International Partnership on Innovation

SAMS - Smart Apiculture Management Services

Deliverable N°2.3

Results of Market Surveys

N°2 SAMS User Centred Design Cycles and Business Development

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IQQO Oromia Agricultural Research Institute	Oromia Agricultural Research Institute, Holeta Bee Research Center	HOLETA	Ethiopia
Universitas Padjadjaran	University Padjadjaran	UNPAD	Indonesia

PRIMARY TRAINING & CONSULTING	Commanditaire Vennootschap (CV.) Primary Indonesia	CV.PI	Indonesia

List of Abbreviations

AAA Asian Apicultural Association

AB Advisory Board

ASS Advisory Support System

ATA Agricultural Transformation Agency

BDS Business Development Services

BPS Indonesian Central Bureau of Statistics

CTA Technical Centre for Agricultural and Rural Cooperation

DSS Decision Support system

EAAP Ethiopian Agribusiness Accelerator Platform

EAB Ethiopian Apiculture Board

EBA Ethiopian Beekeeping Association

EHBPA Ethiopian Honey and Beeswax Producers and Exporters Association

ESAS Ethiopian Society of Apiculture Science

ETB Ethiopian Birr

FDI Foreign Direct Investment

FGD Focus Group Discussion

GIAS Green Innovation & Agritech Slam

HMF Hydoxymethylfufural

ICT Information and Communication Technology

IDR Indonesian Rupiah

IoT Internet of Things

ITB Institut Teknologi Bandung

JMHI Jaringan Madu Hutan Indonesia

MoA Ministry of Apiculture Ethiopia

SDG Sustainable Development Goals

TVET Technical and Vocational Education and Training

UCD User Centered Design

UGM University Gadjah Mada

4IR Fourth Industrial Revolution

Summary of the project

SAMS is a service offer for beekeepers that allows active monitoring and remote sensing of bee colonies by an appropriate and adapted ICT solution. This system supports the beekeeper in ensuring bee health and bee productivity, since bees play a key role in the preservation of our ecosystem, the global fight against hunger and in ensuring our existence. The high potentials to foster sustainable development in different sectors of the partner regions are they are often used inefficient.

Three continents - three scenarios

(1) In Europe, consumption and trading of honey products are increasing whereas the production is stagnating. Beside honey production, pollination services are less developed. Nevertheless, within the EU 35% of human food consumption depend directly or indirectly on pollination activities.

(2) In Ethiopia, beekeepers have a limited access to modern beehive equipment and bee management systems. Due to these constraints, the apicultural sector is far behind his potential.

(3) The apiculture sector in Indonesia is developing slowly and beekeeping is not a priority in the governmental program. These aspects lead to a low beekeeper rate, a low rate of professional processing of bee products, support and marketing and a lack of professional interconnection with bee products processing companies.

Based on the User Centered Design the core activities of SAMS include the development of marketable SAMS Business Services, the adaption of a hive monitoring system for local needs and usability as well as the adaption of a Decision Support System (DSS) based on an open source system. As a key factor of success SAMS uses a multi stakeholder approach on an international and national level to foster the involvement and active participation of beekeepers and all relevant stakeholders along the whole value chain of bees.

The aim of SAMS is to:

- enhance international cooperation of ICT and sustainable agriculture between EU and developing countries in pursuit of the EU commitment to the UN Sustainable Development Goal (SDG N°2) “End hunger, achieve food security and improved nutrition and promote sustainable agriculture”
- increases production of bee products
- creates jobs (particularly youths/ women)
- triggers investments and establishes knowledge exchange through networks.

Project objectives

The overall objective of SAMS is to strengthen international cooperation of the EU with developing countries in ICT, concentrating on the field of sustainable agriculture as a vehicle for rural areas. The SAMS Project aims to develop and refine an open source remote sensing technology and user interaction interface to support small-hold beekeepers in managing and monitoring the health and productivity in their own bee colonies. Highlighted will be especially the production of bee products and the strengthening of resilience to environmental factors.

- Specific objectives to achieve the aim:

- Addressing requirements of communities and stakeholder
- Adapted monitoring and support technology
- Bee related partnership and cooperation
- International and interregional knowledge and technology transfer
- Training and behavioral response
- Implementation SAMS Business cooperation

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Executive summary

This report gives an overview on findings of the current honey and apiculture market in Indonesia and Ethiopia. Since Ethiopia and Indonesia are the main target countries the focus lies on the Ethiopian and Indonesian market – the most important facts about the European market are considered briefly in the last chapter of the report. Next to honey and other bee products, the market results target especially SAMS related fields like data usability and SAMS technology modules. An overview is provided on the following aspects:

- Target market – Who are the potential customers? How many of them are there, what are their needs? What are their buying and shopping habits?
- Bee product landscape – the current state of bee products and related processing industries and where it is headed
- Competition – description of the competitors' positioning, strengths, and weaknesses
- Pricing and forecast – pricing help to determine the position of the company in the market, and the forecast shows what portion of the market the company hopes to get

Therefore, the following fields will be reviewed in detail in the report:

Figure 1 Results of Market Survey - Overview

When developing businesses, the market analysis will enable local teams and local industry to:

1. Avoid putting a lot of resources and time into creating products or services before determining that the solution is needed
2. Determine that the need for planned products or services is big enough that people will pay for it and that the planned business cases can be successful on the local market

3. Ensure that SAMS technology modules and services are viable and sustainable

Used Methodology

Literature study as well as qualitative and quantitative surveys have been conducted to examine the honey and apiculture market in Ethiopia and Indonesia. The user research, which is ongoing since the beginning of the project, resulted in qualitative insights. Quantitative surveys about honey consume in Ethiopia and Indonesia and a technology survey in Indonesia were conducted between November 2019 and February 2020. In total 544 individuals participated in the surveys – 53 in the Ethiopian on honey consume, 445 in Indonesia on honey consume and 46 in Indonesia on technology aspects.

Results Ethiopia

Beekeeping has a long tradition and history in Ethiopia. The traditional method of beekeeping is usually practiced as a hobby to source one's own honey need. Due to low production capacity, it has a very little financial benefit for the traditional beekeepers, but it is very easy to maintain and has very low setup costs. Based on its long tradition and great potential Ethiopia is Africa's leading honey and beeswax producer and 10th biggest ones for honey while 3rd for beeswax in the world.[1] Known as the most populated landlocked country with its high population underlines the importance of the development of the apicultural sector.

