RSF: A Recommendation System for Farmers

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***Abstract*—In this paper, we present a recommendation system named as RSF for farmers, which can recommend farmers most suitable crops to produce in different areas. The system first detects a user's location and works with different agro-ecological and agro-climatic data in upazila level to calculate similarity between upazilas using pearson co-relation similarity algorithm. Then it selects top-*n* similar upazilas. Finally, utilizing the seasonal information and crop production rates of each crop of the similar upazilas, it recommends top-*k* crops to a user of a upazila. The system has been evaluated with real data and we have found a reasonable and satisfactory accuracy. The system can help farmers in producing appropriate crops. As a result, they can increase their lifestyle and can contribute more to the society. We provided the system layout both in Bangla and English so that the farmers as well as the people who works with farmers can get help easily from this.**

***Keywords* — Crop recommendation, recommender system, similarity calculation.**

I. INTRODUCTION

A recommendation system can be defined as a class of software which helps users to obtain the most suitable products according to their preferences, needs, or tastes [1]. It applies knowledge discovery techniques to the problem of personalized recommendations for information, products or services during a live interaction that has become popular and common among e-commerce, social media and content-based websites. With the help of its immense power it can also be applied usefully in the agricultural sectors.

In Bangladesh agriculture is the largest employment sector. As of 2016, it employs 47% of the total labor force and comprises 16% of the country's GDP [2]. The total number of households in rural area is 2,53,07,600 hectare where 1,17,98,243 hectare is agricultural (66.18% of rural). Per capita availability of cultivated land is 0.577 hectare and average cultivated land per agricultural household is 0.703 hectare. The distributions of farming community by the land holding sizes are 86.66% small, 11.66% medium and 1.68% large. These statistics implies obviously that they are poor in terms of income and resources. Evidently the main emphasis given by these farmers is to grow more crops with limited resources. So these farmers are badly in need of improved technologies for increased production of crops (Zaman et al. [3]).

Achieving improved and sustainable agricultural production and productivity growth largely depends on the advancement of agricultural research and its effective applications at farmer's fields through the transfer of technology and innovation. The access to the right information at the right time gives them the capacity to make informed decisions that affect their livelihoods (Sylvester et al. [4]). Considering these facts we aim to develop a recommendation system for farmers that will help them in choosing right crops to be produced. The task of recommending farmers suitable crops can be subdivided into three sub problems. They are location detection, information processing and recommendation generation. In the location detection stage we have to detect the current upazila of the user using GPS technology. This is the basic information gathering stage that will help us in further analysis and processing of the location based information. The major part of the system is the information processing stage which assists in generating recommendation. Here information like physiography, agro-climatic factors and seasonal crop information of different upazilas are stored and processed systematically for reducing the hassle in crop recommendation generation. The final stage of our system is recommendation generation stage where most similar crops are recommended to the user considering crop production rates of the similar upazilas that are found in previous stage. And finally, for the user convenience, we will provide the final recommendation in both Bangla and English. The remainder of this paper contribution can be summarized as follows:

A brief review of related work is provided in Section II. In section III, we detail the framework of our proposed system. Section IV presents the experimental results and system evaluation. Finally, in Section V we conclude and identified future research directions.

II. RELATED WORK

Recommendation systems have been emerged as an independent research area today. To deal with information overload and provide personalized recommendations a lot of works has been done in both industry and academia on developing new approaches for recommendation systems. Such applications include recommending books, CDs, movies, music, tourisms, and so on.

In Sarwar et al. [5] recommendation systems have been classified into three types namely content-based, collaborative and hybrid. In content-based recommendation methods, users are recommended items similar to those that they preferred in the past. Items that people with similar tastes and preferences liked in the past are recommended in collaborative recommendation methods. Whereas hybrid approach is the combination of content-based method and collaborative method

