



DEVELOPING A WEB APPLICATION TO SUPPORT FARMERS IN THAILAND

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Developing a Web Application to support farmers in Thailand

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Abstract

In Thailand, agriculture is the origin of many traditions and beliefs. However, in Thailand, farming is closely related to poverty and a low standard of living. Our sponsor, Urmatt Ltd, has been working for over three decades with impoverished farmers in rural Thailand to help them improve their living conditions. Our goal was to help Urmatt implement e-agriculture by developing an app to reduce inefficiency, better support farmers, and help with maintaining their organic certifications. By interviewing Urmatt's employees and farmers, the team was able to identify the needs of Urmatt and the farmers. Our team designed effective features that will help Urmatt increase their efficiency and improve the support that farmers receive.

Executive Summary

Rural Poverty in Thailand

Thailand's rural population is composed of around 8 million small family farms who pass land from generation to generation (Jitsanguan, 2001; World Bank, 2016; Sirindhorn, 2013). Farming provides employment for 28.5 million people in Thailand, however it goes hand in hand with poverty, as farmers typically produce for their own consumption and sell the excess. (World Bank, 2016; FAO, 2016; Ministry of Finance, Royal Thai Government; The World Bank, 2012; Kristjanson, Place, Franzel, & Thornton, 2002).

Addressing Rural Poverty

According to the United Nations, one in five people around the world lives on less than two dollars a day (United Nations, 2017). Close to 75% of the global impoverished population lives in rural areas, and thus the Food and Agriculture Organization (FAO) posits that agriculture plays an important role in reducing poverty in the rural population, stating that "agriculture is four times more effective at raising incomes among the poor than other sectors" (FAO, 2016).

For the past few years, governments and organizations have been taking measures to reduce poverty in rural areas. In Thailand, the Department of Agriculture focused on developing farming methods and standards while ensuring the preservation of the environment and access to necessary resources (DOA, 2017). The efforts of this department reduced the impoverished population from 35.5 million people in 1986 to just 7.1 million in 2014 (World Bank, 2017). Other than that intervention, governments and companies have used several systems to combat rural poverty, including contract farming, organic farming, and e-agriculture solutions.

Case studies of organic farming from China and India revealed that the promise of higher product prices is often the primary driver which leads to a shift toward organic methods (Giovannucci, 2005). For small farmers, organic farming can be an effective risk management tool that reduces the input costs, diversifies their production, improves local food security, and also increases farmers' incomes (Giovannucci, 2005).

E-agriculture, which is using technology to help with farming, can be specialized to each farm, whether by tracking pest infestations or by giving quick news updates (Doering, 2013). An app called CropIn has been used by farms in India to make farming intuitive and effective for farmers (Mishra, 2017). It gives information about farming practices and predicts when to harvest, along with the size and quality of the yield (Mishra, 2017). This data has allowed farmers to cut revenue losses by 18% (Mishra, 2017). These implementations informed our efforts of providing a similar service to Urmatt and their farmers.

Urmatt Intervention

Urmatt supports the indigenous farmers through a system called contract farming, which hires small farmers to grow specific crops to a company's specifications (Singh, 2002). Besides using contract farming, Urmatt focused on switching to organic farming. Arvind Narula, Urmatt's founder, came to the realization that the use of pesticides and fertilisers was causing health problems in the community, including birth defects (Narula, 2014). These precipitated the change to organic agriculture. The next step that Urmatt is attempting to implement is e-agriculture, which they hope will increase efficiency for the farmers, as well as assist with the organic certification process (Personal communication, 2017).

Our Intervention

The goal of this project was to help Urmatt implement e-agriculture in the form of an app to reduce inefficiency, better support farmers, and help with maintaining their organic certifications. Our project objectives were:

Objective 1: Evaluate the current methods of data sharing between farmers and Urmatt Ltd. and the desired data for each party.

Objective 2: Find and establish a suitable platform.

Objective 3: Design and evaluate a prototype system to address identified data needs.

Objective 4: Test the implementation effectiveness, problems, and successes.

By using research methods such as interviews and field observation we gathered information to help us determine the needs of the company and the problems of the current system. Our findings were:

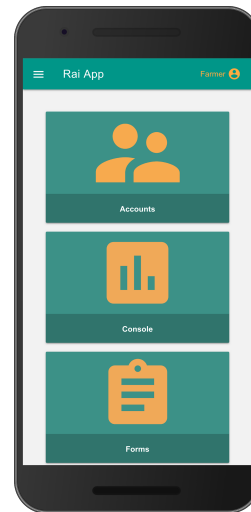
- Field inspectors handle most of the data related to fields and farmers.
- Document control teams create the reports needed for the organic certification.
- A mobile application will make the data collection process more efficient.
- An organized database will reduce the workload in the report creation process.
- Access to historical and personal data is necessary and difficult to obtain.
- There is a need to track farm visits.

Our App: Rai

These findings allowed our team to create a list of features for the app that would be most helpful to Urmatt and their farmers, which are described in Table 1.

| Features | Functions |
|------------------|-----------------------------------------------------------------------------|
| Data Collection | Forms for the inspectors, which include pictures. |
| Farmer's profile | Show farmer's history and general information |
| Analytics | Generate summary table for document control |
| | Generate graphs and tables |
| Interactive Map | View of the farms working with Urmatt Instant access to farmer's profile |
| Check-In | Track the location of the inspectors |
| Offline mode | Save data when there is no internet access |

Table 1: List of features and functions in the app



Some of these features can be seen in the figures below:

Figure 1: Rai Logo

Figure 2: Home Screen

Our Recommendations

1. Implementation: We recommend Urmatt to implement the app among inspectors first, and then among farmers. This is due to the large number of farmers, and the varying literacy rate and familiarity with technology.

2. Knowledge Bank: We recommend that Urmatt collects data about farming practices to better support farmers. Farmers informed us they would like to have access to more farming knowledge so that farmers that work with Urmatt can learn how to most effectively farm and support their families.

3. Customer Interaction: We recommend that an additional expansion of the project could be increasing Urmatt's customer interaction. Customers should be able to track the products they buy back to the farmers that produced them, allowing customers a window into the lives of the farmers.

Conclusion

Our project not only fulfilled our goal, but will fulfill a greater purpose in the future. By increasing the effectiveness of the company through the app, Urmatt will have more resources available to better assist farmers. When Urmatt implements the app among farmers, it will help distribute knowledge so they can share experiences and help each other. At the end of the day, our app will not only be impacting the company but also the local farming communities in Chiang Rai that are struggling with rural poverty.

Table of Contents

| | |
|---------------------------------------------------------------------------|-------------|
| Abstract | iii |
| Executive Summary | iv |
| List of figures and tables | viii |
| Authorship Table | ix |
| 1. Introduction | 1 |
| 2. Background | 2 |
| 2.1 <i>Poverty and Agriculture in Thailand</i> | 2 |
| 2.2 <i>Urmatt Ltd. Intervention</i> | 4 |
| 2.3 <i>Contract Farming</i> | 4 |
| 2.4 <i>Organic Farming</i> | 5 |
| 2.5 <i>E-Agriculture</i> | 5 |
| 2.6 <i>Conclusion</i> | 6 |
| 3. Methodology | 7 |
| 3.1 <i>Evaluate the Current Methods of Data Sharing</i> | 7 |
| 3.2 <i>Find and establish a suitable platform</i> | 7 |
| 3.3 <i>Design and evaluate a prototype system</i> | 7 |
| 3.4 <i>Test the implementation effectiveness, problems, and successes</i> | 8 |
| 3.5 <i>Conclusion</i> | 8 |
| 4. Findings | 9 |
| 4.1 <i>First Objective</i> | 9 |
| 4.2 <i>Second Objective</i> | 11 |
| 4.3 <i>Third Objective</i> | 12 |
| 4.4 <i>Web Application</i> | 14 |
| 4.5 <i>Conclusion</i> | 15 |
| 5. Recommendations | 16 |
| 5.1 <i>Deliverable</i> | 16 |
| 5.2 <i>Implementation</i> | 17 |
| 5.3 <i>Knowledge Bank</i> | 18 |
| 5.4 <i>Customer Interaction</i> | 19 |
| 5.5 <i>Conclusion</i> | 20 |
| References | 21 |
| Appendices | 24 |
| Appendix A: <i>Organic Certification Standards and Procedure</i> | 24 |
| Appendix B: <i>Types of E-agriculture Interventions</i> | 27 |
| Appendix C: <i>Research Methods</i> | 28 |
| Appendix D: <i>Transcribed interviews</i> | 29 |
| Appendix E: <i>Qualitative Coding</i> | 34 |
| Appendix F: <i>Web App vs. Native App</i> | 35 |

| | |
|-----------------------------------------|----|
| <i>Appendix G: Product Design Steps</i> | 36 |
| <i>Appendix H: Deliverables</i> | 37 |
| <i>Appendix I: Code</i> | 56 |

List of figures and tables

| | |
|----------|----|
| Table 1 | iv |
| Figure 1 | v |
| Figure 2 | v |
| Figure 3 | 3 |
| Table 2 | 4 |
| Table 3 | 9 |
| Figure 4 | 10 |
| Table 4 | 15 |
| Figure 5 | 17 |
| Figure 6 | 17 |
| Figure 7 | 17 |
| Figure 8 | 18 |

Authorship Table

| Report | Author | Editor |
|--------------------------------|---------------------------------------|----------------------------|
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| Abstract | Paula | Oliver |
| Introduction | Catherine & Paula | Paula & Oliver |
| Background | Paula, Kanokrak, Laksamon & Catherine | Paula, Catherine & Oliver |
| Methods Chapter | Paula, Oliver, Aleksander & Catherine | Paula, Catherine & Oliver |
| Findings Chapter | Paula, Laksamon & Kanokrak | Aleksander & Oliver |
| Recommendations | Catherine | Paula & Oliver |
| Conclusion | Paula | Oliver |
| Deliverable | Author | Editor |
| Translating forms | Laksamon, Kanokrak & Phasit | - |
| Creating HTML Forms | Laksamon, Kanokrak, Catherine & Paula | Oliver & Aleksander |
| Creating the app (coding) | Aleksander & Oliver | - |
| Tutorial | Laksamon & Kanokrak | Aleksander |
| Monitoring and Evaluation Plan | Catherine | Aleksander |
| Other Work | Author | Editor |
| Translating Interviews | Laksamon, Kanokrak & Phasit | - |
| Cluster Presentations | Laksamon & Kanokrak | Paula |
| Final Presentation | Laksamon, Kanokrak & Paula | Paula, Oliver & Aleksander |
| Final Presentation Animation | Laksamon & Kanokrak | Paula |

1. Introduction

According to the United Nations, one in five people around the world live on less than two dollars a day. Millions more make little greater than this and many people risk slipping back into poverty (United Nations, 2017). Poverty is more than a lack of income and resources - it manifests itself in malnutrition, lack of education, and social discrimination. Close to 75% of the global impoverished population lives in rural areas, and thus the Food and Agriculture Organization (FAO) posits that agriculture plays an important role in reducing poverty of the rural population, stating that "agriculture is four times more effective at raising incomes among the poor than other sectors" (FAO, 2016).

For the past few years, governments and organisations have been taking measures to reduce poverty in rural areas. In China, the government provided economic help to farmers for buying agricultural supplies and provided rural areas with basic necessities such as electricity and clean water (Embassy of the People's Republic of China, 2011). From 2000 to 2010, the rural population affected by poverty decreased from 94 million to 26 million (Embassy of the People's Republic of China, 2011). A system called SmartFarm has used predictive technologies along with providing specific information to farmers in rural India to cut down farmer revenue loss by 18% (Mishra, 2017). In Thailand, the Department of Agriculture focuses on developing farming methods and standards while ensuring the preservation of the environment and the access to necessary resources (DOA, 2017). The efforts of this department reduced the impoverished population from 35.5 million people in 1986 to just 7.1 million in 2014 (World Bank, 2017).

One example of a company attempting to help with poverty is Urmatt, Ltd., a major organic food producer in Thailand. Information published on their website states that one of their goals is to provide assistance to the poorest farmers through price guarantees, training in different farming techniques, and funding (Urmatt Ltd., 2017). According to Urmatt's director of sales, the company helps indigenous farmers by providing the necessary input resources and information. Urmatt transitioned to 100% organic operations and has become the largest exporter of organic jasmine rice in the world, largely due to their management policies. By assembling and analyzing data, Urmatt can be more efficient, get their organic certification, and formulate recommendations for farmers about farming techniques and schedules (Roach, 2016).

The aim of this project was to develop a communication method that will help Urmatt and their contract farmers share data to increase both product yield and product quality. This project completed four objectives. The first was to identify the gaps in communication and data sharing between Urmatt and the farmers through different rounds of interviews. Our second objective was to use the interview information to determine the most suitable platform to develop for the company. The third was to create and test a prototype to ensure its effectiveness and detect any problems. Our last objective was to create a monitoring and evaluation system so that Urmatt can assess the effectiveness of the app and keep improving it when the team leaves. The deliverable of this project addresses the issue of communication between the company and farmers while increasing their yields and product traceability. In the next chapter, we present the problems faced by the agricultural sector in Thailand and explore the different measures that have been taken to better the lives of people living in rural areas.