There is no official data on the total number of beekeepers in Ethiopia, but it is estimated to be more than 1 million. The number of beehives in the country (2016) is 6,189,329 (FAO 2018). About 95% of Ethiopian beekeepers use traditional hive-systems. The remaining percentage of beekeepers use transitional (promoted since 1978) and modern hives. The used hive system differs from region to region and is mainly based on purchasing cost, not on productivity. The annual honey production was estimated to 43,000 t/year with a potential of about 550,000 t/year[2] [3] and 50,000 beeswax production per year; although only 10% have been tapped. This is also shown in a review of Ethiopian beekeeping practices indicates honey bees can grow across all regions in Ethiopia although the sector is underperforming.

Nevertheless, Ethiopia has great potential in producing honey (possibly 27.3% world honey market by 2015) due to flora and fauna, two or three harvesting times etc. for great potential. Nevertheless, beekeeping expansion has been showing low growth due to some constraints such as improper harvesting, bee diseases, pests and predators, poisoning due to agro-chemicals, lack of finance, lack of adequate equipment and deforestation etc.

The Ministry of Agriculture (MoA 2013) also recognized the unused potential of the apiculture sector, which could boost Ethiopia to become one of the main honey producers in the world and lead to a better main income for farmers and beekeepers. Therefore, the MoA identified specific targets, e.g. increase annual honey and beeswax production, increase the annual

[1] https://www.researchgate.net/publication/331037935_Review_of_Ethiopia%27s_Global_Position_in_Honey_and_Other_Bee_Products_Production_and_Marketing_Analysisof_Sectoral_Opportunities_and_Limitations

[2] MoARD (2007): Ministry of Agriculture and Rural Development. Livestock Development Master Plan Study. Phase I Report - Data Collection and Analysis, Volume N - Apiculture. Addis Ababa, Ethiopia.

[3] Taye, B., Desta, A., Girma, C., & Mekonen, W. T. (2016): Evaluation of transitional and modern hives for honey production in the Mid Rift Valley of Ethiopia. Bulletin of Animal Health and Production in Africa, 64(1), 157–165.

honey and beeswax export, they want to achieve by 2025.[4] However, there are no activities to control e.g. the impact of pesticide chemicals on the bee colony by the government. [5]

When we see the trends of import and export of honey the amount of exported honey to the global market is greater than the amount of honey imported to Ethiopia. In terms of price the average price imported and exported honey is 1.8 and 2.7 USD respectively.

There are honey importers in the country, but the quality and safety of the imported honey is not inspected.

In addition to those facts the conducted consumer survey as well as the user research shed light on specific requirements for the Ethiopian bee product market:

Market and Consumer in Ethiopia

- Import-export:
  - Ethiopia is a net-export-country based on import and export values (honey and beeswax) but export declines due to honey quality degradation
  - Ethiopia only exports about 2% of its honey (e.g. by Zembaba Union), but also imports honey from countries like Egypt, EU and United Arab Emirates. Although natural honey is also imported, most imports to Ethiopia are further processed and packaged honey products (e.g. speciality honey products) that usually are produced for high-end hotels or sold in few urban supermarkets. According to a study on the quality of imported honey, a survey indicated there are 10 honey importers supplying to supermarkets and high-end hotels (Sheraton Addis) although the quality and safety is not inspected by the concerned bodies. High-end packaging of products is part of the reason these institutions prefer, as opposed to poorly packaged products in Ethiopia. It also showed that most of the similar establishments are using local products (of a tested quality). It can be concluded that the effects of imported honey are not significant as the majority of users have developed trust in local honey as opposed to other imported products
- Bee-related products: Products such as beeswax, propolis, pollen, royal jelly and bee venom are among the growing export commodities with good potential
- Use of honey: Mainly for *tej* brewing (70%); table honey (20%); beekeepers' household (10%)
- Quality of honey: Impure honey due to pollen etc. and high moisture level, since good quality is not required for *tej*
- Value of bee related products:
  - Average price for honey increases – 2015: 131 ETB/kg (~6.34 USD); 2018: 260 ETB/kg (~9.45 USD)
  - Beeswax is around 300ETB/kg (~30 USD)
  - *Tej* market value 50ETB/liter (rural are); 150ETB - 200ETB/liter (urban area)
- Honey value criteria: Quality, origin, taste, colour, aroma, organic certification, type

[4] Ministry of Agriculture (2013): Apiculture value chain vision and strategy for Ethiopia, International Livestock Research Institute, Addis Ababa, ISBN: 92–9146–410–4

[5] Interview with beekeepers

- Domestic demand: Increasing due to increased *tej* consumption and table honey use
- Honey production: Estimation of 2015 – Ethiopia only taps its potential of honey production by 8,6%
- Type of honey consumption:
  - Consumption refers to per capital growth
  - Liquid honey is preferred
  - Supermarkets are most popular for buying honey
  - Consumer rather buy local honey instead of imported ones (because of availability and price)
  - Honey bought in branded packaging (mainly 250g) in glass jars, although glass business is rarely small and hard to get
  - Require label information on honey
- Origin and content of honey: Information is not provided in informal and traditional honey retailing services
- Bee product value chain: Differs depending on the region and use of honey
- Business concepts:
  - Business concepts on bee related products are very rare
  - Great potential for expanding business with: beeswax, packaging material – especially glass jar, pollen, migratory beekeeping
- Problems of the domestic market which affect the supply line:
  - Illegal cross border honey trade
  - Adulteration of honey bee products
  - Complaints of consumers about increasing prices of honey products by low quality
  - Recurrent drought

Beekeeping and Technology in Ethiopia

- Average price for bee colonies: Continuous growth from 667 ETB/colony (~32.28 USD) in 2015 to 1,200 to 1,500 ETB (~43.64 USD to 54.55 USD) in 2018
- Challenges for beekeepers: Lack of awareness, knowledge and material for successful conduction of beekeeping activities
  - Lack of good beekeeping practice
  - No existing quality control bodies
  - Lack of proper collection, storage and transportation facilities etc.
- Bee hive-productivity: 95% of beekeepers use a traditional beehive - productivity and greater income providing beekeeping is based on used hive types
  - Traditional hive – average of 5-8 kg honey
  - Modern hives - average of 15-20 kg honey
- Quality of the honey

