Yucatan Basin Agriculture Project

Yucatan Basin, Mexico

Background

Yucatan Basin

The Yucatan Basin is located within the state of Yucatan, located in the entire central and northern part of it, and it occupies an extension that represents 89.57% of the state surface; It is bordered to the north by the Gulf of Mexico, to the east by basin A (RH32) and Quintana Roo, to the south by basin B of the (RH33) and to the west by the state of Campeche and the Gulf of Mexico. The only bodies of surface water are the lagoons that are next to the coastline, such as La Rosada and Flamingos; the Celestun, Yucalpeten, and Rio Lagartos estuaries and some cenotes distributed throughout the basin (INEGI. Estudio hidrológico del Estado de Yucatán. 2002)

Figure 1. Yucatan basin (FAO, 2023)

The soil in most of the Yucatan Peninsula has a high infiltration capacity, which means that the whole area acts as a recharge zone for water. As a result, the peninsula is considered a significant water reserve, primarily from underground sources. The natural recharge value is calculated to be 21,813 hm3/year, with an available amount of 2,386.82 hm3/year (CONAGUA; 2020). In 2017, a total of 4,792 hm3 of water was consumed, with 13% going towards public supply, 72% towards the industrial sector, and 14% towards agriculture and cattle raising (CONAGUA; 2017).

The Yucatan Peninsula shows economic and population growth during the last decade (INEGI, 2020). This growth has not been accompanied by improvements in wastewater systems, because a large part of domestic wastewater is discharged into the aquifer without any type of prior treatment. Various studies show that irrigation systems present losses of around 40 to 50% (Tun Dzul et al., 2011). This exposes the need to improve cultivation techniques in order to reduce the demand for water.

Scaling up precision irrigation using Internet of Things (IoT) technology in the Yucatan basin of Mexico, could help improve agricultural productivity while helping close the water supply deficit in the basin. Project partners at Kilimo are preparing to deploy IoT irrigation technology with farmers in the Yucatan basin, and there is widespread interest from farmers to scale up technology to conserve water with irrigated agriculture, particularly for water-extensive crops like pastures, grasslands, corn, soybeans and sugar cane and some water-intensive crops like orange, lemon and tangerine (Kilimo, 2022).

Project Description

The goal of this project is to increase agricultural water use efficiency and productivity, to reduce water demand, and protect mainly groundwater in the Yucatan Basin of Mexico.

A farmers retention plan centered on adopting and renewing irrigation management practices has been devised throughout the project's implementation, scheduled to conclude in 2026. As part of this program, farmers are encouraged to participate in ongoing training sessions and receive economic incentives for reducing their water consumption. Each year, a record of active farmers who utilize our service will be maintained.

The project will support expanded applications of IoT satellite moisture and irrigation management systems on 360 ha of private irrigated family farms to decrease water pumping/diversion. The Kilimo project team uses a Big Data solution that includes a web-based app, annual subscription fee, satellite data, crop soil moisture tests, and measurement of precipitation and irrigation inputs to provide real time irrigation demand information. The technology does not require any hardware to be installed at the farm level and supports tailored irrigation scheduling for a variety of high value crops.

The following selection criteria were used to identify farmers who were best suited to participate in the program to meet specific use requirements for Kilimo’s irrigation monitoring platform and support comparison of water use rates before and after deployment:

- Fields must be located in the Yucatan basin (Figure 1).
- The farmer must possess irrigation records.
- The farmer must be available to meet with Kilimo's agronomy team.
- The farm must have a dependable source of water available for irrigation.

Following the steps outlined in Figure 2, Kilimo will deploy the IoT irrigation management system on 360 total ha over three irrigation seasons starting in March 2024.

It has been shown that less than 10% of farmers worldwide use (or have access to) technology to guide water application. Using Kilimo's technology, farmers have reduced their water withdrawal from the surface and groundwater sources by at least 13%. Additionally, less water withdrawal represents less pumping costs and energy for farmers and, therefore, a reduction in carbon emissions from electric power use.

Figure 2. Diagram of project steps (Kilimo, 2022b).

Project Timeline (Preliminary)

- July 2023: The project is confirmed by the corporation.
- August 2023 - February 2024: Kilimo signs contracts with the farmers that will be involved in the project.
- March 2024 - December 2024: The Kilimo IoT irrigation management system would be deployed starting at the beginning of the winter 2024 crop season.
- The year of initial volumetric benefit claim is expected to be 2024.

- Monitoring and Maintenance: Kilimo will verify the deployment of the IoT irrigation management system on the farms in the Yucatan basin. They will monitor the water savings based on the baseline water usage from the previous three crop seasons (2020-2023), effective rainfall, and water usage after project implementation. Confirmed water savings for the previous crop season will be available in December of the following year.