2. Background

This chapter begins by describing the significance of agriculture in Thailand and how it affects the country on a cultural and economic level. Then we examine the significance and problems of agriculture in Northern Thailand, specifically in the Chiang Rai province. After that, the chapter analyzes the actions our sponsor is taking to improve the lives of farmers. We review these actions in detail and examine our sponsor's next step.

2.1 Poverty and Agriculture in Thailand

Agriculture is the origin of several traditions and beliefs in Thailand and a key factor in the evolution of the country (Hays, 2014). Thailand's rural population is composed of around 8 million small-scale family farms that own 5 to 7 acres of land each (Jitsanguan, 2001; World Bank, 2016). As of 2012, agriculture was a source of employment for 28.5 million people in Thailand (World Bank, 2016) and agricultural activities occupied 41% of the country's land in 2014 (Food and Agriculture Organization of the United Nations, 2017). This shows how important farming is to the Thai way of life.

Family farming is the traditional agricultural structure in Thailand, where farms are passed on to subsequent generations (Sirindhorn, Nov 29, 2013). Usually, family farmers in Thailand produce for their own consumption and then sell the excess (FAO, 2016; Ministry of Finance, Royal Thai Government & The World Bank, 2012). Due to this, small-scale farming tends to go hand in hand with poverty and a low standard of living (Kristjanson, Place, Franzel, & Thornton, 2002).

Furthermore, the country has been facing environmental problems for the past decade, such as water shortages, soil erosion, and decreasing biodiversity. These factors reduce farmers' resources for production and tend to cause reductions in yields (Forsyth, Sivaramkrishnan & Walker, 2008). These are consequences of population growth and commercialization (Forsyth, Sivaramkrishnan & Walker, 2008), as well as the considerable deforestation that occurred from 1961 to 1998 when the forest cover of the country decreased from 53% to 25% (Akber & Shrestha, 2015). Provinces like Chiang Rai, Chiang Mai, and Mae Hong Son exemplify how the country is being affected by these challenges.

2.1.1 Poverty and Agriculture in Chiang Rai

The Chiang Rai province is the northernmost province in Thailand. The province is an important trading center of products like tea and coffee (Britannica, 2016), but is mostly the center of rice production; 62% of the province's agricultural production is rice (Akber & Shrestha, 2015).

The local communities in Chiang Rai are among the poorest in the country. According to the data from 2013 to 2014, Chiang Rai inhabitants have a yearly average income of 66,167 baht (\$2,053), which is lower than the country's average income of 71,292 baht (\$2,212) and other provinces' income, as is reflected in Figure 3.

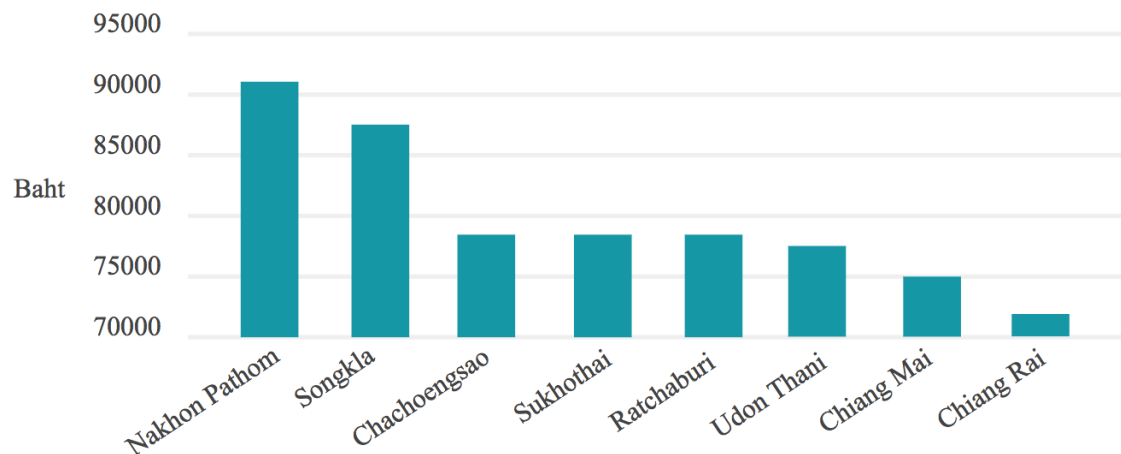


Figure 3: Average Yearly Income in Each Province

Poverty in the province is closely related to farming (Kristjanson, Place, Franzel, & Thornton, 2002), and is a consequence of the different challenges that the farming community in the province faces. In Chiang Rai, minorities are the ones who suffer from poverty the most; immigrant farmers that come from neighboring countries don't have access to the same resources as Thai farmers. According to the Chiang Rai Tourist Office, Hill Tribes like the Karen or the Hmong sometimes live in small communities isolated from the rest of the farming community. An important concern for farmers nowadays is that new generations are leaving their local communities to receive a better education or to find a job with higher income (Tipraqsa & Schreinemachers, 2009). In 2012, only 12% of the farmers were under 25 years of age compared to the 35% that were working in 1985 (Fuller, 2012), which shows that the average farmer age has increased. These generational movements, however, are not the only challenge faced by farmers.

Natural disasters have a large impact for the farmers in Chiang Rai; the most common disasters in the region are floods, monsoons, and rainstorms (Ministry of Finance, Royal Thai Government & The World Bank, 2012). After these disasters, farmers' debt usually increases because they couldn't produce enough to pay for their input costs and personal expenses (Matichon, 2016). In addition to this, over the past few years, farmers in Chiang Rai have encountered an increase in deforestation which caused a considerable loss of the province's biodiversity (Akber & Shrestha, 2015). Biodiversity is important in rural areas because more species means a greater variety of crops, more natural sustainability, and healthier ecosystems that can withstand natural disasters better (Shah, 2014). Therefore, any loss of biodiversity in the province threatens the farmers' resources to grow their products. Research in the province suggests that promoting native species and products and increasing community awareness will help rehabilitate and protect the land (Akber & Shrestha, 2015). In our sponsor's case, helping farmers and taking care of the natural resources are the two objectives that drive the actions of the company.

2.2 Urmatt Ltd. Intervention

When Arvind Narula founded Urmatt Ltd. in 1982, he did it with one purpose in mind: "to work with the poorest people they could find" (Narula, 2014). His objective was to make the new company profitable while supporting indigenous farmers (Urmatt Ltd., 2017). Urmatt supports farmers through a system called contract farming, which hires small farmers to grow specific crops to a company's specifications for a predetermined price. To continue with the company's mission of improving the farmers' life, Urmatt decided to make the company 100% organic. During a conference in Amsterdam, Mr. Narula explained that when he came to the realization that the use of pesticides and fertilizers was causing health problems in the community, including birth defects, it made him decide to move Urmatt to organic agriculture. Urmatt's director of sales, Mr. Sehgal, pointed out that the next step that Urmatt is attempting to implement is e-agriculture, which is the use of technology to improve agricultural work. They hope this will increase efficiency for the farmers, as well as help the company certify their products as organic with increased information.

2.3 Contract Farming

Contract farming is a system for the production and supply of agricultural produce where the farmer commits to provide a commodity to a known buyer based on a set of specifications (Singh, 2002). Even though the specifics of contract farming implementations vary widely, there are pros and cons that apply to the model generally, as described in Table 2.

| | Advantages | Disadvantages |
|---------|-----------------------|-----------------------------------|
| Farmer | 1. Increased income | 1. Power disparity |
| | 2. Specialized inputs | 2. Inequitable contracts |
| | 3. Access to credit | 3. Indebtedness |
| Sponsor | 1. Ensure production | 1. Extra-contractual marketing |
| | 2. Ensure quality | 2. Possibility of Poor Management |

Table 2: Advantages and Disadvantages of Contract Farming

A number of reports, including Little (1994), found that contract farming has been shown to increase incomes for farmers. An exploration of peanut farming in Senegal found that the implementation of contract farming increased gross agricultural revenue by about 55% compared to non-contracted farmers (Warning & Key, 2002). One main reason that sponsors choose the contract farming model is that it has been shown to increase the probability that production numbers will meet needs. In many areas a company's needs for a certain crop simply outweigh the entire production of a region; successful contract farming can allow production to be scaled to meet demands. For example, when PepsiCo built a tomato processing plant in the Punjab region of India, the total tomato crop of the region was 28,000 tons, produced over a 25-28 day period. PepsiCo required a minimum of 40,000 tons of tomato over a 55 day period. They were,

through the effective implementation of contract farming, able to increase the region's production enough to meet their needs (Spice, 2003). Along with ensuring production numbers, there is evidence that contract farming can also help ensure quality standards that would be impossible or impractical to replicate on the open market. Sponsors can increase the likelihood that these standards are met by stipulating them in the original contract and by implementing their own quality control systems (Miyata et al, 2009).

Contract farming is not without its drawbacks. If managed ineffectively or maliciously, contract farming can create a dangerous power disparity between sponsors and farmers, who can become indebted due to either production problems or an over-reliance on new, expensive technologies. Power differences between sponsor and farmer can result in inequitable contracts. A review of contract farming in Punjab, India found that, while contract farming was successful for sponsors, farmers generally felt that contracts were biased and too strict. Specifically, sponsors would overprice services, underprice produce, and pass all risk onto farmers (Singh 2002). The farmers had little ability to bargain due to this power dynamic, which can lead to a dependency on credit and inputs from the sponsor (Fulton & Clark, 1996).

2.4 Organic Farming

The USDA defines organic farming as “a production system that is managed to respond to site-specific conditions by integrating cultural, biological, and mechanical practices that foster cycling of resources, promote ecological balance, and conserve biodiversity” (SARE, 2012). In order for products to be labeled as organic, they must receive an organic certification. This means that farmers must comply with the specific rules for organic farming set out by the certifier (McEvoy, 2012). The details of organic certification can be found in Appendix A. Case studies from China and India revealed that the promise of higher product prices is often the primary driver which leads to a shift toward organic methods (Giovannucci, 2005). For small farmers, organic farming can be an effective risk management tool that reduces the input costs, diversifies their production, improves local food security, and increases the farmers' incomes (Giovannucci, 2005).

In terms of environmental benefits, organic farming has long-term sustainability because it aims to produce foods while establishing an ecological balance to prevent soil infertility, water contamination, biodiversity, climate change, and genetically modified organisms (FAO, 2015). Organic farming can improve soil fertility in different ways when compared to conventional farming (FAO, 2015). Organic farming uses organic fertilizers and pesticides and different soil building practices such as crop rotations. This results in greater biodiversity and reduces the risk of groundwater pollution (FAO, 2015). Organic agriculture also contributes to reducing greenhouse gases and global warming through lowering the carbon in the soil (FAO, 2015). Organic agriculture provides management that helps farmers diversify crops and livestock, and gives them more knowledge about climate change (FAO, 2015).

2.5 E-Agriculture

Moving forward, Urmatt is looking towards e-agriculture, which is the implementation of technology in agriculture (Personal communication, 2017). E-agriculture is an emerging field focusing on the enhancement of agricultural and rural development through improved information and communication processes (Yaduraju, 2016). According to the FAO e-agriculture implementation guide, "interventions have been developed and tested around the world, with

varying degrees of success, to help agriculturists improve their livelihoods through increased agricultural productivity and incomes, and reduction in risks." (FAO, 2017).

There are many types of e-agriculture interventions, which are detailed in Appendix B. These include data logging and management apps, location-based apps, specific calculation apps, news and information apps, non-app training programs, and others (Agrawal, 2013). Many of these apps are used by non-contract farmers to increase yields, but the data logging and management apps serve mostly as a check-in and quality assurance method (Agrawal, 2013).

Technology like this can be specialized to each farm, whether by tracking pest infestations or by giving quick news updates (Doering, 2013). A mobile application called CropIn has been used by farms in India to make farming intuitive and effective (Mishra, 2017). It gives information about when to sow crops, how to deal with crop infestations, what the correct mix of chemicals to use is, what the temperatures around the farm are, as well as predictions as to when to harvest, along with the size and quality of the yield (Mishra, 2017). This data has allowed farmers to cut revenue losses by 18% (Mishra, 2017). Given that about half of the world's population owns a mobile phone and that smartphone access is on the rise worldwide, there is a great opportunity for e-agriculture (FAO, 2017). These implementations can inform our efforts of providing a similar service to Urmatt and their farmers.

2.6 Conclusion

In order to understand the farmer's situation, this chapter examined the importance of agriculture in Thailand and the agricultural structures currently in place. Family owned farms make up the bulk of this structure, many of whom utilize contract farming. Given the usage of contract farming in Thailand, we explained the system as a whole, specifically the advantages and the disadvantages to farmers and companies. Following the increased presence of organic farming in certain areas of the country, the chapter explored how it can benefit the farmers and the land in several ways. Finally, the chapter covered the basics of e-agriculture and presented different cases that exemplify how it can help the farmers and the company. The team used this information to create a plan of action to implement an e-agriculture communication method for Urmatt and their farmers.

3. Methodology

The goal of this project was to create an e-agriculture system that helps Urmatt establish a data sharing and management system between the company and its employees in order to reduce inefficiencies, make organic certifications easier, and help farmers. This chapter presents the objectives and research methods that we employed to gather information to accomplish our goal. Our objectives were:

Objective 1: Evaluate the current methods of data sharing between farmers and Urmatt Ltd. and the desired data for each party.

Objective 2: Find and establish a suitable platform.

Objective 3: Design and evaluate a prototype system to address identified data needs.

Objective 4: Test the implementation effectiveness, problems, and successes.

