Research Study on Factors of Coffee Transformation Processes

for Hill-Tribe Farmers in Mae Chaem, Chiang Mai

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An Interactive Science and Social Project Report submitted to
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ABSTRACT

Presently, hill-tribe coffee farmers across Northern area earn low income from coffee selling, due to the inefficient coffee transforming processes, which directly leads them to face indigent quality of life. Our project's goal is to provide Raks Thai Foundation with effective research data in coffee transformation processes, as options for the hill-tribe farmers to gain better profits from selling coffee.

In collaboration with Raks Thai Foundation, the team designed to identify the current limitation factors of coffee transformation processes in the target villages, Yod Phai and Huay Kee Per villages, which are located in Mae Chaem district, Chiang Mai, based on observation and interview. The team aimed to promote them the importance of coffee transformation processes using financial calculations as significant evidence, and provided possible approaches to overcome such barriers in term of realistic information, together with recommendations for the continuous use of approaches in the future.

บทคัดย่อ

ณ ปัจจุบัน ชาวเขาทั่วทั้งภาคเหนือของประเทศไทยมีรายได้น้อยจากการจำหน่ายกาแฟ เนื่องจากการแปรรูปกาแฟที่ไม่มีประสิทธิภาพเพียงพอ จึงทำให้ชาวเขานั้นประสบกับการดำรงชีวิตอยู่ที่ไม่สมบูรณ์เท่าที่ควร โครงการของกลุ่มนิสิตนั้นได้จัดทำข้อมูลการวิจัยของการแปรรูปกาแฟให้กับมูลนิธิรักษ์ไทย เพื่อเป็นทางเลือกให้กับชาวเขาในการเพิ่มรายได้จากการขายกาแฟ

ทางกลุ่มนิสิตจุฬาลงกรณ์มหาวิทยาลัยร่วมกับมูลนิธิรักษ์ไทย ได้ทำการศึกษาข้อจำกัดของการแปรรูปกาแฟระหว่างสองหมู่บ้าน นั่นคือหมู่บ้านยอดไผ่และหมู่บ้านห้วยขี้เปอะ ในอำเภอแม่แจ่ม จังหวัดเชียงใหม่ การหาข้อมูลนั้นยึดถือการสังเกตการณ์และการสัมภาษณ์เป็นหลัก เพื่อที่จะสนับสนุนการแปรรูปของกาแฟ จากนั้นใช้หลักฐานการคำนวณทางการเงิน การแก้ปัญหาโดยใช้ข้อมูลเท็จจริง พร้อมด้วยคำแนะนำการแก้ไขปัญหา เพื่อชาวเขาจะได้มีการจัดการการแปรรูปผลิตภัณฑ์กาแฟที่มีประสิทธิภาพ และสามารถดำรงชีพอย่างยั่งยืนในอนาคตต่อไป

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EXECUTIVE SUMMARY

Introduction

Many of hill-tribe villages in the northern of Thailand are facing with a low-income issue.[1] Statistically, the hill tribe's population growth is at an annual rate of 2.9 percent while the average annual income per family per year is around 10,000 baht, indicating the low level of income comparing with other areas.[1] Generally, the hill-tribe villagers have done agribusiness as their main occupation such as selling corn, rice and coffee.[2] However, their abilities on generating income from agricultural products are confined due to unexpected external factors; for instance, financial resources and lack of capital. As a consequence, many social programs, both government and private sectors, have been established to support the underprivileged hill tribes in attempting to enable the villagers to restore their self-sustainability.

One of the most successful projects is the Royal Project established in 1969, under the royal patronage of His Majesty the King. The Royal Project was introduced to assist the northern hill-tribe people, who were engaging in unsustainable farming practices.[3] Consequently, the hill-tribe villagers rely not only on large corporations for financial support, but also on Raks Thai Foundation, a non-profit organization whose mission is to strengthen the capacity of disadvantaged to analyze their main problems, determine appropriate solutions, and contribute in improvement actions.[4] One of the projects under Raks Thai Foundation is to support the hill tribes to earn more revenue from agricultural products, especially coffee, because coffee is a sustainable plant due to atmospheric and geographical conditions of the north of Thailand. However, the foundation has not yet found a reliable way to completely achieve their target. Providing a relevant research study on coffee is therefore a key to help the hill-tribe farmers to gain more income.

Methodology

The goal of our project was to provide Raks Thai Foundation with effective research data about coffee transformation processes, as options for the hill-tribe farmers to gain better profits from selling coffee.

To accomplish our goal, we implemented four objectives:

1. Specify standardized coffee transformation processes from successful organizations
2. Determine the concerns regarding coffee selling of hill-tribe farmers in Mae Chaem, Chiang Mai
3. Define the coffee transformation processes and factors in each process from the hill-tribe villages
4. Identify approaches to overcome the limitation factors of coffee transformation processes

We developed productive data including financial calculations in each stage of coffee transformation processes based on the information obtained from Yod Phai and Huay Kee Per villages. This could be applied to rural coffee farming communities across Mae Chaem, Chiang Mai.

Objective 1: Specify standardized coffee transformation processes from successful organizations

For the first objective, it was set to comprehend more about the standard requirement of coffee transformation processes, and study the strategies for overcoming the limitation factors, so that we would be able to adapt such solutions to solve the hill tribe's problems. We collected the qualitative data through observation and semi-structured interviews. A purposive sampling was used for the interviews. The interviews were conducted for the representatives of three successful coffee organizations which are Mr. Jarern Wuiyue, the managing director of Doi Chaang Coffee; Ms. Patchanee Suwanwisolkit, the agriculture scientist of the Research and Development of Coffee on the Highland Chiang Mai; and Mr. Prarob Prapaluk, the owner of Intanon Coffee. The collected data were then analyzed using content analysis technique.

Objective 2: Determine the concerns regarding coffee selling of hill-tribe farmers in Mae Chaem, Chiang Mai

The second objective was to determine the concerns regarding coffee selling of hill-tribe farmers in both Yod Phai and Huay Kee Per villages in order to understand their characteristics and cultures. The information was collected from the observation and semi-structured interviews with the hill tribes and the representative of Raks Thai Foundation, Ms. Sirinun Changaumphai. A convenience sampling was used for the interview with the hill-tribe villagers while a purposive sampling was used for the Raks Thai's staff. Then, the content analysis technique was used to analyze the collected information.

Objective 3: Define the coffee transformation processes and factors in each process from the hill-tribe villages

The team aimed to understand the steps of each coffee transformation processes in order to identify which factors were necessary, and which factors they still lacked and why. The method for data collection was similar to that described in Objective 2. For data analysis, the content analysis technique was used in combination with the SWOT analysis. Also, the financial calculations were used as significant evidence for the hill tribes to consider whether they should continue to move on to the further steps of coffee transformation processes. The calculations consist of break-even point, incremental contribution margin and payback period.

Objective 4: Identify approaches to overcome the limitation factors of coffee transformation processes

Lastly, the team developed this objective to provide ways to solve low-income problems, in relevant to the hill tribes' concerns, by suggesting solutions to overcome the limitation factors of each transformation process, including the benefits of the hill tribes they would gain if they followed our suggestions. The key analyzing aspects from Objective 1-3 were assembled. Then, we compared the factors required for transforming raw coffee to high-value coffee product in each transformation process to the limitation factors of hill-tribe farmers' transformation processes. The hill tribes could then implement the proposed possible approaches to overcome their limitations.

Findings

According to the findings we discovered, there are many factors that have limited the ability of the hill-tribe farmers to gain better income. These barriers are mainly related to financial, social and geographic factors.

Financial factor – Currently, the major concern of the hill-tribe villagers is that they earn less income. Although the hill-tribe communities in both villages have increased the productivity of coffee year after year, the hill-tribe farmers still earn less revenue. One reason is because they cannot transform coffee onto the further steps, thus they cannot sell coffee at a better price. In order to transform coffee products from one stage to next stage, machine is a key investment. However, the cost of machine is very expensive comparing to hill-tribe villagers' financial status, thus they are not be able to afford the machine.

Social factor – The language used in the Yod Phai and Huay Kee Per villages is their local language, causing most of them not to be able to understand, read, write, or speak Thai language. Language barrier hinders the farmers' ability to communicate effectively with potential coffee buyers. As a consequence, they have less opportunity to expand their coffee market channels.

Geographic factor – Both Yod Phai and Huay Kee Per villages are in remote areas, contributing to the undeveloped technology in the communities. Due to the difficulty on technological accessibility, the hill-tribe villagers hardly gain more knowledge of coffee including coffee transformation processes. As a result, they can produce only coffee in the first two steps of coffee processing, which are coffee cherry and coffee parchment. Also, because of the faraway distance between the villages and the downtown Chiang Mai, where a lot of coffee retailers stay, only a few of potential coffee buyers want to trade the coffee products with the hill tribes.

To overcome these limitation factors of the hill tribes in both Yod Phai and Huay Kee Per villages, we proposed the possible approaches:

1. Investment on machinery

Machinery the most important factor required in the coffee transformation processes; pulping machine for transforming coffee cherry to coffee parchment, hulling machine for transforming coffee parchment to green bean, and roasting machine for transforming green bean to roasted coffee. The list of various series for each type of machine is provided in our study.

2. Finding possible sources of funding

The bank for agriculture and agricultural co-operatives (Torgorsor) is the best choice because its target is to directly help the farmers by providing financial assistance on their agricultural business. In addition, Raks Thai Foundation can collaborate with other relevant agencies to financially support the hill tribes.

3. Obtaining information from coffee learning centers

The Research and Development of Coffee on the Highland Chiang Mai and the Royal Project willingly provide information about coffee, from the history of coffee to the process of transforming coffee in every step.

4. Contacting suitable coffee retailers

The list of coffee retailers for every stage of coffee transformation processes is provided as well as their contact numbers.

Conclusion

After collecting all the information from observation and interviews conducted for the representatives from the successful organizations (Doi Chaang Coffee, the Research and Development of Coffee on the Highland Chiang Mai and Intanon Coffee) and the hill-tribe villagers in both Yod Phai and Huay Kee Per villages, as well as the field staff from Raks Thai Foundation, we were able to determine the standardized coffee transformation processes, the concerning issues of the hill tribes, and the limitation factors in each stage of coffee processing for both villages.

One of our strongest parts from our research data is the financial calculation as the evidence towards Raks Thai Foundation and hill-tribe farmers in term of positively income trend if enhancing coffee transformation process. The computations displaying in break-even point, incremental contribution margin and payback period were based on the interviews with the hill tribes. The team set 15 possible scenarios, varying three factors: the productivity of coffee cherries, the cost of machine and the price of coffee in the current market. So, the hill-tribe farmers can adapt these research data with any cases they may confront.

Additionally, the possible approaches were proposed to the hill-tribe villagers in both villages in order to overcome their limitations. By doing so, the hill-tribe farmers would be able to generate more income, and to sustain their quality of life in the long term. Last but not least, recommendations are one of the significant parts of our research study as the options for both Raks Thai Foundation and the hill tribes. We identify the series of steps that would be beneficial to both Raks Thai Foundation and the hill-tribe villagers in generating more incomes from selling coffee.

Recommendations

The recommendations are mainly for Raks Thai Foundation, the hill-tribe villagers in both Yod Phai and Huay Kee Per villages.

Firstly, **we recommend that Raks Thai Foundation assist the Yod Phai and the Huay Kee Per villages in finding funds for investing on machinery**; hulling machine to transform the coffee parchment to green bean, and pulping machine to transform the coffee cherry to parchment, respectively, because machinery is the most significant factor of coffee transformation processes. Secondly, **we recommend that Raks Thai Foundation assist the hill-tribe farmers in marketing development.** It is the most effective and fastest way to gain better profits with less cost of investment. The most suitable marketing strategies are creating brand image, e-marketing and building a storyline. **We recommend that Raks Thai Foundation facilitate enhanced accessibility between potential coffee buyers and hill-tribe villagers** to expand the coffee market channels for the hill tribes.

For the hill-tribe villagers in both Yod Phai and Huay Kee Per villages, firstly, **we recommend that the hill-tribe villagers find more knowledge on coffee transformation processes** in order to gain more profits from selling higher quality of coffee. Next, **we recommend that the hill-tribe villagers confederate as a group** to enhance the hill tribes' bargaining and

negotiation powers, and increase efficiency on selling the coffee products by totaling the products together and sell them one at a time.

Lastly, **we recommend that future WPI-BSAC teams, in conjunction with Raks Thai Foundation, may focus on whether coffee farming should become a major cash crop for the hill-tribe villagers in the Northern Thailand.** Growing coffee is a good choice for hill-tribe villagers because the locations in the Northern Thailand are suitable to grow Arabica coffee, which is very popular in today society coffee market. Therefore, it would be the best decision for both Raks Thai Foundation and the hill-tribe farmers if the future WPI-BSAC teams aim to focus on advantages and disadvantages of coffee farming comparing to corn, so that they can gain more understandings and keep on the right track.

All in all, we wish our recommendations can be beneficial to both Raks Thai Foundation and the hill-tribe villagers to achieve their highest satisfaction on gaining higher incomes and profits from coffee transformation processes.

ข้อมูลบทสรุป

ปัจจุบัน ชนชาวเขาทางภาคเหนือของประเทศไทยจำนวนมากกำลังเผชิญกับปัญหารายได้ต่ำ ซึ่งสถิติการเติบโตของประชากรชาวเขา เป็นอัตราส่วนร้อยละ 2.9 ต่อปี ในขณะที่รายได้เฉลี่ยต่อครอบครัวต่อปีประมาณ 10,000 บาทแสดงให้เห็นว่ารายได้ของชาวเขานั้นอยู่ในเกณฑ์ต่ำมากเมื่อเทียบกับพื้นที่อื่นๆ โดยทั่วไปชาวเขานั้นยึดการเกษตรเป็นอาชีพหลัก เช่น การจำหน่ายข้าวโพด ข้าว และกาแฟ อย่างไรก็ตามความสามารถของพวกเขาในการสร้างรายได้จากผลผลิตทางการเกษตรจะถูกจำกัด เนื่องจากปัจจัยภายนอกที่ไม่อาจคาดคะเนได้ เช่นทรัพยากรทางการเงินและการขาดเงินทุน เป็นผลให้มีโครงการด้านสังคมต่างๆทั้งภาครัฐและภาคเอกชนจัดตั้งขึ้น เพื่อสนับสนุนชาวเขาที่ด้อยโอกาสให้มีแนวคิดที่มุมานะ และสามารถที่จะยืนหยัดได้ด้วยตนเอง

หนึ่งในโครงการที่มีความประสบผลสำเร็จมากโครงการหนึ่งคือ โครงการหลวง ซึ่งถูกจัดตั้งในปี พุทธศักราช 2512 ภายใต้พระบรมราชูปถัมภ์ของพระบาทสมเด็จพระเจ้าอยู่หัว โครงการหลวงได้รับคำแนะนำให้ความช่วยเหลือประชากรชาวเขาทางภาคเหนือที่ประสบปัญหาการเกษตรที่ไม่ยั่งยืน ดังนั้นชาวเขาไม่เพียงพึ่งพาเฉพาะบริษัท ขนาดใหญ่ที่ให้การสนับสนุนทางการเงินเท่านั้น แต่ยังอยู่ภายใต้มูลนิธิรักษ์ไทยซึ่งเป็นองค์กรที่ไม่แสวงหาผลกำไรที่มีภารกิจหลัก คือ มุ่งเน้นปรับข้อเสียเพื่อที่จะวิเคราะห์ปัญหาหลักของชาวเขา แนะแนวทางการแก้ไขที่เหมาะสม และมีส่วนร่วมในการดำเนินการปรับปรุง หนึ่งในโครงการของทางมูลนิธิรักษ์ไทยนั้นคือ การสนับสนุนให้ชาวบ้านไทยภูเขานั้นมีรายได้ที่เพิ่มมากขึ้นจากผลผลิตภัณฑ์ทางการเกษตร โดยเฉพาะอย่างยิ่ง กาแฟ เพราะกาแฟเป็นพืชที่ยั่งยืน เนื่องจากเหมาะสมกับสภาพอากาศและภูมิศาสตร์ทางภาคเหนือของประเทศไทยและไม่ต้องอาศัยค่าใช้จ่ายและแรงงานจำนวนมากในการดูแล อย่างไรก็ตาม มูลนิธิยังไม่พบวิธีที่เชื่อถือได้อย่างสมบูรณ์ที่จะทำให้บรรลุเป้าหมายของงาน การศึกษาวิจัยที่เกี่ยวข้องกับการแปรรูปของกาแฟจึงเป็นกุญแจสำคัญที่จะช่วยให้เกษตรกรชาวเขาได้รับรายได้เพิ่มมากขึ้น

ระเบียบวิธี

เป้าหมายของโครงการของเราคือ การให้ข้อมูลการวิจัยที่มีประสิทธิภาพเกี่ยวกับแปรรูปกาแฟแก่ทางมูลนิธิรักษ์ไทย

เพื่อเป็นตัวเลือกสำหรับเกษตรกรชาวเขาที่จะได้รับผลกำไรที่ดีขึ้นจากการจำหน่ายกาแฟ เราได้พัฒนาข้อมูลการผลิตรวมทั้งการคำนวณทางการเงินในขั้นตอนของการแปรรูปกาแฟของแต่ละขั้นซึ่งเป็นข้อมูลที่ได้รับจากหมู่บ้านยอดไผ่และหมู่บ้านห้วยขี้เปอะ ที่สามารถนำไปประยุกต์ใช้กับชุมชนเกษตรกรรมกาแฟชนบททั้งอำเภอแม่แจ่ม จังหวัดเชียงใหม่ และเพื่อให้บรรลุเป้าหมายข้างต้น กลุ่มนิสิตได้กำหนดวัตถุประสงค์ทั้งสี่ขึ้น อันได้แก่

1. ระบุกระบวนการแปรรูปของกาแฟที่ได้มาตรฐานจากองค์กรที่ประสบความสำเร็จ
2. ตรวจสอบปัจจัยโดยรวมที่มีผลเกี่ยวข้องกับผลิตและจำหน่ายกาแฟของเกษตรกรชาวเขาในอำเภอแม่แจ่ม จังหวัดเชียงใหม่
3. ตรวจสอบกระบวนการแปรรูปกาแฟและปัจจัยการผลิตในแต่ละขั้นตอนของการแปรรูปกาแฟของหมู่บ้านชาวเขา
4. ระบุวิธีการที่จะแก้ไขปัจจัยข้อจำกัด ปรับปรุงและพัฒนา การแปรรูปกาแฟ

วัตถุประสงค์ที่ 1: ระบุกระบวนการเปลี่ยนแปลงกาแฟที่ได้มาตรฐานจากองค์กรที่ประสบความสำเร็จ

วัตถุประสงค์นี้ได้ตั้งขึ้นเพื่อให้ความเข้าใจเกี่ยวกับมาตรฐานของการแปรรูปกาแฟและศึกษากลยุทธ์เพื่อก้าวผ่านปัจจัยข้อจำกัด และนำมาปรับใช้กับการแก้ปัญหาของชาวเขา มีการเก็บรวบรวมข้อมูลเชิงคุณภาพผ่านการสังเกตการณ์และการสัมภาษณ์แบบกึ่งโครงสร้าง กลุ่มตัวอย่างที่ใช้ในการสัมภาษณ์ นั้นเป็นตัวแทนของบริษัทและหน่วยงานด้านกาแฟที่ประสบความสำเร็จซึ่งได้แก่ นายเจริญ วุยเย่ กรรมการผู้จัดการของกาแฟดอยช้าง นางสาวพัชนี สุวรรณวิศลกิจ นักวิทยาศาสตร์การเกษตรของสถาบันการวิจัยและพัฒนากาแฟบนที่ราบสูงจังหวัดเชียงใหม่ และนาย ปรารภ ประภาลักษณ์ เจ้าของกาแฟดอยอินทนนท์ จากนั้น ข้อมูลที่ได้เก็บรวบรวมมานั้นได้ผ่านการวิเคราะห์โดยใช้เทคนิคการวิเคราะห์เชิงเนื้อหา

วัตถุประสงค์ที่ 2: ตรวจสอบปัจจัยโดยรวมที่มีผลเกี่ยวข้องกับผลิตและจำหน่ายกาแฟของเกษตรกรชาวเขาในอำเภอแม่แจ่ม จังหวัดเชียงใหม่

วัตถุประสงค์นี้มุ่งเน้นการตรวจสอบปัจจัยโดยรวมที่ส่งผลต่อการจำหน่ายกาแฟของเกษตรกรชาวเขาทั้งยอดไผ่และหมู่บ้านห้วยขี้เปรอะ เพื่อให้เข้าใจลักษณะและวัฒนธรรมของชาวเขา ข้อมูลที่ถูกเก็บรวบรวมจากการสังเกตและการสัมภาษณ์แบบกึ่งโครงสร้างกับทั้งชาวเขาและตัวแทนของมูลนิธิรักษ์ไทยคือนางสาวสิรินันท์ ช้างอำไพ ในขณะที่การสัมภาษณ์แบบสุ่มกลุ่มตัวอย่างนั้นนำมาใช้สำหรับเจ้าหน้าที่ของมูลนิธิรักษ์ไทย นอกจากนี้ การวิเคราะห์เชิงเนื้อหาและเทคนิคการวิเคราะห์จุดแข็งจุดอ่อนนั้นถูกนำมาใช้ในการวิเคราะห์ข้อมูลที่เก็บรวบรวมไว้ทั้งหมดเช่นกัน

วัตถุประสงค์ที่ 3: ตรวจสอบกระบวนการแปรรูปกาแฟและปัจจัยการผลิตในแต่ละขั้นตอนของการแปรรูปกาแฟของหมู่บ้านชาวเขา

วัตถุประสงค์นี้ตั้งขึ้นเพื่อทำความเข้าใจขั้นตอนของแต่ละขั้นตอนการแปรรูปกาแฟเพื่อระบุปัจจัยที่มีความจำเป็นต่อการผลิตและแปรรูปรวมทั้งระบุปัจจัยที่ยังขาดแคลนและสาเหตุของปัญหา วิธีการในการเก็บรวบรวมข้อมูลเป็นลักษณะเดียวกับที่อธิบายไว้ในวัตถุประสงค์ที่ 2 สำหรับการวิเคราะห์ข้อมูลและการวิเคราะห์เนื้อหานั้นถูกนำมาใช้ร่วมกับการคำนวณทางการเงินที่จะใช้เป็นหลักฐานที่สำคัญสำหรับชาวเขาที่จะต้องพิจารณาว่าพวกเขาควรจะดำเนินการแปรรูปไป ขั้นตอนต่อไปของแปรรูปกาแฟหรือไม่ การคำนวณประกอบด้วยจุดคุ้มทุน ส่วนต่างกำไรที่เพิ่มขึ้น และระยะเวลาคืนทุน

วัตถุประสงค์ 4. ระบุวิธีการที่จะแก้ไขปัจจัยข้อจำกัด ปรับปรุงและพัฒนา การแปรรูปกาแฟ

วัตถุประสงค์นี้ได้รับการจัดตั้งขึ้นเพื่อแนะนำวิธีการแก้ปัญหารายได้ต่ำ ด้วยการเสนอวิธีการที่จะก้าวผ่านอุปสรรคในข้อจำกัดของการแปรรูปกาแฟในแต่ละขั้นตอน รวมถึงประโยชน์ของที่จะได้รับหากชาวเขาศึกษาและปฏิบัติตามข้อเสนอแนะ โดยการนำผลการวิเคราะห์ที่สำคัญจากวัตถุประสงค์ 1-3 รวมเข้าด้วยกันกัน ทำการเปรียบเทียบปัจจัยที่จำเป็นสำหรับการแปรรูปกาแฟที่เป็นมาตรฐานในแต่ละขั้นตอน ตั้งแต่กาแฟดิบไปจนถึงผลิตภัณฑ์กาแฟที่มีมูลค่าสูง ต่อข้อจำกัดของชาวเขา และนำวิธีการที่เป็นไปได้ไปปฏิบัติเพื่อที่จะก้าวผ่านข้อจำกัดเหล่านั้นได้

ผลการวิจัย

สืบเนื่องจากการผลการวิจัยพวกค้นพบว่ายังมีหลายปัจจัยที่มีอยู่อย่างจำกัด การที่ชาวเขาจะได้รับรายได้ที่เพิ่มขึ้น ย่อมมีอุปสรรคเกิดขึ้น ส่วนใหญ่จะเกี่ยวข้องกับปัจจัยทางด้านการเงิน สังคม และภูมิศาสตร์

ปัจจัยทางด้านการเงิน

ปัจจุบัน ชาวเขามีรายได้ที่น้อย แม้ว่าชุมชนชาวเขาในทั้งสองหมู่บ้านได้ผลผลิตเพิ่มขึ้นปีต่อปี ชาวเขายังคงมีรายได้ที่ไม่เพียงพอ เหตุผลหนึ่งเป็นเพราะไม่สามารถที่จะแปรรูปกาแฟขั้นต่อขั้นได้ ด้วยเหตุนี้ชาวเขาไม่สามารถขายกาแฟในราคาที่ดีกว่า การที่จะแปรรูปผลผลิตกาแฟจากขั้นตอนหนึ่งไปอีกขั้นตอน เครื่องจักรคือการลงทุนที่จึงสำคัญ อย่างไรก็ตามค่าใช้จ่ายในการลงทุนเครื่องจักรนั้นมีราคาที่สูงเมื่อเทียบกับสถานะทางด้านการเงิน ดังนั้นชาวเขาจึงไม่สามารถที่จะลงทุนทางด้านเครื่องจักรได้

ปัจจัยทางด้านสังคม

ภาษาที่ทั้งหมู่บ้านยอดไผ่และหมู่บ้านห้วยขี้เปอะใช้เป็นภาษาท้องถิ่น เป็นสาเหตุที่ทำให้ชาวเขาส่วนใหญ่ไม่สามารถทำความเข้าใจ อ่าน หรือสื่อสารเป็นภาษาไทยได้ อุปสรรคทางด้านภาษาเป็นสิ่งที่กีดขวางความสามารถในการสื่อสารอย่างมีประสิทธิภาพต่อผู้รับซื้อกาแฟ เป็นผลให้ชาวเขามีโอกาสที่น้อยที่จะขยายช่องทางการตลาดของกาแฟ

ปัจจัยทางด้านภูมิศาสตร์

ทั้งหมู่บ้านยอดไผ่และหมู่บ้านห้วยขี้เปอะตั้งอยู่ในพื้นที่ที่ห่างไกลมีส่วนทำให้ขาดการพัฒนาทางด้านเทคโนโลยีในชุมชน เนื่องจากมีความยากลำบากในการที่เทคโนโลยีจะเข้าถึง ชาวเขาจึงแทบจะไม่ได้รับความรู้เกี่ยวกับกาแฟเพิ่มขึ้นรวมไปถึงการแปรรูปกาแฟ เป็นผลทำให้พวกเขาสามารถผลิตกาแฟเพียงเฉพาะในหนึ่งหรือสองขั้นตอนเท่านั้น ซึ่งก็คือกาแฟเชอรี่และกาแฟกะลา นอกจากนี้ระยะทางที่ห่างไกลระหว่างหมู่บ้านและตัวเมืองเชียงใหม่ซึ่งมีร้านขายกาแฟตั้งอยู่ แต่มีผู้รับซื้ออยู่น้อยรายที่จะทำการค้าขายกับชาวเขา รวมเป็นข้อจำกัดอย่างหนึ่งเช่นกัน

ในการที่จะก้าวผ่านปัญหานี้ของทั้งหมู่บ้านยอดไผ่และหมู่บ้านห้วยขี้เปอะ ทางกลุ่มนิสิตจึงได้ทำการเสนอการจัดการกับปัญหาที่เป็นไปได้

1. **การลงทุนเกี่ยวกับเครื่องจักร** เครื่องจักรเป็นปัจจัยที่สำคัญที่สุดและจำเป็นในการแปรรูปกาแฟ เครื่องโม่กาแฟในการแปรรูปกาแฟเชอรี่เป็นกาแฟกะลา เครื่องสีกาแฟในการแปรรูปกาแฟกะลาเป็นสารกาแฟ และเครื่องคั่วกาแฟในการแปรรูปจากสารกาแฟเป็นกาแฟคั่ว
2. **การเสาะหาแหล่งเงินทุน** แหล่งเงินทุน เช่น ธนาคารเพื่อการเกษตร และ สหกรณ์เพื่อการเกษตร (ธกส.) เป็นตัวตัวเลือกที่เป็นไปได้ที่สุดในธุรกิจการเกษตรของพวกเขา นอกจากนี้มูลนิธิรักษ์ไทยสามารถทำงานร่วมกับหน่วยงานที่เกี่ยวข้องอื่นๆ เพื่อสนับสนุนทางด้านการเงินของพวกชาวเขา

3. **การจัดหาข้อมูลจากศูนย์การเรียนรู้เรื่องกาแฟ** แหล่งการเรียนรู้ อย่าง ศูนย์วิจัยและพัฒนากาแฟบนที่ราบสูงเชียงใหม่ และโครงการหลวงเต็มใจที่จะให้ข้อมูลเกี่ยวกับกาแฟ จากประวัติของกาแฟจนไปถึงการแปรรูปในทุกขั้นตอน
4. **การติดต่อกับผู้รับซื้อกาแฟ** รายชื่อของร้านกาแฟที่รับซื้อกาแฟในทุกๆ ขั้นตอนการแปรรูปได้ถูกนำเสนอไว้อีกด้วย

สรุป

หลังการเก็บรวบรวมข้อมูลจากการสังเกตการณ์และการสัมภาษณ์ผ่านทางตัวแทนขององค์กรที่เกี่ยวข้องกับการผลิตกาแฟที่ประสบความสำเร็จ อาทิเช่น กาแฟดอยช้าง กาแฟอินทนนท์ และ ศูนย์วิจัยและพัฒนากาแฟบนที่ราบสูงจังหวัดเชียงใหม่ รวมไปถึงเจ้าหน้าที่ของมูลนิธิรักษ์ไทย กลุ่มนิสิตสามารถระบุมาตรฐานของการแปรรูปผลิตภัณฑ์กาแฟ ปัจจัยโดยรวมที่ส่งผลต่อการผลิตและจัดจำหน่ายกาแฟของชาวเขา และข้อจำกัดในปัจจัยการผลิตของแต่ละขั้นตอนของการแปรรูป จากการวิเคราะห์ข้อมูลเหล่านี้ผ่านทางการคำนวณทางการเงิน สามารถเป็นหลักฐานที่สำคัญที่จะพิสูจน์ความสำคัญในการแปรรูปผลิตภัณฑ์กาแฟ ซึ่งการคำนวณประกอบไปด้วย จุดคุ้มทุน ส่วนต่างกำไรที่เพิ่มขึ้น และระยะเวลาคืนทุน นอกจากนี้แล้วมีการเสนอแนะสิ่งที่จะทำให้ชาวเขาก้าวข้ามผ่านปัจจัยข้อขำกัดต่างๆ ซึ่งจะส่งผลให้ชาวเขาสามารถเพิ่มรายได้จากกระบวนการแปรรูปกาแฟและสามารถดำรงชีพอยู่อย่างมีคุณภาพด้วยความมั่นคง

คำแนะนำ

สำหรับคำแนะนำหลักเพื่อมูลนิธิรักษ์ไทยและชาวบ้านทั้งสองหมู่บ้าน ได้แก่ หมู่บ้านยอดไผ่และหมู่บ้านห้วยขี้เปอะ

1. **กลุ่มนิสิตแนะนำให้ทางมูลนิธิรักษ์ไทยช่วยหมู่บ้านยอดไผ่และหมู่บ้านห้วยขี้เปอะในการระดมทุนเพื่อการลงทุนในเครื่องมือ** ได้แก่ เครื่องโม่ที่จะแปรรูปกาแฟเชอรี่เป็นกาแฟกะลา เครื่องสีเพื่อที่จะแปรรูปกาแฟกะลาเป็นสารกาแฟ เพราะเครื่องจักรนั้นเป็นปัจจัยที่สำคัญที่สุดในการแปรรูปกาแฟ
2. **กลุ่มนิสิตแนะนำให้ทางมูลนิธิรักษ์ไทยสนับสนุนชาวบ้านเรื่องการวางแผนพัฒนาการตลาด** เพราะการตลาดนั้นจะเป็นสิ่งที่มีประสิทธิภาพ และให้ผลกำไรที่ดีกว่าในระยะเวลาอันรวดเร็ว อีกทั้งยังใช้การลงทุนที่ต่ำ
3. **กลุ่มนิสิตแนะนำให้มูลนิธิรักษ์ไทยอำนวยความสะดวกในการเข้าถึงที่เพิ่มขึ้นระหว่างผู้ซื้อกาแฟและชาวเขา** จากการสังเกตการณ์ทั้งหมู่บ้านยอดไผ่และหมู่บ้านห้วยขี้เปอะ เนื่องด้วยมีอุปสรรคสำหรับชาวเขาในการเจรจาต่อรอง กลุ่มนิสิตจึงเสนอให้มูลนิธิรักษ์ไทยสนับสนุนชาวเขาในการเจรจา ติดต่อ และสร้างสัมพันธไมตรีต่อผู้ค้ากาแฟ และร้านค้ากาแฟ และจะเป็นแนวทางที่ดีอีกแนวทางหนึ่งหากมูลนิธิรักษ์ไทยจัดหาล่าม เพื่อเพิ่มประสิทธิภาพในการสื่อสารระหว่างชาวเขากับผู้รับซื้อกาแฟ

สำหรับข้อเสนอแนะสำหรับหมู่บ้านยอดไผ่และหมู่บ้านห้วยขี้เปอะ

1. **กลุ่มนิสิตแนะนำให้ทางชาวเขาหาข้อมูลเพิ่มเติมสำหรับการแปรรูปกาแฟ** เพื่อที่จะฝึกฝนกระบวนการการแปรรูปกาแฟและเรียนรู้ด้วยตัวเอง ในอีกทางหนึ่ง หากมีแหล่งข้อมูลอื่นๆด้านการแปรรูปกาแฟ เช่น โครงการหลวง หรือ ศูนย์การวิจัยและพัฒนากาแฟบนที่ราบสูงเชียงใหม่ มหาวิทยาลัยเชียงใหม่ ชาวเขาควรจะเปิดรับโอกาสนั้นเพื่อประโยชน์ของตนเอง

2. **กลุ่มนิสิตเสนอแนะให้ชาวเขารวมตัวกันเป็นกลุ่ม** เพื่อเพิ่มผลการผลิตและราคาขายโดยการรวมกาแฟจากแต่ละครัวเรือนและจำหน่ายในครั้งเดียว ในการทำเช่นนี้ ชาวเขาจะสามรถเพิ่มอำนาจในการเจรจาต่อรองเรื่องราคาต่อพ่อค้าคนกลางและร้านกาแฟอื่นๆ ผลดีอีกข้อหนึ่งคือชาวเขาจะสามารถมีเงินกองกลางเพื่อที่จะพัฒนาการแปรรูปและการผลิตมากขึ้น เช่น การลงทุนซื้อเครื่องจักรในการช่วยการแปรรูปกาแฟ ในการรวมตัวกันนั้นจะทำให้ชาวเขาสามรถคืนทุนจากการลงทุนเครื่องจักรได้รวดเร็วยิ่งขึ้น

สุดท้ายนี้ทางกลุ่มนิสิตแนะนำให้ทางกลุ่มนิสิตรุ่นถัดไปร่วมมือกับทางมูลนิธิรักษ์ไทย โดยมุ่งเน้นไปที่ความสนใจการปลูกกาแฟ กาแฟเป็นพืชที่ควรจะนำมาเป็นพืชเศรษฐกิจแก่ชาวไทยภูเขาในทางภาคเหนือ การปลูกต้นกาแฟนั้นเป็นตัวเลือกที่ดีสำหรับพื้นที่ทางภาคเหนือของไทยเพราะมีความเหมาะสมต่อการเพาะปลูกกาแฟพันธุ์อาราบิก้าซึ่งเป็นที่นิยมในตลาดกาแฟในปัจจุบัน ดังนั้นสิ่งนี้อาจจะเป็นการตัดสินใจที่ดีที่สุดสำหรับกลุ่มนิสิตและและทางมูลนิธิรักษ์ไทย หากแม้ในอนาคตนั้น กลุ่มนิสิตได้เล็งเห็นถึงข้อดีและข้อเสียของการปลูกข้าวโพด สิ่งนี้จะเป็นวิธีที่ทำให้กลุ่มนิสิตรุ่นถัดไปนั้นได้มีความเข้าใจมากขึ้นและตั้งอยู่ในแนวทางที่ถูกต้อง

อย่างไรก็ตามกลุ่มนิสิตมีความคาดหวังว่าคำแนะนำจากกลุ่มนิสิตจะเกิดประโยชน์แก่ทั้งทางกลุ่มนิสิตรุ่นถัดไป ทางมูลนิธิรักษ์ไทยและชาวบ้านไทยภูเขา และสามารถบรรลุเป้าหมายที่พึงพอใจสูงสุดจากการที่มีรายได้และผลกำไรที่เพิ่มมากขึ้นจากการแปรรูปผลผลิตกาแฟ

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1. INTRODUCTION

Many of hill-tribe villages in the northern of Thailand are facing with a low-income issue.[1] Statistically, the hill tribe's population growth is at an annual rate of 2.9 percent while the average annual income per family per year is around 10,000 baht, indicating the low level of income comparing with other areas.[1] This serious concern has led to several dilemmas provoking the difficulty in living condition, and can be referred that the hill tribe's currently financial situation needs significant improvement.

Generally, the hill-tribe villagers have done agribusiness as their main occupation such as selling corn, rice and coffee.[2] However, their abilities on generating income from agricultural products are confined due to unexpected external factors; for instance, financial resources and lack of capital. As a consequence, many social programs, both government and private sectors, have been established to support the underprivileged hill tribes in attempting to enable the villagers to restore their self-sustainability.

One of the most successful projects is the Royal Project established in 1969, under the royal patronage of His Majesty the King. The Royal Project was introduced to assist the northern hill-tribe people, who were engaging in unsustainable farming practices.[3] Additionally, the Royal Project holds contract with the villagers for buying their products, helping the hill tribes to rise above the poverty level. The Royal Project, although has succeeded in upgrading the hill-tribe communities throughout the Northern Thailand, some hill tribes are still waiting for help.

Consequently, the hill-tribe villagers rely not only on large corporations for financial support but also on Raks Thai Foundation, a non-profit organization whose mission is to strengthen the capacity of disadvantaged to analyze their main problems, determine appropriate solutions, and contribute in improvement actions.[4] One of the projects under Raks Thai Foundation is to support the hill tribes to earn more revenue from agricultural products, especially coffee, because coffee is a sustainable plant due to atmospheric and geographical conditions in the north of Thailand. However, the foundation has not yet found a reliable way to completely achieve their target. Providing a relevant research study on coffee is therefore a key to help the hill-tribe farmers to gain more income.

The main goal for this project is to provide Raks Thai Foundation with effective research data about coffee transformation processes, as options for the hill-tribe farmers to gain better profits from selling coffee. To successfully accomplish the goal, the team develops four objectives:

1. Specify standardized coffee transformation processes from successful organizations
2. Determine the concerns regarding coffee selling of hill-tribe farmers in Yod Phai and Huay Kee Per villages, Mae Chaem, Chiang Mai
3. Define the coffee transformation processes and factors in each process from the hill-tribe villages
4. Identify approaches to overcome the limitation factors of coffee transformation processes

The research study consists of current concerns of hill-tribe villagers and limitation factors of coffee transformation processes in the target villages, Yod Phai and Huay Kee Per villages, to promote the importance of coffee transformation processes using financial calculations as significant evidence, and providing possible approaches to overcome such barriers, as well as the recommendations to generate more income from selling coffee and hence live a more sustainable life in the long term.

