Neighbourhood Farm
Stock Management and Data Analysis

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Abstract: Neighbourhood Farm is initiative committed to the development of community market gardens for the growing of organic crops at schools in the Deep South of Cape Town stretching from Muizenberg through to Kommetjie. This project proposal will attempt the implementation of ICTs to amplify the farming operation of the Neighbourhood farm initiative. This part of the project will attempt to design ICT based solution to resolve potential problems relating to stock management and data analysis.

Keywords: SMS-Stock Management System, Food Security, URD

1. Introduction

Food insecurity is a major global challenge in both developing and developed countries with its main effects being heavily felt in poor marginalized populations within these countries. Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life [1]. According to some population statistics, of the estimated additional 2.2 billion people who may be added to the world's population between 2017 and 2050, 1.3 billion will be added in Africa [2]. From the previous fact, food security has become an area of interest that requires much attention especially in the sub-Saharan region. Governments and non-governmental organizations across the globe have been pursuing programs and policies aimed at attaining food security in the past and recent years, with much effort being channeled in the developing countries where insufficient food is a more a common issue. Despite the efforts, most commonly when such programs and policies are set up and initiated, they face several different challenges that threaten their impact in contributing to food security. Some of the challenges that the programs face can be linked broadly to operations and management. In this project we propose the implementation and use of Information Communication Technologies (ICTs) based solutions as amplifiers in the management of operations at farm level specifically concentrating on the Neighbourhood Farm (NF) initiative, a project that is build up inline with the food security programs. ICTs in the Neighbourhood Farm will be implemented in the areas of stock management, data analysis, payment and pre-order .However this part of the project aims to use ICTs in the areas of stock management and data analysis.

1.1 About Neighbourhood Farm

Neighbourhood Farm is a project committed to the development of community market gardens for the growing of organic crops at schools in the Deep South of Cape Town stretching from Muizenberg through to Kommetjie. The communities in this area represent a full economic spectrum from well-resourced to critically in need. The Neighbourhood Farm project does not just aim to grow vegetables and community spirit, moreover there's an economic heart to the project as well. Beyond showing children how food is grown, the market garden provides a small revenue stream from distributing and selling healthy food to

both the school and the local community. This not only makes the gardens sustainable but empowers the community through skills-based training and experience. In turn, these create further economic and entrepreneurial opportunities for marginalized community members [3].

1.2 Problem Statement

Efficiency in the operation of the Neighbourhood Farm initiative is one big stumbling block that can threaten the effective management of the whole initiative. Most projects of similar structure usually fail because of uneconomically viable management and operations hence a crucial need for the Neighbourhood Farm initiative to operate effectively [1]. With quite a number of players involved in the project operations, complex actions are likely to be experience in the areas of general management of the farms (schools) that include stock management and the analysis of data.

Stock Management Problem

The movement of produce stock in and out of the farm needs to be carefully managed and monitored. The management of stock is very significant in the successful operations of each farm and the entire project at large mainly because it influences decisions relating to the quantities that needs to be harvested, how much need to be requested from the other farms as well as how much can be transferred to the other nearby farms among other important reasons. Allowing third party producers to supply the farm with their produce as well as the option of requesting stock from other farms needs a very effectual stock management system to keep track various forms of produce. Poor stock management system often results wastages and loss of the produce (food) which has been previously identified as one of the major contributors to food insecurity.

Data Analysis

Analysing data does not only add operational value through motivation but also goes a long way in making inferences about future performance. Problems are likely to be faced in efforts to determine the performances of products at farm level as well as at the project at large. The tracking of produce wastage and loss is also one potential solution to improve efficiency and productivity of the Neighbourhood Farm project.

1.3 Related Work

Malawi Agricultural Commodity Exchange Market (MACE)

MACE is a commodity exchange market platform that was introduced in Malawi by the government of Malawi. The ICT based MACE was introduced to attend to the the constraint of poor access to market information by farmers in order to strengthen the liberalised markets [4]. It was initiated to assist small holder farmers to have access to market related information to search for better markets and prices for their produces. Through the use of MACE, an improved market performances of rice markets in Malawi was recorded. The success of the MACE provides a strong argument for the usefulness of implementing ICTs in farming or agriculture.