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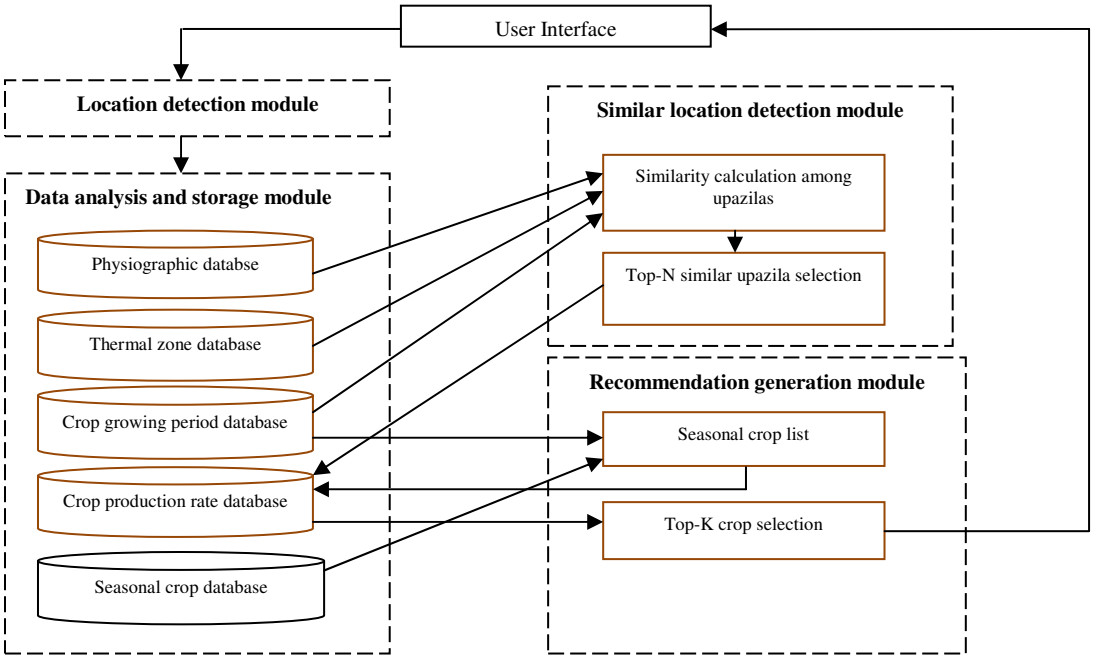

Fig. 1. System architecture of the proposed system

To assist people travelling different areas a location recommendation by Bao et al. [6] is proposed. They used a user's personal preferences and social opinions as information base. Personal preferences are learned automatically from his location history and social opinions are mined from the location histories of the local experts. Category-hierarchy based preference modeling, user similarity computing, and CF-based inference method were used to perform the recommendation that works relatively well in big real datasets. To alleviate irrelevant places that the user may not be interested in an advanced place recommendation method by Chen et al. [7] is proposed taking into account of users check-in history in social sites where they provide semantics such as shopping, eating, drinking and so forth. But they did not consider user's current location and the physical distances among the recommended places. In travel recommender systems by Ravi et al. [8] locations that are recommended to the user are predicted from the location based social network and rating score of the locations are determined by social pertinent trust walker (SPTW) algorithm based on the existing score rated for the similar location categories. After computing the rating score for the location categories, the list of locations with more relevance is recommended to the user.

A semantic web based architecture is proposed by Kumar et al. [9] to generate agricultural recommendations using spatial data and agricultural knowledge bases where knowledge base acts as a domain expert and send recommendations to the farmers based on climate conditions and geographic data. But they implemented the information system partially and shown only the initial results. Besides, they didn't propose what recommendation techniques are to be followed and most of the research and implementation work needs to be done in order to realize the architecture.

To assist farmers of Bangladesh, agricultural ministry has developed a website named 'কৃষি তথ্য সার্ভিস' (Krishi tottho service) where they provide different information regarding agriculture. They also established village information centers, a few tele-centers with the help of several funding agencies and investors. Besides, several NGOs and civil society organizations with the financial support of international development agencies are working with farmers in rural areas to help them in better production (Sylvester et al. [4]).