2. LITERATURE REVIEW

2.1 History of Karen

Karen is the largest hill-tribe group in the Southeast Asia which contains about 3 million people in total.[5] The Karen hill tribes live in three main countries which are Myanmar, Laos and Thailand. In Thailand, the Karen populations are approximately 320,000 people, and most of them live in Chiang Mai province (Figure 2.1).[6, 7] For example, some groups of the Karen reside in Yod Phai and Huay Kee Per villages, Mae Chaem, Chiang Mai (Figure 2.2). Sgaw is the major sub group of Karen. They share the same language, history, culture and tradition, as well as religious. Unlike any other group of hill tribes, most of the Karen hill tribes have Thai citizenship; therefore, they are able to buy land and other goods. The Karen hill tribes prefer to live in the forested or the highland areas because of their agriculture including cultivation of crops and animals. They used to grow the opium poppy as their main cash crop till the government has substituted the cultivation of the poppy with alternative crops such as tea and coffee.[8]

Figure 2.1 Chiang Mai, Thailand (Hdamm, 2009).

Figure 2.2 Mae Chaem, Chiang Mai (Hdamm, 2009).

2.2 Coffee characteristics

There are two main types of coffee beans: Arabica and Robusta coffee. Arabica coffee comes from a tree in the mountains while Robusta coffee comes from a bush that grows at lower altitudes (Figure 2.3). Also, the weather conditions under which the plants are grown, and even the ideal locations for the two plants are very different. Arabica coffee beans are oval, whereas Robusta beans are more circular. Arabica is considered superior in quality to Robusta, with a round flavor and a mild aroma. It is far more popular worldwide than Robusta, to the extent that 70% in the world's production of coffee is Arabica, despite the fact that Arabica is more difficult to grow and less productive than the Robusta variety.[9] There is a wide range of different types of Arabica coffee available, and they can differ from one another significantly. In general, the taste of Arabica coffee is mild and well balanced, but ranges from sweet and soft to sharp and tangy. The smell is almost similar to blueberries before it is roasted. Once it is roasted, Arabica coffee can smell fruity, sweet and fragrant. On the other hand, Robusta coffee has its bitter taste described as burnt

tires or rubbery.[10] This is because Robusta bean contains higher contents of caffeine which is nearly twice as high as that of Arabica coffee (2%-2.5% versus 1.1%-1.5%).[11] As a result, Arabica coffee is more expensive than Robusta coffee.

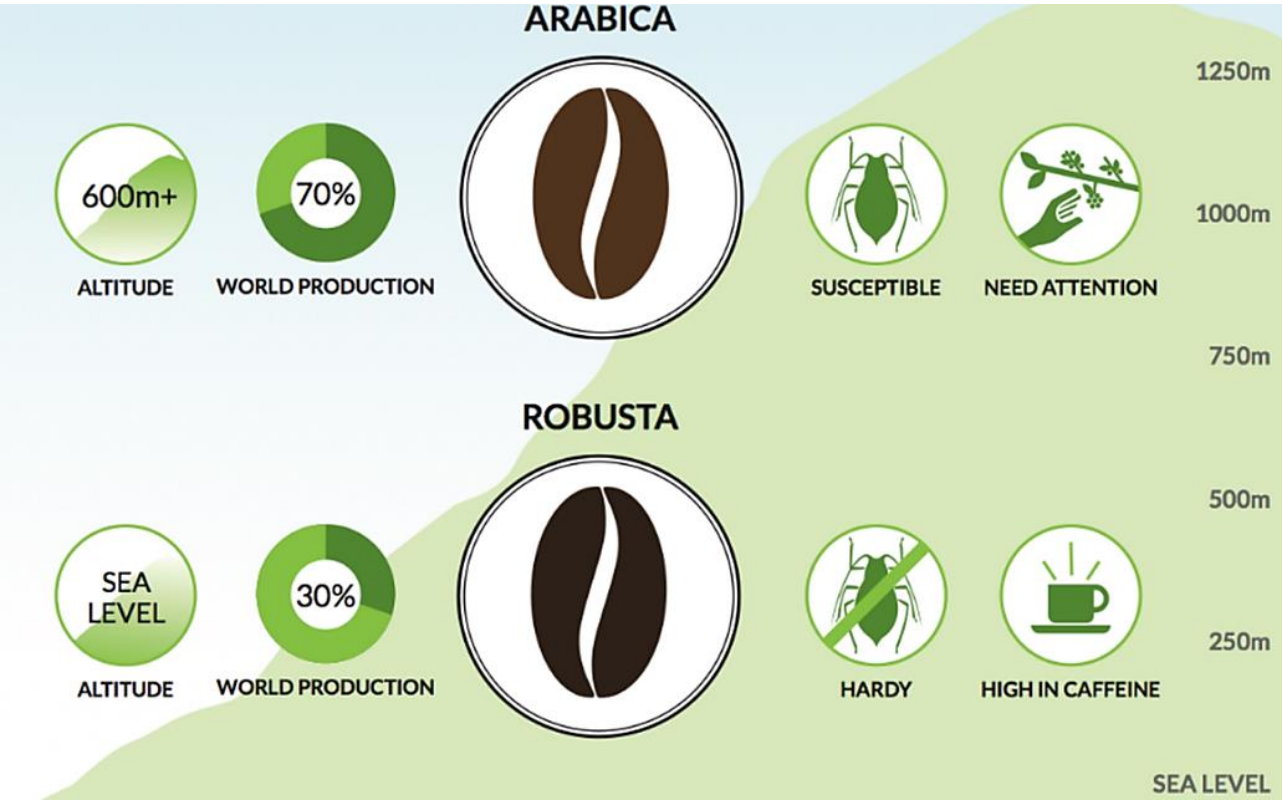

Figure 2.3 The differences between Arabica and Robusta coffee beans (Bean Poster, 2013).

2.3 Coffee production in Thailand

Thailand is the third largest producer of coffee in Asia, after Vietnam and Indonesia.[12] Robusta coffee is widely grown in lowland areas in the South, especially in Ranong and Chumphon provinces. On the other hand, Arabica coffee is grown on highlands in the North, especially in Chiang Rai and Chiang Mai provinces.[13] The statistic of Department of Agriculture showed that Thailand's coffee production is around 30,000 tons per year and 8,000 tons out of full amount are Arabica beans.[13] Arabica coffee is mainly used for roasted and ground coffee in Thailand.[2] Sixty percent of Robusta coffee is exported to other countries and the rest is mostly used in domestic production of instant coffee.

2.4 The overall steps of coffee transformation processes

In order to produce high quality coffee, both Arabica and Robusta coffee, every production step must have quality control (QC) from the start of process to the end of process. The following processes described below are the methods for acquiring great coffee beans: preparation and growing, harvesting, and processing.[14-19]

a) Preparation and Growing

For the preparation of land, all small tress must be removing or weeded out; this is an important step that has to be done one year before planting coffee trees. The coffee trees are planted in the raining season, and must be planted by hand. During the first year after planting, weeding is a significant matter as weeds can take nutrients away from the young trees. The coffee trees will then flower and produce fruits in the next 3-4 years. During that time, weeding and pruning should be carried out regularly.

b) Harvesting

The coffee fruit, which is called coffee cherry, is produced shortly after the tree begins to flower (Figure 2.4). The time for a coffee tree to bear a fruit varies from 3-4 years depending on the different kinds. The coffee cherries are harvested when they are ripe or turn bright red. The cherries can be harvested only once per year based on the geographic zone; the North will harvests the cherries between September and March, whereas the South harvests them between April and May. There are two methods in collecting these coffee cherries: strip picking and selective picking. For strip picking, all the cherries are picked at once using machines. The selective picking requires manual labor to harvest only the ripe cherries. The selective picking results in higher quality coffee beans; however, it is more labor intensive.

Figure 2.4 Various stages of coffee fruits: flowering (left), unripe cherries (center), and ripe cherries (right).

c) Processing

Dry and wet processes are often internationally used in coffee processing method. The main difference is that the dry process is suitable for Robusta coffee and it requires fewer steps (Figure 2.6); on the other hand, the wet process works best for Arabica coffee beans in the case of producing high quality coffee bean. In addition, many of the farmers are using wet method for them to gain higher income. The similarities of these two methods are the sorting process; usually farmers use hand selection to select the best coffee cherries by looking at the size and the color of coffee cherries. Floating tank are using in sorting process, if the coffee cherries sink it is ready to continues the next step, while the float cherries were discarded.

With the dry process, the coffee cherries from the sorting process will be placed in the sunny area up to four weeks with regular turning. The shells of coffee cherries will be removed using hulling machine after the drying process are done, and the coffee cherries

will be ready to be sold by last sorting and grading. The beans are stored in dry room where the bags are laid out without touching the ground or without being piled on one another.

With the wet process, the coffee cherries from the sorting process will be passed through four stages in the wet method, which are pulping, fermentation, washing and hulling, to transform coffee cherries into the green bean (Figure 2.5). Pulping is the stage where outer shells of coffee cherries are removed. This is done shortly or within the day after harvesting and requires pulping machine. Fermentation is the second stage where the coffee beans are immersed in a tank that contains natural enzymes in order to remove mucilage of the beans. The third stage is washing. In this stage, the coffee beans are washed by hand in cold water. After washing, these beans are laid in the sun for drying for 8-10 days and should be turned for even drying.

The dried beans then go through hulling states using hulling machine. Similar to the dry process, the beans are stored in dry room where the bags are laid out without touching the ground or without being piled on one another.

Figure 2.5 Coffee transformation outcomes: coffee cherry–coffee parchment–green bean (SweetMarias, 2013).

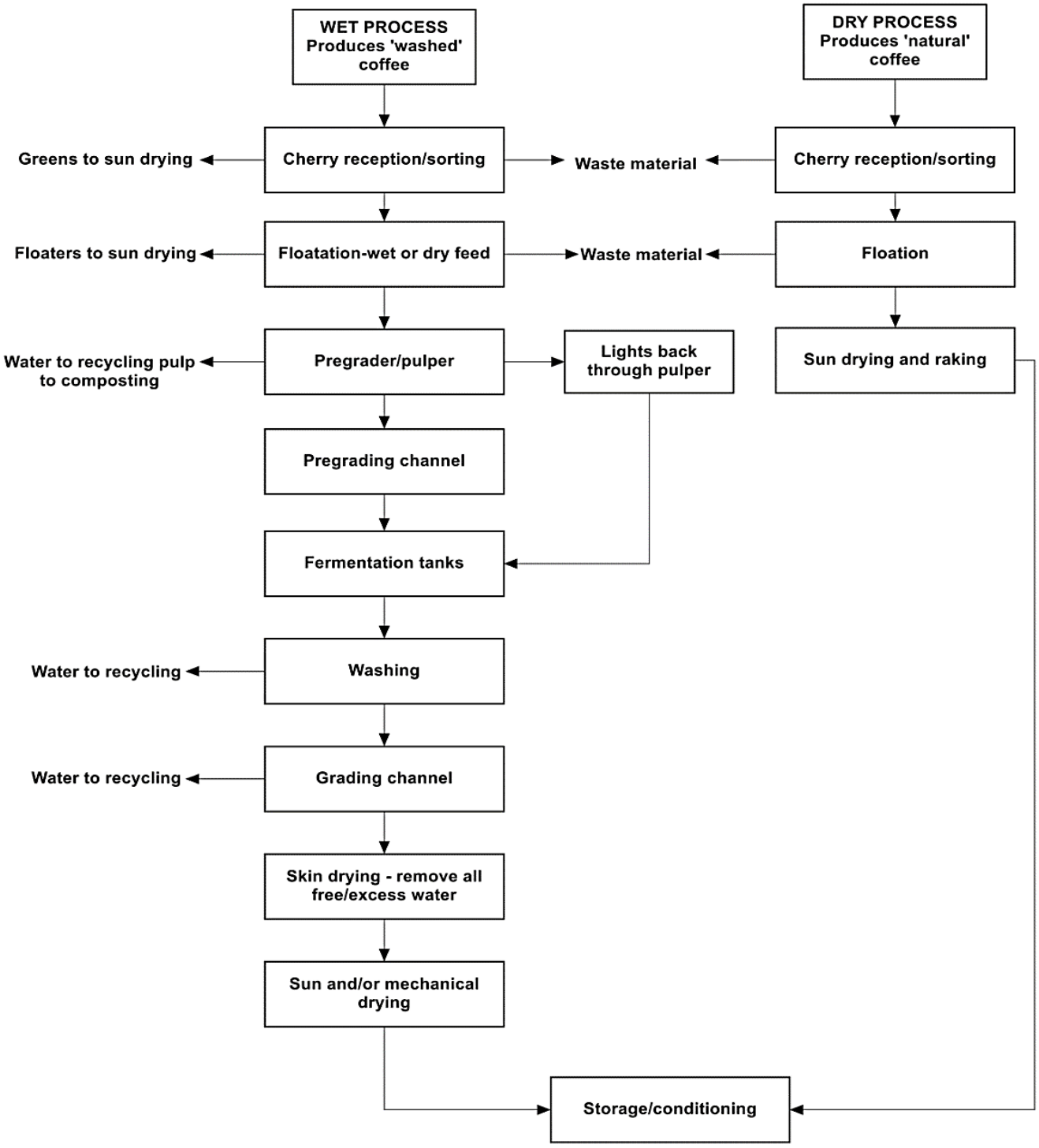

Figure 2.6 The diagram of wet and dry processes (Sabtu, 2012).

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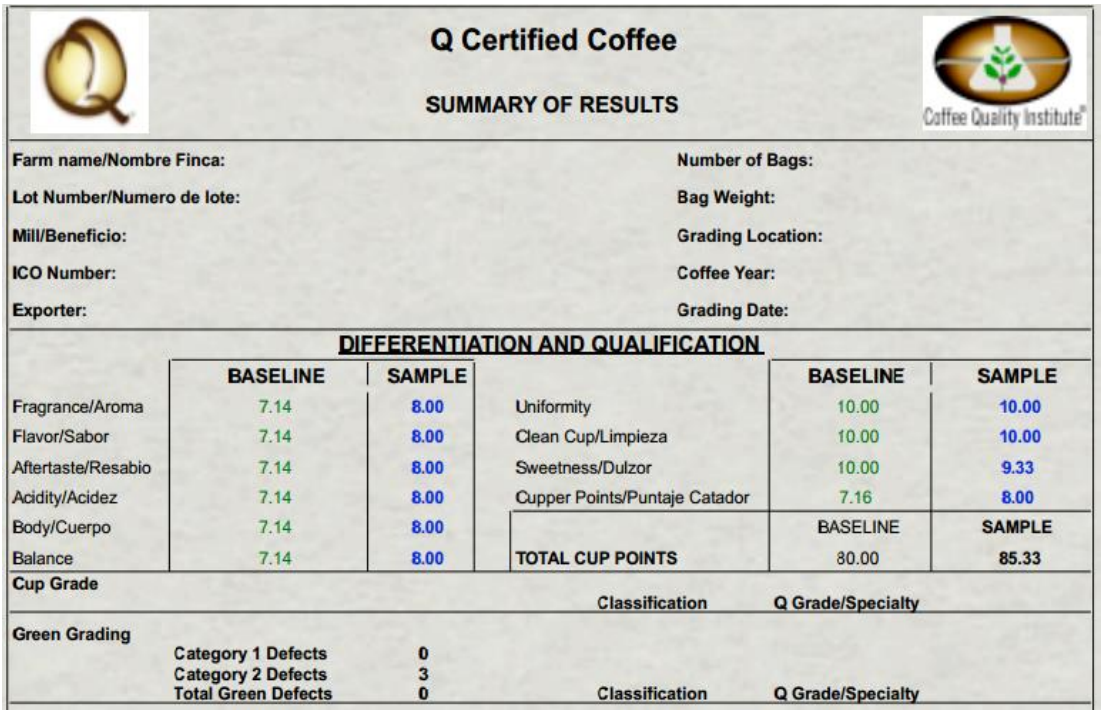
2.5 Coffee grading

After the hulling process, we will get green beans, and those beans must be classified into different grade. Size is a main component for grading the beans.[16] There is a machine that does this process; for instance, if we want to get a size of bean approximately 1/64 inch, we will program those details in the computer and the computer will do it for us.[16]

In reality, grading and classification systems are usually based on some factors; such as size, color or even humidity.[19] In addition, most grading system are very detailed and diverse, In addition, grading system is also based on primary factor, such as, altitude, region, botanical variety, preparation method (wet vs. dry), bean (screen) size, bean shape and color, number of defects, permissible defects, bean density, and reproduction quality.[19]

Systems of grading have evolved primarily in response to quality requirements of buyers for green beans. The Q Grading System, developed by the Coffee Quality Institute, implements industry-recognized standards for quality, both coupling and grading, and is a highly effective method for identifying coffees that sell as premiums in the marketplace.[20] The result of coffee grading is presented through the Q Certified Coffee (Figure 2.7).



Q Certified Coffee

SUMMARY OF RESULTS

Coffee Quality Institute

Farm name/Nombre Finca:		**Number of Bags:**	
Lot Number/Numero de lote:		**Bag Weight:**	
Mill/Beneficio:		**Grading Location:**	
ICO Number:		**Coffee Year:**	
Exporter:		**Grading Date:**	

DIFFERENTIATION AND QUALIFICATION

	BASELINE	SAMPLE		BASELINE	SAMPLE
Fragrance/Aroma	7.14	8.00	Uniformity	10.00	10.00
Flavor/Sabor	7.14	8.00	Clean Cup/Limpieza	10.00	10.00
Aftertaste/Resabio	7.14	8.00	Sweetness/Dulzor	10.00	9.33
Acidity/Acidez	7.14	8.00	Cupper Points/Puntaje Catador	7.16	8.00
Body/Cuerpo	7.14	8.00		BASELINE	SAMPLE
Balance	7.14	8.00	**TOTAL CUP POINTS**	80.00	85.33

Cup Grade

Classification **Q Grade/Specialty**

Green Grading

Category 1 Defects	**0**
Category 2 Defects	**3**
Total Green Defects	**0**

Classification **Q Grade/Specialty**

Figure 2.7 The Q Grading System for coffee bean analysis (Coffee Quality Institute, 2014).

2.6 Factors and Barriers of growing and selling coffee

There are numerous focal points and hindrances to developing and offering coffee small cultivating area in Northern Thailand as illustrated in Table 2.1.[21]

Table 2.1 Favorable circumstances and barriers of coffee production

Favorable circumstances		**Barriers**	
Atmosphere	Cooler climate, Higher height prompts higher quality Arabica coffee.	**Restricted Knowledge**	Farmers need information to enhance cultivating, handling strategies and business abilities for offering.
Cultivating Practices	These methods are more environmental-friendly which can utilize the area.	**Insignificant Transportation**	Absence of cleared streets and method for transportation discourage purchasers to purchase coffee.
Potential for Benefit	Astounding Arabica coffee can generate high income in the business.	**Delegates**	They normally offer amazingly low "take it or leave it" costs for coffee.
		Low Access to Bank Credits	Little, provincial farmers need aptitudes to create a robust strategy for success prompting denied credits from banks

2.7 Strategies to overcome the factor of growing and selling coffee

In Thailand, there are many programs that have been established over the last several years in order to improve quality of life of many rural coffee-farming communities in Northern Thailand; for example, the Royal Projects, the Sufficiency Economy and the Government Loan programs.[22] Moreover, some large companies also endeavor to help small farms around the nation.

The Royal Projects, who purpose to introduce coffee into small communities in Northern Thailand, are not planned to help farmers' additional problems and not cater to specific village so that is why they cannot address any specific disadvantages each village faces.[23] For example, the successfully specialty coffee company named Doi Chaang Coffee, the rural farmers strived for more than 20 years to suitably sell their coffee after it was introduced to communities.[24] For the very first time, the Royal Projects did not address marketing strategies which were significant for the Doi Chaang Coffee farmers' success. However, in 20 years later, they were able to set up a cooperative with plenty of farms and start on selling their coffee throughout Thailand.

Another Thai government effort is to try using the idea of 'Sufficient Economy' to enhance the quality of life for rural farming communities. The concept of 'Sufficient Economy' for rural

farmers is that they should be able to survive on their own with little outside assistance.[25] Once any farm completes this, they can sell small amounts of cash crops, for instance, coffee, or surplus from the crops they eat daily as an additional income. Many of Thai government from the past, tried to help rural farmers to complete the sufficiency lifestyle by setting a set of specific guidelines for them. These guidelines were utterly detailed; they give information on how each farm should separate its crops, how to rotate crops, and how to grow these plants in an environmentally friendly manner.[26] Sufficiency Economy does give guidelines, but does not give any support to help farmers with any problems they faced with.

The last program but very direct is that Thai government offers loans to rural farming communities in vary amount, depends on the village's size.[27] Nevertheless, many communities did not accept these loans because they fear being in debt to the government, especially for coffee farmers, since coffee market is very unstable, so it is more difficult for them to take these loans. In addition, at the harvest time, a lot of farmers have a little money and they are paid once a year because they only sell coffee one time per year, so they think they may not be able to pay back those debts if they took it.

2.8 Case studies of coffee business

Studying from successful coffee organizations is very important because they provide useful information such as their strategies of accomplishing their goals. As a consequence, we can understand which factors are needed for improvement. From our research, there are two significant organizations which are Doi Chaang Coffee and the Research and Development of Coffee on the Highland Chiang Mai.

2.8.1 Doi Chaang Coffee

In 1969, His Majesty the King had a vision to improve the quality of life for hill-tribe people. The government and institutes responded to the words of the King by creating the project of growing winter cash crops to replace the growing of opium.[24] Arabica coffee was one of the winter cash crops that were suitable to climate and landscape in the Northern Thailand region.[24] Doi Chaang Coffee all began when the hill tribes of the Doi Chang Village agreed to generate their own coffee company to solve the problem of selling high quality coffee beans for minimal prices to middlemen. They established themselves as independent, successful coffee producers under the commitment of maintaining sustainable agriculture with minimal impact on the environment. Due to the specialty coffee which was committed to offering Doi Chaang Coffee as a single-estate, certified organic Arabica, a group of Canadian coffee enthusiasts brought Doi Chaang Coffee into the international market as their partners.[24]

The mission of Doi Chaang Coffee states that, *"We strive to have Doi Chaang Coffee recognized as one of the finest coffees available and its name synonymous with high ethical and sustainable business standards. We are committed to bringing economic and environmental sustainability to the indigenous AKHA hill tribe and Doi Chang Village through our BEYOND FAIR TRADE business practices to ensure shared economic sustainability and prosperity"*.[24] As a result, today, the hill-tribe farmers continue to focus on cultivation, processing and domestic sales, while the Canadian group takes responsibility in financing, marketing, roasting and distribution for the international market. Doi Chaang Coffee is considered as "Top 1% Coffees Worldwide".[24]

2.8.2 Research and Development of Coffee on the Highland Chiang Mai

Highland Research and Training Center locates in research institute complex within Chiang Mai University. It was established in 2001 by the cooperation of three foundations in Faculty of Agriculture: Highland Coffee Research and Development Center (supported by The Netherlands government), Highland Training and Development Center (supported by the Narcotics control section of the USA embassy) and Highland Research and Training Station (firstly supported by UNFADAC of the UN, later by Thai government).[28]

The Research and Development of Coffee in Highland Project, under the Faculty of Agriculture, was established to study Arabica coffee as a cash crop instead of opium. The obligations of the foundation are: research and develop the resources on highland; provide the information for the needs of villagers; and support the learning of Chiang Mai University.[28]

The main objectives of the foundation are:

1) Become the Research and Development Center to support the agriculture in highland.
2) Become the Collecting Academic Data Center for supporting and developing the agriculture in highland.
3) Become the coordinator among highland agricultural researchers to join the research.
4) To increase the limitation of ability to become the Research and Development Center of Agricultural in Highland of Asia.
5) Become the Training Center, and develop knowledge for officers and hill-tribe villagers to develop the economics and environment, which includes highland natural resources and forest.
6) Become Research and Development Center of Agricultural on Highland of International and ASEAN.

2.9 SWOT Analysis

SWOT analysis is an analytical framework that can helps your company face its greatest challenges and find its most promising new markets.[29] A SWOT stands for Strengths, Weaknesses, Opportunities, and Threats, it can help to define the probable risks and rewards. The ideal outcome of a SWOT is accurate data that can be utilized to create a solid plan for addressing a weakness and threats, and highlighting or positively exploiting your strengths and opportunities.

The purpose of SWOT analysis is to help organization in order to enlarge full awareness of all possible factors, internal and external, positive and negative, which can affect to the decision making and strategic planning of an organization.[29, 30] The first two letters, S and W, are internal factors which are the resources and experiences in the organization. For example, financial resources, physical resources, human resources, current processes, etc. The last two letters, O and T, are external factors that will affect the organization in some way. However, the external forces cannot be controlled but can be prepared to handle it. For example, market trends, economic trends, political, and etc.[30]

2.10 Financial Calculations

2.10.1 Incremental contribution margin

The incremental contribution margin is an accounting concept to identify the profit and the expected impact of the alternative on future income. It is used to determine the profitability of individual product so that we can know how much margin they will gain more if they choose to move on to the further steps. It can be calculated by deducting the net profit of the next stage from the current stage.[31]

The formula is: Incremental contribution margin (baht/kg) =

Net profit of next stage (baht/kg) – Net profit of current stage (baht/kg)

2.10.2 Break-even point

Break-even point is the point where total costs or expenses equal to total revenue or sales. Moreover, there will be no profit or loss for the company in that point of position (Figure 2.8). Break-even point is very important for the business because the data will be informed the business's margin of safety.[32]

Advantages of using break-even point:

- Understand how good your current product line is.
- Understand the declining period in product life cycle before getting incurred losses.
- Understand how much we need to sell in term of volume before gaining profit.
- Understand whether our target customers are sensitive to price or not.

The formula is: Break-even point (kg) = Cost of investment (baht) / Contribution margin (baht/kg)

Note that: the cost of investment is fixed expense, whereas the contribution margin is calculated from the revenue deducted by the variable expense.

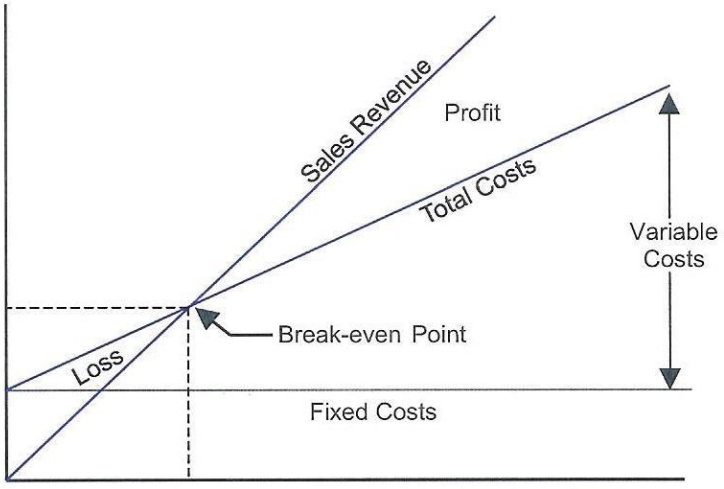


Figure 2.8 Break-even point graph (Biz Tools Pro, accessed Feb 15, 2015).

2.10.3 Payback period

The length of time required to recover the cost of an investment. After calculating this payback period, one will know how long it takes to gain the profit or the cost of investment back.[33, 34]

The formula is: Payback period = Break-even point (kg) / Amount of productivity (kg/yr)

Advantages of using payback period are:

- Simplicity – the concept of payback period is simple and easy to understand and calculate.
- Risk focus – The concept of payback period is considered as a measure of rick; it can be used to compare the relative risk of projects with varying payback periods.

3. METHODOLOGY

Our goal is to provide Raks Thai Foundation with effective research data about coffee transformation processes, as options for the hill-tribe farmers to gain better profits from selling coffee. In order to successfully accomplish our goal, the team developed the following objectives:

1. Specify standardized coffee transformation processes from successful organizations
2. Determine the concerns regarding coffee selling of hill-tribe farmers in Mae Chaem, Chiang Mai
3. Define the coffee transformation processes and factors in each process from the hill-tribe villages
4. Identify approaches to overcome the limitation factors of coffee transformation processes

3.1 Specify standardized coffee transformation process from successful organizations

The first objective was set to comprehend more about the standard requirement of coffee transformation processes, and study the strategies for overcoming possible limitation factors, so that we would be able to adapt such solutions to solve the hill tribe's problems. This objective was divided into two parts: preparation, data collection and data analysis.

a) Data collection

The qualitative data was collected through observation and semi-structured interview. The purposive sampling method was used in which the individual interviews were conducted for the representatives of three successful organizations: Mr. Jarern Wuiyue, the managing director of Doi Chaang Coffee; Ms. Patchanee Suwanwisolkit, the agriculture scientist of the Research and Development of Coffee on the Highland Chiang Mai; and Mr. Prarob Prapaluk, the owner of Intanon Coffee.

We chose these organizations as a role model because they were outstanding in different ways: Doi Chaang Coffee started from being the ordinary hill tribes to prosperous people by upgrading themselves and developing their coffee products to be able to compete in the market; the Research and Development of Coffee on the Highland Chiang Mai, Ms. Patchanee was academically expert in coffee transformation processes, therefore she could give suggestions on how to effectively and efficiently perform coffee processing to maximize the productivity; lastly, Mr. Prarob was the ex-president of Thai Arabica Coffee Association, so he was able to provide us the fact relevant to the hill-tribe concerning issues and the strategies to overcome the limitation in each coffee transformation process.

b) Data analysis

After collecting data from the three successful organizations, we determined the requirements for each coffee transformation process using content analysis technique (Figure 3.1). We organized the data, transferred them into coding forms, categorized them into groups, interrelated and finally interpreted them.

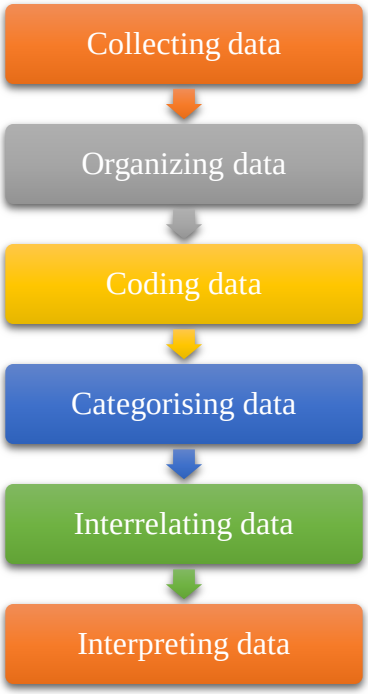


Figure 3.1 Process of content analysis (modified from Maria H.;

Sally-Anne B., Warwick Institute for Employment Research, 2012)

3.2 Determine concerns regarding coffee selling of hill-tribe farmers in Mae Chaem, Chiang Mai

The second objective of our project was to determine the concerns regarding coffee selling of hill-tribe farmers in both Yod Phai and Huay Kee Per villages in order to understand their characteristics and cultures, as well as their current situation of coffee selling. There were three main parts for this objective: preparation, data collection and data analysis.

a) Preparation

At the very first step before collecting data, the team set up semi-structured interview questions for the hill-tribe villagers in both Yod Phai and Huay Kee Per villages. The questions mainly focused on their characteristics and cultures among the community. Then, we conducted a pre-test interview for test group who pretended to be hill-tribe farmers in order to evaluate the interview questions. Additionally, the questions are separated into two sets. The first set was arranged for focus group interview with the hill-tribe villagers in order to gain general ideas. Another set was managed for individual interview with the representative from Raks Thai Foundation to obtain more detailed information.

b) Data collection

The team collected qualitative data by observing the hill-tribe communities in both Yod Phai and Huay Kee Per villages to study the hill-tribe farmer's behaviors. Then, we did small focus groups of hill-tribe farmers for both villages, and followed these up with semi-structured interviews. The interviews were conducted for 16 hill-tribe families in Yod Phai village and 7 families in Huay Kee Per village. A convenience sampling was used for interviewing the hill-tribe farmers since the group sample was based on the availability of communication. The individual interview was conducted for Ms. Sirinun Changaumphai, the field staff from Raks Thai Foundation, to gain deeper information. A purposive sampling was used because she was particularly responsible for supporting the hill tribes.

c) Data analysis

After observing the hill-tribe communities in both Yod Phai and Huay Kee Per villages and interviewing the hill-tribe farmers, all reporting data were organized, coded, categorized, interrelated and finally interpreted, using content analysis technique (Figure 3.1).

3.3 Define the coffee transformation processes and factors in each process from the hill-tribe villages

The third objective was to understand more about the steps of each coffee transformation process, both agricultural and economic aspects, in order to identify which factors were necessary, and which factors they still lacked and why. This objective consisted of three main parts: preparation, data collection and data analysis.

a) Preparation

The team built up a set of interview questions about the management of coffee transformation processes including factors of each transformation step. The interview questions were divided into two sets: one for focus group interview with the hill-tribe villagers in both Yod Phai and Huay Kee Per villages, and another set for individual interview with Ms. Sirinun Changaumphai, the field staff from Raks Thai Foundation. Then, we evaluated these interview questions by conducting a pre-test interview for test group who pretended to be hill-tribe farmers.

b) Data collection

The qualitative data were first collected by observing the current coffee transformation processes and the factors used in each process from our target hill-tribe villages (Yod Phai and Huay Kee Per villages) including infrastructure, amount of labor, working area, machine and equipment. The interview process was the same as that described in Objective 2 (**Methodology 3.2**, page 16).

c) Data analysis

Similar to Objective 1 (**Methodology 3.1**, page 14-15), after observing the coffee transformation processes and interviewing the focus groups of the hill-tribe farmers about each stage of coffee processing, the data were organized, coded, categorized, interrelated and analyzed using content analysis technique (Figure 3.1). The analyzing data were then combined with those from Objective 2 (**Methodology 3.2**, page 16), and were presented through SWOT analysis (Figure 3.2).

Figure 3.2 SWOT analysis (Canvanizer, 2014)

The numbering data gathered from the interviews were calculated as significant evidence that could be inferred as financial status in each possible scenario of coffee transformation processes. We calculated fifteen cases in which three factors were varied: market price, machine cost and productivity in kilogram. The financial calculation was to find incremental contribution margin, break-even point and payback period (**Literature Review 2.10**, page 12-13).

- Incremental contribution margin (baht/kg) =
  Net profit of next stage (baht/kg) – Net profit of current stage (baht/kg)
- Break-even point (kg) =
  Cost of machine (baht) / Incremental contribution margin (baht/kg)
- Payback period (yr) = Break-even point (kg) / Amount of product (kg/yr)

3.4 Identify approaches to overcome limitation factors of coffee transformation processes

After specifying the standardized coffee transformation processes from the successful organizations, determining the concerns regarding coffee selling of hill-tribe farmers, and defining the factors of coffee transformation processes, we assembled the key analyzing aspects from these objectives to identify efficient approaches.

The team gathered all the results and provided ways to solve low-income problems, in relevant to the hill tribes' concerns, by suggesting solutions to overcome the limitation factors of each transformation process, including the benefits of the hill tribes they would gain if they followed our suggestions. We compared the factors required for transforming raw coffee to high-value coffee product in each transformation process (data were collected from Doi Chaang Coffee, the Research and Development of Coffee on the Highland Chiang Mai, and Intanon Coffee) to the limitation factors of hill-tribe farmers' coffee transformation processes. As a result, the hill-tribe farmers could study from our research data as recommendation to gain better income from the current coffee transformation processes.

4. RESULTS AND ANALYSIS

This chapter begins with an overview of standardized coffee transformation processes following by the hill tribes' concerns and the current factors of coffee processing. The team explored the information obtained from the observation and interviews with the representatives of successful organizations, the hill-tribe farmers and the Raks Thai's staff to identify possible solutions for the hill tribes to overcome their limitations. Our findings allowed us to effectively develop the deliverable provided for the Raks Thai Foundation: a research study on the factors of coffee transformation processes for the hill-tribe farmers.

4.1 Specify standardized coffee transformation processes from successful organizations

The interviewees from the three successful organizations of coffee were well collaborated to provide us the useful information about the coffee transformation processes as a standard procedure for the hill-tribe farmers.

In accordance with Mr. Jarern Wuiyue (Figure 3.1a), the managing director from Doi Chaang Coffee, he indicated that the coffee cherries should be harvested at the ripe stage three times a year during October to February. The best harvesting time is between the mid-morning and the afternoon, because the percent humidity will be increased if harvested after that period of time. He pointed out that the Arabica coffee should be transformed by the wet method rather than the dry method (**Literature review 2.4,** page 5-7). This is because the wet method ensures better quality of homogeneous green coffee with few defective beans.

a) b) c)

Figure 4.1 Photographs of the interviewees; a) Mr. Jarern Wuiyue, the managing director of Doi Chaang Coffee; b) Mr. Pralob Prapaluck, the ex-president of Thai Arabica Coffee Association and the owner of Intanon Coffee; and c). Ms. Patchanee Suwanwisolkit, the agricultural scientist from the Research and Development of Coffee on the Highland Chiang Mai.

Ms. Patchanee Suwanwisolkit, the agricultural scientist from the Research and Development of Coffee on the Highland Chiang Mai (Figure 3.1c), agreed with Mr. Jarern that the steps of processing coffee cherry to coffee parchment are sorting and pulping whereas the steps of processing coffee parchment to green coffee are fermenting, washing, drying and hulling. They

suggested that sorting operation should be done by washing the cherries in tanks filled with water, to separate ripe cherries from unripe, overripe and damaged cherries, and to remove dirt, soil and leaves. A milling machine should remove the pulps of the ripe coffee cherries within 24 hours after harvesting to prevent the deterioration of chemical compounds in the cherries that might eventually affect the quality of coffee. After pulping, the mucilage of coffee bean has to be taken away to avoid its degradation that can be contaminated to the coffee beans. Mrs. Patchanee highlighted the fermentation step in which the fermentation tanks with weep hole or the cement wells are used to ferment the pulped coffee beans for 36-72 hours. Then, the coffee parchment is thoroughly washed with clean water at least three times and immersed in water for 12-24 hours. She implied that the sun drying for the wet coffee parchment could be done on a flat concrete, a patios or a mat for 7-10 days. The beans need to be spread out in a layer of 1.5-3 inches, and turned frequently to ensure even drying. The plastic cover is required at night to protect the beans from dew. Mr. Jarern suggested that the dry coffee parchment obtained should have less than 12-13% humidity before transforming to green coffee by hulling machine.

Reported by Mr. Pralob Prapaluck, the ex-president of Thai Arabica Coffee Association and the owner of Intanon Coffee (Figure 3.1b), the roasting coffee step is the most sensitive of all. It requires a balance between temperature and roasting time. For example, if the coffee beans are roasted in high temperature but in short period of time, the outer shell of the beans may be burnt while the insider may be unripe. Furthermore, the use of green coffee with different qualities plays an important role in controlling the balance between temperature and time. For instance, if the sizes of green coffee are diverse, the smaller beans will be completely roasted before the larger ones are starting to turn brown. Therefore, experience and skill are necessary in order to carry out the roasted coffee in order to meet the consumer satisfaction.