- Moisture level also depends on hive type - traditional hives have 1.5-3.0% higher moisture content than modern hives
- Traditional hive honey is a mixture of pollen, wax and honey

- Productivity on beeswax based on hive types
  - Traditional hive - 8.0-10.0%
  - Modern hives - 0.5-2.0%
- Use of technology:
  - Beekeepers are interested in digital tools and convinced that technology can improve their daily beekeeping activities and income
  - Almost no use of digital technology implementation in the apiculture industry in Ethiopia so far
  - Recently, with the support of the SAMS project, the interest to apply digital solutions on beekeeping activities to improve production and predict harvest raises
- Challenges in the use of technology: There is almost no use of digital technology in the apiculture industry in Ethiopia so far – competitors are only Anabi and Kekros
- Affordability of SAMS for Ethiopian beekeepers:
  - The current price for the SAMS device is still above 100 EUR; most beekeepers would be able to afford the system if it was no more than 100 EUR

Support/ Actors

- The government responsible body to oversee the development of the beekeeping sector is the Federal Democratic Republic of Ethiopia Ministry of Agriculture (MoA). Under the ministry, there is a directorate dedicated to beekeeping policy and projects support. National policies and initiatives (e.g. globally competitive honey sector development policy) are rolled out to support the honey value chain, particularly the processing businesses.
- Agricultural Transformation Agency (ATA) has established the Ethiopian Agribusiness Accelerator Platform (EAAP) to test and validate the agribusiness incubator and accelerator concept for Ethiopia focusing on beekeeping. The initial focus for testing the incubator and accelerator models will be the honey and wax value chain given agro-ecological strengths, strong existing demand sinks, high degree of investment attractiveness, strong government support, and other parallel investments that create opportunities for significant leverage.[6]
- Regarding business incubation services for the agribusiness, private incubators like blueMoon (Agritech and agribusiness incubator) and ICEADDIS (through ice180 incubation program) provide business development services (BDS) for SMEs and start-ups in the agriculture sector that also have beekeeping businesses in the program.

[6] http://www.ata.gov.et/programs/highlighted-deliverables/eaap/

- Development cooperation projects also support the beekeeping sector in high scale support. Notably, Green Innovation & Agritech Slam (GIAS) program is annual nationwide business competitions to support wheat, legumes and honey value chains.[7] This project is a collaboration between GIZ, CTA and ICEADDIS.
- There are also sectorial associations that work in support of the apiculture value chain and coordinate development efforts among different actors. This includes, the Ethiopian honey and beeswax producers and exporters association (EHBPA), Ethiopian Beekeeping Association (EBA), and the Ethiopian Apiculture Board (EAB).

Results Indonesia

Although in Indonesia there is a tradition of beekeeping, the beekeeping sector is still small and not considered a profitable business. Being a traditional practice, beekeeping is mostly carried out by elder citizens and the number of young beekeepers is relatively small. Most beekeeping businesses are carried by small farmers with limited capital and as trust in the business is low, banks do not provide credits. Although beekeeping businesses experienced a heyday between the 1980s and the early 1990s, today it is considered “second class farming” and the current state of beekeeping in Indonesia can be described as a suspended era. There is a lack of know-how on proper beekeeping and honey productivity is low. Moreover, beekeeping conditions in Indonesia are threatened by the functional shift of land and by erratic changes in the weather due to global climate change. Considering that beekeepers in Indonesia struggle with absconding of honey bees, lack of knowledge, bee forage, use of pesticides, and lack of storage facilities, infrastructure and market facilities, many face similar problems as beekeepers in Ethiopia.

Complete data on the honey production and total amount of beekeepers in Indonesia is not available because most small and traditional beekeepers and honey hunters do not record their honey harvest amount/sales or are not able to routinely record their production results. Nevertheless, numbers of the Indonesian Central Bureau of Statistics (BPS) show that in 2016, West Java recorded 7,141 *Apis mellifera* hives. Data on the honey consumer side is more abundant, showing that 75% of honey consumers live in Java island, on which approximately 57% of Indonesia´s population lives. Most consumers are students (26%), are government employees (16%), private employees (18%), and entrepreneurs (17%) with income around 5-10 million IDR (283-566 Euro in April 2020). In 2018, honey production data reached 147,274.03 liters, mainly produced by traditional beekeepers for local and national market.

Nevertheless, there is high potential for the beekeeping sector in Indonesia. Raising awareness of the positive health aspects provided by honey and related bee products, has led to a continuous increase of the demand for these products. Moreover, consumers prefer local honey over imported products. Particularly raw honey and other raw bee products have great market potential. In response to the increased demand, Indonesia has turned into one of the Asian countries that import more honey than export. Moreover, the fact that the national honey production cannot satisfy the increasing demand of honey, led to the adulteration of honey – the main problem honey consumers face in Indonesia. This led to the decline of consumer confidence in the authenticity and quality of honey. This is also caused by the lack of governmental regulations, official honey certification, proper label information (traded in the

[7] http://innovation-slam.com/

name of raw material not of its origin), and lack of consumers quality knowledge as well as due to the high value of selling honey.

Moreover, the young beekeepers have shown to have great knowledge in technology compared to their elder colleagues and therefore provide high potential for the implementation of modern beekeeping and digitalization of bee monitoring through solutions such as the SAMS monitoring system. A survey conducted throughout the project showed that SAMS technology and its data utilization is considered useful by those stakeholders. Few start-ups and beekeepers who were involved in project activities, further showed interest in receiving and applying the technology. Nevertheless, change from traditional beekeeping to a more technology-based activity will take time, as beekeeping in Indonesia is mostly done by seniors.

Efforts to foster growth of the beekeeping sector in Indonesia include several local initiatives for the education of domiciled beekeepers as well as projects and research programs. Unfortunately, most of them are of short duration and partly lack good coordination as only few few universities and other scientific institutions who deal with beekeeping activities.