Israel Farm Management Department on-farm software package (Ma’ayan)

The software runs on a PC and enables the farmer to record production activities, monitor, quantify and cost them, make on farm decisions and follow product marketing. Ma'ayan was introduced after the Farm Management Department noticed that many farmers hand record their relevant data that relates to agricultural production, cost accounting parameters and other critical information resulting in an inability to efficiently recall, analyse and meaningfully use information when needed [5]. The first version of the software was released in 1991 and received favourable acceptance. Following on-farm visits and farmer training updates to the software were made and within a few years from the first version more than 600 copies of the software were sold.

1.4 Proposed Solution

The implementation of ICTs to counter solve the problems that the Neighbourhood farm project will possibly face is one viable solution. Effective implementation of Information Communication Technologies will not only solve the stipulated problems but will also enhance and improve the farming practices in the communities. Using Information Communication Technology to effectively manage the stock system and perform data analysis amplifies the management and operations of the whole initiative.

Stock Management System (SMS)

The proposed stock management system aims to allow effective, productive and flexible stock operations between farmer, seller and third part players.

Data analysis

The proposed system aims to extract and analyse data from all parties involved in the operations of the project. The system will view product performances, track wastages and loss in produces among other critical data analysis solutions.

2. User Requirements

The system will be designed to be used by four users who are entitled to different privileges and are exposed to different functionalities. The first user is a Super User who have total control of the system and who is responsible for managing all the farms (schools). An Admin User is privileged to take control of all activities for a specific farm under him. A Third Part supplier is a community member who is registered with any farm who is entitled to supplier a farm with his produces and will have an option to follow up on his produces using the system. The forth user is a Customer who also can be any community member or organization and is entitled to use the system to follow up orders and contributions to the neighbourhood farm. For this part of the project the user requirements that will be defined are that aligned to the interaction of all these different users with the SMS and Data Analysis.

2.1 Requirements Gathering

For this project a number of requirements gathering techniques were performed in order to have a clear set of the user requirements and a concise view of the expected solutions. First a formal meeting was conducted where the founder of the Neighbourhood Farm initiative

introduced the background and underlying details of the project to set a clear picture of the project. Also a similar meeting was set up a few weeks from the first meeting but this second meeting aimed at outlining a high level view of the requirements and addressing some questions from the first gathering. A pilot visit to one of the school that will be used as a model farm followed the two formal meetings, also a visit to a farm with similar setup was done and a more enhanced understanding of the farm set up was gained. The last meeting followed a couple of weeks later with the aim of presenting a first version of a prototype and build up feedback as well as suggestions from the founder.

Table 1: Requirements Gathering Table

Date	Technique	Goal	Identified requirements
9 Feb 2018	*formal meeting*	• *Background of the Neighbourhood Farm project* • *Underlying Details*	*Stock management* *Data analysis*
27 Feb 2018	*formal meeting*	• *Highlight problems and requirements* • *Answer questions and clarifying concepts*	*Produce requisitions* *Produce transfers*
10 Mar 2018	*pilot visit*	• *View ground set up* • *View similar farm set up*	*Record processed stock* *Track wastages*
7 April 2018	*formal meeting*	• *Presenting first prototype* • *Get feedback and suggestions*	*Track produce shelf expiry* *View demands performances*
Weekly Meetings (Group)	*Brainstorm*	• *Updates on progress and challenges*	*Order follow ups* *Farm performances*

3. Requirements Analysis

With the user requirements identified during the gathering process, the requirements analysis proceeds, breaking down the gathered requirements into more compact functional and non-functional requirements.

3.1 Functional Requirements

An overview of the high level functional user requirements that were identified and recorded out through the requirements gathering process are formatted in *Fig 1*. The requirements in the above fig are not organised systematically and are organised according to the user type.

