7**	**1.7**	**1.8**	**1.9**	**1.7**	**1.6**	**1.6**	**1.7**	**1.9**	**1.9**
	Pijijiapan	1.9	2.0	2.1	2.1	2.2	2.0	2.0	2.2	1.6	2.2	1.7	2.0	2.2	2.2	2.0	2.1	2.2	1.8	2.3	2.2
	Tonalá	1.4	1.6	1.4	1.4	1.7	1.6	1.3	1.7	1.6	1.6	1.7	1.6	1.6	1.7	1.6	1.4	1.3	1.6	1.6	1.7
Tuxtla Gutiérrez		**2.9**	**2.6**	**2.8**	**3.1**	**3.0**	**2.8**	**2.6**	**2.7**	**2.9**	**3.2**	**2.4**	**2.7**	**2.6**	**2.7**	**2.3**	**1.5**	**2.3**	**2.4**	**2.2**	**2.3**
	Cintalapa	3.0	4.1	4.0	4.1	3.5	3.6	2.9	2.9	3.4	4.8	4.0	4.0	3.5	3.1	2.8	2.6	2.1	2.6	2.6	2.4
	Tecpatán	0.6	1.0	1.6	1.3	1.9	2.0	1.9	1.8	1.7	1.7	1.0	1.6	1.4	1.3	1.3	1.1	1.5	1.5	1.7	1.6
	Tuxtla Gutiérrez	3.2	2.3	3.0	3.5	3.3	2.9	2.8	3.0	3.1	3.3	2.4	2.7	2.7	2.8	2.4	1.3	2.4	2.5	2.3	2.4
	Venustiano Carranza									3.6	3.2	3.7	3.5	3.4	4.2	2.5	2.5	2.9	2.9	2.1	2.5
Villa Flores		**3.8**	**3.7**	**3.7**	**3.5**	**3.6**	**3.6**	**4.0**	**3.6**	**3.6**	**3.5**	**3.7**	**3.9**	**3.3**	**4.1**	**3.3**	**2.7**	**3.6**	**3.5**	**3.1**	**3.1**
	Independencia	4.5	4.0	4.2	4.0	3.8	4.2	4.0	3.9	3.7	3.7	3.2	3.4	3.0	4.0	3.3	2.3	3.2	3.0	2.7	2.7
	Villa Corzo	3.8	4.1	3.7	3.5	3.8	3.7	3.8	3.9	4.0	3.8	5.0	5.0	4.1	4.7	4.2	4.2	4.6	4.4	4.5	3.9
	Villaflores	3.5	3.2	3.5	3.2	3.4	3.2	4.0	3.2	3.2	3.1	3.7	4.2	3.5	3.6	2.5	2.4	3.8	4.0	2.9	3.5
	Total	**1.9**	**1.9**	**2.1**	**1.9**	**2.0**	**1.9**	**2.0**	**2.0**	**2.1**	**2.1**	**1.9**	**1.9**	**1.8**	**1.9**	**1.7**	**1.5**	**1.8**	**1.8**	**1.7**	**1.8**

Table 17. Historic Corn Crop Yield in Chiapas per DDR / CADER (Ton/Ha)
Source: (Datasets from Agrifood and Fisheries Information Service)

It is relevant to understand that for any given year, there are several municipalities within each CADER that produce corn, depending on weather conditions among other factors.

Oaxaca

Municipalities Producing Maize in 2019		Autumn-Winter		Spring-Summer	
		Municipalities	Harvested Ha	Municipalities	Harvested Ha
Cañada		**13**	**3,947**	**43**	**24,972**
	Cuicatlán	6	409	19	10,559
	Huautla de Jiménez	7	3,538	14	11,173
	Teotitlán			10	3,241
Costa		**29**	**2,039**	**51**	**23,443**
	Pinotepa Nacional	22	1,757	24	12,852
	Pochutla	3	21	12	3,300
	Río Grande	4	261	6	4,356
	Santos Reyes Nopala			9	2,935
Huajuapan de León				**165**	**79,393**
	Huajuapan			53	21,711
	Nochixtlán			32	7,910
	Tamazulapan			34	7,018
	Tlaxiaco			46	42,755
Istmo		**28**	**11,657**	**54**	**53,681**
	Juchitán	11	2,180	23	16,607
	Matías Romero	8	6,154	8	11,116
	Niltepec	4	1,558	5	5,332
	Tapanatepec	5	1,765	5	8,809
	Tequisistlán			13	11,818
Sierra Juárez		**23**	**2,668**	**66**	**17,986**
	Ayutla/Mixe	10	1,640	15	9,459
	Ixtlán	5	455	26	3,901
	Villa Alta	8	574	25	4,627
Tuxtepec		**21**	**26,016**	**21**	**36,006**
	Cihualtepec	2	1,700	2	3,654
	Ojitlán/San Lucas	4	7,828	4	10,335
	San Juan del Río	6	5,307	6	9,553
	Temascal	4	3,863	4	3,987
	Tuxtepec	5	7,318	5	8,477
Valles Centrales				**169**	**148,275**
	Etla			83	61,355
	Miahuatlán			45	45,505
	Sola de Vega			16	20,862
	Tlacolula			25	20,552
	Total	**114**	**46,327**	**569**	**383,756**

Chiapas

Municipalities Producing Maize in 2019		Autumn-Winter		Spring-Summer	
		Municipalities	Harvested Ha	Municipalities	Harvested Ha
Comitán		**10**	**14,502**	**9**	**84,820**
	Margaritas	3	5,650	3	32,160
	San Gregorio	1	6,011	2	16,987
	Trinitaria	6	2,841	4	35,673
Motozintla				**8**	**35,723**
	Amatenango			4	21,433
	Porvenir			4	14,290
Palenque		**11**	**44,583**	**11**	**103,672**
	Ocosingo	1	2,999	1	14,985
	Palenque	4	27,249	4	52,302
	Yajalon	6	14,335	6	36,385
Pichucalco		**23**	**18,704**	**23**	**48,154**
	Bochil	3	1,240	3	15,585
	Juárez	5	6,982	5	7,075
	Pichucalco	6	1,684	6	4,508
	Simojovel	4	7,898	4	17,485
	Tapilula	5	900	5	3,501
San Cristóbal de las Casas		**9**	**8,328**	**24**	**73,008**
	Altamirano	3	3,150	5	19,738
	Chenalhó	4	3,719	5	12,041
	San Cristóbal	2	1,459	14	41,229
Selva Lacandona		**4**	**10,180**	**4**	**27,260**
	Frontera /Echeverría	1	3,688	1	11,800
	Nuevo Orizaba	2	4,295	2	8,590
	San Quintín/Tacitas	1	2,197	1	6,870
Tapachula		**18**	**6,736**	**16**	**23,287**
	Acapetahua	4	1,305	4	8,224
	Huixtla	4	259	4	4,792
	Suchiate	2	577	1	422
	Tapachula	8	4,596	7	9,849
Tonalá		**3**	**1,378**	**3**	**6,042**
	Pijijiapan	1	820	1	3,600
	Tonalá	2	558	2	2,442
Tuxtla Gutiérrez		**14**	**2,701**	**22**	**102,370**
	Cintalapa	2	764	2	10,731
	Tecpatán	3	1,261	4	8,076
	Tuxtla Gutiérrez	8	627	14	66,188
	Venustiano Carranza	1	49	2	17,375
Villa Flores		**5**	**2,202**	**5**	**59,164**
	Independencia	1	1,278	3	23,592
	Villa Corzo	2	373	1	13,065
	Villaflores	2	551	1	22,507
	Total	**97**	**109,312**	**125**	**563,500**

Table 18. Corn Ha harvested in Oaxaca and Chiapas for both seasons in 2019

5.4 Main perils impacting the target population relative to their crops

Mexico's location between two oceans and complex topography increases the country's exposure to extreme hydrometeorological events such as tropical cyclones, frosts, heat waves and floods. This geographic vulnerability is intensified by a sizeable wealth gap (53.2 % of the population lives below the national poverty line) and urbanization. In rural areas, extreme temperatures and erratic rainfall drastically affect agricultural productivity, including both crops and livestock. Since 1990, agriculture has accounted for 80 % of weather-related financial losses in the country43.

43 https://www.climatelinks.org/resources/climate-risk-profile-mexico

The weather-related problems that crops face in Mexico today are varied. Please note that most of the production units that reported damages related to weather are a consequence of Drought (Chart 40)

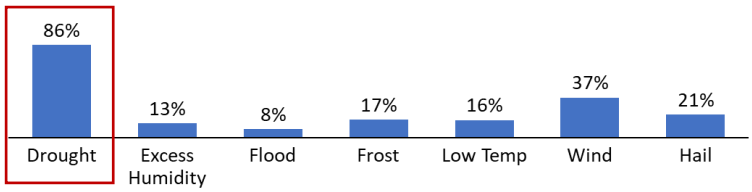


Chart 26. % of Production Units[44] affected by weather-related events (2019. ENA 2019)
Source: (INEGI)

5.5 Effects of climate change

International evidence available regarding climate change impacts within the farm sector is complex and different but can be summarized as follows[45]:

1. CO2 increasing rates have a positive impact in the production and performance of farm sector, at least within given ranges.
2. An increase in temperature initially has a positive impact both in production and performance; however, beyond certain temperature limits, these impacts turn negative. Changes on rainfall patterns represent an important impact against the production and performance of the farm sector that can also be represented as a non-linear function similar to temperature.
3. In most of empiric outcomes it has been observed that temperature changes are quite more important that those related to rain.
4. Specific impacts strongly depend on agro-climate, types of soil and CO2 sensitivity, adding a level of uncertainty to projections.

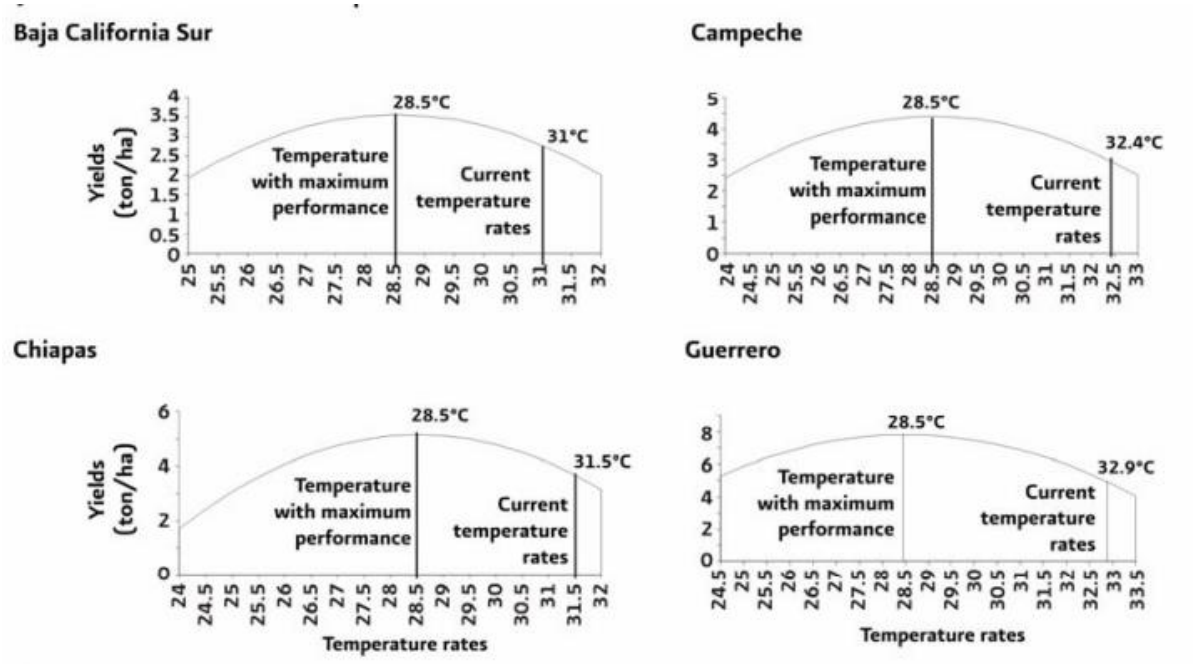


Chart 27. Corn yields with respect to temperature. states with losses due to temperature increase
Source: SEMARNAT (now MINISTRY OF AGRICULTURE or Ministry of Agriculture)46

44 The Production Unit refers to the set of land, infrastructure, machinery and equipment, animals, and other goods used in agricultural activities
45 https://biblioteca.semarnat.gob.mx/janium/Documentos/Cecadesu/Libros/Economics%20of%20climate%20change.pdf
46 https://biblioteca.semarnat.gob.mx/janium/Documentos/Cecadesu/Libros/Economics%20of%20climate%20change.pdf

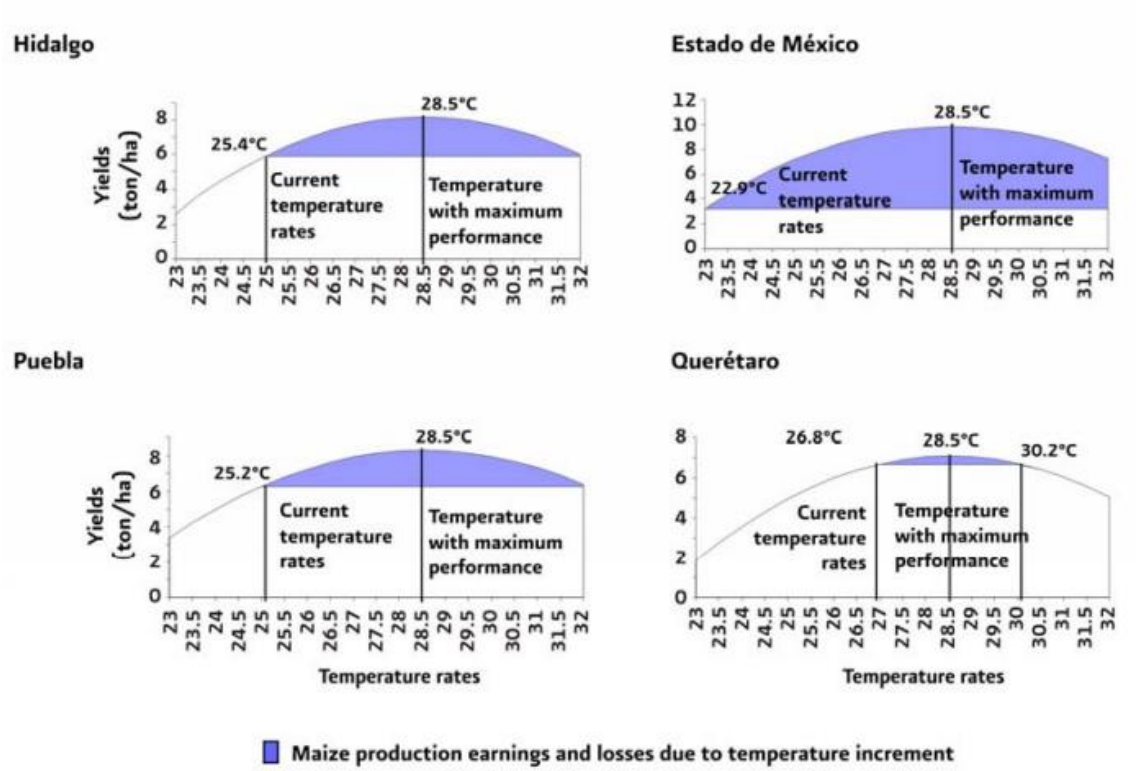


Chart 28. Corn yields with respect to temperature. states with earnings due to temperature increase
Source: SEMARNAT (now SADER or Ministry of Agriculture)47

Considering precipitation, different models show different projections of the effect of climate change, although in average for Mexico, it is estimated that precipitations will decline to -10% in most areas of Mexico, but there will be regions where such decline could be higher. Worth noting is that the State of Baja California would show the highest decline in annual precipitation (- 40%). Northern Mexico could show a 3-4°C increase in temperature, while in most areas of the country changes are projected within a range of 1.5°C–2.5°C, except for some areas in the peninsular zones where changes could be lower to a maximum increase of 1-2°C.48

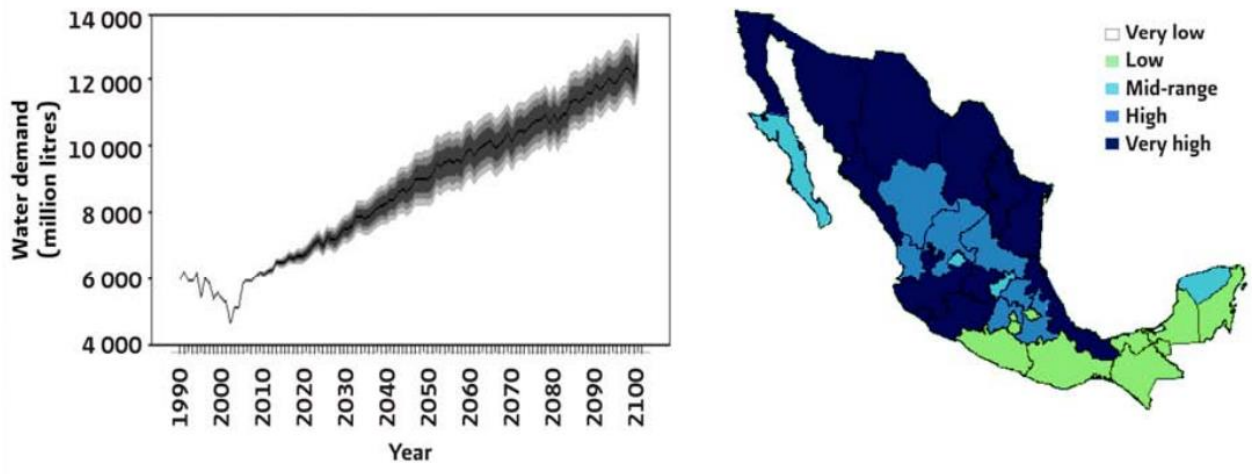


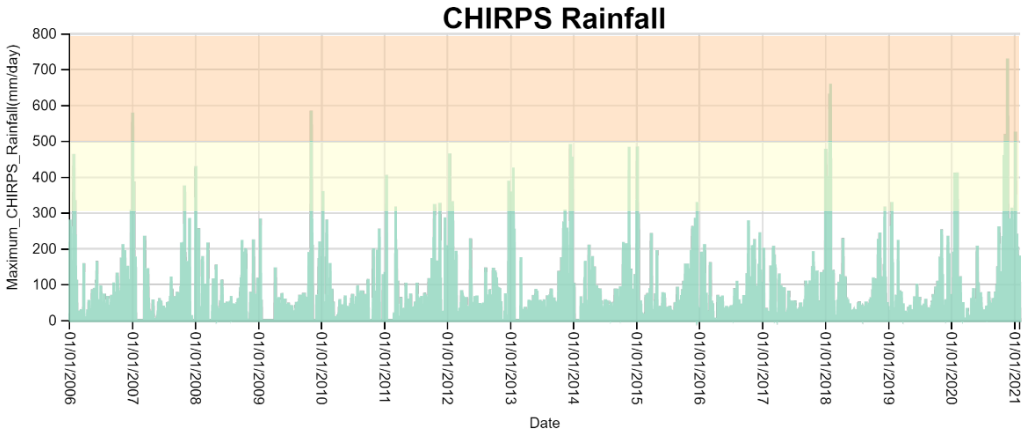
Chart 29. Expected demand for water in 2100 for Agriculture and Livestock Sector
Source: SEMARNAT (now SADER or Ministry of Agriculture)49

47 https://biblioteca.semarnat.gob.mx/janium/Documentos/Cecadesu/Libros/Economics%20of%20climate%20change.pdf
48 https://unfccc.int/files/focus/long-term_strategies/application/pdf/mexico_mcs_final_cop22nov16_red.pdf
49 https://biblioteca.semarnat.gob.mx/janium/Documentos/Cecadesu/Libros/Economics%20of%20climate%20change.pdf

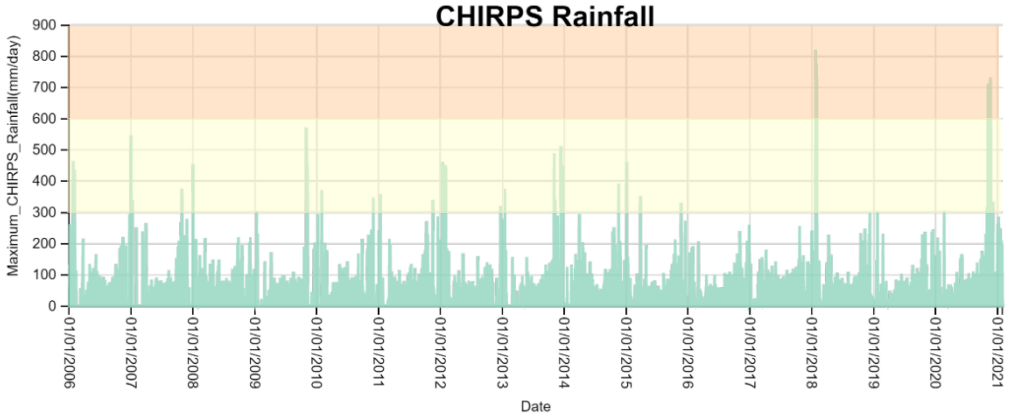
5.6 Frequency of events, which can be covered with respect to affordability

Given the experience from CADENA, **the program wants to address events with a return period that help us filter the frequency noise**. The entry point could be around 5 years, and the exhaustion point around 15 years for rainfall. With drought is more straight forward, there is a clear correlation between the moisture in the soil and the damage to the corn. We extracted maximum rainfall information from CHIRPS50 for the last 15 years to illustratively see what thresholds for each State could be.

Tabasco

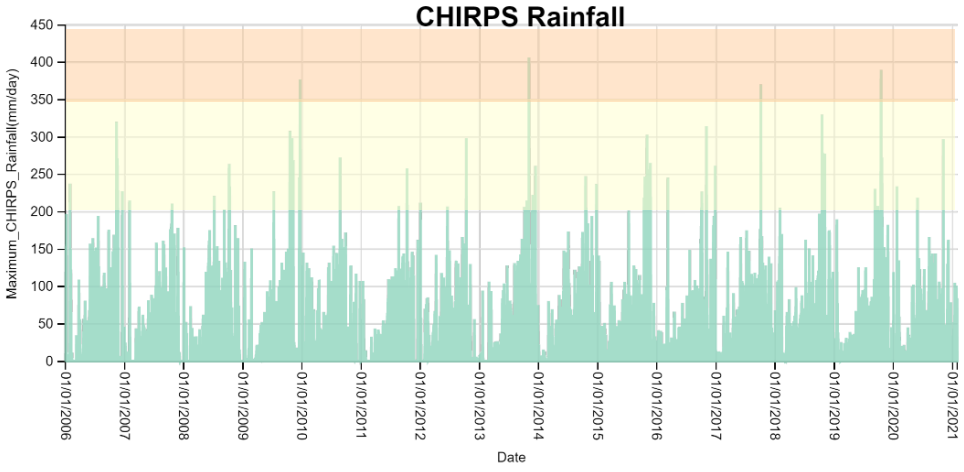


Chiapas



We have validated that there is enough information in the rainfall CHIPRS datato set a pricing at the State level, and possibly at the Municipality one. With this information the underwriting teams can analyze

Oaxaca



50 https://climateserv.servirglobal.net/

the cost of a coverage and the intermediate thresholds for partial compensation for each State.(and municipal and using additional considerations given the microclimates present in general regions of the country, we estimate that privering needs to be addressed at this level our underwriting teams have estimated that pricing at municipality level will help us lower basis risk.

