International Journal of
INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING
ISSN:2147-6799 www.ijisae.org Original Research Paper

AI for Effective use of Water in India for Crop Cultivation

Chinmay Rawat

Submitted: 03/11/2022 **Accepted**: 02/02/2023

Abstract: India has the largest rain-fed agricultural land area and agro based economy in the world. This is due to the fact that 61% of agricultural families in India only utilise rainwater for their crops. The present study's objective is to determine how artificial intelligence (AI) may be used to successfully utilise rainwater for agricultural production of ragi crop in India. Also, with aid of AI, the ideal day to plant a certain crop in order to maximise the use of rainfall, prevent ragi crop damage from untimely rain, and lower the total cost of agricultural production by using less irrigation water have been reported. The historical rainfall data for Bangalore area was collected from Metostat, weather future predictions were collected fromWeather.com, and Python was used for programming. To determine the entire cost of irrigation for the ragi crop, architects were hired. The calculation shows that if the ragi crop were sown on June 1 instead of May 23, 2022, we would have paid 30% less for water irrigation. To sum up, artificial intelligence may be utilised to forecast the ideal day to plant the ragi crop for the highest yield, while also lowering the overall cost of irrigation for agricultural production.

Keywords*: Artificial intelligence, Ragi, Rainwater, Irrigation, Agriculture*

1. Introduction

The amount of water supplied to the agricultural land largely determines the final harvest's quality. Twenty per cent of all farmland is irrigated, and its contribution to global food production is forty per cent.

The primary sources of crop irrigation in India are:

- Canal irrigation helps in withdrawing water without using a dam or barrage.
- Well irrigation has become increasingly common in places without tank or canal irrigation.
- Natural and artificial tanks can be used for irrigation purposes. Bunds are created across the stream, and canals are dug to create a depression on the surface. An ancient method of water management in India is called tank irrigation.
- When it rains, it's collected and used for irrigation; when it doesn't, it's used in other ways.

According to the Journals of India, the total land area and the economic value of rain-fed agriculture in India are the highest in the world. This is because 61% of India's agricultural households use just rainwater for their crops, while rain-fed agriculture accounts for 55% of the country's total planted land.
In this paper, we will research how we can use Artificial Intelligence to use rainwater in crop cultivation in India effectively. The research paper attempts to predict the optimal day for sowing a given crop to optimise the usage of rainfall, stop the damage to the crop due to rainfall at the wrong time and reduce the overall cost of crop production by reducing the irrigation water cost.

2. Literature Survey

There are various sources of rainwater. Oceans and seas are two critical sources of rainwater from which the cloud and winds bring a huge amount of water vapour which condenses and falls on the earth as rain. The most common way of leveraging rainwater for harvesting is:

- Using rainfall as the direct source of irrigation
- Rainwater harvesting - The most common use is a form of supplemental irrigation when water is added to the soil to supplement rainfall during dry spells or times of stress for plants.

Many research studies have analysed the utilisation of rainwater for irrigation in agricultural fields. However, none focuses on using Artificial Intelligence to predict the best sowing day for the crop.

3. Problem Definition

As per the world bank report, one of the top three challenges for Indian crop cultivation is, increasing agricultural productivity per unit of land. However, raising agricultural productivity dramatically depends on the limited water resources available for irrigation. Various studies have happened on the effective use of rainwater harvesting. However, very little has been done to leverage Artificial Intelligence to effectively use rainwater for crop cultivation by predicting the best day for sowing the crop.

In our research, we would use the weather forecast for the region and overlay it with the water needs of the crop

Research Scholar, Delhi Public School, Bangalore South. *chinmayrawat15@gmail.com*

during its growth and recommend the best day to sow the crop to:

- Optimise the usage of rainfall
- Reduce the damage to crop growth due to rainfall
- Reduce the cost

4. Data Collection

In this research, we would use the Ragi crop cultivation in the Bangalore region to showcase how Artificial Intelligence would have effectively used rainwater and reduced cost for the cultivation. Data sources used in this paperare:

