SAFE: Simplified Agro-Farmic Enumerate

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ABSTRACT

The agriculture sector of India employees a major population of Indians. But still, due to emerging constructional projects the agricultural lands are decreasing. And the number of people to feed is increasing day by day. Also, the profit earned by the farmers for their crops is not satisfactory. So, the solution to all these problems could be a proper crop selection. In India, the crop selection is still done using traditional methods. Some still select the crop on the basis of soil type, but it is not sufficient in today's time. Crop selection can be done more accurately with the help of other factors including soil type, climate, water level, season, etc. Crop selection can be done with the help of Data Science. Data Science is a technology that has the potential to transform every industry on this earth, agriculture is among them.

Keywords— Crop Selection; Data Science; Technology and Agriculture; Crop prediction

1. INTRODUCTION

India is one of the top leading countries in the world. India ranks second in terms of farm output in the world. The Agriculture in India dates back to Indus Valley Civilization and even before that in some parts of the Southern states of India. India is a gifted land with twenty agri-climate regions, all 15 major climates in the world exist in India. It possesses 46 of the 60-soil types in the world. India has the tenth-largest arable land in the world. [1]Around 50% of the Indian workforce is employed in the agricultural sector. The agricultural sector contributes around 17-18% of the country's GDP (Gross Domestic Product) [2]. Despite having such a good climatic condition and the workforce the contribution of the agriculture sector to the GDP is not satisfactory. The average income of Indian farmers is estimated to be around Rs. 77,976 per year [3]. This is clearly not a good sign for a nation with half the population engaged in agricultural activity. Figure 1.1 shows the growth rate of the agriculture industry over a long period of time. By looking at the above diagram we can say that the growth rate is not sufficient for a country like India. The agriculture sector is the most

unorganized sector in India. Due to lack of planning the farmers have to suffer the losses in the form of the low selling cost of their crop, degradation of soil quality due to excessive use of fertilizers to grow crops which in return increases the input cost. One of the main reasons for these problems is a poor crop selection strategy. Still, most of the farmers use traditional methods to select the crop they intend to grow. This is basically done by looking at the type of soil the land has or the crop that has been grown for years is continued to be grown on the field. This not only results in the degradation of the land this also results in the overproduction of certain crops in specific regions. Because people belonging to the same area grow the same crop despite their land type and other factors. So, one possible solution is to select the crop wisely and this can be done with the help of modern technology, such as Data Science. Data science is a multi-disciplinary field that uses scientific methods, processes, algorithms, and system to extract the and insight from structured and unstructured data [5].
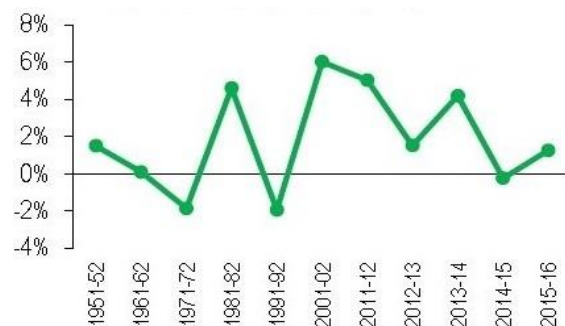

Fig. 1: Agriculture Growth in percentage [4]

This paper will present a propose mechanism for proper crop selection that will match with the farmer's requirement.

2. PRELIMINARY WORK DONE

Among all the work analysis done yet, it was observed that the farmers have not clear vision about what crops do they choose

for their fields. So, there are various sites in up(west) area near Agra (Lachhipura Village), where the survey is taken from various farmers and asks few of the following questions:
(a) What is the most suitable crop grown in your fields?
(b) How much amount do you invest in 1 field?
(c) How much amount of fertilizers and pesticides do you use for the specified crop?
(d) How much crop (in packets) do you expect from your fields?
(e) How much profit do you expect from your crop in a particular season?

From above survey it has been observed that there is misunderstanding among farmers in order to select the specified crop which could be more favourable in order to provide them better profit.

3. BROAD OUTLINE OF WORK
As many studies performed to provide the agricultural solution but only few works for farmer's economic growth, this study focuses more on the financial growth of farmers by suggesting them best possible crop to grown. The study would be undertaken to examine the various aspects responsible for suggesting the possible crops to be grown in the fields. It is proposed to carry out further to find out good profit and cause - effect relationship of agricultural profit after exposing the type of crop to be determined under the following parameters:

3.1 Soil Type
It is very essential for the farmer to know the soil type as it determines what type of crops can be grown on the field. A crop is dependent on the soil as it provides basic nutrients to the plant to grow. A soil with a high concentration of minerals can yield a good quality of crops with high nutrients demand (such as Sugarcane) and vice-versa. India has a very diversified profile in terms of soil type. For example, if one look at the State of Tamil Nadu, he can observe red soil in the district of Salem and Erode and black soil in Coimbatore and Ramanthapuram. Each type of soil has it own properties such as physical (size of grain), chemical (level of potassium or nitrogen) or biological properties.