In the following sections, we examine these objectives and the methods we used to achieve them.

3.1 Evaluate the Current Methods of Data Sharing

The first objective looked to examine the current methods of data sharing that Urmatt employs to determine what a new system could look like. There are several methods that we could have used to obtain the information desired; a description of these methods can be found in Appendix C. However, we chose to do semi-structured interviews so that the team could be prepared with topics to cover while leaving free room for ideas or discussions that participants might bring. Also previous research done about Precision Live Stocking in ten different European countries showed that semi-structured interviews were the right approach for farmers and to obtain in-depth and reliable data (Hartung, 2016).

We interviewed the representatives of Urmatt Ltd. that will be using our prototype. The team met with the Director of Sales to discuss the objectives and timeline of the project.

At the farming sites, the team first interviewed the Field Operations Department's (FOD) manager and inspectors for rice, eggs, and coconuts. Then we visited rice fields and the coconut farms and interviewed farmers. Due to the language barrier, all the interviews at the farming sites were conducted in Thai, the transcription of the translated interviews can be seen in Appendix D. Apart from the interviews, the team also observed the dynamics of the farms to gain more information on how farmers work on a daily basis.

3.2 Find and establish a suitable platform

The purpose of this section was to find the best way to deliver the desired information based on the availability of technology on the farms. Most of the information obtained from the interviews was qualitative, but we also received quantitative data related to field sizes or numbers of farmers. We analyzed the interviews through qualitative coding in order to find out different categories that would help identify the needs, problems, and desires of the different people being interviewed. An example of the process we followed for qualitative coding can be found in Appendix E.

3.3 Design and evaluate a prototype system

In order to learn how to present features effectively, make a user-friendly application, and make sure that all desired features are feasible, our team followed a series of steps, which are described in Appendix G.

The team built the app using Firebase, Google's backend-as-a-service. Firebase includes user authentication, data storage, media storage, and hosting. This streamlined the development process and allowed the team to focus on creating features that are specific to Urmatt's situation. We implemented these features through a combination of HTML, CSS, and JavaScript, the three languages that make up almost every page on the web.

The team tested the prototype with the Urmatt management team in order to ensure that we included all of the functions needed. The team did this by presenting the different app features and functions to them and getting feedback through a group discussion.

The team also wrote a tutorial, in English and Thai, that gives detailed explanations and steps on how to properly use the app, this tutorial can be found in Appendix H. The team's biggest concern with this objective was that users would find the app difficult to use or they wouldn't know how to use it to its full potential. Even though the tutorial might help the users understand the features of the app, we endeavored to create an app that is easy to use without a tutorial.

3.4 Test the implementation effectiveness, problems, and successes

The fourth objective looks to implement a system of monitoring and evaluation that can continue after the project is over. This will allow Urmatt to make improvements and changes over time.

The team created the monitoring and evaluation system as a separate Google form, we wrote it in Thai and English. There is a chance that dissatisfied users would not open the app, so a feedback system within the app itself would be ineffective. The drawback of this method is that the form will have to be sent out manually, which could be seen as antithetical to the goal of increased automation. The increase in feedback reliability makes this trade-off worth it. The form can be found in Appendix H.

Urmatt Ltd. can use the gathered feedback to drive decision making in the future. They may choose to hire freelance developers to implement new features, or simply to maintain the app. Whatever they choose, the transition period could be risky for our platform, as knowledge is always lost when a codebase changes hands. We have attempted to make this transition as smooth as possible by providing readable, maintainable code.

3.5 Conclusion

This chapter presented our project's objectives and examined the different research methods that the team used. The team interviewed farmers, FOD teams and Urmatt management for the first objective. We picked an appropriate platform for the app based on desired features in the second objective and in the third we developed and tested the app. The team proceeded to establish a monitoring and evaluation framework that will take into account the feedback from possible users in the fourth objective. Lastly, the chapter also considered the different limitations that our project might encounter during the process.

4. Findings

Through the completion of the research methods discussed in the previous chapter to gather and analyze data, the team has obtained seven findings. These findings are a result of the team's interviews in the fields and the work done by the team to fulfill our objectives. After we analyzed the interviews, the team defined different categories and looked for commonalities throughout the interviews. In this chapter, we will relate each of the findings to our project objectives, as presented in Table 3, and we will also explain our findings through the information obtained.

| Objective | Findings |
|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Evaluate current methods of data sharing | <ul style="list-style-type: none">● Field inspectors handle most of the data related to fields and farmers.● Document control teams create the reports needed for the organic certification. |
| Find a suitable platform | <ul style="list-style-type: none">● A mobile application will make the data collection process more efficient.● An organized database will reduce the workload in the report creation process. |
| Design a prototype system | <ul style="list-style-type: none">● Access to historical and personal data is necessary and difficult to obtain.● There is a need to track farm visits. |

Table 3: The findings that correspond to each of the team's objectives

4.1 First Objective

Our first project objective was to evaluate the current methods of data sharing between farmers and Urmatt Ltd. and the desired data for each party. To accomplish this objective, we interviewed the FOD inspectors and document control team and we found: field inspectors handle most of the data related to fields and farmers, and the document control team creates the reports needed for the organic certification.

4.1.1 Field inspectors handle most of the data related to fields and farmers

In Urmatt Ltd. the Field Operations Department team (FOD) is composed of managers, a document control team, and the field inspectors. The hierarchy levels follow the diagram in Figure 4. After our interviews with the managers and some of the inspectors, we learned that field inspectors are a key element for each FOD team. This is because their main duty is to visit farms and collect information. Both managers and the document control team rely on that information in order to manage the factory, create the organic certification reports and keep track of the company's progress. One of the inspectors for Hilltribe Organics mentioned that they visit farms every other day. During this visit, they check the chickens' health and whether or not the farm is being managed according to the company's standards. The inspectors of rice fields explained to us that they visit rice farms every day and during each visit, they collect information

from farmers about their latest work in the field. It works similarly for coconut field inspectors. One of the inspectors told us, "I visit farms and talk to the farmers. Ask them about their problems and things they struggle with." Furthermore, one of the rice farmers told us that the inspectors are the ones who take care of recording all the necessary data related to the farmers' work in the fields.

What the team learned from these interviews and farm visits was that the field inspectors serve as a bridge of communication between farmers and the rest of the company. The FOD managers helped us understand that without the information that the inspectors record every day, it would be much more difficult to coordinate the work in the factory, and Urmatt would not be able to assist farmers with their daily tasks and problems. Furthermore, the managers informed us that all the data collection is essential in order to obtain the organic certification for their products every year.

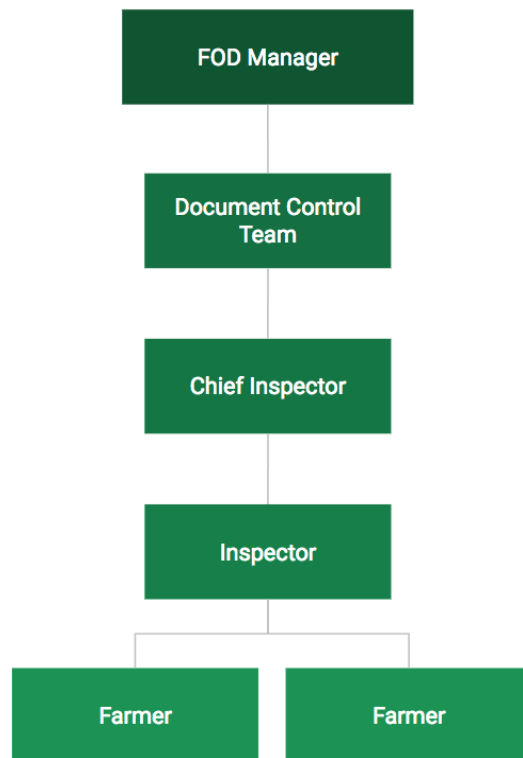


Figure 4: Hierarchy inside a Field Operations Department in Urmatt Ltd.

4.1.2 Document control teams create the reports needed for the organic certification

Another important part of the FOD is the document control team. During our interview with the document control team, they explained to us that their main tasks are to check, manage, and create reports based on the data that inspectors collect during their farm visits. They also try to keep that information as current as possible. This team analyses all the data and then creates a summary that assists them and the managers when generating different reports for organic certifications and keeping track of the farms. The document control team also checks that the inspectors collected all the information correctly. The main purpose of these reports is to keep track of all the activities that happen under the supervision of the FOD teams. This supervision guarantees that Urmatt is working under the organic certification standards. Another goal of this report is to keep managers informed about the progress in the different farms so they can decide on the next steps to take.

As can be seen from these two findings, the Field Operations Department of every product is in charge of managing and analysing the data that inspectors obtain from farm visits in order to create reports that will indicate how each season is going. These reports help managers make decisions regarding farms and factories as well as ensure Urmatt can get and maintain their organic certifications.

4.2 Second Objective

The team's second objective was to find and establish a suitable platform. To accomplish this objective the team analyzed interviews with farmers, inspectors, document control, and managers. These lead to two findings: a mobile application will make the data collection process more efficient, and an organized information platform will reduce the workload in the report creation process.

4.2.1 A mobile application will make the data collection process more efficient

The document control team analyzes and organises collected data from the farms in different reports that inform managers and other supervisors of the company's progress. The data also allows Urmatt to obtain their organic certifications. However, the data collection process is very time consuming and unreliable. Therefore, after analyzing the interviews, we determined that using a mobile application will help the FOD teams to reduce the time they spend in collecting data.

During the interviews, inspectors told us that most of the farmers have a small book where they should record their daily activities in the fields so it is easier for inspectors to collect the data when they visit the farms. The rice inspectors informed us that during their weekly visits they have to fill out the book for the farmers in addition to their own forms. This results in their daily tasks getting delayed. This delay ends up decreasing the inspectors' effectiveness, as in the case of rice farms they work with approximately 2500 fields. Another obstacle in their way is the amount of forms inspectors take to the field. One of the rice inspectors said, "we always carry a stack of documents when we visit farms". Another common issue that inspectors mentioned that it is difficult for them to fill out the forms due to the conditions in the fields when they visit. For example, if it rains they cannot take out the forms without ruining all of the information in them. Or, sometimes there is nowhere to lean on to fill in the forms.

After the farm visits, inspectors told us "we will have a meeting between inspectors to summarize the data" and later they input all the data collected during the day into Excel files. At

the end of the day, the inspectors are taking longer than they should because they have to repeat the data collection process twice, or sometimes three times, for every farm they visit and they have to learn how to work around the different obstacles that come their way.

During the interviews, the FOD manager for rice mentioned the idea of using an application to collect all the data from the farms. The manager said “I would like the application to help us save labor. So, if we were able to input data and information in, it would be great.” This will help the inspectors fill out forms easily as they would have their phone instead of “a stack of papers” and the previously mentioned obstacles such as weather conditions or place to write will no longer be an issue with mobile phones. Furthermore, they will only need to type in the information once instead of writing it in paper and then typing it in a computer. If a mobile application were to be established in the farms, it would help inspectors by allowing them to allocate more time to assist farmers with their problems and less to collecting data.

4.2.2 An organized database will reduce the workload in the report creation process

Through our interview with the document control team for rice, the team got a better insight into how the process works after the inspectors input all their data into different Excel files. The document control team has access to all the farm visits data, and as we previously mentioned in this chapter, their main task is to organize this data and create different reports that give detailed information of the process in the farms and the factories. They also have to update the information when there have been changes in the farms, like field area, or when a new farm starts working with Urmatt. The document control team that we interviewed told us that to create a report they have to start by checking that all the data has been correctly input in the files. They mentioned that this is a time-consuming part of the process as they have to check this data with inspectors or farmers if there are any questions, and then they proceed to summarise all this data so it's easier to access when writing the reports. One of the managers told us that right now this process is very slow, which means that managers don't have access to new information of the fields as often as they would like to.

The manager of one of the FOD teams said that pooled data which can be accessed by the document control will be beneficial for the company, and that “all data should run in central.” This means that all of the data should be in one central place that the managers can easily access. If the team could have access to a platform where they can find all the data easily and in a summarised form, their workload will be reduced and they could be more efficient when delivering the different reports.

These two findings led the team to realise that inspectors would access and collect data using their phones, but the document control team would access the data through their computers and would like to have the ability to generate data summaries with the information that inspectors and farmers record.

4.3 Third Objective

Our third team objective is to design and evaluate a prototype system to address identified data needs. The next two findings are data needs that we identified after analyzing the interviews; access to historical and personal data is necessary and difficult to obtain, and there is a need to track farm visits.

4.3.1 Access to historical and personal data is necessary and difficult to obtain

After the interviews with the three FOD teams, we understood the role that access to historical farm data plays in the process of obtaining the yearly organic certification. The FOD team explained to us that they need to have access to the historical data of each farm so they can know for how long a farm has been working with Urmatt. They talked about the importance of knowing the organic farming history of each farm, as it is necessary to obtain the organic certification. It also gives them an idea of the expertise level that each farmer has in organic techniques. They also mentioned that it would be helpful for inspectors to have access to each farmer's information regarding the number of fields that they have, how long they have been working for the company, what fertilizers they use, etc. Some of the inspectors added that it could be useful for them to have a picture of the farmer with their information too, so it's easier to identify them. This information is also vital for the organic certification, as external auditors need to be able to talk to the farmers and inspect the fields. Having correct information easily available to these auditors is essential for Urmatt's organic certification. Currently, they don't have easy access to all this information as they prioritize the data collected from the farms and don't have the time to update the farmer's historical data. Furthermore, Urmatt stores all the field information in paper copies and inspectors use a printed Google map to locate fields and relate them to farmers.