- Ragi

Millets are a diverse genus of grasses with tiny seeds cultivated worldwide as cereal grains or for animal feed. Ragi, or Finger Millet, is an essential millet that is widely cultivated in many parts of India and Africa. The technical name for this plant is Eleusine coracana. In India, it is the sixth most-produced cereal after wheat, rice, corn, sorghum, and bajra. Ragi (finger millet) is mainly farmed and consumed in the state of Karnataka. However, it is also grown and finished less in "Andhra Pradesh, Tamil Nadu, Odisha, Maharashtra, Uttarakhand, and Goa". The below table shows us the Water requirements during the various stages of Ragi crop growth:

No. of irrigations	**RED SOILS**	**HEAVY SOILS**
1st	Right after sowing the crop	Right after sowing
2nd	After 3 days of soing the crop	On the 4th day
3rd	After 7 days of sowing the crop	On the 9th day
4th	After 12 days of sowing the crop	On the 16th day
5th	After 17 days of sowing the crop	…….

As per the research done in the Ragi crop production so far, below is the recommended detailed water schedule for Ragi crop growth:

Stages	**No. of irrigations**	**80 days**
Vegetative phase (Nursery)		1 to 16
Vegetative phase (in main field)		1 to18
Flowering phase		19 to 40
Maturity phase		Beyond 40 days
Heavy soils		
Establishment	1	1st day
(1-7 days)	2	5th day
Vegetative phase	1	18th day
(8-20 days)	2	31st day
Flowering phase	1	41st day
(21-55 days)	2	51st day
	3	--
Maturity phase	1	61st day
(56-120 days)	2	--
Stop irrigation thereafter		

Light soils		
Establishment	1	1st day
(1 – 7 days)	2	5th day
Vegetative phase	1	15th day
(8 - 20 days)	2	26th day
Flowering phase	1	36th day
(21 - 55 days)	2	45th day
	3	..
Maturity phase	1	58th day
(56 - 120 days)	2	70th day
Stop irrigation after that		

- Cost of Water for Ragi Cultivation

For the Rainwater and Soil water, we would assume the cost to be zero. However, for the water from the Borewell, we would use the below costing:

- **Electricity Cost** - To determine how much it would cost to pump water up from a bore well-using electricity (with a government subsidy), we used the following calculation (Rs. 3.5 is the cost of electricity per KWH) *"Electricity charges =No. of irrigations x No. of hours irrigated per irrigation x Area x hp of motor x 0.75 KWH x 3.5 per KWH"*
- **Amortisation cost** – For the simplicity of the discussion, we would keep the amortisation cost to be 0

"Thus, Irrigation cost was obtained by the summation of electricity charges and amortisation cost i.e., *Irrigation cost = Electricity charges + Amortized cost"*

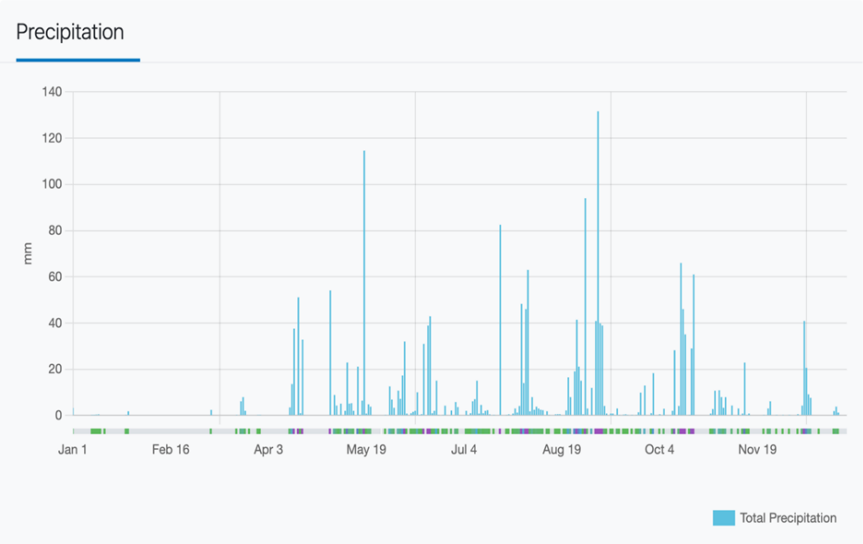
As per the study done by the Department of Agriculture economics; irrigation cost accounts to be ***6%*** of the total cost incurred

