Irrigate.io

Problem:

Water – the canary in the coalmine for India

India is a $2.2 trillion economy growing around 7.3% a year. And it has 1.3bn citizens with a median age of just 27. Sounds like the perfect growth story? Just one small problem – India's running out of water fast. Let's take a quick look at the facts.

Being home to 17% of the world's population India only has 4% of the world's freshwater resources. A key government think tank reported in June 2018 that India would run a 50% water supply deficit in 2030. Delhi, Bangalore and Chennai are expected to run out of water by 2020. The report also states that 40% of Indians will have no access to drinking water by 2030.

Agriculture – the real guzzler

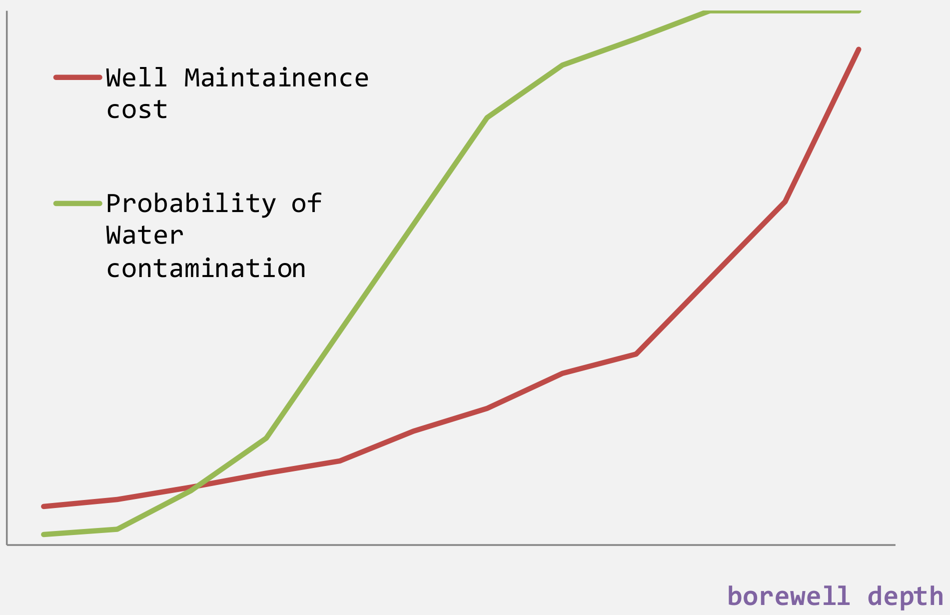
About 90% of Indian water demand comes from agriculture even though just under half of the country's farmland is irrigated. The rest of the land relies on rainfall. Yet the government has pledged to bring more of this rainfed land under irrigation.

For decades farmers across India have been encouraged to grow water intensive crops like rice and sugarcane through a combination of energy subsidies and pricing support from the government. This has inevitably led to an alarming decline in the national groundwater table. These policies cannot continue for long without leaving a destructive imprint on India's growth story. The fix here would be if farmers shifted their focus to less water intensive crops and invested in better irrigation technology. But it's easier said than done since most of India's farmers are small stakeholders.

Irrigation efficiency in India is low – 59m hectares or 86% of total irrigated farmland rely on flood irrigation. Micro irrigation methods like drip and sprinkler are about 50% more efficient that conventional flood irrigation. Only 10m hectares or 14% of total irrigated farmland are under micro-irrigation despite there being broad based subsidy schemes in place for micro-irrigation. Farmers are often reluctant to participate in such schemes due to the high upfront cost and risk that the benefit might not be passed on to them as intended. The proof is in the low adoption rate. The central government has pledged almost $750m towards micro-irrigation adoption over the next two years.

Subsidies – incentives for bad behavior

Farmers only bear the cost of installing and maintaining well infrastructure. This infrastructure is usually powered by the grid and farmers are entitled to free power in most states. Subsidising power for farmers costs state governments billions every year. Until now, the incentive for farmers to use water conservatively has been largely absent. With the status quo, this incentive to save water for farmers really kicks in once borewell maintenance costs and the chances of water contamination rise exponentially with a drastically declining water table:



Social impact – the hidden cost

Aside from the direct economic cost for the government – let’s look at how water shortages affect the average Indian. About 3 in every 4 Indian households do not have drinking water at home. Over two thirds of India’s water is contaminated. 21% of country’s diseases are water related. It is estimated that Indian women spend 150 million work days every year fetching and carrying water. Think how this derails the idea of sustainable development.

