



APPong

an application that provides an overview of the Gula Apong production in Sarawak

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ICT4D in the Field, Malaysia

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0. ICT4D IN THE FIELD

In June 2018, the course `ICT4D in the Field' takes place for the first time. It is located at UNIMAS, Malaysia and is held in collaboration with VU University Amsterdam. 11 Students from the VU come to Malaysia to do a project with 7 students from UNIMAS. Several teachers from UNIMAS and the VU guide the course and give lectures about ICT for development (ICT4D), field research, interview methodology, collaborative and conceptual modelling, value modelling, economic sustainability and about an ICT4D project deployed by VU teachers, the Kasadaka¹. The students get to experience the whole cycle of deploying an ICT4D project, including context analysis, needs assessment and elicitation, use case and requirements specification, rapid prototype development, testing with users, adapting the prototype accordingly and finally sustainability assessment.

Context analysis and needs assessment is done with banana farmers, the Ministry of Industrial and Entrepreneurial Development of Sarawak and inhabitants from Kampung Pinggan Jaya, which is only at 15 km away from UNIMAS. Afterwards, the students and teachers choose three use cases that will be tackled.

The three use cases that are selected are: education in Pinggan Jaya, data collection of banana farmers and data collection of Gula Apong producers.

We have worked on the Gula Apong use case and discuss our research and project in this report.

The team members are Giorgi, Judith, Chris and Kuan (from left to right).



¹ <https://www.kasadaka.com/>

1. INTRODUCTION AND MOTIVATION

Gula Apong is traditional Malaysian sugar. It is very popular in Malaysia and used in snacks, cakes and desserts. Gula Apong is produced in Sarawak by collecting and cooking the juice from Nipa palms, that are endemic to this area. It is sold for 8 Ringgit per kilogram. There is a high local and international demand, for example in China and Singapore. However, the production is limited. The production is done on small scale and the individual producers do not have enough yield to supply for big factories. At the moment, the resources of the area are not fully exploited. The government wants to increase the production by getting an overview of the Nipa trees that are used for production and the trees that are not used. Once they have this, they can assign new producers to the unused areas. At the moment, it is not easy for buyers to find a place where they can buy Gula Apong, because of the local and small scale production. Middlemen profit by buying the Gula Apong and reselling for a higher price. Producers do not dare to sell it for a higher price, because they are afraid of losing customers to others who sell it for a lower price. A mobile platform can help in connecting buyers and sellers, organizing the production in Sarawak and establishing stronger cooperative of Gula Apong producers [7]. In this report, we present a mobile application that addresses all these concerns: APPong.

In Chapter 2 we describe the context of the use case, i.e. the area of interest and we elaborate on Gula Apong and the production process. Chapter 3 reports the needs assessment with three different stakeholders. Another project has been done in Pinggan Jaya to stimulate the Gula Apong market. We introduce it in Chapter 4. In Chapter 5, we provide a use case and analysis report according to the “structured narrative format”. Chapter 6 presents the proof of concept and Chapter 7 discusses the design decisions and test results. We present a model of the value exchange between the actors in Chapter 8. In Chapter 9, we summarize the research process, which is followed by a summary of the project in Chapter 10. We justify the project in Chapter 11 and evaluate in Chapter 12. Future research is proposed in Chapter 13.

The appendices contain our planning (roughly), our task division, summaries of interviews, evaluation forms and a link to the open source code.

2. CONTEXT USE CASE

Gula Apong is a traditional Malaysian sugar (see Figure 1). It is very popular in Malaysia and used in snacks, cakes and desserts, see Figure 2. Gula Apong is produced in Sarawak by collecting and cooking the juice from Nipa palms (Figure 3), that are endemic to this area.

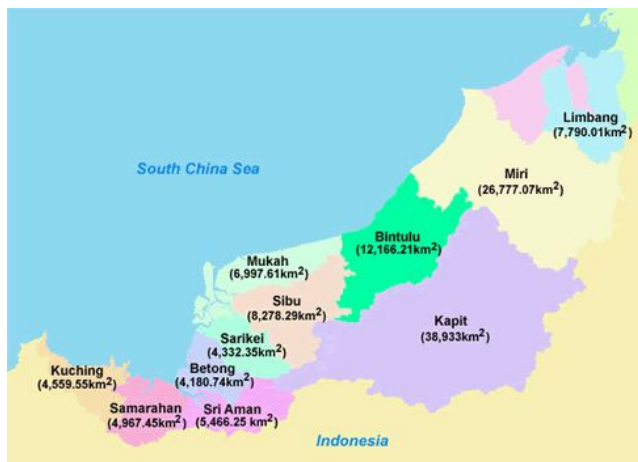


Figure 1. Gula Apong

Figure 2. Ice cream with Gula Apong

Figure 3. Nipa trees in Kampung Pinggan Jaya.

It is sold for 8 Ringgit² per kilogram and is produced on small scale in Sarawak.



Sarawak is the largest state in Malaysia and is divided into 11 divisions: Kuching, Samarahan, Sri Aman, Betong, Sarikei, Sibul, Mukah, Bintulu, Kapit, Miri and Limbang. See Figure 4. The two main languages in Malaysia are Malay (Bahasa Melayu) and English.

Figure 4. Sarawak is divided into 11 divisions. Picture taken from [1].

² The Malaysian Ringgit (MYR) is the Malay currency. 1 Ringgit is 0.21 Euro (on 22 June 2018).

The two main steps in the production of Gula Apong are: collecting juice from Nipa trees (1) and cooking juice in order to produce the sugar (2). This second step takes 5-7 hours [8], [2]. The syrup is left to cool and stored in containers for further packaging [3]. Nipa trees grow close to the water. The producers normally will collect the juice contained in bamboo pole at 4 o'clock in the morning and place back the bamboo at 4 o'clock in the evening. Bamboo is used to catch the juice that comes out of the trees, and to carry it while transporting to the place where it is cooked. Juice can be collected during three consecutive months per year. However, when the tide is high, it is dangerous to go and collect. Namely, crocodiles come closer and attack. Therefore, most producers do not collect during high tide.

Typically, the producers work hard and their family helps in transporting, packaging and selling the product. Very few sell it themselves, often middlemen buy it from them and resell it to the final customer. The production is very time consuming and labor intensive.

Kampung Pinggan Jaya is one of the villages in Sarawak where the production of Gula Apong takes place. The use case will focus on this village, which is located 30 minutes from the center of Kuching and has around 700 inhabitants. Everyone is Muslim and the main spoken language is Malay. Children learn English at school. The primary school is in a village nearby, half an hour by foot. Secondary school is on the others side of the river, in Kuching. The road infrastructure towards the village is good, however the network coverage is poor. Only one spot in the village which is located at the jetty has 4G internet coverage. Most woman of the village are housewives and the men are working in factories or as laborers around the village, with a salary of 1000RM a month (around 230€). The women are selling handicraft products and Gula Apong as a side job, using Facebook, WhatsApp and a website that shows their contact details [9].

3. NEEDS ASSESSMENT

On June 10, we paid a visit to Kampung Pinggan Jaya to interview women that either have a business, or want to start one. Figure 5 shows some of the women and students who interview them. One of the women was Puan Maria: a Gula Apong producer. Next to Gula Apong, she sells sugar vinegar and fermented sugar, with help of her husband and cousin. They have a farm of Nipa trees. Orders are made by calling her husband, since she does not know how to use a phone. They advertise via Facebook and deliver the products themselves or let the customers pick it up at home.

She has customers from Kampung Pinggan Jaya and from outside the village and wants to expand her production and open a store in the city (Kuching).



Figure 5. Interviewing women from Pinggan Jaya.

On June 12, we had a meeting with the Ministry of Industrial and Entrepreneurial Development Sarawak together with Prof. Ibrahim (Engineering Department UNIMAS), as can be seen in Figure 6. Figure 7 shows the building of the Ministry. The Ministry wants to renovate Gula Apong production by monitoring producers' activity, locating Nipa tree areas and by introducing new techniques of collecting and storing the sap. Hence, increasing production output and meeting growing demand. Currently, the only data they have is a hard copy. This is where we, students of Computer Science, Software Engineering and Informatics, come in.

The idea of the Ministry for us is to develop a system that collects data about Gula Apong production in Sarawak. The data that needs to be collected is the names of the producers, their contact details, the amount of trees they have, the size of their farm and the amount of Gula Apong they produce.



Figure 6. Needs assessment with Ministry and Prof. Ibrahim



Figure 7. The MIED

The system we are about to develop should be user friendly for non tech-savvy users. An intuitive interface will make it easier to integrate our monitoring tool in the Gula Apong market.

4. RELATED WORK

In 2016, Yayasan Sejahtera, a foundation that focuses on poverty eradication projects in various parts of the country, started a community enhancement programme in Kampung Pinggan Jaya. The aim of the project is to support the Gula Apong business by providing business, marketing and ICT training. Moreover, the villagers are encouraged to come up with Gula Apong related products that can be commercialized alongside the main ingredient and to work together, including children [4] [5]. This project is currently ongoing and expected to complete in 2019.

In Pinggan Jaya, Gula Apong is used to produce soft drinks, see Figure 8. Manufacturing secondary products out of Gula Apong will open a wider market for people in the village. However, this venture requires relatively huge investment in the machinery, to be precise, 25,000MR, so for now it is not feasible.



Figure 8. The energy drinks “nypa juice” and “nypasips”, made from the juice from Nipa trees.

5. USE CASE DESCRIPTION

5.0. NAME

The name of the application is APPong. APP is short for application (clearly) and Gula Apong is the product where the app is about. The logo can be found in Figure 9.



It shows a hand. The hand is symbol for a connection between people. In the Netherlands, we shake each others hand whenever we meet someone new. Also, when a business deal is made, it is confirmed with a handshake between the parties. Appong connects producers and buyers, but also support cooperation between producers. Moreover, a waving hand is symbol for getting attention, or visibility. Appong aims for more visibility for the producers of Gula Apong. The hand is covered with a Nipa palm, that is the tree where the Gula Apong juice is obtained from.

Figure 9. Logo of APPong.

5.1. SUMMARY OF KEY IDEA

APPong allows producers to enter information about their Gula Apong production and farm. This data is stored, analyzed and visualized in order to give the government a clear overview of the Gula Apong producers, their production and their farms.

Moreover, the stock is visible to customers, so that they can easily find a producer who meets their demand. If buyers enter their demand in the application, this will contribute to a more complete overview of the Gula Apong market. The mobile application will have three different interfaces: one for the producers, one for the government, in particular the ministers of Industrial and Entrepreneurial Development Sarawak, and one for the buyers of Gula Apong.

5.2. ACTORS AND GOALS (STAKEHOLDER ANALYSIS)

Actors

The actors that are involved in this use case are Gula Apong producers, the Gula Apong market (i.e. the consumers), middlemen that buy Gula Apong and resell it to customers, the Ministry of Industrial and Entrepreneurial Development Sarawak and an admin that will manage the application and will help producers with using it.

Current situation

In Figure 10, an overview of the current situation concerning the Gula Apong market is given. Note that currently, only the producers, the middle men and the market segment

are active actors. The middlemen buy Gula Apong for 8 Ringgit per kilo from the producers and resell it somewhere else for twice the price or even more. Gula Apong producers do not get a fair price for the amount of work they do, in comparison to the middlemen.

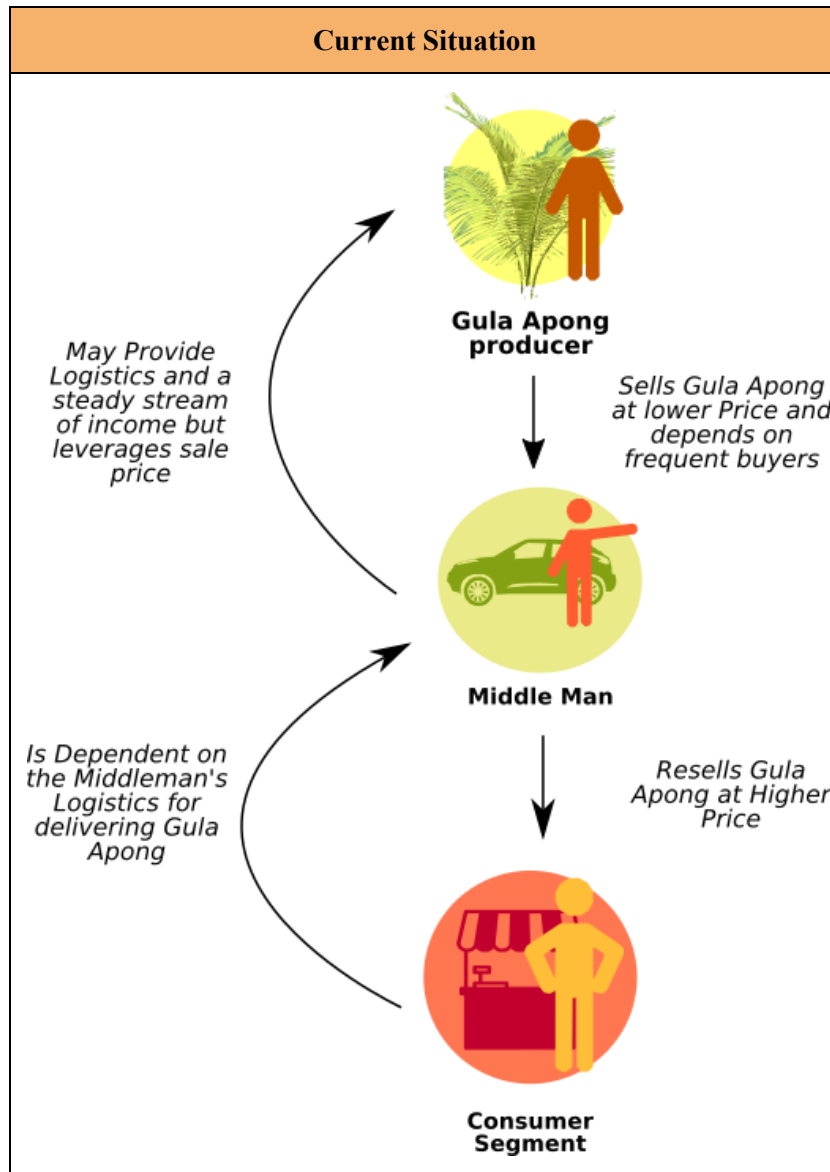


Figure 10. Current situation: some Gula Apong producers have an outlet where they sell their products directly to the customer that uses the Gula Apong. However, for most producers, middlemen come and collect Gula Apong in order to sell it to the consumer.