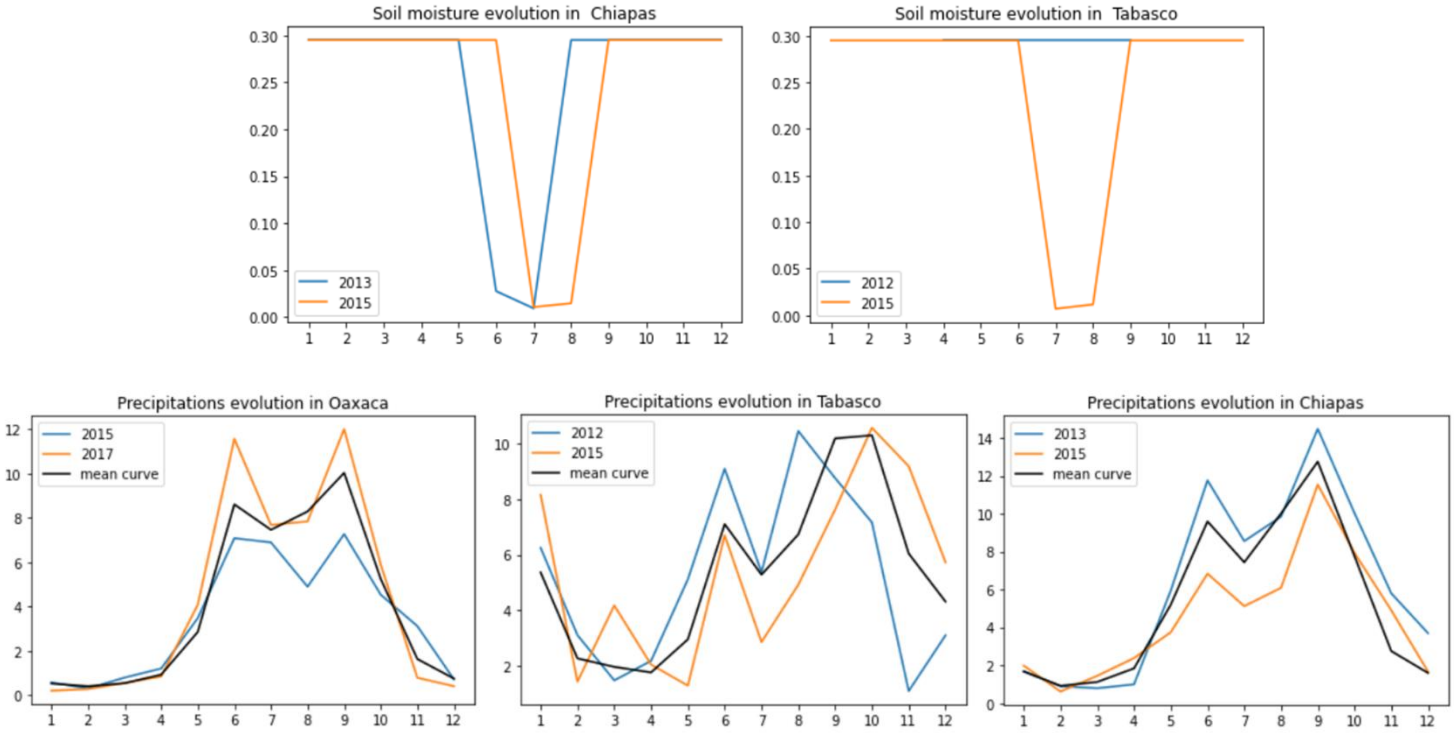
*Chart 30. Frequency of r*ainfall and soil moisture for the three selected states

Likewise, we have validated that there is enough soil moisture information on ERA5 to build an index correlated to the loss events.

5.7 Index-based insurance types (weather index, area yield, etc.)

There are several indexes that can be used for our program that could be appropriate with respect to basis risk, the needs of smallholder farmers and feasible to cover their major/main losses. After the review, our underwriting teams recommended using Standardized Precipitation Index and Soil Moisture Index.

i. **Percent of Normal** [51]. It is a simple calculation suited to the needs of weather forecasters and



general audiences. The index is calculated by dividing actual precipitation by normal precipitation typically considered to be a 30-year mean and multiplying by 100% and this can be calculated for a variety of time scales but usually these time scales range from a single month to a group of months representing a season, to an annual or water year. It is quite effective for comparing a single region or season

ii. **Palmer Drought Severity Index.** PDSI is a soil moisture algorithm calibrated for relatively homogeneous regions and is used extensively to trigger drought relief programs. Some of the

51, 112b, 112c, 112d The index, developed by Gibbs and Maher (1967), avoided some of the weaknesses within the "percent of normal" approach and divided the distribution of occurrences over a long-term precipitation record into tenths of the distribution. (A Review of Some Indices used for Drought Studies)

limitations of the index include the fact that the Palmer values may lag emerging droughts by several months

iii. **MOSEMM.** Another tool in the country to monitoring this phenomenon is the Multivariate Drought in Mexico (MOSEMM), developed in 2017 by CONAGUA and the Institute of Engineering of the UNAM. The MOSEMM52 performs an analysis multivariate, with data from hydrological variables key (rain, humidity and runoff), to improve the definition of the beginning, the persistence and the end of the drought. This gives the intensity and magnitude of drought events in the national territory, using the latest generation information sources.

iv. **Crop-Specific Drought Index for Corn[53].** There are exercises about constructing indexes for specific crops like corn. Combination of more than one index are possible in order to achieve the desired accuracy. For example, using Standard Precipitation Index in combination with Crop Specific Drought Index. The CSDI calculation requires three types of data: weather, soil, and crop phenology. Weather data include precipitation, maximum and minimum temperatures, dew-point temperature, wind speed, and solar radiation. Rain-fed crop yield to be an indicator of agricultural drought risk because of limited moisture supply before and during the growing season

v. **Standardized Soil Moisture Index (SSI).** The standardized difference between the soil moisture curve for one year and the mean curve of precipitations

vi. **Corn Growing Degree Days Index.** To arrive from sowing to flowering it is necessary to count in degree-days (GDD54) and not just days: the development of the corn depends on the temperature and not just on the time (it is not physiologically active at T ° C < 6 ° C). The most common temperature index used to estimate plant development is growing degree days (GDD) which are calculated from the daily maximum and minimum air temperature. Corn growing degree days (GDD) are calculated by subtracting the plant's lower base or threshold temperature of 50 °F (10 °C) from the average daily air temperature in °F or °C. Average daily air temperature is calculated by averaging the daily maximum and minimum air temperatures measured in any 24-hour period.

vii. **Standardized Precipitation Index.** SPI is an index based on the probability of precipitation for any time scale and is used by many drought planners due to its versatility. The advantages of the index include the fact that it can be computed for different time scales, can provide early warning of drought, help assess drought severity and is simpler compared to the Palmer index. Our underwriting teams found a good correlation to losses and it will also be used to construct an index for our program.

viii. **Crop Moisture Index.** It is intended to be a drought index especially suited to drought impacts on agriculture, in that it responds quickly to rapidly changing conditions. It is calculated by subtracting the difference between potential evapotranspiration and moisture, to determine any deficit. Our underwriting teams have found a good correlation to losses using this Index.

a. We defined that a bad year is a year where the detrended yield is below a certain threshold. In fact, we observed in many states and municipalities an increasing trend through time of the yield that can be due to other factors than drought. Therefore, detrending the yield time series appeared to be an important step in order to delete a bias in the data that can come from unmeasurable events that have nothing to do with drought.

b. Then, we studied the correlation between meteorological variables and this detrended yield. For the design of the index, we focused on a state level and on the corn crop developed during the spring-summer cycle.

c. We found that for this crop, the risk period, which is the period where the plant is the most sensitive to drought, is composed of the months of July, August and September. We observed that generally, the precipitation curve of a year where the detrended yield is very low is below the mean curve of precipitations, when the one for a year with a high or normal

52 For drought related queries please visit: http: //201.116.60.187/mapaGob.html
53 https://core.ac.uk/download/pdf/188127895.pdf
54 Corn Growing Degree Days

detrended yield is above it, and especially during the risk period. This shows that there is an increasing relationship between the precipitations and the yield, up to a certain point.

d. We also looked at the temperature time series, and we concluded that there is a decreasing relationship between the temperature and the yield, since the mean temperature of a year with a low yield is generally higher than in the other years.

e. Finally, we analyzed the soil moisture time series at the surface provided in the ERA5 dataset and we studied its link with the yield. We saw that the very bad years are characterized by low levels of soil moisture during the risk period and by a drop in soil moisture around the months of July or August. It seems to be consistent across the states.

f. The soil moisture allows to consider not only rain but also other phenomena that can affect the humidity of the soil in which the plant grows. For the corn crop, it enables us to distinguish more efficiently the very bad years from the others. Therefore, we chose a soil moisture-based index which is the mean soil moisture of each year during the risk period. **If the mean soil moisture during the months of July, August and September is below 0.125m3 per m3 of soil, then the risk of having a low yield for corn is real and serious.**

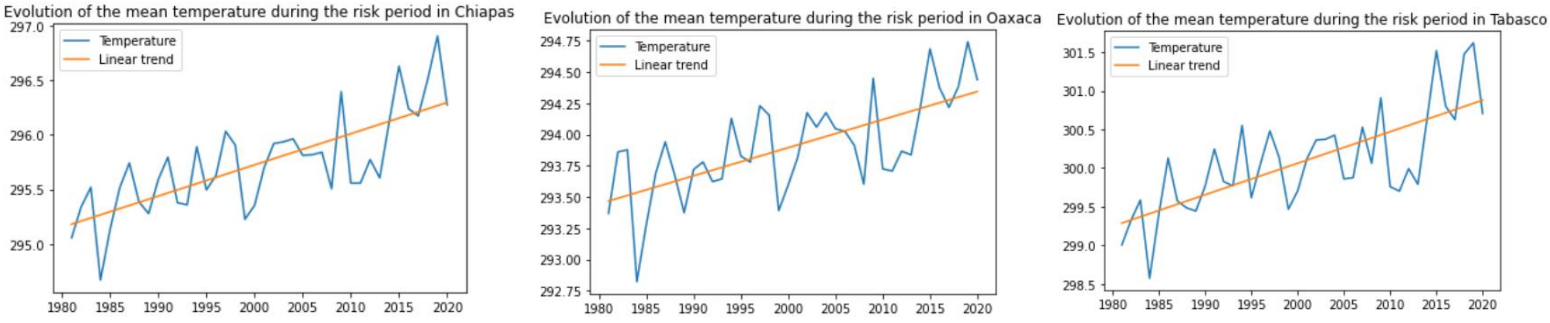


Chart 31. Evolution of the meant temperature during risk periods for Chiapas, Oaxaca and Chiapas
Source: Data Science Team AXA Climate [55]

Our parametric cover can be designed as a weather index, based on excess rain or drought[56]. Those will be measured through the total accumulated rain using the data from CHIRPS (with spatial resolution of 0,05°) aggregated at a regional (CADER or DDR) level with a daily limit agreed in advance with the Insurance Unit from the Ministry of Finance (for example 150 mm) In the case of Soil Moisture Index, we used information from ERA5 (0.1° x 0.1°; Native resolution is 9 km and 4 levels of the ECMWF surface model: Layer 1: 0 -7cm, Layer 2: 7 -28cm, Layer 3: 28-100cm, Layer 4: 100-289cm Some parameters are defined at 2 m over the surface.)

55 Calculation performed by AXA Climate Data Science Team for the construction of a relevant index for the IDF Mexico Agriculture Program
56 Accumulated rainfall information can be found at : https://water.weather.gov/precip/

6 Presentation of the potential set up of a new agriculture insurance scheme to protect smallholder farmers.

We share a potential set up of a new agriculture insurance scheme to protect smallholder farmers, including the risks covered (excess rainfall and drought), examples of potential trigger structures using standard precipitation index in a linear compensation scheme and soil moisture. We separate functions that are needed for the program to work from others that are nice to have.

6.1 Insurance Proposal Concept

Sector. Agricultural Insurance

Duration of the Policy. Annual

Risks to be covered. Excess rainfall and drought. The insurance would cover drought and excess rainfall conditions leading to a catastrophe harvest shortfall of the most predominant staple crop57, which is corn, the insurance cover would provide a standardized business interruption cover for all impacted farmers after a major drought or excess rainfall catastrophic event rather than trying to cover actual crop production losses.

Product: Given the experiences that we have collected from CADENA, the program needs to reach out to the base of the pyramid and to distribute the payout to individual farmers. In light of these premises, operating a traditional insurance array would be extremely expensive due to the loss adjustment costs, and also it would take a longer time for the beneficiaries to receive their payment. Therefore, the target structure proposed is an excess rainfall and drought parametric product at the municipality level based on satellite data from Era 5 for soil moisture and CHIRPS for SP. Our underwriting teams have suggested that the simplest and most cost-effective approach is using pure parametric triggers rather than covers based on yield data given the expense and logistics involved in collecting yield data in Mexico.

The parametric index would aim to reflect the risk of high temperatures, drought and excess rainfall to corn, the predominant staple crop.

Initially, we have set the which is the one CADENA used the targeted maximum payout per Ha of cultivated crop land is MXN 1,500 (USD 75) to MXN 2,000 (USD100). This is the insured sum CADENA used. Since it is relevant for our target beneficiaries, we will use it as a starting point for the structure of our program but remain open to increase it if the funds from the ministry of finance are available to increase it as long as all beneficiaries' have coverage. . The trigger and exit points for the insurance coverage per municipality could be adjusted to ensure the premium amount is consistent across all municipalities.

There are two different trigger structures that could be explored (among a few others):

The cover can be set linearly or in steps depending on the preference Agroasemex, the client. We share two examples using excess of rainfall and soil moisture considering the total exposure that we have got in all three states (1.224.056 Ha dedicated to growing corn) and a potential payout of 10058 USD per Ha. The total limit would be (on this illustrative example) 122.405.600. We will use 120.000.000 to simplify the calculation below:

Linear Compensation for excess rainfall

Once the trigger is reached, the compensation is payed per each mm of rain above or below the trigger at an amount agreed previously. (i.e, 1% of payout per each mm of accumulated rain that is abode the trigger)

57 According to ENA 2019, across the country, out of the producers who reported losses related to weather events, 85.56% reported facing droughts, and 7.7% floods.

58 For Sustenance Family Agriculture producers, the average monthly income is around USD 72, with ~40% of them from their own produce (http://www.fao.org/3/bc944s/bc944s.pdf)

Drought	Option 1	Option 2	Option 3
Trigger (mm)	200	250	300
Floor (mm)	50	50	50
Payout per mm (USD)	600,000	800,000	1,200,000
Limit Insured (USD)	120,000,000	120,000,000	120,000,000

Stepwise Compensation

Pre-defined steps of excess of rainfall (with a percentage tied to mm of rainfall) or (m^3 of water / m^3 of land) for Soil Moisture for drought cover are agreed with the client. It works the same way as the linear compensation, but the steps of the coverage vary according to the interests and risk appetite of the client.

	Trigger	200 mm
	Limit (USD)	120,000,000
mm of rainfall	% Payout	
201-250	25%	30,000,000
251-300	50%	60,000,000
301-400	75%	90,000,000
401-more	100%	120,000,000

Trigger	0.125 m3 m-3 (m3 of water/ m3 of land)	
Limit	120,000,000	
Soil Moisture Index	% Payout	
0.12 – 0.126	25%	30,000,000
0.11 – 0.119	50%	60,000,000
0.10 – 0.109	75%	90,000,000
0.09-less	100%	120,000,000

Start and end date of the coverage period. The beginning of the sowing period in Mexico is in June and November, so most likely the program subscription would start a couple of months before this (September and April).

Program reach. The program will be designed to cover the smallholder farmers who meet our criteria across all states in the country against the mentioned perils. We have gathered information for all states. We have selected a subregion (southeast) of the country to zoom in with our study and to design an operational platform to address the topics in more detail. The three states that encompass it (Oaxaca, Chiapas and Tabasco) are exposed to excess rain and droughts, have large proportion of rural communities with smallholder farmers (1,5 million potential beneficiaries), and have also a high proportion of people living in poverty conditions. There are 1.24 million Ha used for growing corn. A model that operates effectively in the remote communities of those states, we will be repeated for the smallholder farmers in therest of the country.

Partnership targeted structure. Participants signing the partnership agreement: AXA Climate, Guy Carpenter. Munich Re, Swiss Re, Agroasemex, Ministry of Finance are closely collaborating with the project so far and may be interested in signing the partnership agreement later. AXA Climate and Guy Carpenter will be co-leads in the initiative. All partners have local representation in Mexico.

We still have two finalists' potential partners (one will be selected) to provide the front-end platform. (Democrance & Raincoat). We kindly ask that if we have invited to present a full proposal the selected partner can be allowed to join the consortium. As soon as our selection process is finished. This would be the only potential addition to the partnership structure. If not accepted, the vendor will be treated as such.

Policy Owner: Our preferred option is fast and transparent) is having the Ministry of Finance or the Ministry of Agriculture as a contractor on behalf of the beneficiaries. The Ministry of Finance has offered to help us select the option that best serves the interest of the project. it is part of transparent.

Another option is that the State governments act as policy owners (like they did with CADENA). Yet, this option calls for a thorough review of the payout conditions directly to the producers that caused the cancellation of CADENA. The Ministry of Agriculture could be another good option to be the policy owner, because their interests are fully aligned to helping smallholder producers become more resilient and could also help protecting their personal data. If this option is preferred by our counterparts, we will need to properly structure the cash flow structure to keep the program simple and fast.

Agroasemex will provide help designing the product that will be opened to insurers and reinsurers willing to participate in the risk[59]. The premium will be paid in full by the contractor to the insurance institution(s) leading the program most likely using a collective insurance policy. In this (preferred) array, the beneficiaries receive individual certificates (most likely PDF format only and paper by request) distributed by the insurance company.

Target Population Covered/ End Beneficiaries: The program is set to cover only **smallholder farmers** defined as those with: **five or less (total) hectares of land, no access to any other form of insurance, and daily income of USD 15 or less**. According to FAO, Sustenance Family Producers (smallholder farmers) have on average 3.4 Ha of total land, and only 10% of them make profits out of their operations (mostly use their produce for self-consumption (with an avg annual income of USD 867 and Production assets of USD 340, they lack the resources to scale up their production, have no access to irrigation, and are more vulnerable to weather events)[60]. As mentioned before, our goal is to operate the enrollment through existing SADER regional offices and personnel using bank accounts from the federally owned Banco del Bienestar to simplify the whole operation.

The platform needed for the operation of our program needs the following functionality:

- Have multiple entry channels (mobile, SMS, web, etc.)
- Issue and handle policies
- Manage claims
- Process payment
- Configure the product
- Reporting.

A feasible alternative for our program could be partnering with Democrance or Raincoat as suggested before. Once registered, if a triggering event occurs, the farmers receive a confirmation message on their mobile phones and later receive a transfer to their e-wallet through the mobile banking processes of our Mobile Network Operator (MNO) partner. This model is already in use in several countries in Africa (part of the best practices the group researched).

Mass-enrollment events for smallholder farmers could be organized as is the usual practice in India. Such events can be used to inform about the product solution, to collect the necessary data and to provide access to mobile phone-based banking accounts. In any case, we will need to work hand in hand with the Ministry of Finance if the program continues evolving to properly identify and communicate with the beneficiaries. The main challenge is to maintain an up-to-date information dataset of all the beneficiaries and their crops[61].

Best agricultural practices can be shared and allow for the community of small farmers to embrace the benefits of the program[62] either using a digital community (although participation is expected to be very low) or physically if the program could be linked to other existing initiatives from the Ministry of Agriculture.

Subsidies: As agreed with the Ministry of Finance, the product will be fully subsidized by the government considering it would only be covering the most vulnerable smallholder farmers. This would be in line with most similar crop insurance programs for vulnerable farmers in other countries.

Potential contribution to market development. With the termination of the CADENA program, many farmers have been left without a reliable alternative to insure themselves against agriculture risk. Given the fragmentation of the beneficiaries, it is possible that the information regarding insurance alternatives has not reached them all. If a parametric program can be structured observing the latest access to technological satellite imagery, mobile phone enrolment, and direct payment to end beneficiaries, the social and economic impact of the program is relevant. If a sound actionable database of the beneficiaries is developed, and the characteristics of the target group are analyzed in detail, then there is room for additional insurance programs to be developed in order to increase their resilience.

59 There are oncly 6 insurance companies operating the Agroinsurance Line of Business today

60 http://www.fao.org/3/bc944s/bc944s.pdf

)

62 According to ENA 2019 only 1.85% of the production units in the country are certified in good agriculture practices, and 1.32% have received technical assistance regarding services and commercialization.

7 Outline of the basic process-flow

The high-level process mentioned here covers the lifecycle of a policy and shows the collaboration among the partners like product education and marketing, premium collection, policy administration, settlement and payout. The basic flow of our proposal is presented. The design, lessons to be learned and cost drivers of a pilot test are included as well, given the relevance of properly structuring the operation in remote distant communities.

7.1 Outline of Process Flow

We have developed a first draft of the elements that could be part of our program. We want to use it as a high-level guide to question the validity of each element and change it to better address the needs of the smallholder farmers in Mexico, and the technology and other limitations that we might find on our research.

