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Enhancing Irrigation Farming In Nigeria Using Software Technologies

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Abstract- The rapid increase in population in Nigeria has brought the need for a massive increase in agricultural produce to cater for the population. In view of this, traditional farming only during the annual rainy season cannot suffice to cultivate enough farm produce for the nation. Therefore, irrigation farming that allows farmers to plant crops throughout the year is now embraced across the country. However, lack of knowledge about the crops that can grow best in a particular land and the exact amount of water and fertilizer needed in the farm is leading to poor output. This study proposes intelligent irrigation software system to improve irrigation farming in Nigeria by acquiring and sharing information about crops requirements (soil, quantity of water and fertilizer) with farmers. With the use of Global Positioning System (GPS) and expert agricultural information, data is capture by the software, analyzed and shared with the selected farmers. The final output is generated and sends to the Farmer via Short Message Service (SMS) describing the accurate farmland size, suitable crops to plant, as well as the agrochemicals needed in the farmland.

Index Terms- Agricultural Information System, Irrigation farming, AFAN, GPS,

I. Introduction

It wouldn’t be an exaggeration to say that nearly every farmer that is in to irrigation farming for over 10 years in Nigeria now has a mobile phone. A trial being conducted by the AFAN is showing that the mobile has great potential for more than phoning home. About 90% of the country’s food is produced by small-scale farmers cultivating tiny plots of land [1]. Irrigation Agriculture in Nigeria is plagued with problems of poor access to information, inputs and low productivity [8]. Farmers face unpredictable weather brought on by climate change, sometimes the rainy season comes late; at other times, it ends early, and sometimes the rains come late and hard causing floods. At other times, rains don’t come at all, causing drought. With these weather changes, it is difficult for farmers to plan which crops to grow, when to prepare land, when to plant, and how to plan other farming tasks. Worst hit are those from the North who have to respond to serious weather changes, making it difficult for them to farm during dry season, which runs from October to May. The weather during this period is much hotter and drier [7].

Agricultural irrigation in Zamfara State is plagued with problems of poor access to information, inputs and low productivity. Most farmers in state fail to have much knowledge about the nature of their farmlands, the accurate size of their farmlands this drawback leads to either under or over application of agrochemicals and fertilizer, which leads to poor yield and the farmers mostly run their farming at lost and end of becoming discourage in the entire system. Computer technology analyses the data and sends a short message about irrigation for the crop by mobile phone. For example, it tells you how long to run a drip irrigation system for a vineyard, the computer system applies a crop factor for low, medium or high watering over a season and calculates dripper run times, based on the individual irrigation system’s output. A short message is automatically sent to a mobile phone by SMS each morning. For evaporation text message advice, cumulative evaporation readings for the past week are collected and sent by mobile phone. As it develops, more farmers will save money in water monitoring and irrigation costs, by making appropriate budget. The advancement in the technologies has enabled the use of state-of-art technology at a reasonably low cost [11]. The objectives of this study are to:

1) To help farmers to have access to basic information about their farm requirements and weather condition in the farm.
2) Enable farmers to make appropriate planning with regards type of crop to plant, required fertilizer and quantity of water needed daily.
3) Update and share the information regularly with the selected farmers.

For this reason, the proposed study aimed at providing solution to the problems by developing real time Intelligent Irrigation Software System (IISS)**.**

II. RELATED WORKS

The National Economic Council recently reported that Nigeria spends 2.8 billion American dollars annually on food importation [8]. In fact the situation is getting worst as the global food crisis is reaching alarming rate and has become a great concern. Recently, World Bank inaugurates 1.2 billion American dollar 'fast –track facility to boost its support for global agriculture and food to overcome global food crisis [8]. We should note that the first goal of the eight Millennium Development Goals, eradicating extreme hunger and poverty has been traced to agriculture. This first goal calls for halving hunger and poverty by 2015 taking 1990 as the base line [5].

The GPRS feature of mobile phone is used for proving solution to irrigation control problem. Sufficient amount of water can be given to the fields. The system sends messages using GSM [3]. The scheme has a 47m long concrete weir constructed on Oshin River to impound water for irrigating about 100hectares of farmland at the inception. Additional weir was constructed in 2001 down the main weir together with the improvement made by increasing the height of the former weir. Throughout the world, irrigation schedules are based on farmer's experience and changes according to weather fluctuation which can be handled by smart irrigation system. This approach requires PCs (Client/Server) along with additional devices like modems, buffers, etc. for internet connectivity and software support for TCP/IP protocols and control system interaction [4]. The target however is to be able to cultivate about 1000ha. This is one of the reasons for the additional weir constructed in 2002 [9]. With over 70 per cent of rural people in agriculture their access to productive resources and employment is critical. According to IFPRI report 2002, more productive agriculture is vital, for productive gain in agriculture would boost the income of rural people both on and off the farm and to the extent that gains in agriculture productivity leads to lower food prices. Despite this, many rural people do not have the tool they need, to be more productive farmers [6]. For instance they need access to credit and savings institutions, fertilizer, as well as high yield seedlings.