In addition to those facts the conducted consumer survey as well as the user research shed light on specific requirements for the Indonesian bee product market:

Market and Consumer in Indonesia

- Import-export: honey import volume is considerably higher than honey export volume
- Bee-related products: raw honey and bee-related products are very popular, particularly propolis, royal jelly and bee pollen. Beeswax and venom are bought rarely.
- Use of honey: the majority is bought for self-consumption (89,51%), and medicinal/ health aspects, form of live style and nutritional aspects
- Quality of honey: high humidity, and lack of beekeeping facilities lead to low quality; widespread honey adulteration with sucrose
- Value of bee-related products:
    - 1kg table honey is around 200.000 IDR (14.20 USD in 2018; 12.11 Euro in 2020)
    - 100 ml liquid propolis ranges from IDR 45,000 to 300,000 (3.11 – 24.17 USD; 2.77 – 18.49 Euro in 2020)
- Honey value criteria: quality, price, type of honey, and packaging quality
- Domestic demand: increased due to increased awareness of medicinal/ health value of honey and new lifestyle
- Type of honey consumption:
    - Local honey and forest honey are preferred over imported honey
    - Honey is mostly bought in retail stores
    - Honey with honey comb indicates originality of the honey
    - Honey is bought in branded packaging (mainly 250g) in glass jars
    - Require label information on honey

- Origin and context of honey: the origin is not always indicated on labels due to low awareness of the linkage between traceability and quality of honey
- Bee product value chain: The Indonesian Honey supply chain is described, and includes fostered and traditional beekeepers, honey hunters, resellers, distributors, investors and industries/ home industries
- Problems within the domestic market
    - Indonesian industry depends on imported raw materials and components
    - Adulteration of honey
    - Weather changes due to global climate change

Beekeeping and Technology in Indonesia

- Average price for bee colonies: one colony of *Apis mellifera* has a value of around 1,000,000-1,500,000 IDR (57-85 Euro); one colony of *Apis cerana* has a value of around 50,000 – 80,000 IDR (3-5 Euro)
- Challenges for beekeepers: lack of knowledge and materials for successful conduction of beekeeping activities, structural and environmental factors
    - Lack of good beekeeping practice
    - Lack of bee colonies (however there is always demand for it when flowering season suddenly starts and by new beekeepers)
    - Lack of proper storage facilities, infrastructure and market facilities
    - Insufficient quality control
- Quality of the honey: High moisture level due to humid climate
- Bee hive productivity: low productivity as most beekeepers work with the bee species *A. cerana*, which is known to show increased absconding behaviour and to be less productive than *A. mellifera*
- Use of technology:
    - Technology innovation for beekeeping is considered important
    - Almost no use of digital technology implementation in the apiculture industry
    - Few start-ups started using monitoring technology for beekeeping (Calakan, inspired by SAMS; KerabaTani)
    - Recently, beekeepers involved in the SAMS project have shown interest in applying digital solutions and receiving the SAMS monitoring technology
- Challenges in the use of technology:
    - There is almost no use of digital technology in the apiculture sector industry
    - Young beekeepers have shown to have great knowledge in technology, but most beekeepers are of an older generation have no experience with technology
- Affordability of SAMS for Indonesian beekeepers
    - Based on the financial ability of Indonesian beekeepers, and funding ability of different stakeholders, SAMS technology could penetrate the Indonesia market with prices around 1,000,000 - 2,000,000 IDR (57 EUR – 114 EUR).

- potential customers of SAMS businesses are government, universities/ research institutions, business sectors, communities and NGOs.

Figure 2 Baseline for Business Development in Indonesia

EU Market

Although being the second biggest honey producer in the world with around 230,000t produced by only 17 million beehives and about 600,000 beekeepers, EU honey consumer demands are higher than the EU market can cover. Thus, honey is imported from different countries, e.g. Ukraine, China.[8] For importing honey there are several legally binding requirements (e.g. General Food Law of the European Union - Regulation (EC) No 178/2002)).

Besides honey, the apiculture sector in Europe provides beeswax, pollen, propolis, royal jelly, and venom used also in the cosmetic industry, health industry as well as food and beverage industry.[9]

To strengthen the beekeeping sector, there are EU funds available for apiculture activities, including research and monitoring – between 2017 and 2019 the EU provided 216 million EUR, and for the years 2020-2022 around 240 million EUR will be spent in the EU. With the help of

[8] European Commission (2019): Honey Market Presentation. URL: https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/animals_and_animal_products/presentations/market-presentation-honey_en.pdf (access: 15.01.2020)

[9] Part II: Overview of the apiculture sector (2013): Evaluation of the CAP measures related to apiculture Agriculture and Rural Development DG- Final Report. URL: https://ec.europa.eu/agriculture/sites/agriculture/files/evaluation/market-and-income-reports/2013/apiculture/chap3_en.pdf (access: 15.01.2020)

several recent research projects on bee monitoring, many actual market ready products - monitoring systems - can be used to assist the beekeeper in beekeeping activities.[10]

Although not focusing on the European Market, the report is completed with an overview of the European Market – further information is available in D2.1 Report on Needs Assessment and Evaluation.

[10] European Commision (2019): Honey. URL: https://ec.europa.eu/info/food-farming-fisheries/animals-and-animal-products/animal-products/honey (access: 15.01.2020)

1. Methodology

The market research in Ethiopia and Indonesia has been carried out with literature study as well as qualitative and quantitative surveys. Qualitative insights have been collected through the conducted user research since the beginning of the project. Quantitative surveys conducted between November 2019 and February 2020 completed the market research – in total 544 participants were involved (53 in the Ethiopian honey consume survey; 445 in the Indonesian honey consume survey; 46 in the Indonesian technology survey). Further information on the surveys can be found in Chapter 2.1. Ethiopia and 2.2. Indonesia. Additional information about the Ethiopian and Indonesian as well as the European market have been found in existing studies and literature.

1.1 Ethiopia

The qualitative insights are deducted from the UCD in-depth interviews with beekeepers. The in-depth interviews were conducted during the user research phase two, by traveling to beekeeper's location and visiting apiary sites.