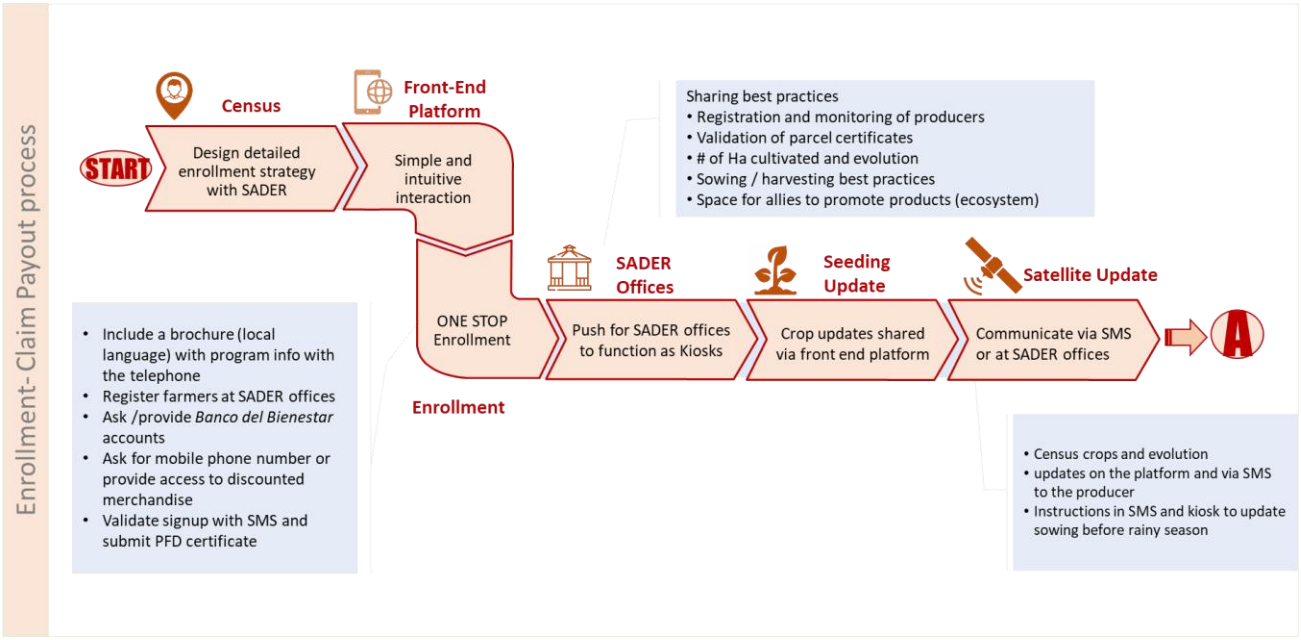


Chart 32 : Proposed Process Flow

Preparations for Enrollment and Customer Journey

1. Preparations
    a. Front end is pre-loaded on the systems from the regional offices of SADER, and is directly connected to the insurance company backing the program in the region (for the pilot test we will use Agroasemex's issuing systems, but after the pilot is finished Agroasemex will step back as a reinsurer)
    b. SADER personnel is trained by Agroasemex supervisors and they receive scripts, guidelines and material to prepare them for their enrollment function
    c. Enrollment is done at SADER offices. There will be an 800-number providing support to SADER personnel and also to farmers (at least during the pilot, to see if it is really needed)
    d. Once the SADER personnel have captured all necessary information and an insurance certificate is provided, they will help the beneficiary get familiar with the basic steps of the program (which the beneficiaries also receive by SMS)
    e. In case of a claim, SADER offices will know which producers will be compensated so they can provide information.

f. Follow up can be done at SADER offices to verify that compensated producers were able to sow their crops again later, and also if they are increasing their productivity year after year.

2. Customer Journey for farmers
    1. Farmer gets program information from SADER office sor from MKT material distributed by the insirance Company
    2. Farmers go to the regional SADER office with the following documentation
        a. National ID
        b. Crop information
        c. Bank account number (if they don't have one, they are offered one from Banco del Bienestar)
        d. Mobile phone number (if they don't have one, they get access to some models at a discounted Price)
    3. Farmers get registered in the program
        a. They receive a PDF insurance certificate (a paper copy only if strictly necessary)
        b. They receive an SMS confirmation
    4. They get access to SMS information and best practices, but can also come to the SADER offices for best practices and to learn about the product
    5. In case of an event that potentially triggers the cover
        a. They receive prevention information and guidelines vìa SMS and pre-recorded messages on their phones
        b. They receive a confirmation that their land is subject to payout in case the threshold was reached
        c. They receive the payout directly to their Banco del Bienestar debit accounts and can cash it at any AMT or banking correspondent in their community
    6. They will receive follow up information to help them sow again their crop land, and guidelines to increase their productivity

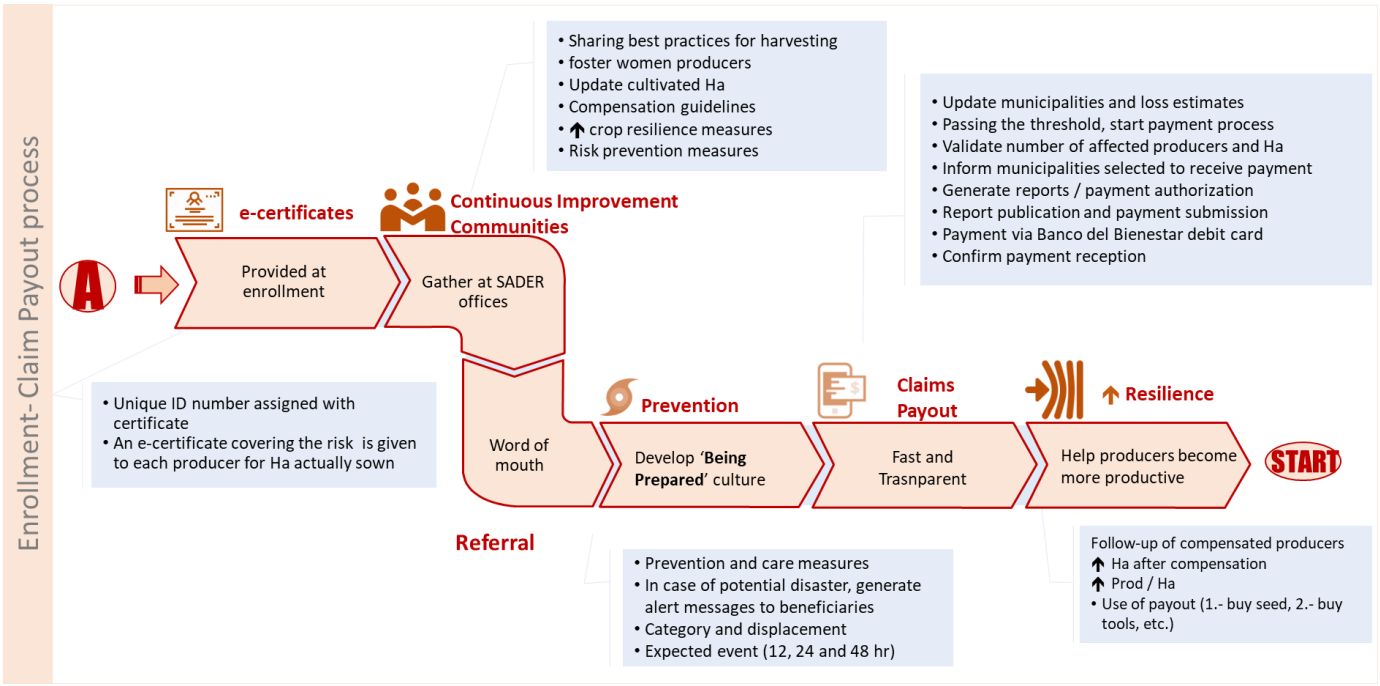


Chart 33 : Proposed Claim Payout Process

7.2 Pilot Design and Implementation.

Given the fragmentation of small rural communities, we want to understand if the people who live further away from local SADER offices are enrolled with the same efficiency as the ones living closer to them. To understand this efficiency, we are including some resources in our Content Note to facilitate the mobilization

of SADER personnel to distant municipalities in an effort to increase their enrollment rate. For the example of the location selected for Oaxaca called San Dionisio del Mar (5,000 inhabitants), the closest 15,000 inhabitant-location is Unión Hidalgo (30 minutes in transport).

There are larger Locations like Juchitán (following the same Example) that is a 30-50-minute drive from Unión Hidalgo and could provide the next level of services for the beneficiaries. SEGALMEX63 is a program present in all DICONSA and LICONSA Stores. The grains such as corn and beans collected by SEGALMEX are destined for the stores run by DICONSA, which provide the basic food products to 25 million people. We want to learn if farmers who receive a payout travel to larger locations to purchase seed and tools at discount prices.

Chart 34. DICONSA stores around San Dionisio del Mar location in Oaxaca

Source: IDF Team (image from google maps)

The beneficiaries of the program could easily access a series of DICONSA stores nearby to cash their claim payout and purchase basic food products at discounted prices, but if we can reach an agreement with SEGALMEX, maybe they could purchase seed over there.

7.2.1 Municipalities Selection Criteria for the pilot

In order to give a criterion in the selection of municipalities and carry out the pilot test in Oaxaca, Chiapas and Tabasco, 14 variables of the 52 that we have in the mother table were considered. We have extended our original pilot from 6 municipalities to 15 in order to better reflect different operational challenges with a larger sample, which in turn is better as well for statistical purposes. In order to simplify the model, each variable of the pillar has an assigned weight, as well as each pillar, that is: Let % *x_i* be the percentage of the variable *x_i* that represents a part of the percentage of 〖Pillar〗 _j. The sum of the percentages for the pillars is 100. In mathematical terms, this is represented as

$$\sum_{i=0}^{n} \%x_i \; = \; \%Pilar_{\,j}$$

The variables *x_i* that were considered to carry out the exercise are the following, together with their criteria to qualify them.

- Marginalization Index (The higher the index, the higher the rating).

63 The Mexican Food Security Guarantee Prices program (Segalmex), is a sectorized body in the Ministry of Agriculture and Rural Development

- Percentage of Rural Population (The higher the percentage, the higher the rating).
- Producers' daily Income (The lowest income, the higher the rating).
- Number of access points (The more points, the higher the rating).
- Homes with a cell phone (The more access they have, the higher the rating).
- Homes with Internet (The more access they have, the higher the rating).
- Number of Roads (The higher the number, the higher the rating).
- Grain Corn Loss Percentage (The higher the loss ratio, the higher the rating).
- Yield (Ton / Ha) (The lower the yield, the higher the rating)
- Frequency of Claims (The higher the frequency, the higher the rating)

Additionally, to the previously mentioned criteria we selected the municipalities with higher percentage of sown (ha) temporal corn grain respect total sown (all crops and modalities of irrigation).

After giving each variable a weight within the choice model, each one will be assigned a rating by calculating percentiles, that is, each variable *x_i* will have the rating stipulated in the following explanation: Let Pi be the percentile of the variable where i = (0,33,66,100) and x_i some variable from the percentage table, then:

For the highest percentile-highest score criterion:

$$Qualification\ (X_i) = \begin{cases} 33\ if\ Min(X_i) \leq X_i < P_{33} \\ 66\ if\ P_{33} \leq X_i < P_{66} \\ 100\ if\ P_{66} \leq X_i < Max(X_i) \end{cases}$$

- For the highest percentile-lowest score criterion:

$$Qualification\ (X_i) = \begin{cases} 100\ if\ Min(X_i) \leq X_i < P_{33} \\ 66\ if\ \ P_{33} \leq X_i < P_{66} \\ 33\ if\ \ P_{66} \leq X_i < Max(X_i) \end{cases}$$

Subsequently, the grade obtained is multiplied by the given weight of the variable. The criteria, the variables and their respective weights are summarized in the following table:

Pilar	Variable	Weight
Pilar I: 20%	Marginalization Index	10%
	%Rural Population	5%
	Daily income	5%
Pilar II: 20%	# access points	5%
	Homes with mobile phone	5%
	Homes with internet	5%
	Number of roads	5%
Pilar III: 30%	Loss ratio (corn)	20%
	Yield (Ton/Ha)	10%
	Claims frequency	30%

Although we took these criteria, we know that it is important to be prepared to confront other scenarios that might come up. The selected states, and more specifically the rural places that we want to pilot at, are places with a low banking, internet and mobile penetration and have few roads; most often, the inhabitants have a basic education and they even may not speak Spanish.

Even though we tried to select the municipalities with the highest banking, internet and mobile penetration, in the three state the penetration it's too low. For example, the fifteen municipalities selected have a range of internet penetration about 0% to 44%. In some cases, the municipalities have only one branches or none, and the mobile penetration have a range of 30% to 88%. Seeing that, we could say that we have a representative selection of municipalities that present to us different scenarios that reflect the characteristics of the municipalities in the nation.

For the pilot we have selected fifteen municipalities, five for each state (a larger sample includes more variance in the conditions of the pilot). The table below shows the characteristics of the municipalities that are divided in three pillars. Pillar I have the socioeconomic variables, Pillar II have the accessibility variables and Pillar II have the risk variables.

For simplicity in the document, we decided to explain only two of the five selected municipalities of every one state.

7.3 Pilot municipalities from Chiapas

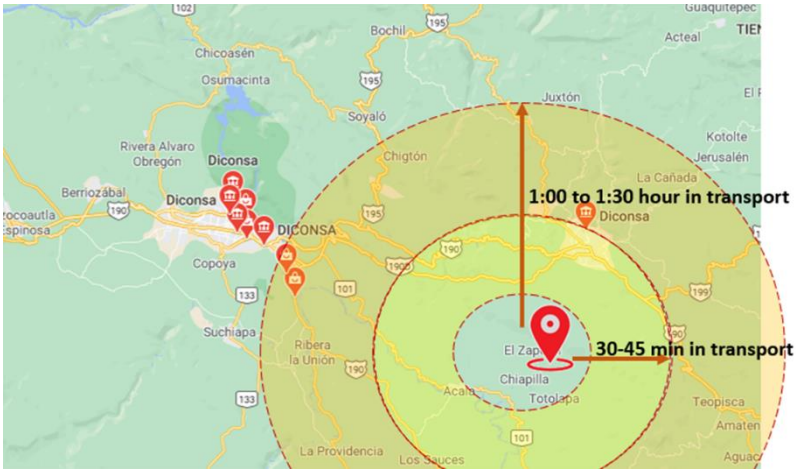
Chiapas had a different criterion compared to Oaxaca and Tabasco: the higher the performance, the higher the qualification. This criterion was modified because we assumed that the higher the number of claims, the lower the yield we would obtain. In the case of Chiapas, no direct relationship was found between these two variables. Thus, it was decided to change the criteria.

3 selected municipalities					
Municipality key	28	110	2	17	58
Pilot municipality	Chiapilla	San Lucas	Acala	Cintalapa	Nicolás Ruíz
Pillar I					
Adult population	4417	5385	15683	63194	3364
Income decile	II	I	II	III	I
Daily income (MXN)	78	49	78	166	49
Predominant socioeconomic level	D	E	D	D+	E
Type of locality	En Transición	En Transición	Semi-urbano	Urbano	Rural
% rural population	67%	67%	50%	33%	100%
Marginalization degree	Alto	Muy alto	Alto	Medio	Muy alto
% Population that speaks indigenous language and spanish	3%	16%	7%	6%	1%
% literate population	80%	80%	85%	90%	87%
% population with basic education	63%	69%	58%	57%	74%
% population affiliated health services	76%	80%	66%	53%	94%
% homes that have piped water	99%	98%	97%	93%	99%
Pillar II					
Total branches	1	0	4	7	0
Total correspondents	0	2	9	29	0
Total ATM	1	0	4	12	0
# contracts that use mobile banking per thousand inhabitants	828	517	5353	21739	212
Telecomm branches	0	0	1	1	0
% homes that have a cell phone	76%	73%	79%	74%	48%
% homes that have internet	2%	3%	10%	21%	2%
# of urban roads per inhabitant	6.11	0.93	10.90	4.92	4.46
# of rural roads per inhabitant	N/D	N/D	N/D	N/D	N/D
% homes with a car or truck	11%	5%	16%	23%	9%
% homes with moped or motorcycle	3%	5%	8%	18%	23%
% homes with bicycle	8%	15%	41%	21%	3%
Pillar III					
Total Sown area (ha) 2019	3,291	3,141	11,257	10,534	2,853
Total sown area (ha) of temporal corn grain 2019	2,589	2,902	9,139	5,425	2,130
% sown of corn grain respect total sown area 2019	79%	92%	81%	51%	75%
% average claims ratio of years lost (SIAP)	25%	20%	20%	20%	19%
Average yield (ton/ha) (SIAP) 2010-2019	2.2	2.5	2.6	2.8	2.7
Claims frequency (CADENA) 2010-2016	2	2	2	4	2

i. Chiapilla

Chiapilla is a municipality in the Mexican state of Chiapas. Its geographical coordinates are 16º 34 "N and 92º 43" W. The territorial extension of the municipality is 86.90 km², which represents 0.70% of the surface of the Central region and 0.11% of the state surface.

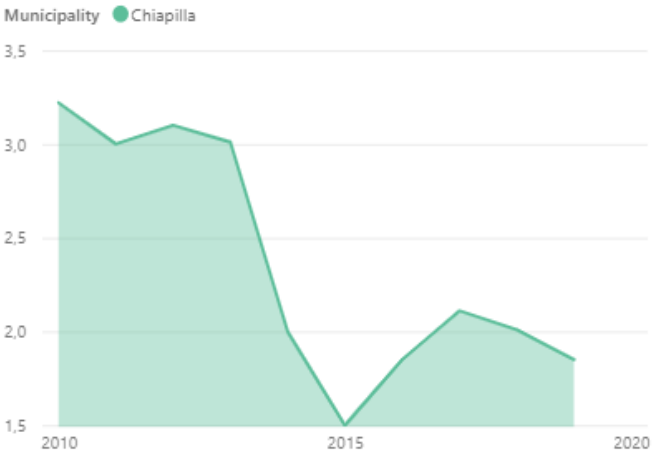
The municipality has 4,417 adults (Population and Housing Census 2020) with a daily average income of MXN 78 (USD 4). The type of locality is defined as “In transition”, which represents 67% of the rural population. It has a high degree of marginalization and D is the predominant SEL64.

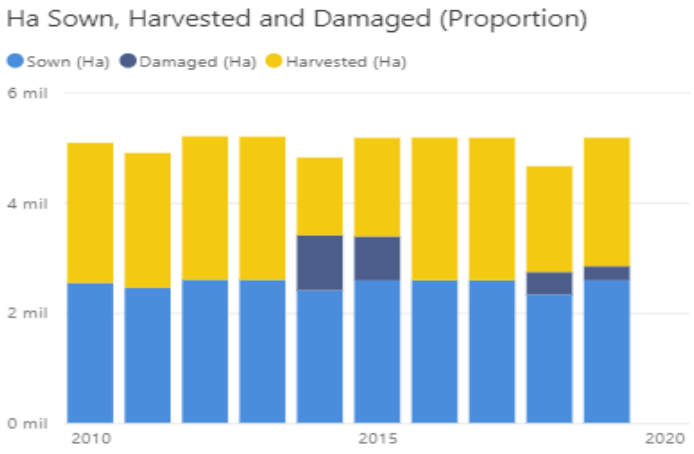


80% of the population can read and write and 63% have completed basic education. Only 3% of the population speak an indigenous language. 76% of the population is affiliated to health services and 99% of the homes have piped water.

The municipality has 2 verified access points, a SOFIPO65 branch and an ATM, but also has two extra correspondents that are not confirmed which both are Telecomm branches in a radius of less than an hour and a half66. In 76% of the homes at least one person has internet and only 2% of homes have internet, which represents a great challenge for us. The number of contracts that use mobile banking per thousand inhabitants is 828 contracts. People in the municipality have little access to transport, 11% of the homes have at least one car or truck, 3% have a motorcycle or scooter and 8% have a bicycle.

The chart below shows the annual corn yield (ton/ha) for spring- summer productive cycle with no irrigation; the bar chart on the right shows the annual corn hectares sown, damaged, and harvested for all the productive cycles present in this municipality. The average yield s the period 2010-2019 was 2.2 tons per hectare. In Chiapilla 79% of the total sown area is dedicated to sown corn. The average loss ratio was 25%.





ii. San Lucas

It belongs to the Central Highlands region; its coordinates are 16 ° 37′00 ″ N 92 ° 43′00 ″ W. Its territorial extension is 97.50 km², (0.20% of the state)67. It has a semi-warm sub-humid climate with rains in the summer.

64 According to the AMIS, SEL D represents that in 56% of households at this level, the head of the household has studies up to elementary school. Internet access in these homes is very low, about 4%. About half of the expenditure (46%) is dedicated to food and only 16% to transport and communication.

65 Popular Financial Societies (SOFIPO) are members of the non-speculative and non-profit social sector.

66 We estimate access points that could be in a radius of less than an hour and a half in every municipality. We considered that the population that doesn’t have any car, motorcycle or bicycle could use a public service, even this estimation is considering the estimated time using a public service.

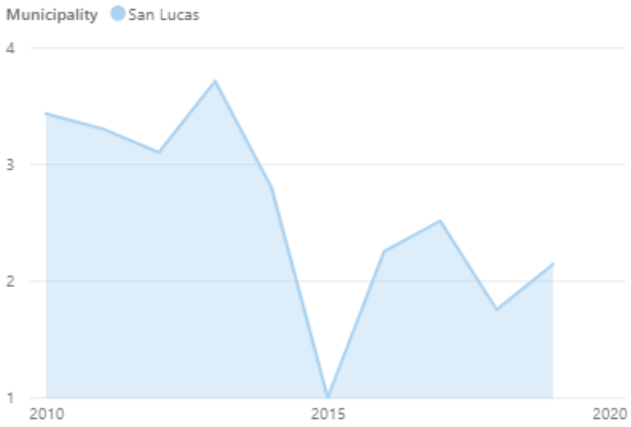
67 https://es.wikipedia.org/wiki/Municipio_de_San_Lucas_(Chiapas)

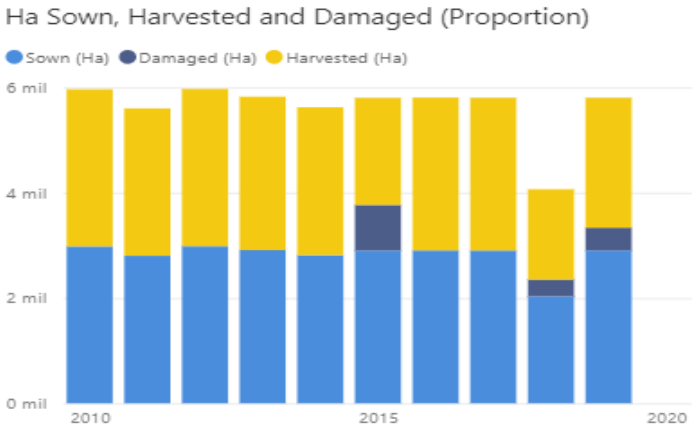
It has 5,385 adults with avg. daily income of MXN 49 (USD 2.5). It has 67% rural population. It has a very high degree of marginalization, and its predominant SEL is E68.