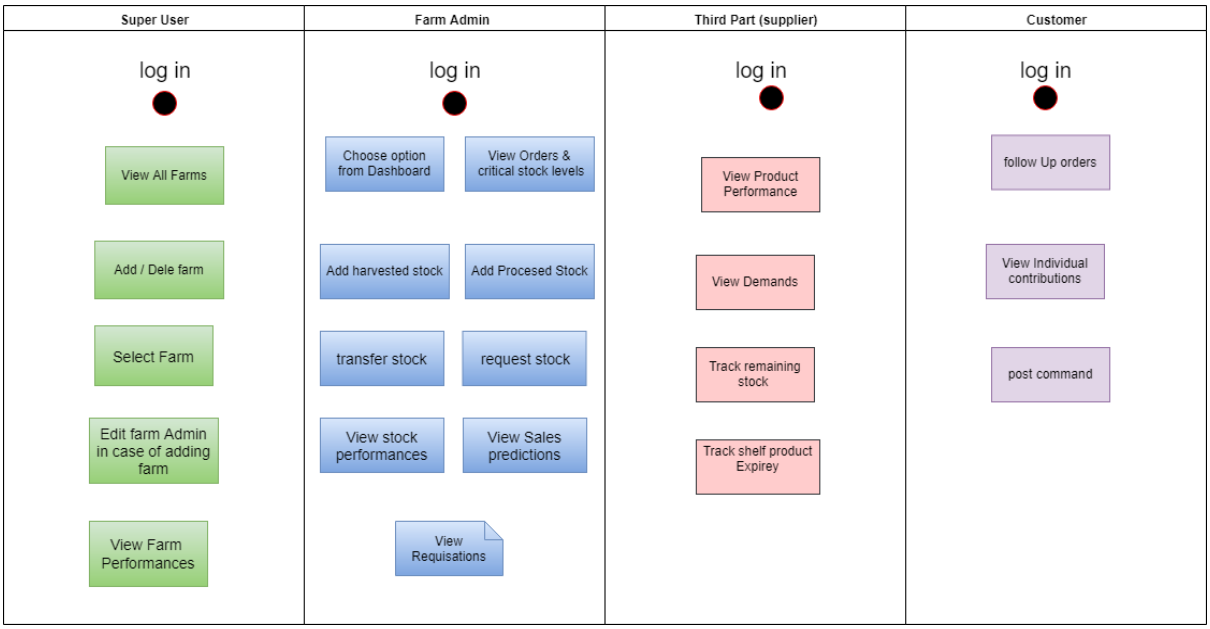

Fig 1: User Requirements Diagram (URD-functional requirements)

3.2 Non-Functional Requirements

A number of non-functional requirements were identified during the data gathering process and some of the requirements include visibility, usability, security and capacity.

Visibility
The aim is to design a simplified system with the most used options clearly visible. Critical notifications should be pushed to the home screen in order to be easily noticed.

Usability
There is a need to design a platform that is easy to use with little or no training needed to operate the system. The main emphasis is to design in a way that allow user to use recognition other than recall

Capacity
There is a need to enable the system especially the SMS to handle large volumes of stock data as large volumes of harvested produces will be pushed into the system.

Security
There is a need to ensure that there is security and data privacy for the users

3.3 Use Case Diagrams

With the user requirements identified during the gathering process, the user requirements from the ERD in Fig 1 can be analysed using the table below.

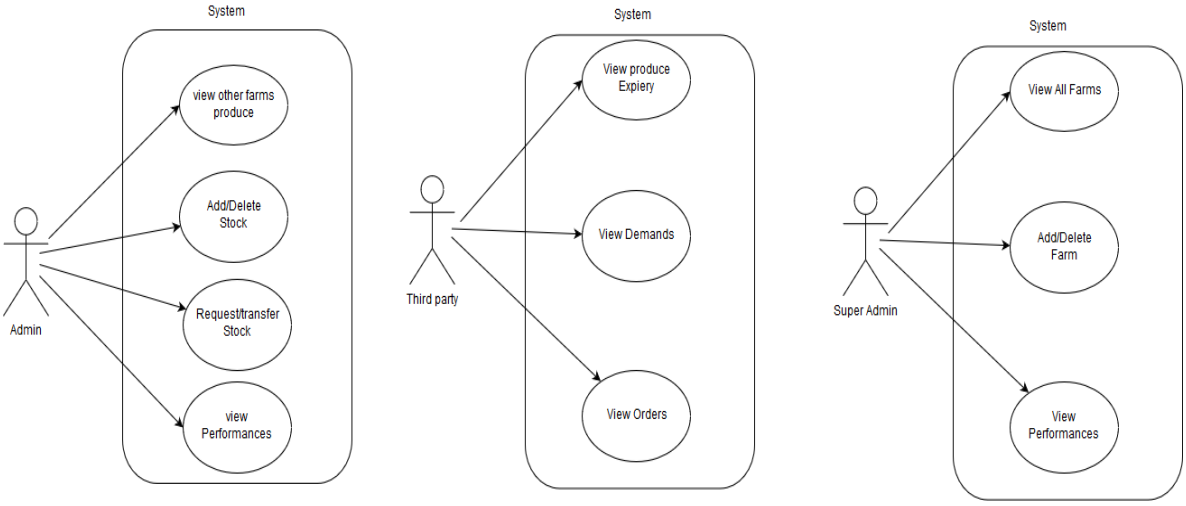

Fig 2: Use Case Diagram (UCD)

