Background

The headwaters of the Lerma River in west-central Mexico are in the Mexican Plateau just southeast of Toluca, where the river originates from the spring-fed Lerma lagoons (CONAGUA, 2012). The Lerma River is Mexico's second longest river, flowing over 700 kilometers through five states to its termination in Lake Chapala (Figure 1). Approximately 60% of Guadalajara's water comes from Lake Chapala. The Lerma basin covers 2.9% of Mexico's landmass, but is home to more than 10 million people, which is roughly 10% of the country's total population (Burton, 2014; Godinez-Madrigal et al., 2019). Agriculture has been an important factor in the development of the basin. The area covered by agricultural land in the Lerma basin has grown by more than 500% over the last 50 years, and now approximately 830,000 hectares of agricultural land account for 15% of all irrigated area in Mexico (DOF, 2006).

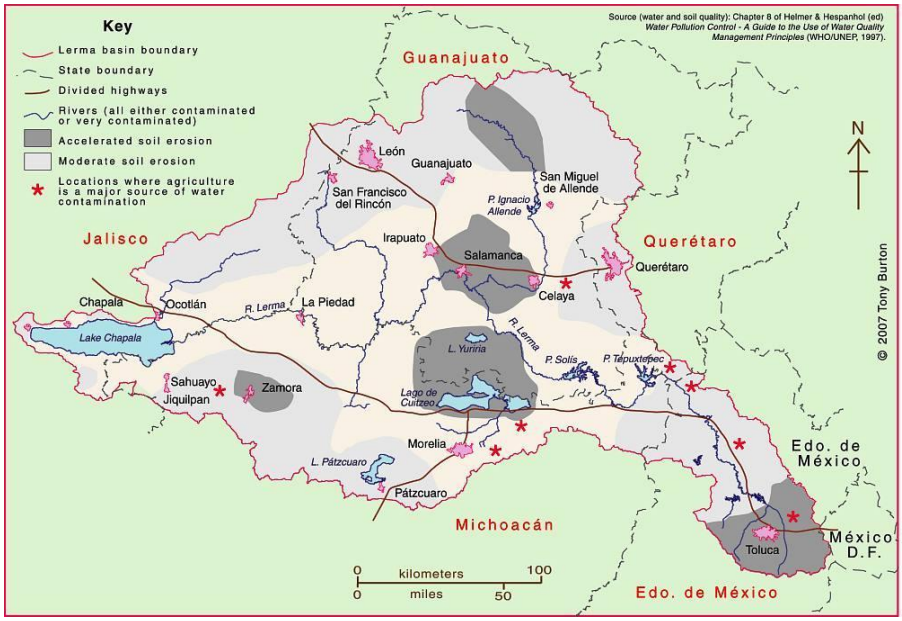

Figure 1. Lerma basin (Burton, 2014)

Water scarcity is a major concern in the Lerma basin. Demand for water out-grew the replenishment capacity of the river basin in the 1980s, and the basin now experiences an aggregated deficit between supply and demand of 1.6-1.8 billion cubic meters per year (The World Bank, 2006). This issue is exacerbated by inefficient water use, particularly in the agricultural sector. The water deficit is often made up by over-pumping groundwater or over-exploiting lakes, which is unsustainable in the long run.

Scaling up precision irrigation using Internet of Things (IoT) technology in the Lerma basin of Mexico could help close the water supply deficit in the basin while improving agricultural productivity. Project partners at Kilimo are preparing to deploy IoT irrigation technology with farmers in the Lerma basin, and there is widespread interest from farmers to scale up technology to conserve water with irrigated agriculture, particularly for water-intensive crops like avocado, asparagus, vegetables, berries, and citrus fruit (Kilimo, 2022a).

Project Description (Proposed)

The objective of this project is to increase agricultural water use efficiency and productivity, to reduce water demand, and protect groundwater and surface water resources in the Lerma Basin of Mexico.