Soil Type	Properties
Clay Soil	Full of minerals, this soil is fertile but quickly gets cooled and waterlogged in water and during the summer, break to crust.
Silt Soil	Like clay silt is fertile, holds water and is easy to compact.
Sandy Soil	It has much larger mineral grains than clay and silt. It is gritty and crumbly in texture.
Chalky Soil	The consistency of the soil varies considerably depending on its precise makeup-some are heavy some quite light, but all chalky soils tends towards alkalinity.
Peat Soil	Full of dark organic matter, peat soils hold lot of water.

Fig. 2: Different types of soil [6]

Table 1: Soil and kind of crop they support

Type of Soil	Suitable crop
Alluvial	Paddy, sugarcane and plantain
Red soil	Red gram, Bengal gram, green gram, groundnut and castor seed
Black soil	Cotton, tobacco, chilly, oil seeds, jowar, ragi and maize
Sandy soil	Coconut, cashew and casuarinas

3.2 Rain Fall
The weather of India affects agricultural activities in the form of rainfall dramatically. The plants need at least some water for their survival; therefore rain (being the most effective means of watering in India) is important to agriculture. The regular rain pattern could be a boon to the farming but too much rain causes serious problems like sweeping away the entire cropping land. Droughts in certain areas cause a halt in the growth of the crops, on the other hand, overly wet weather causes harmful fungus growth. The survivals of the plants depend on varying amounts of rainfall. For example, the production of wheat requires 62.5 to 82cms of rain whereas the production of rice needs hundreds of inches of rainfall to survive [7]. In areas with wet and dry seasons, soil nutrients diminish and erosion increases during the wet season. The previous dry season leads to food shortages into the wet season, as the crops have yet to mature. Developing countries have noted that their populations show seasonal weight fluctuations due to food shortages seen before the first harvest, which occurs late in the wet season. Rain may be harvested through the use of rainwater tanks; treated to potable use or for non-potable use indoors or for irrigation, Excessive rain during short periods of time can cause flash floods. It is also important to see the water requirement of the crop. If the farming season doesn't receive proper rain then the farmer has to be dependent on groundwater.

3.3 Investment
The investment in this context refers to the amount of money invested by the farmer for the overall development of the farm during a particular season. There are varieties of crops, each crop has different requirements like preparation of fields, sowing of crops, harvesting, packaging, and delivery. Each process requires some form of capital ranging from the time invested to the capital investment. A farmer has to pay for the seeds, fertilizers, packaging, labour, transportation, etc. All these costs vary from crop to crop. Therefore, this point marks its own importance in the process of crop selection where farmers should look at this too.

Table 2: Cost of Cultivation and Production of Arhar in different state in Rupees [8]

Crop	State	Cost of Cultivation (/Hectare)	Cost of Production (/Quintal)
Arhar	Uttar Pradesh	9794.05	1941.55
Arhar	Karnataka	10593.15	2172.46
Arhar	Gujarat	13468.82	1898.3
Arhar	Andhra Pradesh	17051.66	3670.54
Arhar	Maharashtra	17130.55	2775.8

3.4 Temperature
Temperature play a very important role for a crop to grow and survive in a particular location or condition. Every crop has its own temperature range under which it can flourish and grow. So, it's important to grow those crops in the region that can flourish in the given temperature range.

India is again a very versatile country in terms of temperature. It has highest temperature of 50.6 $^{\circ}$C in Alwar, Rajasthan and lowest as -45 $^{\circ}$C in Kashmir. But still the crops are grown in both the regions through the year.

4. PROPOSED MECHANISM
The selection of crops is a very important point that is to be considered for efficient agricultural output. The agricultural activity of farming is very important in terms of growth because

it requires a lot of resources (human labour, water, land, fertilizers, etc.) and time to grow a crop. When a crop is wasted it means all these resources along with the investment in terms of time and money all go in vain. There are various important points that need to be taken into consideration during the process of crop selection for the season. The properly selected crop will result in low food wastage rate, increased profit of farmers and crops with high nutrients. Therefore, this paper presents a different angle of crop selection which will consider the important factors for efficient farming.

4.1 Requirement Gathering and Analysis
In this phase the relevant data is gathered, and then analysed for its implementation in the project. The data that the user will input are investment (the amount money the farmer is willing to invest to grow the crop), district and sub-district, time at which the farmer wants to sow the crop.