4. System Design

The gathered and analysed requirements from the previous chapters provides a good basis to proceed with the designing of the proposed solution. In this section we will transform the analysed requirements into design models that describe the details of the data structures, system architecture, interfaces, and components necessary to implement the proposed solution.

4.1 Data Design

From the requirements gathered it is quite clear that the SMS as well as the Data Analysis (DA) component of the proposed involves some high volumes of data and it is critical to have some good structures to handle these numerous volumes. The functional requirements highlighted in the URD (*fig 1*) gives a good understanding of the dimension of data that needs to be handled .Data that include the different farms (schools), produces, quantities of produce in stock etc needs to be handled effectively and efficient data designing is required to produce a good product of the proposed solution. Fig 3 below show the dimension of data flow from the major players that will the involved in the proposed solution

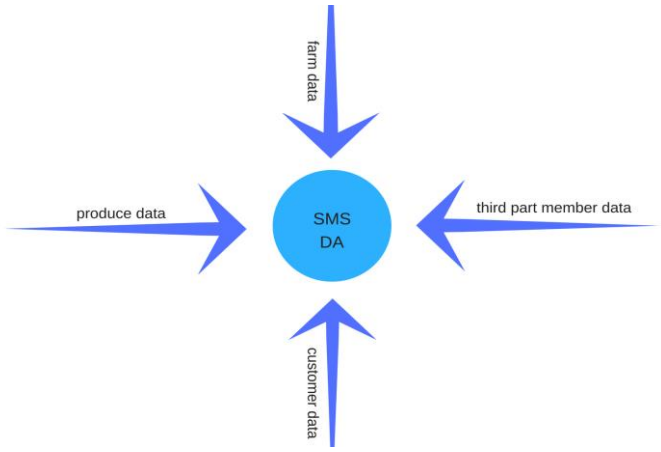

Fig 3: Data Flow Diagram

4.2 Stock Management Design

The Stock management facet forms the core part of the project. The main pinpoint will be storing all relevant information related to quantities of the harvested produces and at the same time updating the quantities after the movement of the produces out of the system through sales (orders) and issuing requisitions as well as adding new stock and receiving requisitions.

4.3 Data Analysis Design

The Data Analysis part of the project follows 4 stages that begin with the data being received from different parties that will interact with the proposed system. The data that is generated by the 4 parties highlighted in the data design section is stored in a database. The database is used as a data warehouse medium that stores all the important data relating to the parties.