The market survey on honey consumption was conducted through online and print out questionnaires to urban honey consumers. Additionally, existing marketing studies and further literature gave insights in the Ethiopian market:

- Melaku Girma, Shifa Ball: Approaches, methods and processes for innovative apiculture development: Experiences from Ada'a-Liben Woreda, Oromia Regional State, Ethiopia. Working Paper No. 8. Publisher: Improving Productivity and Market Success (IPMS) of Ethiopian Farmers project
- Gemechis, L. Y. (2016). Honey Production and Marketing in Ethiopia. Agriculture And Biology Journal Of North America
- Haftu K, Gezu T (2014) Survey on the honey production system, challenges and opportunities in selected areas of Hadya zone, Ethiopia. Journal of Biotechnology and Sustainable Development. Academic Journal
- MoA & ILRI (2013). Apiculture value chain vision and strategy for Ethiopia. Addis Ababa, Ethiopia: Ministry of Agriculture and International Livestock Research Institute.
- Negash, B., & Greiling, J. (2017). Quality Focused Apiculture Sector Value Chain Development in Ethiopia. Journal of Agricultural Science and Technology

With the distribution of questionnaires in Addis Ababa, from November 2019 to January 2020, quantitative insights mainly about honey consumption were conducted with 53 participants. Considering previous similar data collected from other studies, the margin of error of 14% is tolerated. Addis Ababa population is 3.4 million. A sample of 53 responses are nearly representative for the study.

The questionnaires were distributed through email, Telegram, WhatsApp and twitter. A printed version was also used to address the offline honey consumers. The questionnaires were available in two languages (English and Amharic).

The questions addressed the topics: frequency, location, source and purpose of buying and consuming honey, as well as honey quality and favoured packaging material and size.

1.2 Indonesia

Qualitative insights through user research, e.g. interviews with beekeepers and observations of beekeeping locations and Focus Group Discussions (FGD) with stakeholders such as the Indonesian Apiculture Association, the Agency of Forestry, the state-owned forestry company (PERHUTANI), academics, business and beekeepers, were conducted since the beginning of the project. FGD are a data and collection method in qualitative research consisting of a group of people with similar characteristics[11], for instance, they are working in the fields that interact with beekeeping. The locations that were observed are West Bandung Regency Bandung city, Majalengka Regency, Subang Regency, Sukabumi Regency, Bogor City, Bogor Regency, Ciamis Regency and Pangandaran Regency.

Market surveys of honey consumers and technology were conducted from November 2019 to February 2020 in Indonesia with quantitative approach. The quantitative research approach is based on primary data obtained through the conduction of interview-based surveys in Indonesia. A questionnaire is the main means of collecting quantitative primary data. It enables quantitative data to be collected in a standardized way so that the data are internally consistent and coherent for analysis.[12] For the market survey on honey consume online questionnaires (soscisurvey.de survey platform) have been used, distributed via text messages on WhatsApp and twitter with the help of beekeeping partners, advisory board members, agency of forestry, Indonesian Apiculture Association, honey sellers etc.

The market survey on honey consumers was conducted to research the Indonesian honey consumer's demographics, awareness, preference, and product satisfaction. The Solvin formula determines the minimum number of respondents needed as primary data, which is one technique for determining the number of samples with a precision level of 7-10%. The amount obtained using the following formula:

$$n = \frac{N}{1 + Ne^2}$$

where:

n = number of samples;
N = population size;
e = the maximum value of admitted error of estimate equal to ± 5%.

The population size is determined based on Indonesian population employed (aged 15-60+) in the three biggest honey-producer-islands in Indonesia with a total of 102,141,896 people.[13] These islands are Sumatera, Java and Bali & Nusa Tenggara (considered as one island). This decision was made with an assumption that these people have purchasing power towards honey products.

[11] Kountur, R. (2008): Menguasai riset pemasaran. Jakarta (ID): PPM.
[12] Roopa S, Rani MS. (2017): Questionnaire Designing for a Survey. J Ind Orthod Soc 2012;46(4):273-277
[13] Badan Pusat Statistik (2018): Statistik Produksi Kehutanan 2017.
URL: https://www.bps.go.id/publication/2018/12/04/b28817f99d1391871e551abd/statistik-produksi-kehutanan-2017.html

$$n = \frac{N}{1+Ne^2} = \frac{102.141.896}{1+((102.141.896)(0{,}05^2))} = 400 \text{ respondents}$$

Based on the results of calculations with the Slovin formula, it was found that the minimum number of samples of respondents in this study was 400. The total number of participants was 445, based on the result 429 respondents answered the questionnaire as honey consumers.

For the survey on technology, online and offline questionnaires/ interviews were conducted with beekeepers and stakeholders' representatives via meetings and telephone: five beekeepers, 19 government representatives, five university/ research institutions, six businessmen, seven NGO representatives and four persons from communities. In total, 46 participants answered the questions. For the technology market survey, the Slovin formula is not suitable because there weren't enough stakeholders responding due to its specific and narrow scope and the fact that there is not everyone able to reply to such a specific aspect (beekeeping technology).

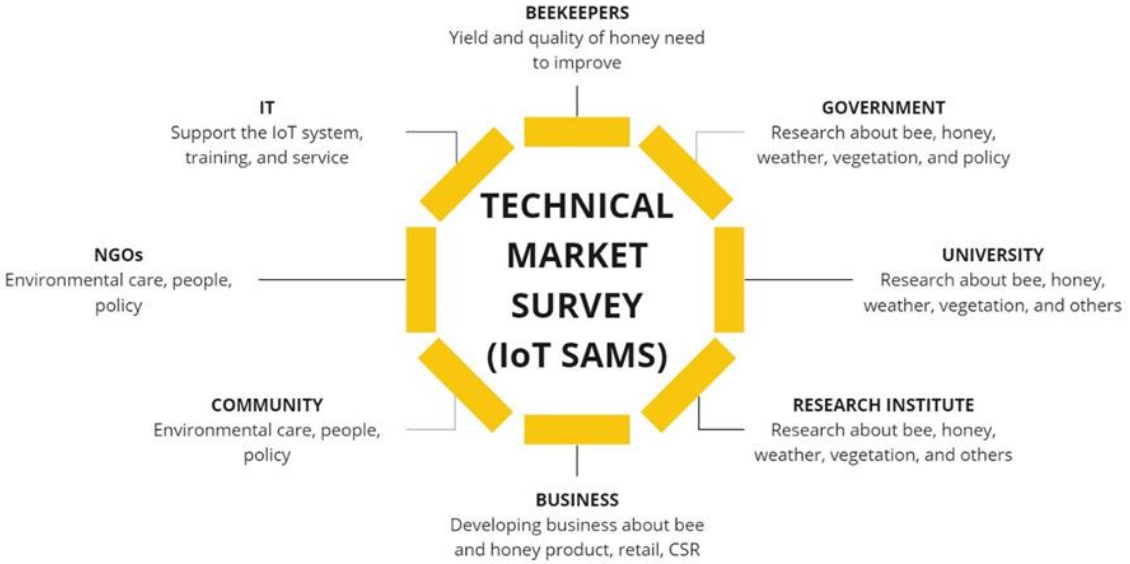

Figure 3 Technical Market Survey (IoT SAMS)

Not much literature exists for the Indonesian honey market. This has already been uncovered during the work for the SAMSwiki. However, additionally existing marketing studies and further literature have given insights in the Indonesian market, e.g.