Solution:

Decentralized reward system to promote better water management:

A 20% improvement in irrigation efficiency across the 47% of Indian farmland under irrigation would lead to an 18% reduction in total water use in India. Procuring such an outcome with current policies implies is difficult since the expected return of investing in micro-irrigation technology is still negative in the short-term for farmers. But imagine a system where farmers are actually rewarded by the government for efficient water management. Sounds like a noble idea but think of the operational challenges.

First of all, imagine the sheer number of government workers needed to verify outcomes at each farm. Secondly, how can we ensure that the outcomes are accurate and not subject to manipulation? Thirdly, farmers may be skeptical to participate if they feel they will not be fairly rewarded due to corruption.

DigitalWater has a solution.

Imagine the following. IoT sensors installed on farmer fields that capture irrigation efficiency data sent straight to a blockchain. That data is run through an algorithm that ranks farmer X, Y and Z in order of their relative efficiency. At the end of a given time period, the highest ranked farmer gets a cash reward of A paid straight into his/her bank account. The cash is funded by the government.

No cheating, no corruption – just fair distribution of government funds to fast-track mass adoption of micro irrigation. The higher the rewards, the more farmers that want to participate. Water efficiency is directly correlated with investment in irrigation technology and is fairly easy to calculate. Absolute water usage on the other hand tells us little about overall efficiency. If a farmer sees the expected return of participation as higher than the current return on farming, participation in the scheme grows and so does water management. Expected return is a function of reward size, number of participants and probability of corruption. A rewarded farmer becomes a model farmer who will likely reinvest in better technology to retain his/her position as a winner. The data harnessed will further help governments plan resource allocation, strengthen drought forecasting and promote competition amongst regions.

IoT:

Our agtech partner Keedagro has developed smart irrigation sensors that send SMS alerts via the cloud to farmers alerting them when and how much to water their fields. In the west, sensors are built for large stakeholders and the economics just don't stack up for fragmented farming economies like India and Brazil. Keedagro's sensors are specifically built for Indian farmers and have gained positive traction from initial adopters. Keedagro's sensors communicate over SMS protocol and transmit data in this form due to network reliability in rural areas. The sensors can also send data over internet protocol. The sensors measure the dialectric constant of the soil, a variable which is linearly correlated with soil moisture. The sensors are housed in polycarbonate casing and powered by lithium ion batteries that are charged by a solar panel. When the battery depletes, the sensors can be charged in 1 hour using a USB cable. Each datapoint is time and geo stamped. The circuit board can only be tampered with if the casing is unscrewed. The sensors are simple to install and maintain.

Soil Science:

Soil moisture is a key variable that provides valuable insights into water management. Analysing first and second order derivatives of soil moisture data enable us to determine water efficiency. For each soil, there are two main defined thresholds of moisture: a) field capacity - at which plants can access all of the available moisture in the soil profile b) permanent wilting point – the level where plants are unable to extract any moisture from the soil and begin to wilt. The optimal level of moisture is below and close to a). An efficient farmer's moisture readings would average out below and as close as possible to field capacity. The algorithms in the blockchain would use variance analysis to rank farmers. Studies provide clear evidence that variance minimization and tightness around field capacity can only be achieved through micro-irrigation practices that enable more frequent but precise irrigation cycles. Flood irrigation is underpinned by higher moisture variance.

FIELD CAPACITY - FARMER A

FIELD CAPACITY - FARMER B

Rewards:

DigitalWater would enter into an agreement with the state governments of Punjab, Haryana, Rajasthan and Gujarat for round 1. **We want the each government to pledge a minimum of $30m or total $120m in rewards for round 1 of which 15% goes to ICO subscribers and 5% for the founding team.** Round 1 lasts from Jun 2019 to April 2020. Reward funds are distributed to farmers at the end of each round. New rewards are set for each round. The top 25% farmers receive tiered rewards, which amount to a minimum of $96m across 25,000 farmers. The maximum reward will be $40,000 while the minimum reward is $610. **Every dollar spent by the government is 100% traceable.**

Expected reward for participant farmer in round 1 = $960
Probability of top 25% farmer actually being paid = 100%

Expected reward for farmer buying subsidized micro irrigation = 10% extra yield – (cost of technology – subsidy x probability of actually being paid the subsidy)