80% of the population can read and write and 69% have completed basic education. 16% of the population speak an indigenous language. 80% of the population is affiliated to health services and 98% of the homes have piped water.

The municipality has 2 confirmed access points, both are correspondents, but there is one extra Telecomm branches that is near of the municipality in a radius of less than an hour and a half. In 73% of the homes at least one person has internet and 3% have internet at home. It has 517 contracts that use mobile banking per thousand inhabitants. 5% of the homes have at least one car or truck, 5% have a motorcycle or scooter and 15% have a bicycle.

The chart below shows the annual corn yield (ton/ha) for spring- summer productive cycle and temporal irrigation; the bar chart on the right shows the annual corn hectares sown, damaged and harvested for all the productive cycles in this municipality. The average yield during the period 2010-2019 it's 2.5 tons per hectare. In San Lucas 92% of the total sown area is dedicated to sown corn. The average loss ratio was 20%.





68 According to AMIS, SEL E means that in most households (95%) the head of the family has elementary school. Internet access at home is practically nil (0.2%). 52% of household spending is used for food and only 11% is used for transport and communication, a similar percentage to that for housing

7.4 Pilot municipalities of Oaxaca

5 selected municipalities					
Municipality key	144	304	130	261	398
Pilot municipality	San Francisco Jaltepetongo	San Pedro Coxcaltepec Cántaros	San Dionisio del Mar	San Miguel Amatitlán	Ayoquezco de Aldama
Pilar I					
Adult population	926	598	3807	5665	3186
Income decile	II	I	II	II	II
Daily income (MXN)	80	51	80	80	80
Predominant socioeconomic level	D	E	D	D	D
Type of locality	Rural	Rural	En Transición	En Transición	Rural
% rural population	100%	100%	83%	83%	100%
Marginalization degree	Alto	Muy alto	Alto	Alto	Alto
% Population that speaks indigenous language and spanish	12%	9%	52%	15%	8%
% literate population	90%	92%	82%	82%	86%
% population with basic education	80%	84%	65%	76%	68%
% population affiliated health services	81%	82%	68%	82%	72%
% homes that have piped water	91%	86%	75%	88%	97%
Pilar II					
Total branches	0	0	0	0	3
Total correspondents	0	0	2	1	4
Total ATM	0	0	0	0	2
# contracts that use mobile banking per thousand inhabitants	55.10	60.24	132.12	38.84	694.08
Telecomm branches	0	0	0	0.00	0.00
% homes that have a cell phone	53%	30%	51%	42%	82%
% homes that have internet	7%	0%	4%	3%	16%
# of urban roads per inhabitant	92.92	78.65	55.95	16.59	66.87
# of rural roads per inhabitant	57.27	65.26	39.93	101.15	9.73
% homes with a car or truck	18%	12%	8%	16%	29%
% homes with moped or motorcycle	10%	5%	11%	2%	13%
% homes with bicycle	9%	7%	24%	3%	55%
Pilar III					
Total Sown area (ha) 2019	438	427	931	1,002	1,916
Total sown area (ha) of temporal corn grain 2019	260	360	727	900	1,262
% sown of corn grain respect total sown area 2019	59%	84%	78%	90%	66%
% average claims ratio of years lost (SIAP)	64%	46%	78%	47%	31%
Average yield (ton/ha) (SIAP) 2010-2019	0.9	0.67	0.69	0.61	0.91
Claims frequency (CADENA) 2010-2016	4	2	6	2	4

iii. San Dionisio del Mar

The territory of San Dionisio del Mar is located on the isthmus of Tehuantepec and in the Juchitán District.

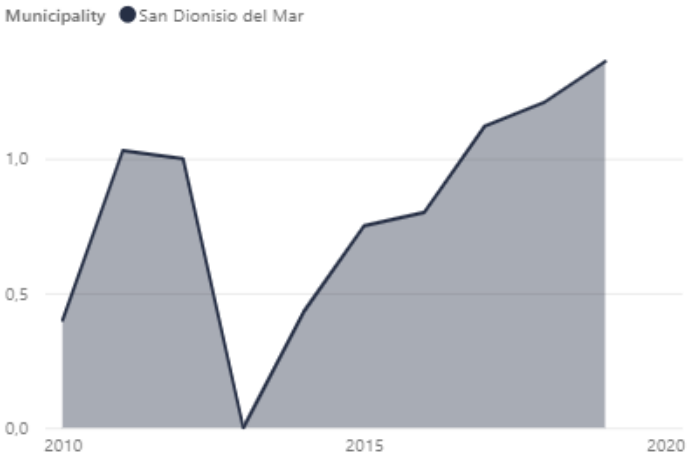
It has 3,807 adults with avg. daily income of MXN 80 (USD 4). The degree of marginalization is classified as high and its predominant SEL is D. The percentage of rural population is 83%, while 65% of the adult population has only basic education.

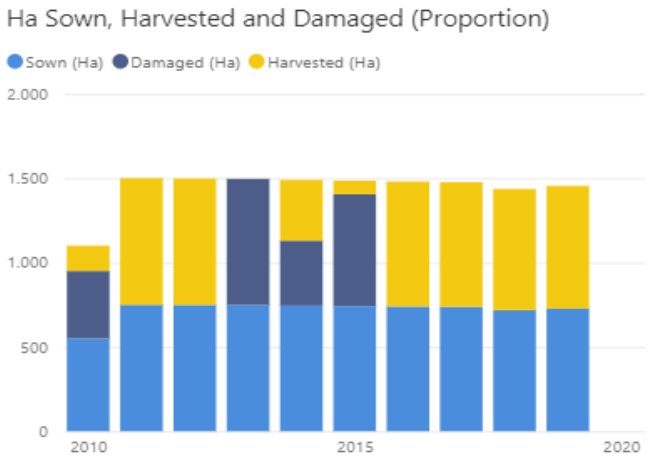
51% of the homes in the municipality have cell phone access, while only 4% have internet services; however, it is a connected municipality, as it has around 90 urban and rural roads. 24% of the population have a bicycle, 11% have a motorcycle and only 8% have a truck.

On the other hand, in San Dionisio del Mar has only 2 confirmed correspondents, but there are about 6 unconfirmed additional correspondents in a radius of less than an hour and a half, these accesses are: Liconsa and Diconsa stores, Telecomm branches and OXXO stores.

The chart below shows the annual corn yield (ton/ha) for spring- summer productive cycle with no irrigation; the bar chart on the right shows the annual corn hectares sown, damaged, and harvested for all the productive cycles in this municipality. The average yield during 2010-2019 was 0.69 tons per hectare. In

San Dionisio del Mar 78% of the total sown area is dedicated to corn. The average loss ratio was 78%, one of the highest.





iv. San Francisco Jaltepetongo

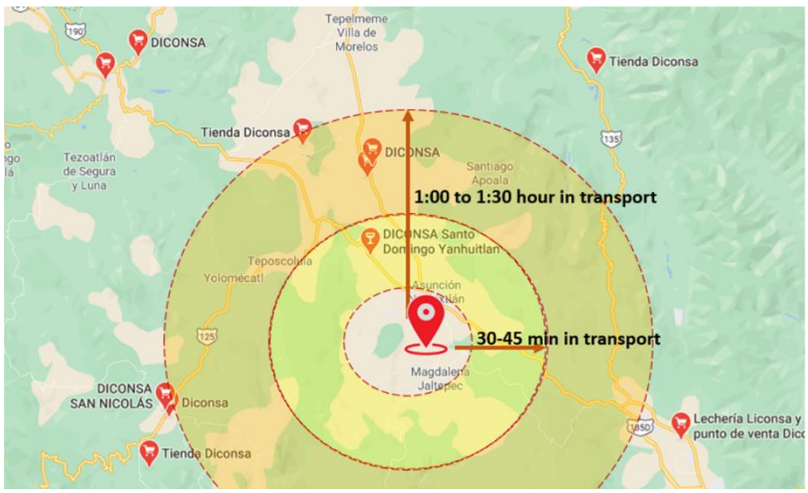
San Francisco Jaltepetongo is one of the 570 municipalities of Oaxaca. It belongs to the district of Nochixtlán, within the Mixtec region. The municipality covers 45.66 km² and is located at an average altitude of 2070 meters above sea level, ranging between 2700 and 1900 meters above sea level. Its geographical coordinates are 17 ° 23′0 ″ N, 97 ° 16′0 ″ W.

It has 926 adults. MXN 80 (USD 4) avg. daily income. The predominant SEL is D. The percentage of the rural population is 100% with a high degree of marginalization. 12% of the population speak an indigenous language, 90% can read and write and 80% have an elementary education. 91% has access to piped water and 81% is affiliated to some health service.

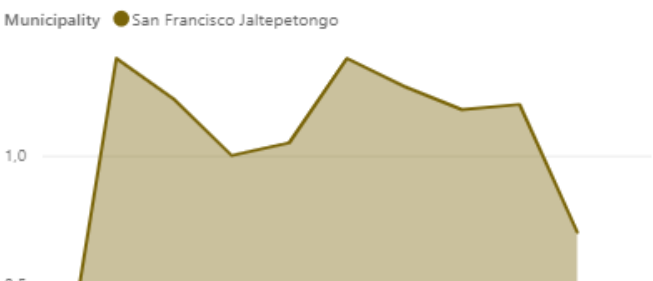
6% of the population uses mobile banking, 53% of households have a cell phone, and 7% of the population has internet services at home.

There are approximately 149 urban and rural roads; however, this municipality is very mountainous.

The municipality has no confirmed access points, however there are 4 non-confirmed correspondents in a radius of less than an hour and a half, these accesses are: Diconsa stores, Telecomm branches and Oxxo stores. 18% of the population have a car, 10% have a motorcycle and only 9% have a bicycle.



The chart below shows the annual corn yield (ton/ha) for spring- summer productive cycle with no irrigation; the bar chart on the right shows the annual corn hectares sown, damaged, and harvested for all the productive cycles in this municipality. The average yield during 2010-2019 was 0.9 tons per hectare. In San Francisco Jaltepetongo 59% of the total sown area is dedicated to sown corn. The average loss ratio was 64%.



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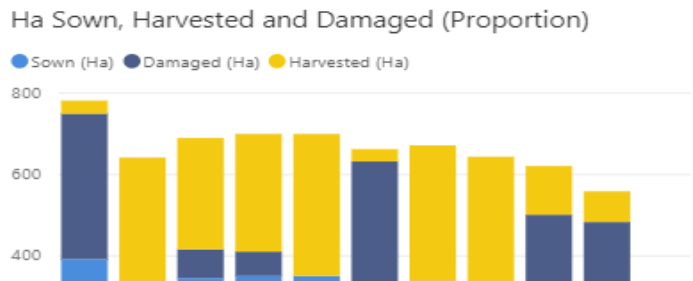


7.5 Pilot municipalities in Tabasco

5 selected municipalities					
Municipality key	11	13	15	3	8
Pilot municipality	Jonuta	Nacajuca	Tacotalpa	Centla	Huimanguillo
Pillar I					
Adult population	23353	104116	37077	81304	142850
Income decile	II	I	II	I	I
Daily income (USD)	7	4	7	7	6
Predominant socioeconomic level	D	E	D	D	D
Type of locality	Semi-urbano	Urbano	Urbano	Urbano	Urbano
% rural population	50%	33%	33%	33%	33%
Marginalization degree	Medio	Muy bajo	Medio	Medio	Medio
% Population that speaks indigenous language and spanish	3.7%	14.5%	23.8%	12.6%	0.3%
% literate population	92%	95%	93%	95%	93%
% population with basic education	64%	44%	62%	56%	61%
% population affiliated health services	81%	70%	71%	63%	66%
% homes that have piped water	94%	98%	95%	83%	85%
Pillar II					
Total branches	2	3	1	9	6
Total correspondents	9	60	13	30	52
Total ATM	7	8	3	10	18
# contracts that use mobile banking per thousand inhabitants	161	339	131	196	323
Telecomm branches	1	1	2	2	3
% homes that have a cell phone	63%	88%	64%	78%	82%
% homes that have internet	8%	44%	17%	19%	20%
# of urban roads per inhabitant	8	3	6	4	9
# of rural roads per inhabitant	N/D	N/D	N/D	N/D	N/D
% homes with a car or truck	11%	30%	12%	13%	23%
% homes with moped or motorcycle	13%	11%	17%	20%	37%
% homes with bicycle	21%	16%	19%	22%	28%
Pillar III					
Total Sown area (ha) 2019	6,079	911	13,498	10,374	51,223
Total sown area (ha) of temporal corn grain 2019	5,515	810	8,472	5,718	11,511
% sown of temporal corn grain respect total sown area 2019	91%	89%	63%	55%	22%
% average claims ratio of years lost (SIAP)	16%	22%	9%	23%	4%
Average yield (ton/ha) (SIAP) 2010-2019	1.4	0.9	1.8	1.4	1.8
Claims frequency (CADENA) 2010-2016	3	3	0	2	6

v. Jonuta

Jonuta is a municipality in the Mexican state of Tabasco, located in the Usumacinta river region and in the swamp's subregion. It is in the south of the state, between the north coordinates 18 ° 28 '; south 17 ° 48 'north; East 91 ° 46 'and 92 ° 21' West.

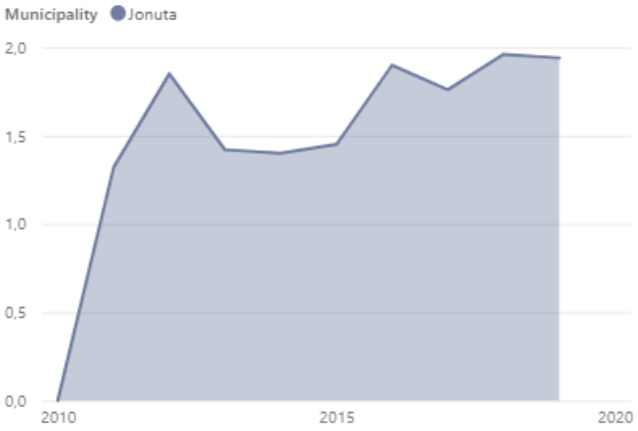
The territorial extension of the municipality is 1,575.64 km², 6.43% of the total of the state.

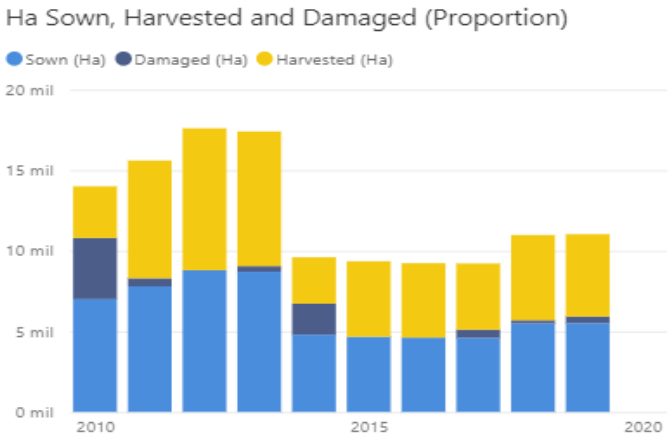
It has 23,353 adults with avg. daily income of MXN 140 (USD 7). The percentage of the rural population is 50%. It has a middle degree of marginalization and it's predominant SEL is D.

92% of the population can read and write, 64% have completed elementary school; 3.7% speak an indigenous language; 81% of the population is affiliated to health services, 94% of the homes have piped water.

The municipality has 19 confirmed access points in total of which 2 are branches, 9 correspondents, 7 ATMs and one Telecomm branch; it also has 9 non confirmed access point in a radius of less than an hour and a half. In 63% of homes at least one person has a cell phone and 8% of homes have internet. 11% of the homes have at least one car or truck, 13% have a motorcycle or scooter and 21% have a bicycle.

In 2019, the total planted hectares represented 3.86% of the territory of the municipality, while the total hectares dedicated to sowing corn in 2019 represented 91% of the total planted hectares. This shows us that the main crop grown in Jonuta is corn. The chart below shows the annual corn yield (ton/ha) for spring-summer productive cycle with no irrigation; the bar chart on the right shows the annual corn hectares sown, damaged, and harvested for all the productive cycles in this municipality. The average yield from 2010-2019 was 1.4 (T/Ha). The maximum reported loss ratio occurred in 2010 with a 54% loss ratio, also the 2011, 2013, 2014, 2017, 2018 and 2019 had losses; and the average of all the years lost is 16%.



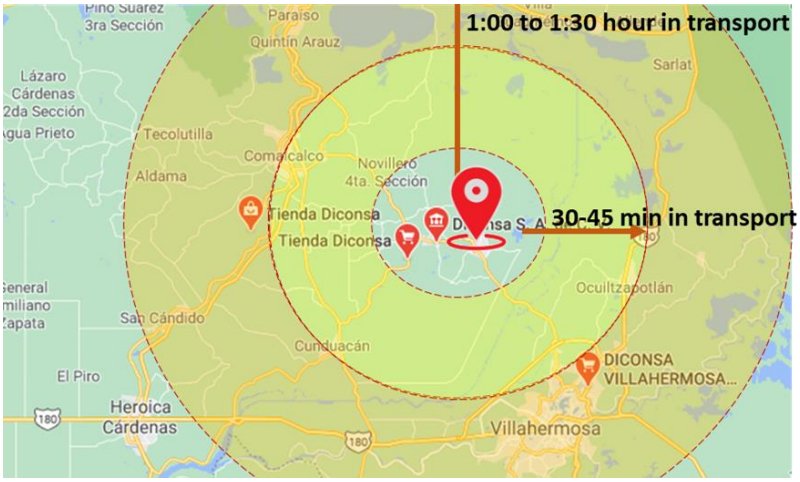


vi. Nacajuca

The municipality of Nacajuca is located in the Chontalpa region in the North of the state, between the parallels 18 ° 09 'of North and 93 ° 01' of West. Its extension is 488.37km², 2.1% of the state. Its territorial division is made up of 14 ejidos, 28 ranches, 11 towns, 3 congregations and 3 rural subdivisions. In the municipality there are 6 regional development centers in which most of the economic and social activities take place, which are: Lomitas, Sandial, Taxco, Oxiacaque, Guatacalca and Mazateupa

.

It has 104,116 adults with an avg. daily income MXN 80 (USD 4). The percentage of the rural population is 33% and it's predominant SEL is E.

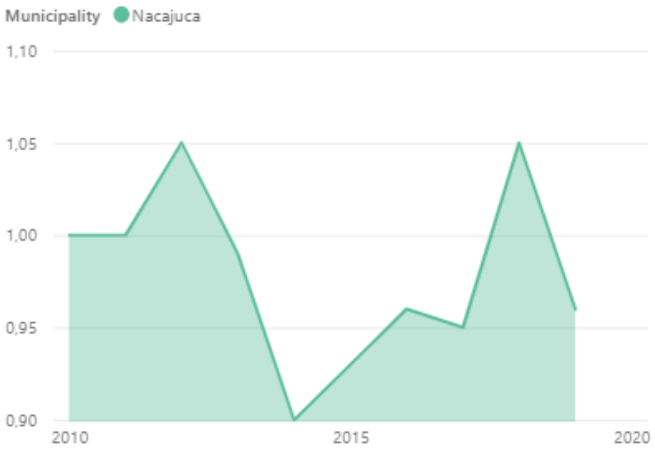


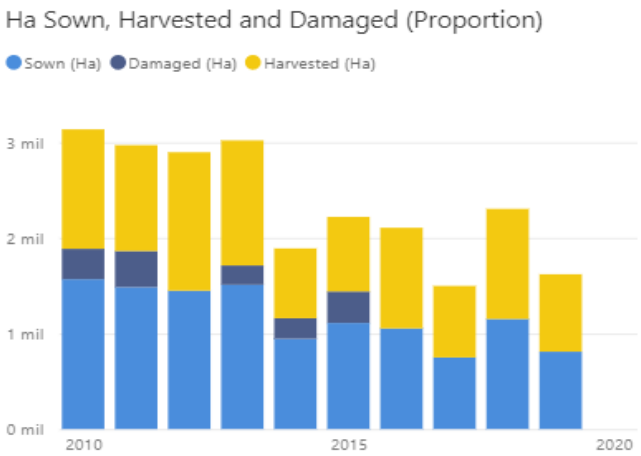
95% of the population knows how to read and write and 44% have completed elementary school. 14.5% of the population speaks an indigenous language. 70% of the population is affiliated to health services and 98% of the homes have piped water.

The municipality has 72 access points confirmed (the highest number of access points in our pilot) of which 3 are branches, 60 correspondents, 8 ATMs and a Telecomm branch, additional to this, also have 13 access point no confirmed in a radius of less than an hour and a half, these accesses are: Diconsa and Liconsa stores, Telecomm and Bansefi branches and Oxxo stores. 88% of homes at least one person has a cell phone and 44% of homes have internet (also the highest percentages of this variables in our pilot test). It has 339 mobile banking contracts per 1,000 inhabitants. 30% of the homes have at least one car or truck, 11% have a motorcycle or scooter and 16% have a bicycle.

In 2019, the total planted Ha were 1.87% of the total territory of the municipality, while the total hectares dedicated to the sowing of grain corn in 2019 represented 89% of the total planted hectares. This shows us that the main crop sown in Nacajuca is grain corn.

The tables below show the annual corn yield (ton/ha) for spring- summer productive cycle and temporal irrigation; the other right figure show the annual corn hectares sown, damage and harvested for all the productive cycles present in this municipality and temporal irrigation. The average yield during the period 2010-2019 it's 0.9. The maximum reported loss ratio was 2011 and 2015, and the average of all the years lost is 22%.





7.6 Lessons to be extracted from the Pilot Test

1. **Operational Set up**
    a. Operational cost of the program for ~30,000 prospects before scaling up? (test cost drivers)
    b. Learn the cost drivers of the operation of the project on a daily basis
    c. Set up the connectivity between all stakeholders. We have an operational process lay out that we want to test and understand before scaling up
2. **Operational Performance**
    a. Supported by SADER offices, do the people living further away from the offices have the same chance of getting enrolled?
    b. Most efficient way to perform Enroller Training

c. How efficient are enrollers and how fast can we cover a Municipality?
d. How to solve operational and connectivity issues on a day to day basis (develop operational scripts and manuals)
e. Check reception from beneficiaries and improve communication to become more efficient
f. Learn hit ratio of actual beneficiaries enrolling in the program and what motivates them to become part of the program to improve scripts and manuals
g. Check what it would take to have bags of seed and some tools at DICONSA stores
h. Check if communication flows as planned in more distant communities
i. Obtain feedback from each community on their problems and ways to solve them to structure best practices for scaling up
j. Will farmers travel to larger communities to purchase seed and tools at discounted prices?