III. METHODOLOGY

Global Positioning System devices, and also Digital Cameras were used in mapping the farm and the data was recorded and uploaded to the computer. This study achieved by examining the trends of irrigation system component parts and its interactions [10]. The goal of farmland mapping is to enable better performance so that it can lead greater profits and serve its constituents more effectively [2]. The finite step by step of solving a problem is term to be algorithm, several algorithms were used to solve the problem, among which include: The algorithm for transforming the waypoints in to the longitude and latitude to distance. Using the 'Haversine' formula to calculate the great-circle distance between two points (the shortest distance over the earth's surface – giving an 'as-the-crow-flies' distance between the points ignoring any hills they fly over). Algorithm for converting the waypoints as input determines the distance and the hectares of the farmland. Also, the algorithm that accepts hectares of the farmland determines the required inputs and agro chemicals needed. Lastly, algorithm for sending sms to the farmer is obtained.

Algorithm 1. Identifying the size of farmland using GPS

```
Procedure Computefarmland_Size( N, longitute1, longitude2, latitude1, latitude2, elevation1, elevation2; var reportfile);
{
counter ← 0;
Const1← 6378137,  Const2 ←6356752.314;
Open file(reportfile);
While (counter<= N and N<>0 ) do
{
        β ← Radiuspt2*SIN(Θ2*PI()/180);
        α ← Radius pt1*SIN(Θ1*PI()/180);
        Hectare ← (Distance↑2)/1000;
        Distance ← (XCoordinate↑2 +  YCoordinate↑2)↑½ YCoordinate ← 2*PI()*(((XY1 +  XY2)/2))/360)*(Latitude 1- Latitude 2);
        XCoordinate ← ((XY1 +  XY2) ↑2 + (α - β) ↑2) ↑½;
        XY1← Radiuspt1*COS(Θ1*PI()/180);
        XY1← Radiuspt2*COS(Θ2*PI()/180);
        Radius pt2 ← (1/((COS(Θ2*PI()/180)) ↑2/Cconst1↑2+(SIN(Θ2*PI()/180))    ↑2/Const2↑2)) ↑½ + (Elevation1 +  Elevation2) /2;
        Radius pt1←(1/((COS(Θ1*PI()/180)) ↑2/Const1↑2+(SIN(Θ1*PI()/180)) ↑2/Const2↑2))    ↑ ½ + (Elevation1 +  Elevation2)/2;
        Θ2←(ATAN((Const2↑2)/(Const1↑2)*TAN(longitude2*PI()/180)))*180/PI();
        Θ1←(ATAN((Const2↑2)/(Const1↑2)*TAN(longitude1*PI()/180)))*180/PI();
        Write (reportfile, Hectare);
        Counter ←counter +1
}
}
End
```

The algorithm is used to compute the size of each farmland. It takes totalfarmlands(N), longitute1, longitude2, latitude1, latitude2, elevation1, elevation2 as input parameter and return hectare as output parameter, and the hectares are stored in a report file.

Algorithm 2. Calculating the quantity of agro chemicals

PROCEDURE AGROINPUT(Crop; Reportfile)
 Open file(Reportfile);
  Ectract :(Reportfile, hectare)
  for all hectare h ∈ farmland **do**
   if crop ← true then
   NPK← getNPK (crop);
   UREA ← getUREA(crop);
   Trigger agrochemicals(crop);
   End if
  End for
}

This algorithm receives type of crop and reportfile and read the hectares from the report file and make computations base on the hectare size and the type of crop.

IV. RESULTS

The result indicate the actual inputs required from the sample of farmlands selected and mapped because the actual size of each farmland was computed. This has helped to eliminate the issue of low input or over applying inputs.

Table 1: Comprehensive Analysis of the Farmland

FARM LAND	Elevation 1	Elevation 2	Longitude1	Longitude2	Latitude 1	Latitude 2	HECTA RE
1	297	299	12.38219	12.38234	005.58067	005.58065	1.52
2	292	297	12.38219	12.38214	00558008	005.58115	1.37
3	299	299	12.38185	2.38190	005.58237	005.58210	1.9
4	398	397	12.38161	12.38139	005.58315	005.58343	1.77
5	298	299	12.38109	12.38017	005.58417	005.58388	1.09
6	298	299	12.38109	12.38017	005.58417	005.58388	1.21
7	364	366	12.38250	12.38340	005.58664	005.58694	1.18

Table 2: The Required Farmland Input and Agrochemicals

FARM LAND	CROP	HECTARE	NPK 20:10:10 (Kg)	UREA 46% (Kg)	NPK 15:15:15 (Kg)	SSP 18% (Kg)	SEED (Kg)	Pestcide (g)	Habicide (g)
1	MAIZE	1.52	456	304	-	-	-	-	-
2	RICE UP LAND	1.37	274	548	-	-	-	-	-

3	S/BEANS	1.9	-	285	285	-	-	-	-
4	G/NUT	1.77	-	265.5	265.5	-	-	-	-
5	MILLET	1.09	436	218	-	-	21.8	-	-
6	COWPEA	1.21	-	-	3.63	1.21	24.2	-	-
7	RICE LOW LAND	1.18	354	236	-	-	82.6	23.6	472

V. CONCLUSION

The system of irrigation is fading simply due to inadequate knowledge from the required agencies to the farmers, leading to a lot of drawback. But with the new system where a farmer can make adequate plan for the farming due to this technology, a lot of people will adherent the system to go back to irrigation.

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