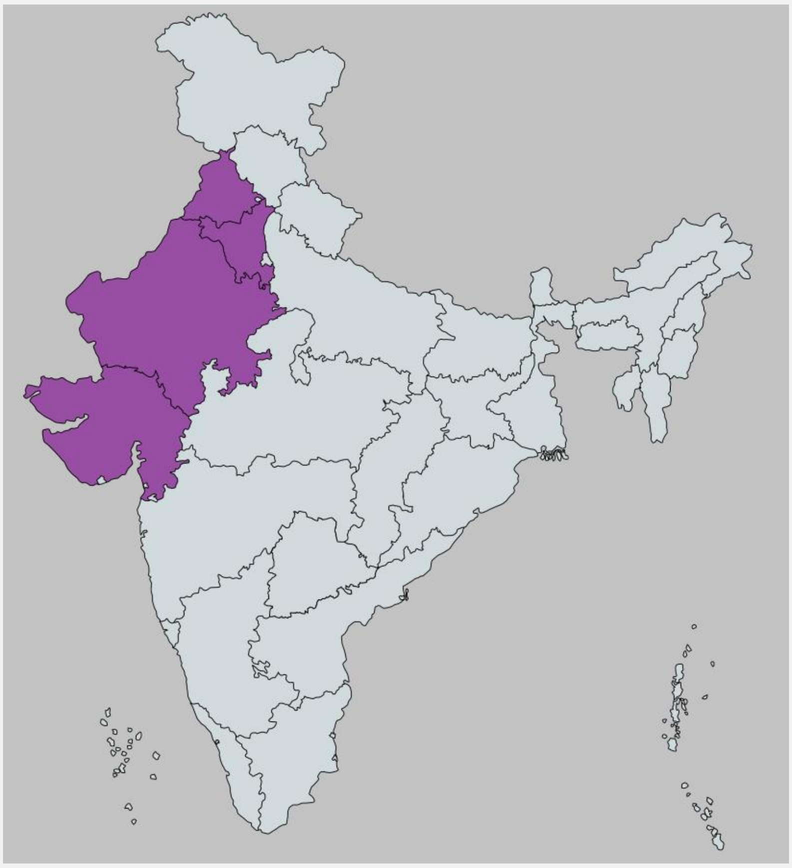
Farmers	Reward	Total
100	$40,000	$4,000,000
500	$20,000	$10,000,000
1000	$15,000	$15,000,000
4000	$7,000	$28,000,000
8000	$4,000	$32,000,000
11400	$610	$6,954,000
75000	$0	$0
100000		$95,954,000

Participation:

Our target farmers for round 1 cultivate 10 irrigated acres+ across Punjab, Haryana, Rajasthan and Gujarat.

The governments can provide farmer databases and support the marketing campaign at the grassroots level. Farmers register their interest through 1. a Mobile app 2. Facebook.

A ballot shortlists 100,000 farmers to participate in the first round. This participation group represents about 1,000,000 acres collectively or just under 1% of total irrigated farmland in the country. Selected farmers will be provided further information before the project goes live, including installation and maintenance guides. A new ballot is done for each round to ensure enough farmers have a chance to participate and other states will be given the opportunity to participate. This means the reward pool also grows. The idea is to initially create a model system in these four states as proof of concept.



Infrastructure:

Keedagro's technical team would be responsible for supplying and maintaining the sensor infrastructure on the ground. Each sensor transmits device health data to the blockchain where faulty sensors are flagged and error tickets are generated for Keedagro to take action. Sensor batteries can typically last up to 30 days without any sunlight. Farmers are advised to not open the sensor unless instructed. This ensures continuity in data and minimizes interference from farmers. A week before the project goes live, all sensors will be functional and parsing test data into the blockchain for calibration purposes. Each state will have a lead project manager, 20 regional managers and a team of 4 engineers to make sure everything is working smoothly on the ground. After each round, the sensors are installed on new farms.

Data:

Each sensor transmits 6 datapoints per day every 4 hours to the blockchain. This means the blockchain stores a maximum of 600,000 data points per day. Transmission can be affected by network availability. Farmers send an activity log via SMS or mobile app to the blockchain each time they are about to plant a new crop, harvest an old crop or charge a sensor. The machine learning algorithm accounts for datapoints around such events so that farmers are not penalised. The data is available to participating governments so they can get their researchers analyzing it. Accumulating vast amounts of real-time soil moisture data gives an accurate picture of how the soil profile is evolving and farmers interact with it across various regions. Machine learning and AI can further enhance the scope of data analysis.