III. System Architecture and Design

The system architecture of Recommendation System for Farmers comprises of four basic modules: 1) Location detection module, 2) Data analysis and storage module, 3) Similar location detection module, 4) Recommendation generation module. The function of location detection module is to detect the current location of a user who enters the system. In data analysis and storage module different information and data stored in the database regarding the system requirements and development are analyzed. Similar location detection module identifies top-n similar location with the help of data storage module and similarity calculation algorithm. Finally, on the basis of top–n location, top-k crops are recommended that are most suitable for the detected location. The architecture of the proposed system is shown in shown in Fig. 1.

A. Location Detection Module

The location of the user is the basic prerequisite for providing recommendation in our system. With the advent of GPS-enabled devices identifying a user's location has become easier. Using the the google play services location APIs we facilitated adding location awareness to our system which is the latest technology for correct location detection. We get the postal code and address of the user directly from this service from which we identify the upazila name of the found location.

B. Data Analysis and Storage Module

After detecting the upazila where a user lives, the next step is to analyze the agro-ecological and statistical information of the locations stored in the database. For better understanding we have divided this module into five components: Crop growing period database, Thermal zone database, Physiographic database, Seasonal crop database and Crop production rate database.

1) Crop Growing Period Database: In this component crop growing period regime codes for every upazila are stored. In Bangladesh rainfall, temperature and soil fertility level are the main factors behind the crop productions in any location. On the basis of analysis and research on the rainfall, water-vaporization and soil fertility, crop growing period is divided into two main climatic seasons in Bangladesh namely Rabi (winter season) and Kharif (summer- rainy season). The Kharif season can further be classified into Kharif-1 (summer season) and Kharif -2 (rainy season) according to the climatic parameters. There are six Kharif-1 crop growing period regimes and twelve Kharif-2 crop growing period regimes in Bangladesh as shown in Table I and Table II. On the basis of Kharif-2 crop growing period, Rabi season is also subdivided into twelve growing period regimes as shown in Table III.

2) Thermal Zone Database: Here we have stored the information about the thermal zoning of each upazila. There are two types of thermal zone identified in our country: rabi or cool temperature regime and extreme summer temperature regime. Depending on the cool temperature growing period five regimes are selected as Rabi regime. They are T1, T2, T3, T4 and T5. The average duration of these regimes is lowest in coastal areas and highest in north-east and north-west marginal areas. These differences in lower temperature affect the crops of Rabi season in different ways. Generally the more time duration average temperature is below the 20˚ C or below the 15˚C, the more suitable it will be for growing wheat, potato and different types of pulses. There are four extreme summer temperature regime in Bangladesh. They are E1, E2, E3 and E4. The number of days of 40˚ C temperature are 0.0 to 0.5 in E1, 0.5 to 5.0 in E2, 5.0 to 1.0 in E3 and 10.0 to 15.0 in E4. Generally extreme summer temperature occur during the months of April and May and sometimes in the eve of June.

3) Physiographic Database: In this database component information about agro-ecological zone (AEZ) are stored. AEZ is the area of the nearly same ecological and soil characteristics agricultural crops production. So cropping pattern of a definite AEZ is mostly same. The homogeneity of a AEZ is more prominent in a sub region and most prominent in a unit level. The land use pattern of the country is influenced by agro ecology, soil physiographic and climatic factors. According to the variations of all these factors and agricultural potential, the total land area has been classified into thirty agro ecological zones which are subdivided into 88 agro-ecological sub-regions, which have been further subdivided into 535 agro-ecological units. In Table IV we are showing the pattern of some of the AEZ in Bangladesh.

TABLE I
CROP GROWING PERIOD OF KHARIF-1 SEASON

Regime Code	Total Days	Duration
P1	10-20	17 March – 2 April
P2	20-30	20 March – 14 April
P3	30-40	22 March – 26 April
P4	40-50	24 March – 8 May
P5	50-60	24 March – 18 May
P6	60-70	17 March – 21 May