4.2 Determine concerns regarding coffee selling of hill-tribe farmers in Mae Chaem, Chiang Mai

After the team observed and interviewed the hill-tribe farmers of both Yod Phai and Huay Kee Per villages, we discovered many concerns that possibly had an impact on selling coffee; for example, education, transportation, accessibility of electricity, mobile phone reception and internet.

4.2.1 Education

Currently, some children in Yod Phai and Huay Kee Per villages have been academically supported from government and the non-profit organizations. This factual concern agreed with the research reporting that, however, the organizations do not have enough budgets to support the 15-year educational system (from kindergarten to secondary level) for every child in the villages Therefore, some groups of children are randomly selected to get the educational opportunity from them. In addition, some of the hill-tribe families stated that, if they want their children to acquire higher education level, they need to afford the tuition fee by themselves. This is difficult for those families because in every month they have to pay not only academic expense but also transportation, accommodation and utility expenses for the children.

4.2.2 Transportation

The distance from both Yod Phai and Huay Kee Per villages to downtown Chiang Mai is approximately 300 kilometers with a lot of non-asphalt and curved roads. The vehicle used has to be the off-road truck and must be driven very carefully. This means that either the middlemen or the hill-tribe farmers have to drive all the way for the coffee. Fortunately, the middlemen come to buy the coffee, at cherry and parchment stages, from the hill-tribe farmers themselves. The farmers can save their money because they do not pay any transportation cost for coffee selling. However, the middlemen can lower the price of coffee due to this inconvenient and uncomfortable route. The hill-tribe farmers from both villages mentioned that if the coffee cherries are not fully filled the middlemen's truck or there is raining on the way to the villages, the farmers get price deduction and hence earn less money than usual.

4.2.3 Accessibility of electricity

Both Yod Phai and Huay Kee Per villages have electricity. The hill-tribe villagers are able to watch television and use the refrigerator. The signal of television broadcast is fully covered the whole village, that is, it allows the people to gain more knowledge from watching TV. With the use of the refrigerator, the villagers can save money from buying new food every day. As recorded from the villagers, most of them do not have to pay for the electricity due to small amount of electricity usage; the Metropolitan Electricity Authority does not charge people who use electricity less than 50 units per month per household.[34] The only people who pay for any electricity bills are the ones who are responsible for machinery because the machines consume much electricity. For example, Mr.Puhae, the Yod Phai village's principle takes responsibility of paying electricity bill for rice milling machine and coffee pulping machine; however, he charged the users for 1 baht/kg for each machine.

4.2.4 Accessibility of mobile phone reception and internet

The Yod Phai village rarely has phone reception and internet accessibility. There is only one spot of the village that is able to use the phone. As a result, the hill-tribe farmers lose opportunities to expand their market channels because it is very difficult to contact the outsiders such as coffee distributors or middlemen. On the other hand, the Huay Kee Per's villagers can access the mobile phone reception and internet more easily. This enables the farmers in Huay Kee Per village to increase the number of their customers.

After considering the concerns, that could possibly affect the coffee selling, of the hill-tribe farmers of both Yod Phai and Huay Kee Per village, we tried to find out more on which factors of production they recently had, which factors they still lacked of and which factors should be improved. Consequently, we could understand more on their availability and could be able to solve the problems efficiently and properly.

4.3 Define coffee transformation processes and factors in each process from the hill-tribe villages

The information about the current coffee transformation processes and the factors in each process obtained from the observation and interviews with the hill-tribe families in Yod Phai and Huay Kee Per villages are separated individually for each village. The financial calculations as a significant evidence to prove the importance of moving on to the further steps of coffee transformation processes are also shown in this objective.

4.3.1 Yod Phai village's findings

According to the interview conducted for 16 hill-tribe families in Yod Phai village, 7 households sell only coffee cherries while other 9 families decide to transform cherries to coffee parchment. They are not able to transform parchment to green bean and roasted coffee because they lack both hulling and roasting machines as well as knowledge of transforming coffee properly. On average there are two farms of coffee per household (approximately 3,200 square meters), which can grow coffee cherries for 300-400 kilograms per year depending on the weather condition. All the coffee farms in Yod Phai village are located within the same area, which is behind the village and near the forest. Coffee cherry can be harvested three times a year. The Yod Phai's farmers keep the cherries for three days before selling to the middlemen, such as the Royal Project Foundation, or the villager's assistance, in which they pick up the cherries from the farmers by themselves. The coffee cherry is currently sold at the market price for 13 baht/kg while the coffee parchment can is sold for 85 baht/kg. However, the price of coffee in each transformation process is based on the market price, which is fluctuated every year. The hill-tribe farmers who transform cherry to parchment earn gross income around 17,850 baht per year while those who stop at selling coffee cherries earn only 13,650 baht per year.

Coffee farming is one of the major cash crops besides corn and rice for the villagers because the coffee can be grown naturally without watering or fertilizing. Moreover, the coffee sprouts are given from the Royal Project Foundation; therefore, coffee requires less cost of investment. There are a few families who hire laborers for harvesting cherries and the cost for each laborer is 4 baht/kg. For the villagers who transform cherries to parchment have to pay 1 baht/kg for the pulping machine as the maintenance cost. Other cash crops for Yod Phai's villagers are rice, corn and bean. They also domesticate animals such as wild pigs, chickens and cows. Consequently, the farmers can enrich the coffee by using cow feces as a natural fertilizer.

4.3.2 Huay Kee Per village's findings

Based on the interview conducted for 7 families from Huay Kee Per village, they all sell only coffee cherries because they do not know how to transform to further step of coffee transformation processes, and they do not have equipment such as machine. Each family has approximately 2-3 farms for growing coffee. Similar to the Yod Phai village, the farmers harvest coffee cherries for 3-4 times a year and keep them for three days before selling to the middlemen such as the Royal Project Foundation and the village's assistance of Yod Phai village. The price of coffee is also fluctuated depending on the market price, which is currently 12 baht/kg. The price of Huay Kee Per village is lower than that of Yod Phai village because the Yod Phai's people purchase the coffee cherries from the Huay Kee Per's farmers. Their annual income from selling coffee is around 3,000-5,000 baht per year. There is no labor cost for every household because they help each other when harvesting cherries. Additionally, the villagers do not have any transportation expense for selling coffee because the middlemen come to pick up the cherries by themselves. Resemble to Yod Phai village, the coffee sprouts are given from the Royal Project Foundation. However, the coffee is not the major cash crop for Huay Kee Per village. The hill-tribe farmers prefer growing corns and beans because they provide them more incomes. They also domesticate animals for earning more money.

To put it simply, the findings about the factors of current coffee transformation processes, in combination with the concerns that could possibly affect the hill-tribe farmers in selling coffee, are presented in the form of SWOT analysis as shown below (Figure 4.2).

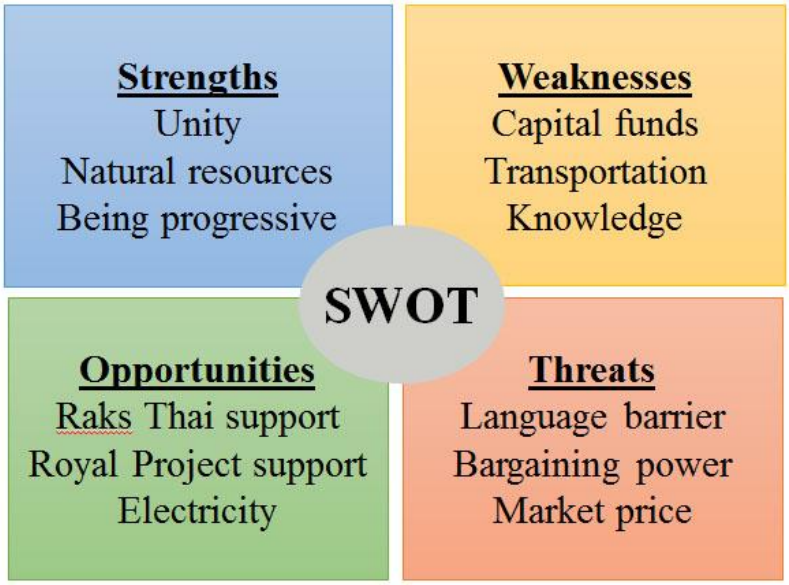


Figure 4.2 SWOT analysis for both Yod Phai and Huay Kee Per villages

In order to prove Raks Thai Foundation and hill-tribes villagers the importance of moving on to the further steps of coffee transformation processes, we provided the financial calculations as significant evidence.

According to various sets of data collected from the interviews with the hill-tribe farmers, we financially calculate the data in 15 possible scenarios, fluctuating in three variables: price of coffee, cost of machine and productivity of coffee cherries in kilograms.

The coffee price is varied from lowest to highest values based on statistical data of coffee selling in the market to understand how much this external factor can affect in different situation. The price listed from lowest to highest values of coffee for the stage of coffee cherry to coffee parchment are 60, 85 and 120 baht, respectively. For the stage of coffee parchment to green bean, the prices are 160, 400 and 500 baht. For the stage of green bean to roasted coffee, the prices are 400, 600 and 1,000 baht.

The cost of machine is provided from highest to lowest price which can be the options for Raks Thai foundation and the hill-tribe villagers to invest.[35-39] The highest costs of machine for pulping, hulling and roasting are 27,000 baht, 380,000 baht and 450,000 baht, respectively. The average cost of machine for pulping, hulling and roasting are 15,000 baht, 26,750 baht and 287,500 baht, respectively. The lowest costs of machine for pulping, hulling and roasting are 14,000 baht, 22,000 baht and 120,000 baht, respectively. However, the cost of machine is calculated in medium price of coffee which is the current market price.

The productivity of coffee cherries in kilograms is set from 200 kilograms as the lowest productivity to 1,000 kilograms as the highest productivity the hill-tribe farmers can afford per household, depending on the hill tribe's efficacy in coffee production. In fact, each household produces different amount of productivity; therefore, in order to gain the accurate results, various cases are provided.

In the step of calculation, we consider three significant formulas (**2.10 Financial Calculations,** page 13-15)**:**

- **Break-even point (kg)** = Cost of investment (baht) / Contribution margin (baht/kg)
- **Incremental contribution margin (baht/kg)** = Net profit of next stage (baht/kg) – Net profit of current stage (baht/kg)
- **Payback period (yr)** = Break-even point (kg) / Amount of productivity (kg/yr)

The tables and bar graphs in Appendix A can be inferred as financial status in each possible scenario of coffee transformation stages. In this case, the team use the productivity of 200 and 1,000 kilograms of coffee cherries in combination with the lowest machine cost (14,000 baht, 22,000 baht and 120,000 baht for pulping, hulling and roasting machines, respectively) and the varied coffee selling price (60, 85 and 120 baht for coffee cherry to coffee parchment stage; 160, 400 and 500 baht for the stage of coffee parchment to green bean; 400, 600 and 1,000 baht for the stage of green bean to roasted coffee as an example for a result explanation in the most understandable view.

According to the diagrams of break-even point (Figure 4.3 and Figure 4.4), it can be obviously seen that the trends of both graph are dramatically decreased in every stage of coffee transformation processes when rising up the amount of productivity and lower cost of machine. For the break-even point starting from 200 kilograms of cherries, kilos to break-even point for parchment are 324, 211 and 142, whereas it takes only 305, 203 and 139 for the break-even point starting from 1,000 kg productivity in order to achieve the turn back.

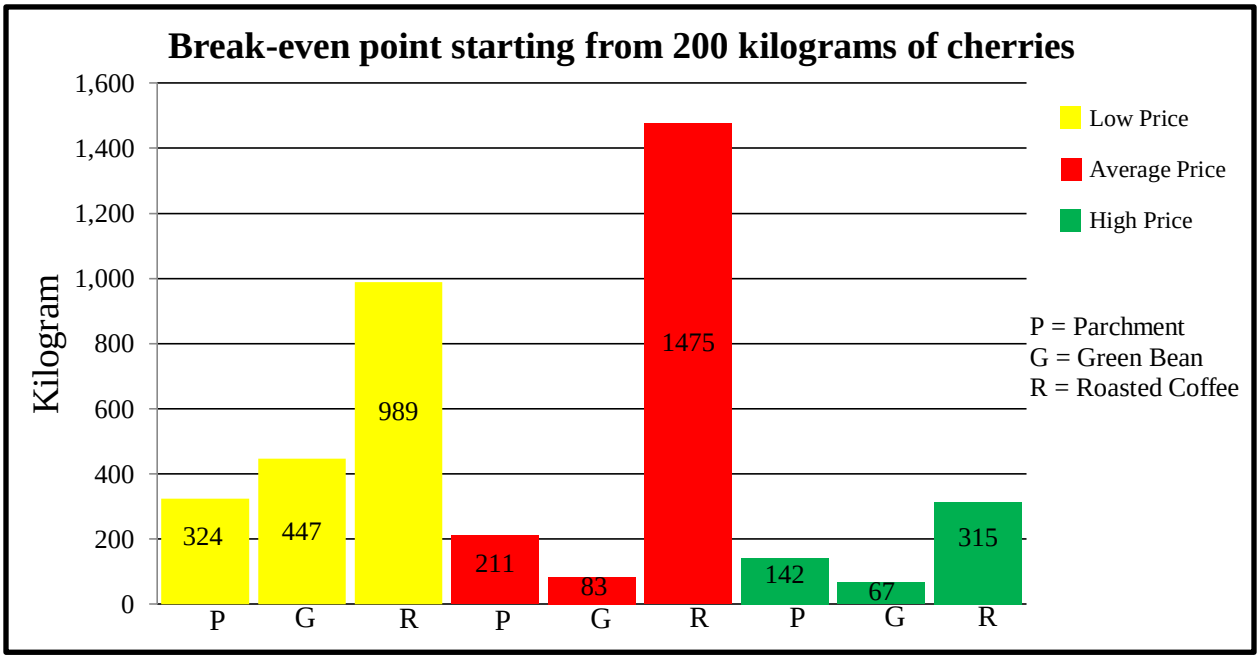


Figure 4.3 Break-even point of coffee transformation processes for 200 kg productivity (Appendix A., Table A.1, Graph A.1.2, page 48)

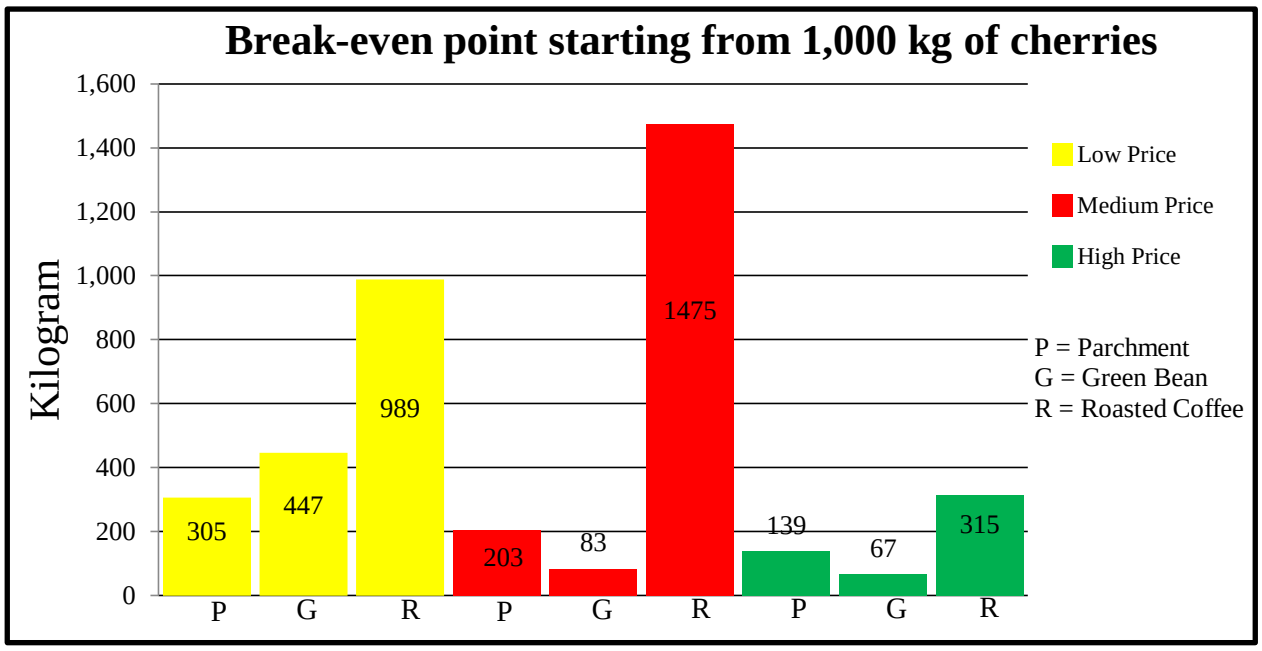


Figure 4.4 Break-even point of coffee transformation processes for 1000 kg productivity (Appendix A., Table A.5, Graph A.5.2, page 56)

Also, the larger amount of kilos on productivity tends to lead the coffee farmers to gain higher incremental contribution margin, especially in the stage of coffee parchment to green bean (Figure 4.5). Considering the highest selling price shown in green bar, the value of incremental contribution margin increases from 101 to 381 baht per kilograms from the stage of coffee parchment to roasted coffee, which is almost four times higher than the previous stage.

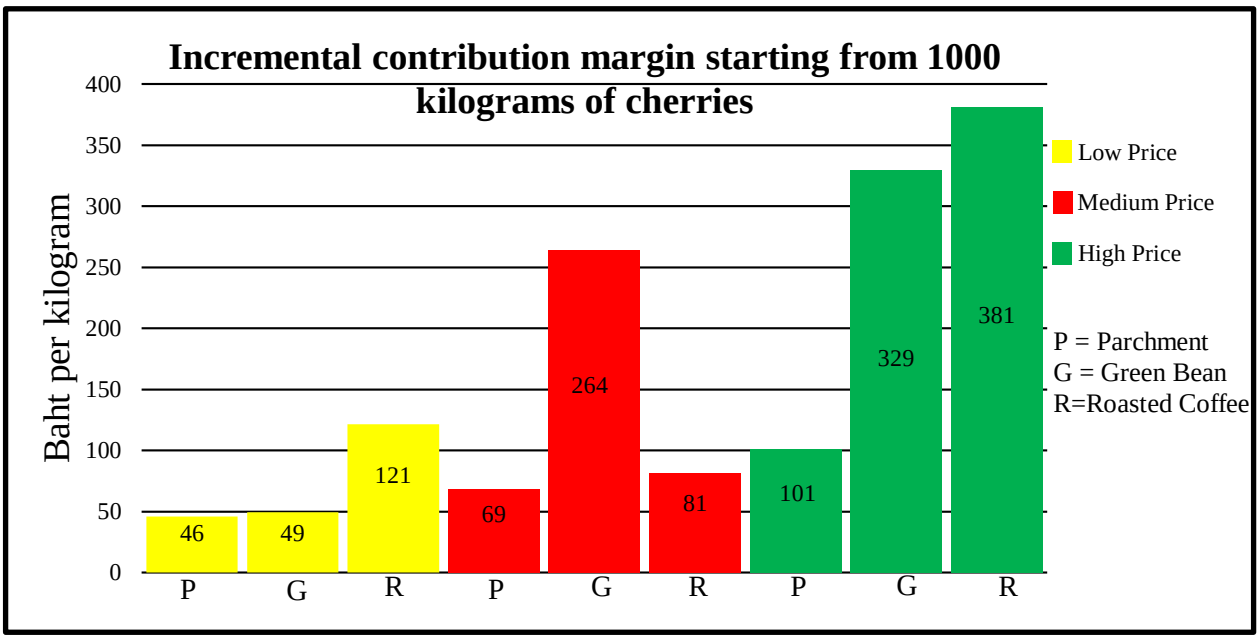


Figure 4.5 Incremental contribution margin of coffee transformation processes for 1,000 kg productivity (Appendix A., Table A.5, Graph A.5.1, page 55).

The diagrams of the payback period clearly show the decreased trend if the amount of productivity of coffee cherries lowers from 1,000 to 200 kilograms (Figure 4.6 and Figure 4.7). It takes almost 10 year to receive the investment cost back for 200 kilograms of cherries while it takes only few years for 1,000 kilograms productivity.

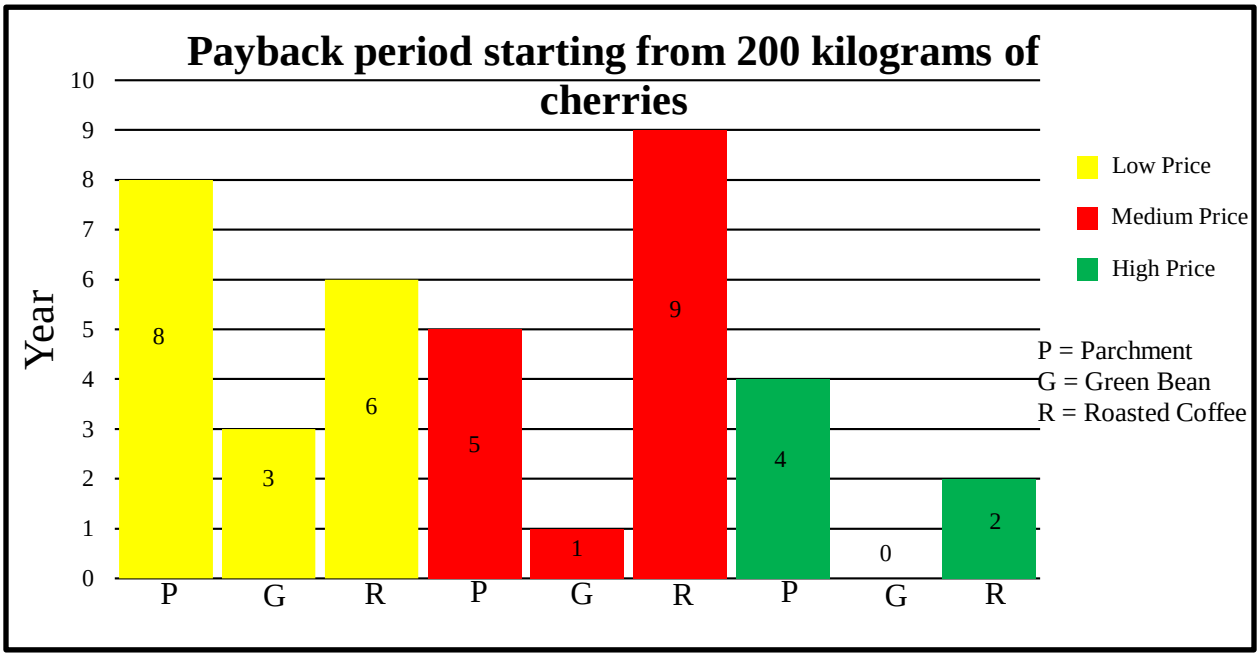


Figure 4.6 Payback periods of coffee transformation processes for 200 kg productivity (Appendix A., Table A.1, Graph A.1.3, page 48).

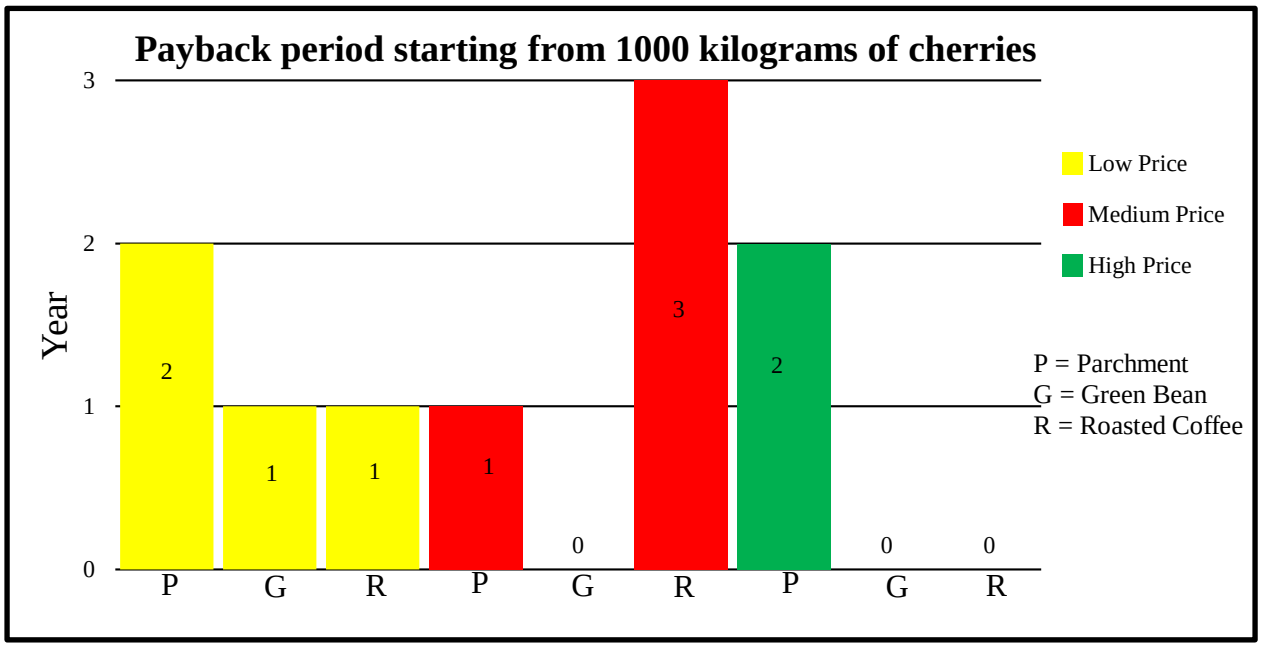


Figure 4.7 Payback periods of coffee transformation processes for 1,000 kg productivity (Table A.5, Graph A.5.3, page 56).

To conclude, all the outcomes are contributed from three factors. Firstly, the hill-tribe farmers gain higher because of the highest productivity. Secondly, less cost of machine can reduce the kilos to break-even point, which is the primary concern for the hill tribes. Lastly, the hill-tribe villagers definitely achieve more income if the price of coffee in the market is high.

4.4 Identify approaches to overcome limitation factors of coffee transformation process

After we analyzed all the collected data from objective 1-3, we assembled the key aspects from each objective and discovered four main factors that limits the ability of the hill-tribe farmers to generate more income from moving on to the further steps of coffee transformation processes. These limitation factors include machinery, financial support, knowledge, and market channels. We then identified the possible approaches to overcome the limitation factors that could efficiently benefit the hill-tribe villagers in the most realistic way.

4.4.1 Limitation factor: machinery

The hill-tribe villagers in both Yod Phai and Huay Kee Per villages are facing with low-income issue. Besides other sorts of income, the hill-tribe farmers earn money from coffee farming. Currently, the hill tribes in Yod Phai village are able to transform coffee cherries to coffee parchment, because Raks Thai Foundation has provided them the pulping machine. On the other hand, Raks Thai Foundation is in the process of assistance for Huay Kee Per village; therefore, the machine is not yet provided for the hill-tribe farmers in the village, allowing them to produce only coffee cherries. Generally, the price of coffee is increased in every stage of coffee transformation processes; the further steps of coffee processing are, the higher the price will be. Without machinery required for each step of coffee processing, the coffee beans cannot be transformed. Thereby, lack of machinery becomes the priority of limitation factors that cause the hill tribes to earn less income.

4.4.1.1 Approach: investment on machinery

The approach for overcoming the limitation on machine is to investing on the machinery, that is, the machine is advantageous for the long term after being invested only once. To complete the whole coffee transformation processes, there are three machines that the hill-tribe farmers must use in each stage, consecutively. First is the pulping machine for transforming coffee cherries to coffee parchment. Second is the hulling machine for transforming coffee parchment to green beans. Third is the roasting machine for transforming green beans to roasted coffee. The team provides variety of series of each machine, as well as its specification, as options for the hill tribes to select the most suitable type of machine for their coffee transformation processes.

For pulping machinery, three various kinds of machine are provided.[35-36] The first option costs about 14,000 baht. Its pulping rate and pulping percentage are approximately 392 kg/h and 94%, respectively. The energy supply for this machine is 0.746 kW, and there are many leftovers of cherry pulps. The second option costs about 15,500 baht. The pulping rate and percentage of this machine are 470 kg/h and 96%, respectively. The energy supply for this machine is 0.746 kW. This machine generates less coffee pulps compared to the first one. The third option costs 22,752 baht. Its pulping rate is around 300-500 kg/h. This machine requires water for increasing the workflow.

For hulling machinery, there are two options.[37-38] The first machine costs 50,600 baht. Its hulling rate for this machine is 150 kg/h. The energy supplies of 5-8 HP (Horse Power) use 3 motors. The second one costs 142,600 baht. It contains high system for hulling, provides less damage on parchment skin, achieves 5 grading system, and acquires high technology for stream system.

For roasting machinery, there are two different kinds of machines.[39] The first one is the roasting machine for 0.5 – 1 kg productivity which can acquire the maximum efficacy up to 4 kg/h. The roasting time for this machine depends on the humidity and the roasting type; it takes approximately 4 – 10 min for light roasted coffee, 10 – 15 min for middle roasted coffee, and 15 – 20 min for dark roasted coffee. This machine generates heat using Liquefied Petroleum Gas (LPG). The second roasting machine is suggested when dealing with the larger scale of productivity, up to 2 kg maximizing in 8 kg per hour. The roasting time is constant for 15 minutes. It generates heat using Liquefied Petroleum Gas (LPG) together with Natural Gas (NG).

However, there are some risks involved in investing on machinery. The machine can be broken down or deteriorated without any notice despite the fact that it is invested only once. Therefore, the machine needs maintenance at least once a year, so that it can be repaired in time if found defective. The maintenance cost for each machine is relatively high.

4.4.2 Limitation factor: financial support

The main reason why the hill tribes in both Yod Phai and Huay Kee Per villages cannot afford the machinery is that they lack financial support. To achieve the whole coffee transformation processes, it requires three machines which are pulping, hulling and roasting machines, consecutively. The cost of machine in each stage is considerably increased as the coffee processing moves on to further steps. Based on their earnings, the hill-tribe farmers do not have enough money to buy the machine.

4.4.2.1 Approach: find possible sources of funding

The approach for overcoming the limitation on financial support is to find possible sources of funding. The first choice is the bank for agriculture and agricultural co-operatives or Torgorsor. As its mission states that, "*To be a secured rural development bank with modern managerial technology and integrated financial services focusing on the uplift of farmers' quality of life*", the bank aims to help the farmers by providing financial assistance, and supporting their agricultural business.[40] The second choice is Raks Thai Foundation. Raks Thai Foundation can collaborate with other relevant agencies, both government and private sectors, in order to financially support the hill tribes.

Nevertheless, there is a potential problem for the hill-tribe farmers. They have low creditability to loan money from the bank because they do not have enough collateral. This problem can be solved by confederating in a group.

4.4.3 Limitation factor: knowledge

Another factor that the hill tribes in both villages lack is knowledge. Lack of knowledge on coffee transformation processes limits the hill-tribe farmers not only from generating more income, but also from moving on the next stages of coffee processing. The hill-tribe villagers must know how to perform each coffee transformation step professionally in order to achieve higher

quality coffee product and gain better profits. Evidently, the hill-tribe villagers can gain higher profit if they continue to transform coffee in the further steps such as green bean or roasted coffee stages. In addition, most of the hill-tribe villagers encounter difficulty on communication with middlemen due to language barrier. This allows the middlemen to take advantages from the hill-tribe villagers by lowering the price of coffee.

4.4.3.1 Approach: obtain information from coffee learning centers

The approach for overcoming the limitation on knowledge is to obtain information from coffee learning centers. The Research and Development of Coffee on the Highland Chiang Mai is the key learning center to learn about coffee. The Royal Project is another option to gain basic knowledge on coffee processing. These two organizations willingly provide knowledge of coffee transformation processes for people who are interested in coffee.

Ms. Patchanee Suwanwisolkit, the agricultural scientist from the Research and Development of Coffee on the Highland Chiang Mai, is academically expert in coffee areas. It would be best if the hill-tribe farmers directly have a site visit at the Research and Development center in Agricultural Department, Chiang Mai University. By doing so, the hill-tribe farmers can be given lectures about coffee starting from the history of coffee to the coffee transformation processes, as well as the coffee entrepreneurship. Moreover, they can closely observe the factors required in each stage of coffee transformation processes, such as pulping, hulling and roasting machines.

However, the potential problem the hill-tribe farmers may face is language barrier. Because most of the hill tribes do not understand Thai language; therefore, it may be difficult for them to gain understandings on coffee transformation processes.

4.4.4 Limitation factor: market channels

The hill tribes in both villages also lack market channels of coffee. Currently, few middlemen directly go to Yod Phai and Huay Kee Per villages for buying coffee cherries and coffee parchment. Besides, the principal's assistance of the Yod Phai village buys the coffee products from the village's members and the people in Huay Kee Per village, and transports them to the downtown Chiang Mai for sales. The limitation factor is due to the faraway distance, which is approximately 300 kilometers, between the villages themselves and the downtown Chiang Mai, as well as poor infrastructures such as non-asphalt roads. This causes difficulty on accessibility for the coffee potential buyers to buy coffee products from the hill-tribe farmers.

4.4.4.1 Approach: contact suitable coffee retailers

The approach for overcoming the limitation on market channels is to contact suitable coffee retailers. For the current situation, the coffee cherries and coffee parchment can be sold to the local middlemen and the Royal Project. If the hill-tribe farmers continue to move on to further steps of coffee transformation processes, there are a lot of potential buyers as listed below (Table 4.1).

Table 4.1 List of coffee retailers

Coffee cherry	Coffee parchment	Green bean	Roasted coffee
Local middlemen	Intanon Coffee	Salottoc 083-424-0225	Too fast to sleep 086-577-8989
The Royal Project	Coffee Cartel 02-953-8957	Coffee Indy 089-142-2028	Mao Coffee 053-282-449
Yod Phai village	Vilatte Coffee	Coffee Today 086-374-6844	
		Blue Knoff 02-955-5608	
		Master Price 084-348-0499	
		Seat2cup 086-316-6629	
		Bona 02-618-2944	

5. CONCLUSION AND RECOMMENDATIONS

After collecting all the information from observation and interviews conducted for the representatives from the successful organizations (Doi Chaang Coffee, the Research and Development of Coffee on the Highland Chiang Mai and Intanon Coffee) and the hill-tribe villagers in both Yod Phai and Huay Kee Per villages, as well as the field staff from Raks Thai Foundation, we were able to determine the standardized coffee transformation processes, the concerning issues of the hill tribes, and the limitation factors in each stage of coffee processing for both villages.

Based on the findings, the financial calculations (break-even point, incremental contribution margin and payback period) evidently proved the importance of moving on to the further steps of coffee transformation processes. Additionally, the possible approaches were proposed to the hill-tribe villagers in both villages in order to overcome their limitations. By doing so, the hill-tribe farmers would be able to generate more income, and to sustain their quality of life in the long term.

Last but not least, recommendations are one of the significant parts of our research study as the options for both Raks Thai Foundation and the hill tribes. We identify the series of steps that would be beneficial to both Raks Thai Foundation and the hill-tribe villagers in generating more incomes from selling coffee.

5.1 Recommendations for Raks Thai Foundation

5.1.1 We recommend that Raks Thai Foundation assist the hill-tribe farmers of both Yod Phai and Huay Kee Per villages in finding additional funds for machine investment.

We recommend that Raks Thai Foundation assist the Yod Phai and the Huay Kee Per villages in finding funds for investing on hulling machine to transform the coffee parchment to green bean, and pulping machine to transform the coffee cherry to parchment, respectively. We recommend this because machinery is the most significant factor of coffee transformation processes. Without machinery (pulping, hulling and/or roasting machines), the coffee cherries cannot be transformed to coffee beans that can be sold in much higher price. According to the financial evidence (**Results and Analysis 4.3**, page 23-26), we discovered that even the lowest cost of machine benefits the hill-tribe coffee farmers considering from the descending kilos to break-even point and shorter payback period. Moreover, machine is a fixed cost that can be invested only once but continues to be advantageous for the long term.

Generally, it is hard for the underprivileged hill tribes to getting start on investment because they do not have enough money at the beginning. Therefore, we recommend that Raks Thai Foundation assist in contacting with the financial support organizations; for example, the bank for agriculture and agricultural co-operatives or Torgorsor. Furthermore, Raks Thai foundation should encourage the villagers to confederate as a group so that they can have more power on negotiation and be more efficient in managing financial resources.

5.1.2 We recommend that Raks Thai Foundation assist the hill-tribe farmers in marketing development.

Due to the limitations of coffee distribution channel (**Results and Analysis 4.4**, page 29-30), marketing development is one of the key factors that Raks Thai Foundation should be concerned because it is the most effective and fastest way to gain better profits with less cost of investment. The most suitable marketing strategies are creating brand image, e-marketing and building a storyline. Firstly, creating an attractive image of the coffee products, such as name, logo, and package, helps reminding customers of the products. If the customers have positive attitude toward a brand image, they are more likely to purchase and remember the products in the long term. The brand image should be pictures describing the background of the hill-tribe farmers, and promote environmental-friendly trend[41]. Secondly, e-marketing can be used to increase the accessibility of the customers. As e-marketing uses digital technologies to sell the products, the hill tribe's coffee products can be sold easily via website or social media. Lastly, building a storyline about the village's background can promote the coffee selling. Reported by Mr.Pralob Prapaluck, the ex-president of Thai Arabica Coffee Association, "*the Aka-Ama Coffee is popular and famous because they sell their stories, so now it becomes more than a coffee shop*". Furthermore, according to the Corporate Social Responsibility of Starbucks, Doi Tung Coffee and Doi Chaange Coffee, the customers tend to interest in and appreciate the villager's stories on producing coffee, resulting in an increased selling rate.

5.1.3 We recommend that Raks Thai Foundation facilitate enhanced accessibility between potential coffee buyers and hill-tribe villagers.

Through the observation in both Yod Phai and Huay Kee Per villages, as well as the interviews with the representative of Raks Thai Foundation, we found that an underlying problem in both villages is a limited communication with coffee buyers caused by language barrier, low education, and few representatives to communicate with middlemen. As there are many obstacles in the communities, we recommend that Raks Thai Foundation assist in contacting and building a good relationship with potential coffee buyers as well as coffee retailers. There are many potential buyers that buy coffee in each coffee transformation process; for example, Coffee Indy and Coffee Today for selling green beans, and Amazon Coffee for selling roasted coffee. Moreover, if Raks Thai Foundation can provide translators for the hill-tribe villagers to communicate with customers, the hill tribes will be able to expand their market channels and hence generate more incomes from selling more coffee products.

5.2 Recommendations for the hill tribes in both Yod Phai and Huay Kee Per villages

5.2.1 We recommend that the hill-tribe villagers find more knowledge on coffee transformation processes.

According to our interviews with the hill tribes in both Yod Phai and Huay Kee Per villages, some know how to transform coffee cherries to the green bean stage but some do not. As a result, most of them choose not to transform but sell the harvested coffee cherries, generating very low income. We recommend that the hill-tribe villagers pay close attention to the ones who know how to transform coffee cherries to further steps of coffee transformation processes, so that

they can learn and practice the coffee processing. Additionally, when the experts from the Royal Projects or the Research and Development of Coffee on the Highland Chiang Mai come to give lecture on coffee transformation processes, the hill tribes should be fully participated.

