School of Science

Department of Computer Science and Mathematics

Course: Bachelor of Information Technology

Project Title: National Irrigation Board Management System

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Table of Contents

1: EXECUTIVE SUMMARY

1.1: Problem statement.

Rice growing in Kenya is typically based on irrigation schemes, with an approximation of 13000 ha. Most of the rice produced in Kenya comes from Mwea irrigation schemes whereby rice production is based on recurrent flooding of paddy soil. Studies have shown that soil fertility in the region is medium to high in terms of nutrients composition therefore suitable for average rice production. Despite the suitable nutrients composition, most of the regions in Mwea have become stagnant in terms of rice production which has been fronted by soil degradation. Identifying possible nutrients hotspots could be an initial point of identifying nutrients deficiencies, toxicity levels, and ph. concentration in soil and indorse appropriate agricultural practices, such as right quantities of fertilizer applications, chemical applications to avert the degradation effects.

Accordingly, there is a need to store such data in a system that tracks changes in soil composition. In essence, if the system shows a consistent soil composition at a certain season or region, it is easy for the board to recommend appropriate measure and even predict soil nutrients composition changes, therefore easier to advise farmers. To acquaint you with a broader repertoire, the National Irrigation Board lacks a substantive inventory system, therefore the proposed system will store data regarding nutrients compositions across different regions and automate manual record keeping.

1.2: Purpose and Motivation

The main objective of the project is to create a desktop application that enables rice irrigation boards across the Mwea region to calculate nutrients composition across different regions as well as automate manual inventory tasks at the organizations. The motivation to develop this project is spearheaded by:

- An interest to create a system that achieves efficiency, and productivity in the operation
- Interest to minimize inventory cost and maximize sales at the irrigation board.
- An interest to integrate the entire business
- Automation of inventory work, therefore, saves time and effort to do an inventory recount.
- Keep track of soil conditions in the regions.
- Ensure accurate record keeping.
- Ensure that the farmers are happy and the overall rice production in the region are uplifted.
- Increase my knowledge horizon in technologies such as SQLite, python and its frameworks such as Tkinter.

2: PROJECT DESCRPTION

2.1 Overview:

Plants need nutrients for germination, growth, fight pest and diseases and reproduce. With a wide variety of nutrients composition, soil acts as the epicenter of plant growth. The soil nutrients are divided into micronutrients and macronutrients, nonetheless, nutrients composition is not limited to plant species, and rather nutrients composition is based on crop variety. Macronutrients are nutrients that are by large necessitated by crops during the development period, such as nitrogen, phosphorous, potassium, magnesium, and calcium. As much as micronutrients are required in small quantities they play a vital role in plant growth. Such nutrients include Boron, Iron, and Zinc.

In crop farming, crop production is reliant on the nutrients supplied to the crops, or even the crop farming strategy assimilated by the farmer, for example, the farmer may decide to add compost manure as a nutrient supplement or as a strategy to improve soil water retention capabilities. Ideally, soil composition is composed of organic matter (5%), water (20-30%), mineral (45%), and air (20-30%). Soil composition is dynamic and complex therefore, it may fluctuate or vary depending on the soil type, water availability and retention capacities, farmers' cultivation practices, etc.

In Kenya's food supply metric, rice farming is considered, the third staple food after maize and wheat. Like any other crop, rice farming undergoes processes such as planting, pest and disease control, fertilizer application and harvesting. It takes about four to five months for

rice crops to become mature. Rice farming is dependent on the type of soil, nonetheless, most of the rice crops are grown in paddy soil. Various varieties of rice crops include Sindano, Basmati, Pishori, Aromatic, Basmati 370, Basmati 217, BW 196, Jasmine-85, NARIKA 10, NARKA 11, Nam Roo, WAB 181-18, and ITA 310.

2.2: Basic rice growth requirements

Paddy soil

- An ecological condition of annual rainfall gauging as from 800 mm to 2000 mm.
- The temperature of 20-36 degree Celsius
- Soil type: an average composition to a mixture of clay soil and sandy soil.
- Soil PH level: 4.5 – 7.0
- Land should be plowed two weeks prior to sowing and flooding of the farm.
- Flooding is done to a depth of 10 cm, 15 days before transplanting the seeds.
- Weeding is carried out 4-5 weeks after transplanting and is carried out twice.
- Pest and disease control. Diseases include- blast, mottle, damping off, sheath bright, sheath rot. Pest includes leaf miners, rice borer, birds, rice sucking bugs, rice leafhopper, etc.
- Harvesting is done 5-6 months after planting. Dependent on the rice variety.
- Expected yield from a paddy soil: 25-30 sacks /acre.