TABLE II
CROP GROWING PERIOD OF KHARIF-2 SEASON

Regime Code	Total Days	Duration
K1	105 – 115	12 October – 30 January
K2	115 – 125	15 October – 12 February
K3	115 – 135	15 October – 17 February
K4	115 – 135	15 October – 17 February
K5	120 – 140	15 October – 22 February
K6	120 – 145	21 October – 2 March
K7	120 – 145	24 October – 5 March
K8	135 – 150	27 October – 18 March
K9	135 – 150	27 October – 18 March
K10	135 – 150	21 October – 23 March
K11	135 – 150	1 November – 22 March
K12	135 – 150	3 November – 25 March

TABLE III
CROP GROWING PERIOD OF RABI SEASON

Regime Code	Total Days	Duration
K1	170 – 180	27 May – 18 November
K2	180 – 190	24 May – 24 November
K3	190 – 200	21 May – 2 December
K4	200 – 210	16 May – 9 December
K5	210 – 220	9 May – 10 December
K6	220 – 230	3 May – 14 December
K7	230 – 240	27 April – 18 December
K8	240 – 250	24 April – 25 December
K9	250 – 260	18 April – 29 December
K10	260 – 270	12 April – 2 January
K11	270 – 280	3 April – 3 January
K12	280 – 290	27 March – 6 January

TABLE IV
CHARACTERISTICS OF DIFFERENT AGRO-ECOLOGICAL ZONES

AEZ ID	AEZ	Sub regions	Land type	Organic matter content	Fertility level	Soil Type
1	Old Himalayan Piedmont	a) North-central; b) Northern; c) Southern	High, Medium high, Others	Low	Low to medium	Sandy loam, loamy, Silt clay-loam
2	Young Brahmaputra and Jamuna Floodplain	a) High Jamuna Floodplain, b) Upper Brahmaputra Floodplain, c) Upper Brahmaputra – Jamuna Floodplain	Medium high, Others	Low	medium	Sandy loam, loamy, Silt clay-loam
22	Northern and Eastern Piedmont Plain	a) Northern and Eastern Basins, b) Northern and Eastern Plains and Basins, c) North-western Plains and Basins, d) South Sylhet Piedmont Plains and Basins	High, Medium high, Medium Low, Others	Medium	Low to medium	Grey, Loam, Dark Grey loamy
23	Chittagong Coastal Plain	a) Beach Ridges, Mangrove Swamp and Mud Clay b) Mangrove Tidal Floodplain; c) Piedmont Plains and River Floodplains; d) Young Tidal Floodplain	High, Medium high, Medium Low, Others	Low	medium	Grey silt loam, Silt clay loam

TABLE V
SEASONAL CROP TABLE

Crop name	Season
Potato	Rabi
Ropaamon (ufsi)	Kharif-2
Brinjal	Rabi, Kharif-1
Wax gourd	Kharif-2

TABLE VI
AVERAGE CROP PRODUCTION RATE FOR DIFFERENT CROPS IN DIFFERENTUPAZILAS

Upazila Name	RopaAwosh (ufsi)	Boro (local)	Sugarcane	Sweet gourd	Tomato	Ginger
Raozan	3.5	2.8	80	23	64	13
Fathikchari	3.5	2.8	80	23	64	1.3
Satkania	3.45	2.85	80	0	64	13

TABLE VII
SIMILARITY MATRIX

SimWeight	u_x	u_y	....	u_k	....	u_u
u_x	1	$SimWeight_{x,y}$		$SimWeight_{x,k}$	....	$SimWeight_{x,u}$
u_y	$SimWeight_{y,x}$	1	....	$SimWeight_{y,k}$	....	$SimWeight_{y,u}$
....	....	....	....	....	....	....
u_j	$SimWeight_{j,x}$	$SimWeight_{j,y}$	....	$SimWeight_{j,k}$	....	$SimWeight_{j,u}$
....	....	....	....	....	....	....
u_u	$SimWeight_{u,x}$	$SimWeight_{u,y}$	....	$SimWeight_{u,k}$	....	1

4) Seasonal Crop Database: We have maintained a crop database where all the crops which are produced in our country are stored along with seasonal information. In Table V we have shown sample structure of its maintenance.