5.2.2 We recommend that the hill-tribe villagers confederate as a group.

Based on our observation on both Yod Phai and Huay Kee Per villages, we consider that everyone's productivity of coffee cherries in kilograms is nearly the same due to similar harvesting condition. However, they choose to sell separately so that it is hard for them to enhance both the negotiation and the bargaining powers. Moreover, the selling price for Huay Kee Per village has been forced down by Yod Phai village that has higher innovation of coffee transformation processes. Therefore, we recommend that the hill-tribe villagers confederate as a group to increase efficiency on selling the coffee products by totaling the products together and sell them one at a time. By doing so, the hill tribes will gain more power to chaffer with the potential coffee buyers including middlemen and coffee retailers. Another advantage is that the hill-tribe farmers can accumulate money among communities for buying the machine required in each stage of coffee transformation processes. The unification can quickly achieve the payback period on machinery investment comparing to the household's expenditure. As a result of being cooperative, they can also propose to hold an OTOP, the local entrepreneurship stimulus program, for selling their coffee products more widely, earning more sustainable profit in a long term.

5.3 Recommendation for the future WPI- BSAC teams

We recommend that future WPI-BSAC teams, in conjunction with Raks Thai Foundation, may focus on whether coffee farming should become a major cash crop for the hill-tribe villagers in the Northern Thailand.

According to our field trip observation, there are some hill-tribe farmers who have misunderstandings about agricultural techniques, such as those from Huay Kee Per village. Most of them focus on other cash crops, which can give them money in the short period of time such as corns. However, they do not know well on the following effects after harvesting those crops. In order to growing corn, there are a lot of chemicals used in corn production which negatively impacts the environment.[42] For instances, Nitrogen diminishes water quality, Phosphorous promotes excessive plant growth in waterways, and Ammonia contributes to greenhouse gases.[42] Moreover, growing corn is not a sustainable long-term cash crop like growing coffee is, because corn farming will destroy the soil in the long term and it will take times to recover that area.

Consequently, growing coffee is a great choice for hill-tribe villagers because the locations in the Northern Thailand are suitable to grow Arabica coffee, which is very popular in today society coffee market. So, it may be a good decision for both Raks Thai Foundation and the hill-tribe farmers if the future WPI-BSAC teams aim to focus on advantages and disadvantages of coffee farming comparing to corn, so that they can gain more understandings and keep on the right track.

All in all, we wish our recommendations can be beneficial to both Raks Thai Foundation and the hill-tribe villagers to achieve their highest satisfaction on gaining higher incomes and profits from coffee transformation processes.

บทสรุปและคำแนะนำ

หลังการเก็บรวบรวมข้อมูลจากการสังเกตการณ์และการสัมภาษณ์ผ่านทางตัวแทนขององค์กรที่เกี่ยวข้องกับการผลิตกาแฟที่ประสบความสำเร็จ อาทิเช่น กาแฟดอยช้าง กาแฟอินทนนท์ และ ศูนย์วิจัยและพัฒนากาแฟบนที่ราบสูงจังหวัดเชียงใหม่ รวมไปถึงเจ้าหน้าที่ของมูลนิธิรักษ์ไทย กลุ่มนิสิตสามารถระบุมาตรฐานของการแปรรูปผลิตภัณฑ์กาแฟ ปัจจัยโดยรวมที่ส่งผลต่อการผลิตและจัดจำหน่ายกาแฟของชาวเขา และข้อจำกัดในปัจจัยการผลิตของแต่ละขั้นตอนของการแปรรูป จากการวิเคราะห์ข้อมูลเหล่านี้ผ่านทางการคำนวณทางการเงิน สามารถเป็นหลักฐานที่สำคัญที่จะพิสูจน์ความสำคัญในการแปรรูปผลิตภัณฑ์กาแฟ ซึ่งการคำนวณประกอบไปด้วย จุดคุ้มทุน ส่วนต่างกำไรที่เพิ่มขึ้น และระยะเวลาคืนทุน นอกจากนี้แล้วมีการเสนอแนะสิ่งที่จะทำให้ชาวเขาก้าวข้ามผ่านปัจจัยข้อจำกัดต่างๆ ซึ่งจะส่งผลให้ชาวเขาสามารถเพิ่มรายได้จากกระบวนการแปรรูปกาแฟและสามารถดำรงชีพอยู่อย่างมีคุณภาพด้วยความมั่นคง

คำแนะนำ

หลังจากที่จัดทำการจัดการกับปัญหาสำหรับชาวเขาเพื่อที่ก้าวข้ามปัจจัยที่มีอยู่อย่างจำกัดของการแปรรูปกาแฟ ข้อเสนอแนะก็เป็นอย่างหนึ่งที่สำคัญของผลงานวิจัย ซึ่งเป็นทางเลือกของมูลนิธิรักษ์ไทย และ ชาวเขา กลุ่มนิสิตได้ทำการชี้แนะแต่ละขั้นตอนที่จะเป็นประโยชน์ทั้ง มูลนิธิรักษ์ไทย และ ชาวเขา เพื่อก่อให้เกิดรายได้รับที่มากขึ้นจากการขายกาแฟ

5.1 ข้อเสนอแนะสำหรับมูลนิธิรักษ์ไทย

5.1.1 กลุ่มนิสิตขอแนะนำให้มูลนิธิรักษ์ไทยเอื้ออำนวยชาวเขาของทั้ง หมู่บ้านยอดไผ่ และ หมู่บ้านห้วยขี้เปอะ ในการจัดหากองทุนสำหรับการลงทุนเครื่องจักร

ทางกลุ่มนิสิตแนะนำให้มูลนิธิรักษ์ไทยเอื้ออำนวย หมู่บ้านยอดไผ่ และ หมู่บ้านห้วยขี้เปอะ ในการจัดหากองทุนเพื่อที่จะลงทุนด้านเครื่องสีเมล็ดกาแฟเพื่อที่จะแปรรูปจากกาแฟกะลาเป็นสารกาแฟ และ เครื่องโม่กาแฟเพื่อที่จะแปรรูปกาแฟเชอรี่เป็นกาแฟกะลา ทางกลุ่มนิสิตแนะนำในด้านนี้เพราะเครื่องจักรเป็นปัจจัยที่สำคัญของการแปรรูปกาแฟ ถ้าปราศจากเครื่องจักร กาแฟเชอรี่ก็ไม่สามารถแปรรูปเป็นเมล็ดกาแฟที่จะขายได้ในราคาที่สูงขึ้นได้ สอดคล้องกับหลักฐานทางด้านการเงินกลุ่มนิสิตค้นพบว่าต้นทุนที่ต่ำของเครื่องจักรก็เป็นประโยชน์ต่อชาเขาที่ปลูกกาแฟ พิจารณาจากกิโลกรัมที่ลดลง ถึง จุดคุ้มทุนและระยะเวลาคืนทุนที่สั้น นอกจากนี้เครื่องจักรยังเป็นต้นทุนที่คงที่ ซึ่งสามารถลงทุนเพียงครั้งเดียวแต่ยังสร้างผลประโยชน์ในระยะยาว

โดยทั่วไปมันเป็นเรื่องยากของชาวเขาที่ด้อยโอกาสที่จะได้รับโอกาสในเริ่มต้นลงทุน เพราะพวกเขาไม่ได้มีเงินมากพอตั้งแต่เริ่มต้น ด้วยเหตุนี้ทางกลุ่มนิสิตมีข้อเสนอแนะให้มูลนิธิรักษ์ไทยในการเอื้ออำนวยเรื่องการติดต่อกับองค์กรที่สนับสนุนทางด้านการเงิน ตัวอย่างเช่นธนาคารเพื่อการเกษตรและสหกรณ์เพื่อการเกษตร หรือ ธกส. นอกจากนี้มูลนิธิรักษ์ไทยควรส่งเสริมให้ชาวบ้านร่วมใจกันเป็นกลุ่มเพื่อให้พวกเขาสามารถมีอำนาจในการต่อรองมากขึ้น และ มีประสิทธิภาพมากขึ้นในการจัดการทรัพยากรทางการเงิน

5.1.2 กลุ่มนิสิตขอแนะนำให้มูลนิธิรักษ์ไทยเอื้ออำนวยเกษตรกรชาวเขาในการพัฒนาทางด้านการตลาด

เนื่องจากข้อจำกัดของช่องทางการจัดจำหน่ายกาแฟ การพัฒนาการตลาดเป็นหนึ่งในปัจจัยสำคัญที่มูลนิธิรักษ์ไทยควรจะมีส่วนเกี่ยวข้องเพราะ การตลาดเป็นสิ่งที่มีประสิทธิภาพมากและเร็วที่สุดในการที่จะได้รับผลกำไรที่มากขึ้นโดยใช้ค่าใช้จ่ายที่น้อย กลยุทธ์ทางการตลาดที่เหมาะสมสุดก็คือ การสร้างเครื่องหมายทางการค้า, การตลาดอิเล็กทรอนิกส์ และ สร้างเรื่องราวความเป็นมา ประการแรกคือการสร้างภาพลักษณ์ที่น่าสนใจของผลิตภัณฑ์กาแฟ เช่น ชื่อผลิตภัณฑ์ โลโก้ และ บรรจุภัณฑ์ เพื่อที่จะเตือนใจลูกค้าเกี่ยวกับผลิตภัณฑ์ หากลูกค้ามีทัศนคติที่ดีต่อภาพลักษณ์ ลูกค้าก็มีแนวโน้มที่จะซื้อสินค้า และ จำได้ในระยะยาว ภาพลักษณ์ของสินค้าควรจะอธิบายเกี่ยวกับความเป็นมาของเกษตรกรชาวเขา และ ส่งเสริมกะแสที่เกี่ยวกับการเป็นมิตรกับสิ่งแวดล้อม ประการที่สองตลาดอิเล็กทรอนิกส์สามารถนำมาใช้เพื่อเพิ่มการเข้าถึงของลูกค้า ในขณะที่ตลาดอิเล็กทรอนิกส์ใช้เทคโนโลยีดิจิตอลในการขายสินค้า ผลิตภัณฑ์กาแฟของชาวเขาสามารถขายได้ง่ายดายผ่านทางเว็บไซต์ หรือสื่อสังคมออนไลน์ อย่างสุดท้ายสร้างเรื่องราวความเป็นมาเกี่ยวกับหมู่บ้านสามารถส่งเสริมในการขายกาแฟ จากคำบอกเล่าของคุณปรารภ ประภาลักษณ์ อดีตประธานของสมาคมกาแฟอาราบริก้าแห่งประเทศไทย “ กาแฟ อาขา อาม่า เป็นที่นิยม และ มีชื่อเสียง เพราะพวกเขาขายเรื่องราวของพวกเขา ดังนั้นตอนนี้ร้านกาแฟของพวกเขาเป็นมากกว่าร้านกาแฟ” นอกจากนี้ ตามความรับผิดชอบต่อสังคมของกาแฟสตาร์บัค กาแฟดอยตุง และ กาแฟดอยช้าง ลูกค้ามีแนวโน้มที่จะสนใจและ เห็นคุณค่าในเรื่องราวของชาวบ้านในการปลูกกาแฟ ส่งผลอัตราในการขายเพิ่มขึ้น

5.1.3 กลุ่มนิสิตขอแนะนำให้มูลนิธิรักษ์ไทยอำนวยความสะดวกในการเข้าถึงที่เพิ่มขึ้นระหว่างผู้ซื้อกาแฟ และ ชาวเขา

กลุ่มนิสิตแนะนำให้มูลนิธิรักษ์ไทยอำนวยความสะดวกในการเข้าถึงที่เพิ่มขึ้นระหว่างผู้ซื้อกาแฟและชาวเขา จากการสังเกตการณ์ทั้งหมู่บ้านยอดไผ่และหมู่บ้านห้วยขี้เปอะ เช่นเดียวกับการให้สัมภาษณ์กับตัวแทนของมูลนิธิรักษ์ไทย พบว่าชาวเขาส่วนใหญ่มีการสื่อสารที่น้อยมากกับพ่อค้าคนกลาง ซึ่งเกิดจากปัญหาทางภาษาในการสื่อสาร ระดับทางการศึกษา และจำนวนตัวแทนการเจรจากับพ่อค้าคนกลางมีจำนวนน้อย

เนื่องด้วยมีอุปสรรคสำหรับชาวเขาในการเจรจาต่อรอง กลุ่มจึงเสนอให้มูลนิธิรักษ์ไทยสนับสนุนชาวเขาในการเจรจาติดต่อ และสร้างสัมพันธไมตรีต่อผู้ค้ากาแฟ และร้านค้ากาแฟ ทั้งนี้ทั้งนั้นผู้ที่ซื้อกาแฟมาเป็นระยะเวลาหนึ่ง นิยมซื้อกาแฟที่ผ่านการแปรรูปในแต่ละขั้นตอน เช่น กาแฟอินดี้ ซื้อสารกาแฟ เป็นต้น สิ่งนี้จะเป็นอีกแนวทางที่ดีอีกแนวทางหนึ่งหากมูลนิธิรักษ์ไทยจัดหาล่ามสำหรับชาวเขา เพื่อเพิ่มประสิทธิภาพในการสื่อสารและการเจรจาต่อรองระหว่างชาวเขากับผู้รับซื้อกาแฟ และเพื่อเพิ่มโอกาสในการขยายธุรกิจกาแฟของชาวเขาให้มีรายได้เพิ่มมากขึ้น

5.2 ข้อเสนอแนะสำหรับหมู่บ้านยอดไผ่ และหมู่บ้านห้วยขี้เปอะ

5.2.1 กลุ่มนิสิตแนะนำให้ทางชาวเขาหาข้อมูลเพิ่มเติมสำหรับการแปรรูปกาแฟ

กลุ่มนิสิตแนะนำให้ทางชาวเขาหาข้อมูลเพิ่มเติมสำหรับการแปรรูปกาแฟ โดยสืบเนื่องมาจากการสัมภาษณ์ชาวเขาทั้งสองหมู่บ้าน จึงสรุปได้ว่า ชาวเขาส่วนใหญ่รู้จักวิธีการแปรรูปกาแฟ จากกาแฟเชอรี่เป็นสารกาแฟ แต่ยังคงมีส่วนน้อยที่ไม่รู้ นอกจากนี้ชาวเขาส่วนใหญ่เลือกที่จะไม่แปรรูปกาแฟ โดยเลือกที่จะขายกาแฟเชอรี่ซึ่งขายได้กำไรต่ำ กลุ่มนิสิตจึงแนะนำให้

ชาวเขาทั้งสองหมู่บ้านที่ยังไม่มีความรู้ด้านการแปรรูปกาแฟนั้น ศึกษาอย่างใกล้ชิดกับผู้ที่สามารถให้ข้อมูลได้ เพื่อที่จะฝึกฝนกระบวนการการแปรรูปกาแฟและเรียนรู้ด้วยตัวเอง. ในอีกทางหนึ่ง หากมีแหล่งข้อมูลอื่นๆด้านการแปรรูปกาแฟ เช่น โครงการหลวง หรือ ศูนย์การวิจัยและพัฒนากาแฟบนที่ราบสูงเชียงใหม่ มหาวิทยาลัยเชียงใหม่ ชาวเขาควรจะเปิดรับโอกาสนั้นเพื่อประโยชน์ของตนเอง

5.2.2 กลุ่มนิสิตเสนอแนะให้ชาวเขารวมตัวกันเป็นกลุ่ม

หลังจากการสังเกตการณ์ทั้งสองหมู่บ้าน ทางกลุ่มได้พิจารณาว่า ผลผลิตของชาวเขาส่วนใหญ่มีจำนวนเท่า ๆ กันเนื่องด้วยเทคนิคการเก็บเกี่ยวที่คล้ายคลึงกัน แต่ทว่า ชาวเขาต่างคนต่างขาย ซึ่งทำให้ชาวเขาเสียเปรียบในการเจรจาต่อรองเรื่องราคา ในอีกแง่มุมหนึ่ง จำนวนการขายกาแฟของหมู่บ้านห้วยขี้เปอะจะมีไม่มากเท่า ยอดไผ่เนื่องด้วยหมู่บ้านยอดไผ่มีการแปรรูปที่ดีกว่า ฉะนั้น กลุ่มนิสิตจึงเสนอแนะให้ชาวเขาทั้งสองหมู่บ้านรวมตัวกันเป็นกลุ่มเพื่อเพิ่มผลการผลิต และราคาขายโดยการรวมกาแฟจากแต่ละครัวเรือนและจำหน่ายในครั้งเดียว ในการทำเช่นนี้ ชาวเขาจะสามรถเพิ่มอำนาจในการเจรจาต่อรองเรื่องราคาต่อพ่อค้าคนกลางและร้านกาแฟอื่น ๆ ผลดีอีกข้อหนึ่งคือชาวเขาจะสามารถมีเงินกองกลางเพื่อที่จะพัฒนาการแปรรูปและการผลิตมากขึ้น เช่น การลงทุนซื้อเครื่องจักรในการช่วยการแปรรูปกาแฟ ในการรวมตัวกันนั้นจะทำให้ชาวเขาสามรถคืนทุนจากการลงทุนเครื่องจักรได้รวดเร็วยิ่งขึ้น เปรียบเทียบกับแต่ละครัวเรือนที่ต้องใช้จ่ายกันเองซึ่งใช้เวลานานกว่าในการคืนทุน ท้ายที่สุดแล้วในการรวมตัวกันของชาวเขาจะมีโอกาสทำให้เกิดผลิตภัณฑ์ โอทอปขึ้นมา ชาวเขาจะมีตลาดการจำหน่ายกาแฟที่กว้างมากขึ้น และมีโอกาสพัฒนาในลำดับต่อๆไป

5.3 กลุ่มนิสิตแนะนำให้ทางกลุ่มนิสิตรุ่นถัดไปร่วมมือกับทางมูลนิธิรักษ์ไทย มุ่งเน้นไปที่ความสนใจการปลูกกาแฟ

กาแฟเป็นพืชที่ควรจะนำมาเป็นพืชเศรษฐกิจแก่ชาวไทยภูเขาในทางภาคเหนือ สุดท้ายนี้ทางกลุ่มนิสิตแนะนำให้ทางกลุ่มนิสิตรุ่นถัดไปร่วมมือกับทางมูลนิธิรักษ์ไทย โดยมุ่งเน้นไปที่ความสนใจการปลูกกาแฟกาแฟเป็นพืชที่ควรจะนำมาเป็นพืชเศรษฐกิจแก่ชาวไทยภูเขาในทาง ภาคเหนือการปลูกต้นกาแฟนั้นเป็นตัวเลือกที่ดีสำหรับพื้นที่ทางภาคเหนือของไทยเพราะมีความเหมาะสมต่อการเพาะปลูกกาแฟพันธุ์อาราบิก้าซึ่งเป็นที่นิยมในตลาดกาแฟในปัจจุบัน ดังนั้นสิ่งนี้อาจจะเป็นการตัดสินใจที่ดีที่สุดสำหรับกลุ่มนิสิตและและทางมูลนิธิรักษ์ไทย หากแม้ในอนาคตนั้น กลุ่มนิสิตได้เล็งเห็นถึงข้อดีและข้อเสียของการปลูกข้าวโพด สิ่งนี้จะเป็นวิธีที่ทำให้กลุ่มนิสิตรุ่นถัดไปนั้นได้มีความเข้าใจมากขึ้นและตั้งอยู่ในแนวทางที่ถูกต้อง

อย่างไรก็ตามกลุ่มนิสิตมีความคาดหวังว่าคำแนะนำจากกลุ่มนิสิตจะเกิดประโยชน์แก่ทั้งทางกลุ่มนิสิตรุ่นถัดไป ทางมูลนิธิรักษ์ไทยและชาวบ้านไทยภูเขา และสามารถบรรลุเป้าหมายที่พึงพอใจสูงสุดจากการที่มีรายได้และผลกำไรที่เพิ่มมากขึ้นจากการแปรรูปผลผลิตกาแฟ

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APPENDIX A. Raks Thai Foundation

"Raks Thai Foundation" is a legacy of CARE International which helps people who are facing hardship, being disadvantaged and victims of natural disasters in Thailand along with its counterparts in approximately 80 countries of the world today. Raks Thai Foundation's mission is to strengthen the capacity of poor and disadvantaged communities to analyze root causes of problems, define suitable solutions and attend in development activities.

The CARE International was first established in 1945, after World War II, to assist and improve the suffering of people especially in European countries. The CARE International in Thailand was launched in 1979 to aid Cambodian war refugees. Relief centers were located at the borders of Thailand: Prachinburi, Trad, Chantaburi, and Surin. In 1984, the CARE International in Thailand expanded its movement to include disadvantaged communities in many areas in north region of Thailand.

Raks Thai Foundation was established on August 15, 1997 as an independent Thai local foundation to CARE International in promoting strong communities, assisting the disadvantaged in society, and developing local productivity. Dr. Krasae Chanawongse was appointed as the founding chairperson of the Raks Thai Foundation and continues in the role of Chair Executive Board up to present.

Raks Thai Foundation's purposes consist of enhancing individual capacity, especially for the lower income in difficult situations, in order to help them access resources and tools to lead productive, quality lives, with the ability to exercise their rights with honor. Raks Thai Foundation implements programs in five development areas: health promotion and prevention of HIV/AIDS; educational support; promotion of business, community enterprise and occupational development; management of natural resource and environment; and assistance and rehabilitation of victims of natural disasters.

For health promotion and prevention of HIV/AIDS, Raks Thai Foundation aims to increase awareness and understanding, with an emphasis on prevention of HIV/AIDS, by providing information about symptoms, treatments, and consequences, relevant to sex values on youth's attitudes.

For educational support, Raks Thai Foundation focuses on the improvement of learning process through communities as a source of wisdom and know-how. This includes general knowledge, leadership and vocational skills. On the occasion of the King's 84^{th} birthday anniversary, Raks Thai Foundation pays homage to His Majesty the King by means of demonstrating the "84 Years – 84 Schools" project. The project aims to expand opportunities for school-age youth from low-income families to achieve their educational potential and to acquire long-life skills of self-awareness and self-development.

For promotion of business, community enterprise and occupational development, Raks Thai Foundation promotes alternative occupations in the northeast region through knowledge management to raise the capacity of community enterprise in low-income villages. The activities include support for the production process through collaborative planning and management among communities, revolving funds and market development.

For management of natural resource and environment, Raks Thai Foundation's focuses on preserving the balance of sustainable communities while maintaining the diversity and abundance of the natural resources; building stable occupations in harmony with the environment upon the principles of "sufficiency economy"; reducing the consequences of natural disasters, food shortages, epidemics, and global warming.

For assistance and rehabilitation of victims of natural disasters, Raks Thai Foundation moves or migrates people from the area affected by catastrophe to a better place which can give them more sophisticated atmosphere in order to sustain their quality of life by trying to recover such wretch in both physical and mental. Sometimes government's support is needed because this kind of compensation is quite beyond the local's power. Raks Thai Foundation also provides food that is clean and medicine for victim since natural disaster, such as flooding, makes water and food dirty. Their task is to make sure that food and water meet the quality standard.

Raks Thai Foundation has played an important role as social workers for a long period of time; they take part in various kinds of development activities and try to determine the best solution for each problem by analyzing from the root cause. Among these many kinds of works, one of the significant Raks Thai's goals is occupation development. They support underprivileged hill tribes in Northern area in order to gain more income by promoting alternative occupations. Basically, such hill tribe's villagers are full of unique folk wisdom; they can produce handicrafts made from abundant local resources. The thing is they still lack of knowledge in management and have no value added on each product. By this limited factor, it seems like they cannot gain full benefits as they deserve.

As our project deals directly with market development, we have highly attempt to build a new business model for hill tribe's community. The main purpose is to diversify market linkages to sell local products at larger margins by using knowledge from industrial management which we have studied so far. Moreover, one of our group members is from material science major, so he may adapt skills for product screening or selection process. As a result, we will create business model which can be used efficiently in both ways; producing and marketing.

By all means, running our project successfully can sustain benefits of the hill tribe communities which obviously meet Raks Thai Foundation's obligation. Promoting more income from such business model, large amount of profit will be returned to the villagers which makes them have more confident to proudly stand on their own throughout the crucial social stream.

Although, Raks Thai Foundation is full of high potential and power in developing and strengthening the hill tribe communities, there are challenges to their ability to accomplish their mission and the proposed project. Shown below are the lists of challenges that Raks Thai Foundation may face:

1. Business location – the location of a business is the place where it is situated; hence, three basic factors that need to be considered in choosing a location for a business are market, raw materials and transportation costs. The nearness of the market and the cost of delivering the goods are likely to be important factors. If the raw materials are bulky or expensive to transport, nearer place seems to be better in order to saving value of the products. Also, fuel's price has been increasing every interim, thus it would be better to find the location near the warehouses.

2. Educating villagers – Raks Thai Foundation needs to show how important of the marketing is by using rapid and simple teaching material models, so that the villagers will understand and willingly learn to improve their skills and productivity in order to gain a reliable and more income from the product sales.

3. Customers - target customers must be identified in order to know their wants and tastes so that the hill tribe villagers can motivate them to buy the products. What challenges the most is "what if no one buys the products."

4. Resistance to change – many tribes do not wish to change their traditions and participate in the projects. Therefore, Raks Thai Foundation needs to find the most efficient and effective way to persuade them.

5. Price is too low – the tribes do not have time or resources to find a market that will support and allow them to sell products in high price. They tend to settle for low prices because they need an immediate source of money to pay for physiological needs, such as food and healthcare. It challenges Raks Thai Foundation in a way that the price of the product must be higher to benefit the villagers and be affordable to customers in order to get their attention.

6. Diversity – Raks Thai Foundation and the hill tribe villagers are absolutely different which can cause troubles such as misunderstanding when communicates due to different spoken languages and cultures. Difference in perspective can lead to uncontrolled product quality. Since different people have different standard, understanding each other's standard and setting up the same goal are necessary to prevent mistakes and errors.

7. Economic downturn – this must be concerned when there comes an economic downturn at the time Raks Thai Foundation is working hard on the project. The business model will not successfully work unless there are contingency plans to back up the economic downturn situation.

8. Product inventory – there are many environmental factors which can affect quality of the products such as temperature and humidity; thus, if the inventory or storage is not good enough or seems to be low grade, some negative effects might be occurred on the products.

9. Environmental concerns – impacts from environment, such as natural disaster, can cause a lot of problems to both Raks Thai Foundation and the hill tribe villagers: shortening productivity; damaging natural resources; breaking transportation pathway; harming both organizational people's and villager's health; and cutting off network connection.

10. Leadership – the Leadership Succession Research studies on nonprofits suggest that there is a leadership capacity deficit in the nonprofit sector. Raks Thai Foundation as a nonprofit organizations needs to build their leadership capacity and improve their succession planning. Raks Thai Foundation sector has wonderful leaders and these leaders have passionately participated in the sector's growth over the years. Yet, some of these same leaders find it difficult to guide the organization's strategic plan and may not have a succession plan in place. While leadership seats in these organizations may not be currently vacant, a retirement or a quick departure from the organization could leave the nonprofit organization empty-handed when it comes to leadership succession.

APPENDIX B. Interview Questions

Objective 1: Specify standardized coffee transformation processes from successful organizations

1. How do you know that coffee cherries are ready to pick, what time is the best time for picking coffee cherries? And Why?
2. As we did a research on coffee transformation processes, we knew that there are two methods for transforming coffee cherries into coffee parchment, which is dry and wet method, we would like to know that what is the difference between two methods, and which method is suitable for Arabica coffee cherries?
3. How long does it take to transform one coffee stage to another stage, and which factors or steps involve in transforming each coffee stage?
4. How many kilograms of coffee cherries can you harvest during the harvesting season?
5. How long for keeping products until it rotten in each process? Have you ever let your product expired and How do you store your remaining product?

Objective 2: Determine concerns regarding coffee selling of hill-tribe farmers in Mae Chaem, Chiang Mai

1. Is there any investment cost from growing coffee?
2. How many kilograms of coffee cherries can you sell during the harvesting season?
3. How much income do you gain from selling coffee a year?
4. Do you have any transportation cost from selling coffee? If yes, How much of it?
5. Do the price of coffee cherry or coffee parchment varies much?
6. Do you have daily accounting in the family
7. Do you have any spare money in case of emergency?

Objective 3: Define coffee transformation processes and factors in each process from the hill-tribe villages

1. Which stage of coffee product that you would able to sell?
2. Do you know there are also some machines involving in coffee transformation processes?
3. Do you know how to transform one coffee stage into further stage? If yes, why don't you transform to further stage to get higher income?
4. Are you ready to move on the next stage if they're any opportunity?
5. Is money the most concerning issue for you? If not, what else?

APPENDIX C. Coffee Successful Organizations

1. Doi Chaang Coffee

In 1969, the Royal Project was established, under the royal patronage of His Majesty the King, to assist the northern hill-tribe people, who were engaging in unsustainable farming practices, and encourage people to grow other winter cash crops instead of opium. Doi Chaang coffee was found in 1983, with the help of the government and local communities. It began when the hill tribes of the Doi Chang village agreed to generate their own coffee company to solve the problem of selling high quality coffee beans for minimal prices to middlemen. They established themselves as independent, successful coffee producers under the commitment of maintaining sustainable agriculture with minimal impact on the environment. The main crop of Doi Chaang is Arabica coffee, because it is a wintery sustainable crop. Arabica coffee suits both geographic and weather conditions of Doi Chaang's location where the elevation is about 1100-1700 above sea level. Due to the specialty coffee which was committed to offering Doi Chaang Coffee as a single-estate, certified organic Arabica, a group of Canadian coffee enthusiasts has brought Doi Chaang Coffee into the international market as their partners.

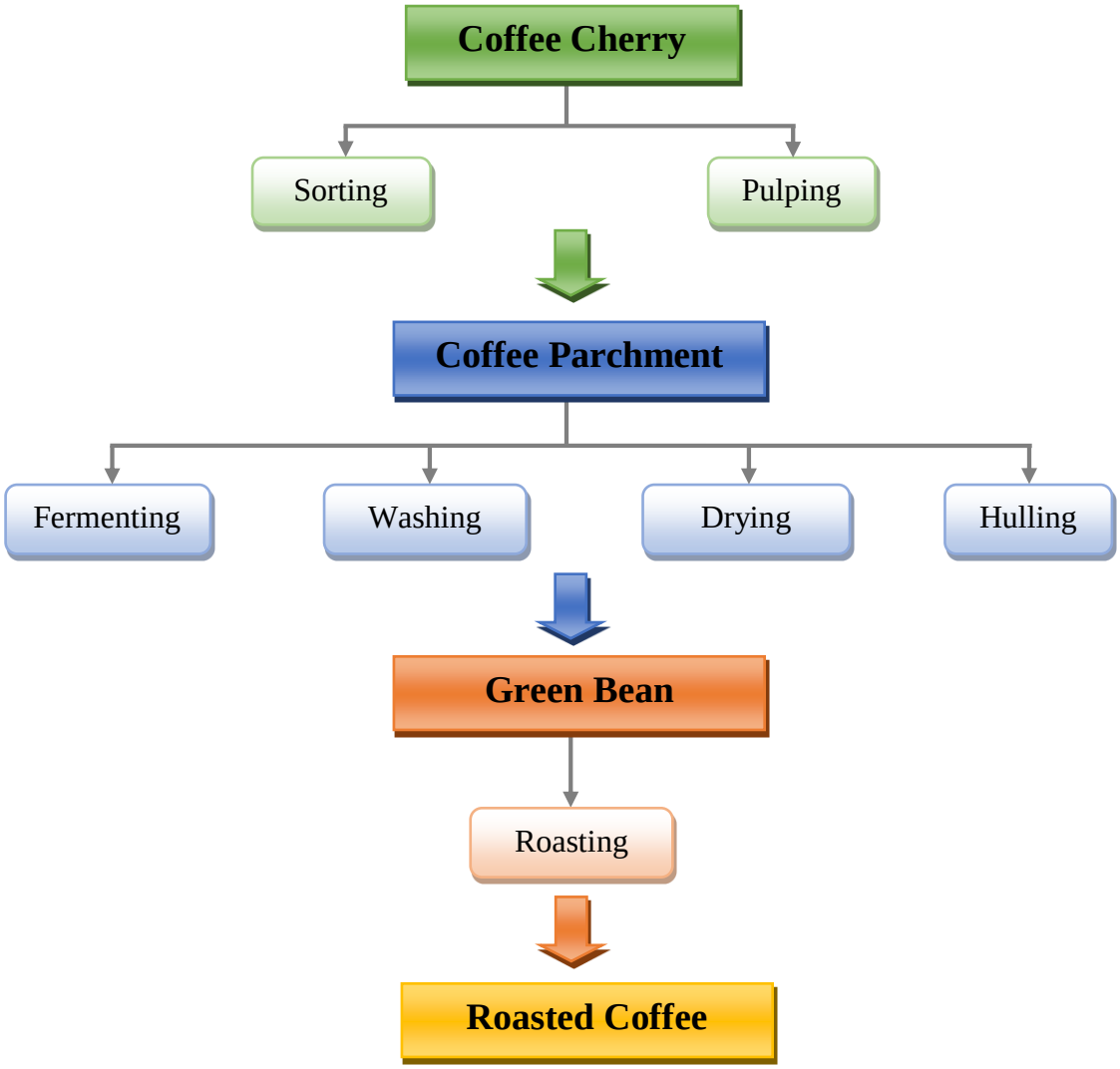
2. Research and Development of Coffee on the Highland Chiang Mai

The Highland Research and Training Center locates in research institute complex, alongside Mae Taeng Irrigation canal within Chiang Mai Univeristy. The Center was established in 2001. One of development units name is Highland Coffee Research and Development Center supported by the Netherlands government. Their aim is to support coffee farmers on highland to be able to sustain themselves on coffee production process including other interested entrepreneur. The facility consists of classrooms, laboratories, a roasting facility, seedbeds and a small coffee shop.

3. Intanon Coffee

Intanon Coffee selects only good quality coffee from the best planting areas of Thailand which are located around 1000 – 1300 meters above sea level. Intanon Coffee buys coffee cherries or coffee parchment from the hill tribes in order to enhance their quality of life. Coffee cherries take more than 10 months from flowering to being ripe cherries, gathering nutrition to become good quality. The cherries are then transformed to green beans or roasted coffee by Intanon Coffee's workers. Intanon Coffee's tasks are: determining brewing process and green coffee production; checking for the pest; and identifying acid – base and humidity level of coffee beans. The humidity level is measured using the Moisture Balance machine. Every bag of coffee is tested before hulling and roasting to prevent stain of low quality green beans and roasted coffee. The quality is implemented using a test colorimeter machine based on SCAA (Specialty Coffee Association of America). Every cup of Intanon Coffee is proudly present, with the best quality of coffee beans, by baristas who build not only the reputation, but also the happiness of the customers.