Urmatt also wants to have access to the farmers' family history and information; they mentioned that they would like to know the number of people in the household, their ages, and previous occupations. Urmatt would like to have this information to help the elderly members of the community by giving them artisanal jobs that don't require hard physical labor and that can provide more income to the family. By doing this Urmatt helps the farmers by reducing their pressure to provide income to the whole family and it also builds relationships between the members of the community.

If Urmatt had better access to each farm history and the farmer's personal data, the inspectors would be able to help farmers in a better way and it would also help make the creation of the report for organic farming less labor intensive.

4.3.2 There is a need to track farm visits

In the current system, there is no precise way to confirm that inspectors are completing their daily farm visits. Each FOD team has their own way of checking whether or not the inspectors went to the farms. For instance, for the rice farms, the inspectors currently take pictures of themselves with newspaper when they visit the farms. Urmatt would rather have a system which gives the manager the exact date and time of the visit. Moreover, the FOD of the rice farms said that instead of them using the current inspector checking system, "Can we share our location in the application like the inspector is here at the moment?" as a new way for them to check the inspectors. In addition, after interviewing with the egg FOD, we figured out that an alternative way to track farm visits can be done by taking pictures through the application. The egg FOD mentioned that they would like to access the pictures of the farm activities when people visit farms and it will also be "an evidence that our staff (inspector) went to the farm."

4.4 Web Application

From the findings above, the team decided that a web application would be helpful for both the inspectors and the document control team. The web application is not only suitable for this case but it also has other applicable advantages that are described in Appendix F, the main one being that it can be used on any device. In order for this application to be helpful for Urmatt it will address the concerns and needs mentioned in the previous findings. Below we describe the different features that the team decided to include in the app.

4.4.1 Features

The features that the team will include in our app respond to the needs we identified through the different findings, and table 4 relates each feature to the corresponding finding.

| Finding | Features |
|-------------------------------------------------------------------------------|--------------------------------------------------------|
| A mobile application will make the data collection process more efficient | Data Collection, Harvest Date Estimation, Offline Mode |
| An organized database will reduce the workload in the report creation process | Analytics |
| Access to historical and personal data is necessary and difficult to obtain | Farmer's Profile, Interactive Map |
| There is a need to track visits | Check-In |

Table 4: List of features that correspond to the chapter's findings.

The following list gives a detailed explanation of why each feature is needed for increasing efficiency, supporting the farmers, or helping Urmatt obtain their organic certifications and how it will function in the web application. These features are:

- **Data Collection**

In order to help inspectors during the data collection process, this feature allows the inspectors to fill out electronically the different forms they use during the farm visits. This feature replaces all the paper forms that inspectors have to carry. Inspectors are also able to upload pictures of the farms that monitor the progress of the fields. This will make the collection of data for organic certification easier and increase the effectiveness of the process.

- **Offline Mode**

As farms can sometimes be in areas without internet access, the FOD managers were concerned that the inspectors will lose time if the app didn't work without service. Our web application will store the information when the inspector's phone or tablet has no service, and it will upload the information automatically as soon as the inspector has service or wi-fi.

- **Analytics**

The document control personnel will use this feature as they would like to “be able to see the data summarized”. This feature provides them with different summaries of data in the form of tables and graphs. The document control team will now have an organised database that will allow them to access any information they want instantly. This feature will reduce the report creation time and it will make their work more efficient.

- **Farmer’s Profile**

This feature addresses the difficulty that the company now has accessing farmer's historical data. This feature allows inspectors search for the farmer's profile, which shows the farmer's history and other general information. This helps inspectors to carry fewer documents and help the external auditors organize information needed to grant organic certifications. Also if the inspector can access the farmer’s information while he is visiting fields, it will help him understand and address any problems that the farmers might have.

- **Check-In**

As the company has a current need for tracking the farms' visits, this feature locates inspectors at a certain place when they submit the data collection forms. Thanks to this, managers are able to check what farms the inspectors visited in a day, which helps Urmatt be sure that the data they are collecting is accurate and increase efficiency among the inspectors.

- **Interactive Map**

This feature will give the inspectors instant access to a map that identifies all the fields they work with and shows the location of the inspector at the moment of using the map. When inspectors click in a field, the map allows them to view the farmer profile related to that field. The interactive map will help inspectors have a quicker and easier access to the farmer’s profile, and will also help inspectors plan their daily visits more effectively as they will be able to choose the field that are close to each other and that they need to visit that day or week. Furthermore, the management team will be able to use the map to compare the locations where the inspectors have checked in and keep personnel accountable for farm visits.

4.5 Conclusion

In this chapter, the team identified, from the interviews, the different desires and needs that Urmatt Ltd. currently has. All this information helped our team to decide that a web application would be a suitable solution to address the company's needs. The next chapter presents the final deliverables of the project and explores what the future steps for the project are once the team has completed all its objectives.

5. Recommendations

In the previous chapter, we analysed the findings from our data gathered. Based on that information, we have created our deliverable and present what the next steps for our project will be after we leave the site. The first recommendation is related to the implementation of the app in the farms and how it should take place. Then, there are two recommendations for future projects related to the app that will add more functionality, increase the number of users or expand its impact.

5.1 Deliverable

To meet our project goal, we developed a web application that will support the sharing of data and make Urmatt processes more efficient. The web application that the team developed is called Rai. To support users of this app, we developed a tutorial. This tutorial covers topics such as the main features of the app and how to use these features, including how to create accounts, fill out forms, and access users profiles. To allow the app to be useful in the future, we provided Urmatt with a monitoring plan to keep the app working once we leave the site.

Some of the features of Rai and its general appearance can be seen in figures 5 through 7. A complete set of features of the app is included in Appendix H.

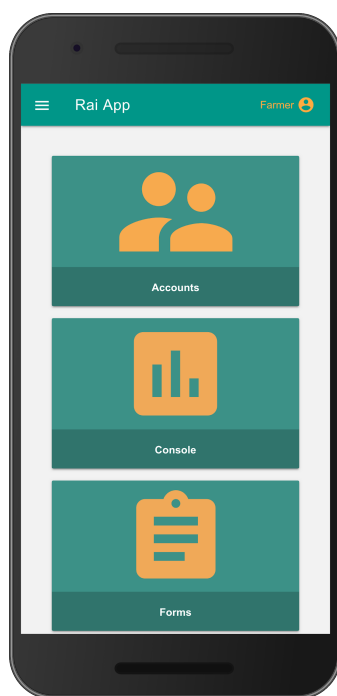


Figure 5: Rai Homepage

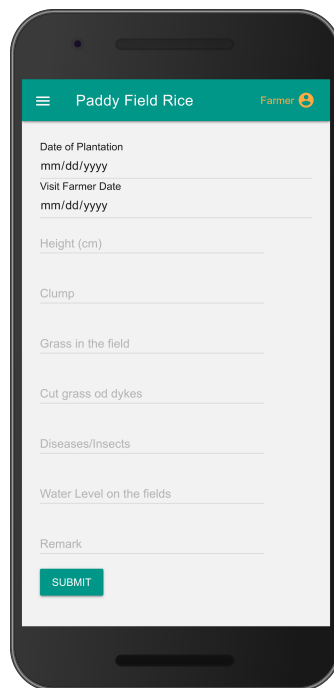


Figure 6: Data Collection form

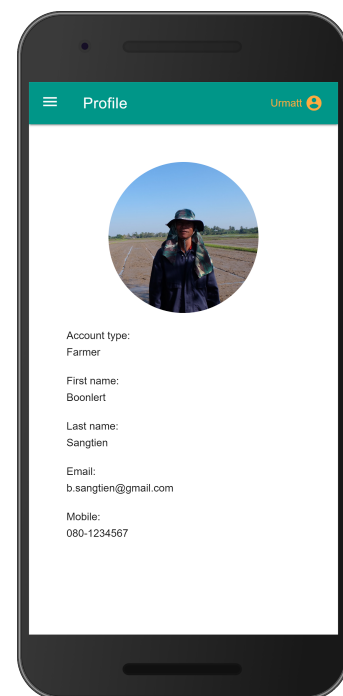


Figure 7: Farmer's Profile

The team wrote a tutorial for Urmatt and the FOD teams to read before using the app. This tutorial guides the user through the different features using screenshots from the app. The tutorial will help Urmatt implement the app among their FOD teams as it will help users have a better experience while using it. There are two versions of this tutorial: one for Urmatt and FOD

managers, and another for the inspectors, both available in English and Thai. A screenshot of what the tutorial looks like can be seen in Figure 8, the complete tutorial is included in Appendix H.

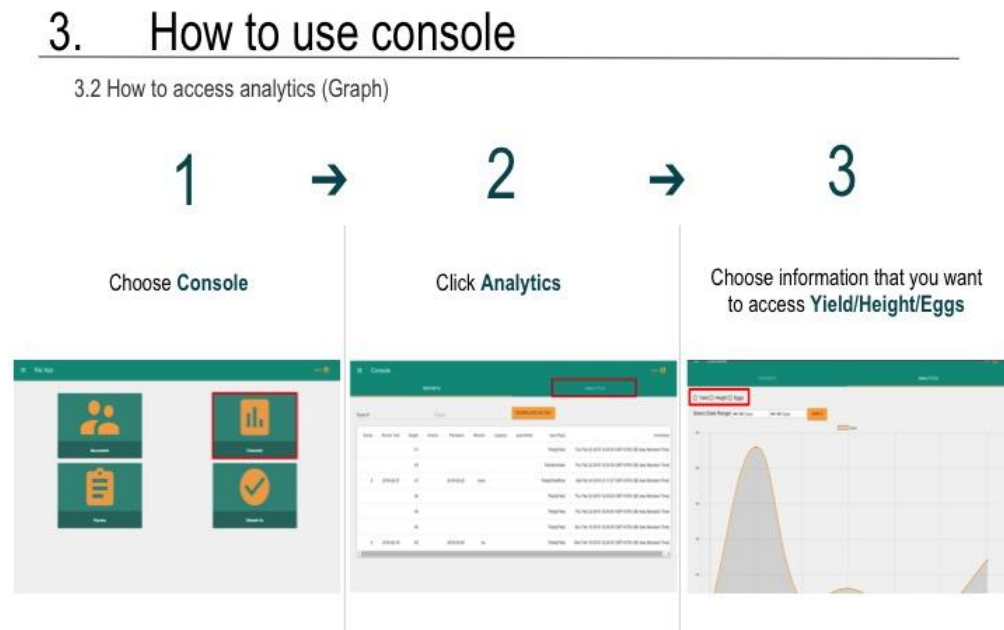


Figure 8: Sample page of the tutorial

Finally, the team will give the monitoring plan to the company in a Google form, the form is available in both languages. This plan will include different steps to follow and the recommendations previously mentioned in this chapter. This plan can be seen in Appendix H. The access the code used used for the deliverable, the instructions are in Appendix I.

5.2 Implementation

We recommend to Urmatt that they implement the app first among FOD teams, and then among farmers. This is due to a large number of farmers, and the varying literacy rate and familiarity with technology.

For the implementation with the FOD teams, the team recommends that managers, and the document control team will have profiles with access level to create accounts for new members. The implementation should start with the rice FOD team and then move to the other FOD teams. The purpose of this segmented implementation is to help Urmatt identify any problems with the app or the implementation in the early stages. Once the first implementation is successful, Urmatt should develop a strategy to implement the app in the rest of the FOD teams following what they've learned from the first implementation and any problems that came up during that time. By the time Urmatt decides to give farmers access to the app, all the FOD teams

in the company will be used to working with the app and will know how to introduce the app to the farmers.

However, there are a few issues that may come up in the implementation for the farmers, given that according to the Hilltribe Organics FOD team, some of the farmers can read Thai but not speak it, some can speak Thai but not read or write in it, and some have no experience with Thai. In addition to language barriers, not all of the farmers have smartphones. This is less of a problem in coconut farming, where there are only thirty farms to supply, but for rice farming, where there are 2,000 to 4,000 farms in the wet season, providing technology to all of them is a major logistical hurdle. Urmatt has expressed its willingness to provide smartphones to farmers that do not already possess them, but as stated, the number of rice farmers makes that difficult. In addition to that, farmers leave and join the Urmatt system frequently, which would make providing devices to them all even more difficult. These issues and the amount of support Urmatt is willing to give should be understood completely before a solution is developed.

As our team focused on implementation for the FOD teams, we recommend that another WPI/CU team or Urmatt focus on the implementation for farmers. We have made an interface for the farmers, but Urmatt should improve the interface after conducting more research. For instance, with the language barrier, different types of farms have different methods to convey information, but Hilltribe is especially interesting as they use different symbols to overcome language differences. Interviews with the farmers and the FOD teams that focus on language and communication could give important information about the way that the app could be most effective. Knowledge about a better communication strategy could significantly improve the app.

5.3 Knowledge Bank

We recommend that Urmatt collect and distribute data about farmer practices in order to better support farmers. Currently, there are several systems being used for planting, harvesting, and dealing with pests. While these practices are all organic, farmers have stated that they would like to have access to best practices information so that farmers working with Urmatt can learn how to most effectively farm and support their families.