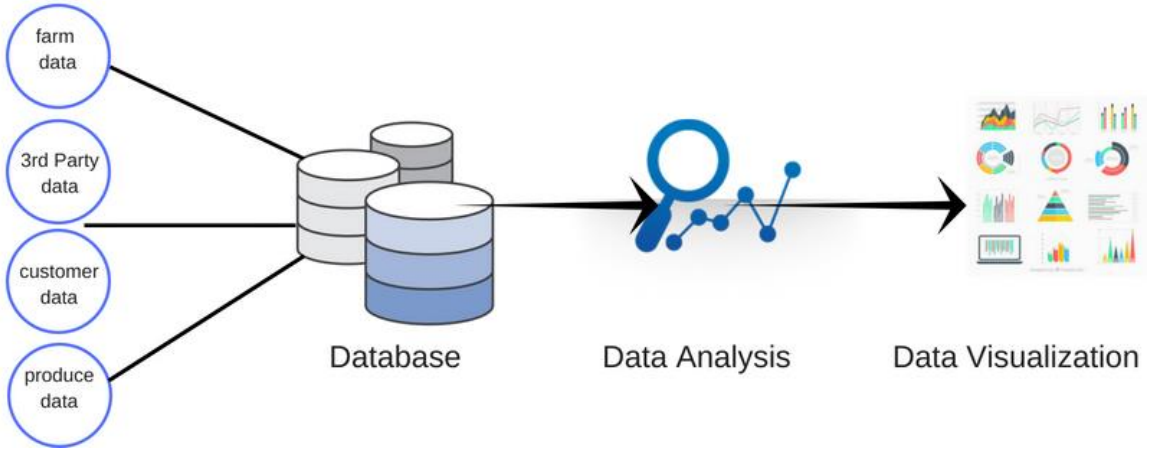

Fig 4: Data Analysis Implementation Diagram

Data that is stored in the database will be retrieved and analysis will be performed on the data. At the data analysis stage *Fig 4*, pandas will be used to carry out some data manipulation and analysis. Pandas is an open source, easy to use python library that is used to perform data manipulation and analysis.

4.4 System Architectural Design

The proposed system follows quite a simple architectural design that allows the system to function as expected. The system will be hosted in the cloud where the application will have access to some crucial tools that are offered in the cloud. In the Fig 4 below the user interacts with a device which acts as a client allowing the user to have access to the application that is hosted on the cloud

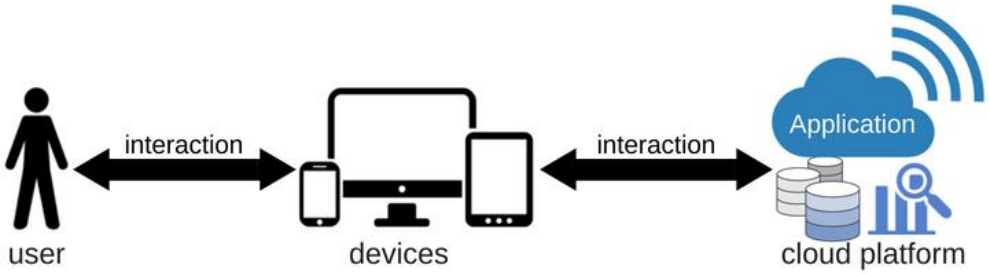

Fig 5: Architectural Design of the proposed System

4.5 Interface Design

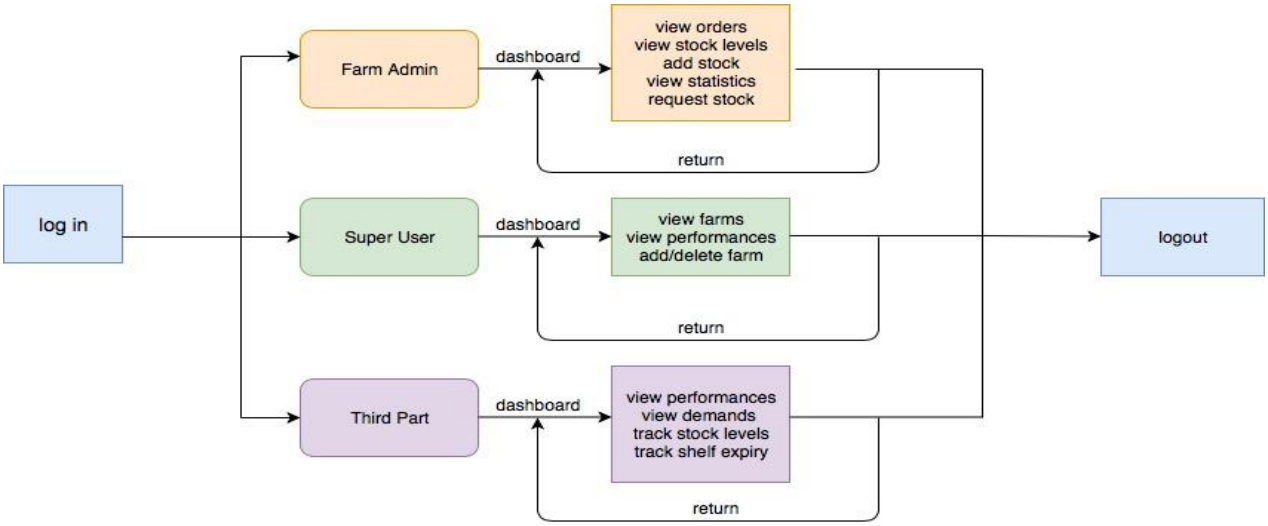

Fig 6: Interface Flow Diagram

5. Prototype Designing

In this chapter we will develop a typical prototype of the proposed system based on the designs covered in the Design section to depict the concepts, design alternatives, and screen layouts. For the prototype, only the main functionalities of the proposed system are considered and tools such as database and analytical tools are not implemented in the backend.