5) Crop Production Rate Database: There are about one hundred types of crops produced in Bangladesh. Not all of them are suitable for producing in all area. Only considering the crop growing period regime code, thermal regime code and physiographic location code can't give the proper idea of crop growing trend in a location. So, we have also considered crop production rate of each crop in metric ton per hectare for every upazila. In Table VI we have shown average crop rate of some of the crops in Raozan, Fathikchari and Satkania Upazila.

C. Similar Location Detection Module

In this module we detect the upazilas which are most similar to the current user's upazila. This module consists of two components: Similarity calculation and Top-N similar upazila selection.

1) Similarity Calculation: Using the information stored in crop growing period database, thermal zone database, and physiographic database similarities of the other upazilas with current user's upazila are calculated. We used pearson co-relation based similarity algorithm to calculate the similarities which is the most popular among the similarity measurement algorithms for recommender system.

Let, N = $|C_j|$ be the set of regime codes in our system. Assume that both upazilas u_x and u_y have weight values (percentage of the total area under the considering regime code for a upazila) w_j and w'_j for regime code C_j. Then two vectors U_x and U_y can be constructed respectively as below:

$U_x = <w_1, w_2, \ldots, w_j, \ldots, w_N>$

$U_y = <w'_1, w'_2, \ldots, w'_j, \ldots, w'_N>$

Then pearson co-relation similarity is computed as :

$$SimWeight_{x,y} = sim_{pearson}(x,y) = \frac{\sum_j \left((w_j - \bar{U}_x)(w_j' - \bar{U}_y)\right)}{\sqrt{\sum_j (w_j - \bar{U}_x)^2}\sqrt{\sum_j (w_j' - \bar{U}_y)^2}}$$

2) Top-n Similar Upazila Selection: After measuring the similarity weight between two upazilas, we then formulate a similarity matrix(SM) for all upazilas. The (j,k)-th element of SM, $SimWeight_{j,k}$, contains the similarity weight of two upazilas j and k ($1 \le j \le |U|$, $1 \le k \le |U|$, $j \ne k$) where $|U|$ is the total number of upazilas. From Table 3.8, given a upazila (u_j) as a query, we can rank other upazilas in this set ($u_k \in U, j \ne k$) according to their similarity weight ($SimWeight_{j,k}$) to u_j. Then a group of upazilas ($U', |U'| = n$) *with relatively* high similarity weights can be retrieved as *"similar upazilas"* of u_j.We considered that we have the regime codes for upazilas as shown in Table VIII. Fig. 2 shows the algorithm to work with such information for getting top-N similar upazilas.

D. Recommendation Generation Module

The final module of our system architecture is recommendation generation module. Here we use average crop production rate database and top-n similar upazilas for generating recommendation. In this module to decide which crops are to be considered for recommendation at first we have to know current season. We developed an algorithm shown in Fig. 3 for identifying the current crop production season by utilizing Table I, Table II and Table III. Then we filter out the crops for current identified season from the crop list shown in Table V.

Let, X = $|Crop_j|$ be the set of all crops of current season in our system. Then we used following formula for calculating average production rate of each crop:

$$R_j = \frac{1}{m}\sum_{i=1}^{n} (r_{i,j} \times SimWeight_i) \; ; r_{i,j} \neq 0, \; m \leq n, \; i \epsilon U'$$

Where R_j is the average production rate of each crop $j \epsilon X$, $r_{i,j}$ is the production rate of each crop j for upazila i, m is the total number of upazilas for which $r_{i,j} \neq 0$ and $SimWeight_i$ is the similarity weight of upazila i for current upazila. Then a group of crops($X' \epsilon X$) with relatively high average production rates are retrieved as the top-k recommendable crops for user of current upazila. Corresponding algorithm is shown in Fig. 4.