3. **Design for scaling up**
   a. What are the most important features to include in the order of municipalities scale up to ensure the most vulnerable farmers are covered first?
   b. How can we create shared value through our program efficiently addressing real social needs?
   c. What does it take to create value for Democrance/Raincoat, Telcel and other possible allies?
   d. Develop operational manual to be used for each Regional / Subregional activation (DDR and CADER)
   e. Develop a reporting system to control the setting up of the operation and its BAU performance
   f. Understand potential sources of deviation in implementation schedules, document them including mitigation actions
   g. Understand what the best practices for enrollment from each community are, to develop a guide for enrollers and improve enrollment efficiency
   h. Establish a communication system with/among enrollers (could be as simple as WhatsApp group) to share best practices

7.7 Cost Drivers of the Pilot Test

Pilot Test Cost Drivers		Cost type		One Off			BAU		
		Fixed	Variable	Unit Cost	# units	One-off Cost	Unit cost	# Units	BAU Cost
Platform	Design (validate that complete functionality is included)	x							
	Development (if possible using Agile Streams)	x							
	Set Up in devices	x							
	Testing	x							
	Q&A	x							
	Production	x							
	Maintenance		x						
Enrollers	Recruiting (look for people with local language skills)		x						
	Tablets		x						
	Design of training materials		x						
	Distribution of training materials		x						
	Train the trainers		x						
	Training sessions		x						
	Salaries		x						
Communication	Design of materials	x							
	Content Creation	x							
	Printing		x						
	Translation to local languages		x						
	Distribution		x						
Mobile phone communication	Creation of Agr Package with all data required		x						
	Cost of phone		x						
	Cost of Tablets		x						
	Monthly cost of line		x						
	Cost of SMS communication		x						
	uploading APP to phones and Tablets		x						
	e-wallet set up (or bank account)	x							
	Operational cost of mobile communication		x						
	Antenna/Coverage for Remote Municipalities		x						

Chart 35 Cost Drivers

To assess the cost of the pilot test, we need to interact with some potential allies that provide us with cost estimate for the development and for the operation of the array that we have proposed. We have already started talks with Telcel which is the largest local provider of mobile infrastructure to assess high level

costs and estimated time schedule. Also, we have started conversations with *democrance* to understand how much it would cost and time to adapt their existing technology to our specific needs.

We have started conversations with the Ministry of Finance to explore potential government programs that could provide the enrollment function. We need to understand in detail the cost that it will imply to train them and if it is possible that the government may absorb it. We need to structure the cost of getting all communication materials designed, printed and distributed to the enrollers.

8 Proposed Project partners' roles and responsibilities

- **Agroasemex.** The local agro insurance company, owned by the Federal Government will act as data facilitator and local expert. They are invited to weekly meetings and so far, have provided access to databases, and relevant feedback from their operational experience.
    - Will be the re-insurance leading company that sets up all operational processes for the rest of participating insurance companies to join in.
    - Will facilitate their satellite network for crop follow up,
    - Will facilitate the contact with SIAP to use them as Calculation Agent.
    - Will also provide training and coaching to enrollers and supervise the operation together with the consortium.
    - Will help making the necessary adjustments to the already registered parametric product to use it for our program.
- **Ministry of Finance (through its USPSS)**
    - Will provide constant feedback on the structure of the program.
    - Will help us get the best contractor figure (either them or SADER) for the program
    - Will provide access to information and contact with relevant government authorities to facilitate the right implementation of the project.
    - Will also facilitate the obtention and management of beneficiaries' information (properly observing privacy related issues). They are providing access for to the Ministry of Agriculture and its regional offices (DDR and CADERs), and through them to DICONSA authorities to explore potential synergies.
    - Will facilitate that the project gets the necessary funding/subsidies to operate once it reaches its operational stage based on the results of the pilot test.
- **AXA Climate**
    - Co-leader, risk & modelling capacity, international experience.
    - Will continue acting as operational lead and facilitating the right environment for the rest of the team to join efforts to achieve our goal.
    - Will provide insurance/reinsurance capacity, plus an array of climate related services.
    - Will continue working on all ISF/IDF documentation and other requirements for the advancement of the program. AXA Climate will sign the agreement and all legal requirements to continue co-leading the initiative.
    - Will participate sharing costs (financial or in kind) for the implementation of the initiative.
    - Will directly supervise and coordinate tasks and activities for the full proposal if we are invited to present it.
    - Will participate in the design of the indexes and pricing at municipality level
    - Will continue collaborating in the steering committee of the project
- **Guy Carpenter**
    - Co-leader and structuration experience. They have many years of experience and have implemented similar operational solutions for the reinsurance sector. Alfredo Honsberg has personally brought Telcel to the table to help us design a solution together. He has many contacts to structure the operational pilot test, and to make the whole proposal operational.
    - Guy Carpenter will sign the agreement and all legal requirements to continue co-leading the initiative. Guy Carpenter will participate sharing costs (financial or in kind) for the implementation of the initiative.
    - Guy carpenter is helping with the structuring of the RFP to decide the vendor that best fulfills the requirements of our project
    - Will help coordinadte all activities and tasks for the development of the full proposal as well in case we are invited to present the document.
    - Will continue collaborating in the steering committee of the project
- **Swiss RE**
    - Risk and modelling capacity, international experience. They have been actively involved in the design of the proposal and have shared their operational experience to adequately address technical local issues given their experience with similar programs.
    - Will collaborate in the design of the indexes and pricing at municipality level
    - Will participate with risk capacity
    - Will collaborate in the automation of the pricing models
    - Will continue collaborating in the steering committee of the project
- **Munich RE**
    - Risk and modelling capacity, international experience.

- They are also interested in providing their international experience (and previous IDF experience too) to better structure the solution.
- Will also participate with risk capacity.
- They brought Raincoat to the project (given past experience with them in other geography) and will help with the setup of the program as well

- **Other Insurance Companies.**
  - Will be invited to participate in the program as soon as it is structured. We will maintain communication through the agreement we will seek to formalize through AMIS mentioned earlier in the document.

9 Short description on how the scheme fits into the insurance landscape and the plans of the government

9.1 Involvement of local entities in the agriculture insurance market (private insurers, Fondos and Agroasemex) in the distribution of the product

Insurers/reinsurers. The IDF group is committed to having as many insurance and reinsurance companies as possible. We believe that it is in the best interest of the beneficiaries (but also of the market) to allow competitors to drive better practices. We know that one of the premises of the ISF is to have open source information and fully agree to help develop local capabilities.

Once we have designed the basic lay out of the program and started aligning possible complementary mobile phone/banking allies, our objective is to openly share all information with the rest of the sector through AMIS[69] and invite them to participate in it once the project is approved. There are only six insurance companies participating in the Agriculture insurance sector today.

In complement to (re)insurance companies, Fondos are another existing player in the insurance market that could be of interest to the program. Fondos are small mutual insurance funds that are a unique feature of the Mexican agricultural insurance market and can only provide insurance to their members. **They are formed by local growers to provide commercial insurance products** that support the provision of credit to farmers throughout much of the country70. As insurance entities, the Fondos retain low levels of risk (typically up to 5% of the sum insured) and are dependent on the availability of affordable reinsurance to operate71.

The law also restricts the transactions that Fondos may enter and regulates their operations. Under the law they may only provide agriculture related damage insurance, agriculture related property insurance, credit, life insurance and/or accident and illness related insurance. As Fondos are civil associations constituted by farmers without the need to contribute capital, they are not intended to generate profits either for the Fondo itself or its members. The Fondos system is critically dependent on the availability of reinsurance. At present all Fondos have “stop-loss” reinsurance policies. These are policies designed to limit claim coverage within the Fondo (losses) to a specific amount.

Since Fondos are organizations that provide commercial insurance to their members under the conditions previously mentioned, our target beneficiaries are not part of them (one of the requirements to be part of the program is not having access to any other form of insurance). Nonetheless, we believe that is relevant to get in contact with them, in case there are producers that, given the cancelation of government subsidies, have been left out without insurance (if they meet the rest of the eligibility criteria).

9.2 Government entities best suited to pay the premium subsidies and funding flow to the agriculture insurance market

The new General Law on Comprehensive Disaster Risk Management and Civil Protection in Mexico includes a proposal to create a new Federal Agency for the Financial Management of Public Risks. The proposal is backed by the Insurance, Pensions and Social Security Unit of the Ministry of Finance and Public Credit. The agency would be made up of three units: the analysis unit, the operational management unit, and the compliance unit. Each one of the units with specific purposes to achieve an adequate transfer of risks and solving issues in the management of those risks. Part of the goal is expanding the participation in federal programs to more companies, since currently 80 percent of the premium is controlled by only five insurers.72

The comprehensive risk strategy of the new Federal Agency seeks to make State governments aware that they are exposed to risks and bring insurance mechanisms closer to the population. Among the priorities

69 Mexican Association of Insurance Institutions

70 According to OINFA’s 2012 annual report, 388 *Fondos* were operating across the country that year out of a total of 429 licensed with the SHCP. 85% of them were for Crops, 10% for Livestock, 1% for Aquaculture and 4% for Property (Farm owners/Rural facilities)

71 Mexico Agriculture Insurance Market Overview. World Bank LAC June 2013

72 https://www.elasegurador.com.mx/blog/la-agencia-federal-de-gestion-financiera-de-riesgos-publicos/#:~:text=Crear%20la%20Agencia%20Federal%20de,de%20Hacienda%20y%20Cr%C3%A9dito%20P%C3%BAblico.

of the new Federal Agency are: maintain approved budget of 0.4% of Federal Government Programmed Spending.

Given the new role of the mentioned Federal Agency, it is the best suited entity in the government to pay for or guide State Governments in gathering the necessary resources to pay for insurance program subsidies.

9.3 Network of shops with social perspective that could help with farmers sign up for the insurance program or help increase their resilience.

Smallholder farmers purchase their inputs on a small basis that means that they do not qualify for volume discounts as large farmers do. They normally purchase their tools and other inputs in a highly fragmented small inputs store close to their communities. To lower the prices and increase the availably of the inputs or tools, there is a need for a larger distributor to become part of the effort.

DICONSA (for example) operates the Rural Supply Program with more than 27 thousand fixed and 300 mobile stores throughout the country. DICONSA has 302 rural and central warehouses, 3 bulk warehouses and almost 4 thousand vehicles that travel thousands of kilometers every day on dirt roads. Its main purpose is to supply rural communities with basic and complementary basket products, the latter are divided into the following groups: food and nutrition products, hygiene and health products and other products73.

Likewise, DICONSA is working on the gradual conversion of the stores to "Community Service Units", which consists of incorporating into the store at least three additional services to the supply in addition to the marketing of basic products. If DICONSA would be interested in including seeds and some basic agriculture tools to their product offering in some of their rural warehouses for example, it could help smallholder producers cash in their claims payout and use the money more efficiently, increasing their resilience.

DICONSA currently has got a very granular network of stores and other formats in Oaxaca, Chiapas and Tabasco74. This infrastructure could be very beneficial for the smallholder producers to acquire and benefit from the program and fair prices.

	Community Stores	Service Centers	Mobile Stores	Rural warehouses	Central Warehouses	Branches	Warehouse & Granary	Operative Units
Oaxaca	2.486	10	30	30	3	1		3
Tabasco	1.074	2	10	11	1	1		
Chiapas	2.087	14	26	24	2		1	2

Under this new concept, if DICONSA would be interested in incorporating seeds and some basic agriculture inputs and tools to their product offering some of their rural warehouses, it could help the scheme, facilitating smallholder producers to collect their claims payout and immediately purchase new inputs or tools to recover their production, thus increasing their resilience.

9.4 Current law and regulation (for public and private entities) for introducing a new insurance program to support smallholder farmers

Our program setup and structure has been validated with Agroasemex and with the Insurance Unit of the Ministry of Finance. There is an already existing registration of a parametric coverage that can be adjusted

73 https://www.gob.mx/DICONSA/que-hacemos

74 https://www.gob.mx/DICONSA/acciones-y-programas/metodologia-de-capacitacion-y-contraloria-social-de-DICONSA

and reused for our program. This registration allows the project to shorten registration times compared to a completely new product.

9.4.1 Changes in the General Law of Comprehensive Disaster Risk Management and Civil Protection

The Chamber of Representatives (lower chamber) approved the new general law on comprehensive disaster risk management and civil protection, which replaces the General Law on Civil Protection, where financing and co-financing mechanisms are defined (which replace the Emergency Assistance Fund (FONDEN)), in case of a natural disaster, which must be contracted by the state governments.

Likewise, the Chamber endorsed the new General Population Law, which includes the creation of a National Identification Service (under the Ministry of the Interior), as well as the Unique National Identity Card as a digital document that reliably certifies the registration and identities a person. The ID will be the official identification document in front of all Mexican authorities, as well as for all types of procedures and services. In addition to the person's name, the ID will contain the Unique Population Registry Code (CURP), as well as their biometric data of each registered person.

These changes are relevant for the study because:

1. The GLCDRMCP includes a new Federal Public Risk Management Agency that once it becomes operational, will set the guidelines for the proper risk management measures that states must follow, and it will also provide with technical expertise regarding the risk transference needs of the states, and it will standardize the coverage for any given risk.75
2. The National ID card with biometric information can be used to better track the beneficiaries of any program. We need to investigate the timeframe for deployment and, if it is possible to use it to identify the beneficiaries of the new insurance program as well as, if it can be linked to a bank card to a specific segment (people living in vulnerable rural communities)

9.4.2 Microinsurance Framework

The team agreed that the best approach is to work within the current legal framework, only having potential impact in secondary laws. The study will observe the Mexican law regarding microinsurance products whose purpose is to provide access to insurance protection for low income population using low cost distribution & operations. Microinsurance can be distributed through agents and brokers, financial intermediaries, other physical and moral persons with proper authorization76. For a product to be considered as microinsurance, some aspects must be observed77:

1. Personal Insurance. For individual products the maximum sum insured is four times the minimum salary78 of Mexico City (~3,500 EUR). For collective products the maximum sum insured is three times the minimum salary of Mexico City (~2,625 EUR)
2. P&C Insurance. For collective products the maximum sum insured is three times the minimum salary of Mexico City (~2,625 EUR)
3. Insurance must be done through adhesion contracts
4. Insurance must not include the participation of the insured in any form (deductibles, copayment, franchise)

Relative to the contract of the product there are some guidelines that must be met as well:

1. Clear, precise and simple drafting of the policy or certificate
2. Use of simplified mandatory clauses for consumer protection
3. Exclusions may only be general and not related to individual risk
4. The validity of the insurance policies may not be annual under certain conditions
5. Delivery of policy or certificate with minimum data and simplified general conditions (the institution has the obligation to deliver at any time the full version registered with the CNSF)
6. Simplified mechanisms for premium collection

75 Today, each State acquires the protection that they believe best suits their needs. Yeti t is not always enough and relevant.
76 Observing the art. 41 of the General Law of Institutions and Mutual Insurance Societies regarding insurance distribution.
77 According to *Circular* (official document) CNSF S-8.1
78 Minimum salary in Mexico City (and rest of the country except border cities) is equivalent to 5.13 EUR per day in 2020

7. The proof of payment of the premium serves as proof of the conclusion of the insurance contract
8. Simplified procedure for claiming and paying compensation (no more than 5 business days). This point is particularly relevant for people to trust insurance companies, and as well to be relevant in its contribution to resilience.

- If yes, are there any recommendations as to how to formulate the various laws or secondary regulation (likely on subsidies; government funds set up; technology providers etc.)
- With a clear idea of what the program will look like; what would the legal, organizational- and administrative set-up of the insurance program be?

10 Sustainability. Fostering a more sustainable ecosystem in Mexico through the implementation of our project.

In agriculture, sustainability is a complex idea with many facets, including economic (a sustainable farm should be a profitable business that contributes to a robust economy), social (it should deal fairly with its workers and have a mutually beneficial relationship with the surrounding community), and of course environmental aspects79. We are interested that the project will contribute at different levels, for example, sharing and supporting sustainable agriculture practices for all beneficiaries. We will get in contact with partners with the right expertise80 that can provide us with content as we move forward with the implementation.

1. **Contributing to having fair agricultural practices**. Communication activities of the project will inform beneficiaries on indispensable/recommended social and environmental standards to be observed:
    a. Child labor free products.
    b. Decent wages for all smallholder producers. By providing the end beneficiary with direct compensation, the producers will be empowered to make decisions about their best interest to improve their productivity.
    c. Green agricultural economy, which does not generate deforestation, nor contamination of soils and water.
2. **Fostering gender parity, local languages and other inclusion measures** in all our communications.
3. **Providing Financial Inclusion Tools** for the farmers to develop a more resilient personal economy.
4. Observing 8 of the 17 Sustainable Development Goals as we roll our project.
    a. No poverty
    b. Zero Hunger
    c. Good health and Well-being
    d. Quality Education
    e. Gender Equality
    f. Decent work and economic growth
    g. Industry innovation and infrastructure
    h. Reduced inequalities
5. **Facilitating an environment in which best practices can be easily shared** among beneficiaries. We want our kiosks, digital platform, SMS messages and/or other forms of communication to periodically include practices that help farmers improve their productivity in a sustainable way.
6. **Managing natural resources responsibly**
    a. Improving and maintaining healthy soil
    b. Managing water wisely
    c. Minimizing air, water, and climate pollution
    d. Promoting biodiversity
7. **Crop productivity measures81**
    a. **Rotating crops and embracing diversity**. Crop diversity practices include intercropping (growing a mix of crops in the same area) and complex multi-year crop rotations.
    b. **Planting cover crops**. Cover crops, like clover or hairy vetch, are planted during off-season times when soils might otherwise be left bare. These crops protect and build soil health by preventing erosion, replenishing soil nutrients, and keeping weeds in check, reducing the need for herbicides.
    c. **Reducing or eliminating tillage**. No-till or reduced till methods, which involve inserting seeds directly into undisturbed soil, can reduce erosion and improve soil health.
    d. **Applying integrated pest management (IPM).** A range of methods, including mechanical and biological controls, can be applied systematically to keep pest populations under control while minimizing use of chemical pesticides.
    e. **Adopting agroforestry practices**. By mixing trees or shrubs into their operations, farmers can provide shade and shelter to protect plants, animals, and water resources, while also potentially offering additional income.

79 https://www.ucsusa.org/resources/what-sustainable-agriculture

80 Like University of Chapingo or other agricultural institutions willing to share best practices with our beneficiaries.

81 https://www.ucsusa.org/resources/what-sustainable-agriculture

11 APPENDIX 1: Mobile Phone, Bank and Internet penetration

11.1 Mobile Phone penetration

11.1.1 Percentage of the target population having a smart phone and/or a basic phone

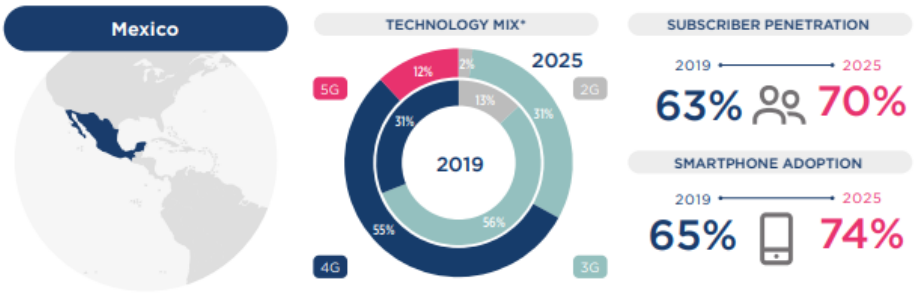


Chart 36. Mobile phone penetration in Mexico

Source: The Mobile Economy in Latinamerica[82]

63% of the population in Mexico had a mobile phone subscription in 2019, most of them with 3G technology. These numbers however vary from municipality to municipality when we analyze rural communities. Given that at the moment we have no access to the number (or percentage) of smallholder farmers with mobile phone access at municipality level, we believe it is important that during the pilot test, the percentage of beneficiaries with mobile phone access and the capillarity will be validated, since it will be one of the primary communication tools for the program (using SMS).

According to the 2020 Census[83]:

1. In Oaxaca, there are 1,121,846 inhabited households, and 812,319 of them have access to mobile phones (72.4%). Moreover, out of the 789,029 homes that have no internet access, 493,840 have mobile phone access (**63% of homes with no internet do have mobile phones**)
2. In Tabasco, there are 668,486 inhabited homes, and 563,390 of them have access to mobile phones (84.2%). Moreover, out of the 439,565 homes that have no internet access, 339,678 have mobile phone access. (**77% of homes with no internet do have mobile phones**)
3. In Chiapas, there are 1,348,205 inhabited homes, and 944,695 have access to mobile phones (70%). Moreover, out of the 1,049,093 homes that have no internet access, 660,130 have mobile phone access (**63% of homes with no internet do have mobile phones**)

Once we have discarded the nine Urban municipalities of the State of Oaxaca, we have observed that the adoption of mobile phones is not as widely accepted as anticipated. Chiapas on the other hand has a higher penetration of mobile phones.

For Oaxaca, rural communities represent 98% of the municipalities, with 76% of the total population in the state. Close to 60% of the population live in rural communities where less than 50% of them use a mobile phone, and only ~17% live in places where 50% or more of the adult population has a mobile phone.

Given that there are more homes with mobile network access than there are homes with internet access, this technology will be used as the predominant form of communication with the producers. At regional SADER offices, we will ask them for a mobile phone number for the enrollment and link it to the program together with the bank account number from Banco del Bienestar, and the insurance certificate number that we will provide them.

82 Mobile Economy in LatAm report Link

83 https://www.inegi.org.mx/sistemas/Olap/Proyectos/bd/censos/cpv2020/Viviendas.asp

Oaxaca

SEL	Lower than 25%		25%-50%		51%-75%		Over 75%	
	# Mun	# People	# Mun	# People	# Mun	# People	# Mun	# People
C+	115	382,131	54	422,098	36	277,117	2	13,920
C	59	245,777	21	132,710	8	62,920		
C-					1	11,778	1	17,890
D+					1	35,171		
D	129	493,850	20	259,221	15	264,729		
E	88	439,659	3	17,755	1	2,077		
Total	391	1,561,417	98	831,784	62	653,792	3	31,810
	69%	38%	17%	20%	11%	16%	1%	1%

Table 19. Mobile phone penetration per SEL's in number of municipalities and adult population

Source: Team analysis of INEGI databases

For Chiapas, rural communities represent 89% of the municipalities, with 38% of the total population in the State. Close to 60% of the population live in rural communities where less than 50% of them use a mobile phone, and only ~17% live in places where 50% or more of the adult population have a mobile phone84.