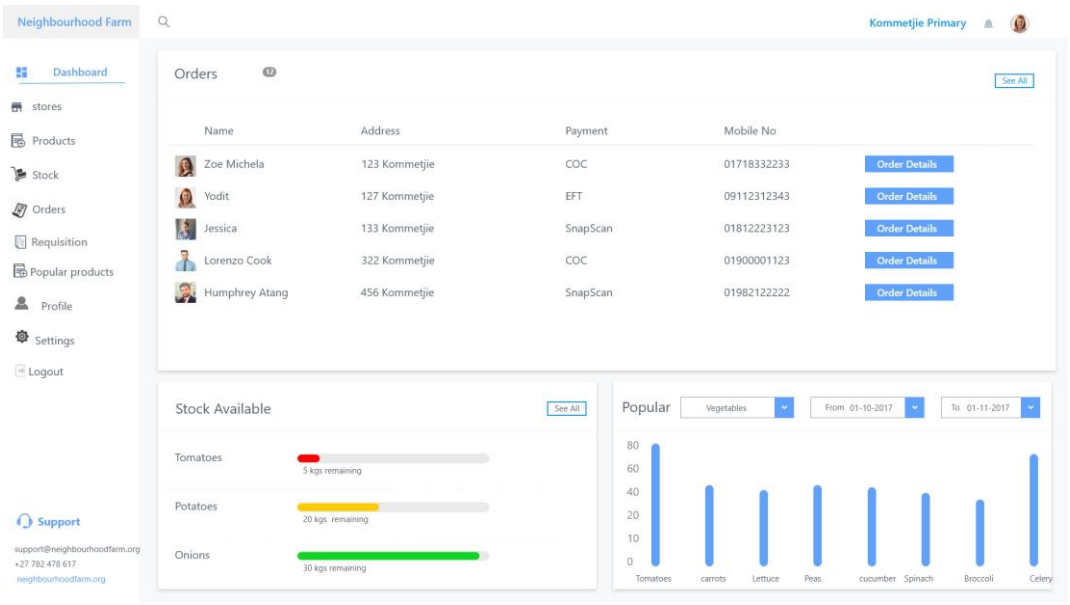

Fig 7: Welcome Page

The welcome page *Fig 6* allows provides the user with important information such as orders that needs attention and a glance of the available stocks with colours indicating the level of stock available for each produce. The dashboard gives the user the ability to navigate to the different options of the system.