APPENDIX D. Coffee Transformation Processes



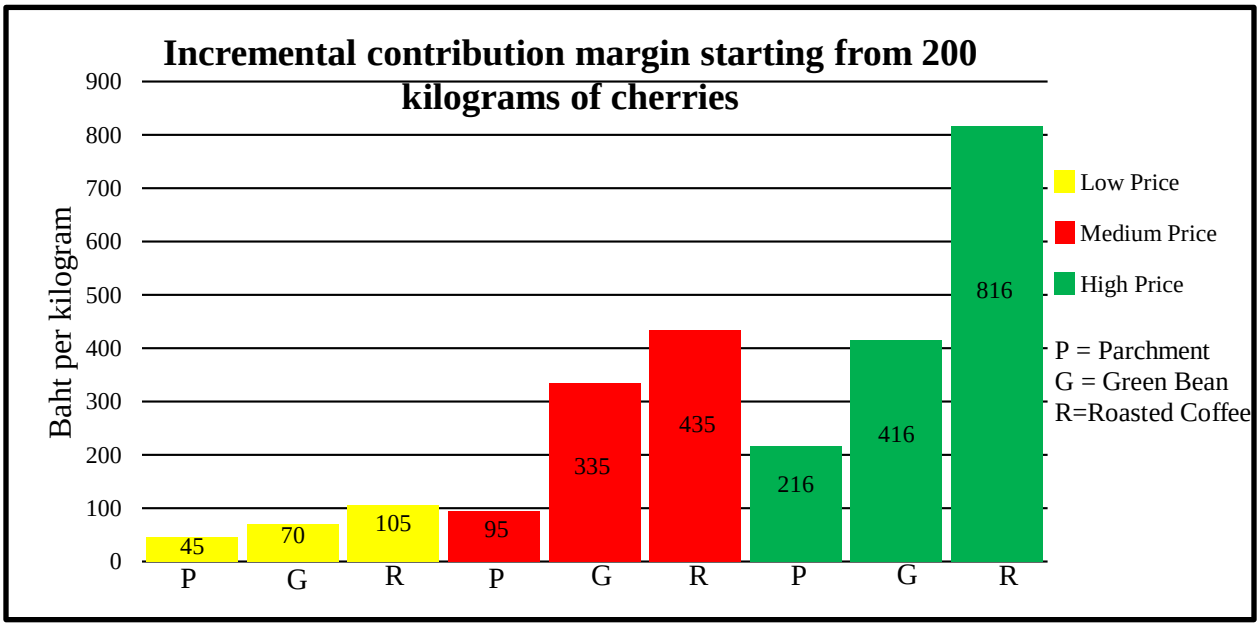
APPENDIX E. Financial calculations for each coffee transformation process

A. Highest cost of machine

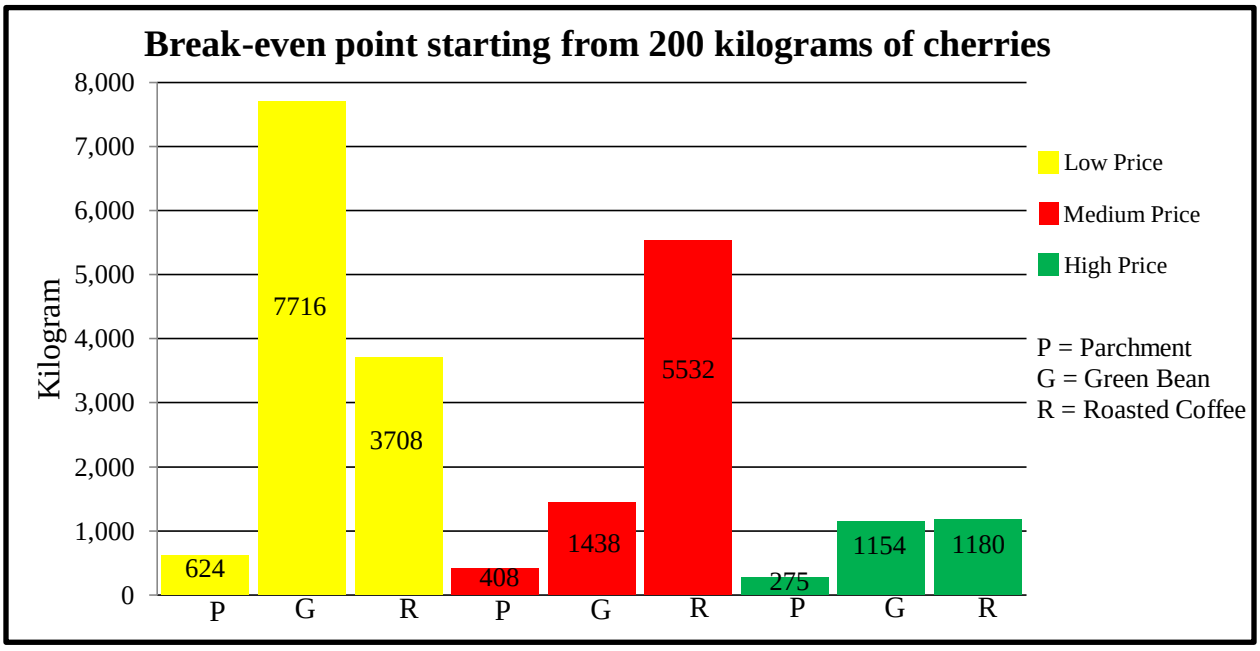
Table A.1 Table of financial calculation with the productivity starting from 200 kilograms of cherries with highest cost of machine

High price	Based on market price of arabica coffee in 2556-2557											
Medium price	**With the highest cost of machine**											
Low price	*There is no significant difference in the graph of parchment to roasting stage due to decimal point ignorance.											
(Assume 200 kg Cherry in 1 year)	Harvesting to Cherry			Cherry to Parchment			Parchment to Green Bean			Green Bean to Roasted Coffee		
	Revenue											
Price (bht/kg)	10	12	15	60	85	120	160	400	500	400	600	1000
Productivity	1:1	1:1	1:1	5:1	5:1	5:1	5:4	5:4	5:4	1:1	1:1	1:1
Total Revenue (bht)*	2000	2400	3000	2400	3400	4800	25600	64000	80000	64000	96000	160000
Expense	Fixed cost											
Machine (bht)	0	0	0	27000	27000	27000	380000	380000	380000	450000	450000	450000
Expense	Variable cost											
Transportation distance (km)	0	0	0	300	300	300	300	300	300	300	300	300
Disel oil cost (bht/L)	0	0	0	25	25	25	25	25	25	25	25	25
Used liters (L/km)	0	0	0	13	13	13	13	13	13	13	13	13
Product Transportation cost (bht)	0	0	0	650	650	650	650	650	650	650	650	650
Transportation (bht/kg)	0	0	0	3	3	3	3	3	3	3	3	3
Labour (bht)	8	8	8	8	8	8	8	8	8	8	8	8
Rent/Maintainance (bht/kg)	0	0	0	2	2	2	28	28	28	36	36	36
Electricity (bht/month)	0	0	0	200	200	200	2800	2800	2800	3640	3640	3640
Electricity(bht/kg)	0	0	0	2	2	2	26	26	26	137	137	137
Total Expense (bht/kg)*	0	0	0	15	15	15	66	66	66	184	184	184
Contribute Margin (bht/kg)	2	4	7	45	70	105	95	335	435	216	416	816
Kilogram to breakeven point	0	0	0	597	384	257	4021	1136	875	2085	1082	552
Incremental contribution margin(bht/kg)	**0**	**0**	**0**	**43**	**66**	**98**	**49**	**264**	**329**	**121**	**81**	**381**
Break even for parchment (kg)	**0**	**0**	**0**	**624**	**408**	**275**	**0**	**0**	**0**	**0**	**0**	**0**
Break even for green bean (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**7716**	**1438**	**1154**	**0**	**0**	**0**
Break even for roasted coffee (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3708**	**5532**	**1180**
Payback period (yr)	**0**	**0**	**0**	**16**	**10**	**7**	**48**	**9**	**7**	**23**	**35**	**7**

Graph A.1.1 Incremental contribution margin starting from 200 kilograms of cherries



Graph A.1.2 Break-even point starting from 200 kilograms of cherries



Graph A.1.3 Payback period starting from 200 kilograms of cherries

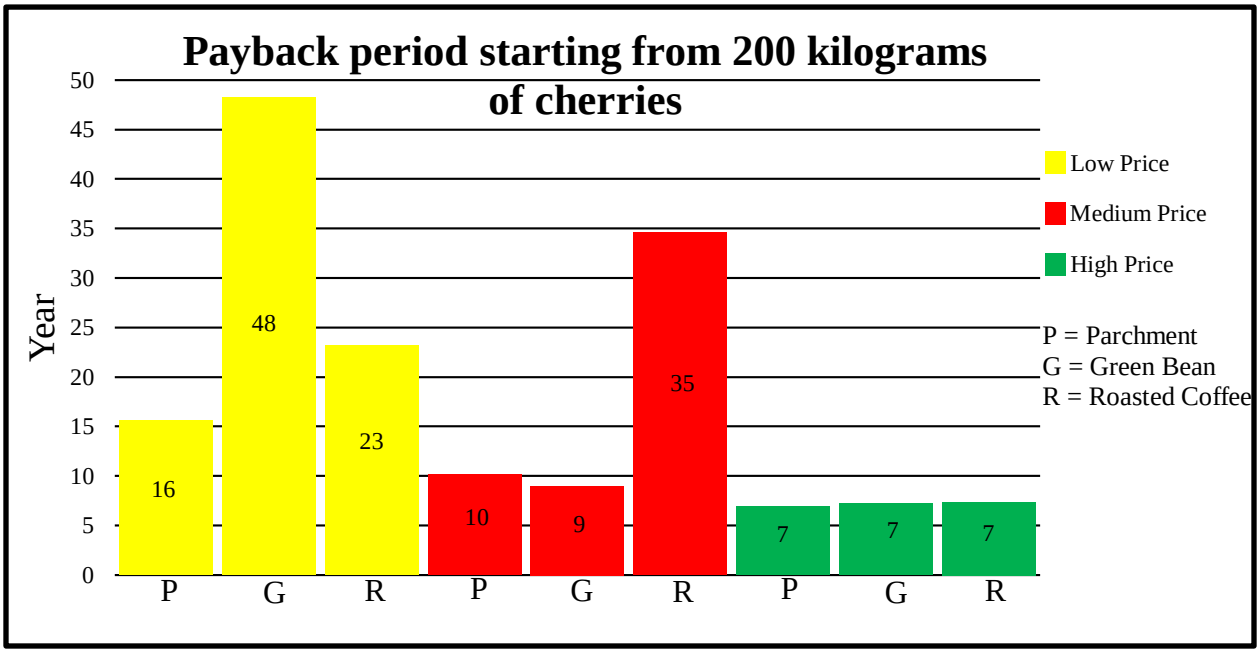
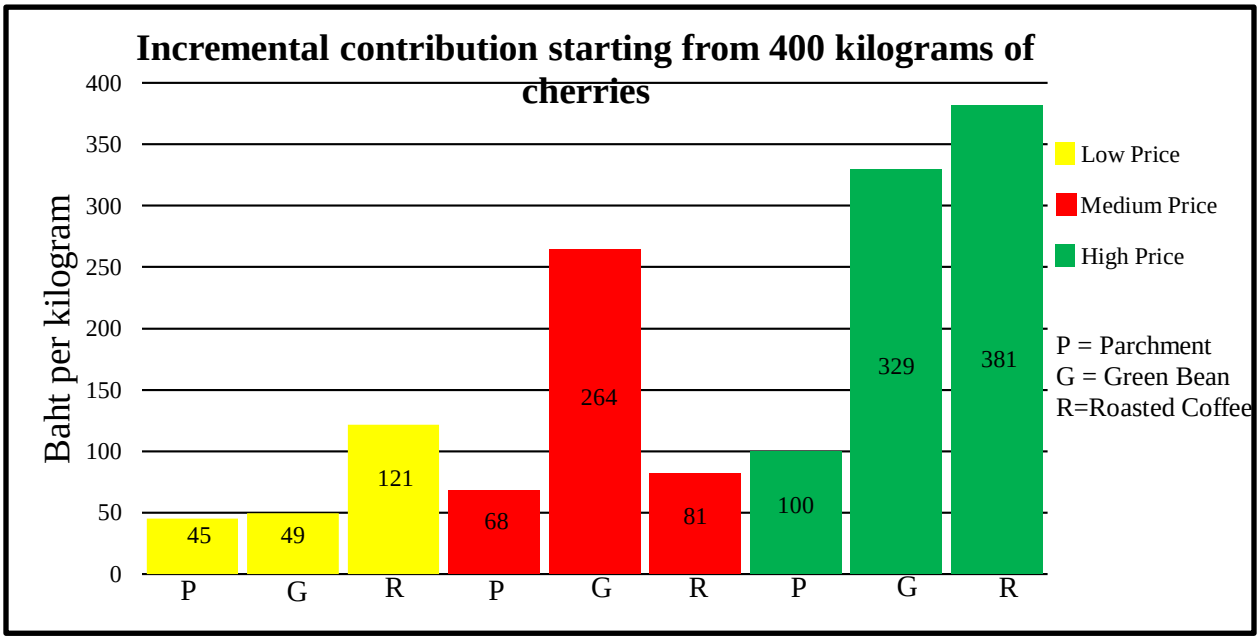


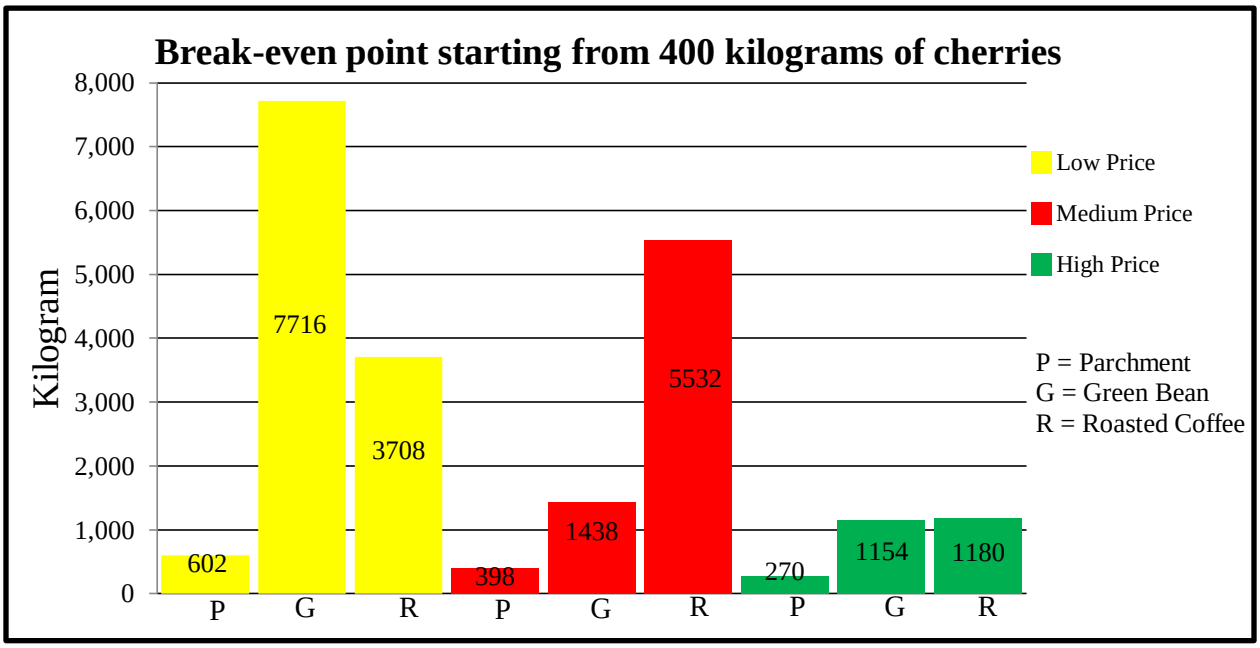
Table A.2 Table of financial calculation with productivity starting from 400 kilograms of cherries with highest cost of machine

High price Medium price Low price	Based on market price of arabica coffee in 2556-2557 **With the highest cost of machine** *There is no significant difference in the graph of parchment to roasting stage due to decimal point ignorance.											
(Assume 400 kg Cherry in 1 year)	Harvesting to Cherry			Cherry to Parchment			Parchment to Green Bean			Green Bean to Roasted Coffee		
Revenue												
Price (bht/kg)	10	12	15	60	85	120	160	400	500	400	600	1000
Productivity	1:1	1:1	1:1	5:1	5:1	5:1	5:4	5:4	5:4	1:1	1:1	1:1
Total Revenue (bht)*	4,000	4,800	6,000	4,800	6,800	9,600	51,200	128,000	160,000	128,000	192,000	320,000
Expense	Fixed cost											
Machine (bht)	0	0	0	27,000	27,000	27,000	380,000	380,000	380,000	450,000	450,000	450,000
Expense	Variable cost											
Transportation distance (km)	0	0	0	300	300	300	300	300	300	300	300	300
Disel oil cost (bht/L)	0	0	0	25	25	25	25	25	25	25	25	25
Used liters (L/km)	0	0	0	13	13	13	13	13	13	13	13	13
Product Transportation cost (bht)	0	0	0	650	650	650	650	650	650	650	650	650
Transportation (bht/kg)	0	0	0	2	2	2	2	2	2	2	2	2
Labour (bht)	8	8	8	8	8	8	8	8	8	8	8	8
Rent/Maintainance (bht/kg)	0	0	0	2	2	2	28	28	28	36	36	36
Electricity (bht/month)	0	0	0	200	200	200	2,800	2,800	2,800	3,640	3,640	3,640
Electricity(bht/kg)	0	0	0	2	2	2	26	26	26	137	137	137
Total Expense (bht/kg)*	0	0	0	13	13	13	64	64	64	183	183	183
Contribute Margin (bht/kg)	2	4	7	47	72	107	96	336	436	217	417	817
Kilogram to breakeven point	0	0	0	576	376	253	3,953	1,131	871	2,069	1,078	550
Incremental contribution margin(bht/kg)	**0**	**0**	**0**	**45**	**68**	**100**	**49**	**264**	**329**	**121**	**81**	**381**
Break even for parchment (kg)	**0**	**0**	**0**	**602**	**398**	**270**	**0**	**0**	**0**	**0**	**0**	**0**
Break even for green bean (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**7,716**	**1,438**	**1,154**	**0**	**0**	**0**
Break even for roasted coffee (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3,708**	**5,532**	**1,180**
Payback period (yr)	**0**	**0**	**0**	**8**	**5**	**3**	**24**	**6**	**5**	**15**	**23**	**5**

Graph A.2.1 Incremental contribution margin starting from 400 kilograms of cherries.



Graph A.2.2 Break-even point starting from 400 kilograms of cherries



Graph A.2.3 Payback period starting from 400 kilograms of cherries

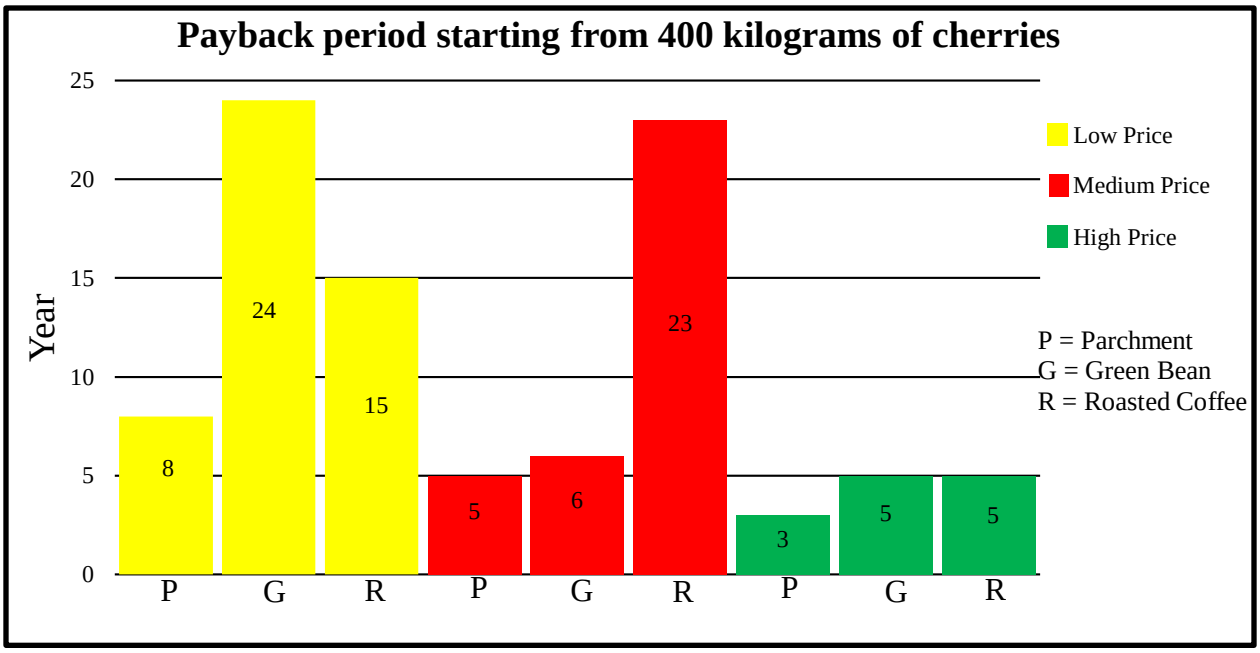
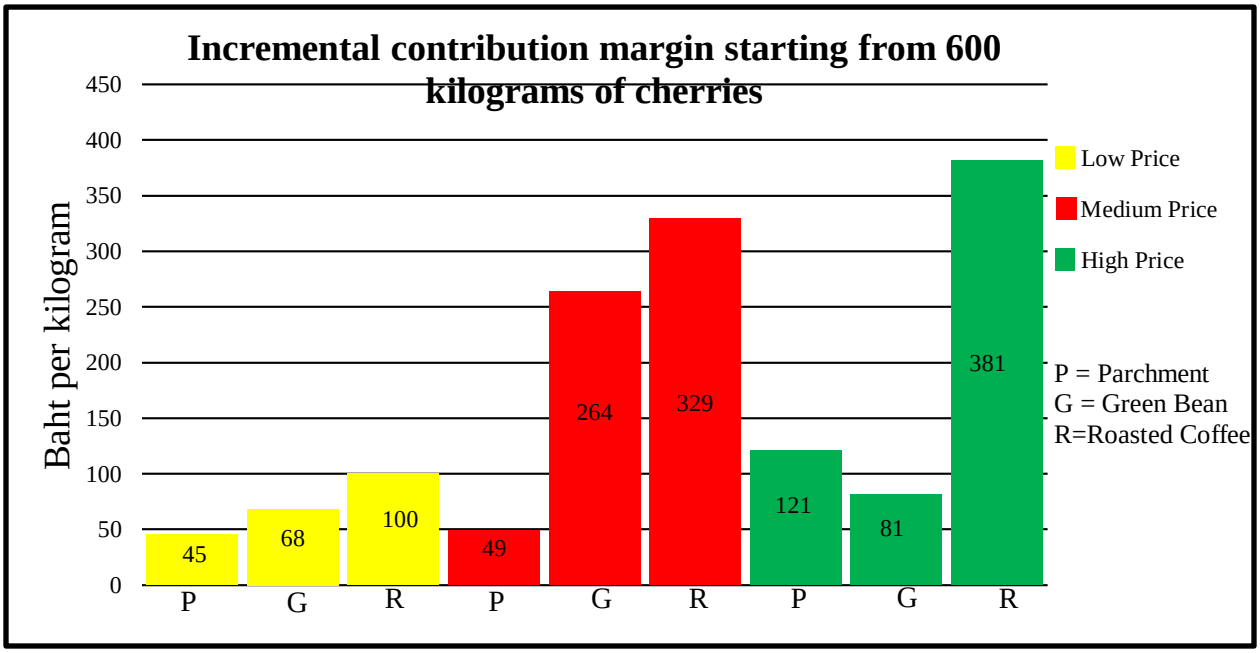


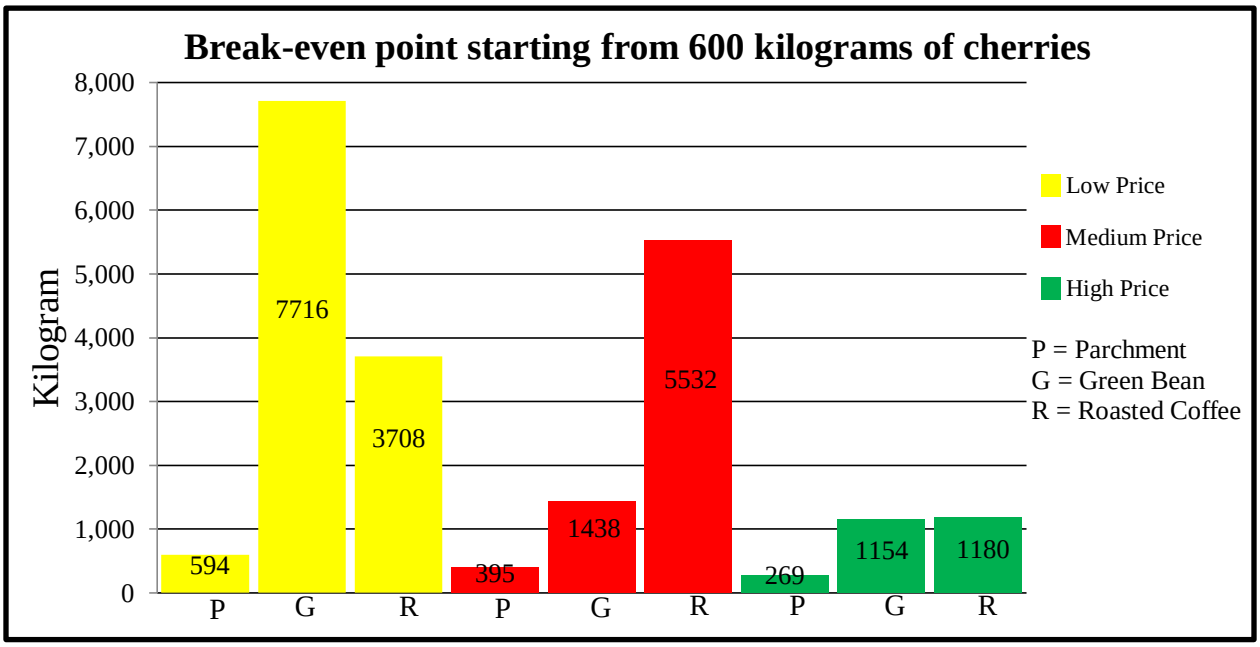
Table A.3 Table of financial calculation with the productivity starting from 600 kilograms with highest cost of machine

High price	Based on market price of arabica coffee in 2556-2557											
Medium price	**With the highest cost of machine**											
Low price	*There is no significant difference in the graph of parchment to roasting stage due to decimal point ignorance.											
(Assume 600 kg Cherry in 1 year)	Harvesting to Cherry			Cherry to Parchment			Parchment to Green Bean			Green Bean to Roasted Coffee		
Revenue												
Price (bht/kg)	10	12	15	60	85	120	160	400	500	400	600	1,000
Productivity	1:1	1:1	1:1	5:1	5:1	5:1	5:4	5:4	5:4	1:1	1:1	1:1
Total Revenue (bht)*	6,000	7,200	9,000	7,200	10,200	14,400	76,800	192,000	240,000	192,000	288,000	480,000
Expense	Fixed cost											
Machine (bht)	0	0	0	27,000	27,000	27,000	380,000	380,000	380,000	450,000	450,000	450,000
Expense	Variable cost											
Transportation distance (km)	0	0	0	300	300	300	300	300	300	300	300	300
Disel oil cost (bht/L)	0	0	0	25	25	25	25	25	25	25	25	25
Used liters (L/km)	0	0	0	13	13	13	13	13	13	13	13	13
Product Transportation cost (bht)	0	0	0	650	650	650	650	650	650	650	650	650
Transportation (bht/kg)	0	0	0	1	1	1	1	1	1	1	1	1
Labour (bht)	8	8	8	8	8	8	8	8	8	8	8	8
Rent/Maintainance (bht/kg)	0	0	0	2	2	2	28	28	28	36	36	36
Electricity (bht/month)	0	0	0	200	200	200	2,800	2,800	2,800	3,640	3,640	3,640
Electricity(bht/kg)	0	0	0	2	2	2	26	26	26	137	137	137
Total Expense (bht/kg)*	0	0	0	13	13	13	63	63	63	182	182	182
Contribute Margin (bht/kg)	2	4	7	47	72	107	97	337	437	218	418	818
Kilogram to breakeven point	0	0	0	569	373	251	3,931	1,129	870	2,064	1,077	550
Incremental contribution margin(bht/kg)	**0**	**0**	**0**	**45**	**68**	**100**	**49**	**264**	**329**	**121**	**81**	**381**
Break even for parchment (kg)	**0**	**0**	**0**	**594**	**395**	**269**	**0**	**0**	**0**	**0**	**0**	**0**
Break even for green bean (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**7,716**	**1,438**	**1,154**	**0**	**0**	**0**
Break even for roasted coffee (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3,708**	**5,532**	**1,180**
Payback period (yr)	**0**	**0**	**0**	**5**	**3**	**2**	**16**	**3**	**2**	**8**	**12**	**2**

Graph A.3.1 Incremental contribution margin starting from 600 kilograms of cherries



Graph A.3.2 Break-even point starting from 600 kilograms of cherries



Graph A.3.3 Payback period starting from 600 kilograms of cherries

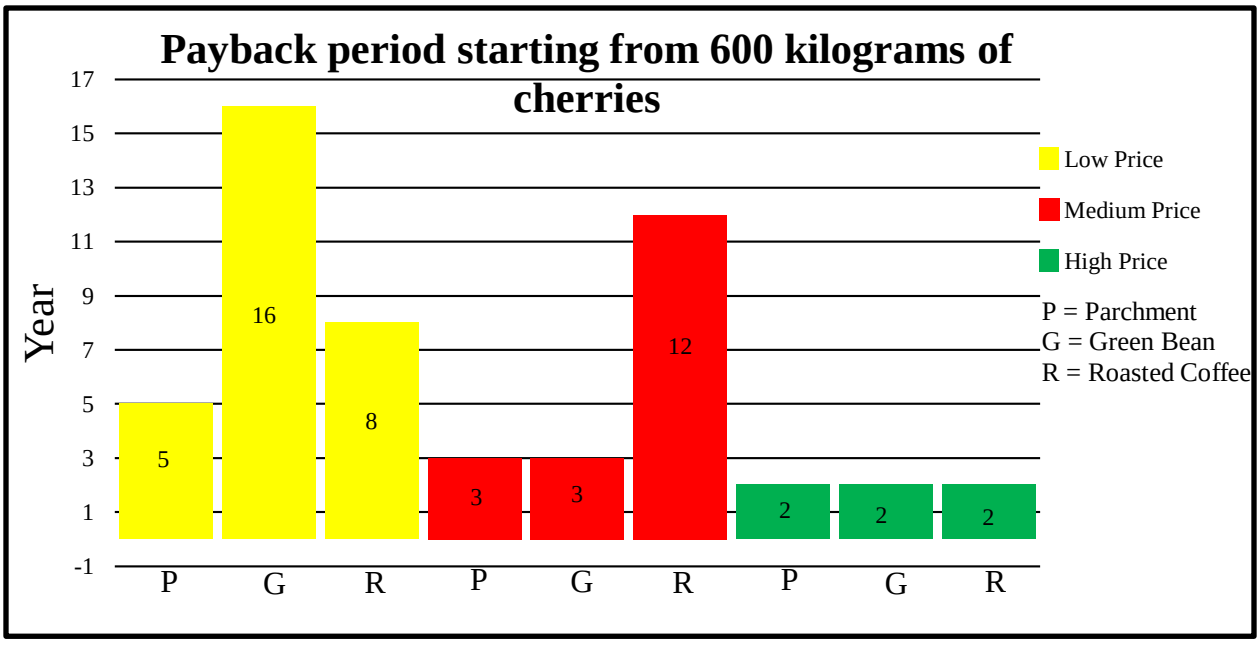
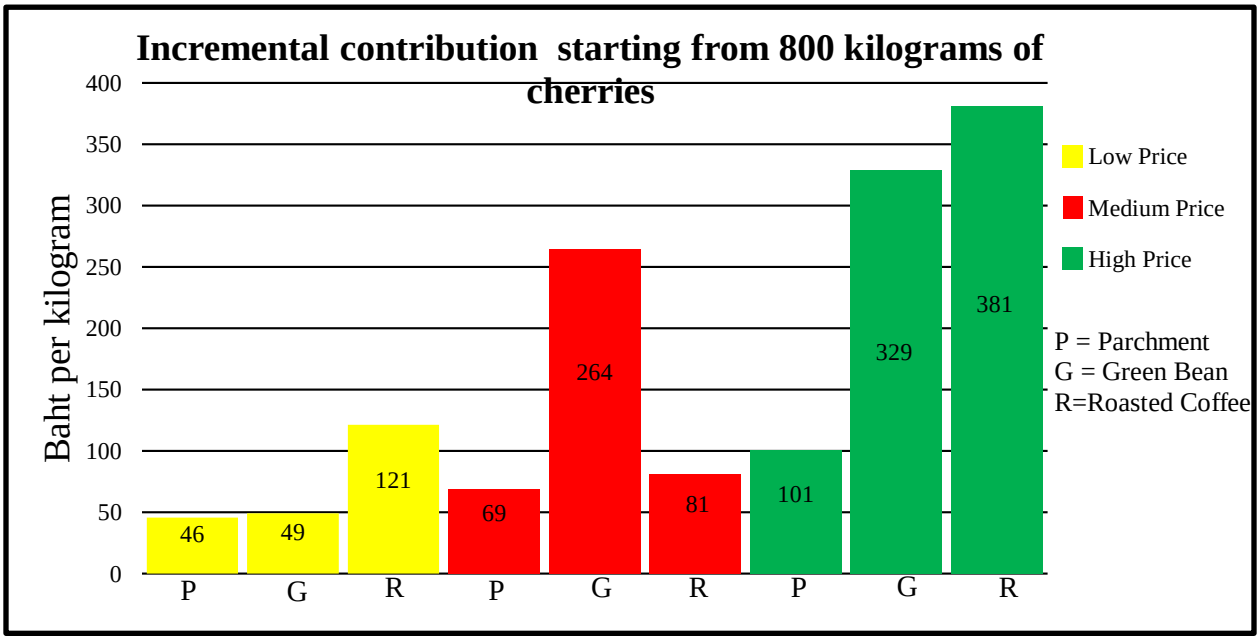


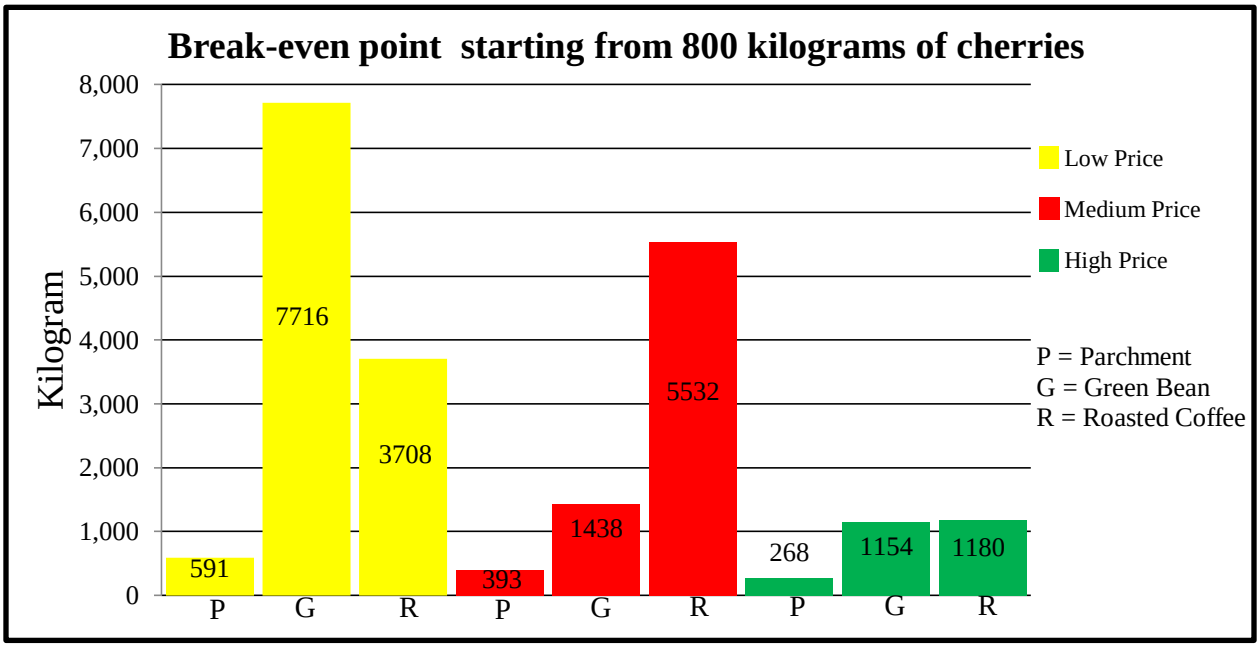
Table A.4 Table of financial calculation with productivity starting from 800 kilograms of cherries with highest cost of machine

High price	Based on market price of arabica coffee in 2556-2557											
Medium price	**With the highest cost of machine**											
Low price	*There is no significant difference in the graph of parchment to roasting stage due to decimal point ignorance.											
(Assume 800 kg Cherry in 1 year)	Harvesting to Cherry			Cherry to Parchment			Parchment to Green Bean			Green Bean to Roasted Coffee		
	Revenue											
Price (bht/kg)	10	12	15	60	85	120	160	400	500	400	600	1000
Productivity	1:1	1:1	1:1	5:01	5:1	5:01	5:04	5:4	5:04	1:01	1:1	1:01
Total Revenue (bht)*	8000	9600	12000	9600	13600	19200	102400	256000	320000	256000	384000	640000
Expense	Fixed cost											
Machine (bht)	0	0	0	27,000	27,000	27,000	380,000	380,000	380,000	450,000	450,000	450,000
Expense	Variable cost											
Transportation distance (km)	0	0	0	300	300	300	300	300	300	300	300	300
Disel oil cost (bht/L)	0	0	0	25	25	25	25	25	25	25	25	25
Used liters (L/km)	0	0	0	13	13	13	13	13	13	13	13	13
Product Transportation cost (bht)	0	0	0	650	650	650	650	650	650	650	650	650
Transportation (bht/kg)	0	0	0	1	1	1	1	1	1	1	1	1
Labour (bht)	8	8	8	8	8	8	8	8	8	8	8	8
Rent/Maintainance (bht/kg)	0	0	0	2	2	2	28	28	28	36	36	36
Electricity (bht/month)	0	0	0	200	200	200	2,800	2,800	2,800	3,640	3,640	3,640
Electricity(bht/kg)	0	0	0	2	2	2	26	26	26	137	137	137
Total Expense (bht/kg)*	0	0	0	12	12	12	63	63	63	182	182	182
Contribute Margin (bht/kg)	2	4	7	48	73	108	97	337	437	218	418	818
Kilogram to breakeven point	0	0	0	566	371	251	3,920	1,128	870	2,062	1,076	550
Incremental contribution margin(bht/kg)	**0**	**0**	**0**	**46**	**69**	**101**	**49**	**264**	**329**	**121**	**81**	**381**
Break even for parchment (kg)	**0**	**0**	**0**	**591**	**393**	**268**	**0**	**0**	**0**	**0**	**0**	**0**
Break even for green bean (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**7,716**	**1,438**	**1,154**	**0**	**0**	**0**
Break even for roasted coffee (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3,708**	**5,532**	**1,180**
Payback period (yr)	**0**	**0**	**0**	**4**	**2**	**2**	**12**	**2**	**2**	**6**	**9**	**2**

Graph A.4.1 Incremental contribution starting from 800 kilograms of cherries



Graph A.4.2 Break-even point starting from 800 kilograms of cherries



Graph A.4.3 Payback period starting from 800 kilograms of cherries

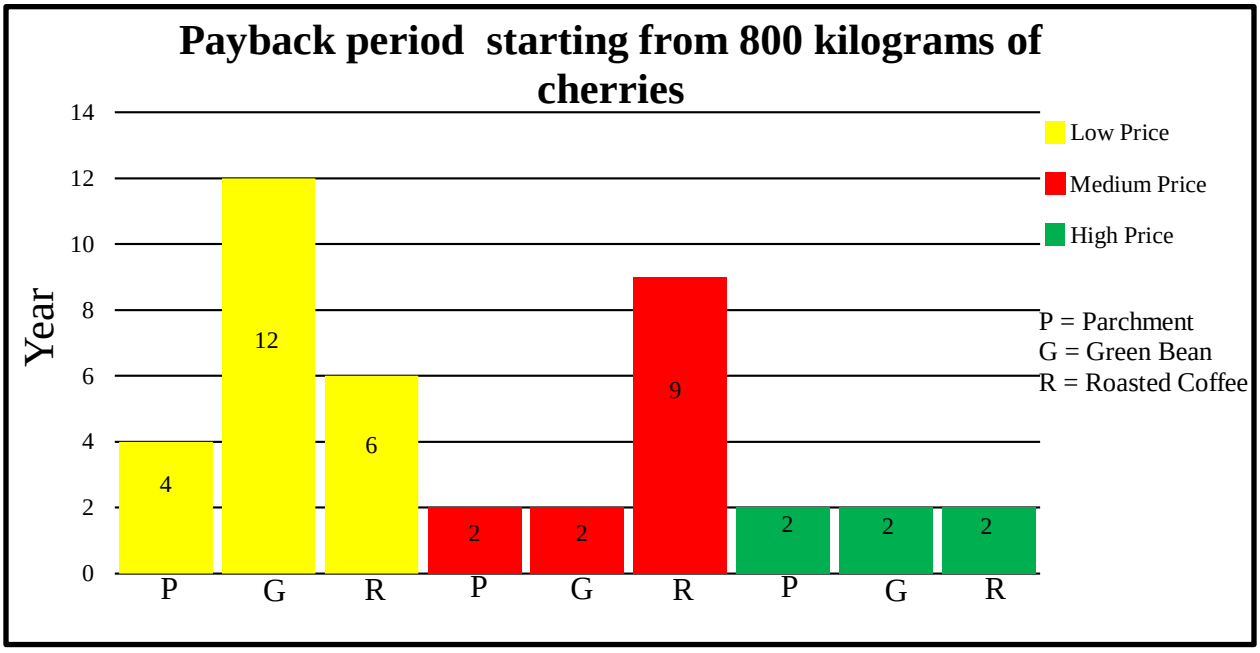
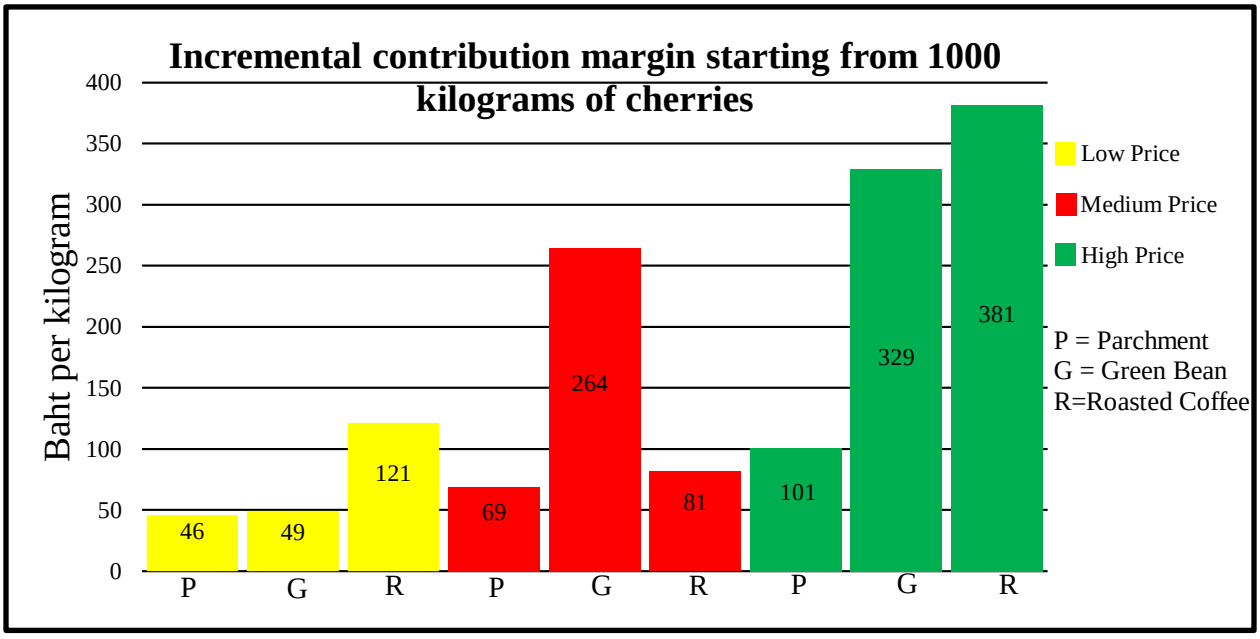