APPong will connect producers and buyers and will help in removing the middlemen, and in turn help the producers to get a profit that is in correspondence with the work they do.

Origin of the use case

The use case initiates from the Ministry of Industrial and Entrepreneurial Development. The Ministry of Industrial and Entrepreneurial Development Sarawak (MIED) is responsible for the promotion, coordination and implementation of industrial development activities in Sarawak [6]. The MIED has budget to support Gula Apong producers and is interested in an application that provides an overview of the production. The idea is that producers share information about themselves, their farms and their production with the ministry via the app.

Incentives for producers

Producing Gula Apong is a tough job. It is not easy and sometimes dangerous to reach the trees and producers do not earn a proper salary for the work they do. Moreover, they are worried about having enough buyers. Some Gula Apong producers have an outlet where they sell their product, while some sell their product at home. Whenever they produce Gula Apong, they are not sure whether they will sell their product. Not because there is not enough demand, but because the possible buyers do not know where to buy the sugar.

The application will increase the visibility of Gula Apong producers, by showing to buyers a list of producers with their stock and contact details. Moreover, if the producers participate in the project by entering their data and using the app regularly, the government will make their area officially their property (gazette). At the moment, it is the government who owns all areas, although in practice the areas are divided among several producers who collect the Gula Apong juice there. However, it is not sure whether the government has the power to realize this.

Desired situation

Figure 12 shows the situation that is desired by the government, when the application is actively used by producers and buyers. It might take a year or so for the application to be actively used by the market. Hence, there will be a period in between the current situation and the desired situation. We call it the uptake phase and it is shown in Figure 11. In the uptake phase, there will be buyers who use the application to get Gula Apong, but there will also still be buyers who contact the producers directly or via middlemen, as they do now.

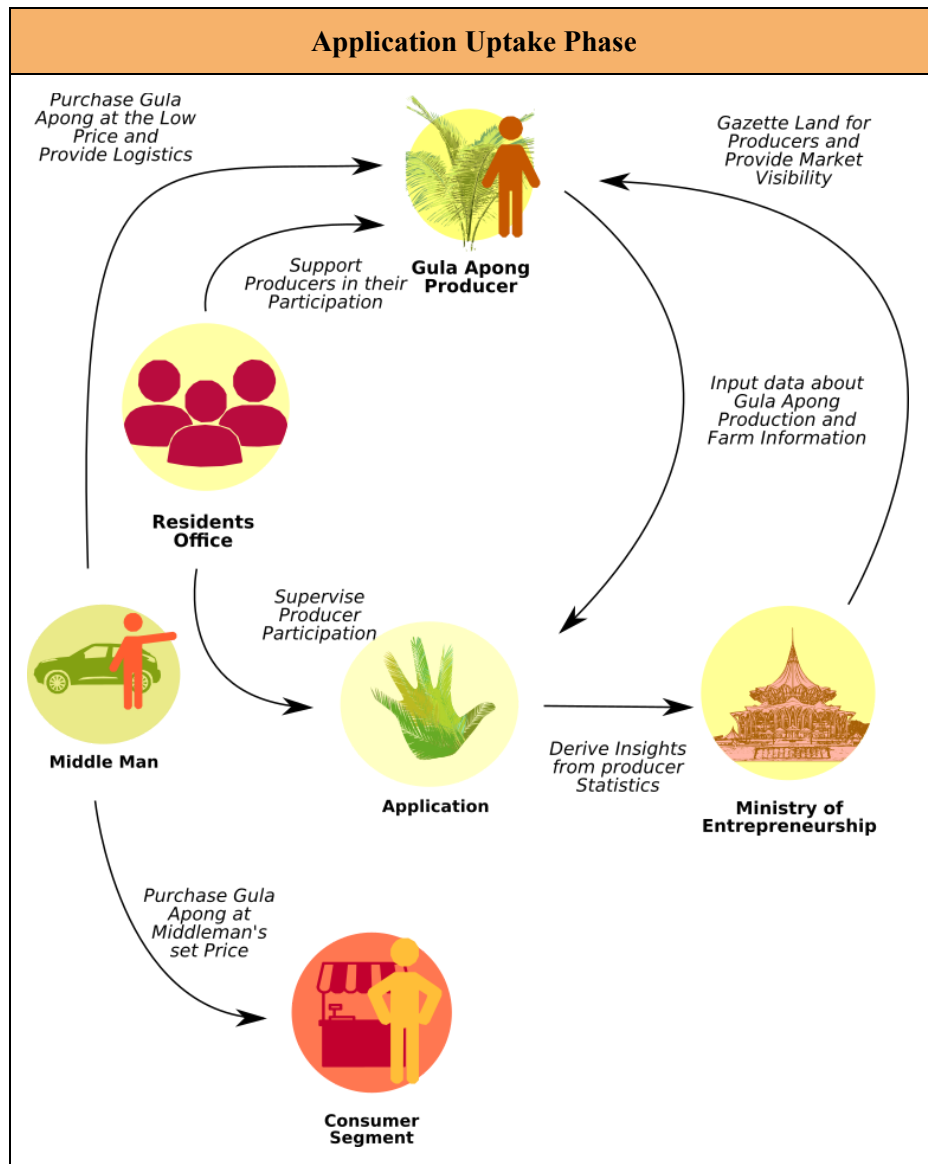


Figure 11. The uptake phase of the application.

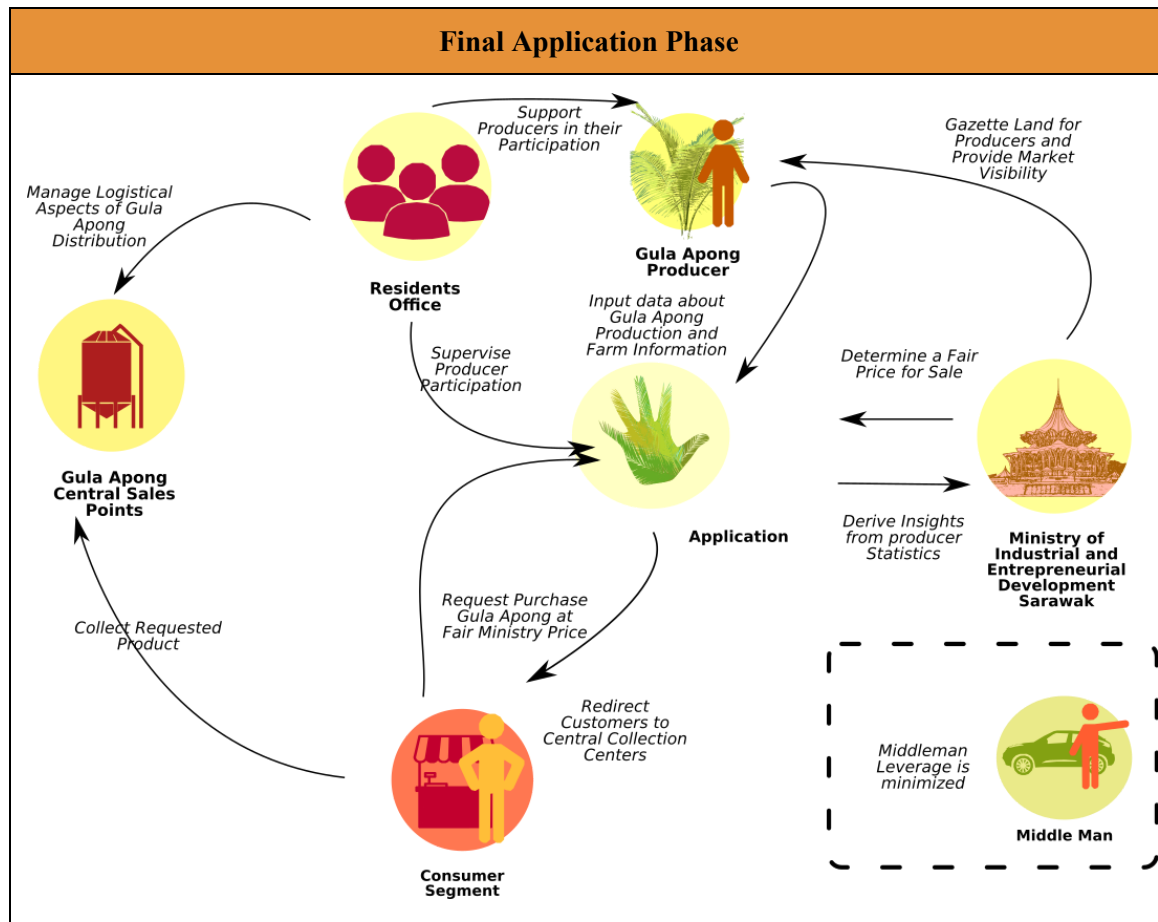


Figure 12. Situation that is desired by the government, the final phase.

Finally, Table 1 gives an overview of the actors involved in the use case.

The actors of this use case and their concerns			
ID	Actor	Description	Concerns
ACT-PR	Producer	A Gula Apong producer. Does not own the Gula Apong mangroves, but tends to them and is able to harvest from them. The producers have divided the land amongst each other to determine who can harvest where.	<p>Increase profit, either by creating a steady source of revenue or by increasing selling price.</p> <p>Increase visibility.</p> <p>Acquiring ownership over their mangroves.</p>

ACT-MD	Middleman	A broker between consumer and producers. Buys the Gula Apong at very low prices, but is able to resell their goods at much higher prices.	Reselling Gula Apong to consumer market at higher margins of profit.
ACT-CM	Consumer Market	An unexplored market that include personal consumers, who consume Gula Apong for personal use, and business consumer, who use it for production of desserts and cakes, to be sold at very high margins of profit.	Acquiring a reliable supply of Gula Apong to sustain their business (business consumers). Finding sellers to buy Gula Apong from (personal consumers).
ACT-ME	Ministry of Industrial and Entrepreneurial Development Sarawak	In charge of ensuring that entrepreneurs in Sarawak are able to sustain their businesses. Have the ability to create policy in order to sustain the application.	Would like data on the total production of Gula Apong in order to increase it. Interested in supporting entrepreneurs through policy and market visibility.
ACT-RO	Resident Office	In charge of overseeing their district, and helping its residents sustain their business. Also will assume the role of application administrator to ensure that producers will be willing to participate with the program.	Help its district's entrepreneurs acquire higher market visibility. Oversee producer participation with the Gula Apong program, and investigating the challenges producers are facing.

Table 1. Actors and their goals

5.3. CONTEXT AND SCOPE

The main purpose of the application is to collect data from Gula Apong producers in an efficient and easy manner. Namely, the MIED wants an overview of:

- The names and contact details of the producers
- The amount of productive trees they have.
- The size of their farm(s).
- The amount of Gula Apong in kg, per week.

And, if possible:

- The location of their farm(s).
- The names of their regular customers.

A rough overview will be enough. The idea is that producers enter, every week, an estimate of the amount that they produced that week. When they start using the app, they should enter data about their farm. The government is willing to help the producers with marketing and to give them land as an incentive.

Other purposes of APPong are to link customers and producers and to unite producers. Right now, the producers are not collaborating and no union of producers exist. They all sell the Gula Apong for 8 Ringgit per kg. No one dares to increase the price, because they are afraid that someone else sells it for less. However, if all producers would agree on a higher selling price, they would not have to be afraid that customers can buy it for less at another place. The app can serve as a first platform that support collaboration between producers. Namely, the app can help in uniting the producers by showing a recommended selling price, that is based on the current production. It will increase their profit if everyone will use this selling price. Also, their profit will increase if they are no longer dependent on middlemen and instead communicate with customers via the app. By showing the current stock and contact information to interested buyers, APPong simplifies communication.

Literacy and computer literacy of producers

The producers are literate, but have had limited education. Their wives and children are more experienced with using mobile phones and computers than them.

Therefore, actually the family of the producers, and not the producers themselves, will be the end-users of APPong. The phones used are old Android phones.