TABLE VIII
REGIME CODES FOR SIMILARITY CALCULATION

Upazila	Regime codes					
	agro climatic Codes			agro ecological codes		
	K6P4T3E1	K6P4T2E1	K5P4T2E1	22	23	29
u1	0.15	0.45	0.40	-	0.4373	0.5627
u2	0.92	0.08	-	-	0.639	0.361
u3	0.08	0.82	0.10	0.06	0.94	-

Algorithm: Similar_upazila_selection
Input: Current upazila.
Goal: Top-N similar upazila selection by similarity weight calculation

1. **begin**
2. Get regimeCode from table for current_upazila
3. Sum up the regimeCodeWeights
4. Get regimeCode from table for upazilas ≠ current_upazila
5. **for** each upazila ≠ current_upazila**do**
6. sum up the regimeCodeWeights
7. calculate the similarity_weight with respect to current_upazila
8. **end for**
9. sort out the similarity_weight of each upazila in descending order
10. select top-N upazilas from sorted similar upazila list
11. **end**

Fig. 2. Algorithm for calculating top-N similar upazilas

Algorithm: Current_season_detection
Input: Current date and month
Goal: Find out the current season for crop production

1. **begin**
2. **for** each type crop growing period regimeCode of current_upazila**do**
3. **if** (current_month=end_month **and** current_date < =end_date)
4. get the season
5. **elseif** (current_month=start_month **and** current_date>=start_date)
6. get the season
7. **elseif** (current_month<end_month **and** current_month>start_month)
8. get the season
9. **elseif** (current_month>end_month **and** current_month>start_month)
10. get the season
11. **else**
12. do nothing
13. **end if**
14. **end for**
15. **end**

Fig. 3. Algorithm for current season detection

Algorithm: Crop_recommendation
Input: Seasonal crop list and top-N similar upazila list
Goal: Top-k suitable crop selection for recommendation

1. **begin**
2. **for** each crop in seasonal crop list **do**
3. **count=0;**
4. **sum=0;**
5. average_crop_rate**=0;**
6. **for** each top-N upazila do
7. **if** (crop production rate != 0)
8. **sum = sum**+crop production rate* similarity_weight of the upazila
9. **count**++;
10. **else**
11. do nothing
12. **end if**
13. **end for**
14. average_crop_rate=(**sum/count**)*crop production rate for the current_upazila
15. **end for**
16. Sort out the crops list according to average_crop_rate in descending order
17. Select top-k crops from sorted crop list
18. Recommend the top-k crops to user
19. **end**

Fig. 4. Algorithm for top-k crop recommendation

IV. IMPLEMENTATIONS AND EXPERIMENTS

In this section, we provide the implementation procedure and performance analysis of our developed system.

A. Experimental Setup

The developed recommendation system for farmers (RSF) has been developed on a machine having the windows 7, 2.20 Core i5-5200 processor with 4GB RAM. The system has been

developed using XML in the front end and SQLite Manager is used in the back end for storing related data to complete this project. For coding we have used JAVA in Android Studio.

We considered total fourteen crop growing upazilas under Chittagong zila for experimental purpose. For each upazila we have collected real data related to seasonal, agro-ecological and climatic data from "Agricultural information office", "Soil Resource Development Institute (SRDI)" and "Bangladesh Agricultural Extension Department". We found that there are mainly seven climatic regime codes the weight of which varies upazila-wise in Chittagong region. We saved the data associated with these weight values in our database and performing associated operations recommended top-10 crops.

B. Implementation

In our system we have considered two languages : Bangla and English for user interface. We have set interface in Bangla by default so that a user can continue with the system in Bangla. But if he wishes to change the interface language to English he has to select it. Fig. 5 shows the user welcome interface both in Bangla and English. Next, if the user presses in the button as in Fig. 6 the system will start its location detection activity for current user and If the system can successfully identify the location, a toast message is shown (Fig. 7). Then the next step of recommendation generation for the identified upazila starts in the backend. After the recommendation generation processing is over in backend as described before we get the top-k crops as shown in Fig. 8.