Chiapas

SEL	Lower 25%		25%-50%		50%-75%		Over 75%	
	# Mun	# People	# Mun	# People	# Mun	# People	# Mun	# People
E	3	2,309	27	102,218	7	20,004	1	379,754
D	-	-	7	7,980	44	235,266	20	120,962
D+	-	-	-	-	2	18,577	8	-
C-	-	-	-	-	-	-	-	144,672
C	-	-	-	-	-	-	4	-
C+	-	-	-	-	-	-	-	155,599
A/B	-	-	-	-	-	-	1	-
Total	3	2,309	34	110,198	53	273,847	34	800,987
	2%	0%	27%	9%	43%	23%	27%	67%

Table 20. Mobile phone penetration per SEL's in number of municipalities and adult population

Source: Team analysis of INEGI databases

Tabasco

SEL	Lower than 25%		25%-50%		50%-75%		Over 75%	
	# Mun	# Households	# Mun	# Households	# Mun	# Households	# Mun	# Households
E		-	-	-	-	-	3	79,044
D		-	-	-	2	13,621	10	450,170
D+		-	-	-	1	12,347	1	8,208
C-		-	-	-	-	-	-	-
C		-	-	-	-	-	-	-
C+		-	-	-	-	-	-	-
A/B		-	-	-	-	-	-	-
Total	-	0	0	0	3	25,968	14	537,422
	0%	0%	0%	0%	18%	5%	82%	95%

Table 21. Mobile phone penetration per SEL's in number of municipalities and adult population

Source: Team analysis of INEGI databases

84 To calculate this number, we used data from INEGI 2020 National Census. In the page we consulted: people living in places tagged as habitational homes, by state and municipality and availability of a mobile phone. Once we got the number of people per municipality who have a mobile phone, we contrasted it to the total number of people in the Municipality. Lastly, we grouped in ranges (25%, 50%, 75%, and over) to get an idea of how generalized the access to mobile phone issue is. The page where we got the information can be accessed following this link

11.1.2 Internet and mobile phone usage

Although our goal is to enroll farmers supported by the regional offices from SADER, we analyze internet and mobile phone penetration to select the most suitable means of communication for the program. The main reason is that there is a high degree of people have only basic education, and a low adoption of technology was identified. Thus, we aim to use pre-recorded messages and local audio trucks and radios to communicate with them, together with written messages.

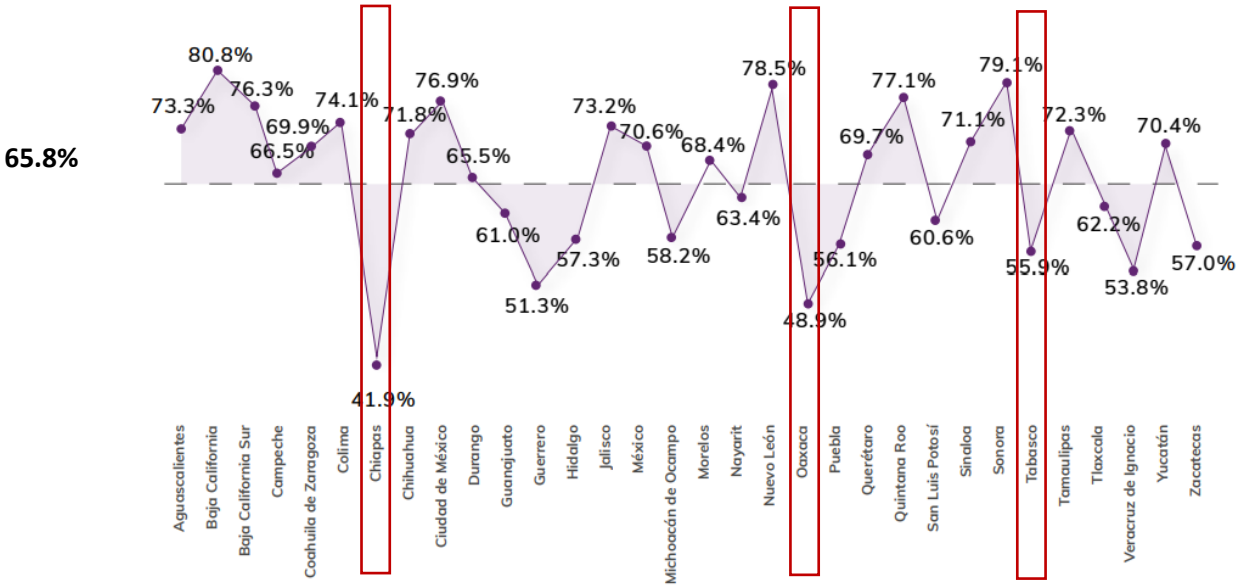


Chart 37. Probability of internet usage per State
Source: (IFT, ENDUITIH 201885)

85 Picture taken from http://www.ift.org.mx/sites/default/files/contenidogeneral/estadisticas/usodeinternetenmexico.pdf

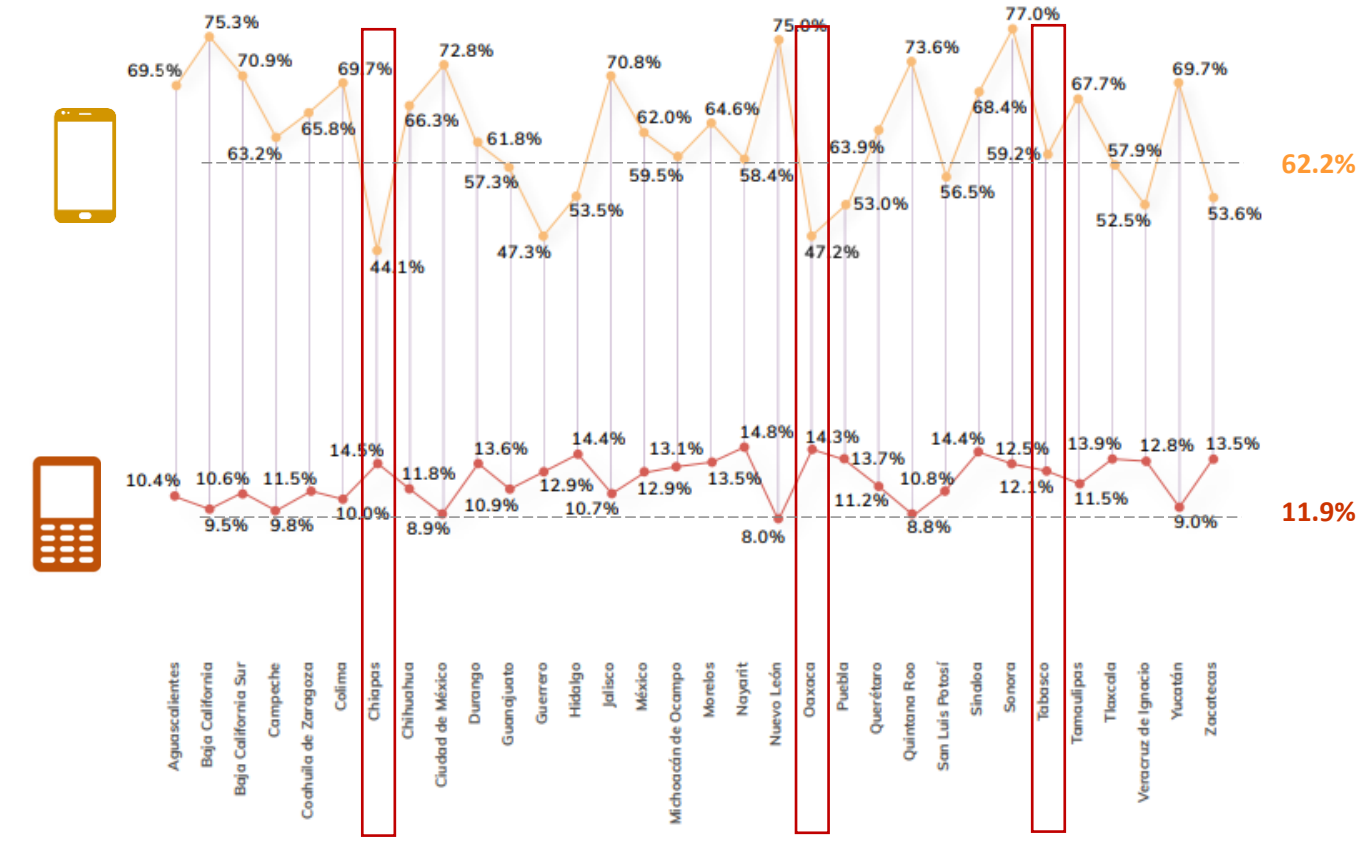


Chart 38. Likelihood of people using smartphone vs conventional mobile phone per State

Source: (IFT, ENDUITIH 201886). Relevant graph for Oaxaca and Chiapas. People have access to mobile phones, however, the lowest access to smartphones (and their funcionality) and use simple mobile phones. Implication : communication would need to be based on simpler versions of the technology.

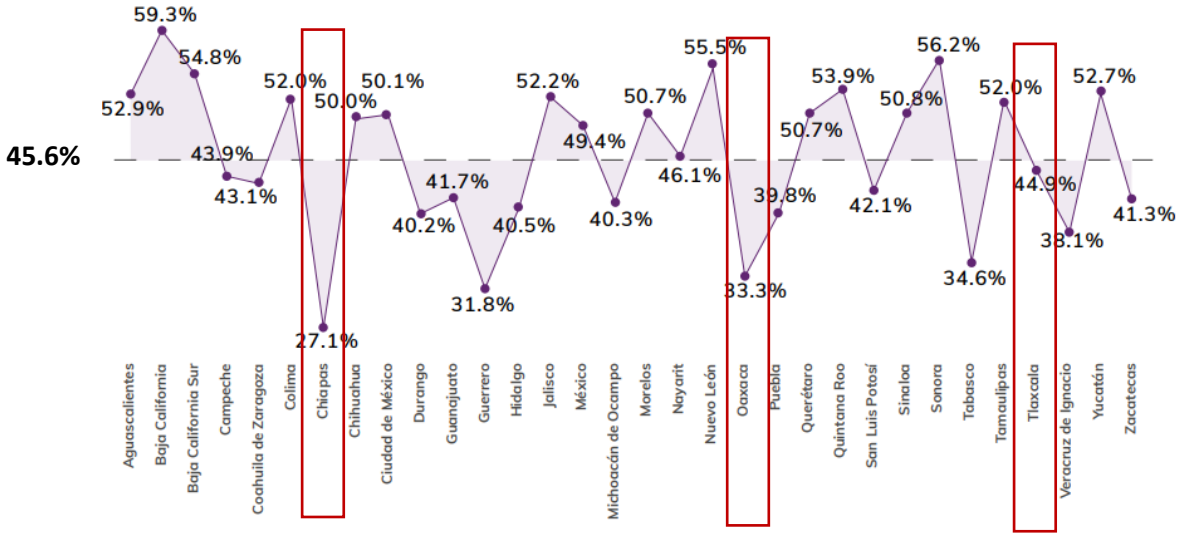


Chart 39. Probability of using online training by State

Source: (IFT, ENDUITIH 201887)

86 Picture taken from http://www.ift.org.mx/sites/default/files/contenidogeneral/estadisticas/usodeinternetenmexico.pdf
87 Picture taken from http://www.ift.org.mx/sites/default/files/contenidogeneral/estadisticas/usodeinternetenmexico.pdf

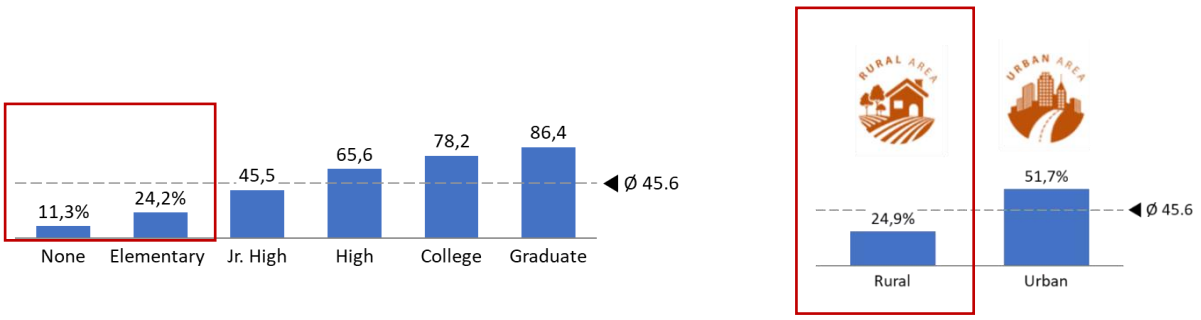


Chart 40. Probability of using online training by educational level and by community type
Source: (IFT, ENDUITIH 201888)

11.2 Bank account penetration

At the end of 2019, the total number of bank branches in the country was 16,883, that is, 1.1% higher than in 2018, with Municipal coverage of 51% and demographic coverage of 92%. Banks accounted for 76% of the branches in the country, whereas Banco Azteca is the institution with the highest number, having 1,874 units89.

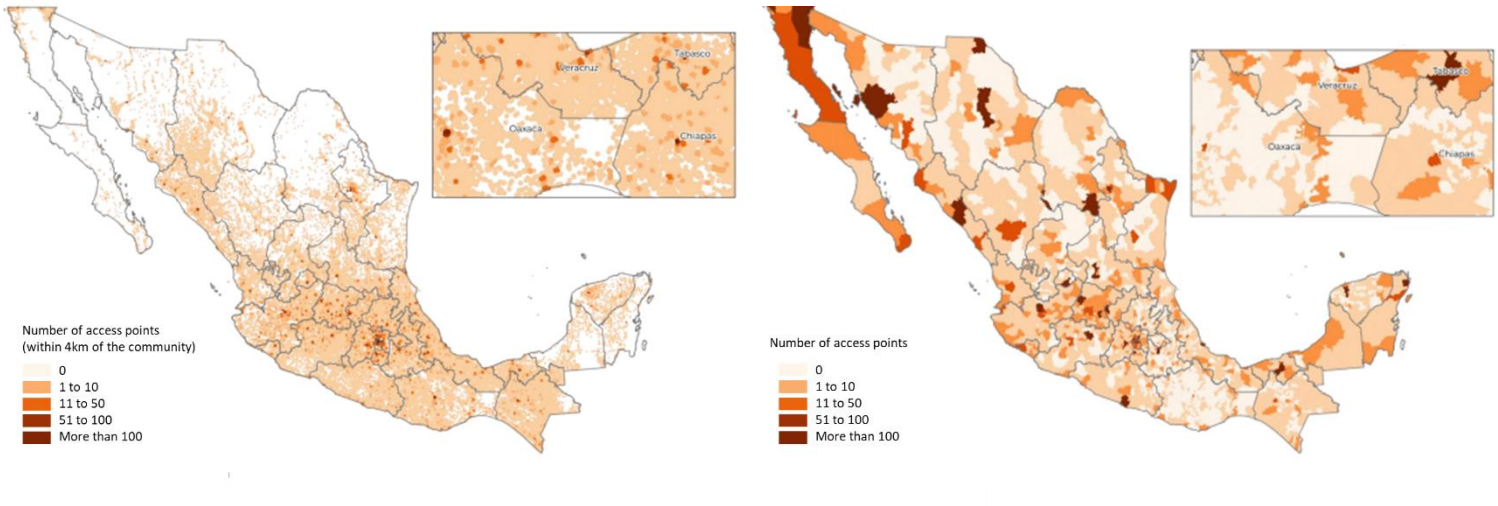
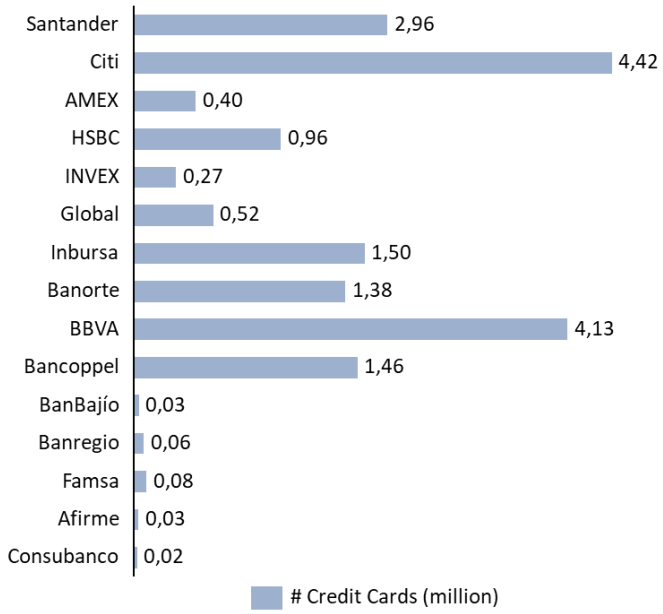


Chart 41. Concentration of georeferenced bank branches (left) and branches per Municipality (right)
Source: CNBV 2019

11.2.1 Main used banks by those with bank accounts

In Mexico there are 20 banks authorized to work with Correspondents: ABC Capital, Afirme, American Express, Azteca, Banamex, BanBajío, BBVA Bancomer, Bancoppel, Bankaool, Banorte, Bansefi, Bansí, Compartamos, Famsa, Forjadores, HSBC, Inbursa, Invex, Santander, Scotiabank. The most used banking correspondents are: Convenience stores, Pharmacies, Department stores, Telecomm and Pemex Service Stations, among many others. The services that each correspondent offers will depend on the agreements it has with each banking institution. The most common are: service payment, withdrawals, deposits, credit payments. 90

88 http://www.ift.org.mx/sites/default/files/contenidogeneral/estadisticas/usodeinternetenmexico.pdf
89 https://www.gob.mx/cms/uploads/attachment/file/581089/Panorama_IF_2020.pdf
90 https://www.gob.mx/cnbv/articulos/corresponsales-bancarios-114482?idiom=es



According to ENIG 202091 (Financial Inclusion Survey) the number of banking branches in the country increased 1% compared to 2018, reaching the figure of 16,883. There was at least one branch in 51% of the country's municipalities, where 92% of the population lives (demographic coverage). Likewise, the percentage of the population living within 4 kilometers of a bank branch was 77%92. About three out of every four branches belonged to some commercial bank, while cooperative savings and loan societies accounted for 13%.

The number of correspondents93 was 48,397, which implied a growth of 8% compared to the previous year, obtaining a municipal coverage of 74% and a demographic coverage of 98%. The percentage of the population living within 4 km of a correspondent was 87%. The average number of financial institutions per correspondent was 8.1.

Chart 42. number of credit cards per bank in Mexico 2018 (millions)
Source: Banxico94

11.2.2 Cooperatives or structures that could serve to facilitate the knowledge transfer and support the farmers in the sign up for the insurance

Although at the beginning we thought we could leverage communication efforts with some savings cooperatives, we will leave this option for a later stage in order to keep the start of the project as simple as possible. We believe nonetheless that they may help the farmers become more financially resilient by using some of their products, but also help increasing the enrollment to our program.

SOCAPS AND SOFIPOS95. These institutions not only offer services such as savings, investment and loans to the common population, but are also located mostly in localities far from urban areas or medium and small towns that are not served by traditional banks. The main cooperative in the region is *Caja Popular Mexicana* savings and loan cooperative focuses on granting consumption and housing loans. It also expanded its operations to financing for micro-entrepreneurs and loans focused on the agricultural sector. Other **SOCAPS** cooperatives include:

Oaxaca
Caja Popular Mexicana, S.C. de A.P. de R.L. de C.V.
Caja Solidaria San Dionisio Ocotepec, S.C. de A.P. de R.L. de C.V.
Cooperativa Acreimex, S.C. de A.P. de R.L. de C.V.
Cooperativa Lachao, S.C. de A.P. de R.L. de C.V
Cooperativa Yolomecatl, S.C. de A.P. de R.L. de C.V.
Esperanza Indígena Zapoteca, S.C. de A.P. de R.L. de C.V.
Finagam, S.C. DE A.P. DE R.L. DE C.V.
Chiapas
Caja La Sagrada Familia, S.C. de A.P. de R.L. de C.V.
Caja Popular San Juan Bosco, S.C. de A.P. de R.L. de C.V.
Cooperativa Acreimex, S.C. de A.P. de R.L. de C.V.
Fesolidaridad, S.C. de A.P. de R.L. de C.V.

91 https://www.gob.mx/cnbv/prensa/64-2020-panorama-anual-de-inclusion-financiera-2020?idiom=es
92 https://www.gob.mx/cnbv/prensa/64-2020-panorama-anual-de-inclusion-financiera-2020?idiom=es
93 A correspondent is a commercial place that performs some banking transactions (i.e., cash disbursement)
94 https://www.banxico.org.mx/publicaciones-y-prensa/rib-tarjetas-de-credito/%7BC58F409E-3116-F8E6-335A-5B4550115020%7D.pdf
95 Cooperative Savings and Loan Societies (SOCAP) or Savings Banks and authorized Popular Financial Societies

Finagam, S.C. DE A.P. DE R.L. DE C.V.

Tabasco

Sistemas de Proyectos Organizados en Comunidad, S.C. de A.P. de R.L. de C.V.

SOFINCO (Community Financial Societies). Promote savings and credit support for the productive development of the rural sector, they can receive donations and government support in favor of people who reside in rural zones.96 According to CONDUSEF, there is currently a SOFINCO authorized and supervised by the CNBV, whose name is SMB rural. SMB rural is a financial institution that provides financial products and services to highly marginalized and highly marginalized communities. It has 43 branches nationwide97.