- Rainfall recorded in Bangalore region

We have used the historical data for rainfall in the Bangalore region from Metostat

- Weather forecast for Bangalore region

We can use the future data for rainfall in the Bangalore region from https://weather.com/



Method and System Architecture

The research will assist in predicting the best day of sowing the crop in the next 15 days from the intended day of sowing. For instance, if the farmer wants to plant the crop on May 23rd, the computation of the total cost of irrigation, which the farmer might incur during the complete crop production process (sowing to harvest), if

the farmer would have sown the crop on May 23rd, May 24th, May 25th and so on. From this data, one can predict the best day for crop sowing.

AI Methods

In our research, we used the weather forecast from weather.com, which uses AI technologies to predict the weather.

Programming Language

We would use Python for our programming needs.

System Architecture

In this research we have used the below architecture to calculate cost of irrigation for Ragi crop in the Bangalore region:

1. Use the Ragi crop production irrigation needs for the Ragi crop as shown in the Data Collection section above.
2. *Compute the cost of irrigation for the Ragi crop for the given region and given day using the below step*

Loop to calculate Cost of Irrigation for total duration of Ragi Crop cultivation (from date of sowing to date of harvesting)

{

Step1: *Water need for the day = Find water need for the given day of crop growth using the ragi crop Data Collection section above (for e.g. two irrigation are required on 5th day and one irrigation on 18th day of crop growth)*

Step2: *Rainfall on the given day = Use the rainfall data for the given day as shown in the data section above*

Step3: *Water purchase required for a given day = Water need for each day – Rainfall on the given day*

Step4: *Total Cost of irrigation = Water purchased for each day during the crop growth (sowing to harvest) *Irrigation cost // As computed in above section for water cost*

}

Compute the total cost of irrigation for ragi crop (sowing to harvest) for different day of crop sowing i.e.

Sowing Day of the Crop	Total Cost of Irrigation for 80 days, from the day of sowing to harvest
May 23rd	….
May 24th	….
.....	…

From the table above, the day that results in the lowest cost is our preferred day for crop sowing.

5. Results and Analysis

Using the above data, method, and System architecture, we have got the below results for the Ragi crop cultivation using sowing day as May 23rd or June 1st as example days:

Sowing Day of the Crop	Total Cost of Irrigation for 80 days, from the day of sowing

May 23rd 2022	(Purchase of water required 5 times) * Water Required * cost of water
June 1st 2022	(Purchase of water required 3 times) * Water Required * cost of water

From the above data, we can easily deduce that if the sowing of the ragi crop had happened on June 1st than May 23rd, we would have reduced the water irrigation cost by 30%.

6. Conclusion and Future Work

Our proof of study confirms that Artificial Intelligence can be used to predict the best day for sowing the ragi crop for an optimal yield and reducing the total irrigation cost for crop production. The project also insists on using artificial intelligence methods to save water for all crop production and include other factors like water moisture content when sowing.

References

[1] World Bank data for Water in Agriculture - https://www.worldbank.org/en/topic/water-in-agriculture

[2] World Bank (India: Issues and Priorities for Agriculture) https://www.worldbank.org/en/news/feature/2012/05/17/india-agriculture-issues-priorities

[3] Journals of India - https://journalsofindia.com/rainfed-agriculture-in-india/

[4] Rainwater Harvesting for Agricultural Irrigation: https://www.mdpi.com/2073-4441/11/7/1320

[5] TNAU Agritech Portal - https://agritech.tnau.ac.in/

[6] TNAU Ragi Crop Water requirements - https://agritech.tnau.ac.in/agriculture/millets_ragi.html

[7] Weather Record Keeper - https://meteostat.net/en/station

[8] IBM weather - https://weather.com/

[9] IBM Weather Company - https://weather.com/news/news/2021-07-28-ibm-weather-company-forecast-accuracy