The project will support the use of artificial intelligence and site-specific data to improve irrigation management on 178 ha of private irrigated family farms, to decrease groundwater pumping and diversion of surface water. The Kilimo project team uses a “Big Data” solution that includes a web-based application, annual subscription fees, 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 Lerma basin
- The farmer must possess irrigation records from 2019-2021
- 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 irrigation management system on 4-6 farms covering 178 total hectares for a period of three irrigation seasons (mid-October to early May) starting in Fall 2022. Three-year contracts are in process and will be signed with farmers for all 178 hectares of farmland on which the technology will be implemented once funding is secured. Kilimo is targeting crops with high water usage in the basin, including avocado, asparagus, other vegetables, berries, and citrus fruits (Kilimo, 2022a).

It’s been shown that less than 10% of farmers worldwide use (or have access to) technology to guide water application. With the technology solution provided by Kilimo in the past, farms have realized at least a 13% reduction in water withdrawal from surface and/or ground water sources. In addition, the reduced water withdrawal correlates with decreased pumping costs for farmers with associated carbon reductions from electric power use.

Figure 1. Diagram of project steps (Kilimo, 2022b).

Project Partners

- Kilimo is an agricultural technology start-up, active in 6 countries with over 60,000 hectares of land under service, with a mission to simplify water management on large-scale farming, improving the producer´s bottom line and reducing environmental impact. Kilimo will lead project implementation.
    - Agronomy Team: In charge of giving the Kilimo service to the farmer and helping them adopt the tool and take advantage of it.
    - Management Team: In charge of collecting all the information needed to achieve the impact goals and reporting them to Intel.
- Local agricultural stakeholders (i.e. farmers).

Project Timeline (Preliminary)

- June 2022: This project can go under contract as soon as June 2022
- October 2022: the Kilimo artificial intelligence (AI) irrigation management system would be deployed starting at the beginning of the 2022 crop season
- 2025: Project completion
- The year of initial volumetric benefit claim is expected to be 2022
- Monitoring and Maintenance: Kilimo will verify the deployment of the IoT irrigation management system on the farms in the Lerma basin. They will monitor the water savings based on the baseline water usage from the previous three crop seasons (2019-2021), effective rainfall, and water usage after project

implementation. Confirmed water savings for the previous crop season will be available in June of the following year.

Intel Cost Share: TBD%

- Total Project Cost: $110,000 to implement IoT irrigation technology on 178 ha for 3 irrigation seasons
- Intel Contribution: $TBD

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 Lerma 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.

- A typical irrigation season in the Lerma basin typically starts in mid-October and ends in early May.
- Projects are expected to conserve 750 cubic meters of water per hectare per crop season with Kilimo IoT irrigation management system, based on analysis of pilot projects.
- 178 ha will be outfitted with Kilimo IoT irrigation management systems. These systems will operate over three crop seasons, starting in October 2022.
- Data from the three crop seasons prior to project implementation 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 use pre- 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.

Pre-project condition: Irrigators currently feel the soil or look at the crop to assess irrigation need. These methods are applied across 178 ha of farmland each crop season

Post-project condition: Use of Kilimo's IoT irrigation management system on 178 ha of farmland each crop season

> Area of precision agriculture improvements = 178 ha/crop season
>
> Water savings for farmland with Kilimo IoT irrigation management system = 750 m^3/ha/crop season

Reduced withdrawal = Water savings = 178 ha/crop season * 750 m^3/ha/crop season = 133,500 m^3/crop season

When complete, the total anticipated volumetric benefit is 133,500 m^3/year (35.3 MGY)

Volumetric Benefit (Preliminary)

- Preliminary Total Benefit: 35.3 MGY
- Preliminary Intel Benefit: TBD based on cost share.

The irrigation season in the Lerma basin occurs over two calendar years. Therefore, the volumetric benefits in the project start year (2022) and project end year (2025) will be prorated for the portion of the irrigation season falling within that calendar year (Table 1).

Table 1. Projected annual volumetric water benefits attributable to Intel.

Year	Farm Area with Kilimo System (Area and number months)	Annual Water Volume Conserved	
		cubic meters	million gallons
2022	178 ha (2.5 months)	47,679	12.6
2023	178 ha (7 months)	133,500	35.3
2024	178 ha (7 months)	133,500	35.3
2025	178 ha (4.5 months)	85,821	22.7

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.

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