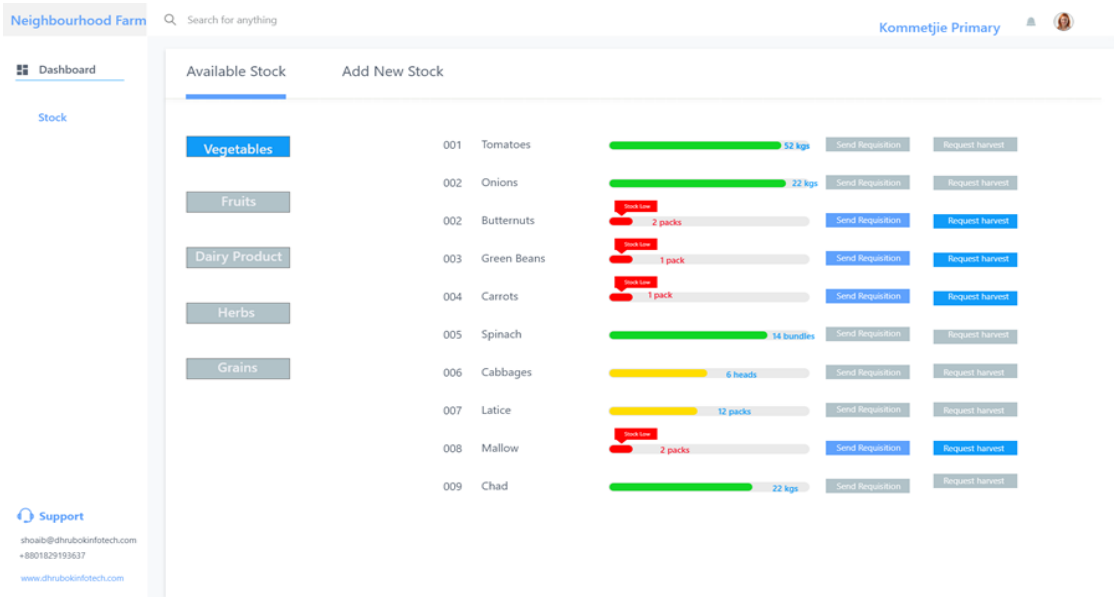

Fig 8: stocked Produce View

The stock tab allows the user to view the stock level of the produces. The stock will be categorized in different types such as vegetables, fruits, herbs etc. and upon selecting a certain type a list of the produces that falls under the category will be displayed with their respective available quantities. The stock gives the user an option to request or send stock from and to other farms respectively as highlighted in *Fig 7*.

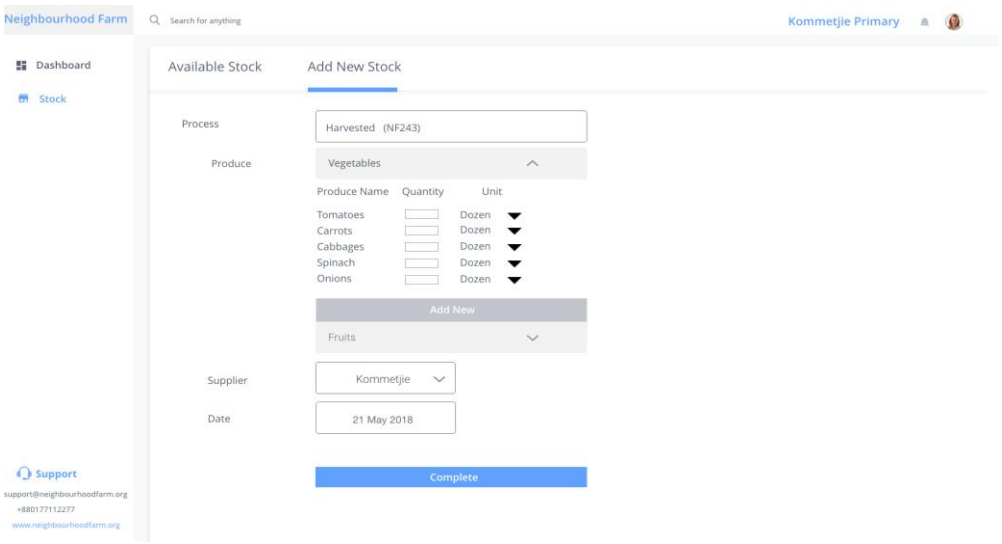

Fig 9: Adding new stock (harvested)

The tab to add stock gives the user the option to capture into the system the different types and quantities of the harvested produces. The process field allows the user to give the harvested produce a batch ID to keep track of it in the system. The user can select the appropriate category of the produce and captures the quantities harvested before the produces are processed and packed. The interface to add new stock gives the user the option to specify the supplier of the captured stock as well as the date of capturing.