2.3: Macro and Micronutrients Prominence

2.3.1: Nitrogen

- Encourages vegetative development of plants by imparting a health green color on plants
- Rice crops depend on nitrogen for the decomposition of matter
- During the rice growth period, rice requires nitrogen for early vegetation and panicle initiation stage
- Promotes tillering which would lead to better yields

2.3.2: Phosphorous

- Promotes growth at an early stage
- Promotes the development of strong root development
- Promotes early flowering
- Critical for producing maximum rice grains yields.
- Increases resistance to disease and strengthens rice stems.

2.3.3: Potassium

- Enhances the ability of crops to resist diseases and adverse conditions.
- Plays an important part in the production of starch.
- Improves the plants' ability to absorb other nutrients
- Influences tillering and branching of plants and increase grain weight.

2.3.4: Calcium

- Promotes activity of soil bacteria concerned with the fixation of nitrogen
- Assists in the development of good root systems.

- An essential component in the development of cell wall

2.3.5: Zinc

- Important in the synthesis of carbohydrates
- Regulates consumption of sugar
- Acts as a metal activator of enzymes
- Rice crop removes 30-40 g Zn per ton of grain

2.4: Deficiencies

Lack of nitrogen leads to:

- Stunted growth in rice
- Yellowing of leafs
- Abundant foliage
- Retarded flowering

Phosphorous deficiency

- Rice crops stunt with a reduced tillering
- Stems thin and spindly
- Poor branching in rice
- Poor root growth

2.3: Soil degradation in rice farms

Soil degradation has become a common threat especially when it comes to paddy and loam soil. Maybe, with the high intake of nitrogenous and phosphoric components, the soil loses its ability to absorb more nutrients. Soil degradation occurs when the soil loses its chemical, biological, and physical composition therefore losses its soil fertility. Soil degradation is a general term representing loss of organic matter in the soil, reduction of soil fertility in the soil, higher changes in soil acidity levels, alkalinity levels, salinity, change in soil structural conditions, or even accumulation of toxic chemicals in the soil. Crop practices and fertilizer application criteria have registered to affect micronutrient availability, and structural condition of the soil (Haifa Group, 2020). Accordingly, studies have satisfied that soil pH, a nutrient composition such as phosphorous and organic matter composition affects macro and micronutrient availability under various soil conditions. PH level plays a crucial part in soil composition as it acts as a predictor towards the estimation of heavy metals in the soils. Consequently, soil ability to provide micronutrients directly to the crops is a dependent factor towards the physiological function of the plants, structural development of the plants, and better product quality.

The need for rice consumption has increased rapidly per capita. Following a EUCORD report (), the rice consumption rate commonly in the urban region has increased by 12%, compared to wheat at 4% and maize at 1%. Unfortunately, the country is a deficit to maintain such a huge ration. With such a deficit the country is forced to import rice from outside countries such as Pakistan, India, Thailand, and Vietnam.

2.4: Determining Nutrient composition.

Determining the nutrient compositions such as nitrates, potassium and phosphorous can assist to reveal how the soil is functioning and determine the cycle of nutrients in the soil. Often nutrients test provides average nutrients compositions (mg/L) of all the tested nutrients in that type of soil. In a rice farming setting, determine the nutrients composition in the paddy soil can assist know what type of fertilizer to apply, what quantity of fertilizer to apply, deficient nutrients that need to be supplemented or balanced, and determine the seed type that would be favorable in that soil condition. For example, higher nutrients levels in the paddy soil can surpass the flowering of the rice crops but with a balanced composition of nitrogen and phosphorous rice, growth criteria is optimal. Following a Jove, Cambridge (2020) journal, the author delineates that “determining the nutrients composition assists the farmers to know the nutrients deficiencies and surpasses that can detriments rice growth. Most nutrients in the soil are removed after harvesting as the nutrients are utilized in rice development life cycle, For example, accumulation of nitrogen is high at the initial growth stage and later nitrogen is translocated to the grains after flowering. Accordingly, some nutrients such as zinc and phosphorous availabilities dependent on soil pH level. For example, if the soil pH is greater than 6.8 (pH>6.5) zinc is most likely to be deficient particularly if the rice variety is not tolerant of that soil

condition. Accordingly, optimum availability of potassium occurs if the soil pH level range between 6 and 6.5. When the soil is acidic, potassium is absorbed by other nutrients such as iron and aluminum oxide.

	Nitrogen	Phosphorous	Potassium	Calcium	Iron
Low	0-15	0-25	0-60		
Medium	15-30	25-30	60-100		
High	30+	50+	100+		

Guide for interpreting nutrients concentration from plant tissues analysis.