- Putra, R.R. and Rosnita. 2015. Analisis Sikap Konsumen Dalam Mengonsumsi Madu Sialang Produksi Mr. Honey Di Kota Pekanbaru Analysis of Consumers' Attitude in Consuming Sialang Honey Produced by Mr. Honey in Pekanbaru. Jom Faperta Vol. 2 No. 2 Oktober 2015
- Honey Indonesia (2017) URL: https://www.tridge.com/products/honey/ID?q=indonesia%20honey
- Jaya, Firman (2017) Produk-produk Lebah Madu dan Hasil Olahannya. UB Press. Malang
- JMHI (2018) Jaringan Madu Hutan Indonesia. URL: http://www.jmhi.info/ (access date: 20.11.2018)
- Ministry of Industry. URL: https://www.kemenperin.go.id/download/18384

- SAMSwiki (2018) SAMS. URL: https://wiki.sams-project.eu/index.php/English
- Shouten, C. N., Lloyd, D. J., & Lloyd, H. (in press) Beekeeping with the Asian Honey Bee (Apis cerana javana Fabr) in Indonesia (status: 10.11.2018)

2. Target market

In 2020, Ethiopia has currently a total population of around 114,513,573[14], the population of Indonesia is about 273,089,669[15]. Potential customers of the SAMS businesses along the honey and apiculture value chain are honey (and bee product) consumers on the one hand and beekeepers and other apiculture stakeholders, e.g. associations, government, potentially interested in beekeeping technology on the other hand.

This chapter gives an overview of the potential customers of SAMS businesses – it describes who are the potential customers, how many of them are there in Ethiopia and Indonesia, what are their needs, their demographics and what are their buying and shopping habits. Besides existing literature and studies, most results have been gained through conducted surveys in Ethiopia and Indonesia from November 2019 to February 2020.

2.1 Ethiopia

In general, 90% of the Ethiopian honey is sold locally and directly to honey consumer. Value-added products that use honey as an ingredient are also popular e.g. bakery products and *tej* (locale honey beverage).[16] It is estimated that there are more than 1 million beekeepers in Ethiopia.[17] Moreover, there are several beekeeping associations and other apiculture stakeholders.

2.1.1 Honey consumers

In the Ethiopian honey consume survey conducted from November 2019 - February 2020 the buying and shopping habits of Ethiopian honey consumers have been documented. 53 participants have answered the questionnaire.

2.1.1.1 Purpose of honey consumption

In the Ethiopian context, it is observed that most of the honey consumers use honey as table honey. It is also used as food and beverage ingredients, e.g. for the locally brewed honey made beverage *tej*, as well as alternative medicine and substitute for sugar.

[14] Worldometer. (2020): URL: https://www.worldometers.info/world-population/ethiopia-population/ (access: 08.05.2020)
[15] Worldometer. (2020): URL: https://www.worldometers.info/world-population/indonesia-population/ (access: 08.05.2020)
[16] https://www.hilarispublisher.com/open-access/beekeeping-practices-production-potential-and-challenges-of-bee-keeping-among-beekeepers-in-haramaya-district-eastern-ethiopia-2157-7579-1000255.pdf
[17] Gupta, R. K., Reybroeck, W., van Veen, J. W., & Gupta, A. (2014): Beekeeping for Poverty Alleviation and Livelihood Security: Vol. 1: Technological Aspects of Beekeeping. Dordrecht: Springer Netherlands

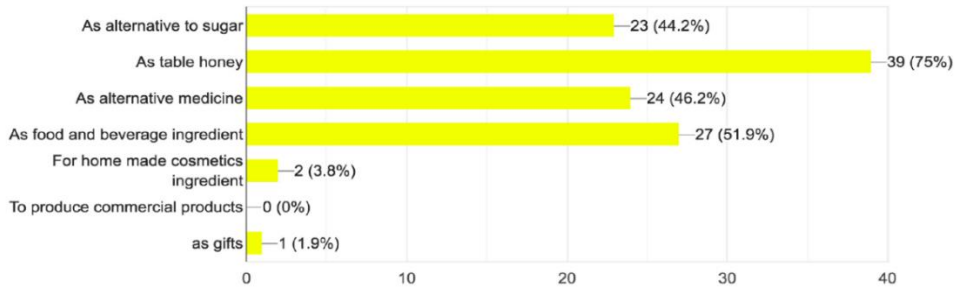

Figure 4 Ethiopian Consumer for Consuming Honey

2.1.1.2 Motivation of buying honey

Most honey consumers buy honey for its consumption within the family followed by personal consumption (mostly for medicine purpose) and buying honey for others. Very few of the survey respondents use honey for commercial purpose (value added honey products). As the survey shows but also the previous studies, this is one major issue with value addition except for the famous local beverage *tej* (see chapter 3.1).

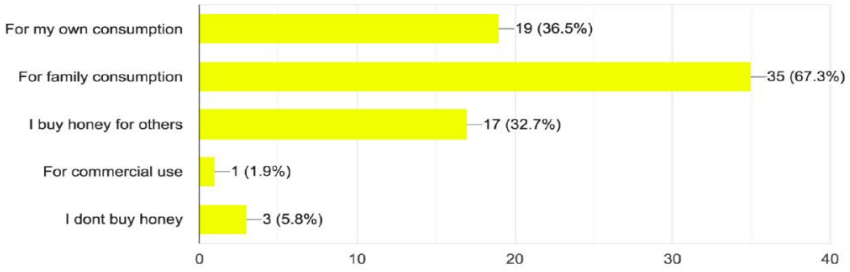

Figure 5 The purpose of buying honey

2.1.1.3 Sources of buying honey

Supermarkets have the highest popularity for buying honey because they are offering the highest diversity of honey varieties (locations, taste & colour) in one place. Buying honey directly from beekeepers is an accessible option for some of the honey consumers. There is a notable use of home delivery honey retailers and corner shops. Owning a beehive and using other market to get honey is also used as alternative way to source honey but it is very low in popularity percentage.