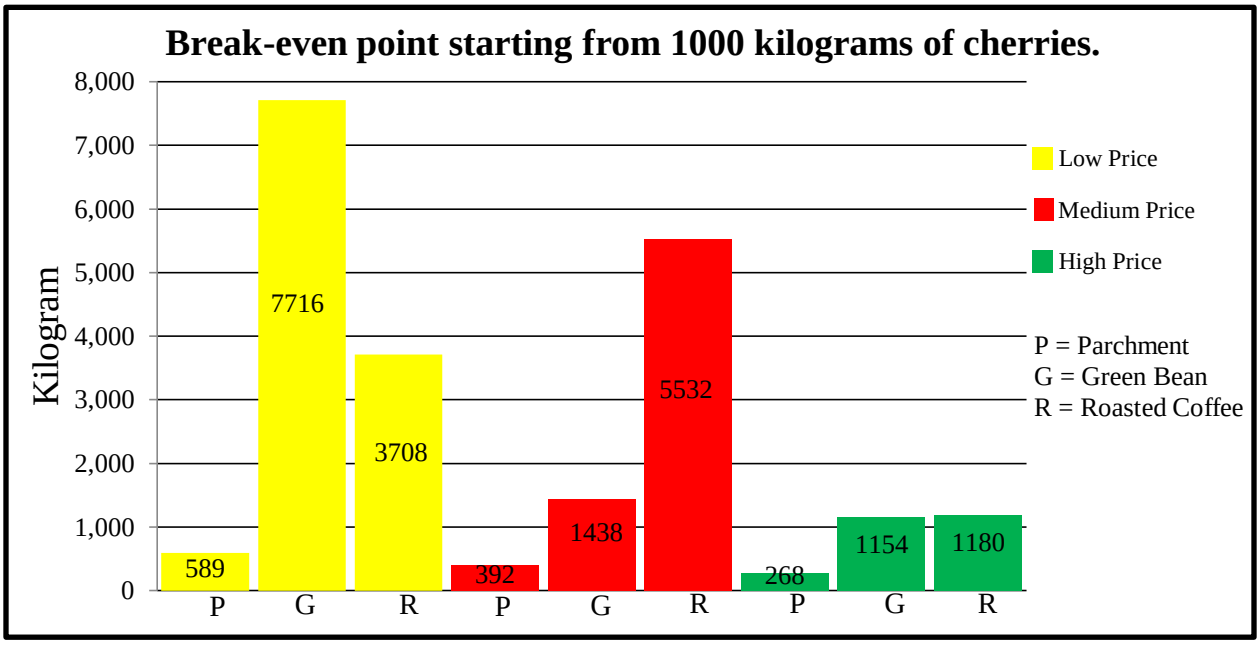
Table A.5 Table of financial calculation with the productivity starting from 1000 kilograms of cherries with highest cost of machine

High price	Based on market price of arabica coffee in 2556-2557											
Medium price	**With the highest cost of machine**											
Low price	*There is no significant difference in the graph of parchment to roasting stage due to decimal point ignorance.											
(Assume 1000 kg Cherry in 1 year)	Harvesting to Cherry			Cherry to Parchment			Parchment to Green Bean			Green Bean to Roasted Coffee		
Revenue												
Price (bht/kg)	10	12	15	60	85	120	160	400	500	400	600	1000
Productivity	0	0	0	0	0	0	0	0	0	0	0	0
Total Revenue (bht)*	10,000	12,000	15,000	12,000	17,000	24,000	128,000	320,000	400,000	320,000	480,000	800,000
Expense	Fixed cost											
Machine (bht)	0	0	0	27,000	27,000	27,000	380,000	380,000	380,000	450,000	450,000	450,000
Expense	Variable cost											
Transportation distance (km)	0	0	0	300	300	300	300	300	300	300	300	300
Disel oil cost (bht/L)	0	0	0	25	25	25	25	25	25	25	25	25
Used liters (L/km)	0	0	0	13	13	13	13	13	13	13	13	13
Product Transportation cost (bht)	0	0	0	650	650	650	650	650	650	650	650	650
Transportation (bht/kg)	0	0	0	1	1	1	1	1	1	1	1	1
Labour (bht)	8	8	8	8	8	8	8	8	8	8	8	8
Rent/Maintainance (bht/kg)	0	0	0	2	2	2	28	28	28	36	36	36
Electricity (bht/month)	0	0	0	200	200	200	2,800	2,800	2,800	3,640	3,640	3,640
Electricity(bht/kg)	0	0	0	2	2	2	26	26	26	137	137	137
Total Expense (bht/kg)*	0	0	0	12	12	12	63	63	63	182	182	182
Contribute Margin (bht/kg)	2	4	7	48	73	108	97	337	437	218	418	818
Kilogram to breakeven point	0	0	0	564	371	250	3,913	1,127	869	2,060	1,075	550
Incremental contribution margin(bht/kg)	**0**	**0**	**0**	**46**	**69**	**101**	**49**	**264**	**329**	**121**	**81**	**381**
Break even for parchment (kg)	**0**	**0**	**0**	**589**	**392**	**268**	**0**	**0**	**0**	**0**	**0**	**0**
Break even for green bean (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**7,716**	**1,438**	**1,154**	**0**	**0**	**0**
Break even for roasted coffee (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3,708**	**5,532**	**1,180**
Payback period (yr)	**0**	**0**	**0**	**3**	**2**	**1**	**10**	**2**	**1**	**5**	**7**	**1**

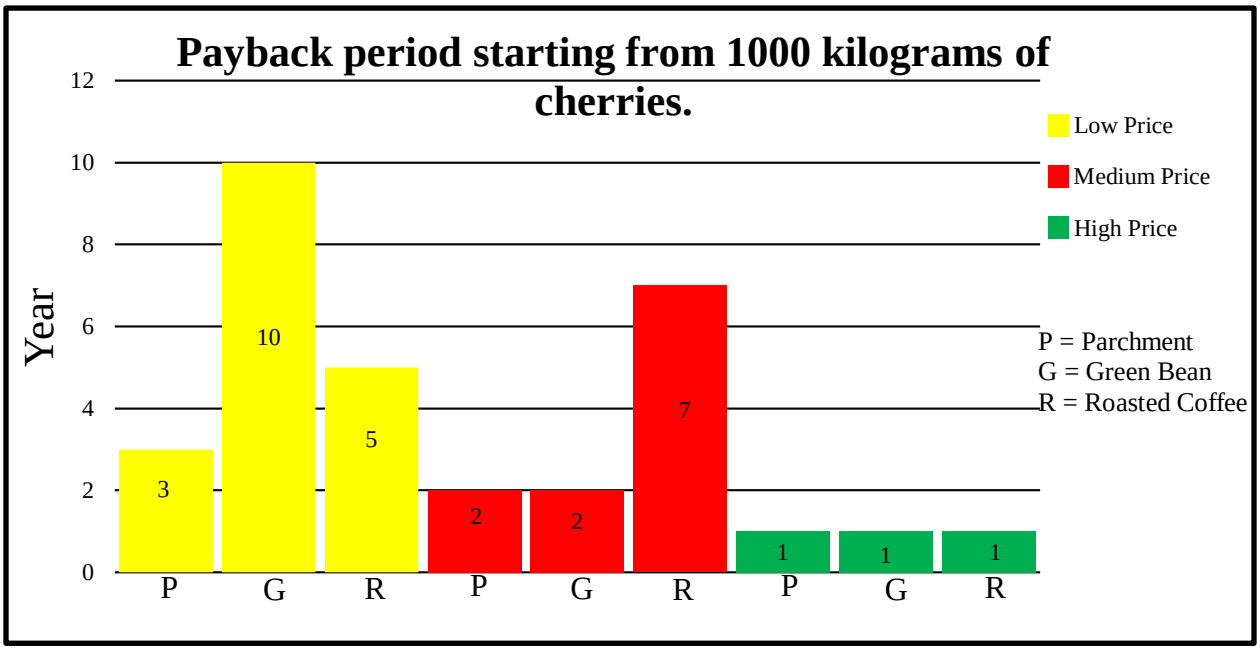
Graph A.5.1 Incremental contribution margin starting from 1000 kilograms of cherries



Graph A.5.2 Break-even point starting from 1000 kilograms of cherries



Graph A.5.3 Payback period starting from 1000 kilograms of cherries

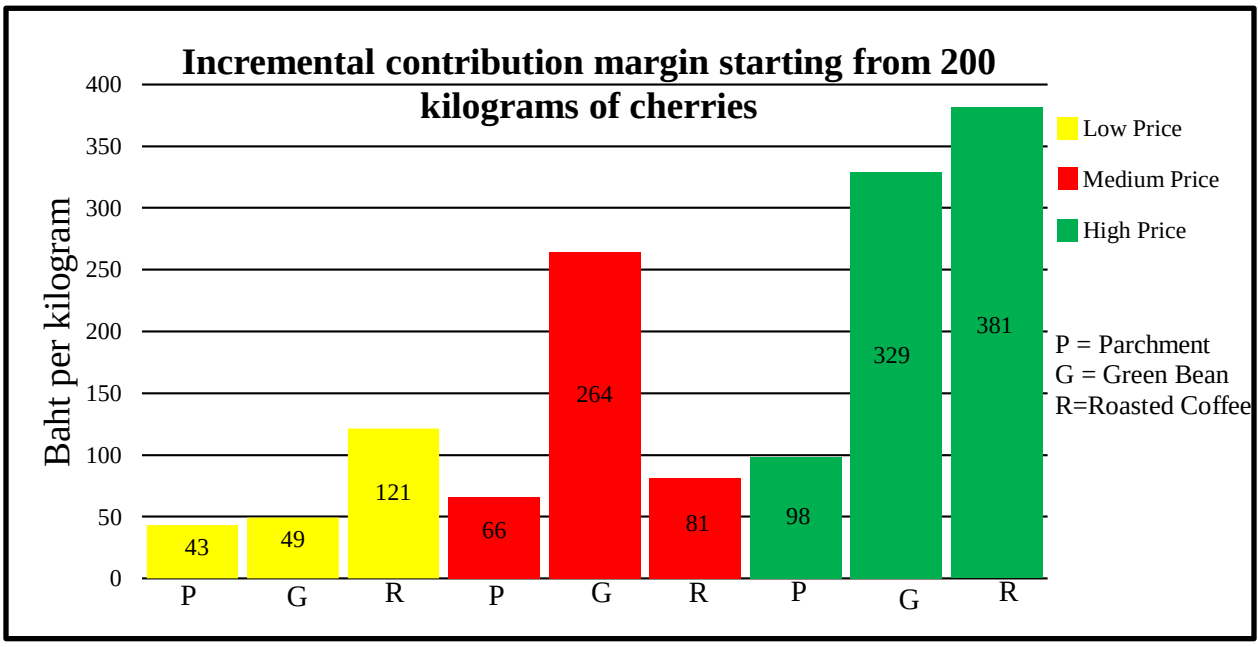


B. Average cost of machine

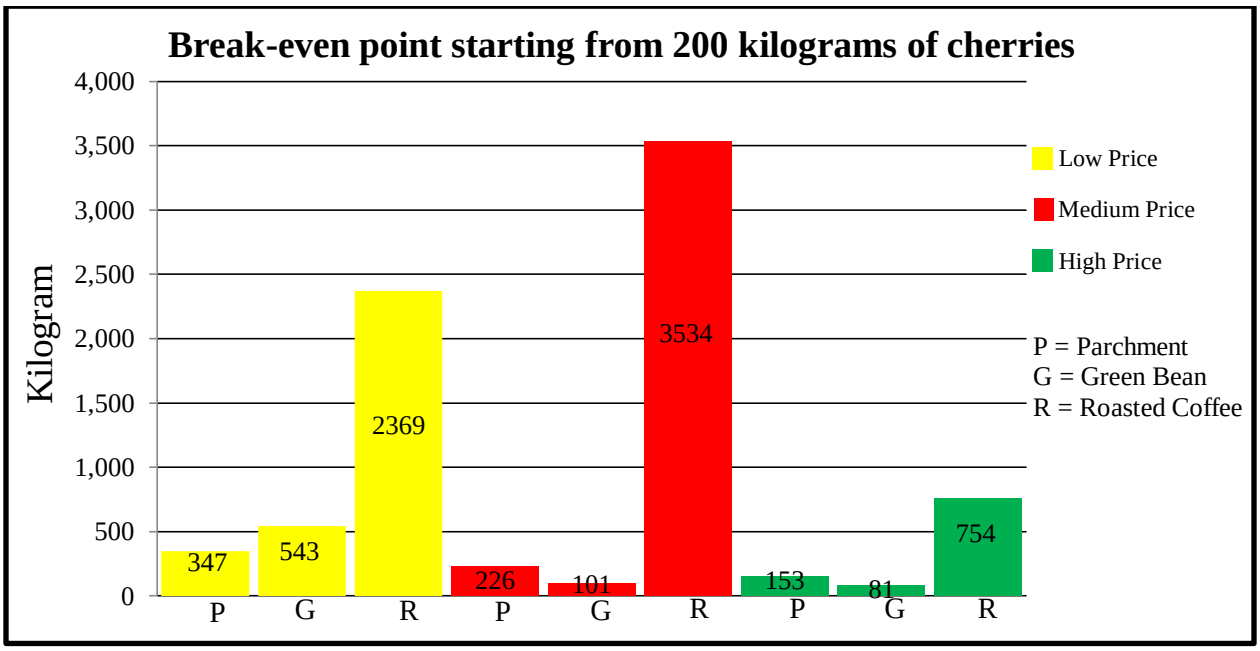
Table B.1 Table of financial calculation with the productivity starting from 200 kilograms of cherries with average cost of machine

High price	Based on market price of arabica coffee in 2556-2557											
Medium price	**With average cost of machine**											
Low price	*There is no significant difference in the graph of parchment to roasting stage due to decimal point ignorance.											
(Assume 200 kg Cherry in 1 year)	Harvesting to Cherry			Cherry to Parchment			Parchment to Green Bean			Green Bean to Roasted Coffee		
Revenue												
Price (bht/kg)	10	12	15	60	85	120	160	400	500	400	600	1000
Productivity	1:1	1:1	1:1	5:1	5:1	5:1	5:4	5:4	5:4	1:1	1:1	1:1
Total Revenue (bht)*	2000	2400	3000	2400	3400	4800	25600	64000	80000	64000	96000	160000
Expense	Fixed cost											
Machine (bht)	0	0	0	15000	15000	15000	26750	26750	26750	287500	287500	287500
Expense	Variable cost											
Transportation distance (km)	0	0	0	300	300	300	300	300	300	300	300	300
Disel oil cost (bht/L)	0	0	0	25	25	25	25	25	25	25	25	25
Used liters (L/km)	0	0	0	13	13	13	13	13	13	13	13	13
Product Transportation cost (bht)	0	0	0	650	650	650	650	650	650	650	650	650
Transportation (bht/kg)	0	0	0	3	3	3	3	3	3	3	3	3
Labour (bht)	8	8	8	8	8	8	8	8	8	8	8	8
Rent/Maintainance (bht/kg)	0	0	0	2	2	2	28	28	28	36	36	36
Electricity (bht/month)	0	0	0	200	200	200	2800	2800	2800	3640	3640	3640
Electricity(bht/kg)	0	0	0	2	2	2	26	26	26	137	137	137
Total Expense (bht/kg)*	0	0	0	15	15	15	66	66	66	184	184	184
Contribute Margin (bht/kg)	2	4	7	45	70	105	95	335	435	216	416	816
Kilogram to breakeven point	0	0	0	331	214	143	283	80	62	1332	691	352
Incremental contribution margin(bht/kg)	**0**	**0**	**0**	**43**	**66**	**98**	**49**	**264**	**329**	**121**	**81**	**381**
Break even for parchment (kg)	**0**	**0**	**0**	**347**	**226**	**153**	**0**	**0**	**0**	**0**	**0**	**0**
Break even for green bean (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**543**	**101**	**81**	**0**	**0**	**0**
Break even for roasted coffee (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2369**	**3534**	**754**
Payback period (yr)	**0**	**0**	**0**	**9**	**6**	**4**	**3**	**1**	**1**	**15**	**22**	**5**

Graph B.1.1 Incremental contribution margin starting from 200 kilograms of cherries



Graph B.1.2 Break-even point starting from 200 kilograms of cherries



Graph B.1.3 Payback period starting from 200 kilograms of cherries

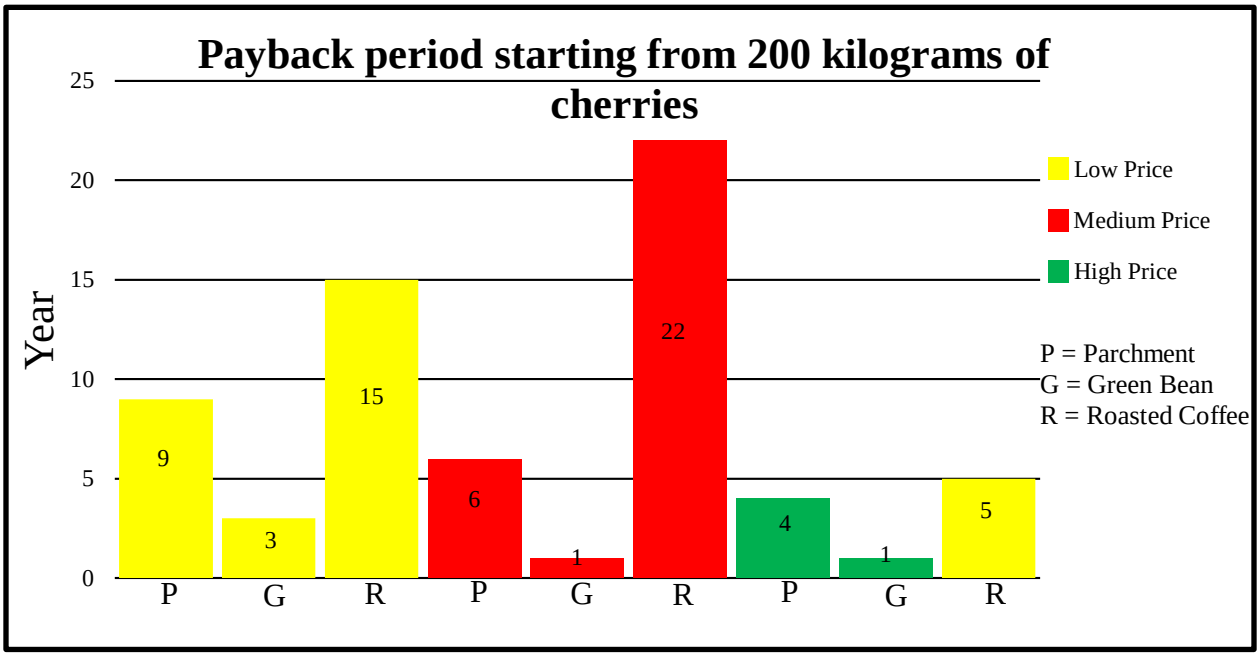
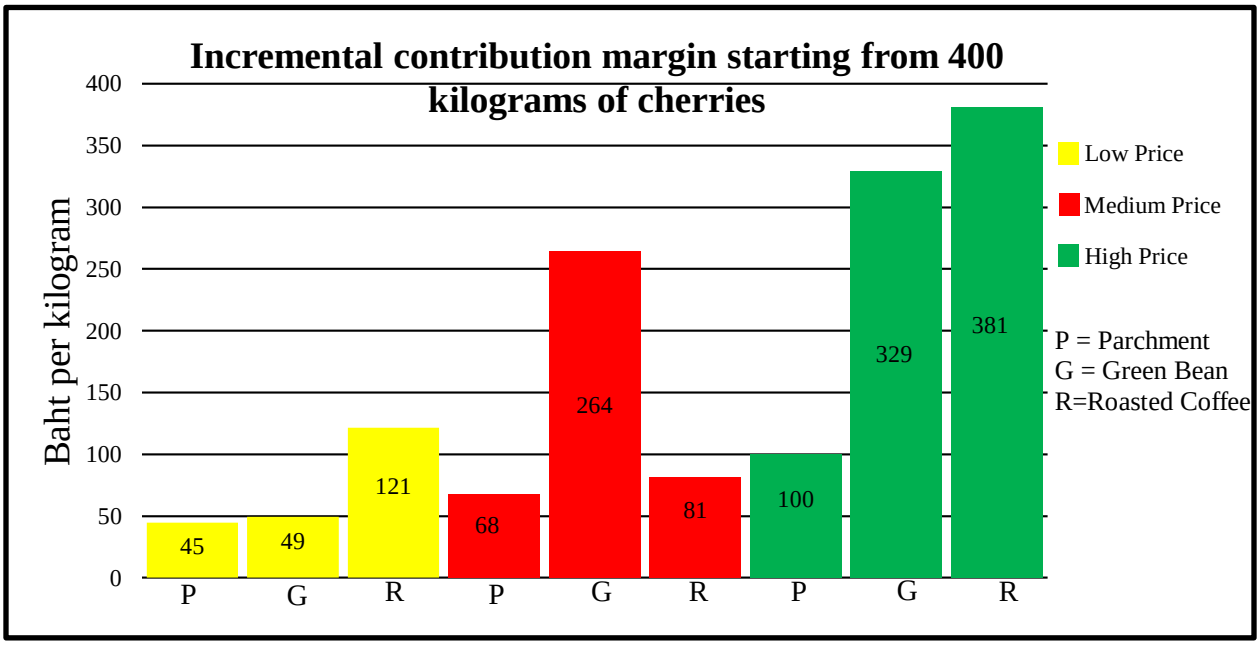


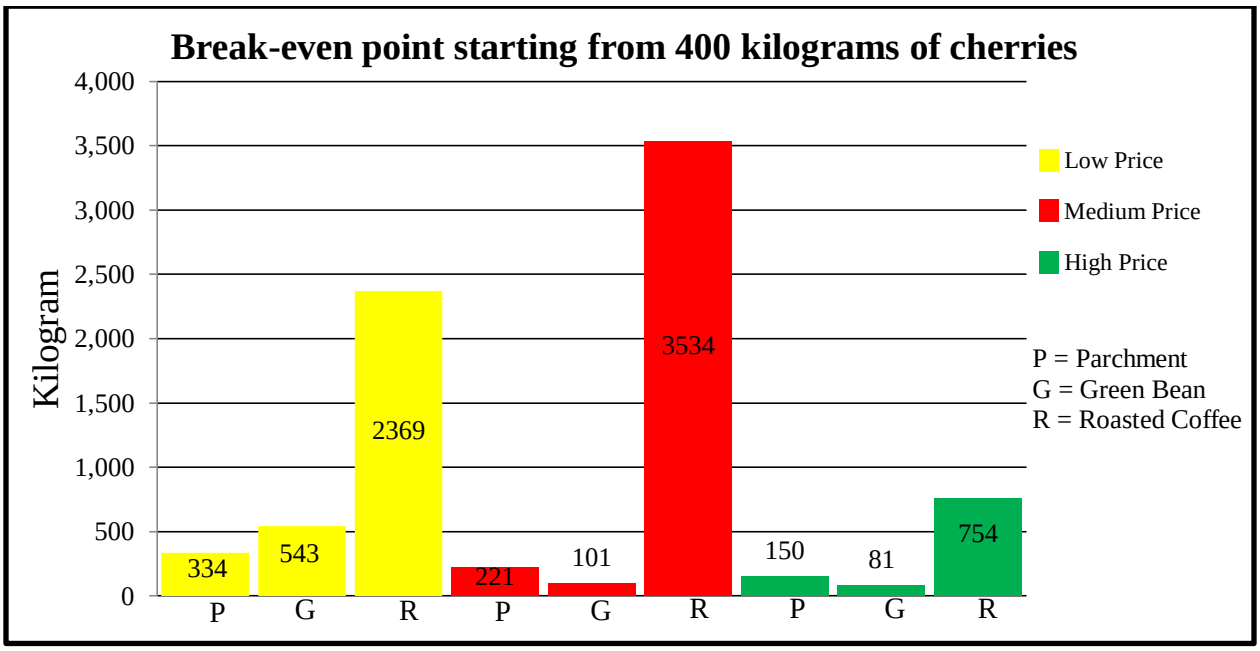
Table B.2 Table of financial calculation with the productivity starting from 400 kilograms with average cost of machine

High price	Based on market price of arabica coffee in 2556-2557											
Medium price	**With average cost of machine**											
Low price	*There is no significant difference in the graph of parchment to roasting stage due to decimal point ignorance.											
(Assume 400 kg Cherry in 1 year)	Harvesting to Cherry			Cherry to Parchment			Parchment to Green Bean			Green Bean to Roasted Coffee		
Revenue												
Price (bht/kg)	10	12	15	60	85	120	160	400	500	400	600	1000
Productivity	1:1	1:1	1:1	5:1	5:1	5:1	5:4	5:4	5:4	1:1	1:1	1:1
Total Revenue (bht)*	4,000	4,800	6,000	4,800	6,800	9,600	51,200	128,000	160,000	128,000	192,000	320,000
Expense	Fixed cost											
Machine (bht)	0	0	0	15000	15000	15000	26750	26750	26750	287500	287500	287500
Expense	Variable cost											
Transportation distance (km)	0	0	0	300	300	300	300	300	300	300	300	300
Disel oil cost (bht/L)	0	0	0	25	25	25	25	25	25	25	25	25
Used liters (L/km)	0	0	0	13	13	13	13	13	13	13	13	13
Product Transportation cost (bht)	0	0	0	650	650	650	650	650	650	650	650	650
Transportation (bht/kg)	0	0	0	2	2	2	2	2	2	2	2	2
Labour (bht)	8	8	8	8	8	8	8	8	8	8	8	8
Rent/Maintainance (bht/kg)	0	0	0	2	2	2	28	28	28	36	36	36
Electricity (bht/month)	0	0	0	200	200	200	2800	2800	2800	3640	3640	3640
Electricity(bht/kg)	0	0	0	2	2	2	26	26	26	137	137	137
Total Expense (bht/kg)*	0	0	0	13	13	13	64	64	64	183	183	183
Contribute Margin (bht/kg)	2	4	7	47	72	107	96	336	436	217	417	817
Kilogram to breakeven point	0	0	0	320	209	140	278	80	61	1322	689	352
Incremental contribution margin(bht/kg)	**0**	**0**	**0**	**45**	**68**	**100**	**49**	**264**	**329**	**121**	**81**	**381**
Break even for parchment (kg)	**0**	**0**	**0**	**334**	**221**	**150**	**0**	**0**	**0**	**0**	**0**	**0**
Break even for green bean (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**543**	**101**	**81**	**0**	**0**	**0**
Break even for roasted coffee (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2369**	**3534**	**754**
Payback period (yr)	**0**	**0**	**0**	**4**	**3**	**2**	**2**	**0**	**0**	**7**	**11**	**2**

Graph B.2.1 Incremental contribution margin starting from 400 kilograms of cherries



Graph B.2.2 Break-even point starting from 400 kilograms of cherries



Graph B.2.3 Payback period starting from 400 kilograms of cherries.

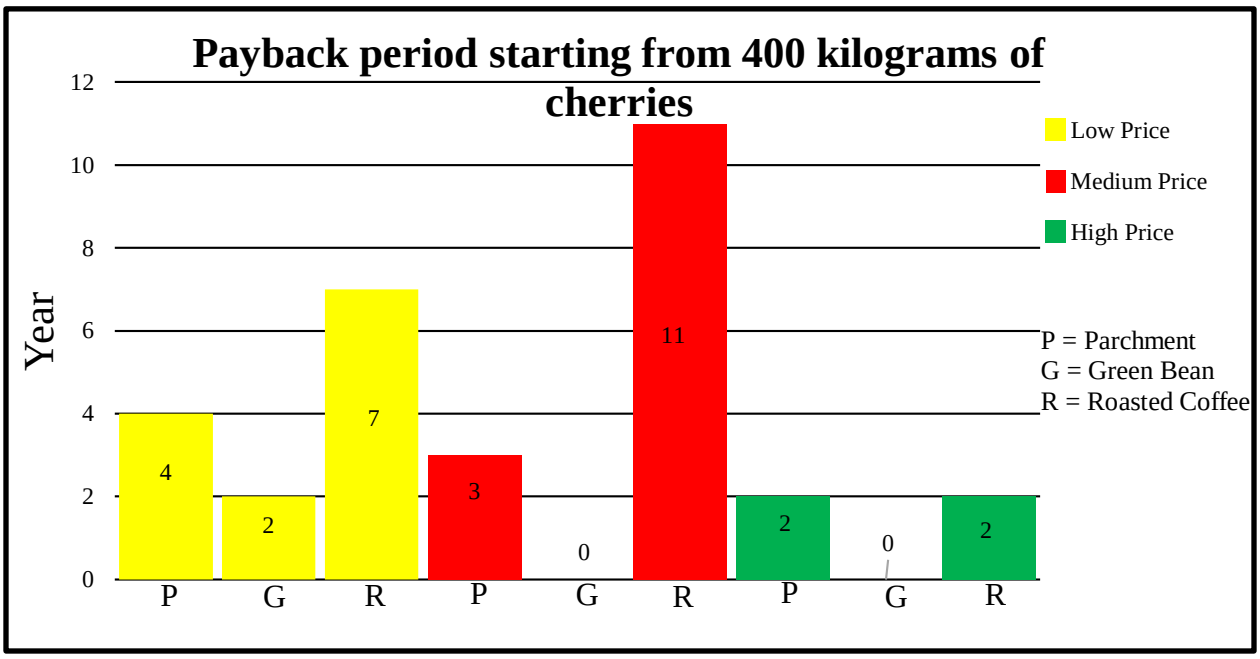
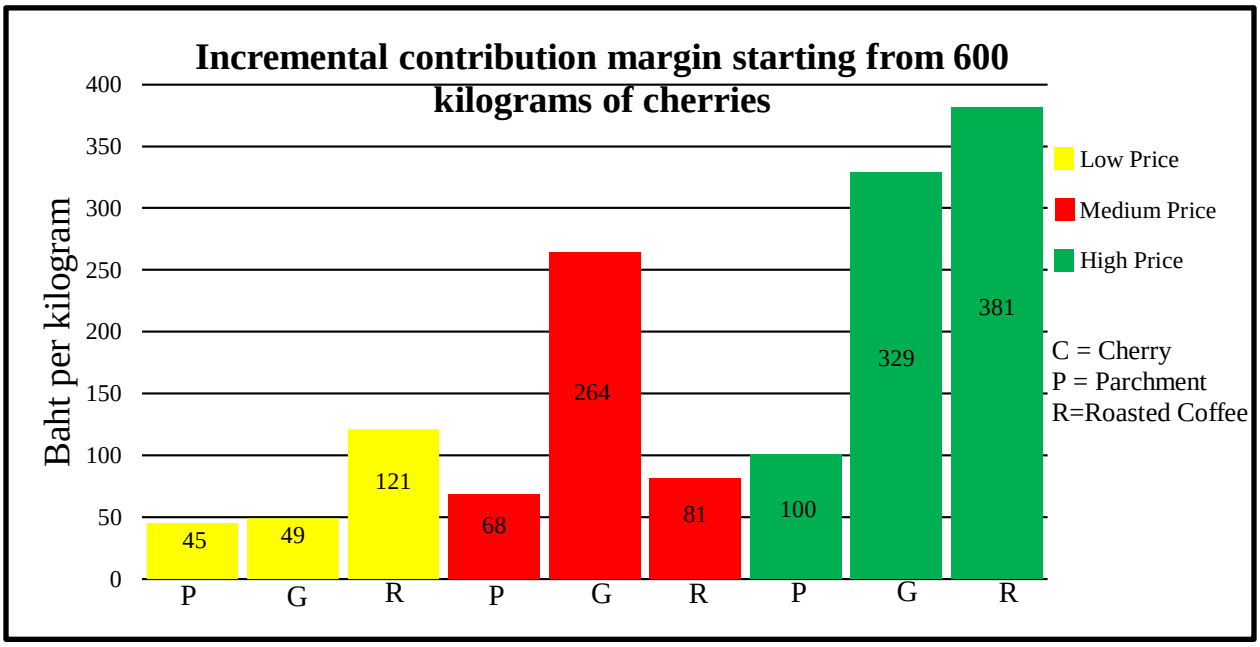


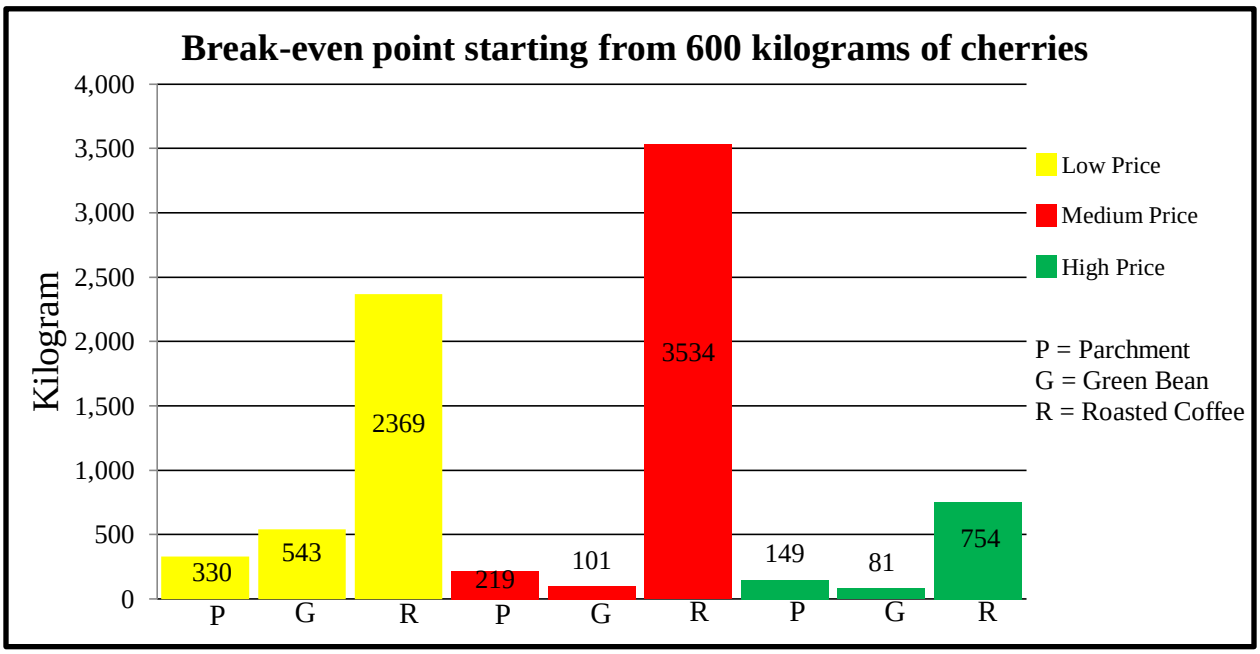
Table B.3 Table of financial calculation with the productivity starting from 600 kilograms with average cost of machine

High price	Based on market price of arabica coffee in 2556-2557											
Medium price	**With average cost of machine**											
Low price	*There is no significant difference in the graph of parchment to roasting stage due to decimal point ignorance.											
(Assume 600 kg Cherry in one year)	Harvesting to Cherry			Cherry to Parchment			Parchment to Green Bean			Green Bean to Roasted Coffee		
Revenue												
Price (bht/kg)	10	12	15	60	85	120	160	400	500	400	600	1000
Productivity	1:1	1:1	1:1	5:1	5:1	5:1	5:4	5:4	5:4	1:1	1:1	1:1
Total Revenue (bht)*	6,000	7,200	9,000	7,200	10,200	14,400	76,800	192,000	240,000	192,000	288,000	480,000
Expense	Fixed cost											
Machine (bht)	0	0	0	15,000	15,000	15,000	26,750	26,750	26,750	287,500	287,500	287,500
Expense	Variable cost											
Transportation distance (km)	0	0	0	300	300	300	300	300	300	300	300	300
Disel oil cost (bht/L)	0	0	0	25	25	25	25	25	25	25	25	25
Used liters (L/km)	0	0	0	13	13	13	13	13	13	13	13	13
Product Transportation cost (bht)	0	0	0	650	650	650	650	650	650	650	650	650
Transportation (bht/kg)	0	0	0	1	1	1	1	1	1	1	1	1
Labour (bht)	8	8	8	8	8	8	8	8	8	8	8	8
Rent/Maintainance (bht/kg)	0	0	0	2	2	2	28	28	28	36	36	36
Electricity (bht/month)	0	0	0	200	200	200	2800	2800	2800	3640	3640	3640
Electricity(bht/kg)	0	0	0	2	2	2	26	26	26	137	137	137
Total Expense (bht/kg)*	0	0	0	13	13	13	63	63	63	182	182	182
Contribute Margin (bht/kg)	2	4	7	47	72	107	97	337	437	218	418	818
Kilogram to breakeven point	0	0	0	316	207	140	277	79	61	1319	688	351
Incremental contribution margin(bht/kg)	**0**	**0**	**0**	**45**	**68**	**100**	**49**	**264**	**329**	**121**	**81**	**381**
Break even for parchment (kg)	**0**	**0**	**0**	**330**	**219**	**149**	**0**	**0**	**0**	**0**	**0**	**0**
Break even for green bean (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**543**	**101**	**81**	**0**	**0**	**0**
Break even for roasted coffee (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2369**	**3534**	**754**
Payback period (yr)	**0**	**0**	**0**	**3**	**2**	**1**	**1**	**0**	**0**	**5**	**7**	**2**

Graph B.3.1 Incremental contribution margin starting from 600 kilograms of cherries