10 branches in Oaxaca

1. Ayoquezco de Aldama, Sierra Sur. Núm. tel. 526488251021
2. Ejutla de crespo, Sierra Sur. Núm. tel. 9515730853
3. Miahuatlán de Porfirio Díaz, Sierra Sur. Núm. tel. 52648825105
4. San Agustín Loxicha, Sierra Sur. Núm. Tel 9585253170
5. Rio grande, Costa. Núm. 9541120233
6. Santa Catarina Loxicha, Costa. Núm. 526488251051
7. San Baltazar Loxicha, Costa. Núm. 9581151683
8. Cieneguillas, Costa. Núm. 526488251052
9. Santa María Colotepec, Costa. Núm. 9541322594
10. Pochutla, Costa. Núm. 9585840113

6 branches in Chiapas

11. Simojovel, Chiapas. Núm. 9196850795
12. Larráinzar, Chiapas. Núm. 9656566060
13. Chenalho, Chiapas. Núm. 9196737138
14. San Cristóbal de las casas, Chiapas. Núm. 9676315326
15. Tenejapa, Chiapas. Núm. 967101191
16. El parral, Chiapas. Núm. 9656566060

11.2.3 Mobile payment facilities offered by banks as well as other potential candidates like Banco del Bienestar and other MFIs

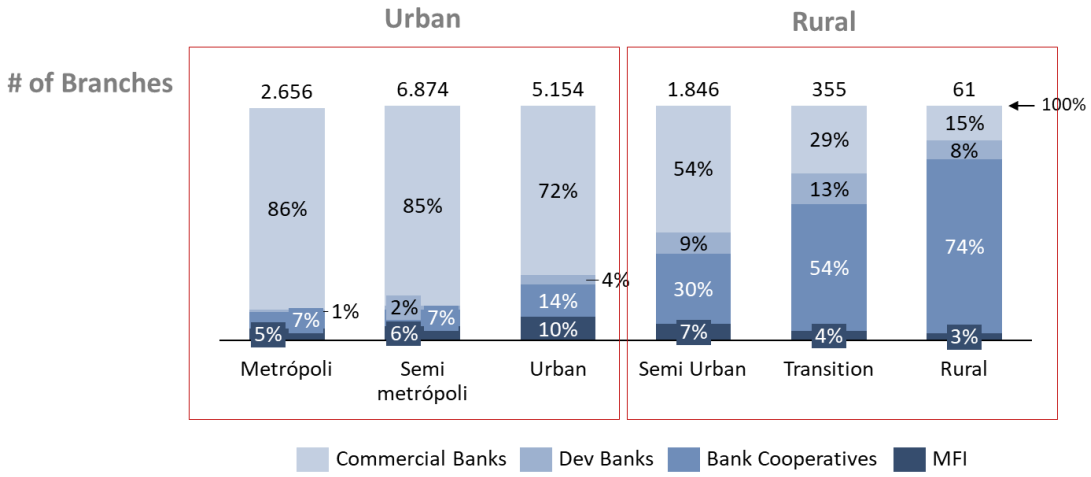


Chart 43. Branch distribution per type of bank and community

Source: CNBV 2019

96 https://www.gob.mx/cnbv/acciones-y-programas/sociedades-financieras-populares-sociedades-financieras-comunitarias

97 http://www.smbrural.mx/

In rural areas, bank cooperatives and microfinance institutions have a larger share of participation, given that they are specialized in the target segment.

11.2.4 Level of penetration of *Banco del Bienestar* in the target sub-regions

The percentage of the population with access to at least one branch within 4 km of their home was 76.5%, which represents 19.3% of the towns with more than 20 inhabitants. At the end of 2018, the number of commercial bank branches for every 10,000 adults was 1.4 for Mexico98.

According to the ENIF 2018, the percentage of the population that used a branch, by age group ordered in descending order, according to the concentration of use, was 47% for those aged 30 to 39 years; 44% for those aged 40 to 49; 43% for those from 50 to 59 years old; 42% for the 18 to 29 year old; and 37% for the 60 to 70 year old99.

The *Banco de Bienestar* (Welfare Bank) National Credit Society, Development Banking Institution, is the main disperser of resources from social programs of the federal government. As a social bank, it promotes and facilitates savings among Mexicans, inside and outside the country, as well as access to first and second-tier financing in an equitable manner for individuals and legal entities, thus promoting financial inclusion, which carried out with a gender perspective and considering indigenous communities.100

Banco del Bienestar is present in the most distant and highly marginalized localities, directly through a wide network of branches, and indirectly through institutional and commercial agreements or alliances with correspondents and private companies, as well as with cooperatives and savings banks that are part of *'L@ Red de la Gente'* (the *Network of the People*).

The Network of the People is a commercial alliance between 163 Popular Savings and Credit companies (Savings Banks, Cooperatives, Popular Financial Societies) and the Banco del Bienestar that aims to offer financial services, with the firm intention of reaching the regions of difficult access in the country. Currently the 163 organizations that participate in *L@ Red de la Gente* (among popular savings and credit societies and Banco del Bienestar) represent a total of 2,416 branches with a presence in 937 municipalities, located throughout the national territory101.

Presence of Banco del Bienestar in Oaxaca, Tabasco and Chiapas:

Oaxaca	Tabasco	Chiapas
Acatlan de Perez Figueroa	Cardenas	Acala
Asucion Nochixtlán	Centla	Chenalho
Ayoquezco de Aldama	Cunduacan	Cintalapa
Ciudad de Huajuapam de Leon	Macuspana	Comitán
Ciudad Ixtepec	Villahermosa Centro	Concordia
Heroica Ciudad Ejutla de Crespo	Villahermosa Urbana	Copainala
Heroica Ciudad de Tlaxiaco		Emiliano Zapata
Huautla de Jimenez		Escuintla
Juchitan de Zaragoza		Huehuetan
Miahuatlan de Porfirio Diaz		Juárez
Oaxaca de Juarez		Marques de Comillas
		Motozintla
		Ocosingo
		Oxchuc

Among the end users of financial services in the sector and segments of the population lacking formal financial services, the Network of the People provide access to comprehensive financial services that strengthen their social and economic well-being, in support of local and regional development.

Given that our goal is to use SADER's already existing infrastructure and personnel for enrollment, the farmers who are part of their existing social programs already have a Banco del Bienestar account. They

98 https://www.gob.mx/cms/uploads/attachment/file/581089/Panorama_IF_2020.pdf
99 https://www.gob.mx/cms/uploads/attachment/file/581089/Panorama_IF_2020.pdf
100 https://www.gob.mx/bancodelbienestar/que-hacemos
101 http://www.bansefi.gob.mx/LaRedGente/Pages/default.aspx

will also be natural candidates for one of them in case they still don´t have it. We analyze here the bank account penetration in case we need to offer an additional alternative for those who ask for it (just if necessary)

Bank accounts and branches become relevant for the program as well, because we need to guarantee that the producers, having received the payout, will have access to a place to withdraw the money and make use of it in the vicinity.

11.2.5 Percentage of the target population that have a bank account

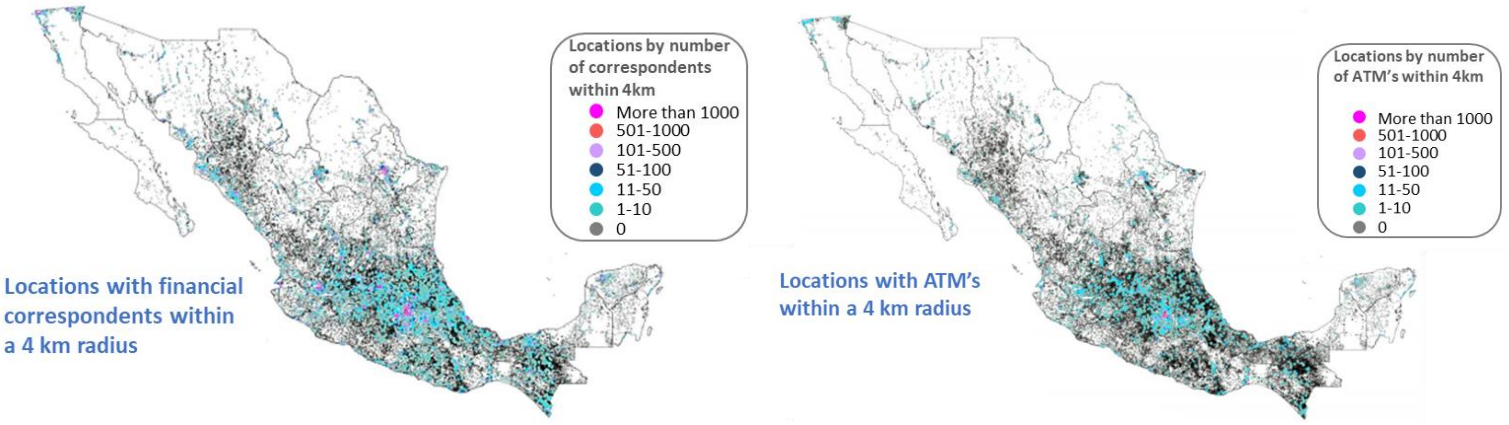
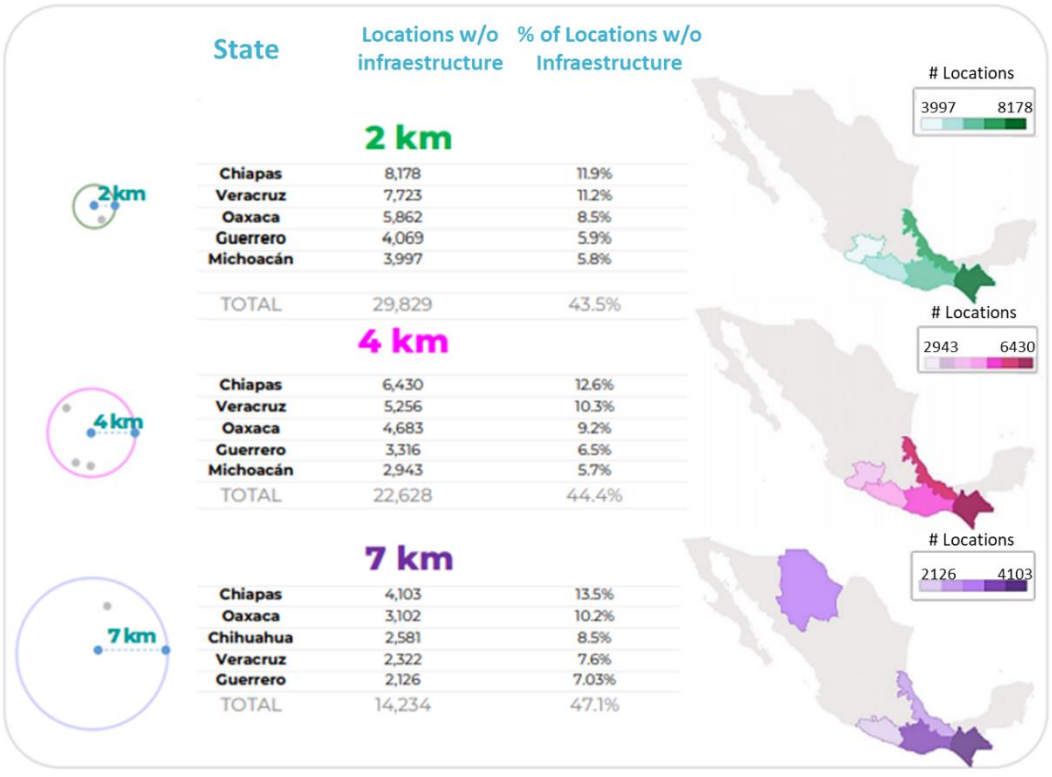


Chart 44. Locations (communities) by concentration of correspondents (left) and by ATM's (right) within a 4km radius

Source: Mexican Government on financial inclusion 102

Our target is to use Banco del Bienestar accounts to pay each farmer directly in case of a claim. During the enrollment process, we will ask farmers if they have a Banco del Bienestar account. We will confirm with



102 https://www.gob.mx/cms/uploads/attachment/file/597762/Mapas_Infraestructura_202006.pdf

Banco del Bienestar the necessary requirements for people who don't already have an account to get it at the enrollment point.

Chart 45. states with highest number of locations (communities) without financial infrastructure[103]
Source: Mexican Government on financial inclusion 104

We reviewed locations with banking infrastructure to know If our beneficiaries must travel long distances to cash out their payout in some communities.

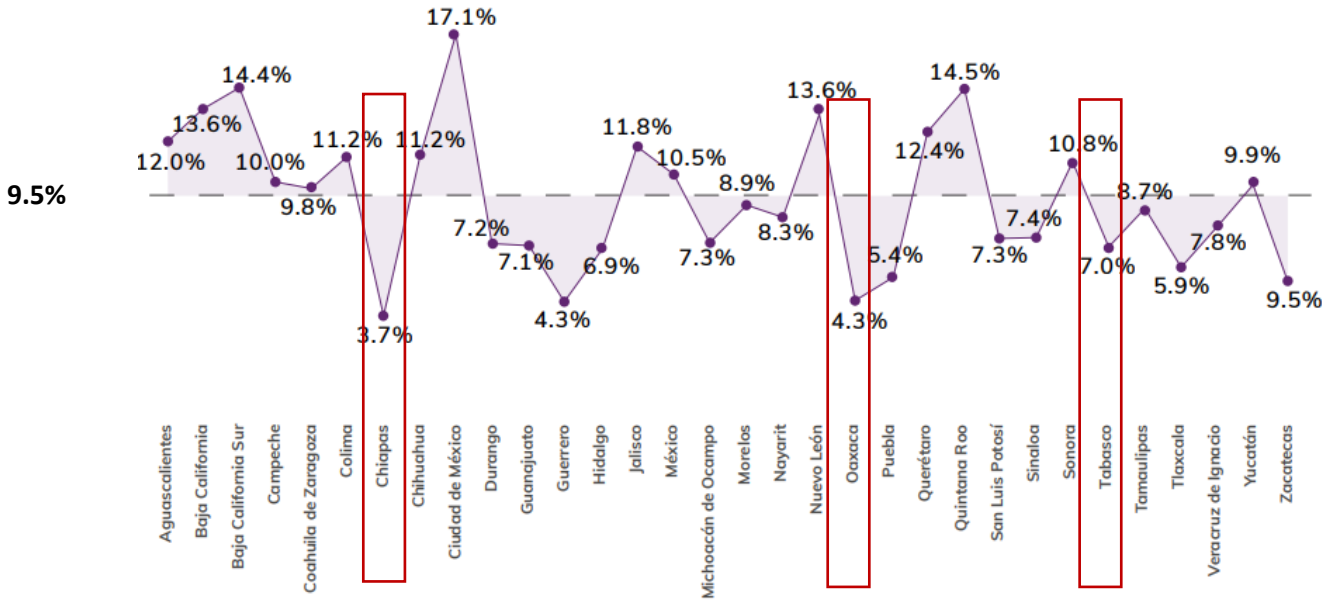


Chart 46. Probability of using online banking by state[105]
Source: (IFT, ENDUITIH 2018106)

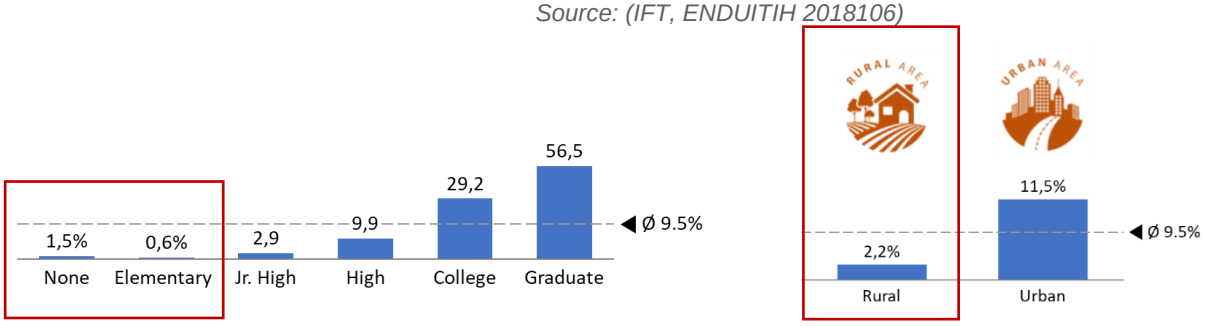


Chart 47. Probability of using online banking by degree of education and Community type
Source: (IFT, ENDUITIH 2018107)

[103] The reading of the graph implies that in Chiapas for example, there are 4,103 communities (13.5%) that have no access to financial services infraestructure in a 7km radius (86.5% do have access)
[104] https://www.gob.mx/cms/uploads/attachment/file/597762/Mapas_Infraestructura_202006.pdf
105 People in Mexico have a 9.5% probability of using internet banking (almost 1/10 of the population). This average is varies given different circumstances (people in Mexico City have the highest probability of using online banking with 17% given the availability of resources to do it). On the other hand, people in Chiapas are less likely to use online banking (3.7% chance) given limited access, diffusion, education, etc.
106 Picture taken from : http://www.ift.org.mx/sites/default/files/contenidogeneral/estadisticas/usodeinternetenmexico.pdf
107 Picture taken from : http://www.ift.org.mx/sites/default/files/contenidogeneral/estadisticas/usodeinternetenmexico.pdf

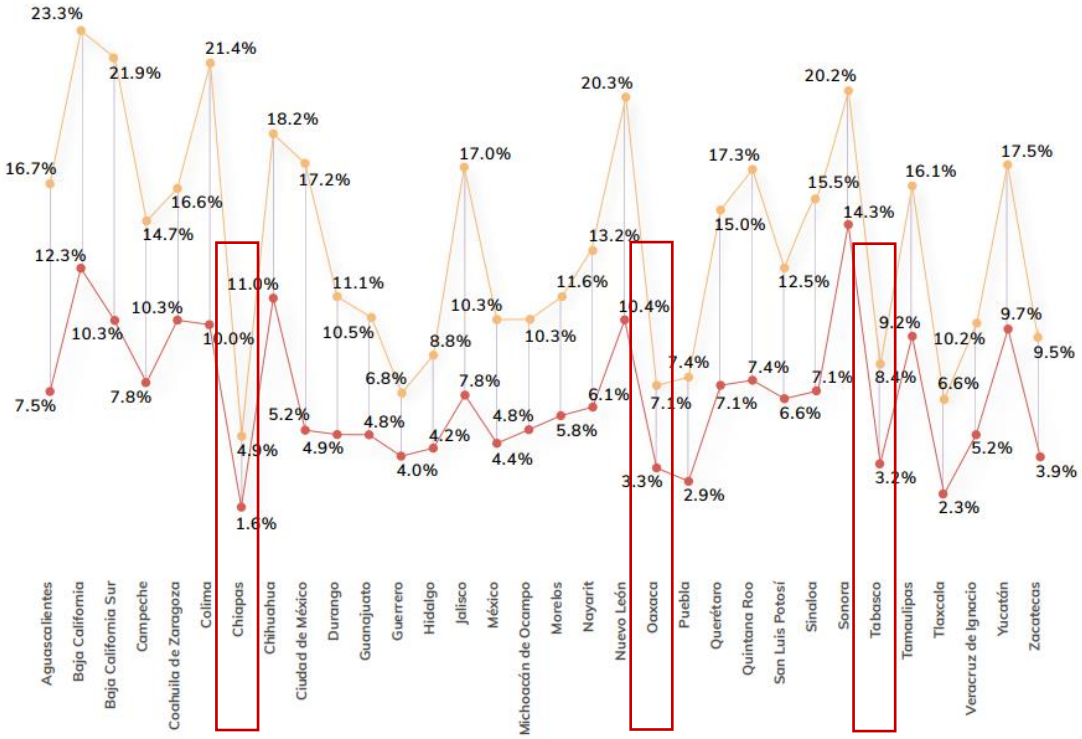


Chart 48. Probability of Purchasing and Selling over the internet by State

Source: (IFT, ENDUITIH 2018108)

We have explored online banking and the probability of doing transactions via internet, due to the low penetration of traditional branches in the southeast region. Given this challenge, we explored different alternatives for the direct payout of insurance to the smallholder farmers, among them: using digital wallets from a bank, pre-approved debit cards, bank reference numbers, or a digital payment from a telephone carrier109. Telcel's ClaroPay is a ready to use digital wallet ready to be tested as an additional alternative during the pilot test (among others) and see if farmers see it as convenient compared to the Banco del Bienestar main alternative.

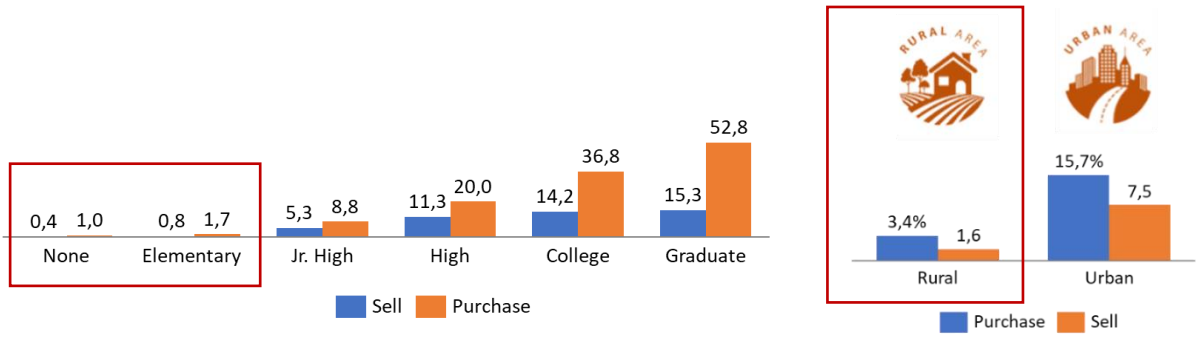


Chart 49. Probability of Purchasing and Selling over the internet by level of education and community type

Source: (IFT, ENDUITIH 2018110)

108 Picture taken from : http://www.ift.org.mx/sites/default/files/contenidogeneral/estadisticas/usodeinternetenmexico.pdf

109 We have discussed the issue with Telcel and they have a digital solution aimed and rural communities called Claropay. The solution works as a digital wallet that receives funds using an APP pre-loaded in their phones, and cashing the resources with affiliated correspondents

110 Picture taken from : http://www.ift.org.mx/sites/default/files/contenidogeneral/estadisticas/usodeinternetenmexico.pdf

Given the low penetration of online banking, we propose using only the traditional debit card approach with Banco del Bienestar for our beneficiaries. In this way we can guarantee during the enrollment that each farmer has an account number to receive funds that can be withdraw in a banking correspondent within a certain radius (30 to 35 minutes travel in public transportation).

Over 70% of the population live in rural communities where less than 50% of them use mobile banking, and only ~3% live in places where 50% or more of the adult population have access to mobile banking.

Given the very low banking penetration in rural communities in the three states studied in detail, we believe that in order to maintain the simplicity of the program we should start only enrolling people using Banco del Bienestar accounts.