Urmatt could achieve this through the following objectives:

1. Learn the different practices that are being used across the different types of farms.
2. Use historical data and research to determine the best practices.
3. Compile the different methods in a comprehensive guide.
4. Determine the best method to disseminate the information.

The first objective would involve interviewing many different farmers in order to get a comprehensive list of the techniques currently being used on the farms. These techniques involve the use of different fertilizers, planting methods, ways to deal with pests, and harvesting methods. Unless a majority of the farmers are interviewed, it is unlikely that all of the methods would make it onto the guide. When our team interviewed three different rice farmers, the team found three different planting methods and two different methods of dealing with pests.

The second objective involves taking all of the different practices that were found in the first objective and using research and historical data to determine the best practices.

The third objective would be taking all of this information and creating a comprehensive guide that covers all of the different best practices in a way that is understandable, reproducible, and clear to every farmer that is receiving the information. After the information has been collected, the method for dispersing the information becomes the next hurdle. Many farmers cannot read or write Thai and especially in Hilltribe Organics, some of the farmers don't speak

Thai. Due to this, the best method to disperse information would have to be determined by a team dedicated to this project.

Potential problems could arise in the form of farmers being unwilling to share their practices with others and the aforementioned issues with communication. There are also many different farmers to potentially visit, so that could prove to be a challenge for any team trying to collect data from all of them. The language barrier could also present a problem, as communication with farmers could be an issue in both collecting the information and disseminating information.

5.4 Customer Interaction

We recommend that an additional expansion of the project could be in increasing the customer interaction for Urmatt. Currently, there is a system for some interaction with the egg farmers, in the form of stamps on the eggs and an egg tracker website. The egg tracker website has a map of all of the farms. The stamps have a farm code, which shows which farm those eggs came from. The website has pictures of the farmers and descriptions of them.

This could be achieved with several objectives:

1. Learn the system currently used for eggs.
2. Determine the best system to use for all of Urmatt's products.
3. Design a prototype and test.

The first objective is important because Urmatt already has a tracking system in place, where based upon codes stamped onto eggs, you can search on their egg tracker back to the farm it was produced on. This system is designed to connect customers to the people that produce their food. Our sponsor has expressed interest in expanding the system for the other products. The current system also prints the farms that coconut water comes from on the bottles, but it does not allow customers to track back to the farms.

The second objective involves research on not only the current system but other systems that could be used for Urmatt's products. This would also involve speaking with the manufacturing and FOD teams in order to determine the best way to implement a system. There could be research done on other projects from companies that are attempting to connect their farmers and their customers. In addition to that, the systems currently in place are not well advertised, so coming up with a better system for encouraging customers to look up their farmers would be involved in this step as well. This could be a good advertising point for the company if designed correctly. As always, designing and testing a prototype is the most important step to ensure functionality. This would likely have to be approximated, as actual customer interactions would be hard to test.

Some problems that may come up are that changes to the manufacturing system may be inconvenient and expensive, so the design should try to be as low impact as possible. In addition to that, the team knows that this system works for eggs, and would be easier to implement for coconut water, as those bottles are already labeled with what farm they come from. However, for products like chia seeds and rice, one package may come from multiple farms, which makes the tracking system difficult.

5.5 Conclusion

The purpose of this project was to design a platform to help Urmatt establish a data sharing system between the company employees. The web application that our team designed satisfies that purpose by making the data collection and report creation processes more efficient. If Urmatt follows the recommendations, this app can reach more people and have a greater impact.

Our project not only fulfilled our goal, but will fulfill a greater purpose in the future. By increasing the effectiveness of the company through the app, Urmatt will have more resources available to better assist farmers. When Urmatt implements the app among farmers, it will help distribute knowledge so they can share experiences and help each other. At the end of the day, our app will not only be impacting the company but also the local farming communities in Chiang Rai that are struggling with rural poverty. “Rai will impact the life of at least two thousand farmers” (Narula, Personal Communication).

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Appendices

Appendix A: Organic Certification Standards and Procedure

While there is no worldwide standard for organic certification, the International Federation of Organic Agriculture Movements (IFOAM) has compiled a general standards requirement, otherwise known as the Common Objectives and Requirements of Organic Standards (COROS). This is a form that compiles the various international organic certifications and has the most common standards within it. While it is normally used to ascertain the weaknesses and strengths of the various organic systems, it is also a useful tool to examine the organic 'standard' as determined by IFOAM in collaboration with the FAO and the worldwide organic standards (IFOAM, 2017).

The full copy of the COROS can be found below, but the main applicable points are thus:

1. Employ long-term ecological systems-based organic management
2. Assure long-term, biologically based soil fertility
3. Avoid/minimize synthetic inputs at all stages of the organic product chain and exposure of people and the environment to persistent, potentially harmful chemicals
4. Minimize pollution and degradation of the production/processing unit and surrounding environment from production/processing activities
5. Exclude certain unproven, unnatural and harmful technologies from the system
6. Treat animals responsibly
7. Promote the natural health of animals
8. Maintain organic integrity throughout the supply chain
9. Provide organic identity in the supply chain
10. Achieve fairness, respect and justice, equal opportunities and non-discrimination for employees and workers

These standards are the ones that must be met, but there are also IFOAM standards about how to collect this information. These are the general guidelines of inspection and certification as defined by IFOAM (IFOAM, 2012).

1. Evaluation
 - a. Scope
 - i. The certification body shall evaluate operators against all certification requirements specified. The evaluation shall consist of a review of documents and an on-site inspection visit.
 - ii. When the scope of certification is for labeling of conversion to organic, verification of compliance with these requirements shall take place during the conversion period.
 - b. Review of application and preparation of inspection
 - i. Prior to the inspection, the certification body shall review the application documents to ensure that certification can be carried out and that application of certification procedures is possible. In particular, the certification body shall review whether
 1. Documents submitted by the operator are complete;
 2. The operator appears to be able to comply with all certification requirements (applicable procedures and standards);
 3. The scope of the certification sought is within the scope of the certification services provided. (New scope could also be a new geographical area where the certification body is not yet active.)

4. The certification body shall assign qualified personnel to the evaluation in line with the requirements of 2.2 and 2.3 above, and provide them with appropriate work-related documents.
 5. The certification body shall inform inspectors about any non-conformities and the associated requests for corrective action issued previously, to enable the inspectors to verify whether the non-conformities have been resolved. 15 IROCB
- c. Inspection protocol Inspection is carried out in order to verify information and compliance with certification requirements applicable to the operator. It shall follow a set protocol to facilitate non-discriminatory and objective inspection. The inspection protocol shall at the very minimum undertake the following:
- i. Assessment of the production or processing system by means of visits to facilities, fields and storage units (which may also include visits to non-organic areas if there is reason for doing so);
 - ii. Review of records and accounts in order to verify flow of goods (production/sales reconciliation on farms, input/output reconciliation and the tracing back of audits in processing and handling facilities);
 - iii. Identification of areas of risk to organic integrity;
 - iv. Verification that changes to the standards and to requirements of the certification body have been effectively implemented; and
 - v. Verification that corrective actions have been taken.
- d. Particular requirements to address high-risk situations. The certification body shall amend and adapt its certification procedures to address higher risks found in certain situations specific to organic certification. Potential high-risk situations and related measures include:
- i. Partial conversion and parallel production. In order to prevent co-mingling or contamination of organic products with other products that do not meet the standards, the certification body should verify whether handling and documentation regarding production or processing, storage and sales is well managed and makes clear distinctions between certified and non-certified products. In cases where products are not visibly distinguishable, specified measures should be applied during harvest and post-harvest handling to reduce the risk.
 - ii. Intensive production and high dependence of external inputs, short production cycles. Depending on the risk identified, the certification body should decide whether it is appropriate to increase the frequency of inspections.
 - iii. Where an operator is certified also by other certification bodies within the same organic scope, the certification body should seek information exchange with the other certification bodies involved to prevent misuse of certificates.
- e. Requirements for group certification systems
- i. If the certification body conducts group certification based on an internal quality management system, it should apply a specific group certification program.

- ii. The group certification program should specify the scope for group certification and requirements applicable to the group, including those for an internal quality management system, to ensure conformity by all group members to the applicable standards. These should follow an agreed code of good practices.
 - iii. When assessing the effective application of the internal quality management system to address the particular situation of group certification, the certification body should apply 16 IROCB adapted measures to the regular on-site inspection protocol according to an agreed code of good practices.
- f. Reporting The certification body shall report evaluation findings according to documented reporting procedures.
 - i. Inspection reports shall follow a format appropriate to the type of operation inspected, and facilitate a non-discriminatory, objective and comprehensive analysis of the respective production system.
 - ii. The inspection report shall cover all relevant aspects of the standards, and adequately validate the information provided by the operator. It shall include
 - 1. A statement of any observations relating to conformity with the certification requirements;
 - 2. Date and duration of the inspection, persons interviewed, fields and facilities visited; and
 - 3. Type of documents reviewed.
 - iii. The certification body shall promptly notify the operator of any non-conformity to be resolved in order to comply with applicable certification requirements.
 - iv. The certification body shall document and apply measures to verify effectiveness of corrective actions taken by operators to meet the requirements.

Appendix B: Types of E-agriculture Interventions

| Type of System | General Function | Looks At | Provides | System Examples |
|---------------------------------|----------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------------------------------------|------------------------|
| Data Logging and Management App | Assists farmers in creating and maintaining data records | Pest infestation | Efficiency | CropIn |
| | | Labor usage | Cost management | FarmNXT |
| | | Inventory usage Equipment usage | Manure management information | Manure Monitor |
| | | Area coverage Chemical usage Property records | | Wireless Monitor |
| Location Based App | Functions like maps to assist farmers and consumers | GPS | Management of operations | FarmNXT |
| | | Watering equipment | Efficiency | Delaware Fresh |
| | | Farmers' markets | Avoid collisions | Michigan Market Finder |
| | | | Give access to consumers | Farmer Apps |
| Specific Calculation App | Makes simple yield calculations based on data | Weight of cows | Yield Forecasts | FarmNXT |
| | | General input information | Meat from a cow | CropIn |
| | | | Monitoring Information | Wireless Monitor |
| News and Information App | Provides information quickly to farmers | Pest infestation | Pest identification | Poverty Action Lab |
| | | Weather | Notifications about planting, weeding, fertilizing, fire prevention, and harvesting | FarmNXt |
| | | | Weather warnings | CropIn |
| Training Program | Gives farmers training that improves farming techniques | Current soil conditions | Soil and condition based crop choices | Dupont Pioneer |
| | | Current farming practices | In person classes on efficient practices | Climate Smart Project |

(Agrawal, 2013), (CropIn, 2017), (FarmNXT, 2017), (Doering, 2013), (Poverty Action Lab, 2016), (Robbins, 2014), (DuPont, 2013)

Appendix C: Research Methods

B.1 Description and comparison of research methods

For qualitative methods, there are three main examples: participant observation, interviews, and focus groups. Interviews are the most popular research method as they suppose direct interaction with participants. Depending on how interviews are structured, they can be categorized in three different ways: informal, semi-structured and standardized (Gill, Stewart, Treasure, & Chadwick, 2008). The table below summarizes the strengths and weaknesses of each method.

| Method | Advantages | Disadvantages |
|-------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------|
| Informal Interview | Interview is customized to participant | Unorganised |
| | Participants feel more comfortable | Data gathering is complicated |
| | | Time-consuming |
| Semi-structured | Flexibility | Data collection is still complicated |
| | In-depth answers from participants | |
| | Researcher can predict outcomes and be better prepared | |
| Standardised | Quick to follow through | Allow limited responses |
| | Data gathering is structured | Less flexibility |
| | | Responses might lack depth |
| Participant Observation | Gives better insight of the community | Time-consuming |
| | Provides information that might be difficult to obtain using other methods | Researcher might lose objectivity after being close to the community |
| Focus Groups | Gives insight understanding group norms and dynamics | The discussion might be dominated by a few members only |
| | Faster way of collecting different insights | Participants might censor ideas in order to please the group |
| | Reduction of biases from the moderator | Require a skilled researcher to moderate the discussion |

(Mack, Woodsong, MacQueen, Guest & Namey, F), (Gill, Stewart, Treasure, & Chadwick, 2008), (Santos, Danielson & Chess, 2007).

In participant observation, researchers can also develop a deeper relationship with the participants through observation. This consists of the researcher learning how participants manage their daily tasks in their own environment. This method is used to gain a deeper understanding of the participants and to verify what participants might have answered in an interview (Mack, Woodsong, MacQueen, Guest & Namey, 2005).

Focus groups are group discussions guided by the researcher on certain topics. These group discussions can be seen as a combination of both interview and participant observation, as

the researcher is asking the group several questions regarding a general topic and is also observing the interactions between the group members (Santos, Danielson & Chess, 2007).

Appendix D: Transcribed interviews

D.1 Interviews with FOD Teams

D.1.1 Interview with Coconut FOD

Date: 31/01/2018

Usually, when you visit the farms, do you only use farm activities book?

- There will be soil and water inspection that the sample will be collected and send to labs

How often do you check the farms?

- Once per week, for one farm. There are instructions for checking farms.

Currently, is there any problems with collecting data?

- Sometimes we don't see the farmers, so we won't know the main problem. Problems like the fertilizers will be an issue.
- Meeting with the farmers in the factory. At first, it's once per three months but after changing the leader, the organization gets messed up.

When you visit the farms do you carry lots of document with you?