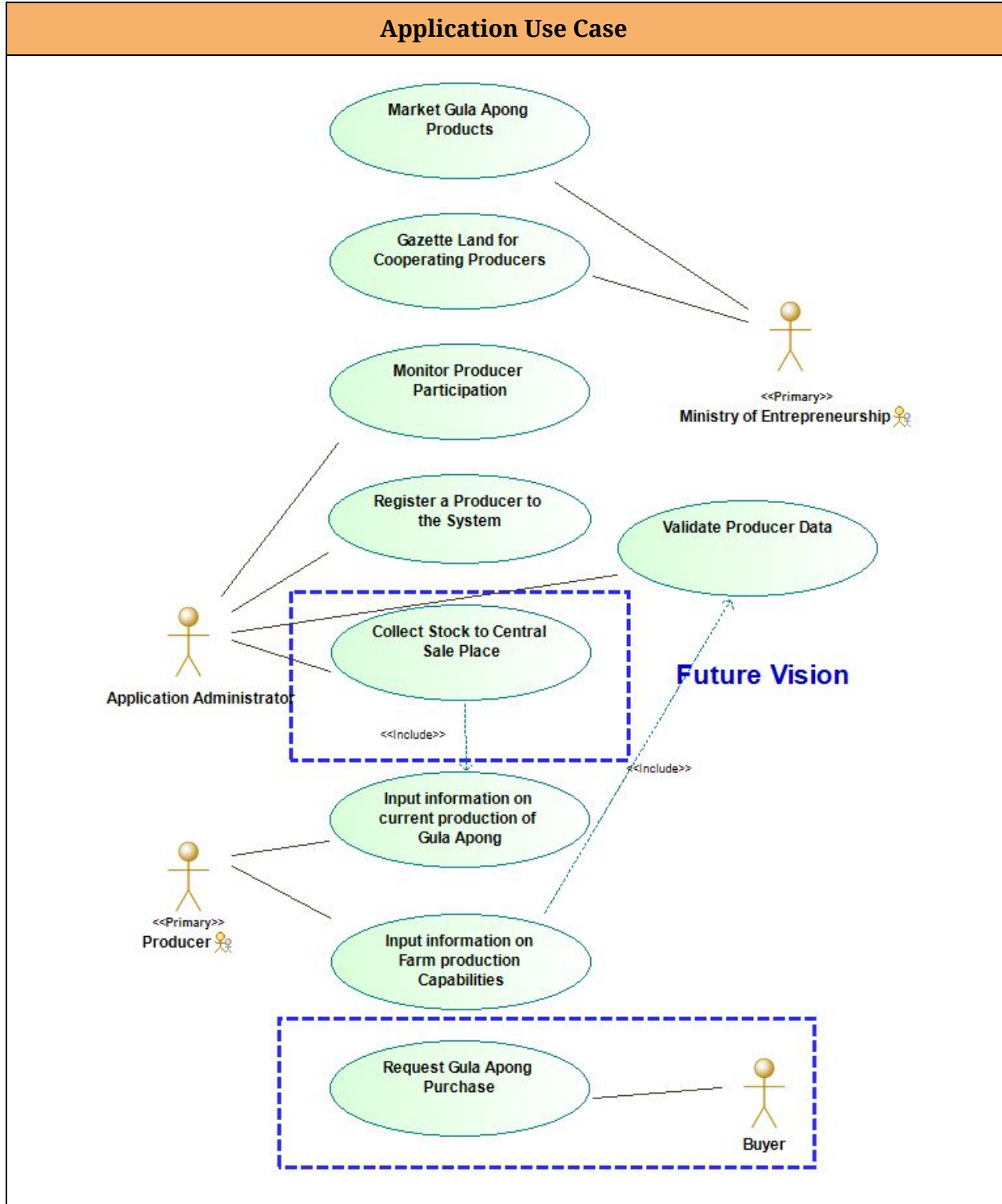
Language

We will develop the application in English first, because this is a language we, developers, know. In the future, it will be useful to make the application in Malay, so that the user group can be expanded.

The use case focuses on Kampung Pinggan Jaya. The producers are innovative and willing to work with us. We will try the app there and then further expand.

5.4. USE CASE SCENARIO SCRIPT

In Figure 13, a use case diagram can be found. The roles of the producer, the MIED, the buyer and the admin are indicated.



Legenda:



	<p>Service</p> <p>Aspects and activities that fall within our service domain. All aspects not within this outline are not included inside the application domain.</p>
	<p>Final Situation</p> <p>These are the final aspects of the project, which occur after the uptake phase. This phase starts after the logistics for distribution have been solved, after enough production information has been collected, and after the Gula Apong market has adapted to the project's service.</p>

Figure 13. Use case diagram.

5.5. INTERACTION AND COMMUNICATION

An activity diagram of the use case is shown in Figure 14. This gives more insight in the interactions between actors and the tasks of all actors.

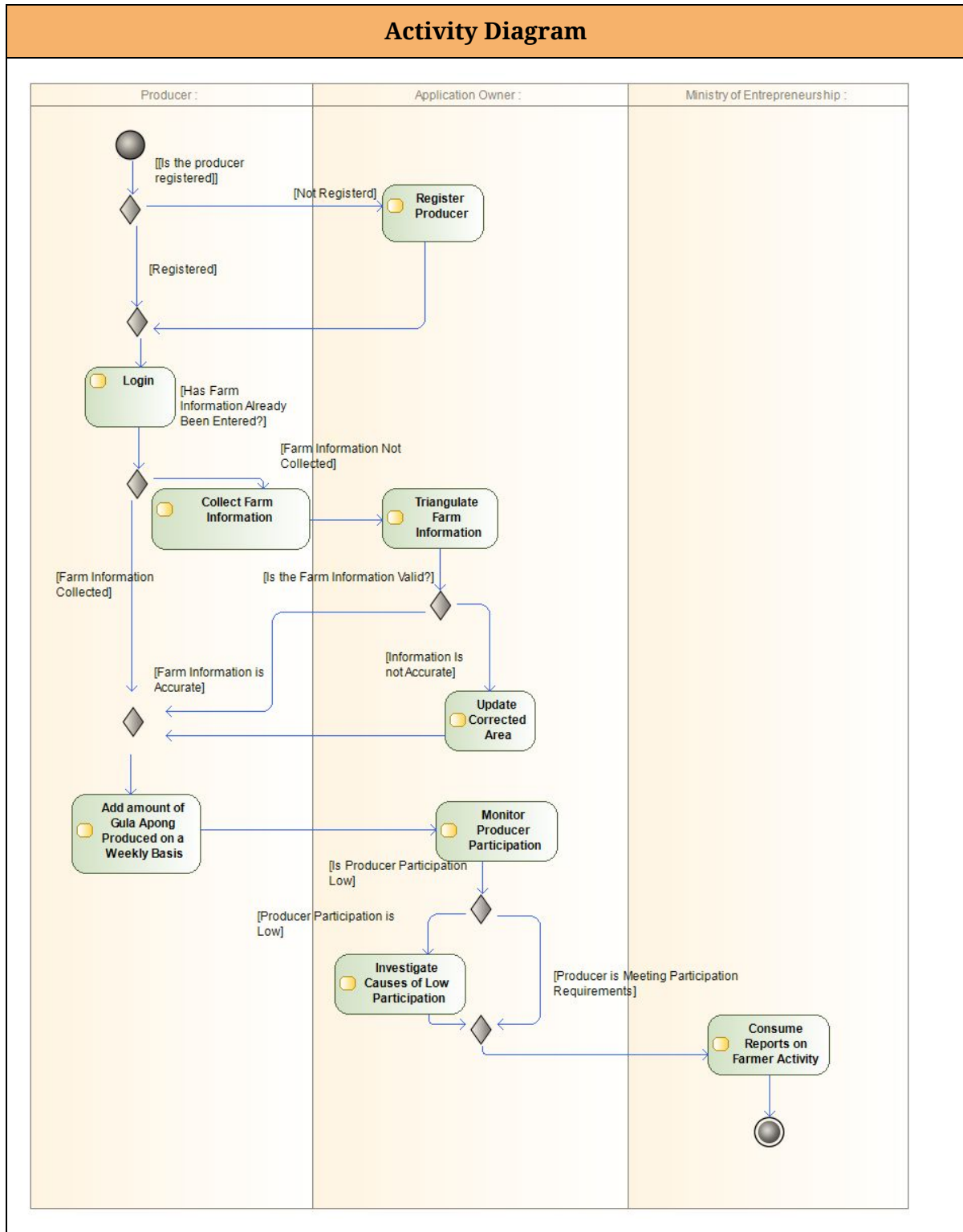


Figure 14. Activity diagram.

5.6. INFORMATION CONCEPTS

The data that the government wants from the producers is:

- Name and contact details of producer.
- Number of production trees, should be entered once during registration.
- The size of their farm(s).
- Amount of Gula Apong produced in kg, should be entered every week.

And, if possible:

- The location of their farm(s), is tracked via GPS.
- The names of their regular customers.

The UML class diagram in Figure 15 shows the meaning of important concepts concerned with this use case. It shows all the information of interest about the production, the farm, the producer, i.e. all the information that should be reported to the ministry, but it also shows what information the admin and the buyer should enter in the system when registering. Moreover, it shows the relation between those concepts and actors.

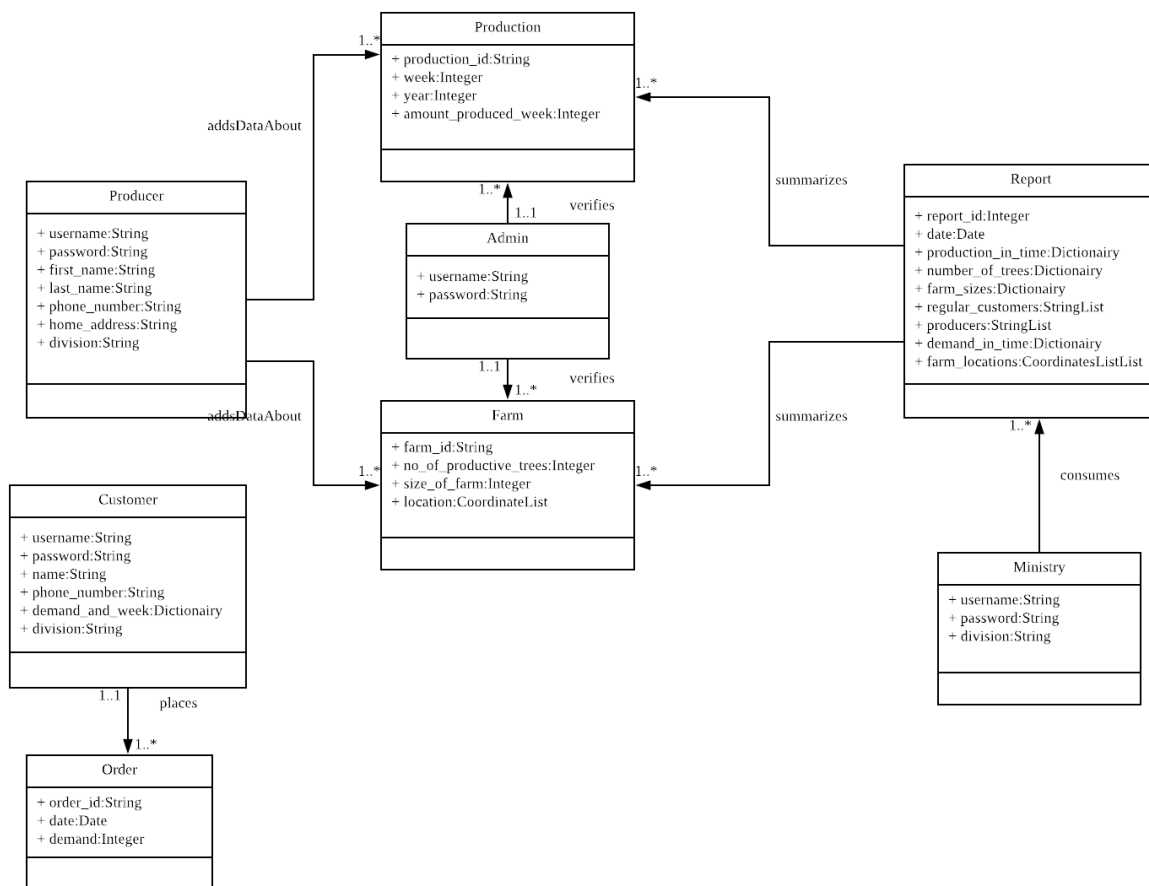


Figure 15. UML Class diagram.

5.7. TECHNOLOGY INFRASTRUCTURE

We were presented to several requirements that shaped the technological stack and the way each component should interact with each other. Offline capabilities and mobile application were among the requirements. Based on our experience and ease of use we decided to write a hybrid application that supports offline functionality out of the box. More details about our decision about technological stack is in Section 6.1.

The client application is written in Ionic 1 and Cordova framework. It lets us run the application on multiple platforms with same source code. Client application uses PouchDb library as an interface to local database. It also provides an out of the box mechanism to synchronize local with remote database. Users always read and write against a local database and PouchDb manages synchronization with remote storage. For the remote database we use noSQL technology - CouchDb. We decided to follow a data model where each user has their own databases. For graphical representation see Figure 16. This data model is important in our case because CouchDb's synchronization unit is a single database. This means that if a single database contained information for multiple users each user would have had to synchronize the data that does not belong to them. Whereas, separating user information keeps the size of the database small, which is essential to reduce synchronization time and space used on client device.

One more aspect of the application is a server program which is responsible for registering users. It receives requests from client devices and redirects them to CouchDb. User registration consists of several steps: creating a user and several tables for the user. Server code manages all the functions that require administration rights. We decided not to give administrator rights to mobile users since it would have involved security risks and introduce more complexity to mobile application source code.

CouchDb and server code can be launched on most major operating systems. This means that infrastructure to support the mobile application can be started on a local computer or in the cloud. Hence, UNIMAS computational resources can be used to keep the backend running to handle client data. See Figure 16 for an abstract overview of the technology infrastructure.

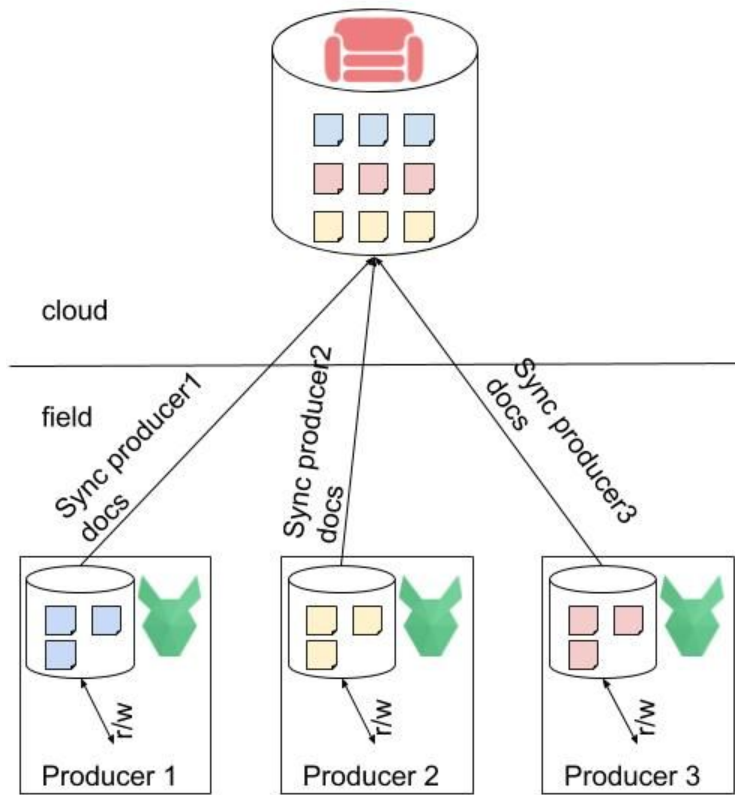


Figure 16. Overview of infrastructure

5.8. COST CONSIDERATIONS

Costs of application

In this section we estimate the costs connected to running the technological stack for the application. As we mentioned in Section 5.7, we have a mobile application for clients, code and database running on a remote computer. The project is supposed to be maintained by UNIMAS students and staff. Hence, the labour costs will be covered by UNIMAS. The university provides computational resources that can be used to run the server code and the databases. So, they also carry the operational costs.