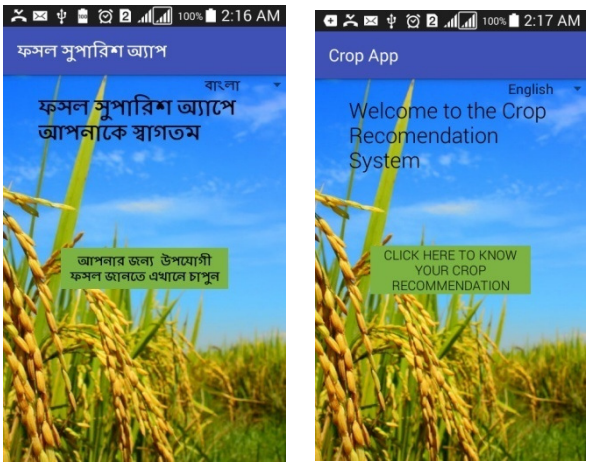

Fig. 5. Welcome layout of the system

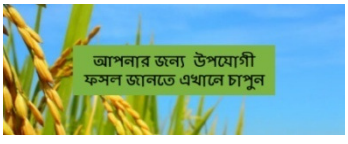

Fig. 6. Request for starting location finding activity

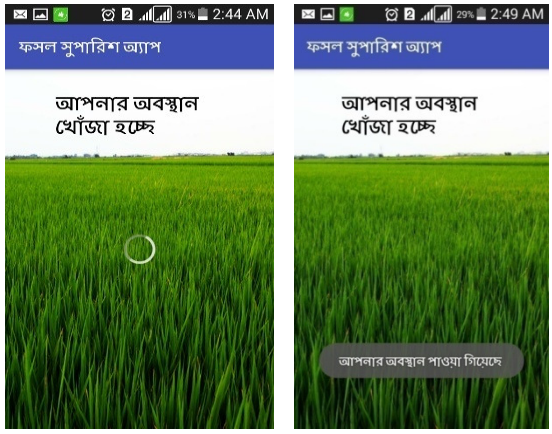

Fig. 7. Location finding activity

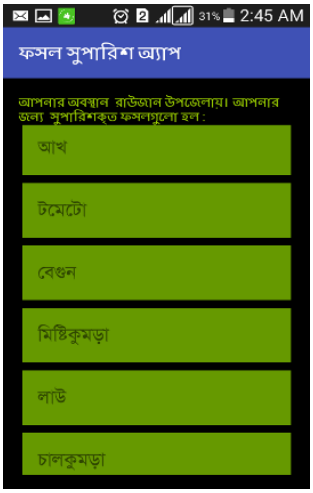

Fig. 8. Top-k recommended crops for current user

C. Performance Evaluation

We have evaluated the performance of our proposed system with respect to documents of Table IX. We used precision and recall performance evaluation metrics for performance analysis of our system. Precision is the fraction of recommended crops that is actually relevant to a upazila, while recall can be defined as the fraction of relevant crops that are also part of the set of recommended crops. They can be computed as:

$$precision = \frac{correctly\ recommended\ crops}{total\ recommended\ crops}$$

$$recall = \frac{correctly\ recommended\ crops}{total\ useful\ recommended\ crops}$$

We show the result for top-10 crops for each upazila in Table X and in Fig. 9.

TABLE IX
KHARIF-1 CROP LIST IN DIFFERENT UPAZILAS

Upazila name	Total useful recommended crops	Crops name
Raozan	11	*Ropaawoshufsi, Sugarcane, Sweet Gourd, Bottle gourd, Brinjal, Tomato,teasle gourd, Bitter gourd, Kangkong, Cucumber,String bean*
Sitakundu	8	*Ropaawoshufsi, Sugarcane, Sweet gourd, Brinjal Tomato, Teasle gourd, Bitter gourd, String bean*
Mirsorai	10	*Ropaawoshufsi, Sugarcane, Sweet Gourd, Bottle gourd, Brinjal, Tomato,Teasle gourd, Cucumber, Ginger,Okra.*
Anowara	13	*Ropaawoshufsi, Sugarcane, Sweetgourd, Bottle gourd, Brinjal, Tomato,Teasle gourd Bitter gourd, Kangkong, Cucumber,String bean, Ginger,Okra*
Satkania	10	*Ropaawoshufsi, Sugarcane, Sweetgourd, Bottle gourd, Brinjal, Tomato, Cucumber,String bean, Ginger,Okra.*
Fathikchari	14	*ropaawoshufsi, sugarcane, sweet gourd, bottle gourd, brinjal, tomato,teasle gourd, kangkong, cucumber,string bean, ginger,okra, peanut, maize*
Rangunia	11	*Ropaawoshufsi, Sugarcane, Sweet gourd, Bottle gourd, Brinjal, Tomato,Teasle gourd, Bitter gourd, Cucumber,String bean,Okra,*
Lohagara	12	*Ropaawoshufsi, Sweet gourd, Bottle gourd, Brinjal, Tomato,Teasle gourd, Bitter gourd, Kangkong, Cucumber,String bean, Ginger,okra*
Bowalkhali	10	*Ropaamon local, Sweetgourd, Bottle gourd, Brinjal, Tomato, Bitter gourd, Kangkong, Cucumber,String bean, Ginger,Okra*
Bashkhali	14	*Ropaawoshufsi, Sugarcane, Sweetgourd, Bottle gourd, Brinjal, Tomato,Teasle gourd, Bitter gourd, Kangkong, Cucumber,String bean, Ginger,Okra, Sesame*