- 2026: Project completion.

Cost of the project

- Total Project Cost: $110,000 USD to implement IoT irrigation technology on 360 ha for 3 irrigation seasons .

KPIs summary and Payment Schedule

Project duration: 2023-2026

Mexico

Minor Basin	Yucatan
Water replenished (m3) in 2025	108.000
Project cost (USD)	$110.000

	Year	2023	2024	2025	2026	Total
Estimated hectares acquired	has	60	120	180		360
Potencial savings x has	m3		300	300	300	
Total potencial savings	**m3**		**18.000**	**36.000**	**54.000**	**108.000**
Cost of m3 replenish	USD/m3		0,99	1,01	1,03	
Cost of project	**USD**		**$17.820**	**$36.360**	**$55.836**	**$110.016**
Estimating date of water savings delivery			dic-2024	dic-2025	dic-2026	

Payment Schedule	**%**	**USD**
At the time of contract signing	30%	33,000
dic-23	20%	22,000
dic-24	20%	22,000
dic-25	15%	16,500
dic-26	15%	16,500

Notes:

(a)The proposal was designed based on the information gathered. This may need to be modified based on additional customer needs.

(b) The proposal considers july-2023 as the maximum contract closing date. After that date, terms need to be renegotiated as acquiring hectares takes time.

(c) Prices don't include VAT.

(d) The number of hectares is a reference based on our historic savings per has.

(e) There is a potential for inflation to impact the project budget. If costs were to increase, the total project budget for the work described in this pre-project Benefit Summary would increase and could affect final volume accounting. Furthermore, if the project were to extend beyond the dates of the initial contract (e.g., to cover subscription fee costs beyond the initial three-year period), the cost would increase.

Restore Volumetric Benefit Calculation

Method

The volumetric water benefit is calculated based on the reduced withdrawal by individual farmers in the Yucatan basin due to the elimination of over-irrigation and associated losses as a result of improved irrigation regimes. This volume of water can be made available for other water uses, which will contribute to basin water resilience.

Data & Assumptions

Input data and assumptions supporting the volumetric benefit calculation, which are listed below, were provided by BEF in partnership with Kilimo and obtained through literature.

- Projects are expected to conserve 300 cubic meters of water per hectare per crop season with Kilimo IoT irrigation management system, based on analysis of pilot projects.
- 360 ha will be outfitted with Kilimo IoT irrigation management systems. These systems will operate three crop seasons, starting in March 2024.
- Data from the three crop previous seasons, will be used to calculate baseline rainfall and irrigation rates. Post project rainfall and irrigation data will be compared to the baseline rates to quantify changes in water consumption that take place as a result of the project.
- In the event that a farmer is not able to provide all the information needed to calculate the water savings, Kilimo will use standard regional crop, precipitation, and weather data to perform annual calculations.

Calculation

Kilimo will determine a baseline and post-project monitoring data to calculate the total volumetric water benefit of the project. The expected total volumetric water benefit from the project is shown below.

Use of Kilimo's IoT irrigation management system on 360 ha of farmland each crop season.

Area of precision agriculture improvements = 360 ha

Water savings for farmland with Kilimo IoT irrigation management system = 300 m^3/ha/crop season

Reduced withdrawal = Water savings = 360 ha * 300 m^3/ha/crop season=108,000 m^3

Volumetric Benefit (Preliminary)

The irrigation season in the Yucatan basin occurs over three calendar years. Therefore, the volumetric benefits in the project start year (2023) and project end year (2026) will be proportional for the portion of the irrigation season falling within that calendar year (Table 1).

Table 1. Projected annual volumetric water benefits.

Year	Farm Area with Kilimo System (Area and number months)	Annual Water Volume Conserved
		cubic meters
2024	60 ha	18,000
2025	120 ha	36,000
2026	180 ha	54,000

Notes

- This is a pre-project evaluation of estimated volumetric benefits and is based on information available at this time.
- The potential impact of inflation on project costs is included in this summary, but it is an estimate.

References

- http://asam.centrogeo.org.mx/index.php/resultado-5?showall=1&limitstart
- https://files.conagua.gob.mx/conagua/generico/PNH/PHR_2021-2024_RHA_XII_Pen%C3%ADnsula_de_Yucat%C3%A1n.pdf
- https://www.inegi.org.mx/contenidos/productos/prod_serv/contenidos/espanol/bvinegi/productos/historicos/2104/702825224165/702825224165.pdf
- https://remexcu.org/index.php/blog/26-travesiaenelagua/276-a-donde-va-el-agua-en-la-peninsula-de-yucatan-la-gran-reserva-de-agua-en-mexico