Oaxaca

SEL	Lower than 15%		15%-30%		30%-50%		Over 50%	
	# Mun	# People	# Mun	# People	# Mun	# People	# Mun	# People
C	77	341,941	11	99,466				
C-			2	29,668				
C+	164	608,732	40	466,959	2	15,171	1	4,404
D	150	729,999	10	192,781	4	95,020		
D+			1	35,171				
E	89	440,815	3	18,676				
Total	480	2,121,487	67	842,721	6	110,191	1	4,404
%	85%	52%	12%	21%	1%	3%	0%	0%

Chiapas

SEL	Lower 25%		25%-50%		50%-75%		Over 75%	
	# Mun	# People	# Mun	# People	# Mun	# People	# Mun	# People
E	37	48,467	5	21,258	2	23,051	-	-
D	31	43,626	22	125,636	13	156,257	-	-
D+	-	-	4	7,922	4	111,337	-	-
C-	-	-	-	-	-	-	-	-
C	-	-	1	4,918	1	60,157	2	158,828
C+	-	-	-	-	-	-	-	-
A/B	-	-	-	-	-	-	1	324,295
Total	68	92,093	32	159,734	20	350,802	3	483,123
	55%	8%	26%	15%	16%	32%	2%	44%

Tabasco

SEL	Lower than 25%		25%-50%		50%-75%		Over 75%	
	# Mun	# Households	# Mun	# Households	# Mun	# Households	# Mun	# Households
E	3	13,891	-	-	-	-	-	-
D	11	80,106	1	108,022	-	-	-	-
D+	2	6,468	-	-	-	-	-	-
C-	-	-	-	-	-	-	-	-
C			-	-	-	-	-	-
C+	-	-	-	-	-	-	-	-
A/B					-	-	-	-
Total	16	120,465	1	108,022	0	0	0	0
	94%	53%	6%	47%	0%	0%	0%	0%

Table 22. Traditional banking account penetration per SEL's (# municipalities and adult population)
Source: Financial Inclusion Report and own analysis111

Providing people with *Banco del Bienestar* accounts will allow them to cash their payouts in any banking correspondent.

111 https://www.gob.mx/cms/uploads/attachment/file/481172/PanoramaIF_2019.pdf

12 APPENDIX 2: Context

In this section we present general information about the country, its population divided by SEL and type of communities, climate, exposure the extreme weather events, and a brief introduction to agriculture

12.1 General information

Mexico is a federal republic comprising 32 federal entities: 31 states and Mexico City. The entities are divided into 2,457 free municipalities. The country has the twelfth largest Gross Domestic Product (GDP) worldwide in 2017 with purchasing power parity of $2,344,197 international dollars and is ranked 80th in terms of per capita GDP112. The country generates around 1.4% of the world's energy and is the fifteenth largest energy producer in the world. Furthermore, it occupies the thirteenth place in oil exports with 2.8% of the world's production113.

12.2 Population

While rural population now represents less than a quarter of total Mexico population (approximately 28.8 million out of 126 million), two-thirds of the country's poor households are living in rural localities114. This stresses the importance of weather risk reduction for poverty reduction efforts in Mexico115.

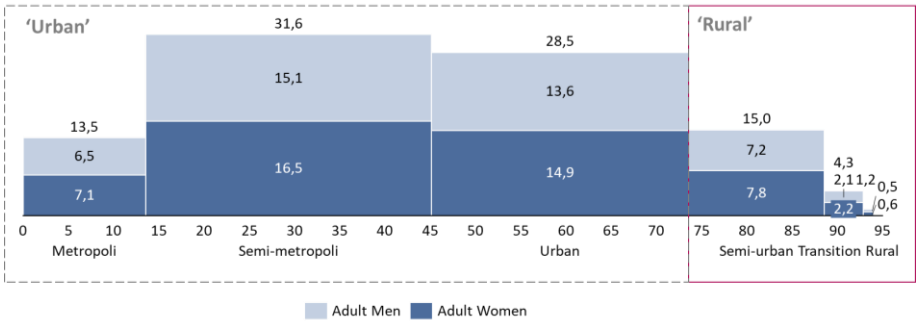


Chart 50 : Adult population in Mexico according to settlement type (%)

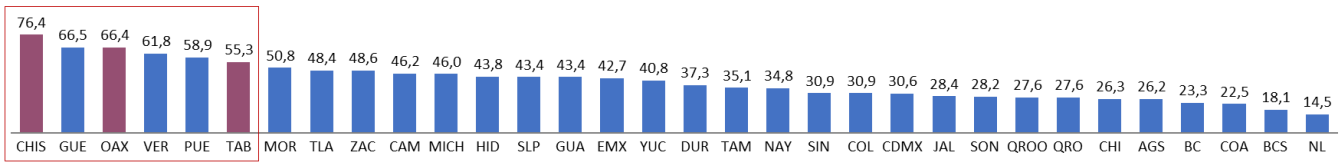


Chart 51. Mexico poverty rate by State116

Chart X above shows that Chiapas, Oaxaca and Tabasco are at the top of the States with largest proportion of people living in poverty, and they are also in one of the regions with highest exposure to excess rain.

112 https://www.worldometers.info/gdp/gdp-by-country/
113 Sixth National Communication and Second Biennial Report of Update for the Convention United Nations framework on Climate Change, MEXICO. 2018
114 http://www.ift.org.mx/sites/default/files/contenidogeneral/estadisticas/usodeinternetenmexico.pdf
115 Weather index insurance and shock coping: Evidence from Mexico's CADENA program Alain de Janvry, Elizabeth Ramirez Ritchie, Elisabeth Sadoulet May 7, 2016
116 https://www.statista.com/statistics/1036147/poverty-rate-mexico-state/

12.3 Rural and Urban population in Mexico

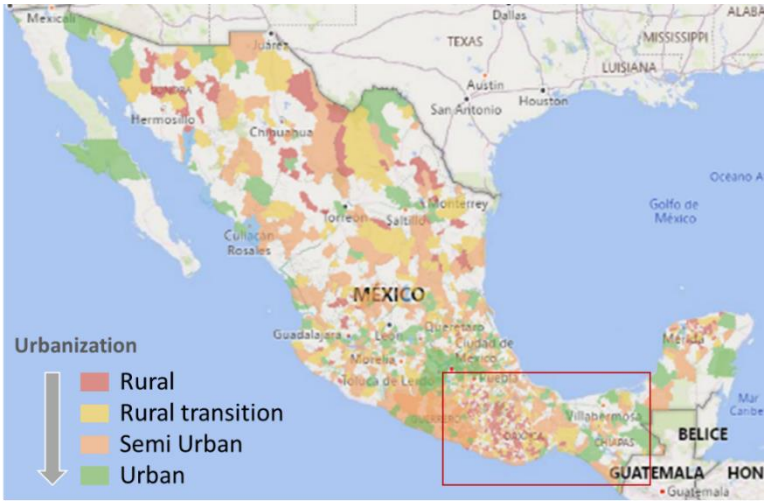


Chart 52. Distribution of Rural and Urban municipalities
Source: IDF Group database of the project

12.4 Geography and climate

Mexico is part of North America117, its southern region is in the intertropical zone and the northern region in the temperate zone. Mexico is located at the same latitude as the Sahara Desert.118 The northwest and center (two thirds of total surface area) is considered arid or semi-arid, with annual rainfall below 500 millimeters (mm). In contrast, the southeast is humid with average rainfall that exceeds 1,000 mm per year119. The north-central zone is predominantly dry, with extreme temperatures and little rain.

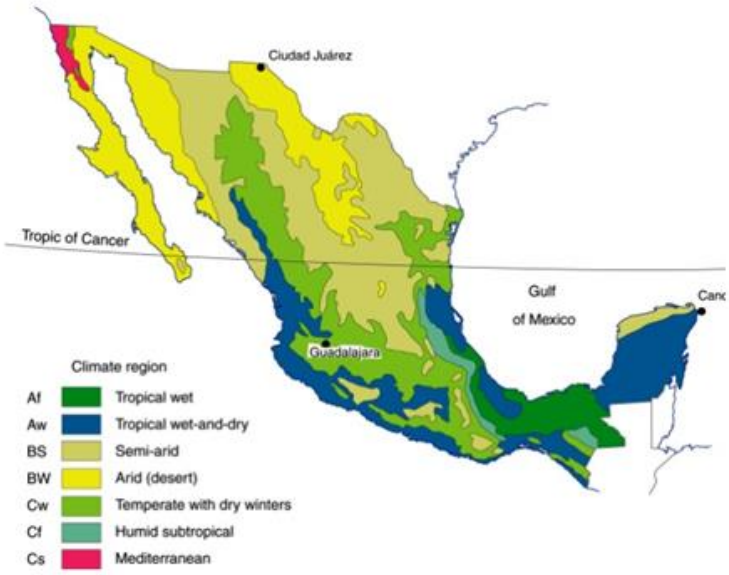


Chart 53. Major climate regions in Mexico.
Source: Geo-Mexico120.

117 INEGI, 2017
118 Statistics of water in Mexico. Edition 2017. Mexico: National Water Commission.
119 INEGI 2016
120 https://geo-mexico.com/?p=9512

The annual precipitation varies between 300 and 600 mm (100-300 mm in regions with a very dry climate) and the average temperature is between 18 and 22 degrees Celsius (° C). The mild climate is concentrated around of the Eastern and Western Cordilleras with average temperatures between 10 and 22 ° C and precipitation average between 600 and 4,000 mm per year. In the warm areas, which are concentrated in the south and southeast of Mexico, average temperatures range from 22 to 26 ° C with an average annual precipitation between 1,000- and 4,000-mm. Rain is observed as a distribution bimodal with a maximum in June and a relative minimum in July and August.

12.5 Extreme Weather

The location of the country in an intertropical region makes it subject to hurricanes from both the Pacific Ocean and the Atlantic. The effects of these phenomena, in terms of swells and winds, are mainly felt in coastal areas from the Pacific, the Gulf and the Caribbean. Rainfall intensifies these phenomena and can cause floods and landslides not only on the coasts but also in the interior of the territory. Of the 25 cyclones that on average arrive every year to the seas near the country, four or five tend to make landfall and cause severe damage. There are also heavy rains during the rainy season, with consequent floods and major landslides, unrelated to the cyclonic activity121.

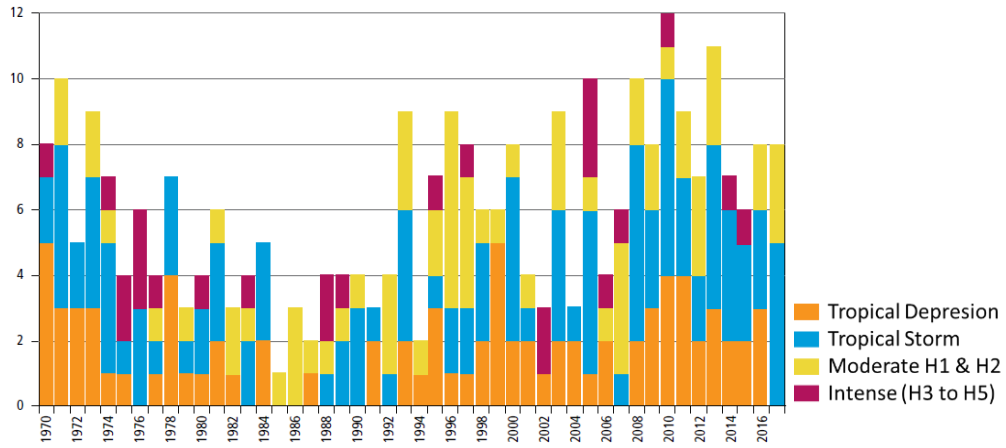


Chart 54. Tropical Cyclones in Mexico 1970- 2017.
Source: Statistics of water in Mexico. Edition 2017. Mexico: National Water Commission.

12.5.1 Excess Rainfall

The effects of convectional rain are enhanced by the presence at that time of year over southern Mexico of the **Intertropical Convergence Zone**, a broad belt of generally rising air which migrates seasonally either side of the equator. Orographic precipitation sets virtually all the rainfall and snowfall records, even more than hurricanes. Tenango, Oaxaca is the rainiest place in Mexico; it receives about 5000 mm (16.4 ft) of rain each year. The orientation of mountain ranges is therefore critical to understanding precipitation patterns. The cyclonic or frontal precipitation that also affects Mexico is the form of precipitation brought by the mid-latitude storms known as *nortes*, and the tropical storms that sometimes evolve into hurricanes. *Nortes* occur when the polar air behind a cold front displaces the warmer surface air, forcing it to rise as the cool air pushes its way underneath. At the surface, a sudden drop in temperature and the advent of cold winds marks the passage of the front.122

121 CENAPRED. Hazard Diagnosis and Risk Identification of Disasters in Mexico. 2014
122 https://geo-mexico.com/?p=9508

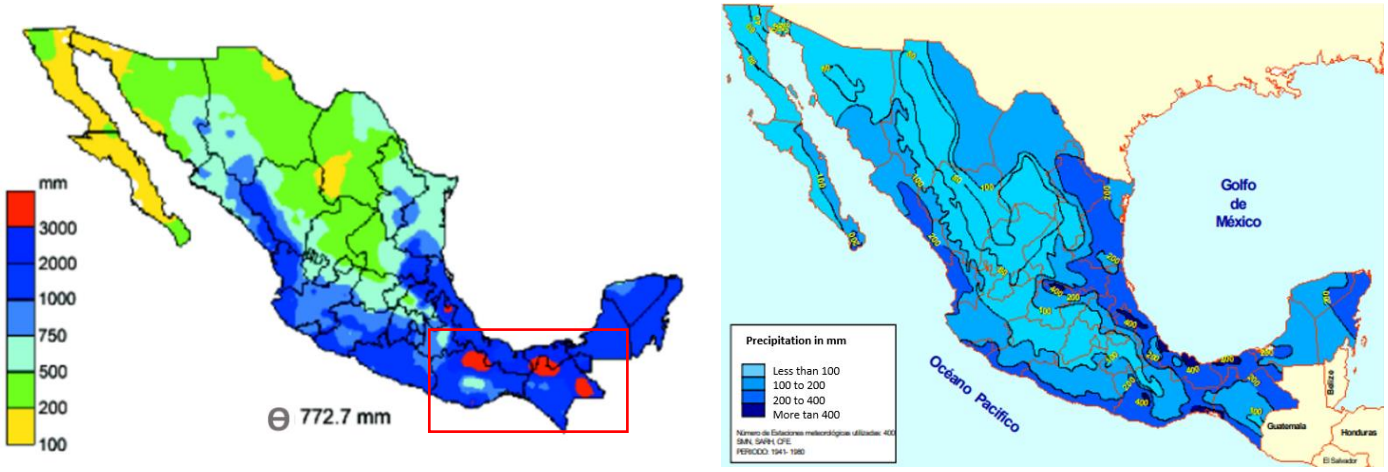
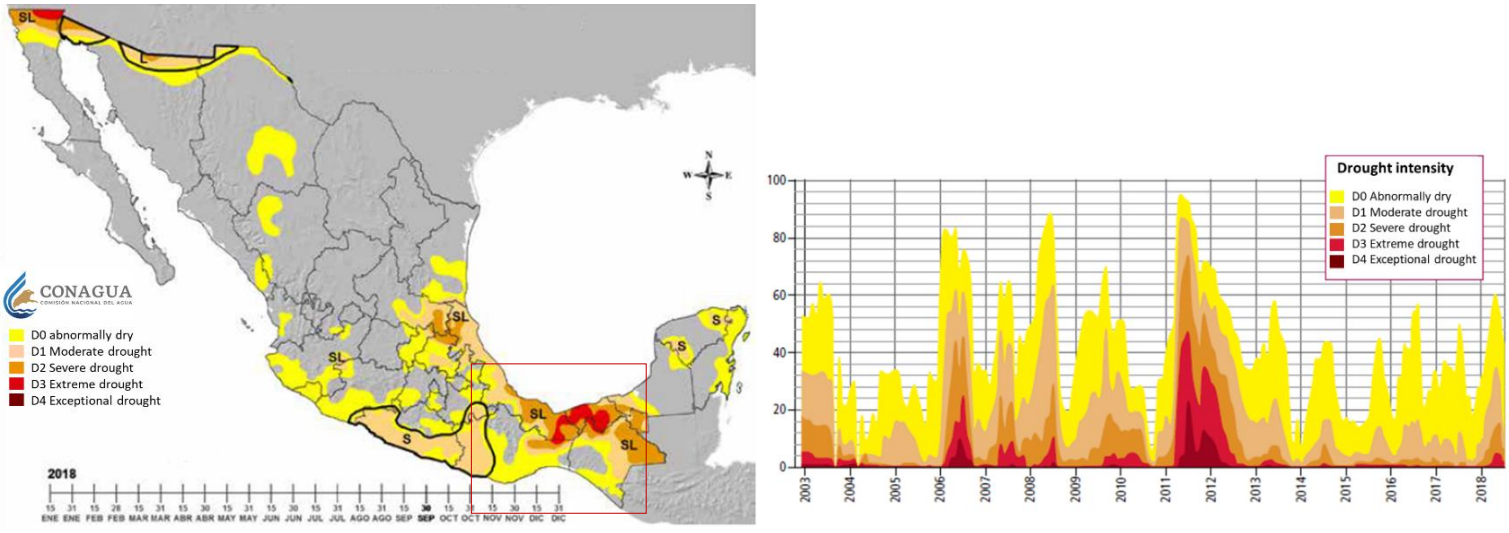


Chart 55. Average annual rainfall (left) and maximum 24hr precipitation (right) in Mexico per region.
Source: CENAPRED123.

12.5.2 Drought

Droughts can occur at any time and place; however, there are specific areas in Mexico of greater susceptibility to the phenomenon, determined basically because of its geographical location. Normally the north and the *Bajío124* region (see frame in the figure below) have higher incidence of this phenomenon causing serious hydrological imbalances, which harm agricultural production systems. Normally, (given their relatively high frequency compared to earthquakes that are more severe but less frequent) droughts are the costliest natural disasters, affecting more people than any other form of natural disaster. For example, in 2018, 84.4% of the total damages and losses were due to Hydrometeorological phenomena, 9.9% due to geological phenomena, 4.6% due to chemical ones, and 1.1% were socio-organizational.125



123 http://www.cenapred.gob.mx/es/Publicaciones/archivos/36-DIAGNSTICODEPELIGROSEIDENTIFICACINDERIESGOSDEDESASTRESENMXICO.PDF

124 The Bajío is a geographical, historical, economic and cultural region of the Central-North-West of Mexico, mostly north of the Lerma River. This region includes part of the States of Aguascalientes, Jalisco, Michoacán, Guanajuato, Querétaro, San Luis Potosí and Zacatecas

125 CENAPRED 2018 Socioeconomic impact of disasters report (link)

Chart 56. Drought affected areas Sep 2018, b) % Area of the country affected by one or more drought categories.126

12.6 Agriculture

Mexico is the twelfth largest food producer in the world. About 22% of the population —28.8 million people — live in rural areas and 145 million ha are dedicated to activities agricultural (FAO, 2018). Between 2012 and 2016 the agriculture sector contributed 3.1% of GDP and employed approximately 13% of the economically active population (INEGI, 2018).

In 2019 the agricultural area of the production units was 27.4 million Ha, up 3.6% from 2009. The area sown that year was 20.6 million ha and the harvested of 19.4 million ha. The agricultural surface distribution was 79% rainfed and 21% irrigation (INEGI, 2017). Between 2012 and 2016, agriculture represented 61.4% of the primary activities127 GDP, with a growth of 17.2% during the same period (INEGI, 2018).

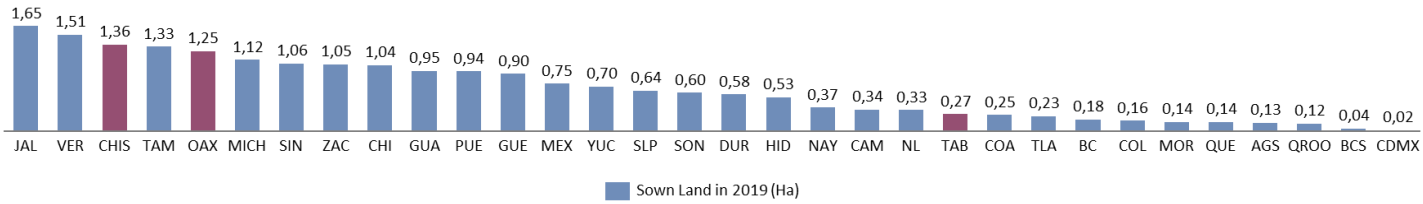


Chart 57. Total sown land in 2019 per State (Million Ha).
Source: SIAP Database

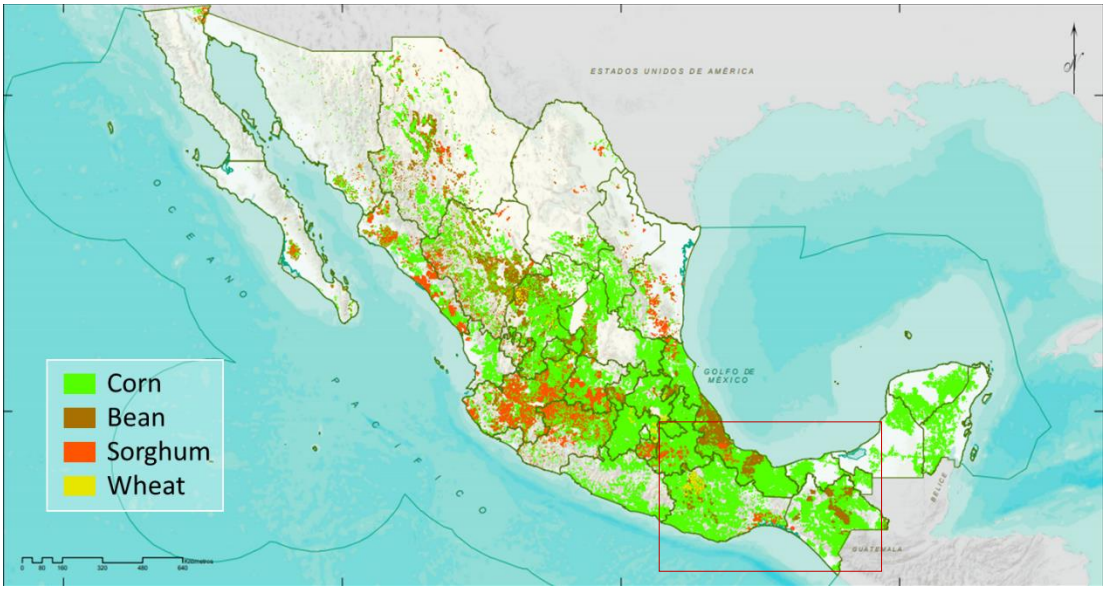


Chart 58. Main staple crops Sown land in 2019
Source: Ministry of Agriculture (SADER)128

Chiapas, Oaxaca and Tabasco in the southeastern region of the country accounted for 2,879,558 Ha of sown land in 2019, or 14% of all the sown land in the country129.

FIN

126 Sixth National Communication and Second Biennial Report of Update for the Convention United Nations framework on Climate Change, MEXICO. 2018
127 Primary activities GDP includes: forestry, hunting, and fishing, as well as the cultivation of crops and livestock production.
128 https://www.gob.mx/cms/uploads/attachment/file/435882/Mapa_con_la_estimaci_n_de_superficie_sembrada_de_cultivos_b_sicos_2019.pdf
129 SIAP Database