- Moderately, sometimes I will carry the whole document files. Look at how well the farmers are doing, how well the farms doing and the things the farm is lacking. The farmer will report what they want to us. Then we will discuss it during the meeting such as the fertilizer and its price.

The documents that are for the farmers and FOD, is it the same documents?

- Farmer visit for us is a pink book and for the farmers will be a regular notebook. And we will check the notebooks that they've written to see when they water, and if it matches with the pink book. When they put the fertilizers, when they do the shoveling, and pulling stems.

So you copied the farmer activity data from the farmer's notebook?

- Yes, we copy and ask whether they really have done what they wrote down in their notebook. Then they need to sign and record the date.

Problems with harvesting?

- Problem is the size of the coconut does not match with contact farmers.

Daily Activities

- I visit farms and talk to the farmers. Ask them about their problems and things they struggle with. For example, the number of coconuts.

What do you want from the application? Do you have anything you wish we should add?

- If possible, I want the farmers to have access to the application. Let them see our company's system and coconut price day by day so that they will not leave our company. Currently, our company's coconut orders are not stable, the demands are sometimes high and low so the price will not be the same. If the farmers understand us, it would be better.

Do you have documents to check? Like the documents for soil and trees.

- Yes, there is a group of people who will go in and check the trees, get some samples of the soil for further investigation. For several years, there will be results from the lab, but for last year there was no investigation due to insufficient money.

Is that information important to the report?

- Very important, because that information will show that we did not use any chemicals since we are doing the organic process. If we use fertilizer, we will have to consider the conditions of contract farm, whether if there are any disagreements.

D.1.2 Interview with rice FOD team

Date: 22/01/2018

What do you want to see or add into the application that we are making?

- I would like the application to help us save labor. Because we always carry a stack of documents when we visit farms. So, if we have the application and able to input data and information in it would be great. For example, using a map and press on to the fields, the information of the farmer will pop up. This will help us reduce the working steps.

Farmers information that you want to add?

- I want to have a section where we can add pictures of farmer activities. For example, spraying fertilizer process.

Will you use this application every day?

- YES

How many farms do you visit a day?

- We have 2500 fields that we are responsible for. So it is about 100 farmers/fields(each field may/ may not be owned by the same farmer) per one month. After we're done collecting data and information, we will have a meeting between inspectors to summarize the data. Each farmer must be checked by inspectors for the minimum of 4 times. Things that we do every day is filling up the farmers manual and farmer visit. All data should run in central. Pooled data should be accessed by the document control people. Document control is the one who prepares/summarized the data for inspector into a report. They deal with all information from inspector and farmers.

If you know that if the inspector put something wrong in the report, would you ask him to make the changes or is there someone else that make these changes?

Actually, the document control people should make the changes and revises it.

How to set up the database to make it easy for you to use. How to create a report or document that is useful to you?

The report or the data should be in Excel file. Whatever data from the summary record or data should be in Excel because some boss they need only this kind of data but other may need differently. The printout should be in cultivation form. Because we record all the record in cultivation form.

How often do you fill out information?

- usually, there is information such as how many rice field a farmer has, how many rai in one field, how much yield expected from each field. These were filled upper one crop season. However, inspection information will be filled every time the inspector inspect the farms.

If the area does not have any internet access, can they save the information and upload it later?

- Can we share our location in the application like the inspector is here at the moment? Because our inspector often went out to inspect the field. This can be used to identify the inspector location and allow their boss to know their location too.

Do you want the pictures to have a date on it?

- Yes, if it is possible then sharing the location is not necessary. Right now, we are using newspaper and let the inspectors take a picture with it to make sure that they went to the fields not somewhere else.

Do you have anything more to add to the application?

- It would be nice if farmers can see where the inspectors are by looking at the application. Also, let the farmers see each other's progression and share information. For example, what type of fertilizer others use.

D.1.3 Interview with Document Control Team

Date: 23/01/2018

Usually, what kind of work do you do, like your daily activities?

In the morning, we have to check like if there is any problem with the farmers. So sometimes farmers would call us or they might line us or they would give a message to the officer to give us later. Cases like those who are outside and have some changes, such as the number of acres, which might get lower or higher. If it gets higher, then it will be added to the map, but if it gets lower, then we can decrease because we already have the information. In the beginning, we will have a meeting that relates to fertilizer, the type of seed that we use, which one we already have we will then contract cooperative? or sometimes we suggest them that about the seed we use. They then can use the seed that came from us, because those seeds were picked from farmers. In terms of updating information, we always check using line which is very convenient. In term of communication, communicating with other places like the mill, if there is any change or if there is any concern with the report like the number of new farmers and the older farmers, we will always update those type of information.

While working, which part do you think is a waste of time?

The part that is waste of time would be making reports for the boss. Each boss will ask for a different format, for each report we need to make a different style that suits each boss' style. So, we waste a lot of time on finding information and sorting information.

What do you think about an application that can sort information for you? Will it save you time?

It's possible to save time for the inspectors but for us (Document control), I think it can not help us manage the information. This app may help us find information of the farmers by clicking on the map. If this app helps our inspector to input the right information then the report we made will also be right. The thing is in my opinion, this application is more suitable for going into the field for the inspectors to use not us.

How often do you change the data you have?

Usually, we do change the data we have but the data is flexible. For example, the amount of rice field farmers have and rice fields owner(they change owner). These are all data that depends on different factors.

What kind of format do you want for the information and data to be in so that you can work easier?

If the information obtained is in the format that was given to you then it will help us a lot. Also, if the application can summarize the data for me it will be awesome. For example, the amount of female and male farmers.

D.2 Interviews with farmers

D.2.1 Rice Farmer 1

Date: 23/01/2018

What do you think about sharing information between farmers, like information about the fertilizer, which fertilizer would be most effective?

- It's good, usually, we share information with one another, very open to sharing of what each has.

What if other farmers want our information, would that be a problem

- That would not be a problem

What do you think of sharing phone numbers of farmers with others to make it easier to contact each other? Would it be convenient?

- Yes

Usually, when you input data into the booklet, is there any problem of recording data

- Usually, the inspector will take care of that

What do you use to communicate with the inspectors

- Telephones

What if there is a problem, do you ask help from the inspectors?

- Yes

Is there any other information you want that would be beneficial to farming or working. Example, we can insert information that is fertilizer related, or about insects.

- The company provides a booklet and they follow, like the chemical used to kill insects is also from the booklet.
- Inspector: there are courses about farming for farmers
- There are courses about farming

Do you usually use smartphones, and what application do you use.

- Yes
- Application like youtube, google

Can you use mobile application

- Yes, we can, but not at a high level, mainly use for youtube

What kind of problem you usually face while working.

Example, how often do you see insects and how do you usually eliminate them.

- There is herb, prickly chili, orange juice, distilled water

Is there seed product from the company that can be used to grow

- There is different seed product. If there is an application, then there might be other products that are similar.

D.2.2 Rice Farmer 2

Date: 23/01/2018

Daily activities

- I mostly do farming and also play sports

What do you think about sharing information between farmers, like information about the fertilizer, which fertilizer would be most effective?

- Normally, farmers do come together and share information about farming. For example, do you have any problem with farming? Which fertilizer give the most yields.
- Last year, we ferment the golden apple snail and use it as an organic fertilizer.

Do you make your own fertilizer?

- Yes, if I have leftover food, I use it as a fertilizer.

*The rest of the conversation was not related to our project.

D.2.3 Rice Farmer 3

Date: 23/01/2018

How many days does it take for growing rice?

- It depends on the rice type. Some took 120 days and some took 90 days.

Why did you use the throwing technique for farming?

- It saves cost and gets lots of products.

Do you have any problems with organic farming?

- The main problem is faced is golden apple snail. Because we don't use chemicals, they are hard to get rid of. So I mainly searched google and watch youtube on how to get rid of them.

What do you think about sharing information among farmers?

- I like it. We can share about how to deal with the golden apple snail.

Do you have a smartphone? What do you use it for?

- Yes, I do have a smartphone. I'm a new generation farmer so I use it to search for new information. For example, how to do organic farming.

What features do you want us to put into the application we're making?

- Knowledge. It would be useful if you add useful information for farmers to see so that the older generation can get into new information easier without needing to search on google.

How many days does it take for growing rice?

- It depends on the rice type. Some took 120 days and some took 90 days.

D.2.4 Coconut Farmer

Date: 31/01/2018

What do you think about sharing information among farmers?

- I think it's good, we usually share information.

How often do you harvest?

- 25 days

Are there any problems when planting the coconuts?

Example like insect problems?

- There is some that are dried, so we have to plant them again. Sometimes, the beetle eats them.

How often do you see the beetle?

- Many times

What ways do you prevent the insects?

- There are no ways to prevent it

Does the company provide instruction booklet for preventing beetles?

- No, but actually those beetles cannot be prevented or eliminated. It flies around and comes when unguarded.

Appendix E: Qualitative Coding

This is an example of the qualitative coding that the team did to analyse the interviews. The purpose of this coding is to find common categories, such as inspector duties or problems, throughout all the interviews that help the team understand better the situation and determine how the app would be helping the farmers.

| Interview | Information Categories |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|
| <p><i>How often do you inspect farms?</i></p> <ul style="list-style-type: none">- We go every other day. But for recording we do once a month because we have up to 54 coops. <p><i>We wanted to know what kind of forms do you use and information you collect.</i></p> <ul style="list-style-type: none">- There are lots of forms. Some we let the farmers do, a calendar form. In the calendar there will be space for farmers to note down detail about their activities each day. For example, how many eggs collect? How many chicken died? Or they wash the chicken coop today. <p><i>And when you visit the farms, do you face any problems?</i></p> <ul style="list-style-type: none">- If the place is not convenient to write, sometimes we use our phone instead. To take pictures in different places and will come back to see and write down the details later. Which this will slow down the process. | <p>Inspector Duties</p> <p>Problems</p> <p>Possible Features</p> |

Appendix F: Web App vs. Native App

| Type of App | Main Advantages |
|-------------|----------------------------------------------------------|
| Native | Better user experience |
| | Better performance |
| | Better access to operating system specific functionality |
| Web App | Not platform specific |
| | Shorter development time |
| | Lower development cost |

Appendix G: Product Design Steps

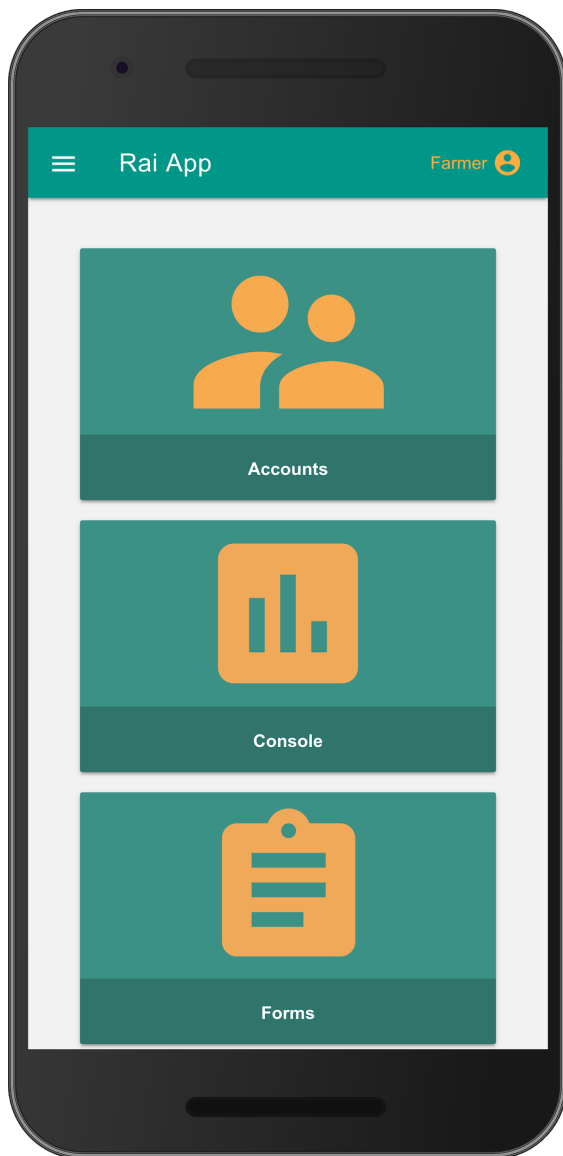
- 1) **Determine features** - Evaluate farmer desires, codifying them and determining which ones could feasibly be implemented into the app. This is done in the first objective.
- 2) **Design user interface** - Mockup different presentations for the features determined above.
- 3) **Acquire feedback** - Present user interface mockups to other students and teachers and determine the most usable ones by asking where they would look for specific features in the app. Once a basic, functional app is built, use the same process with the app instead of mockups, and the farmers and Urmatt Ltd. will now be included.
- 4) **Implement feedback** - Make changes to the user interface to make it more user-friendly.
- 5) **Repeat steps 3 & 4** - Continue acquiring and implementing feedback until project time ends.
- 6) **Monitoring and evaluation** - Leave a plan in place to monitor and improve the app. Explained in more detail below.