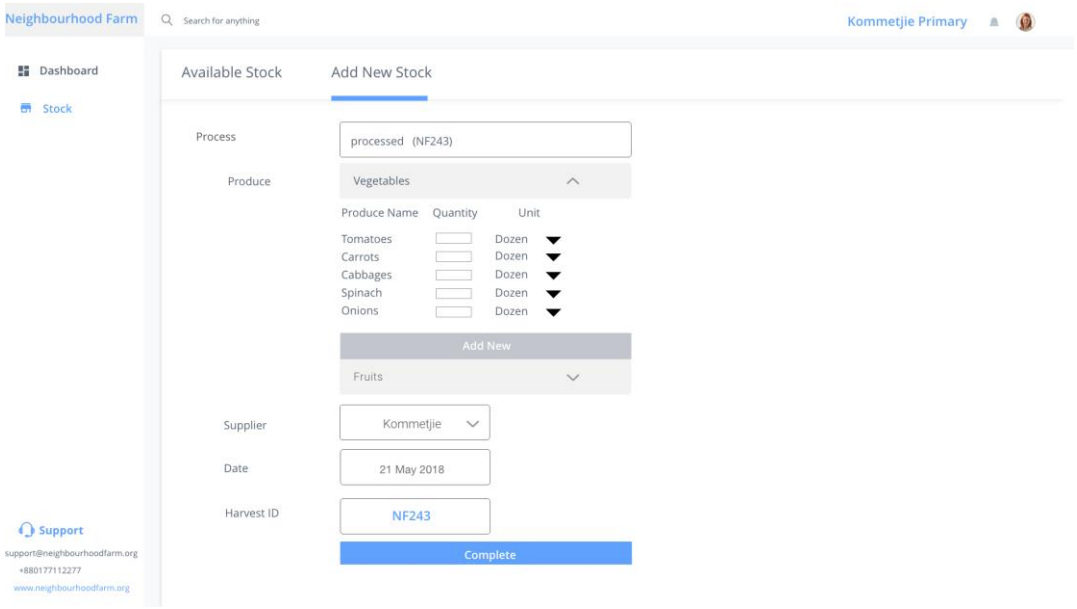

Fig 10: Adding new stock (processed)

Fig 9 is an interface of capturing the produce when they have been processed. The process defines the stage of the produce and identifies the batch of the produce. The main essence of this interface is to allow the system to track on the wastages that happen between harvesting and processing. The harvest Id field allows the system to match the captured harvested produce and the processed.

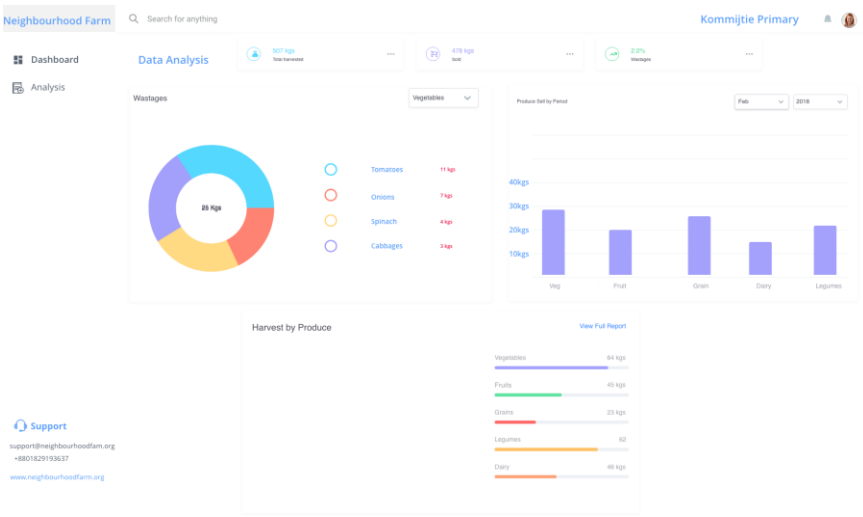

Fig 11: Analysis Display

The Analysis tab allows the user to view some analysis displayed in graphs and tables. The interface displays tables and graphs with general statistics on wastages, demand and harvest.

More versions of the prototype will be built and evaluated with the NF team and feedback will be given in order to have a clear understanding of the proposed system that is needed and most importantly to develop the a system that will be useful to the Neighbourhood Farm initiative.

6. Project Plan

NF PROJECT PLAN	Phase	Time
Research	completed	Feb 26 - Mar 14
Identify Requirements	completed	Mar 15 - 28
Requirements Analysis	completed	Mar 22 - Apr 3
Highlight proposed solution	completed	Apr 4 - 22
Term 1 Presentation	completed	Apr 26
Set Up development Environment	completed	Apr 23 - 26
Prototype Building	completed	Apr 28 - May 7
Evaluate Prootype	completed	May 7 - 13
Use Case & Flow Diagrams	completed	May 8 - 19
Project Level Design	completed	May 20 - Jun 5
Term 2 Presentation	Working on it	Jun 6
Prototype Implementation		Jun 7 - 18
Front End Interface Layout		Jun 19 - Jul 5
Back End Layout		Jul 1 - 15
User Aunthentication		Jul 16 - 28
Development- Front & Back end		Jul 19 - Nov 5
Term 3 Presentation		Sep 27
Component Integration		Sep 28 - Nov 10
Testing		Oct 20 - Nov 17
Project Documentation Finalising		Nov 11 - 28
Final Presentation		Nov 29

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