Smart contracts:

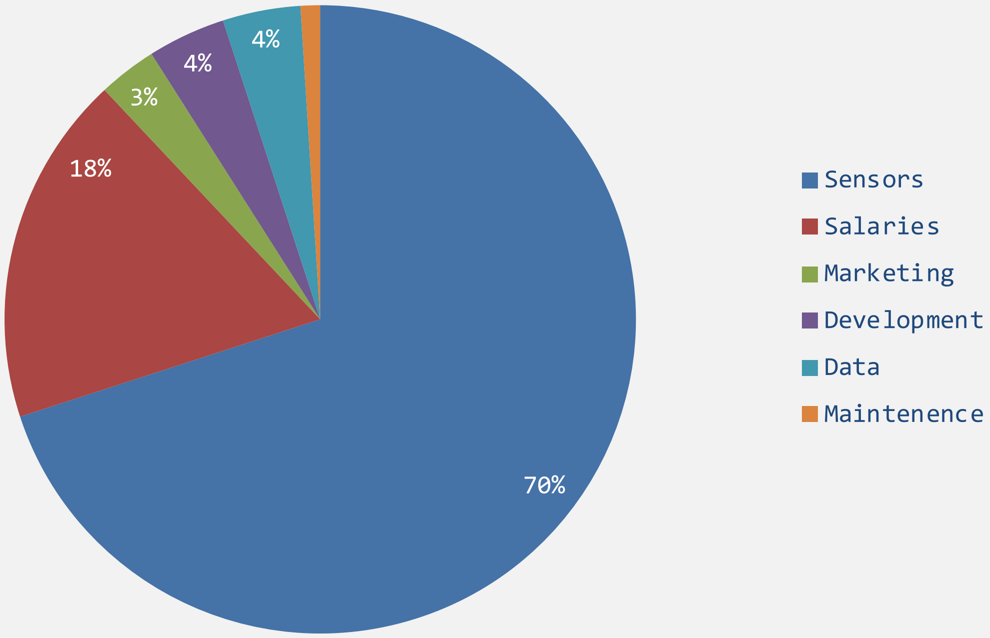
Ranking
minRank(farmer 1(var(FC)), farmer 2(var(FC)), farmer 3(var(FC)),..,farmer X(var(FC)))

Variance
farmer 1(mean(raw(farmer 1) - FC(farmer 1))^2

Field capacity
FC(farmer) = mean(datapoint after initial saturation(12,13,,24)

Initial coin offering:

The softcap is $10m while the hardcap is $20m. ICO subscribers are entitled to 15% of the total reward pledged by the governments in each round. This would guarantee an 80% return on investment basis the softcap in round 1. Until the government pledges the reward funds, capital raised from the ICO remains in escrow. If the government doesn’t pledge the funds by the end of 2018, we will return the ICO funds back to investors. This is how the ICO funds would be spent:



FAQs:

Why should these 4 governments pay rewards of $120m to their farmers?

Punjab, Haryana, Rajasthan and Gujarat collectively pay almost $4bn per year in irrigation related power subsidies and interest charges from previous arrears. The goal of micro-irrigation across India is hindered by 2 current problems:

1. **No monetary benefit from saving water for farmers**
2. **Negative short-term return on micro-irrigation**

Blockchain technology makes it possible to reverse that. The marginal return on this $120m will be far more widespread than the marginal return on $120m in power subsidies.

Why should the government pay 20% to Irrigate.io?

We are investing in the infrastructure to make this happen and get paid after successful completion of each round.

How will you manage such a large network of sensors?

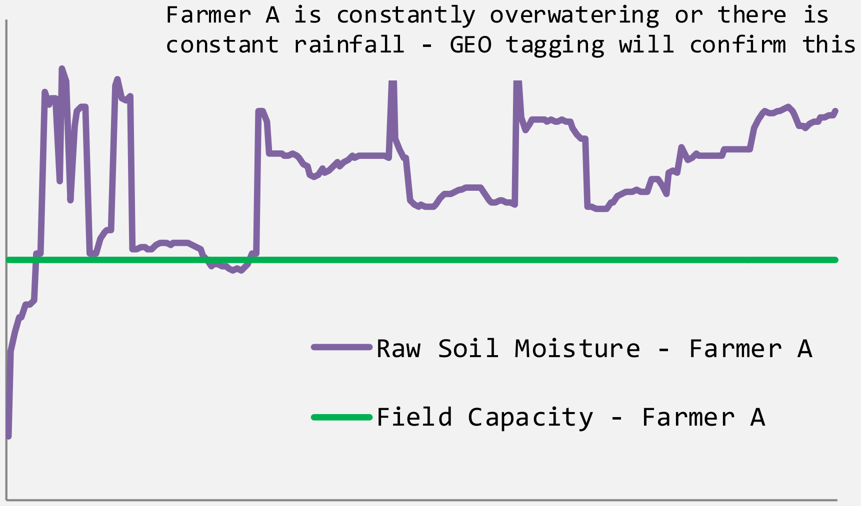
Firstly, this is by no means a simple feat. We'll have a team of 20 regional managers across each state to manage installation. The sensors will send status updates to the blockchain every 4 hours so that issues are logged and flagged in time. Farmers are instructed on sensor use and engineers can be deployed on site if required.