Based on our experience with developing hybrid mobile applications with a similar technological stack, we estimated system requirements for server computers to support backend services for mobile clients. Our rough calculations indicate that a server with 2-core CPUs, 2Gb of memory and 30Gb of storage is enough to handle couple of hundred users who read and write data daily. Supposedly, UNIMAS has enough overprovisioned computational resources to host the aforementioned services. Additionally, our clients do not generate much data and hence there is no need for large internet bandwidth. Even then, we suppose that UNIMAS pays fixed monthly fee for internet service and that our application will not introduce any extra charges.

Our evaluation does not indicate any cost requirements other than mobile network charges for application users.

Overview of costs and profit of Gula Apong producers

In Table 2, we provide an overview of the costs and profit of Gula Apong producers, according to the information we have obtained by conducting interviews with two producers and Prof. Ibrahim.

Table 2. Simple overview of cost, profit and production of one producer.

Average production per day (KG)	Selling price producer (MYR)	Costs per day (MYR)	Profit per day (MYR)	Work days per week (Day)	Profit per week (MYR)	Profit per month (MYR)	Production per week (KG)	Production per month (KG)
20	8	40	120	2	240	960	40	160

All prices are in Ringgit and the productions are in kg Gula Apong.

On average, the producers collect 100 liter sap per day, which is good for 20-25 kg of Gula Apong.

The Gula Apong is sold for 8 Ringgit per kg. The costs consist only of the wood that is needed to cook the juice with. The profit per day is estimated on 120 Ringgit. A good salary per hour is 50 Ringgit. However, right now they do not get this. Currently, they

earn around 20 Ringgit per hour.

Middlemen resell the Gula Apong for 16 Ringgit or more. In order for producers to get a good salary as well, their selling price should be raised.

In the future, the application could display a recommended selling price to be used by all producers. If they all agree to increase the selling price, they do not need to be afraid to lose customers, because the customers can not get it cheaper elsewhere. Currently, the producers are afraid to increase the price, because they will lose customers.

The recommended selling price (RSP) could be determined by assuming a reasonable salary (50 Ringgit per hour). It can be computed with:

$$\text{RSP} = (\text{fair_salary_per_hour} * \text{hours_worked_per_day}) / (\text{production_per_day}) \quad (1)$$

5.9. FEASIBILITY AND SUSTAINABILITY

In our opinion, the main challenges concerning feasibility and sustainability of this project are the technical sustainability and the socio-economic sustainability.

Namely, we have made a framework for an application, that should be improved on by others. Who is going to maintain the app and provide the app training to producers? Due to the limited time scope of the project, the goal has been to only make the start of an application that can later be improved by UNIMAS students. A session with MIED was conducted on June 28, and ministers intend to put the app online. Dr. Cheah from UNIMAS suggests that an UNIMAS team will work on it to ensure that the application will evolve. The sustainability of the project is highly dependent on the future maintainers. The prototype that we deliver is functional and ready-to-use, but we expect that there is a wish for more features when it will be used in production environment. See *Future Work*.

An even bigger challenge is the socio-economic sustainability: are producers willing to cooperate and use the app? If they do not take it up, then the project failed. For example, is it worth it? And, are producers willing to provide data about their customers? Previous projects have shown that the producers are not open to innovation. For example, the way they collect the juice is still the traditional: they cut a leaf from the flower and they use a bamboo container to catch the sap. However, instead of bamboo containers, a plastic bag could be used. In a plastic bag, rain water and insects can not come in, while in bamboo, everything can come in. This will of course affect the quality or quantity of the end product. According to interview with Bujang, it is suggesting that bamboo will give smokier flavor and high quality of Gula Apong. The porous lining of bamboo prevents the Gula Apong juice from fermenting before boiling process. In contrast, plastic bags are much lighter and therefore easier to carry. Moreover, plastic bag collecting method is suitable for the factories who mass producing the alcohol drinks. In a previous project, the farmers were told about this new way of collecting juice, but they would not adopt it and now they still stick to the traditional manner. However, the producers in Kampung Pinggan Jaya have indicated to be curious (last year they used plastic bottles) and willingly to innovate. Hence, we will introduce the application first in this Kampung.

Another concern is the verification of the input. Will producers enter their data honestly? Or maybe, they have the good intention, but make mistakes in calculations or while entering the data. In order to be sure that the information that is gathered is roughly correct, a resident officer has to visit the producers now and then and verify.

Furthermore, we anticipated that the Ministry would be able to provide support for farmers in exchange for the information that they generate, such as gazetting of land. However, policy interventions are more difficult than we previously anticipated.

Therefore, it is critical that other venues for sustainability are explored. For example, we hoped to develop a functional customer interface where we can provide better market visibility for farmers. However, this is a feature that must be expanded further. Granting producers an empirical way to measure the benefit of using our application would provide an incentive to participate in the program. For example, providing information on how many consumers have viewed their producer information on a given week. This demands further research to determine what sort of information is useful for producers, and also the development of a business model which could ensure participation with our application.

Possible conflict of interests

The Ministry, the producers and the buyers all have different interests in this project. The main interest of the Ministry is the data, in order to be able to better support the producers but also to increase the total production. The producers' incentive will be to increase visibility and the gazettement of their farms. These differences might lead to conflicts. Possibly, the producers do not want to provide all data the Ministry wishes. For example, data about their regular customers could be sensitive.

Innovation

All data that the government possess about the Gula Apong production in Sarawak is currently written down with pen on paper. To digitize the data is new. It will be new for producers to submit their data on a mobile phone. With such innovation, challenges arise. Issues related to innovation are compatibility, complexity, trialability and observability. We discuss how APPong addresses these factors.

Is APPong localized, i.e. appropriate for the people that will use it and their culture? We have taken into account the computer literacy and the language of the end-users. The interface is made for users that are literate and speak English. The producers themselves are not, but often, their wife or children are. The ministry and the buyers are assumed to be literate as well. Typically, the producers have a low education level on average. Moreover, we have incorporated the technical conditions, such as the fact that some people live in uncovered areas and also the farms are often in such areas.

As using an app like this will be new to part of the end-users, it was important to make interaction with and usage of the application not more complex than necessary. We only ask the producers for basic information and not more than Ministry wants. Moreover, the Ministry plans to assign an admin that will help users with registering and managing the app.

Idea is to do a first trial in Samarahan, obtain feedback and improve the app and then extend further to other divisions. The usage can be easily checked by looking at the database. If producers are going to use APPong, the databases will be filled with information quickly. Making a counter on the app could improve visibility even more.

5.10. KEY REQUIREMENTS

MoSCoW (Must have, Should have, Could have, Won't have) list of requirements

Must have: if one of the must have requirements fails, the project is considered as failed.

Should have: these are important requirements, but they can also be done later or with another solution.

Could have: these are desirable but not necessary, and could improve user experience or customer satisfaction for little development cost. These will typically be included if time and resources permit.

Won't have: least-critical, lowest-payback items, or not appropriate at that time.

The app..

- Must be suitable for cheap Android phones (Version 5.0 and higher).
- Must be offline accessible.
- Must be easy in use, in particular for Gula Apong producers.
- Must have an entry field for the number of productive trees that a producer has.
- Must have an entry field for the amount of Gula Apong produced (in kg) the current week.
- Must be able to collect/track the location of the farms.
- Must be able to determine the size of the farms, if the coordinates are known.
- Must be able to collect/track the date.
- Must allow for editing and removing data in producer and ministry interface.
- Must show how much Gula Apong is produced in total by all producers in time (on weekly basis).
- Should enable users to login with username and password.
- Should use graphs to visualize the production data.
- Should have an entry field for the names of the regular customers.
- Should have an entry field for the amount of juice in liters collected.
- Should have an entry field for the selling price.
- Should be accessible for Ministry on the Web.
- Could use graphs to visualize the demand data.
- Could have authentication.
- Could have a text that explains what the app does.
- Won't be able to accept payments.

6. PROTOTYPE / PROOF OF CONCEPT

In this chapter, we present the prototype or proof of concept that we have developed. We implemented three different interfaces.

Producer interface

When a producer logs in, they arrive at the Producer Dashboard page, that shows a graph of their production history and buttons that lead to ‘‘My production’’, ‘‘My farms’’ and ‘‘My customers’’, see Figure 17 a,b,c,d. With this prototype, a producer can enter data and see an overview of their own data. The data is about the farms, their production and their customers.

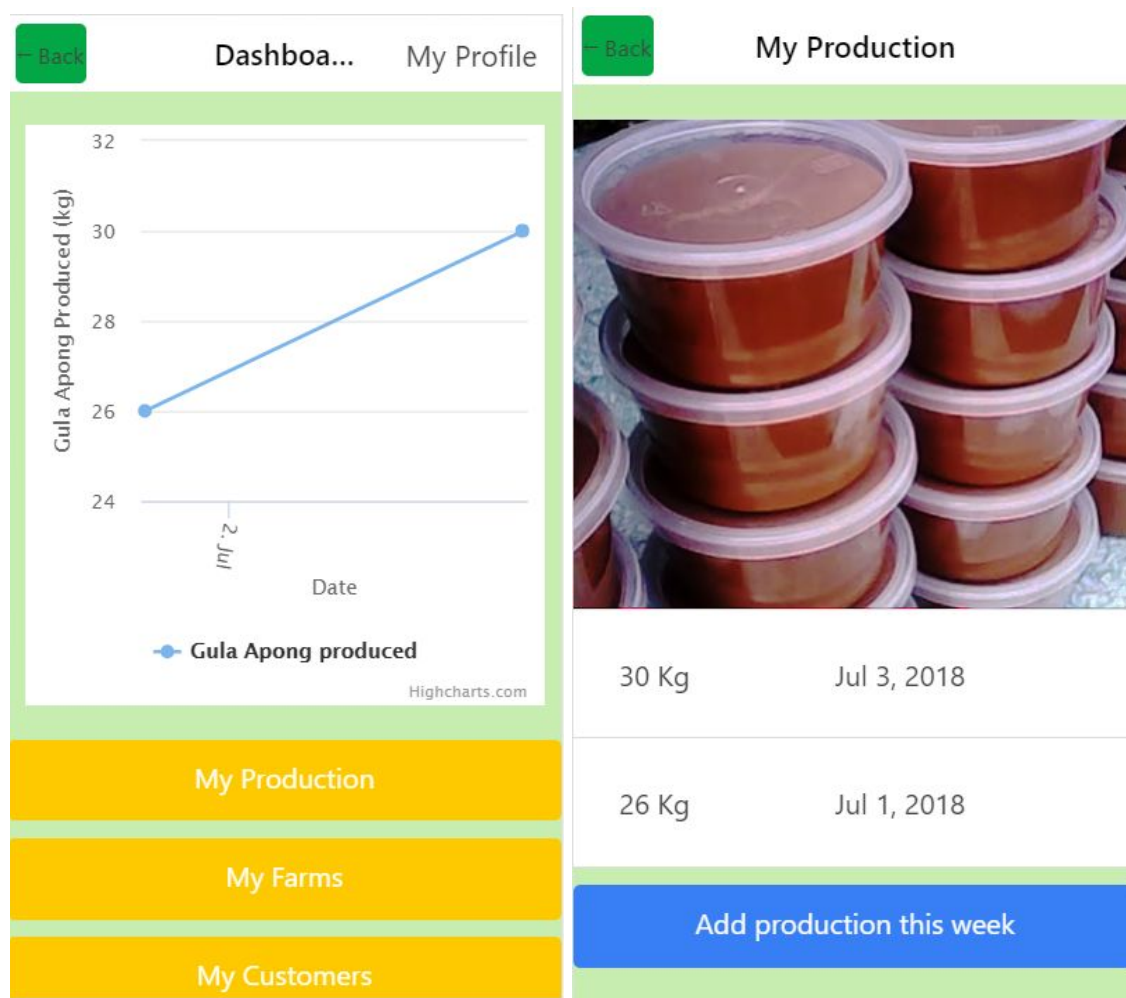


Figure 17. a, b. Dashboard producer and page ‘‘My Production’.