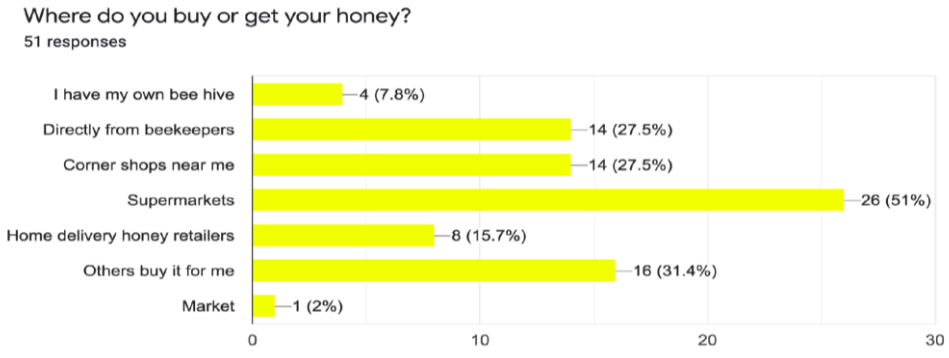

Figure 6 Where Ethiopian Consumers Buy Honey

2.1.1.4 Local and Imported Honey

Honey consumers in Ethiopia mainly buy local honey, some consumers buy both local and imported honey and almost no consumers primarily buy imported honey: 20.0% of the respondents buy local and imported honey, 5.6% don't buy honey. This result is supported by studies mentioning that only 2% of locally produced honey is exported to the international market.

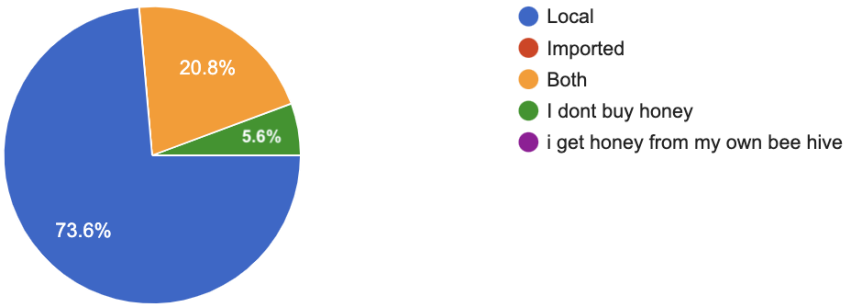

Figure 7 Imported vs. Local Honey in Ethiopian

2.1.1.5 Frequency of buying honey & Honey Packaging Size

In the urban honey market, it is very common to buy honey in branded packaging. The survey showed that there is a preference for 250g/month, 500g/month or 100g/month which is also related to their use case of honey (Figure 8). Besides, honey consumers prefer to buy (or store) honey in glass jars; plastic containers are also appreciated by some honey consumers (Figure 9). According to Awraris et. all (2012), to the favored storage materials for honey also belong plastic bags, tins/barrels, plastic containers, clay/log pots and animal skin.[18] Nevertheless, glass is a rare packaging material.

In interviews with beekeepers and honey consumers during the UCD research, it became clear that if the consumers do not buy honey from corner shops or supermarkets the packaging could be in a very different form and come with informal appearance e.g. drinking water bottles and reused glass jars in varying sizes. In some cases, buyers must bring a container to buy the honey from the retailer.

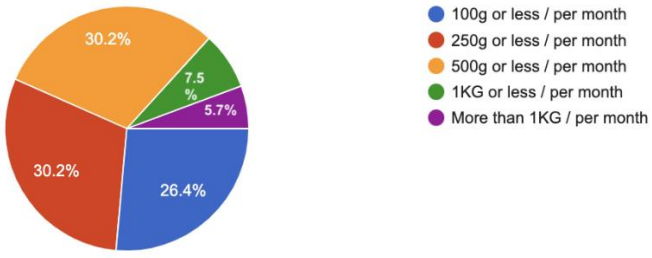

Figure 8 Honey Packaging Size in Ethiopia

[18] Awraris, G., S., Yemisrach, G., Dejen, A., Nuru, A., Gebeyehu, G., & Workneh, A. (2012): Honey production systems (*Apis mellifera* L.) in Kaffa, Sheka and Bench-Maji zones of Ethiopia. Journal of Agricultural Extension and Rural Development, 4(19), 528-541.

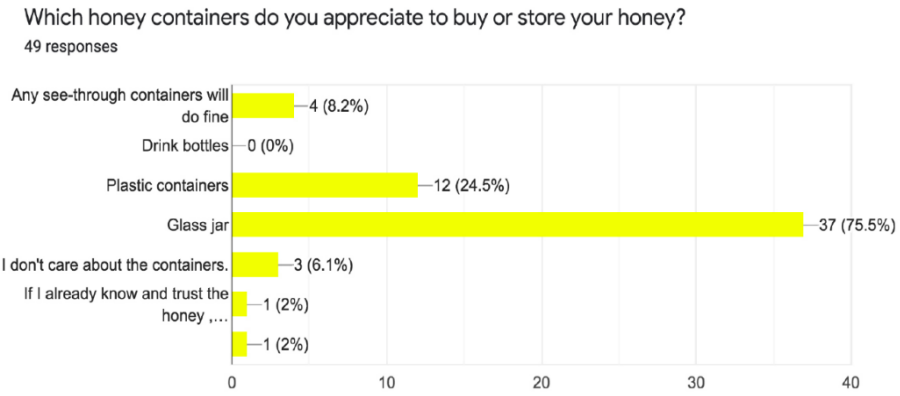

Figure 9 Favoured Honey containers

2.1.1.6 Knowledge about Label Information

The Ethiopian Food, Medicine and Healthcare Administration and Control Authority Proclamation No. 661/2009 authorizes the setting of standards and regulations for locally-produced and imported foods, in areas such as production, promotion, storage, packaging and labelling. In a subsequent Parliamentary Proclamation – Ethiopian Food, Medicine and Healthcare Administration and Control Authority Regulation No. 189/2010 – the Food, Medicine, Healthcare and Control Authority (FMHACA) was established, under the purview of the Ministry of Health, as the competent authority responsible for setting and enforcing food safety standards and regulations.[19] Despite these regulations, labelling regulations are not widely enforced.