TABLE X
PRECISION AND RECALL FOR TOP-10 CROPS

Upazila Name	Total useful recommended crops	Total recommended crops	Correctly recommended crops	Precision	Recall
Raozan	11	10	8	0.8	0.73
Sitakundu	8	10	6	0.6	0.75
Mirsorai	10	10	6	0.6	0.60
Anowara	13	10	8	0.8	0.62
Satkania	10	10	8	0.8	0.80
Fathikchari	13	10	8	0.8	0.63
Rangunia	11	10	8	0.8	0.73
Lohagara	12	10	6	0.6	0.50
Bowalkhali	10	10	6	0.6	0.60
Bashkhali	14	10	8	0.8	0.57

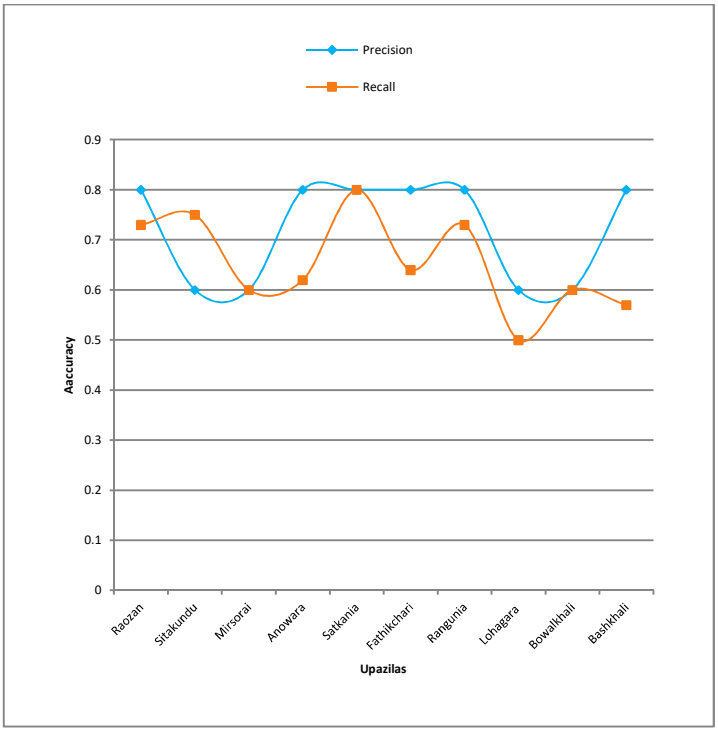

Fig. 9 Precision and recall curve

V. CONCLUSION

In Bangladesh farmers are the main economic power source. However, the lacks of appropriate knowledge in deciding which crops are appropriate for him to grow at different sessions compel them in producing wrong crops and thus they are misguided. In this paper we developed a recommendation system to help farmers in choosing appropriate crops. From the experimental evaluation, we found that the developed system can recommend appropriate crops to a satisfactory level. Although in this paper, we considered the system for upazila level, the system can be extended to the union level and also to village level which can provide much better crop recommendation. Variations in crops can also be considered and user feedback can be added in further research.

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