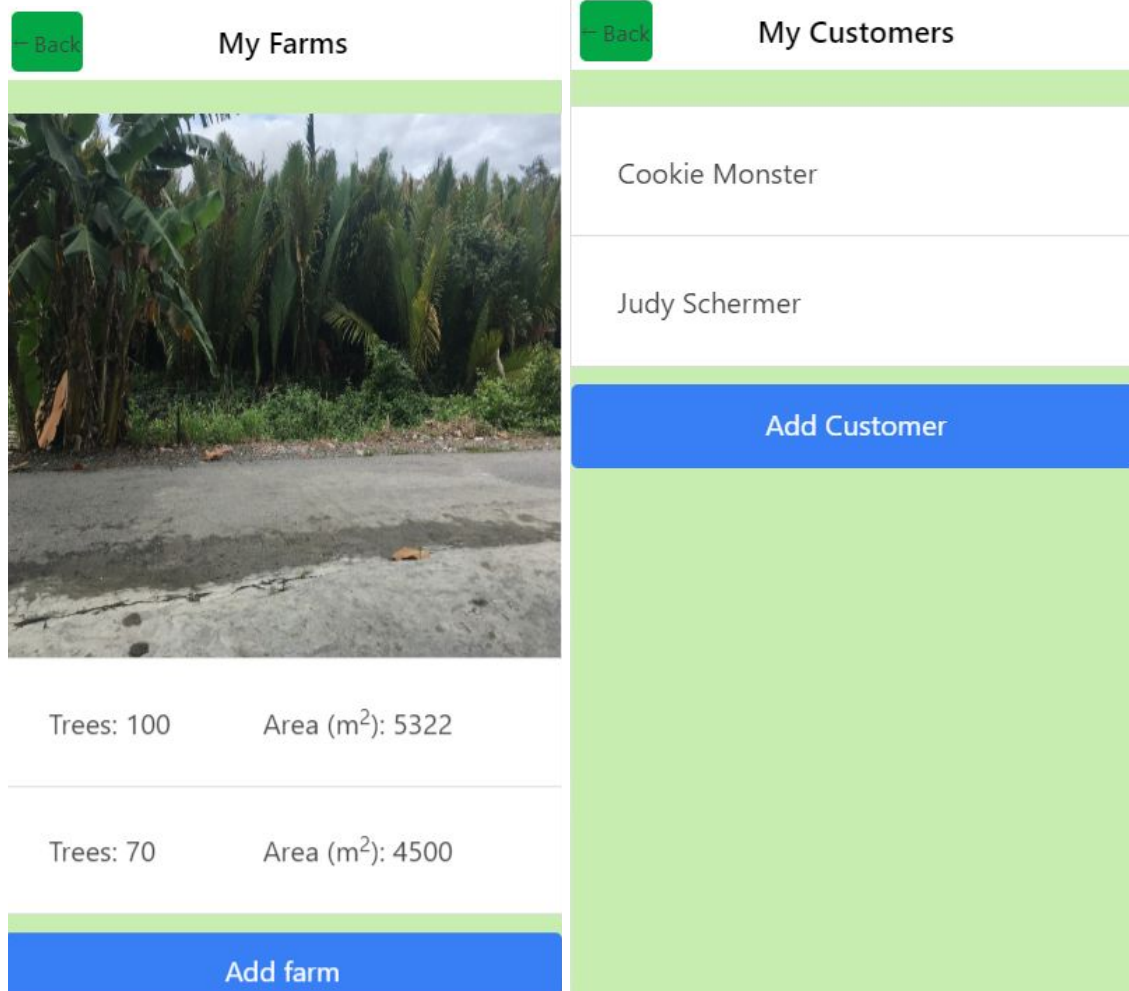



Figure 17. c ,d. Pages “My Farms” and “My Customers”.

The pages “My Production”, “My Farms” and “My Customers” provide an overview of the production per week, of the farms that a producers uses and of the (regular) customers of a producer. All pages have a button to a page that allows to add new information, see Figure 18a,b,c,d.

Back
Production this week



Gula Apong Produced this week (kg)

0

Submit!

We would like to know how much **Gula Apong** you produce to get an overview of the production in your area.

Back
Add or view customer

First name

Last name

Is reselling

Phone number

Submit

Figure 18.a,b. Pages “Add production this week” and “Add customer”. All information that is entered here is stored in databases. If a customer is added, it is displayed on the page “My customers”. If a production is submitted, it is shown on “My Production”, but also it is shown in the graph that can be seen on “Dashboard Producer”.

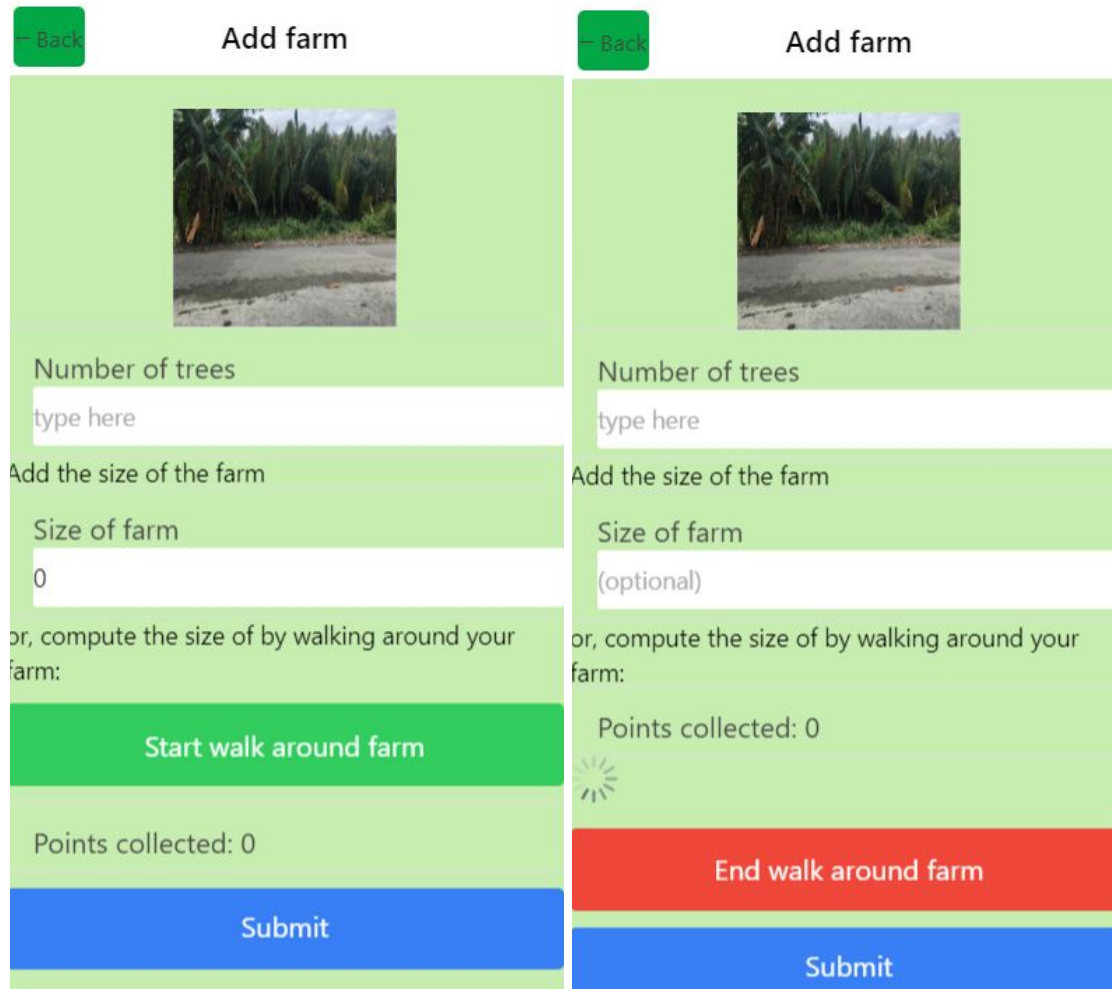


Figure 18.c,d. The page “Add farm” allows producers to add information about their farm. They should enter the number of trees the farm has and the size of the farm. Instead of the latter, they can also choose to walk around their farm and let the app compute the size of it. Then they have to press ‘start’ and ‘end’ whenever they have finished their walk. GPS coordinates will be tracked along the way, and “points collected” displays the amount of coordinates collected, realtime.

Ministry Interface

Figure 19 shows the start page that is shown when a minister is logged in. With this prototype, the ministry can not do anything right now. In the future this should be improved.



Figure 19. Left shows the dashboard of the Ministry Interface. The idea is to show a graph with production of all producers in time. Then there is a page `Overview of Price` that shows the recommended price in time. However, these pages are not working yet. There is not yet an overview of the total production and of the selling prices. This Figure just shows the design, with example graphs and this is to be implemented in the future.

Producer Interface

The producer interface is very basic. The producers can submit their demand. The idea is that they also select their producer, but this is not functional right now.

The demand is stored in a database. See Figure 20 for the dashboard of the producer interface, or ``the webshop (to-be)``.

Figure 20. Left, the Buyer Dashboard is shown. Buyers can enter the amount of Gula Apong they want to buy, in kg or in cans of 30 kg. When they press ``Submit'', they are forwarded to the page on the right. There they select a producer that they would like to buy from. In the future, the page on the right should also display the stock of the different producers. Currently, the page on the right is just a design and is not yet functional.

General pages

Next to these three interfaces, there are pages that are for all users the same. Namely, the login page, the signup page, the help page and the ``My Profile'' page. They can be found in Figure 21 a,b,c,d.



Welcome!	← Back Signup
	First name Last name Address Phone number I am in.. ▼
Username 1 Password	Username 1 Password  I am.. ▼
<div>Login</div> <div> <div>Sign Up!</div> <div>Contact us!</div> </div>	<div>Sign up</div>

Figure 21. a,b. Login and signup page. When someone wants to use the app, they should fill in their name, address, phone number and a username and password. Also, they indicate their division and their role: producer, buyer or minister.

Back
Profile

First name

Schermer

Last name

Judy

Address

Uilenstede 175, Amstelveen, 1

Phone number

0031645815004

I am in..

Samarahan

Username

1


I am..

Producer

Save

Log out

Back
Help



Contact us (Giorgi, Judy, Chris, Kuan) at
example@gmail.com or 06-23456789

Figure 21. c,d. Left shows the “My Profile” page, that allows for viewing and editing your personal data. On the right, a help page is shown. Dummy contact data are given. The idea is that it shows contact details of the managers of the application.

7. DESIGN DECISIONS AND REPORT OF USER TESTS

Prototype APPong: Gula Apong producers enter data about their production, namely: how much kg they produce (should be entered on weekly basis), how many trees they have and names and contact details of their regular customers. The location of their farm will be tracked and the size of their farm will be computed automatically. The app gives producers an overview of their own data. Buyers can enter their demand. In the future, all data should be displayed in a nice way to the government.

7.1 DESIGN DECISIONS

A common phone in the area is an old Android smartphone. We decided to make a hybrid mobile application, which works on Android but also on other operating systems. Main reason for this is that we have experience with developing hybrid apps, and not with native (apps that are designed for Android) ones. Considering expansion of the application, the more operating systems it suits, the better. Furthermore, we consider that the learning curve of developing a native app (Android, Iphone, etc) is quite steep, while developing hybrid apps leverages HTML and JavaScript, which has more widespread use. For similar reasons we decided to use earlier versions of the Ionic and Cordova frameworks rather than the latest distributions. The earlier versions still use JavaScript rather than TypeScript. This may make it easier for other developers to expand the project, given that JavaScript is still very widely used, while migration to TypeScript demands more time to understand this paradigm shift.

The application can be used offline. This is necessary, because part of the target group does not have internet in their homes and users should be able to enter the data at home. Whenever the user moves to a place with internet connection, their generated data is uploaded to a central database. For this, we leveraged PouchDB as a local database which is able to synchronize with a global database: CouchDB. As noSQL databases, these databases are very efficient for large databases, though noSQL requires a paradigm shift from traditional relational databases. Rather than having an entity model which stores records for each user, in noSQL, each user has its own database for entries. An advantage to this design is that there is no need for locks when updating databases. This is especially useful considering that large batches of data may have to be updated at a time, given that the offline database must eventually synchronize with the global database. Furthermore, we tried to avoid vendor locking, and PouchDB and CouchDB are open source frameworks. This is an advantage over Google's Firebase, which has similar functionalities, though it is owned by Google. Finally, CouchDB and PouchDB have synchronization functionalities out of the box, which helped with rapid development of our software.

It is important for our application to be very easy in use, at least concerning the interface for the producers. If the app is not intuitive, producers (or their family) will not use it. We decided to let an admin register the producer, but after registering, the producer ('s family) should be able to manage the app themselves. For producers, adding farm information allows for them to be able to input farm information such as tree count and farm area manually. However, we also understand that perhaps their farm area may not be measured yet. Thus, farmers may leverage GPS modules from their phones to be able to estimate their farm area. Farmers must walk around the perimeter of their farms, and after returning at their starting point, the application is able to estimate the area around the farm.

The amount of Gula Apong produced is entered each week. It is an estimation of the total amount of Gula Apong, so if a producer has two areas with trees, they enter the sum of the yield of both areas. We think that it will be too complicated for the producer to enter the information per area. Namely, in that case they have to keep track of what Gula Apong comes from which area. If the stakeholders are highly interested, it could be implemented in the future.

Furthermore, we developed a view for producers to be able to keep track of their customers. We decided to separate this view from other critical fields such as production of Gula Apong and farm information. This is because there may be certain privacy concerns from producers whenever they input customer information. For example, a producer might not feel comfortable with inserting information about their customers. If we would request all producers to fill in the customers along with the production of the current week, these producers will not fill in the customers and hence would not be able to fill in the production either.

We have developed a prototype page which also allows customers to request Gula Apong from registered producers. However, this view needs more backend development in order to be functional. This feature would be closely tied to the collection of customer information, as these transaction brokering could be handled from the application. This would also provide further incentives for farmers to participate in the program, given that government support is very limited until it can be proven that Gula Apong industry has potential for expansion. Our project prioritized the producer collection aspects as this is critical information for both customers and the government as stakeholders. We anticipated further support from the government to producers, though this may not occur as soon as expected. Therefore, there is a sustainability concern which should be addressed by producing a functioning customer page in the future work. Ultimately, time constraints led us to divert our efforts towards developing an intuitive and functional producer interface rather than producing multiple pages for different stakeholders while sacrificing usability.

7.2 QUESTIONS TO EVALUATE THE APPLICATION

The end-users are the producers/the family of the producers, the ministry, the admin and the buyers. To evaluate the application, we would like to ask the different end-users the following.