4.2 Data Processing
In this phase data is processed. To processes the data following steps are to be followed:
Process the collected input data from farmer. This means that on the basis of district and sub-district we have to find out the temperature and the rainfall of that particular area for a period of 1 year.
- On the basis of location (district or sub-district) soil type is defined.
- On the basis of location, rainfall in mm for a year is defined.
- Now all these data will be saved in a different table that will act as a base table.

There will be a data set containing crops with the fields crop name, temperature(the suitable temperature at which the crop can flourish), soil type (type of soil supported by the crop), water requirement (amount of water required to grow the crop in mm), capital required (the amount of money required to grow the crop i.e. price per hectare), time(best suitable month to grow the crop). This table will act as a reference table to select the crop; hence it will be known as reference table.

4.3 Implementation
This model, of best crop prediction is based on scores. A crop having a higher score would mean it is more suitable for the farmer to grow that crop in his field. Similarly, a crop with low score would mean it is not suitable for the farmer to grow that crop in the given scenario. The crops will be filtered from the reference table based on the value in the base table.

4.4 Mathematical Model
On the basis of the base and the reference table a new table will be created known as score table. The fields of this table will be as follows:
- Soil: The soil is divided into 3 types as Best, Average and Worst having score as 3, 2 and1 respectively.
- Month: The month attribute is divided into five categories as M-2, M-1, M, M+1 and M+2 having scores 1, 2, 3, 2, 1.
- Rainfall: The rainfall attribute is also divided into five parts as W-2, W-1, W, W+1 and W+2 having scores 1, 2, 3, 2, 1.
- Temperature: Temperature is divided into 3 categories which are T-1, T and T+1 with scores 0, 1, 0.
- Investment: This is divided into two parts which are exact having a score as 1 and more/less with the score of 0.
- Crop Name: This will show the name of the crop.
- SAFE Factor: This field will show the total score for each and every crop. The highest score for this field can be 11 and the lowest can be 3.

Now, on the basis of the base and reference table the score for each crop will be calculated and mapped to the score table. Now for the best crop selection we have to calculate the scores of the crops, that is SAFE Factor.

$$\text{SAFE Factor} = (S+W+T+C+M)$$

Let I be the set of inputs such that:
I=S, W, T, C, M

Where,
S= Soil
T=Temperature
C=Capital/Investment
M=Month
W= Water Availability/Rainfall

$$\text{SAFE Percentage}=\text{SAFE Factor}*100/(\text{SAFE Max})$$
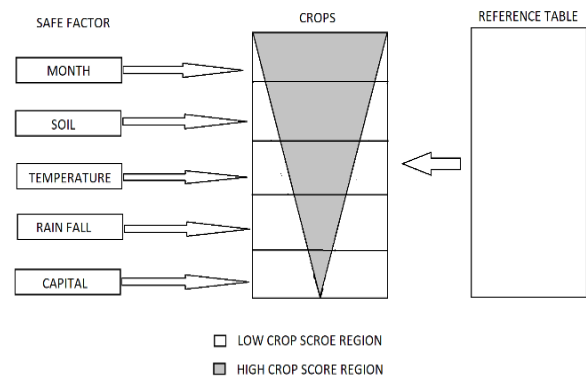

Fig. 3: SAFE Factor Scoring

Now the top crops with the highest scores will be shown to the farmers. The farmer can go with the highest scoring crop or can choose any one in the case of clashes between the score on the basis of capital.

5. CHALLENGES
As this is a new technology there will be many challenges in the initial implementation of the project. Some of these are as follows:
- India being such a diverse nation with so many soil types and climate it is difficult to cover all the land and crops.
- Due to too many types of crops and the land the choice for the farmer to select any particular crop will be difficult.
- As most of the farmers are not educated enough to read and write they will not be able to enter the required inputs.
- The farmers are not well aware of the profit of selecting a proper crop for their field.
- The unavailability of technology such as the internet or mobile or laptop access to the farmers at the ground level.

6. CONCLUSION
By the implementation of the method described in this paper, a farmer can easily choose the best suitable crop for their land. As this model require few data inputs it is practically viable for the farmers to use and leverage the technology for their benefit. As we are using a web-based model in this project that can be accessed through the internet. And the internet is pretty cheap in India, thus it will help to implement this model to root level in India. The proper crop selection will not only help the farmer to make more profit for his crop but it will all so ensure that they can adapt to new crops according to the situations and time. It is the need of the hour that the crop selection should be done wisely and with the help of new technology because the

traditional method is no longer sustainable for the country like India in today's time.

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