Who owns the sensors and what happens to them after round 1?

The company owns the sensors and after the first round they will be installed in new locations determined by the ballot for round 2. If the government wants to buy the sensors in round 1 to keep them installed, we would consider a bid.

Beyond soil moisture, what else will you know?

Geo-tagging enables the blockchain to verify the location of each sensor and the integrity of its data by cross-checking against weather reports.



What if farmers try to move their sensors around?

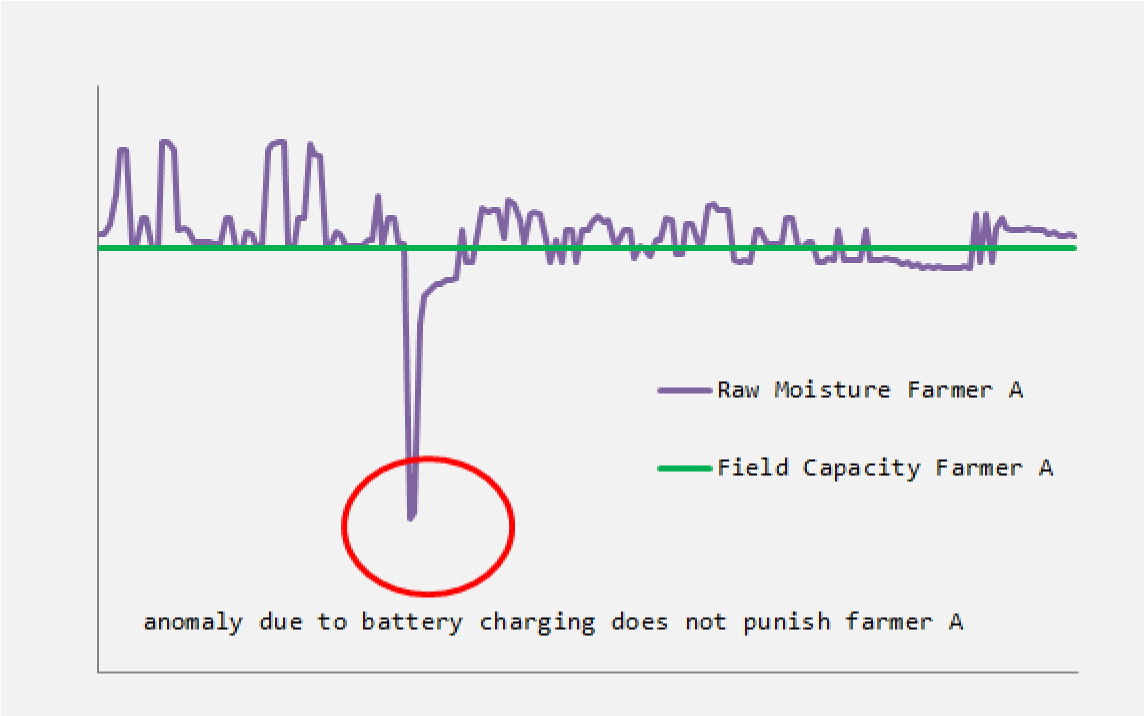
Farmers will be advised that tampering without prior instruction will lead to disqualification.

What if farmers try to manipulate their data?

As farmers can't see the data themselves, under-watering and over-watering will not derive any benefit to them since the algorithm measures variance from field capacity. For example, if a farmer waters a field and deliberately ignores the soil around the sensor – this would count against him/her.

How can you guarantee that your smart contracts treat all farmers fairly?

The smart contracts democratize the handling of incoming data and don't differentiate based on farmer. If one sensor has 1000 readings and another has 900, the one with 900 readings is treated no less differently. When a farmer charges a sensor, he/she maintains an activity log which is stored in the blockchain so that datapoints such as this one can be isolated:



Roadmap:

Nov 2018: ICO opens
Dec 2018: ICO closes
Dec 2018: Production starts or refund ICO funds
Jun 2019: Round 1 goes live
Apr 2020: Round 1 closes
Jun 2020: Round 2 goes live

Team:

CEO:
CTO:
CBDO:
CMO:

Groundstaff:

4 x State project managers
80 x District managers
16 x Technical engineers