We have some general questions that we would like to ask all end-users and we have more specific questions per group of users.

Everyone:

- Is there any thing that confuses you, is there anything you don't understand?
- Is there anything in the app that you do not need?
- Is there anything else that should be in the app but is not there?
- Do you like the layout of the app?
- Did it take long to understand it?
- Would you use this?

Producers/family of producers:

- Would you pay for this?

Ministry:

- Is there any other data that you would like to see?

Buyers:

- Does the app help you to find a seller of Gula Apong?

Due to time constraints, we have only been able to get feedback from the Ministry. In the uptake phase, it would be valuable to get feedback from more users. For evaluation at a later stage, we already made evaluation forms, with mostly closed questions, that could be used on large scale. The evaluation forms can be found in Appendix D, in English and Malay.

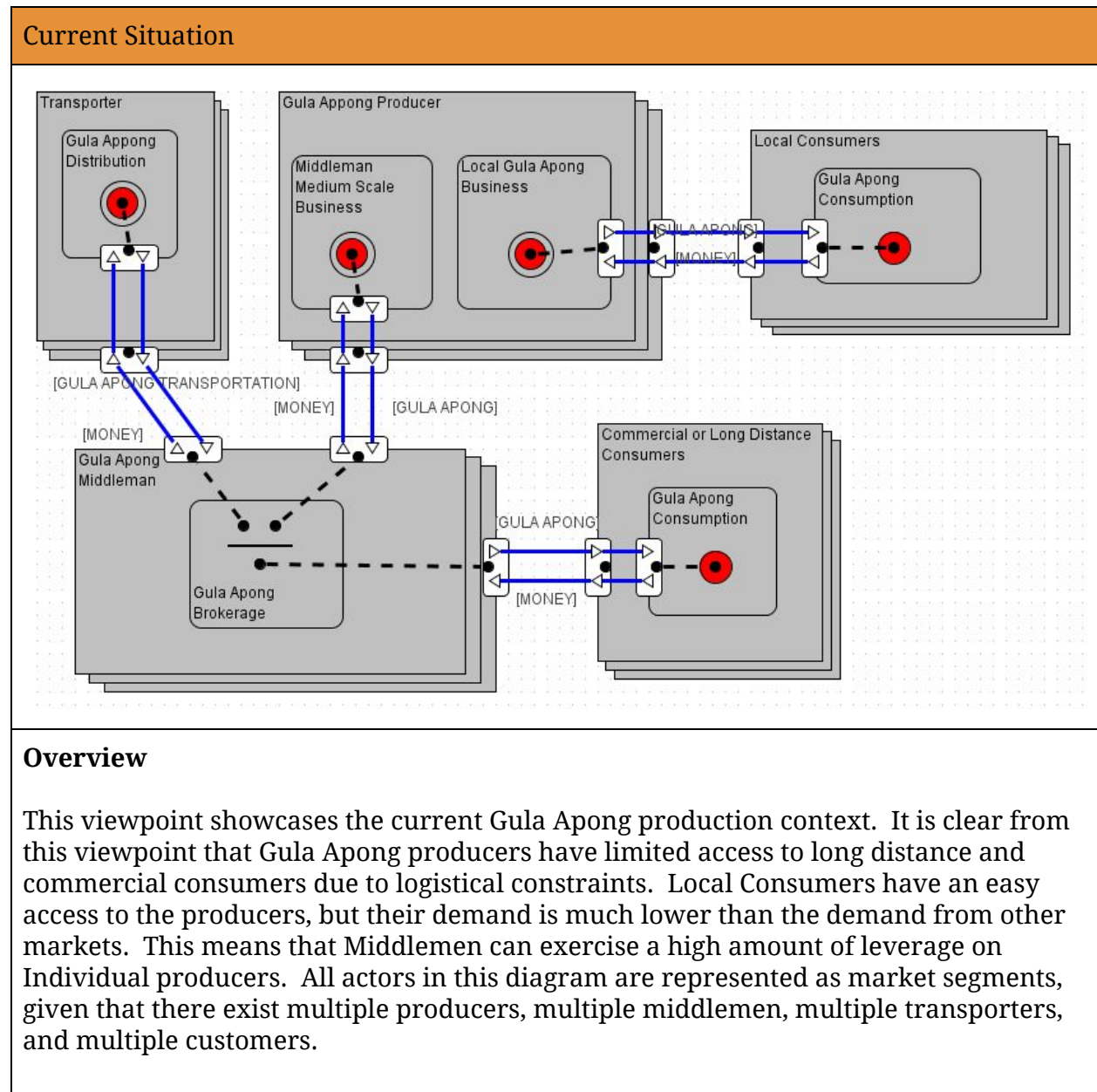
7.3 USER TESTS

We have not been able to test the application with buyers and producers of Gula Apong due to time constraints. However, we have presented the prototype to Prof. Ibrahim and the Ministry. On 26th of June, prof. Ibrahim, after seeing our prototype, had a few more requests: he let us know that, not only the GPS coordinates of the farm are interesting, but the size of the farm is of interest too to the Ministry. Moreover, they want to know who the regular customers are. Lastly, they wish to get an overview of the producers who produce regularly, so that they know who deserves to receive land. We have been able to implement all of these features. We let the user select their region upon registering. Prof. Ibrahim advised to change ``region” into ``division”, since otherwise there will be too many options. There are only 11 regions in Sarawak and way more regions.

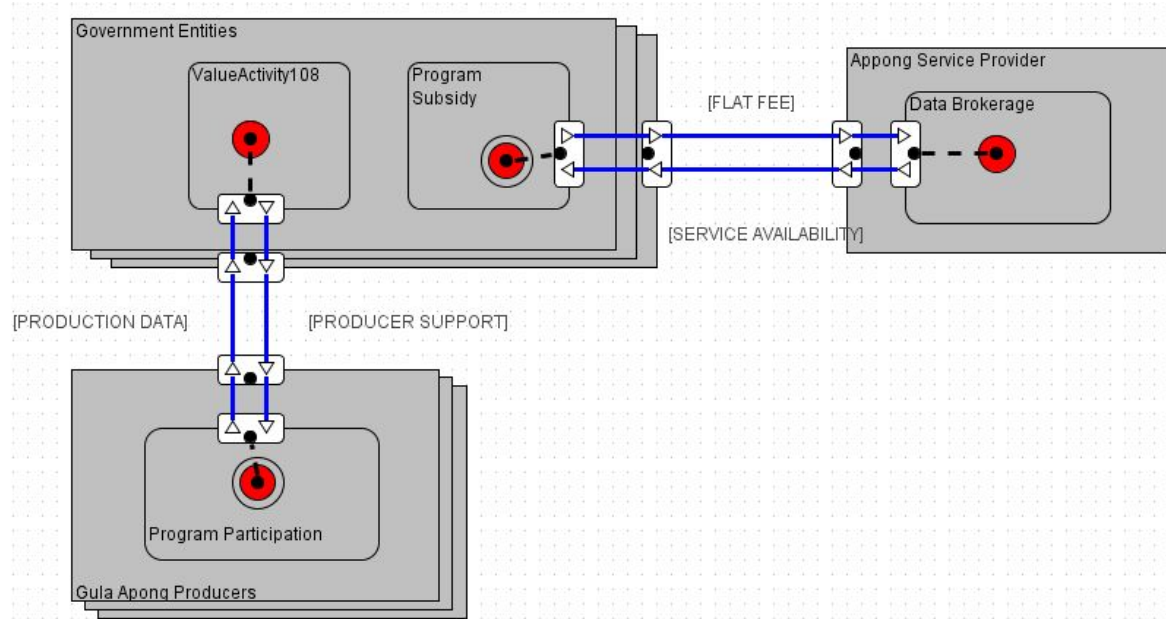
Moreover, Prof. Anna Bon and Prof. Ibrahim told us that a buyer interface would be nice. Then, on June 28th, we have presented APPong to the Ministry and staff from UNIMAS and VU. They asked for a few more features: to deploy it on Android (we had not done that yet, although it was on the planning), make an entry field for the size of the farm and they would like to download the app as soon as possible. They would like to see the buyer interface still and to start using it. They are planning on using it for other products and crops too. We managed to deploy the app on Android and to make an entry field for the farm size, however we have not had the time to improve the buyer interface, so that is still very basic.

8. A SUSTAINABLE VALUE MODEL

Below, we analyze the value exchange between different parties involved in this use case, by means of networked value model, i.e. e3 value diagrams.



Government-Service Value Exchanges



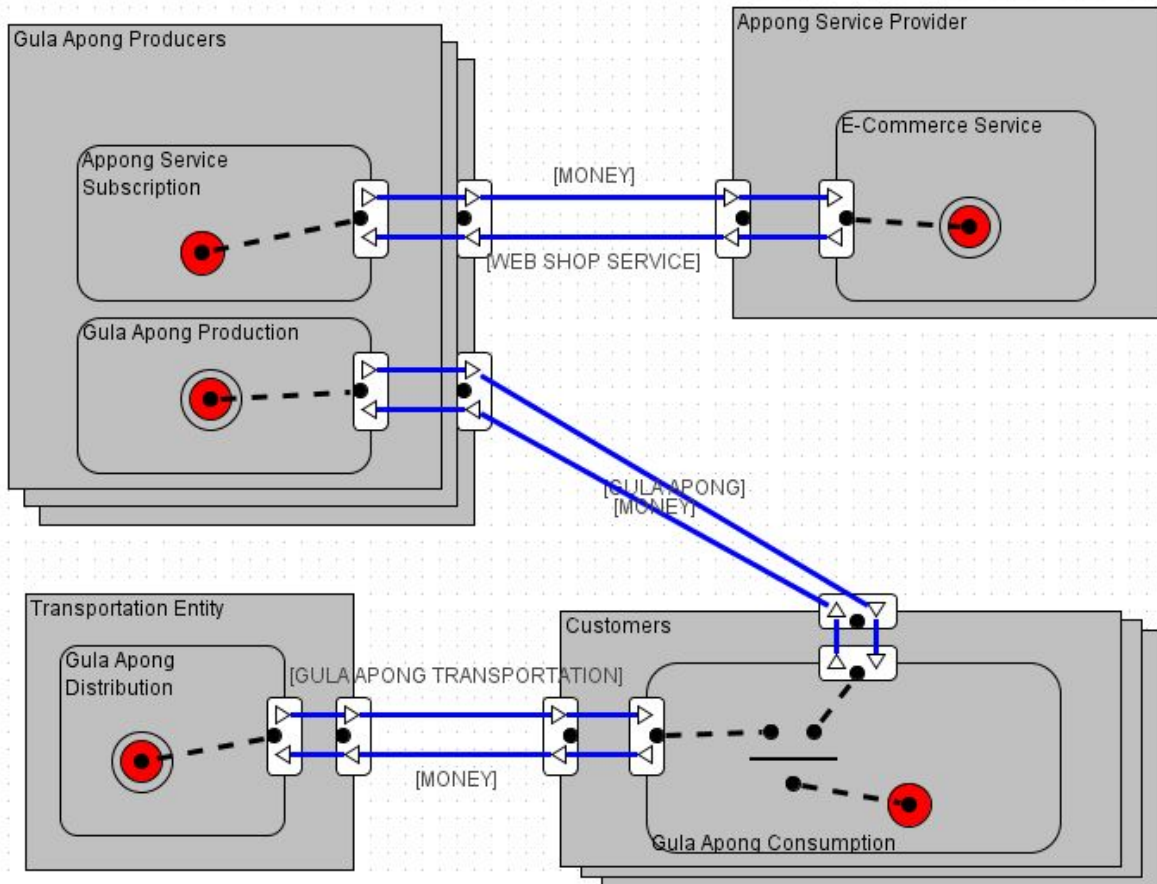
Overview

This viewpoint showcases the value exchange between Government entities, Producers, and the Appong Service Provider during the uptake phase. The viewpoint also shows that the government is interested on production data from Gula Apong producers. This data is achieved only if all three actors cooperate in their roles. A Gula apong producer receives support in exchange for participation. The government receives data in exchange for a subsidy to sustain the program, and for the government to provide support to producers in order to incentivize their participation. Producer support can include the gazetting of land for producers, better market visibility for farmers, and any sort of policy support for producers.

Vulnerabilities

This diagram shows that the program participation has many vulnerabilities. It is critical for the Government to be involved in supporting Gula Apong Producers. The Gazetting of land is one of the possible value offerings. This sort of policy intervention may give the government leverage over producers, where participation is a precondition for sustained gazetting of land. Furthermore, market visibility must be effective, otherwise Gula Apong Producers will not find an incentive to input their data. Also, there must be government involvement in order to sustain the Appong service Provider in the long term.

Consumer-Producer Value Exchanges



Overview

This viewpoint showcases the interaction between Consumers, Producers, and Service Providers. It demonstrates that Appong's role is to provide a Web Shop Service which in turn will give Gula Apong producers bigger market visibility. In return, the Producers can pay in order to get access to this service (to help the project remain sustainable). The Middlemen are then omitted from the picture as the application assumes such a role. Transportation and logistics are something that is also handled by the Customer market.

Vulnerabilities

It remains a critical practice for gula apong producers to keep inputting production and farm data for the government. This data is still relevant, also for the Web-Shop Service. Failure from behalf of Producers to input this data puts the project at risk.

Furthermore, the application must be able to truly deliver better market visibility, otherwise the producers may find no incentive to invest in the web-shop service. Also, there exists a risk for Customers to circumvent the application in favor of Interacting with Producers directly. If this is not taken care of, the application may become irrelevant, and the project may fail.

9. OUR APPROACH

We started the project with field research. We visited Pinggan Jaya to interview women that have a (small) business. Moreover, we interviewed a Gula Apong producer in his shop along the road in Pinggan Jaya. Those interviews gave us a lot of information about Gula Apong, the production process and the market. Before this, we had never heard of Gula Apong, so these interviews were very useful if not crucial. Later, we also got a tour around the farm of one of the producers. This trip gave us a small peek into the life, or at least the work, of Gula Apong producers. The field research took place the first two weeks we were here, along with conversations with the other important stakeholder: the Ministry of Industrial and Entrepreneurial Development. In an ICT4D project, this part is so important, because one can not do a project without knowing about the cultural context of the stakeholders and beneficiaries. The culture is so different from ours, and we have to take into account that the language is different and also the computer literacy is different than we are used to in the Global North.