Nutrients	Plants Part	Growth Stage	Nutrients concentration required for adequate growth.
Phosphorous (p)	Y-leaf*	Mid-tiller Panicle Initiation	0.14% - 0.27%
			0.18% - 0.29%

Potassium (k)	Y-leaf	Mid-tiller	1.5% - 2.7%
		Panicle Initiation	1.2% - 2.5%
Calcium (Ca)	Y-leaf		
		Panicle Initiation	0.16% - 0.39%
		Mid-tiller	0.19% - 0.39%
Magnesium (Mg)	Y-leaf	Panicle Initiation	0.12% - 0.21%
		Mid-tiller	0.16% - 0.39%
Sulphur (S)	Ws	Panicle Initiation	0.17%
		Mid-tiller	0.15%
Iron (Fe)	Y-leaf	Panicle Initiation	89 - 193 ppm
		Mid-tiller	74 - 192 ppm
Manganese (Mn)	Y-leaf	Panicle Initiation	237 - 744 ppm

		Mid-tiller	252 - 792 ppm
Zinc (Zn)	Y-leaf	Panicle Initiation	22 - 161 ppm
			33 - 160 ppm

2.5: Proposed systems.

The proposed systems is a desktop-based application whereby the national irrigation board staffs can calculate various nutrients compositions in paddy soils. This software is developed to perform two tasks. First, the system will calculate the nutrients' composition in a certain region, calculates the total composition of the selected nutrients and recommend the type of fertilizer, type of rice seed favorable in that soil condition. Accordingly, the recommendation will include nutrients percentages to be applied in the soil either to surpass or increase soil nutrients based on the soil pH level of that region. After calculating the nutrient requirement levels, the results are stored in the database, therefore a researcher or an interested farmer can refer to the prior compositions and relate various soil nutrient distributions across a given period. All records are saved in the database for report generating.

The second part of the system entails an inventory system, whereby the user inputs and a product name, assign a unique id to the product, enters the stock of the product, cost priced and selling price, total selling prices and cost prices and the vendor name. The inventory part of the

system assists the organization to reduce the manual input and output of the product, instead, the system automates the process. As well the system can assist monitor and track and control transactions at the board.

The software features a well thought and simple design, with an attractive user interface, combined with a search product capabilities, a comprehensive database storing each transaction singly and a printout option whereby users can print a transaction or even a recommendation.

For example, consider a soil composition that has a nutrient percentage of nitrogen – 30%, phosphorous 25%, potassium – 15%, the zinc percentage of 18% and a pH level of 5. The system will calculate the total composition of the soil in the tested region, then add the composition to the database. If the soil test results are wrong the users can edit the tests. In our case, the total soil composition is 88 indicating that the soils have a high nutrients composition. Thereafter the system will recommend the type of rice seeds that are favorable to that soil condition, the type of fertilizer to apply in such a soil condition to prevent overloading the paddy soil with nutrients chemical application and a recommendation on how to reduce or improve the soil pH level.

After identifying soil requirements, the user can now add new products or update products in the inventory. For example, add a Basmati rice variety, to the database.

Systems configuration

H/W configuration

System: Intel (R) Celeron (R)

Hard disk: 500GB

Monitor: 15 “LED”

Input devices: keyboard, Mouse

RAM: 4GB

S/W system configuration:

Operating system: windows 7,8,10

Coding language: python, tkinter

Database: SQLITE 3.

Modules. Interface one.

- Search: searches all product names by its assigned ID.
- Add to the database: adds the products ID, product name, stock of the product, cost price of the product, selling price, total cost and selling price, vendor name and vendor, vendor phone number.
- Update database: updates products ID, product name, stock of the product, the cost price of the product, selling price, total cost and selling price, vendor name, and vendor, vendor phone number
- Clear all: clears all fields in the systems.
- Calculate total: calculates the total composition of nutrients in the soil.
- Add composition: adds the total composition to the database.
- Suggest: providers' recommendations based on the total nutrients composition.

Modules: Interface two.

- Search: Searches the product by its ID, and outputs product name and the price of that product.
- Add to Cart: adds the selected products, together with the quantity and total to the cart.
- Calculate Change: calculates the total change, after calculating the total amount in the cart and subtracting from the given amount.
- Generate bill: generates a bill showing the total products bought by the farmer, and the total amount and change.

Conclusion

The national irrigation board management system is a software that tries to overcome the low production of rice in the Mwea region by calculating the nutrients composition after every season as well as reduce the time and effort spent in record keeping. By automating the process it is easier for the researchers to improve or introduce rice seed varieties that favor that soil condition. Accordingly, it will be easy to track different soil nutrients variation therefore, the organization can recommend best practices that will improve crop yields.

Further scope.

This software can operate in any operating system and an agricultural sector that needs to improve crop production in that region. Modifications of the software can be easily done to suit the mandated environment. It can be used as an inventory system in a store, aiming to store daily transactions or actually automating the manual work in a store.

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