Graph B.3.2 Break-even point starting from 600 kilograms of cherries



Graph B.3.3 Payback period starting from 600 kilograms of cherries

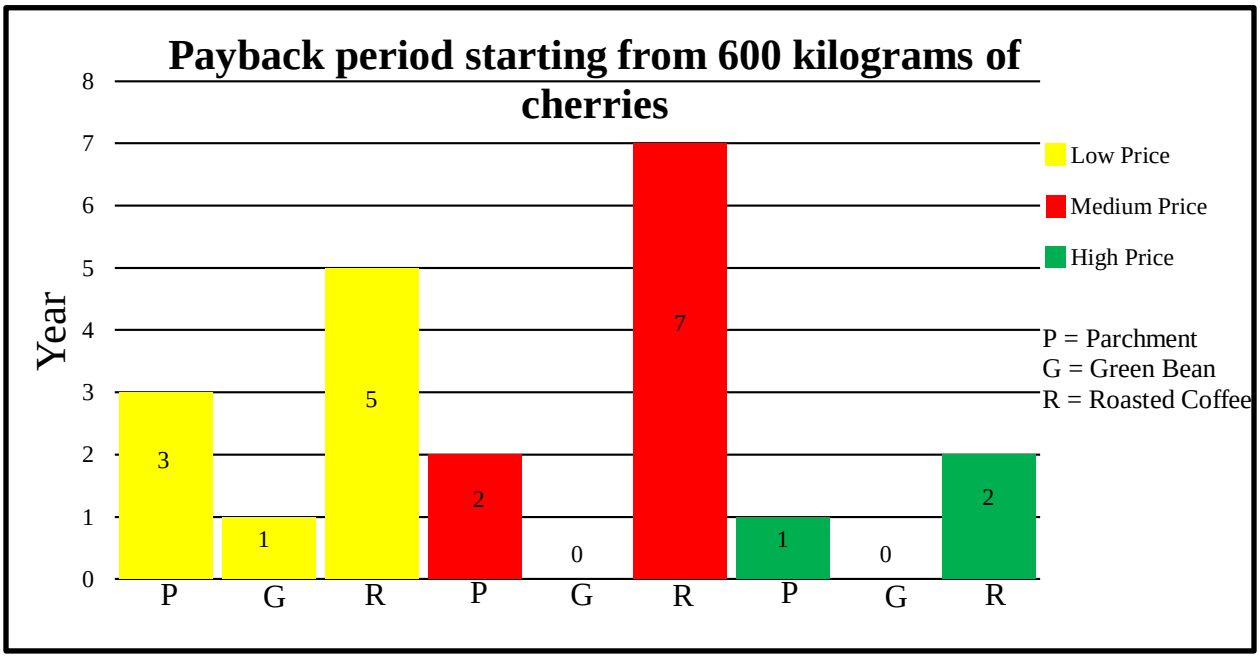
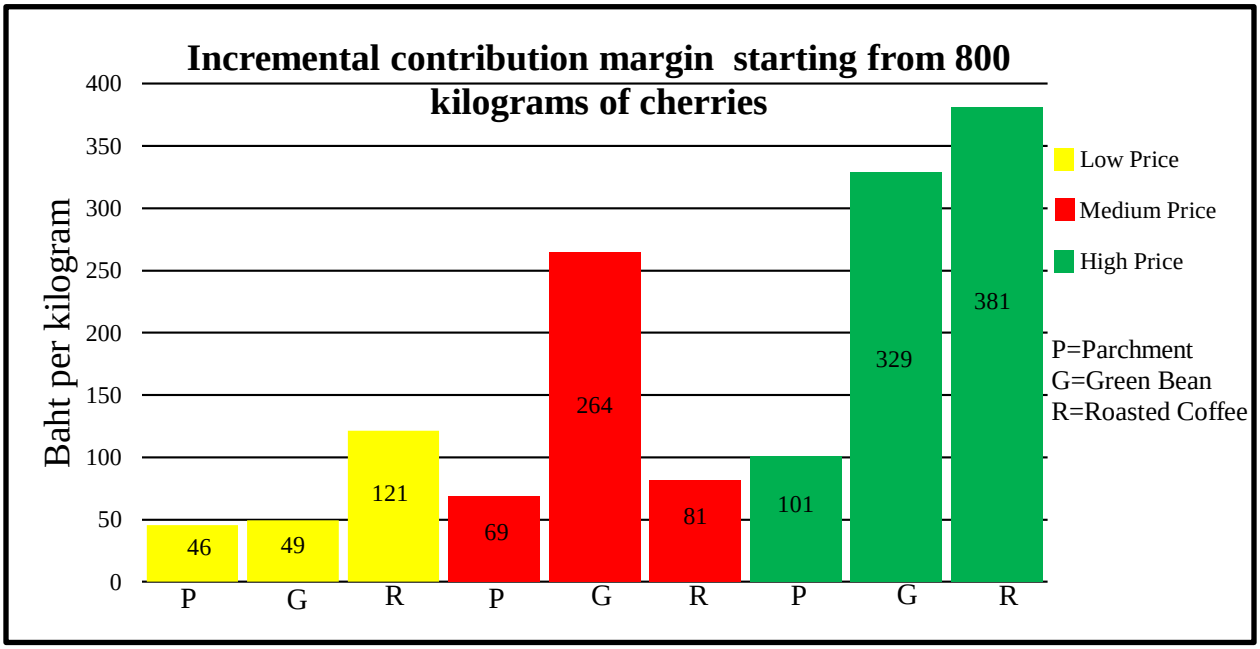


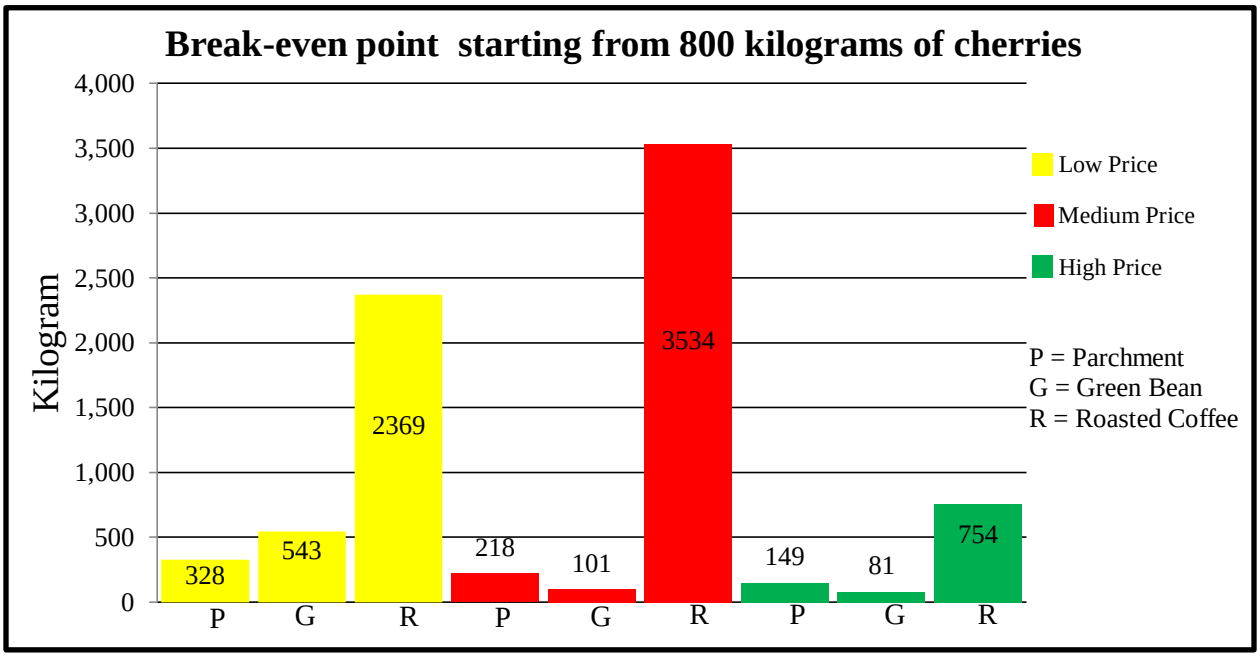
Table B.4 Table of financial calculation with the productivity starting from 800 kilograms of cherries with average cost of machine

High price	Based on market price of arabica coffee in 2556-2557											
Medium price	**With average cost of machine**											
Low price	*There is no significant difference in the graph of parchment to roasting stage due to decimal point ignorance.											
(Assume 800 kg Cherry in 1 year)	Harvesting to Cherry			Cherry to Parchment			Parchment to Green Bean			Green Bean to Roasted Coffee		
Revenue												
Price (bht/kg)	10	12	15	60	85	120	160	400	500	400	600	1000
Productivity	1:1	1:1	1:1	5:1	5:1	5:1	5:4	5:4	5:4	1:1	1:1	1:1
Total Revenue (bht)*	8,000	9,600	12,000	9,600	13,600	19,200	102,400	256,000	320,000	256,000	384,000	640,000
Expense	Fixed cost											
Machine (bht)	0	0	0	15,000	15,000	15,000	26,750	26,750	26,750	287,500	287,500	287,500
Expense	Variable cost											
Transportation distance (km)	0	0	0	300	300	300	300	300	300	300	300	300
Disel oil cost (bht/L)	0	0	0	25	25	25	25	25	25	25	25	25
Used liters (L/km)	0	0	0	13	13	13	13	13	13	13	13	13
Product Transportation cost (bht)	0	0	0	650	650	650	650	650	650	650	650	650
Transportation (bht/kg)	0	0	0	1	1	1	1	1	1	1	1	1
Labour (bht)	8	8	8	8	8	8	8	8	8	8	8	8
Rent/Maintainance (bht/kg)	0	0	0	2	2	2	28	28	28	36	36	36
Electricity (bht/month)	0	0	0	200	200	200	2,800	2,800	2,800	3,640	3,640	3,640
Electricity(bht/kg)	0	0	0	2	2	2	26	26	26	137	137	137
Total Expense (bht/kg)*	0	0	0	12	12	12	63	63	63	182	182	182
Contribute Margin (bht/kg)	2	4	7	48	73	108	97	337	437	218	418	818
Kilogram to breakeven point	0	0	0	315	206	139	276	79	61	1,317	687	351
Incremental contribution margin(bht/kg)	**0**	**0**	**0**	**46**	**69**	**101**	**49**	**264**	**329**	**121**	**81**	**381**
Break even for parchment (kg)	**0**	**0**	**0**	**328**	**218**	**149**	**0**	**0**	**0**	**0**	**0**	**0**
Break even for green bean (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**543**	**101**	**81**	**0**	**0**	**0**
Break even for roasted coffee (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2,369**	**3,534**	**754**
Payback period (yr)	**0**	**0**	**0**	**2**	**1**	**1**	**1**	**0**	**0**	**4**	**6**	**1**

Graph B.4.1 Incremental contribution margin starting from 800 kilograms of cherries



Graph B.4.2 Break-even point starting from 800 kilograms of cherries



Graph B.4.3 Payback period starting from 800 kilograms of cherries

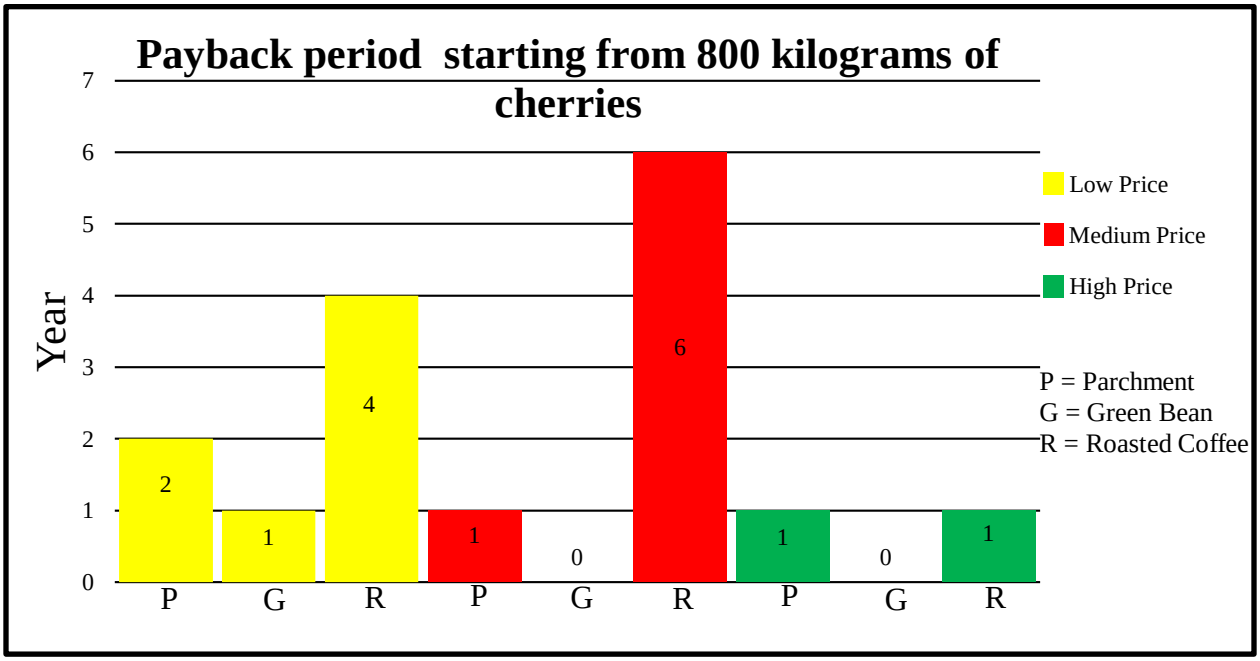
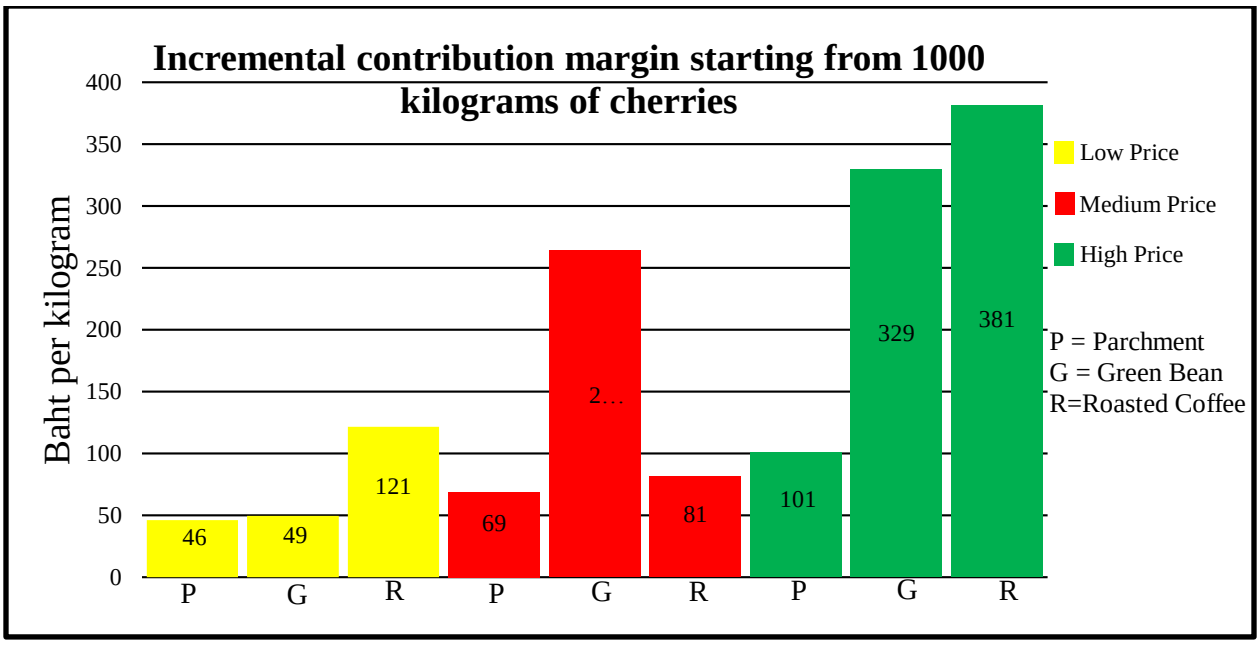


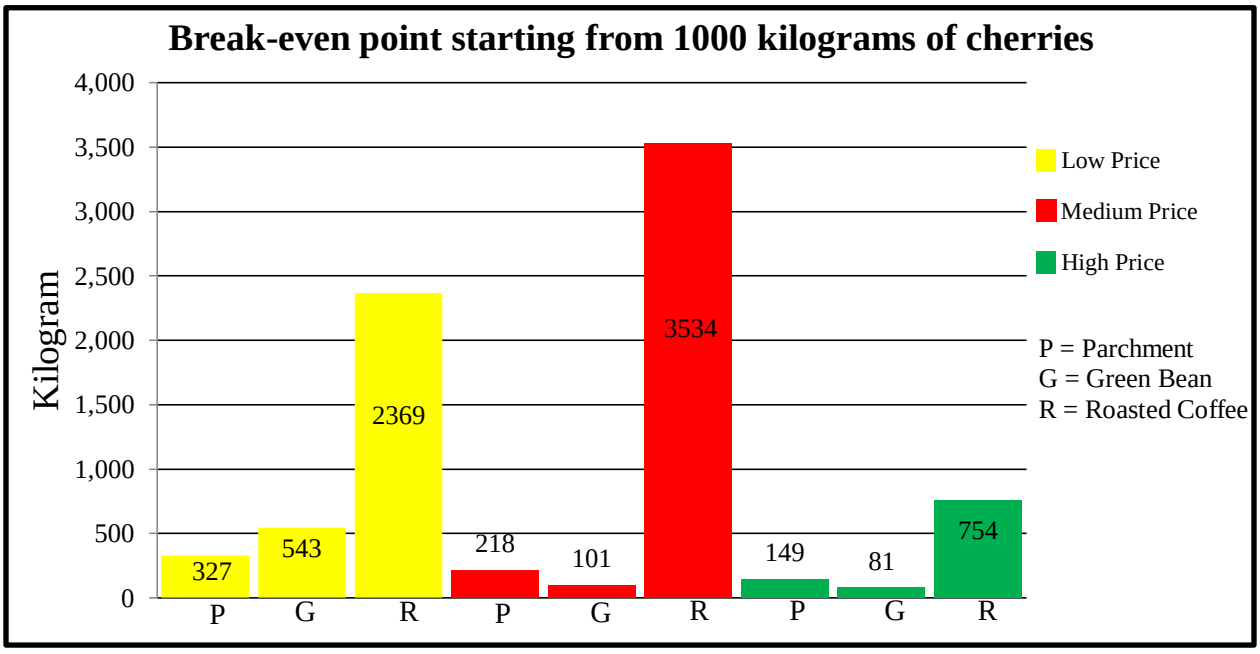
Table B.5 Table of financial calculation with the productivity starting from 1000 kilograms with average cost of machine

High price	Based on market price of arabica coffee in 2556-2557											
Medium price	**With average cost of machine**											
Low price	*There is no significant difference in the graph of parchment to roasting stage due to decimal point ignorance.											
(Assume 1000 kg Cherry in 1 year)	Harvesting to Cherry			Cherry to Parchment			Parchment to Green Bean			Green Bean to Roasted Coffee		
Revenue												
Price (bht/kg)	10	12	15	60	85	120	160	400	500	400	600	1000
Productivity	1:1	1:1	1:1	5:1	5:1	5:1	5:4	5:4	5:4	1:1	1:1	1:1
Total Revenue (bht)*	10,000	12,000	15,000	12,000	17,000	24,000	128,000	320,000	400,000	320,000	480,000	800,000
Expense	Fixed cost											
Machine (bht)	0	0	0	15,000	15,000	15,000	26,750	26,750	26,750	287,500	287,500	287,500
Expense	Variable cost											
Transportation distance (km)	0	0	0	300	300	300	300	300	300	300	300	300
Disel oil cost (bht/L)	0	0	0	25	25	25	25	25	25	25	25	25
Used liters (L/km)	0	0	0	13	13	13	13	13	13	13	13	13
Product Transportation cost (bht)	0	0	0	650	650	650	650	650	650	650	650	650
Transportation (bht/kg)	0	0	0	1	1	1	1	1	1	1	1	1
Labour (bht)	8	8	8	8	8	8	8	8	8	8	8	8
Rent/Maintainance (bht/kg)	0	0	0	2	2	2	28	28	28	36	36	36
Electricity (bht/month)	0	0	0	200	200	200	2,800	2,800	2,800	3,640	3,640	3,640
Electricity(bht/kg)	0	0	0	2	2	2	26	26	26	137	137	137
Total Expense (bht/kg)*	0	0	0	12	12	12	63	63	63	182	182	182
Contribute Margin (bht/kg)	2	4	7	48	73	108	97	337	437	218	418	818
Kilogram to breakeven point	0	0	0	313	206	139	275	79	61	1,316	687	351
Incremental contribution margin(bht/kg)	**0**	**0**	**0**	**46**	**69**	**101**	**49**	**264**	**329**	**121**	**81**	**381**
Break even for parchment (kg)	**0**	**0**	**0**	**327**	**218**	**149**	**0**	**0**	**0**	**0**	**0**	**0**
Break even for green bean (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**543**	**101**	**81**	**0**	**0**	**0**
Break even for roasted coffee (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2,369**	**3,534**	**754**
Payback period (yr)	**0**	**0**	**0**	**2**	**1**	**1**	**1**	**0**	**0**	**3**	**4**	**1**

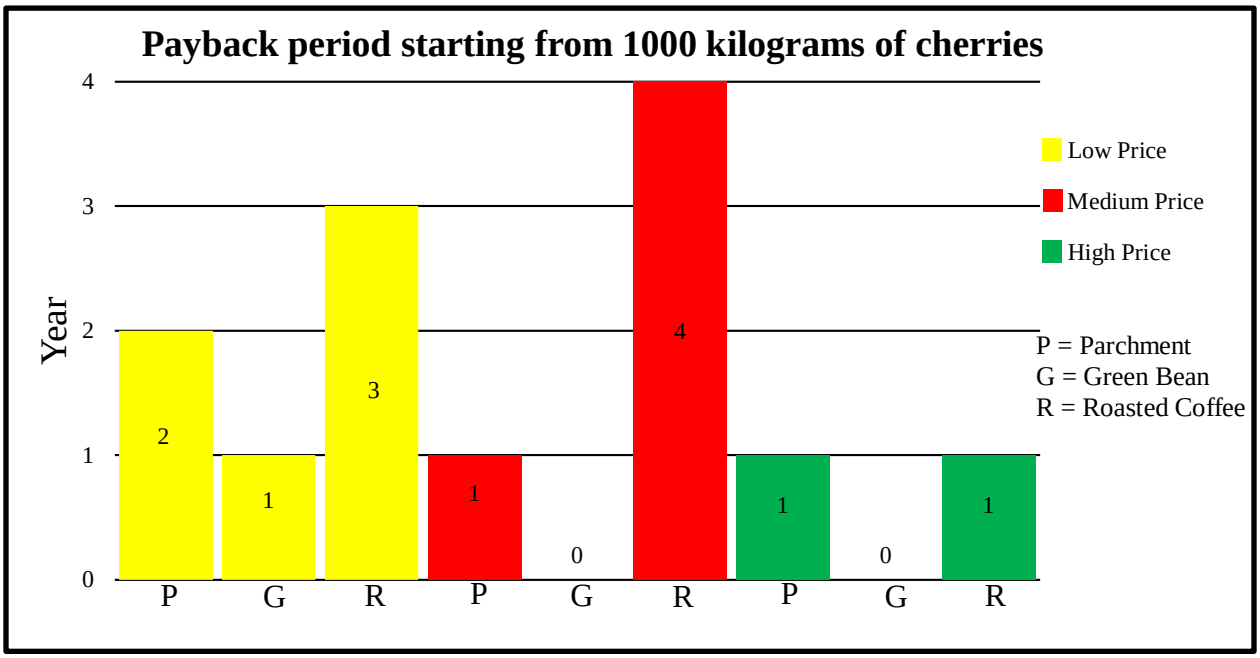
Graph B.5.1 Incremental contribution margin starting from 1000 kilograms of cherries



Graph B.5.2 Break-even point starting from 1000 kilograms of cherries



Graph B.5.3 Payback period starting from 1000 kilograms of cherries

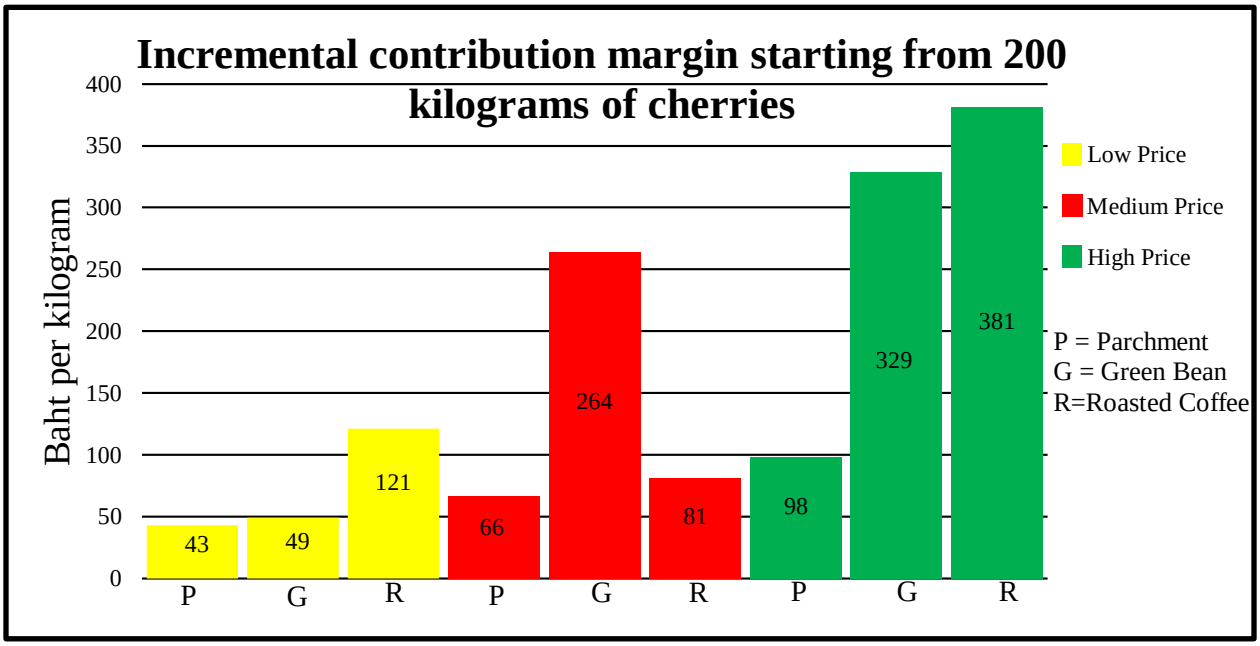


C. **Lowest cost of Machine**

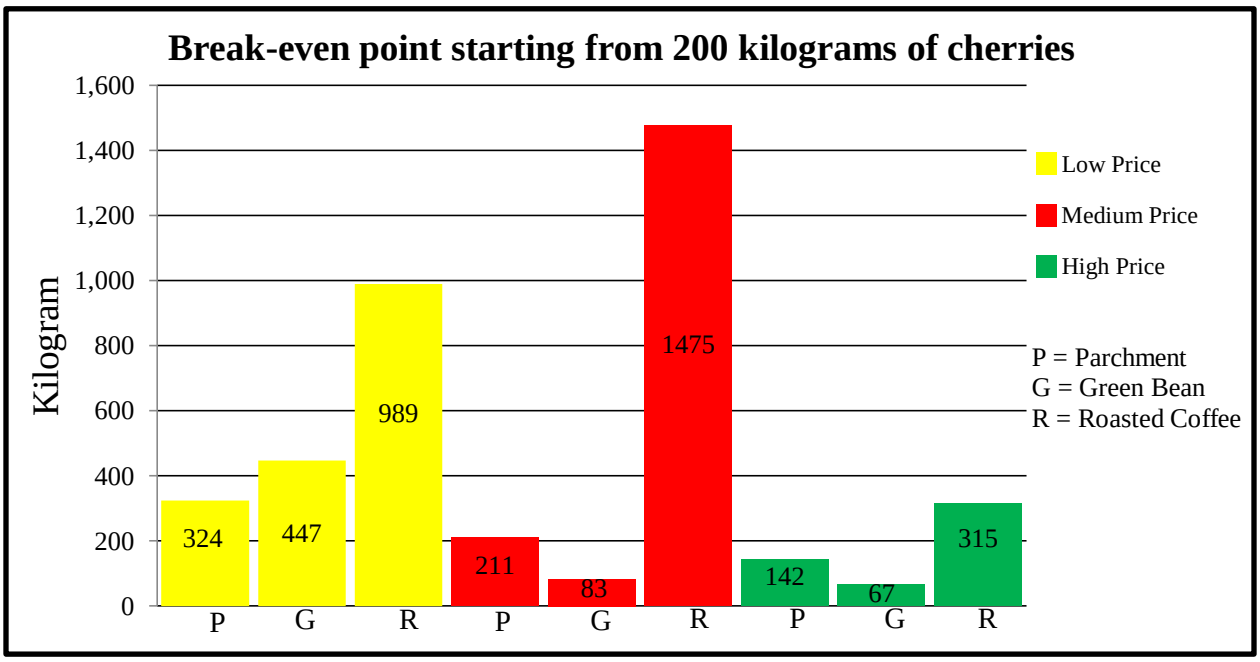
Table C.1 Table of financial calculation with the productivity starting from 200 kilograms of cherries with lowest cost of machine

High price	Based on market price of arabica coffee in 2556-2557											
Medium price	**With the lowest cost of machine**											
Low price	*There is no significant difference in the graph of parchment to roasting stage due to decimal point ignorance.											
(Assume 200 kg Cherry in 1 year)	Harvesting to Cherry			Cherry to Parchment			Parchment to Green Bean			Green Bean to Roasted Coffee		
	Revenue											
Price (bht/kg)	10	12	15	60	85	120	160	400	500	400	600	1000
Productivity	1:1	1:1	1:1	5:1	5:1	5:1	5:4	5:4	5:4	1:1	1:1	1:1
Total Revenue (bht)*	2,000	2,400	3,000	2,400	3,400	4,800	25,600	64,000	80,000	64,000	96,000	160,000
Expense	Fixed cost											
Machine (bht)	0	0	0	14,000	14,000	14,000	22,000	22,000	22,000	120,000	120,000	120,000
Expense	Variable cost											
Transportation distance (km)	0	0	0	300	300	300	300	300	300	300	300	300
Disel oil cost (bht/L)	0	0	0	25	25	25	25	25	25	25	25	25
Used liters (L/km)	0	0	0	13	13	13	13	13	13	13	13	13
Product Transportation cost (bht)	0	0	0	650	650	650	650	650	650	650	650	650
Transportation (bht/kg)	0	0	0	3	3	3	3	3	3	3	3	3
Labour (bht)	8	8	8	8	8	8	8	8	8	8	8	8
Rent/Maintainance (bht/kg)	0	0	0	2	2	2	28	28	28	36	36	36
Electricity (bht/month)	0	0	0	200	200	200	2,800	2,800	2,800	3,640	3,640	3,640
Electricity(bht/kg)	0	0	0	2	2	2	26	26	26	137	137	137
Total Expense (bht/kg)*	0	0	0	15	15	15	66	66	66	184	184	184
Contribute Margin (bht/kg)	2	4	7	45	70	105	95	335	435	216	416	816
Kilogram to breakeven point	0	0	0	309	199	133	233	66	51	556	289	147
Incremental contribution margin(bht/kg)	**0**	**0**	**0**	**43**	**66**	**98**	**49**	**264**	**329**	**121**	**81**	**381**
Break even for parchment (kg)	**0**	**0**	**0**	**324**	**211**	**142**	**0**	**0**	**0**	**0**	**0**	**0**
Break even for green bean (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**447**	**83**	**67**	**0**	**0**	**0**
Break even for roasted coffee (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**989**	**1,475**	**315**
Payback period (yr)	**0**	**0**	**0**	**8**	**5**	**4**	**3**	**1**	**0**	**6**	**9**	**2**

Graph C.1.1 Incremental contribution margin starting from 200 kilograms of cherries



Graph C.1.2 Break-even point starting from 200 kilograms of cherries



Graph C.1.3 Payback period starting from 200 kilograms of cherries

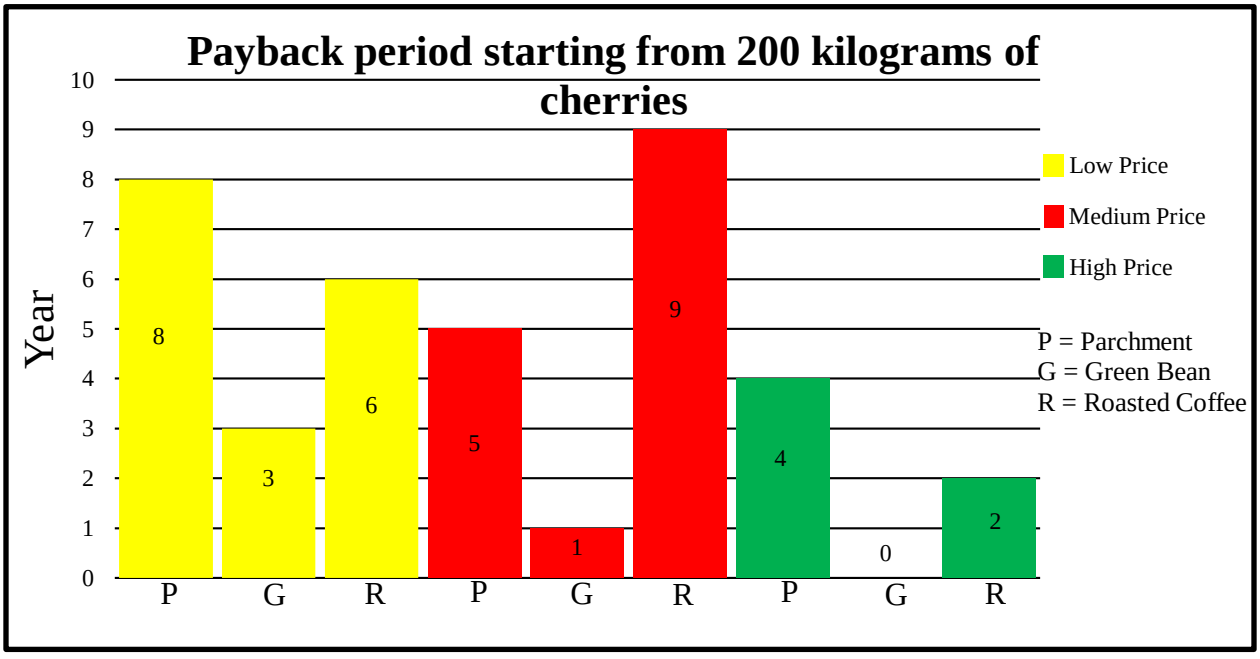
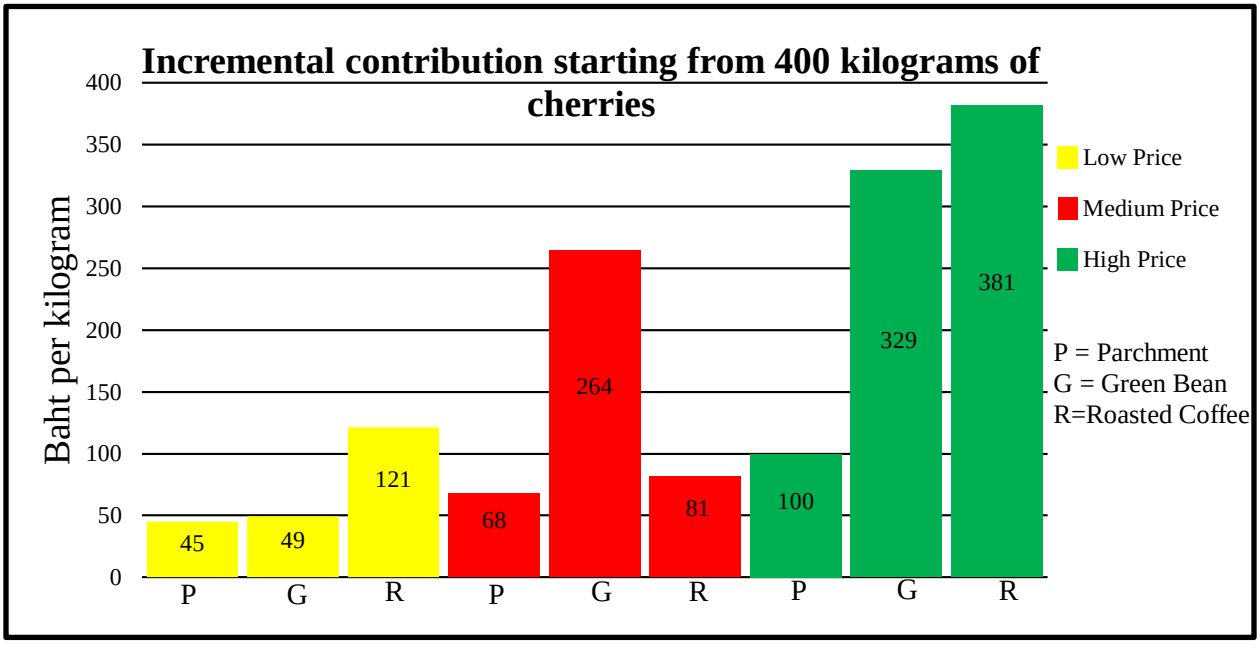


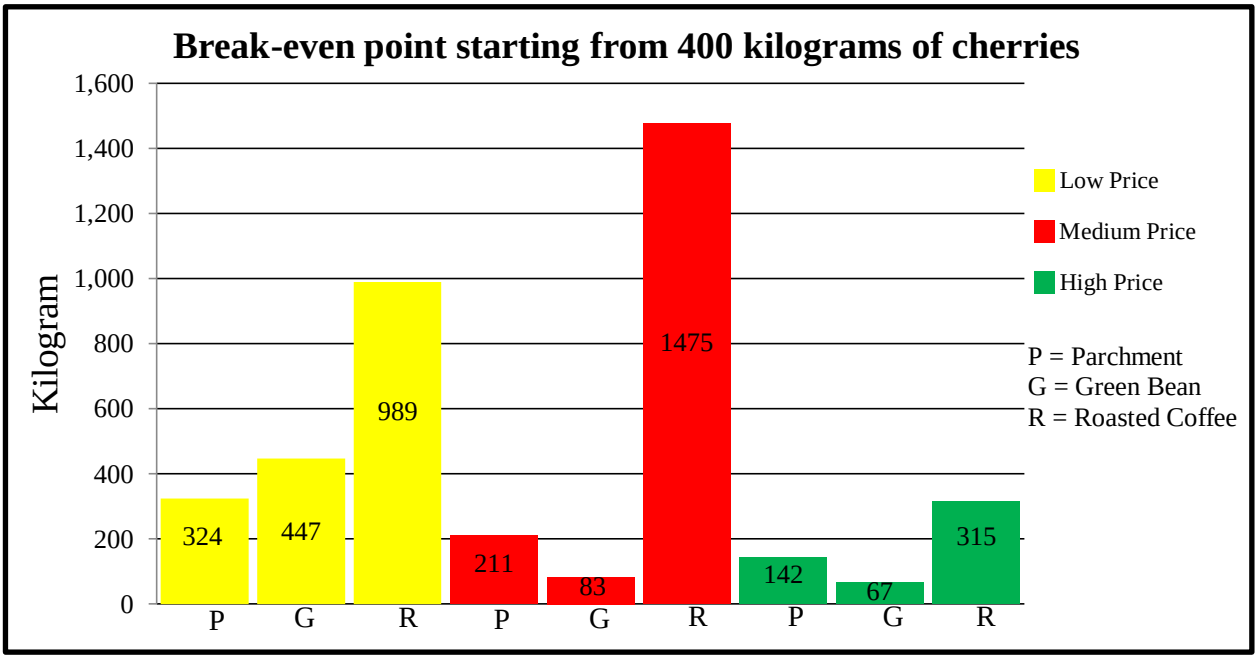
Table C.2 Table of financial calculation with the productivity starting from 400 kilograms with lowest cost of machine

High price	Based on market price of arabica coffee in 2556-2557											
Medium price	**With the lowest cost of machine**											
Low price	*There is no significant difference in the graph of parchment to roasting stage due to decimal point ignorance.											
(Assume 400 kg Cherry in 1 year)	Harvesting to Cherry			Cherry to Parchment			Parchment to Green Bean			Green Bean to Roasted Coffee		
	Revenue											
Price (bht/kg)	10	12	15	60	85	120	160	400	500	400	600	1000
Productivity	1:1	1:1	1:1	5:1	5:1	5:1	5:4	5:4	5:4	1:1	1:1	1:1
Total Revenue (bht)*	2,000	2,400	3,000	2,400	3,400	4,800	25,600	64,000	80,000	64,000	96,000	160,000
Expense	Fixed cost											
Machine (bht)	0	0	0	14,000	14,000	14,000	22,000	22,000	22,000	120,000	120,000	120,000
Expense	Variable cost											
Transportation distance (km)	0	0	0	300	300	300	300	300	300	300	300	300
Disel oil cost (bht/L)	0	0	0	25	25	25	25	25	25	25	25	25
Used liters (L/km)	0	0	0	13	13	13	13	13	13	13	13	13
Product Transportation cost (bht)	0	0	0	650	650	650	650	650	650	650	650	650
Transportation (bht/kg)	0	0	0	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63
Labour (bht)	8	8	8	8	8	8	8	8	8	8	8	8
Rent/Maintainance (bht/kg)	0	0	0	2.00	2.00	2.00	28.00	28.00	28.00	36.40	36.40	36.40
Electricity (bht/month)	0	0	0	200	200	200	2,800	2,800	2,800	3,640	3,640	3,640
Electricity(bht/kg)	0	0	0	1.50	1.50	1.50	26.25	26.25	26.25	136.50	136.50	136.50
Total Expense (bht/kg)*	0	0	0	13.13	13.13	13.13	63.88	63.88	63.88	182.53	182.53	182.53
Contribute Margin (bht/kg)	2	4	7	46.88	71.88	106.88	96.13	336.13	436.13	217.48	417.48	817.48
Kilogram to breakeven point	0	0	0	298.67	194.78	130.99	228.87	65.45	50.44	551.79	287.44	146.79
ncremental contribution margin(bht/kg	**0**	**0**	**0**	**44.88**	**67.88**	**99.88**	**49.25**	**264.25**	**329.25**	**121.35**	**81.35**	**381.35**
Break even for parchment (kg)	**0**	**0**	**0**	**311.98**	**206.26**	**140.18**	**0**	**0**	**0**	**0**	**0**	**0**
Break even for green bean (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**446.70**	**83.25**	**66.82**	**0**	**0**	**0**
Break even for roasted coffee (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**988.88**	**1,475.11**	**314.67**
Payback period (yr)	**0**	**0**	**0**	**3.90**	**2.58**	**1.75**	**1.40**	**0.26**	**0.21**	**3.09**	**4.61**	**0.98**

Graph C.2.1 Incremental contribution margin starting from 400 kilograms of cherries.