The meetings with Prof. Ibrahim and the Ministry made clear what they expect from the system. From these interviews, we elicited the requirements for the application. Then, we started coding and showed our first prototype to Prof. Ibrahim on 26 June. We got some feedback, he had a few more requirements, and we edited our app accordingly. We made networked value models, to address the economic sustainability of the project. We modelled the current market situation and the situation that is desired by the government. Then, we figured that the application will not be uptaken from one day to the next. Hence, we modelled the situation in between the start of the application and the moment that it is used on big scale (the 'uptake phase'). Moreover, we asked producers whether they would be interested in the application and they gave us their feedback, which we incorporated. In the end, we made sure that we documented everything, so that other Computer Science students can maintain our application.

Giorgi has taken the lead in programming the application, since he has the most experience of us all. He has made a hybrid app before with Ionic. Chris and Judith have participated in the programming, with assistance of Giorgi when necessary. Kuan started with modelling and later the others have helped and improved and Chris has focused on the networked value diagrams. Judith has taken the lead in the documentation and everyone else has helped with this. Everyone was involved in different tasks (coding, documenting, summarizing interviews, modeling) and we are very proud of that, because we think that this yields the best results.

10. CONCLUSION (SUMMARY OF PROJECT)

We have done context analysis on Gula Apong production in Sarawak, and in particular in Kampung Pinggan Jaya. There is a need of the Ministry of Industrial and Entrepreneurial Development for an overview of the Gula Apong production in this area. This need comes from the desire to increase the total production. The government wants to know the capacity of the different producers and which trees are harvested, so that they can support the producers and start to exploit the unused farms.

APPong assesses this need via the easy interface that allows producers to enter data and the Ministry to overview the data. Moreover, it raises visibility of producers via its buyers interface, that shows contact details of sellers and enables buyers to place orders. The expectation is that the Ministry and the producer and the buyer will benefit from this application. The application is a first step in organizing the production in Sarawak. We are positive about the sustainability of the project. There are suggestions for other features and we expect that in the future, students from UNIMAS can implement those to make the app even more useful and attractive.

11. JUSTIFICATION

The application will be beneficial for the Ministry, for producers and for buyers. The middlemen will not benefit, since they will not be needed anymore if the application is fully uptaken. Right now, the middlemen get paid a lot for the work they do, while the actual Gula Apong producers are paid too little. This makes the job unattractive and producers are afraid that it is so bad, that in the future, Gula Apong will not be produced anymore. Producers have told us that their children do not want to take over the business. It pays too little for the hard work and therefore they prefer an office job in the city. APPong could help increase the profit producers make, by guaranteeing buyers and by setting a higher price per kg. If the situation is as bad as some producers describe and there is an actual risk that the expertise will be lost, then this application could be the change that makes the job more popular and will help sustain the craft.

Other than that, it will help advertising the product, by, on long term, increasing total production and making constant supply for China and Singapore possible.

12. REFLECTION AND DISCUSSION

Our project started after the initial interview with the MIED along with professors Hans, Jaap and Ibrahim on June 12, 2018. The interest of the Ministry was to modernize Gula Apong production with the end goal of increasing marketability and production volume. The ministry proposed many solutions, though they did not have an initial idea for a software solution. The ministry was interested in a proof of concept which would help them truly realize the possibilities of software as a suitable contribution to this industry. They expressed that they hope to collect more data on producers as their current data is outdated and limited and not digitized.

Soon after this meeting, we had a debriefing to identify possible software solutions for farmers. Professor Ibrahim offered a broader picture on the Gula Apong production context given that he has been involved with the ministry and with Gula Apong producers for some time. Thus, he became one of our primary sources of information when developing this application. Initially, the scope of our project was very ambitious, and it was not clear to us whether our time constraints would allow us to develop the entirety of the project. The high level description of the desired project included a data collection system that could aggregate farmer data on production and the farm's production capabilities. From this data, the ministry could extract information to potentially help producers to market their goods, and to determine a fair price for producers to sell their goods.

There were certain aspects that were not considered or not fully developed during our interviews. Sustainability of the project is a critical challenge. Our initial expectations were that the MIED would be eager to contribute with incentivizing farmers to participate with the application. It is still unclear when the ministry will intervene in order to provide incentives for farmers to provide their data. With regards to gazetted land for farmers, the ministry stated that this was beyond their jurisdiction, thus our assumptions of government support must be reassessed. This is a major challenge in sustaining the project. Thus, a further expansion of the project is necessary in order to provide value for farmers from within the APPong in order to ensure participation, rather than relying on government entities. A market system to advertise Gula Apong products and to keep track of gula apong stock would naturally keep producers and consumers engaged in the application. At the moment, this feature is in its basic stages and must be expanded in order to be an effective feature in our application.

Furthermore, usability was initially not deemed a particular challenge, as we aimed to create an app for a more IT literate segment, such as producer's wives and children. However, we realized that our assumption could put the project at risk, given that we did not get a chance to perform end-user testing with the producer's families. Therefore, we

tried to simplify our application, and we overhauled our initial interface in order to make our design as intuitive as possible. However, given the time constraints, localization was not possible to include in our development cycles. Also, the project's interface must ultimately be tested with the targeted audience, and this was not possible to perform due to time constraints. The MIED stated in our final that they were interested in conducting a pilot study with the Samarahan region to verify the impact of the application, and perhaps testing can be made in further cycles if UNIMAS students take over the project.

Also, we assumed that the MIED kept a thorough record of gula among producers, thus we did not anticipate uptake would be difficult. However, our final meeting with the ministry showed that the ministry does not have access to all gula among producers, and in fact they are interested in identifying them all. Our application does not address this concern, except for the fact that registration is possible. Drawing from other ICT4D initiatives, it may be possible for advertisement for the application to take place via radio or roadshows, if the ministry is willing to invest on the application's uptake. Further, it may be possible to expand the application to allow new and unidentified producers to request contact with the ministry or the regional office (if help is needed with registration or other aspects). However, this is also something that must be further developed in the project and to be discussed with the involved stakeholders.

With regards to the possible impact of the application, this hinges on whether the application manages to connect producers and consumers. We found out from our interviews that Gula Apong is subject to price elasticity, which was a factor that was not considered in our initial interviews. We interviewed a producer in Kampung Pingang Jaja, and we found out that one of the fears that producers have in increasing gula among prices is the loss of customers. There exist many alternatives to gula apong, including blends of palm and cane sugar, which may be lower in quality, but may compete with pure gula-among if drastic price increases occur. We assumed from our initial interviews that a large segment of gula among producers was isolated from each other, and that the static gula among prices were due to producer-producer competition. We anticipated that by providing market information to all farmers through our application, a cooperative may be formed in order to increase the price of gula among across all producers. This was initially a measure to address the issue of unethical gula among middlemen. However, we must take into account the price elasticity of gula among. Nonetheless, we expect that the project may help gula among producer by providing better market visibility, and possibly connecting producers and consumers directly as opposed to relying on middlemen.

After a few interviews with the producers, they are keen to have a technology application to intervene with their production activities. According to them, it is a good initiative as to increase the visibility of gula among production. In turn, more businesses and more incomes for their families. The producers usually have limited knowledge or

skill on information technology. It is advisable to develop the app in the sense that they can use without ease and understand the nature of the app. To do so, UNIMAS team will take over the app training session and maintenance process after students back to their country. Hence, a simple design, an easy to use user interface and English in language are implemented in this app. However, in future, a dual language (English and Malay) is advisable to implement in this app as they have limited knowledge on English language.

Another major limitation of the project has to do with error handling. As it stands, we have limited error handling and validation of data. That is to say, there exists a risk that erroneous data may be entered, and we do not discuss ways to validate or triangulate this data. For example, entry fields at the moment allow negative input of Gula Apong production. Furthermore, if a producer decides to delete a farm from their farm information section, then this data is also deleted from the global database. Thus, there is a risk of destruction of data. Furthermore, production data can also be modified or deleted, therefore this data is also at risk of deletion. Also, the calculation of farm area is an approximate rather than exact data. While the algorithm provides useful values to give a broad picture on a farm's size, there exists a risk in which GPS values are not reliable due to lower GPS coverage in a particular area. However, this is a useful solution given that GPS coverage is independent from the internet, and is higher than internet coverage itself.

13. FUTURE WORK

APPong is a first step in organizing the Gula Apong production in Sarawak. Only basic and necessary functionalities are implemented due to the time constraint of approximately three weeks. A second step will be managed by other students from UNIMAS in the future.

Below, we list some features that will hopefully increase user satisfiability without making it more difficult in use. We have the following suggestions to improve APPong, ordered on importance³:

- Include an overview of buyers.
- Enable users to pay via the application.
- Recommend a selling price to all producers, so that they will earn a fair salary.
- Expand with a web application.
- Translate app in Malay.
- Include an overview of the demand.
- Currently, if a producer has two areas with trees, they enter the sum of the yield of both areas. If there is interest to know the amount of production for each area separately, this could be implemented in the future.
- Error handling: the input should be validated and error messages should be shown whenever the input is not in the correct format.
- Make a 'contact admin' button.

³ Priorities are made based on the conversations with Prof. Ibrahim.

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8. Interview with producer of Gula Apong in Pinggan Jaya, 26 June.
9. Findings from field research Tom de Jong, BSc Information Sciences, 6 June 2018.

APPENDIX A - PLANNING

Thursday 7 - Friday 8 June: Introduction course

Friday 9 June: Visit banana factory

Sunday 10 June: Interview with women (of which one Gula Apong producer) from Kampung Pinggan Jaya (KPJ).

Monday 11 June: Interview with Gula Apong farmer Zul from Asajaya.

Tuesday 12 June: Visit Ministry of Industrial and Entrepreneurial Development

Wednesday 13 June: Lecture on Interview Methodology and e3 value and selecting use cases and dividing groups. We decided to do the Gula Apong use case.

Thursday 14 - Saturday 16 June: Hari Raya Break

Sunday 17 - Monday 18 June: Modelling, documenting, implementing.

Tuesday 19 June: First feedback round with Prof Ibrahim. We have showed him our initial design of the application and a diagram of the stakeholders and their role.

Wednesday 20 - Monday 25 June: making business model, documenting, implementing.

Tuesday 26 June:

- Interview with Gula Apong farmer from Pinggan Jaya. We show him a first working prototype of the application and test it with him.
- Second feedback round with Prof Ibrahim. We have showed him our first working prototype.

Thursday 28 June: Present prototype to Ministry, feedback round from Ministry.

Friday 29 June - Sunday 1 July: Finish implementation and documentation and prepare final presentation.

Monday 2 July: Final presentation at UNIMAS.

APPENDIX B - TASK DIVISION

Kuan Huiggy: design application, diagrams, summary and transcription of interviews.

Giorgi Kikolashvili: code (taking lead), diagrams.

Judith Schermer: code (help), design application, diagrams, documentation, summary and transcription of interviews.

Chris Valladares: code (help), design application, diagrams, documentation, summary and transcription of interviews.

APPENDIX C - SUMMARIES OF INTERVIEWS

Interview Women Kampung Pinggan Jaya 10 June

Seven women from Kampung Pinggan Jaya were interviewed. However, only 1 of them produces Gula Apong. Here, we summarize the interview we had with her.

What do you produce?

She produces sugar, sugar vinegar, fermented sugar.

On which part of the business would like to improve / get help?

She wants to expand production. Her production depends on clients who aren't regular.

How do you sell your products? (do you use a middle man..)

She has clients from village and from outside of village. Clients call.

Do you have issues with selling your product? (unreliable customer, cancelled order..)

Middleman mixed pure sugar with other stuff and she fired him.

Do you use computer/mobile phone, and if yes, what do you use it for? Do you use radio? And television? How do you get orders? How you distribute products?

Does not use tech. Wants to learn how to read and write and use phone. Customers call her husband to place orders. Clients take products from her or she delivers them.

Have you already started advertising, if yes, what do you do?

Yes, on Facebook.

Are others involved in the production?

Husband and cousin helps her.

How do you obtain the ingredients for your product? (do you use a middle man.. do you go to Kuching..)

Take from farm. And the farm is supplied by her husband.

How do customers know that you have enough of your product?

Produce portions. Keep products that isn't sold.

Do you have any suggestions? Is there anything else we should talk about?

She wants to open store in the city to sell her product.

Interview Gula Apong farmer "Zul" in Asajaya 11 June

The mangroves already bare fruits. Within six months, from flower to fruit. From each fruit/mangrove plant, 1 or 2 liters of white liquid. Every day he (Zul) will collect from 100 trees. He gets circa 100 liters per day, that equals 20 kg of Gula Apong. He does this every day, depending on high tide and low tide. He supplies to all shops along the road here. But they still want more, so he does not even supply enough.

Takes 5 hours cooking. 2PM he starts cooking bamboo. In the morning, he collects the sap. 5 years ago, Gula Apong was only 3 or 5 Ringgit/kg. Today, 8 Ringgit/kg.

He has to buy wood to burn the juice. Cost price is basically the wood. Burning by gas is not strong enough. 150 Ringgit of wood can be used for 4 burnings. 1 burning: 20 kg. $20 \text{ kg} * 8 \text{ Ringgit} = 160 \text{ Ringgit}$. So 1 day is enough for cost of wood. Other days are for labour and profit. Some of IBAN workers in West-Malaysia buy it here and sell it in West-Malaysia. They buy in cans, each can is 30 kg. They package it themselves and sell there. They are many mangrove trees. Some upstream, some middlestream. They divided it among themselves. He looks at 100 trees. He can not do more, he does not have time. He has to look there every day. The tree is only good for 3 months. After 3 months, they wait for new fruit to come. Once fruit is back, ready to collect sap again.