Appendix H: Deliverables

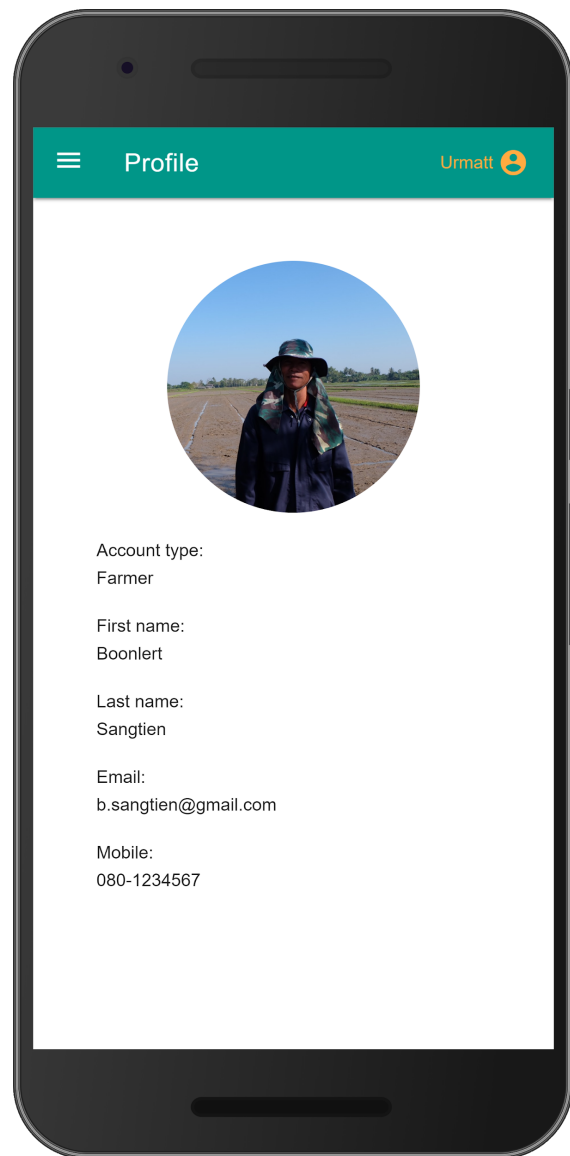
H.1 App

App's logo:





App Homepage



Farmer's Profile

☰ Paddy Field Rice Farmer

Date of Plantation
mm/dd/yyyy

Visit Farmer Date
mm/dd/yyyy

Height (cm)

Clump

Grass in the field

Cut grass od dykes

Diseases/Insects

Water Level on the fields

Remark

SUBMIT

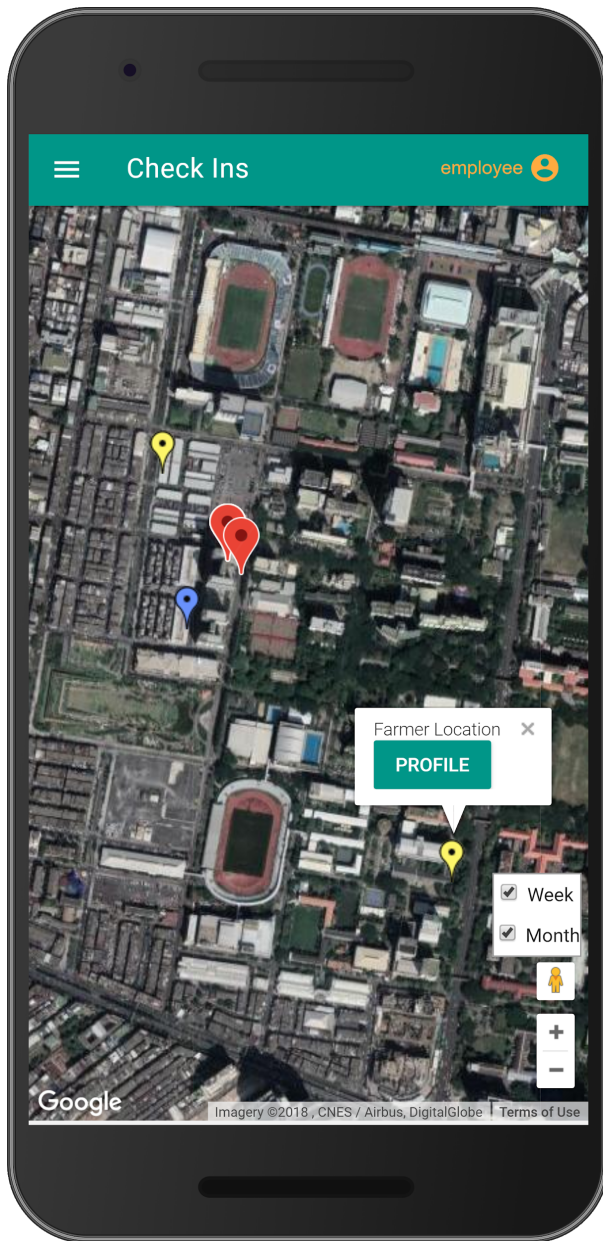
Example of form for Data
Collection

☰ Console

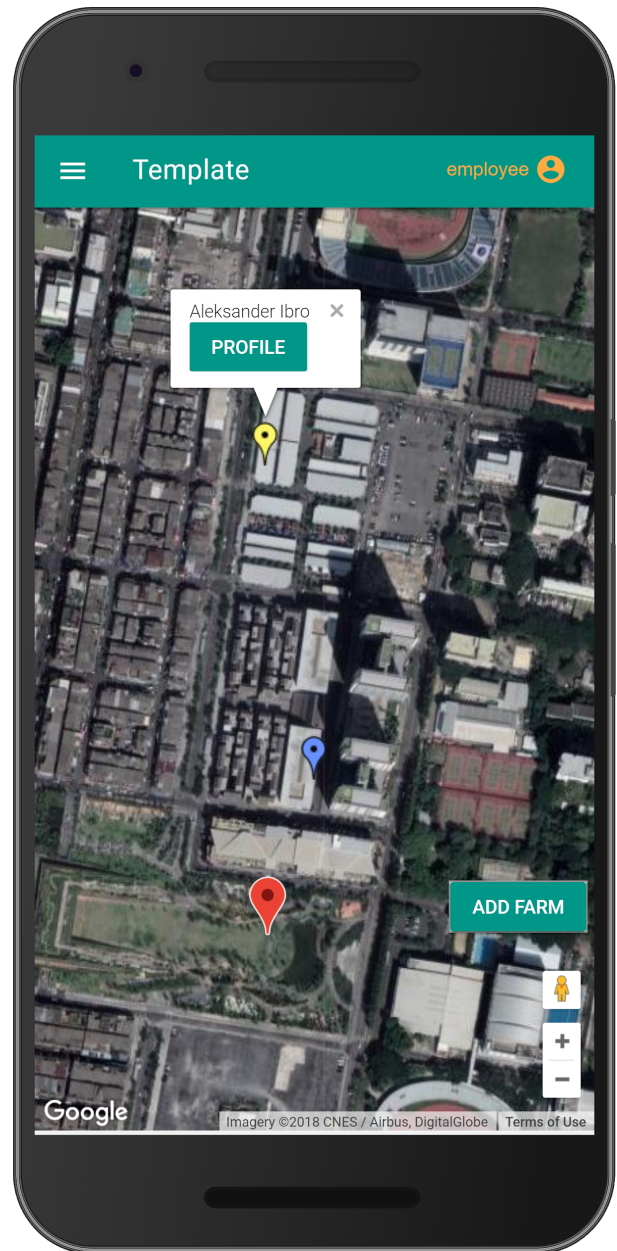
CHECK IN!

Success! Checked in at:
13.7416751, 100.52549429999999
on Sat Feb 24 2018 09:34:44 GMT-0500 (EST)

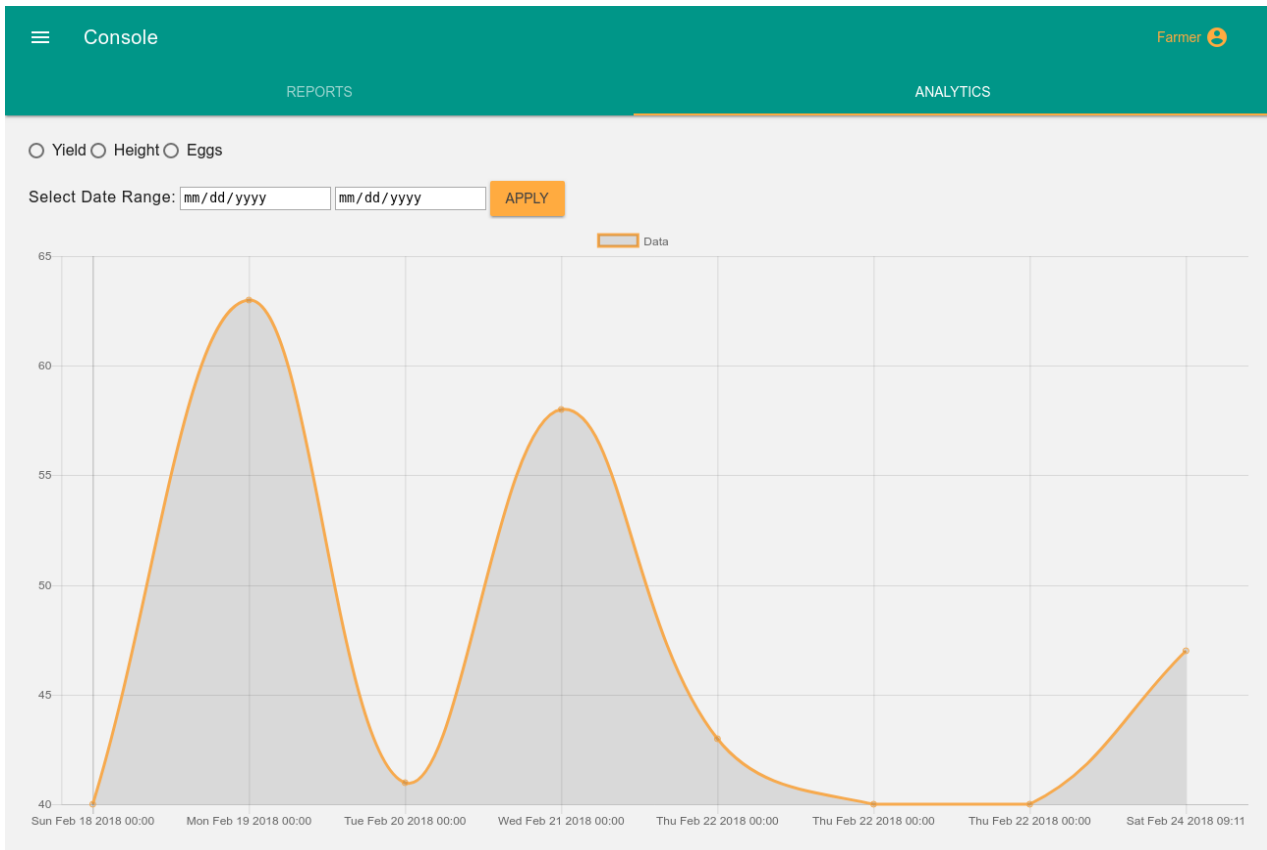
Inspector Check-In
Confirmation



Inspectors Weekly/Monthly
check-ins showing in the map



Farmer's profiles in the
Interactive Map



The analysis feature: graph that plots the yield in a determined period of time

H.2 Tutorial

H.2.1 Manager Tutorial

1. How to create account

1.1 Farmers

1 → 2 → 3

Choose menu  on the top left of the screen

Click
Create Account

Click **New Farmer** to create farmer's account



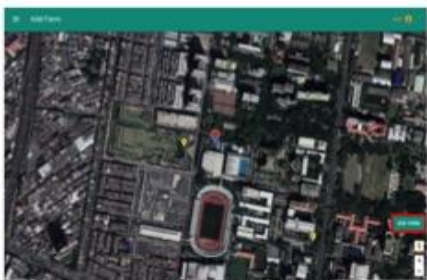
1. How to create account

1.1 Farmers

4 → 5

Select farmer's farm on the map and click **Add farm**

Input farmer's information
and click **Sign up**
(Please, wait for image to be uploaded)



1. How to create account

1.2 Inspectors

1



2

Choose menu  on the top left of the screen



Click
Create Account



1. How to create account

1.2 Inspectors

3



4

Click **New Inspector** to create account



Input inspector's information
and click **sign up**
(Please, wait for image to be uploaded)



1. How to create account

1.3 Urmatt Employee

1



2

Choose menu  on the top left of the screen



Click
Create Account



1. How to create account

1.3 Urmatt Employee

3



4

Click **New Urmatt Employee** to create account



Input informations
and click **Sign up**
(Please, wait for image to be uploaded)