Graph C.2.2 Break-even point starting from 400 kilograms of cherries.



Graph C.2.3 Payback period starting from 400 kilograms of cherries.

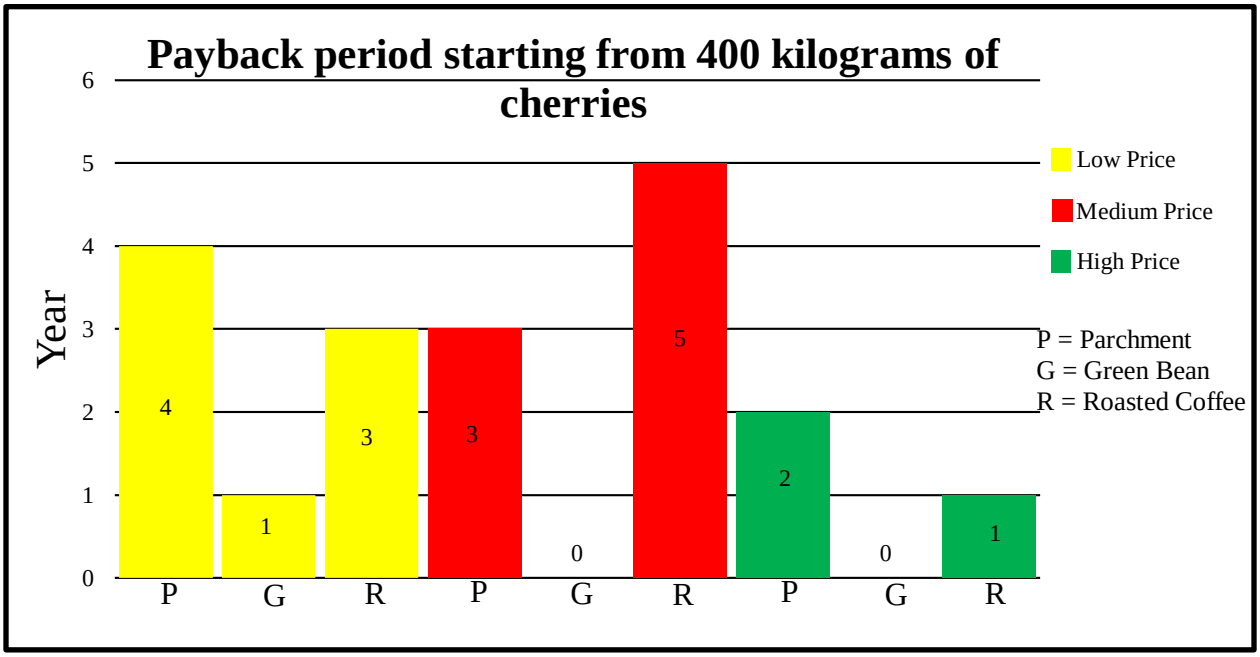
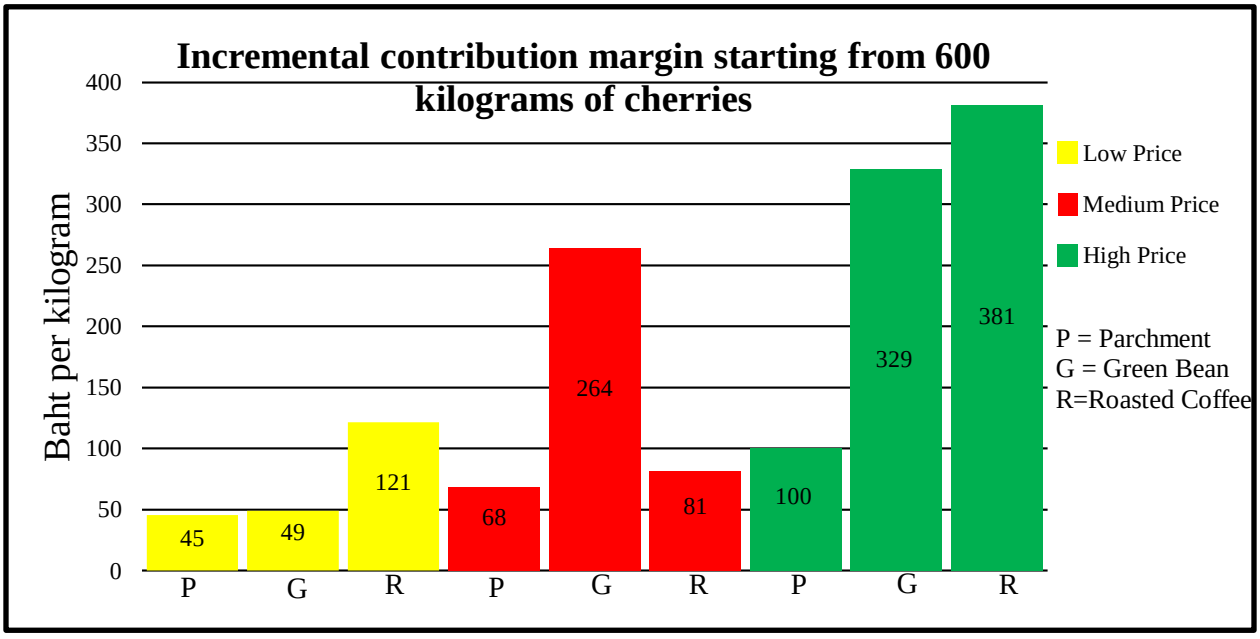


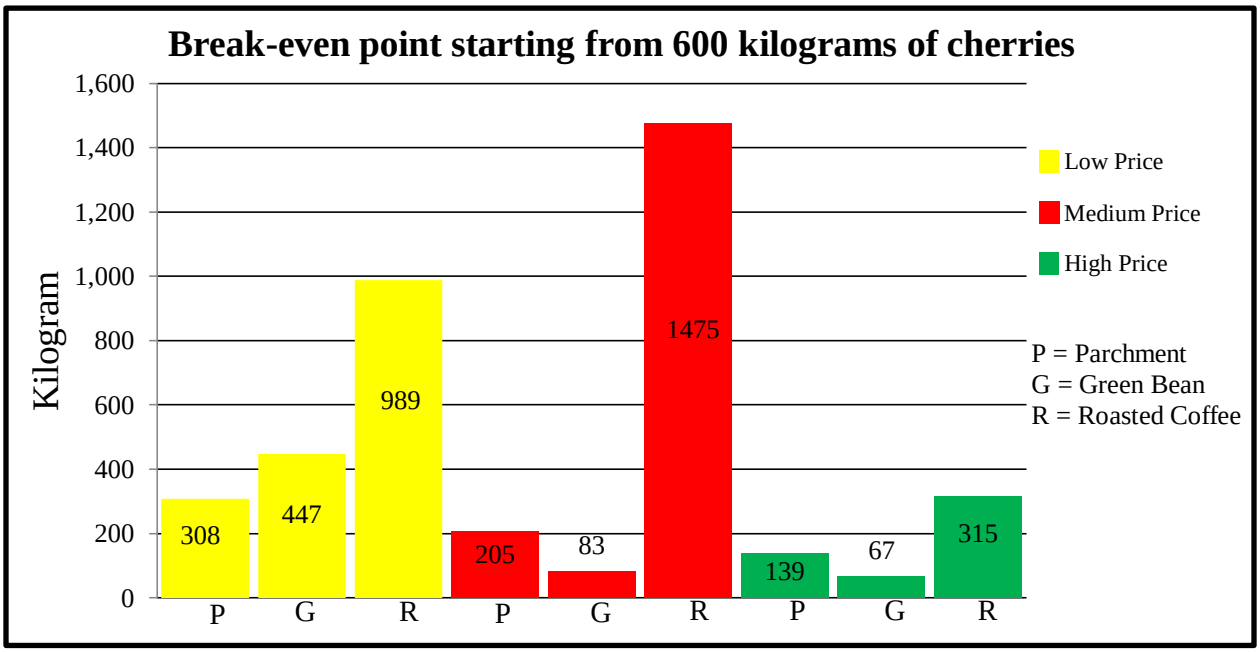
Table C.3 Table of financial calculation with the productivity starting from 600 kilograms of cherries with lowest cost of machine

High price	Based on market price of arabica coffee in 2556-2557											
Medium price	**With the lowest cost of machine**											
Low price	*There is no significant difference in the graph of parchment to roasting stage due to decimal point ignorance.											
(Assume 600 kg Cherry in 1 year)	Harvesting to Cherry			Cherry to Parchment			Parchment to Green Bean			Green Bean to Roasted Coffee		
Revenue												
Price (bht/kg)	10	12	15	60	85	120	160	400	500	400	600	1000
Productivity	1:1	1:1	1:1	5:1	5:1	5:1	5:4	5:4	5:4	1:1	1:1	1:1
Total Revenue (bht)*	6000	7200	9000	7200	10200	14400	76800	192000	240000	192000	288000	480000
Expense	Fixed cost											
Machine (bht)	0	0	0	14000	14000	14000	22000	22000	22000	120000	120000	120000
Expense	Variable cost											
Transportation distance (km)	0	0	0	300	300	300	300	300	300	300	300	300
Disel oil cost (bht/L)	0	0	0	25	25	25	25	25	25	25	25	25
Used liters (L/km)	0	0	0	13	13	13	13	13	13	13	13	13
Product Transportation cost (bht)	0	0	0	650	650	650	650	650	650	650	650	650
Transportation (bht/kg)	0	0	0	1	1	1	1	1	1	1	1	1
Labour (bht)	8	8	8	8	8	8	8	8	8	8	8	8
Rent/Maintainance (bht/kg)	0	0	0	2	2	2	28	28	28	36	36	36
Electricity (bht/month)	0	0	0	200	200	200	2800	2800	2800	3640	3640	3640
Electricity(bht/kg)	0	0	0	2	2	2	26	26	26	137	137	137
Total Expense (bht/kg)*	0	0	0	13	13	13	63	63	63	182	182	182
Contribute Margin (bht/kg)	2	4	7	47	72	107	97	337	437	218	418	818
Kilogram to breakeven point	0	0	0	295	193	130	228	65	50	550	287	147
Incremental contribution margin(bht/kg)	**0**	**0**	**0**	**45**	**68**	**100**	**49**	**264**	**329**	**121**	**81**	**381**
Break even for parchment (kg)	**0**	**0**	**0**	**308**	**205**	**139**	**0**	**0**	**0**	**0**	**0**	**0**
Break even for green bean (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**447**	**83**	**67**	**0**	**0**	**0**
Break even for roasted coffee (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**989**	**1475**	**315**
Payback period (yr)	**0**	**0**	**0**	**3**	**2**	**1**	**1**	**0**	**0**	**2**	**3**	**1**

Graph C.3.1 Incremental contribution margin starting from 600 kilograms of cherries



Graph C.3.2 Break-even point for starting from 600 kilograms of cherries



Graph C.3.3 Payback period starting from 600 kilograms of cherries.

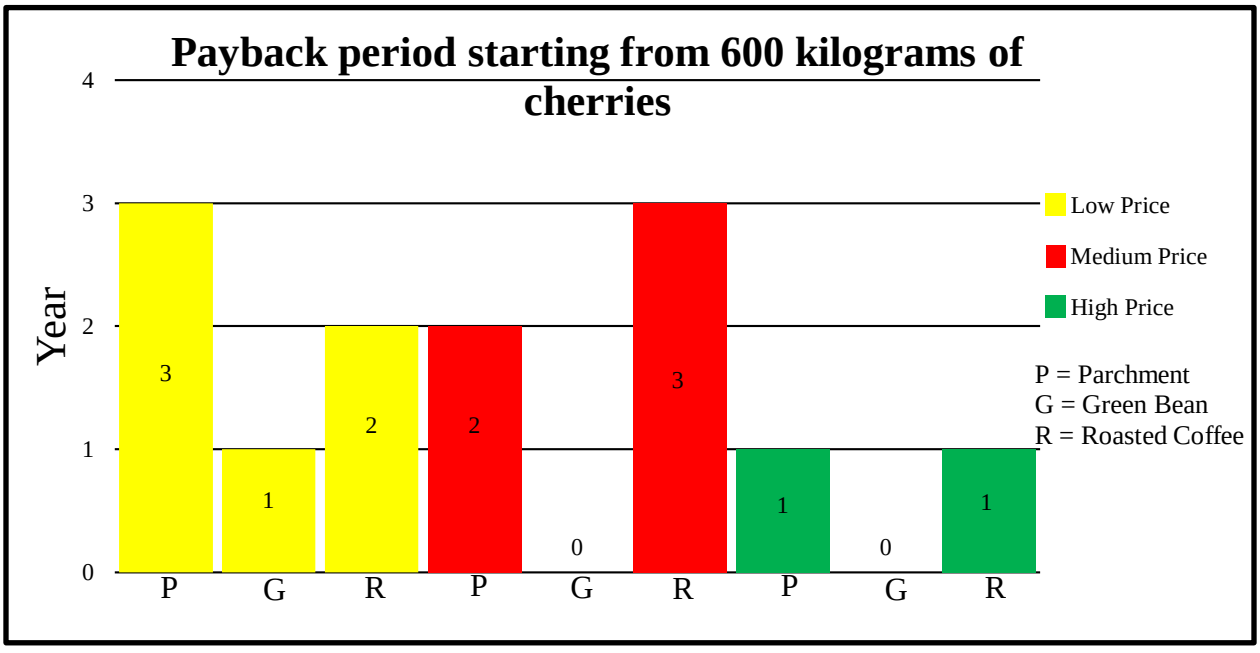
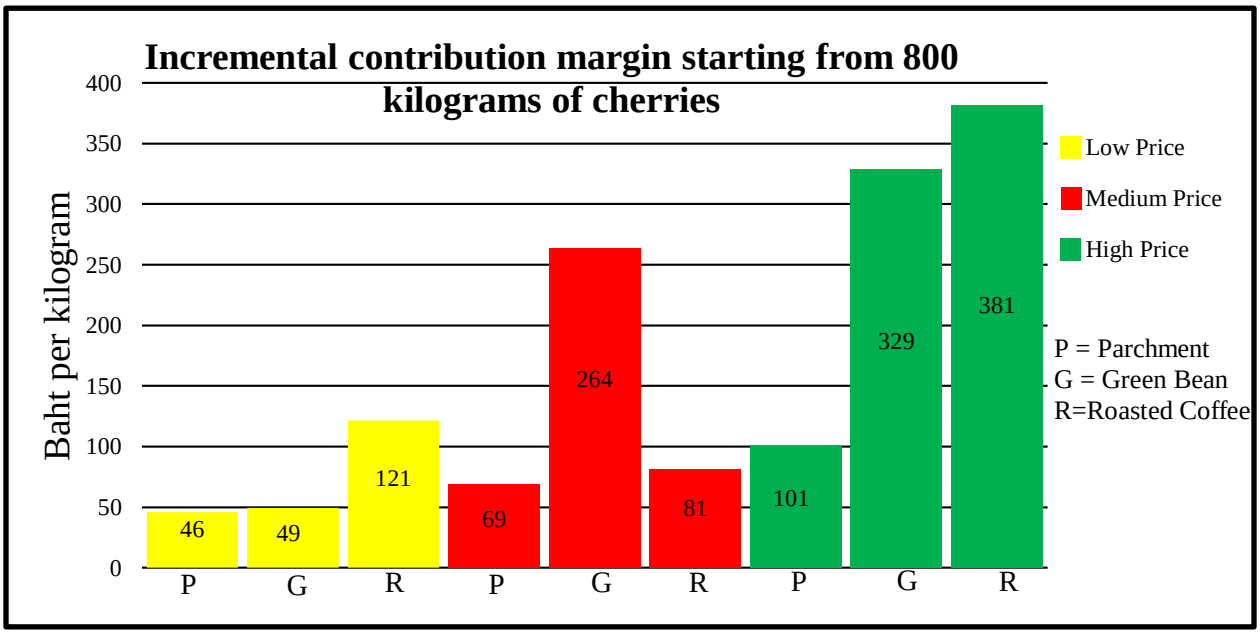


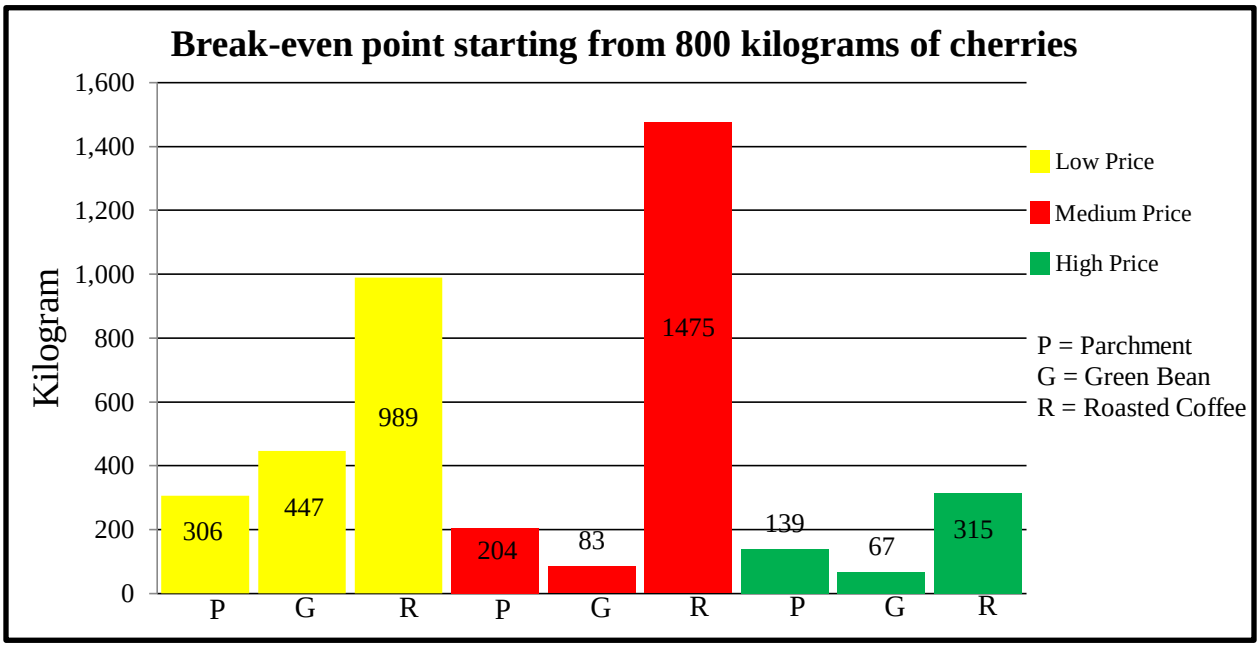
Table C.4 Table of financial calculation with the productivity starting from 800 kilograms of cherries with lowest cost of machine

High price	Based on market price of arabica coffee in 2556-2557											
Medium price	**With the lowest cost of machine**											
Low price	*There is no significant difference in the graph of parchment to roasting stage due to decimal point ignorance.											
(Assume 800 kg Cherry in 1 year)	Harvesting to Cherry			Cherry to Parchment			Parchment to Green Bean			Green Bean to Roasted Coffee		
Revenue												
Price (bht/kg)	10	12	15	60	85	120	160	400	500	400	600	1000
Productivity	1:1	1:1	1:1	5:1	5:1	5:1	5:4	5:4	5:4	1:1	1:1	1:1
Total Revenue (bht)*	8000	9600	12000	9600	13600	19200	102400	256000	320000	256000	384000	640000
Expense	Fixed cost											
Machine (bht)	0	0	0	14000	14000	14000	22000	22000	22000	120000	120000	120000
Expense	Variable cost											
Transportation distance (km)	0	0	0	300	300	300	300	300	300	300	300	300
Disel oil cost (bht/L)	0	0	0	25	25	25	25	25	25	25	25	25
Used liters (L/km)	0	0	0	13	13	13	13	13	13	13	13	13
Product Transportation cost (bht)	0	0	0	650	650	650	650	650	650	650	650	650
Transportation (bht/kg)	0	0	0	1	1	1	1	1	1	1	1	1
Labour (bht)	8	8	8	8	8	8	8	8	8	8	8	8
Rent/Maintainance (bht/kg)	0	0	0	2	2	2	28	28	28	36	36	36
Electricity (bht/month)	0	0	0	200	200	200	2800	2800	2800	3640	3640	3640
Electricity(bht/kg)	0	0	0	2	2	2	26	26	26	137	137	137
Total Expense (bht/kg)*	0	0	0	12	12	12	63	63	63	182	182	182
Contribute Margin (bht/kg)	2	4	7	48	73	108	97	337	437	218	418	818
Kilogram to breakeven point	0	0	0	294	193	130	227	65	50	550	287	147
Incremental contribution margin(bht/kg)	**0**	**0**	**0**	**46**	**69**	**101**	**49**	**264**	**329**	**121**	**81**	**381**
Break even for parchment (kg)	**0**	**0**	**0**	**306**	**204**	**139**	**0**	**0**	**0**	**0**	**0**	**0**
Break even for green bean (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**447**	**83**	**67**	**0**	**0**	**0**
Break even for roasted coffee (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**989**	**1475**	**315**
Payback period (yr)	**0**	**0**	**0**	**2**	**1**	**1**	**1**	**0**	**0**	**2**	**2**	**0**

Graph C.4.1 Incremental contribution margin starting from 800 kilograms of cherries



Graph C.4.2 Break-even point starting from 800 kilograms of cherries



Graph C.4.3 Payback period starting from 800 kilograms of cherries

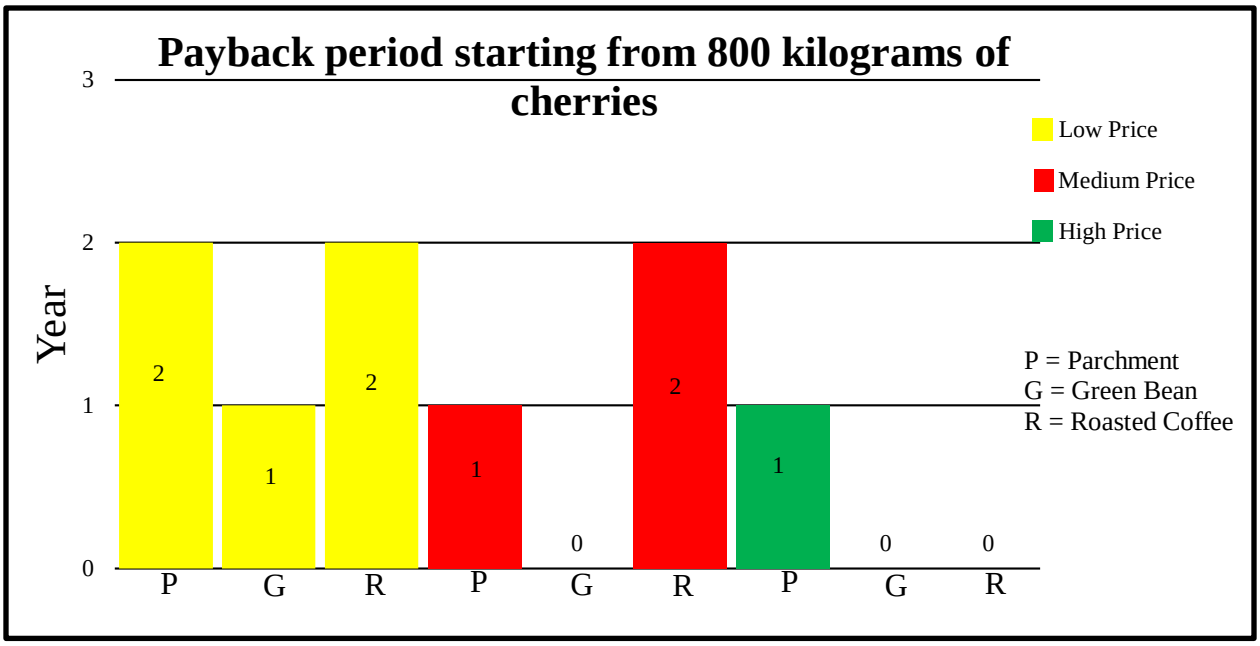
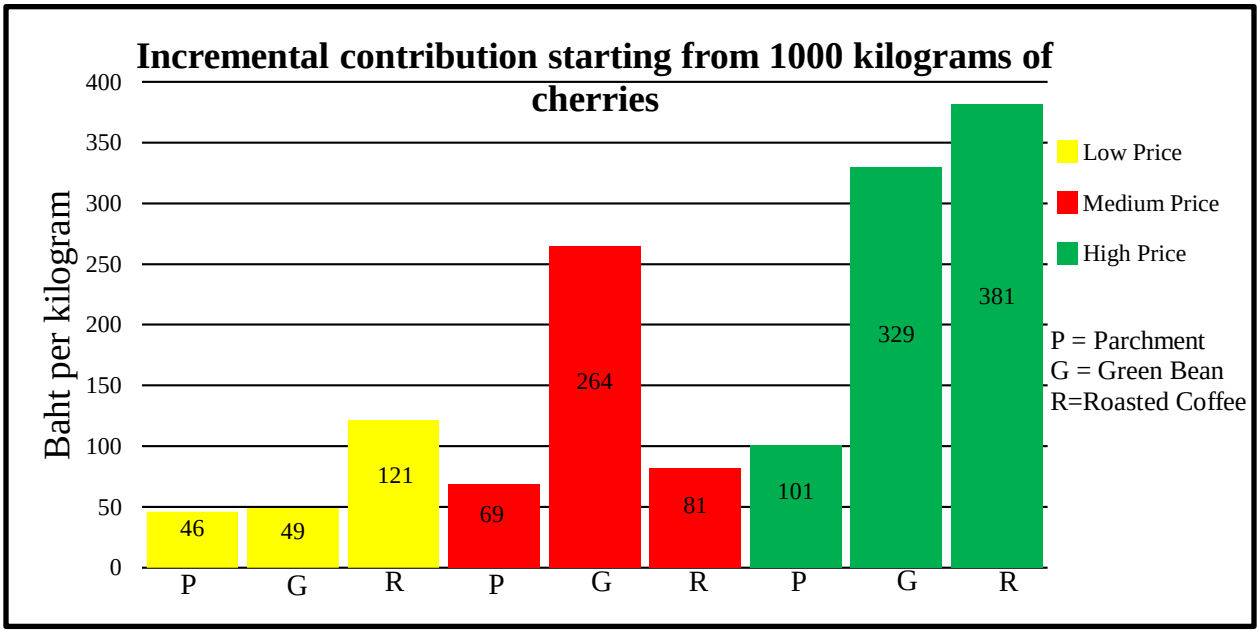


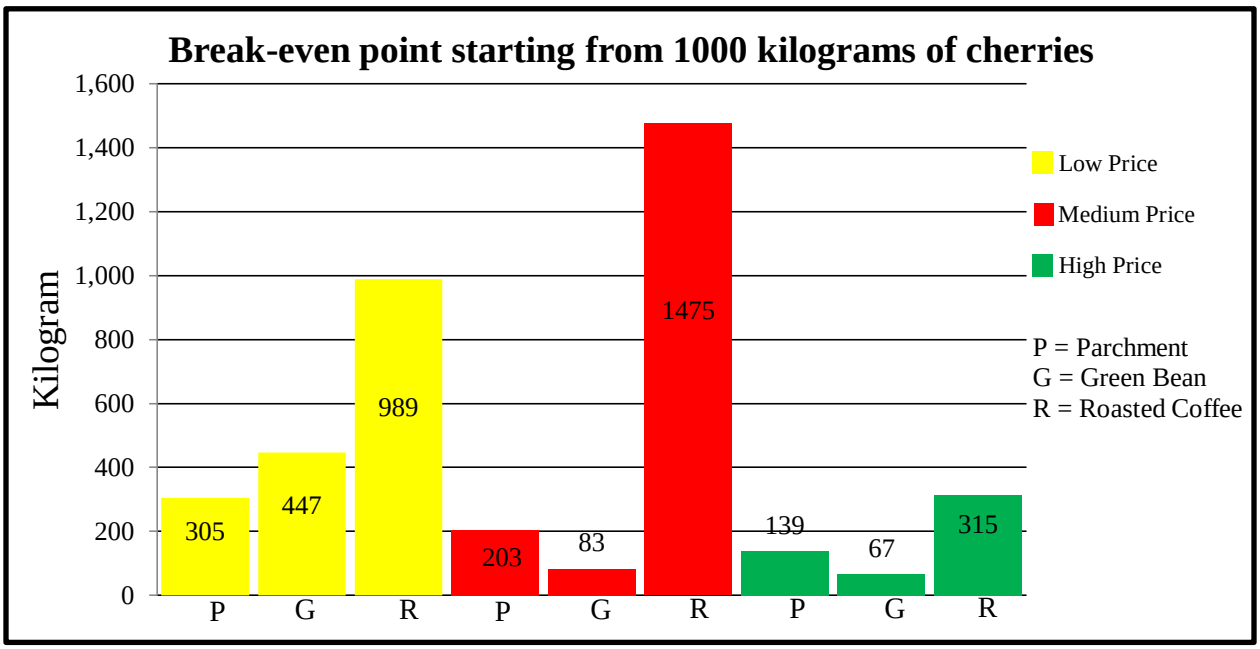
Table C.5 Table of financial calculation with the productivity starting from 1000 kilograms of cherries with lowest cost of machine

High price	Based on market price of arabica coffee in 2556-2557											
Medium price	**With the lowest cost of machine**											
Low price	*There is no significant difference in the graph of parchment to roasting stage due to decimal point ignorance.											
(Assume 1,000 kg Cherry in 1 year)	Harvesting to Cherry			Cherry to Parchment			Parchment to Green Bean			Green Bean to Roasted Coffee		
Revenue												
Price (bht/kg)	10	12	15	60	85	120	160	400	500	400	600	1000
Productivity	1:1	1:1	1:1	5:1	5:1	5:1	5:4	5:4	5:4	1:1	1:1	1:1
Total Revenue (bht)*	10,000	12,000	15,000	12,000	17,000	24,000	128,000	320,000	400,000	320,000	480,000	800,000
Expense	Fixed cost											
Machine (bht)	0	0	0	14,000	14,000	14,000	22,000	22,000	22,000	120,000	120,000	120,000
Expense	Variable cost											
Transportation distance (km)	0	0	0	300	300	300	300	300	300	300	300	300
Disel oil cost (bht/L)	0	0	0	25	25	25	25	25	25	25	25	25
Used liters (L/km)	0	0	0	13	13	13	13	13	13	13	13	13
Product Transportation cost (bht)	0	0	0	650	650	650	650	650	650	650	650	650
Transportation (bht/kg)	0	0	0	1	1	1	1	1	1	1	1	1
Labour (bht)	8	8	8	8	8	8	8	8	8	8	8	8
Rent/Maintainance (bht/kg)	0	0	0	2	2	2	28	28	28	36	36	36
Electricity (bht/month)	0	0	0	200	200	200	2,800	2,800	2,800	3,640	3,640	3,640
Electricity(bht/kg)	0	0	0	2	2	2	26	26	26	137	137	137
Total Expense (bht/kg)*	0	0	0	12	12	12	63	63	63	182	182	182
Contribute Margin (bht/kg)	2	4	7	48	73	108	97	337	437	218	418	818
Kilogram to breakeven point	0	0	0	293	192	130	227	65	50	549	287	147
Incremental contribution margin(bht/kg)	**0**	**0**	**0**	**46**	**69**	**101**	**49**	**264**	**329**	**121**	**81**	**381**
Break even for parchment (kg)	**0**	**0**	**0**	**305**	**203**	**139**	**0**	**0**	**0**	**0**	**0**	**0**
Break even for green bean (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**447**	**83**	**67**	**0**	**0**	**0**
Break even for roasted coffee (kg)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**989**	**1,475**	**315**
Payback period (yr)	**0**	**0**	**0**	**2**	**1**	**1**	**1**	**0**	**0**	**1**	**2**	**0**

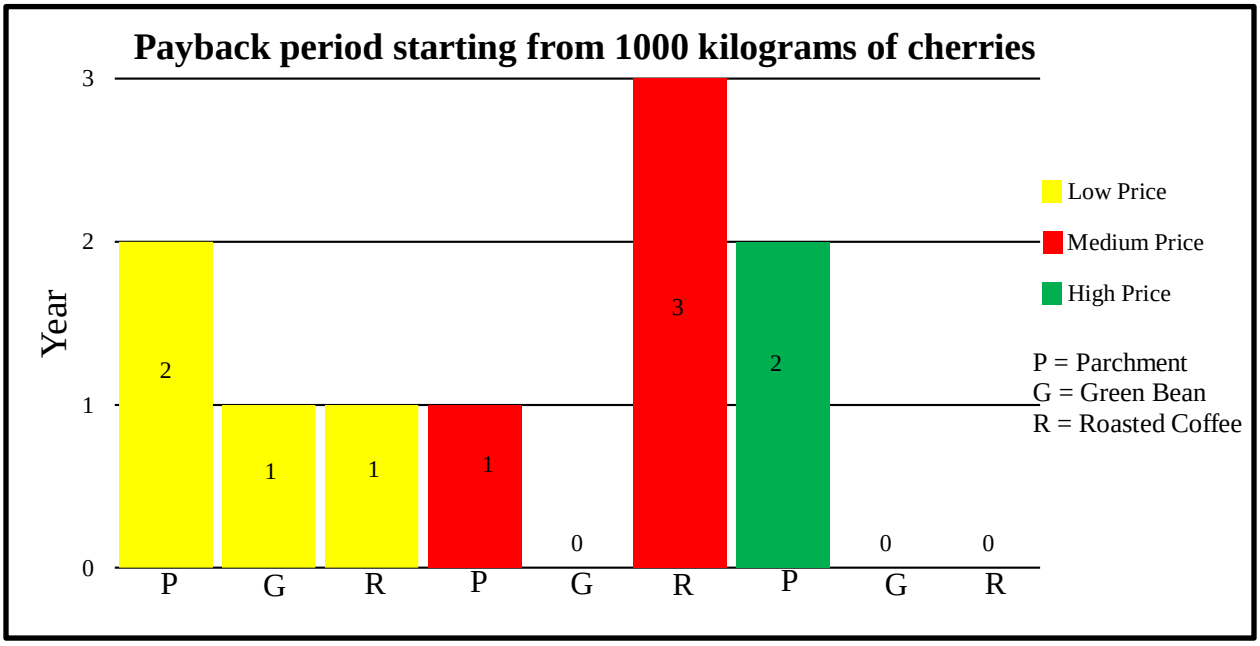
Graph C.5.1 Incremental contribution margin starting from 1000 kilograms of cherries



Graph C.5.2 Break-even point for starting from 1000 kilograms of cherries.



Graph C.5.3 Payback period starting from 1000 kilograms of cherries.



APPENDIX F. Summative Team Assessments

By working with distinctive personal characteristics of SSP teammates, we all were able to discover our own strengths and identified areas of improvements. From understanding one's task, we were capable to delegate suitable work to appropriated person.

In fact, this was the first time for Interactive Social and Science Project that allowed the 3rd and 4th year students to cooperate together, which caused considerateness due to the unfamiliarity and generation gap. As time goes by, we tried to learn among teammates' attribute that led us to adapt own humor towards each other, aided between senior and junior students and created the working atmosphere commensurate as a family. As we mentioned in the very first step in the code of conduction, working with happiness, we always maintained such precedent, and this played as fundamental in our group dynamic.

Nevertheless, among characteristic's differences, we realized that it was not possible to approve various opinions from all teammates to make decision on the working progress. Respect and rational thinking were needed in this transaction focusing on common interests as greatest importance.

Although our team had no chance to comply with cross-cultural as IQP-SSP team, the cross-functional was challenged us in every day, and this provided us the board range of knowledge which we could never experience in the classroom or anywhere else.