He has only 2 acres. Every year you can collect one time for 1 tree.

Profit: In four days, minus costs of wood, in three days, say 20 kg per day,

20 kg per day, $20 * 3 = 60 \text{ kg}$ in three days, $60 * 8 \text{ Ringgit}$, so around 500 Ringgit in four days. The range is 15-25 kg every day.

In this area, there are around 15 people who collect the sap, that is $15 * 15 = 225 \text{ kg}$ per day that is collected here (way more than in Pinggan Jaya). Normally, after two days the Gula Apong here is sold. Depends on traffic. Caramel can last for 2 years when it is solid (without additions). Sap from Nira trees is delicious and healthy. He has regular customer. These people are entrepreneurs, they sell and package. They make cakes or ice cream. He sells to them for 6/7 Ringgit. They cannot sell the sap in open market, because after 24 hours it will become alcohol automatically. This farmer is a typical producer. He earns around 2000 Ringgit.

Others would like to be Gula Apong producer as well, but there is no more area left where they can collect sap. You have to take care of the plant. Can not just get the sap. The areas where the trees grow are already divided amongst locals. Some produce Gula Apong, but some do not. Actually all land is owned by the government, but in practice it seems like the locals own the land and divided it. Like a tribal rule.

The government does not know what the total capacity of the caramel is. There is no way to ask one by one. Sometimes he gets support from government in terms of machines. But he does not use the machine, because it is bad for quality/quantity.

Interview Ministry and Prof Ibrahim 12 June

Gula Apong: traditional Malaysian sugar.

Production process of Gula Apong consist of the following main steps (Judith: in my understanding):

1. Collect juice (sap) of mangrove trees (trees are also called “nipa”).
2. Cook the juice in order to produce sugar.

Gula Apong is being sold 8 Ringgit/kilo.

Now, production is limited. Demand is high, lot of consumption (also internationally). Whatever is produced will be sold.

Nipa (the mangrove trees that contain the fruit) can be planted.

Worried about production: The juice is collected in traditional manner, difficult to reach the trees. They use bamboo to collect the sap. Bamboo with sap is heavy. A plastic bag would be lighter to carry. No insect, rain water can come in in a plastic bag. In bamboo: everything can come in.

There must be a way to make mass production, besides plantation. We are not fully exploiting the resources that we have at the moment.

When high tide: can't produce. In low tide: is difficult to reach all trees.

Improvements for production process:

1. Have proper way of collecting the sap.
2. Maybe make general collection point. And from there bring it to the cooking place.

Where do we come in?

Gather data: where are the productions taking place?

Where is the potential of the Gula Apong industry?

Judith: if I understand correctly, you want us to make a system that collect data about Gula Apong production in Malaysia.

Number of farmers is small, area is big.

Idea for us:

Make a dummy system

The system can be used at later stage, when farmers have mobile phone. They cannot use it yet in the jungle.

They can provide a map for us that shows the areas that are used and the areas that are not yet exploited. (right? Or do they want us to make such a map?)

Farmers are not so much in concern of the price.

Middleman is man that determines the price.
Farmers get same amount of money anyways.
Very few of the farmers are selling it themselves.

Malaga is also producing Gula Apong, but they add sugar, so the Glucose Index (GI) is higher and quality worse.

Interview Prof Ibrahim 19 June

The actors are producers (terminology: use “producer” instead of “farmer”), an admin (preferably admin from residential state), ministry and buyers (middlemen and actual customers, and regular and new customers).

The incentives for producers are: Producers can keep their land (gazette) if they use the app actively, also their products will be more visible.

The data that Ministry wants is:

- The location of the field(s) that a farmer uses for production.
- The amount of production trees.
- The amount of Gula Apong that is produced, per week in kg.
- The names of regular customers.

How to collect the data from the producers?

- weekly basis production capacity, not daily.

One of the objectives for this app is to

- reduce reliance from middlemen (as middlemen profit most from the producers and the buyers, buying low price but selling high price).

Other expectations and objectives of app:

- Source of Gula Apong data, manage the statistics and data.
- Support collaboration between Gula Apong producers.
- Increase the visibility of Gula Apong.
- Obtain overview of producers.
- Determine production capacity.
- Obtain overview of buyers.
- Why are they buying? For home, business or commercial?
- Obtain overview of demand and supply.
- Determine appropriate price Gula Apong (future work).
- Policy on app participation/gazette the lands.

Interview Chris van Aart 20 June

Chris van Aart has made an application for farmers in Mali, Mr. Jiri, that enables them to easily indicate the area of their farm and the amount of trees.

The application works as follows: a farmer walks around his farm with his mobile phone, which then determines the GPS location every 5 seconds or so. When they start their walk, they press ``start'' and when they covered the whole area, they press ``finish'.

Then they enter the amount of trees they have in the system.

The GPS coordinates are not accurate in non-covered areas and even worse with old phones. Therefore they save the coordinates every 5 seconds. Also, the system provides an accuracy parameter, that tells how accurate the coordinates are. Then, they can make a threshold, and if coordinates are not accurate enough, they will get notified.

In order to increase accuracy, one can also use the application in combination with a step counter or with satellite pictures. The latter, however, will be more complicated.

Interview Producer Bujang 26 June

Bujang and his colleagues, Kampung Pinggan Jaya

Summary by Kuan

Facts on his farm:

- 10 hectares of apong tree.
- estimate 10,000 trees planted.
- no need fertilizers for the trees.
- 3 workers including him.
- process takes 7 hours to boil the gula apong.
- market price for gula apong rm8/kg
- they also selling raw gula apong sap to alcohol factory.
- usually 1 litres rm8.
- he got regular customers, which usually order from whatsapp and ads from fb.
- usually do not have any stocks left.
- if higher demands from customers, they may ask other producers to sell gula apong to them.
- selling to local markets, middle man and peninsular malaysia (kelantan)
- the current demand for gula apong (for kelantan) is 1 ton/month
- intention to international market
- want to collaborate with other producers to make a new energetic drink based on raw gula apong sap.
- estimate 60 litres, to boil down to 10kg of gula apong.
- production per day 20 - 30 kg of gula apong.
- want to explore other gula apong final products.
- one of his intention is to make energetic drinks.
- 1 litres can make 50 bottles, selling for rm 100, rm 2 per bottle.

How they harvest gula apong sap:

- Gula apong tree usually will bloom 2 - 3 flowers in one time.
- to maximize the output of gula apong sap, they will softly hit the flower trunk, as doing so, the flower trunk will not so stiff, to make the better flow of apong sap.
- the trunk can be used in cooking material.
- in contrast, the trunk is in bitter taste, while the sap is sweet as corn sugar taste.
- the fruits from the tree also in cooking, the taste like a coconut flesh, salty taste.
- to make sure the trees will not wither after harvesting, they will use up to 2 flower trunks per tree.
- also when slicing off the trunk to collect the sap, they will stop when it is near to bottom, as to prevent the tree from withering.

Application:

- his kid can help data entry about his weekly production.

- may not have difficulty in English application as his kid using it.
- think it is useful as government intend to help producers too.

Training:

- UNIMAS provides trainings on the techniques to harvest the gula apong.
- the correct techniques to slice off the trunk to maximize the output of raw gula apong sap.
- in 1987, NGO provided the plastic containers in oppose to bamboo containers.
- however, the quality of gula apong sap degraded when it is white, as the sap have oxygen trapped and fermentation might occurred.
- the white gula apong sap may becomes alcohol (tuak).
- the good quality of gula apong sap is in reddish color.
- the bamboo containers have porous in wall lining and makes oxygen escape from the gula apong sap, which delay the fermentation.
- they do know the machines to mass produce the energetic drinks based on gula apong.
- it is cost about rm25,000 for a machine.
- might need a factory which cost around rm20,000 to store these stocks.
- want to hire workers from their villages and give them job opportunities.
- for current gula apong production, they want 20 ppl to maintain the farm.

Beliefs:

- The bamboo containers usually not contaminated with bugs or rainwater because they think the god gave them this opportunities and protect them in the same time.
- they are quite grateful with what they have.
- wish to expand more in hope for their family convenience.
- not eating the crocodiles meat, when he does, the croc will follow him whenever he is in the water.
- same as for the snake.

Commercialized products:

- They introduce their own brand name and the new design for energy drink (designed by an UNIMAS student).



Boiling gula apong.



Pak Bub's Apong.



Energy Drink

Summary by Anna

At 8.30 we (André, Leeuw, me) take a Grab to Kampung Pinggan Jaya. We meet Dr Cheah and the students on the road, heading towards the Gula Apong producing place of the KPG community leader.

There we can see the process in progress of producing Gula Apong: cutting the flower from the Nipah palm trees, collecting the sugar water (air manis) in bamboo containers and preparing the caramel in a huge pan, cooking for 7 - 8 hours.

The school group (Nip, Ludwig, Tasos, Guusje), Judith and Cheah went back to the road and went to visit the School at Kampung Muhibah by scooter (close to KPG, crossing the bridge).

Dr. Fausa and dr. Sue (two sisters, both software engineers, working as lecturers at UNIMAS) were our translators from Malay to English, so we could interview the two gula apong producers. In this area, three people produce Gula Apong together. They “own” a terrain of 10 ha (approx. 1 km x 100 m); there are 10.000 Nipah trees here. 1 person can operate 100 trees per day. The juice is collected in bamboo cans. This is done in the very early morning, before dawn. Every tree produces about 1,5 l juice. The juice is boiled for 7 hours, to become caramel: gula apong. 4 bottles of juice (6 l) will produce 1 kg of g.a. There are three men to operate the farm, hence the three men harvest 300 trees per day. This yields on average 50 litres g.a. juice per day, the condensed gula apong will estimate in 20kg. 1 kg of g.a. is now sold for 8 ringgit.

The government wants to change the bamboo cans into plastic assuming that this will improve the hygiene of the gula apong. The producers explain us that bamboo is much better. It gives the brown color and smoky taste to the g.a. that is so characteristic. Moreover, bamboo is permeable. In plastic bottle the sugar starts to ferment immediately, which deteriorates its quality. The color and taste are not the same, the sugar will be white. Plastic is not recommendable as it cannot stand the heat, near the boiling pan, and it easily breaks.

Currently, sales of g.a. goes well. The producers have a steady customers base who contact them via Facebook and Whatsapp. They themselves do not know how to do this, but their children manage the social media for them. They do not need to sell to the middlemen. They can also sell the syrup directly to a factory who makes an alcoholic drink. That would make 8 MYR per liter.

They have also costs: burning wood. They buy this at 50 ringgit: enough wood for three days. And they still make a small profit.

They could buy a machine to make the GA into an energy soft drink. The investment to have this machine is 25,000 MYR. They cannot get a loan. With this machine they can easily 50 bottles from 1 kg of g.a.

The farmers know other g.a. producers in the region. They do not collaborate. Only when they get a large order they cannot respond to, they contact the other producers to do a group sales. There is no cooperative. There are less and less g.a. producers. Their children prefer to work in an air conditioned office in Kuching. The expertise how to make g.a. will eventually be lost. It is not easy, and requires experience and many special

skills.

Giorgi got almost bitten by a snake. Leeuw hit his head and was injured.

After the meeting with the G.A. producers we went to KPG, for a refreshment and some snacks at the Community House. All snacks and drinks made with gula apong.

Feedback MIED 28 June

- We have presented a slideshow.
- Main wishes from them:
- Deploy on android
- Make buyer interface
- Make entry field "regular customers" for producers
- Make entry field for "size farm" if producer knows the size, then it does not need to be computed
- Web interface
- Open source
- They want to download it Monday and maybe use it for other crops and gula apong products too.
- They want to start collecting the data.
- They were worried whether it could be used offline.


APPENDIX D - EVALUATION FORMS

[English]

Evaluation of APPONG

Using the scale from 1 to 5, please tick (x) in each statement below:-

1. Very weak 2. Weak 3. Normal 4. Good 5. Very good



A. APPLICATION	1	2	3	4	5
This app interface is user friendly.					
This app has an attractive design.					
This app is easy to use.					
This app is useful in my daily task.					

B. USER	1	2	3	4	5
I can easily understand the functions of the app.					
I can use without any assistance.					
I will continue to use this app in my daily task.					
I will recommend this app to my friends/producers.					

What benefits do you get from this app? How can the app assist in your farm/expertise?

Suggestion/comment for future development.

[Malay]

BORANG PENILAIAN APLIKASI APPONG

Dengan menggunakan skala 1 hingga 5, sila tandakan (x) pada setiap pernyataan berikut:-

1. Sangat Lemah	2. Lemah	3. Memuaskan	4. Baik	5. Sangat Baik
<hr/>				

A. APLIKASI	1	2	3	4	5
Aplikasi ini sangat mesra pengguna.					
Aplikasi ini mempunyai reka bentuk yang menarik.					
Aplikasi ini sangat senang untuk digunakan.					
Aplikasi ini sangat membantu dalam kerja harian saya.					

B. PENGGUNA	1	2	3	4	5
Saya dapat memahami fungsi-fungsi aplikasi ini.					
Saya dapat guna aplikasi ini tanpa bantuan.					
Saya akan terus menggunakan aplikasi ini dalam kerja harian saya.					
Saya akan mensyorkan aplikasi ini kepada rakan/pengeluar gula apong.					

Apakah faedah/kebaikan yang anda akan dapat dari aplikasi ini? Bagaimanakan aplikasi ini membantu anda melaksanakan tugas di tempat kerja anda?

Cadangan/komen penambahbaikan aplikasi ini.

APPENDIX E - CODE

The code is open source and can be found on
https://github.com/Cvalladares/gula_aponc_mobile.

The algorithm that is used to compute the size of an area using a list of GPS coordinates is based on the algorithm that Chris van Aart used for Mr. Jiri, a mobile app for monitoring tree population in rural environments.