2. How to access accounts

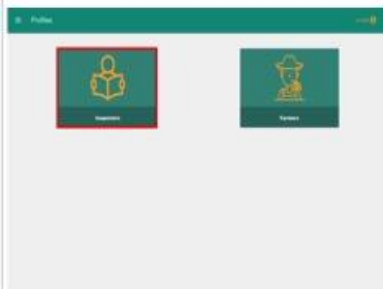
2.1 Inspectors

1 → 2 → 3

Choose **Accounts**



Click **Inspectors** to access inspector's information




Type the name of inspector you want to find on **Search**



2. How to access accounts

2.1 Inspectors

4 → 5 → 6

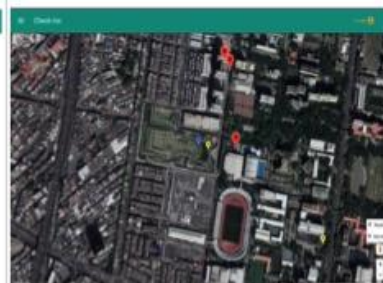
Click  to see inspector's profile



To access all the location where the inspector check-in, click **Show Check-In**



All the location check-in by the inspector will show up



2. How to access accounts

2.2 Farmers

1



2

Choose **Accounts**



Click **Farmers** to access farmer's information



2. How to access accounts

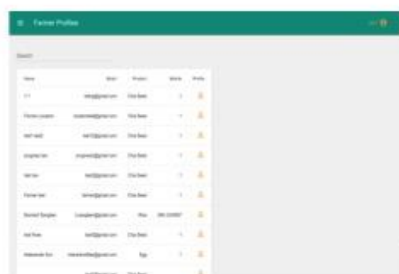
2.2 Farmers

3

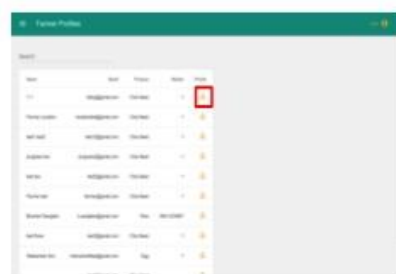


4

Type the name of farmer you want to find on **Search**



Click 👤 to see farmer's profile



3. How to use console

3.1 How to access reports (Tablet, Android, iOS)

1



2

Choose Console



Users can choose for the
desire information by typing
on **Search**



3. How to use console

3.1 How to access reports (PC)

1



2

Choose **Console**



Users can choose for the desire information by typing on **Search**



3. How to use console

3.2 How to access analytics (Graph)

1



2

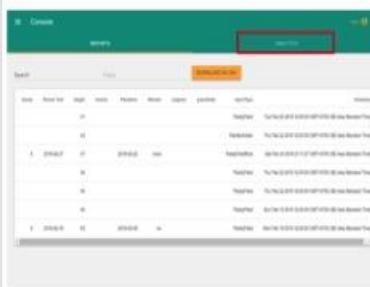


3

Choose **Console**



Click **Analytics**



Choose information that you want to access **Yield/Height/Eggs**



3. How to use console

3.2 How to access analytics (Graph)

4



5

Select data range and click **Apply**



The graph will appear on this page

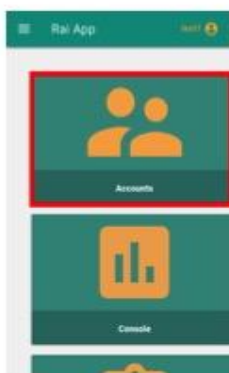


1. How to access accounts

1.1 Inspectors

1 → 2 → 3 → 4 → 5

Choose **Accounts**




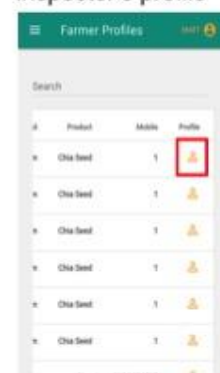
Click **Inspectors** to access farmer's information



Type the name of farmer you want to find on **Search**



Scroll to the right to see profile icon 
Click to see inspector's profile



Inspector's information will appear on this page

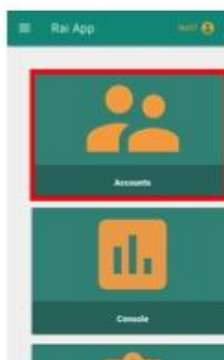


1. How to access accounts

1.2 Farmers

1 → 2 → 3 → 4 → 5

Choose **Accounts**




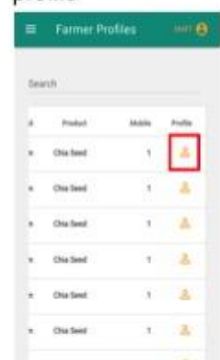
Click **Farmers** to access farmer's information



Type the name of farmer you want to find on **Search**



Scroll to the right to see profile icon 
Click to see farmer's profile

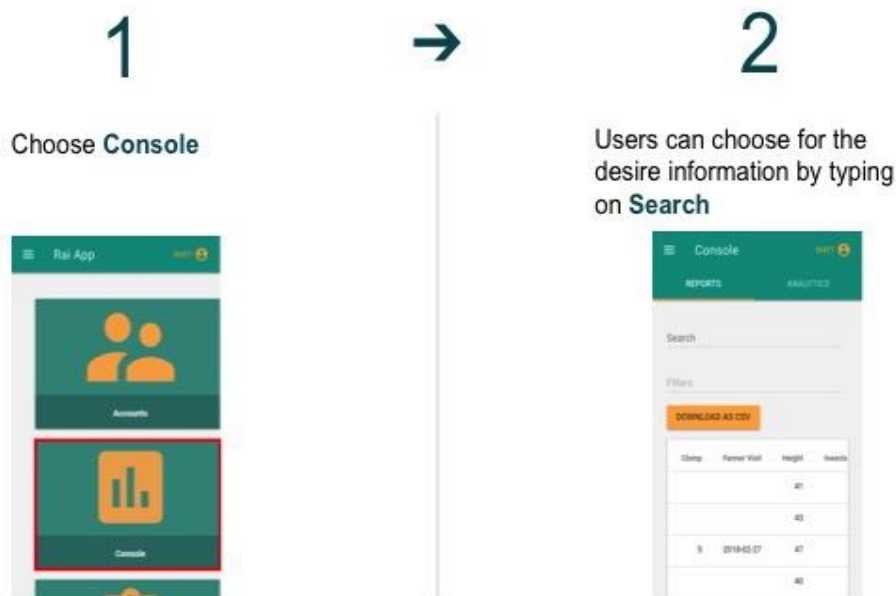


Farmer's information will appear on this page



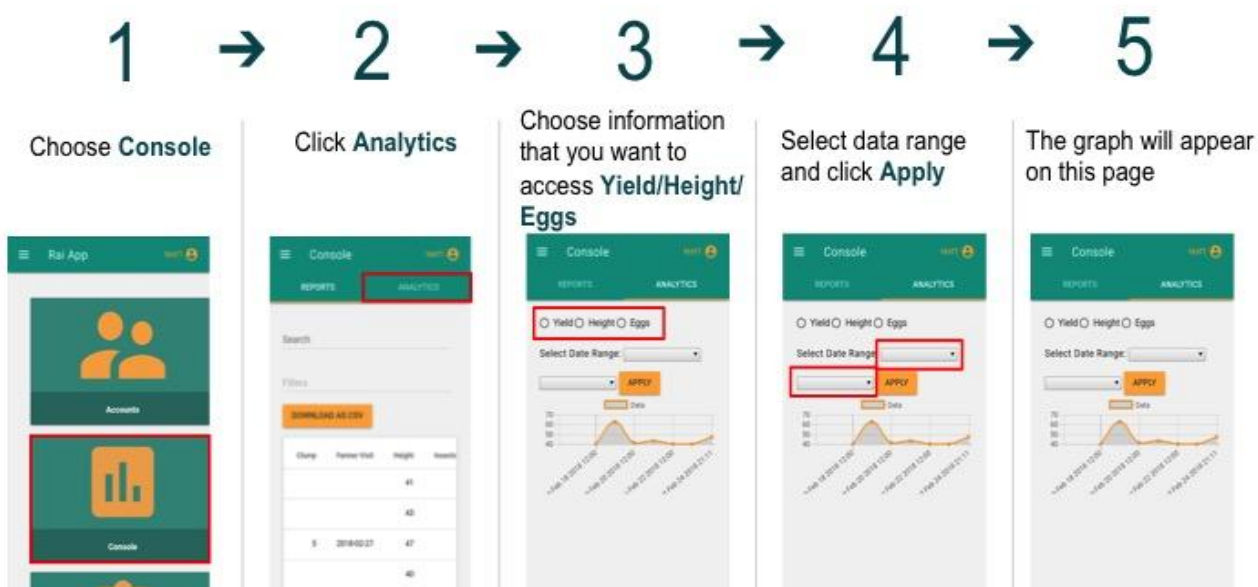
2. How to use console

2.1 How to access reports



2. How to use console

2.2 How to access analytics (Graph)



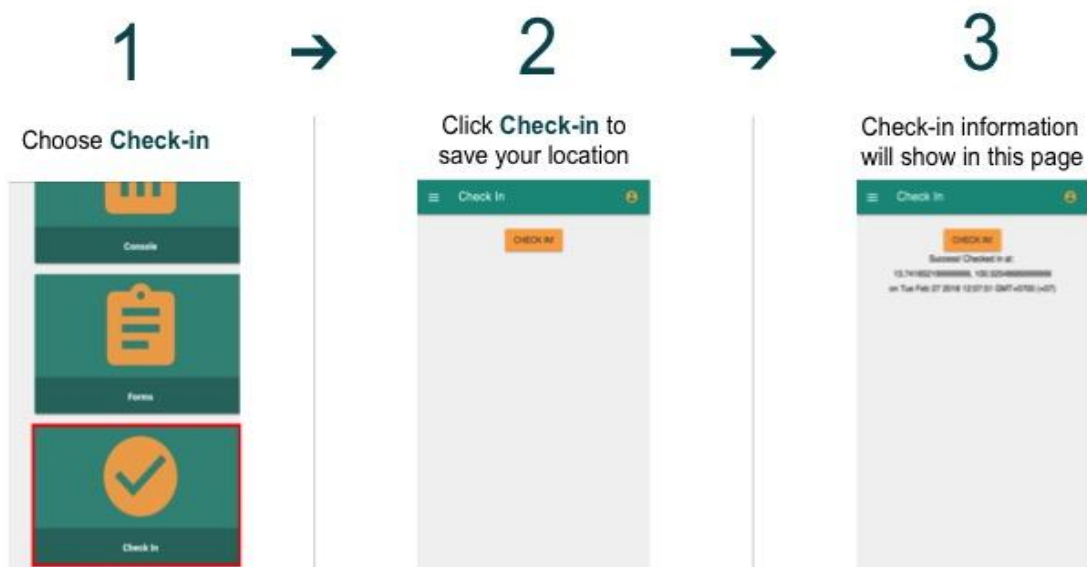
3. How to input information

3.1 How to input information



4. Check-in

4.1 How to Check-in



5. How to assign farmer

5.1 How to assign farmers that are in charge of

1 → 2 → 3 → 4 → 5

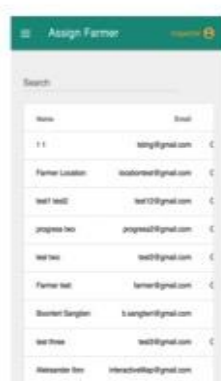
Choose menu
on the top left of
the screen



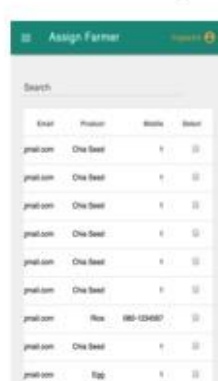
Click **Assign
Farmer**



Scroll down or
search the name of
farmer



Scroll to the right
and choose farmers
that are in charge of



After selecting
farmers, click **Add**
to assign farmers



H.3 Monitoring Plan

Monitoring and Evaluation

There are different sections to the form: a general one and specific ones for the different features of the app. The questions gauge the usefulness of each feature and have an open ended section so that if problems occur, they can be addressed.

* Required

How often do you use the app in one week *

- ☐ Once or twice
- ☐ Three to five times
- ☐ Six to ten times
- ☐ Greater than ten times

How satisfied with the app are you?

| | 1 | 2 | 3 | 4 | 5 | |
|--------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|--------------------------|
| I'm not at all satisfied | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | I'm completely satisfied |

How easy was the app to use? *

| | 1 | 2 | 3 | 4 | 5 | |
|----------------------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------|
| I need someone to show me how to use the app | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Very Easy |

What issues have you encountered? *

- ☐ The app was confusing to use
- ☐ The app was missing features I needed
- ☐ I experienced bugs
- ☐ The app was visually unappealing
- ☐ The app crashed
- ☐ None
- ☐ Other:

What do you like most about the app: *

- ☐ Stability
- ☐ Look and Feel
- ☐ Speed
- ☐ Navigation
- ☐ Content
- ☐ Functionality
- ☐ None
- ☐ Other: _____

What do you like least about the app: *

- ☐ Stability
- ☐ Look and Feel
- ☐ Speed
- ☐ Navigation
- ☐ Content
- ☐ Functionality
- ☐ None
- ☐ Other: _____

Which feature is most useful to you: *

- ☐ Checking in
- ☐ Using the map
- ☐ Farmer's profile information
- ☐ Data summarization
- ☐ Digital forms

Which feature do you use most often: *

- ☐ Checking in
- ☐ Using the map
- ☐ Farmer's profile information
- ☐ Data summarization
- ☐ Digital forms

Which feature is least useful: *

- ☐ Checking in
- ☐ Using the map
- ☐ Farmer's profile information
- ☐ Data summarization
- ☐ Digital forms
- ☐ None

What were you looking for the app to accomplish?

Your answer

Anything else you would like to share about the mobile app?

Your answer

Is there anything you feel could improve the app?

Your answer

SUBMIT

Appendix I: Code

To see the most up-to-date code for the application, visit the GitHub repository at:

<https://github.com/osand317/urmatt-app>

There the code can be downloaded as a .zip file or cloned using the following command:

```
git clone https://github.com/osand317/urmatt-app
```