However, according to the survey results, most honey consumers want to see accurate information about the honey and good packaging design. The informal and traditional honey retailing services do not offer honey content description or branding of honey as a product.

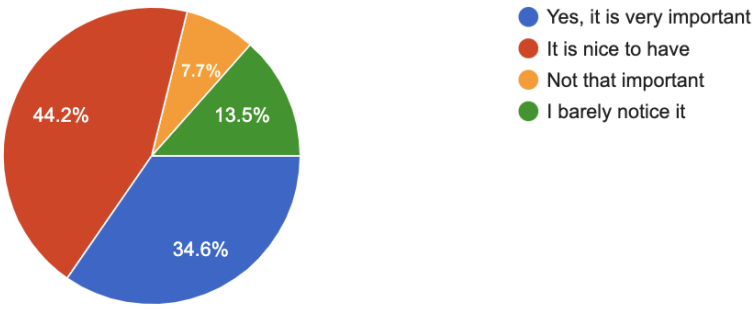

Figure 10 The Importance of Honey Label for Ethiopian Consumers

[19]http://agriexchange.apeda.gov.in/ir_standards/Import_Regulation/Ethiopias%20Food%20and%20Ag%20Import%20Regs%20and%20Standards%20FAIRS%20Addis%20AbabaEthiopia332017.pdf

2.1.1.7 Honey Type

The types of honey vary regionally as well as in terms of colour, consistency and purity.[20] The three main types of honey produced in Ethiopia are red, yellow and white. However the most recognized brands are the Tigrai white honey, the Wonchi volcano honey, Dawro Konta Honey, Woliso honey, Shalala honey, Horde honey, Geteche honey, Bodago honey, Wondo honey, and Wassara honey.[21] The survey showed that most honey consumers in Ethiopia prefer to buy extracted liquid honey, some are also consuming crystallized honey and very few buy comb honey.

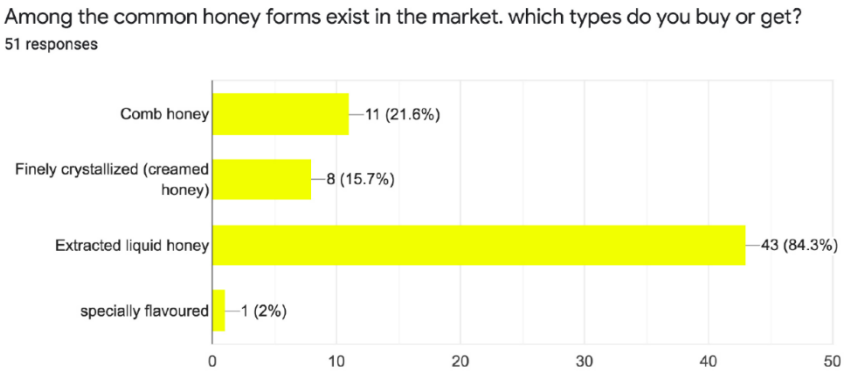

Figure 11 Honey Type in Ethiopia

2.1.1.8 Cluster Analysis based on commonly recognizable values

Honey consumers have several objective and subjective criteria to value honey. The most common ones are:

1. Quality (referring purity of the honey as beekeepers are selling whatever production they have to intermediaries who sell it in bulk on the market, mixing it sometimes with lower quality honey, because of these reason[22], consumers check the purity of honey specially to avoid adulteration with sugar and lower quality honey by testing, trusting and experience)
2. Origin (which is used to identify a collective preference for the flora of a particular production area; not a common label information)
3. Test of the honey (most of the honey is sold in open markets, the sellers give a small amount of honey to buyers to test and check the quality of the honey)
4. The colour of the honey
5. The aroma of the honey
6. Organic quality assurance (for consumers outside of Ethiopia, quality and standards authority of Ethiopia has been identified to work on the packaging and organic certification of honey)
7. Personal preference of a particular type

The most common feature to influence the decision of honey consumers is the quality of the honey which is about the pure natural existence of the honey. The second most preferred

[20] https://www.idosi.org/aje/8(4)15/1.pdf
[21] https://www.fondazioneslowfood.com/wp-content/uploads/2015/04/ING_libretto_mieli.pdf
[22] https://africanbusinessmagazine.com/uncategorised/honey-ethiopias-liquid-gold/

feature of the honey is the test of the honey followed by price, origin and colour of the honey, the aroma and the organic certification are the least influencing features of honey consumers.

Since it is not common to verify organic products in Ethiopia, most honey consumers did not expect to see organic certification stamps on honey packaging, but this does not translate to they don't care about the nature of their honey.

Moreover, the quality of the honey is the feature less likely affected by the price of the honey, followed by the taste of the honey (Figure 13).

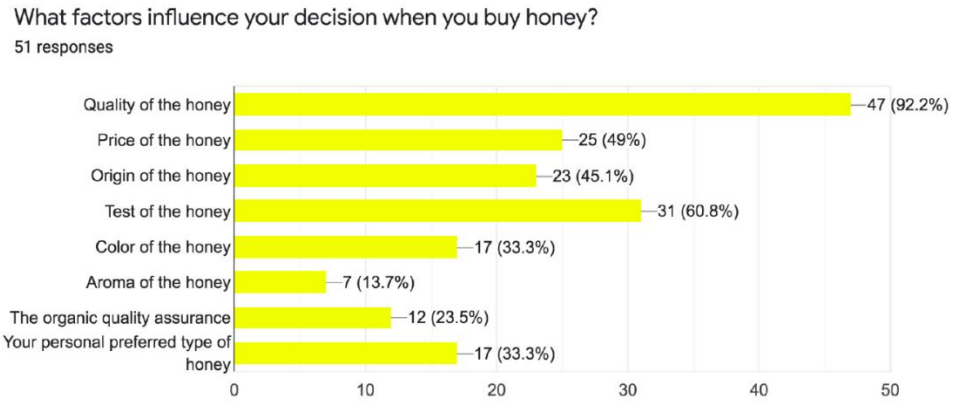

Figure 12 The Most Important Factor that Will Not Be Compromised for Price

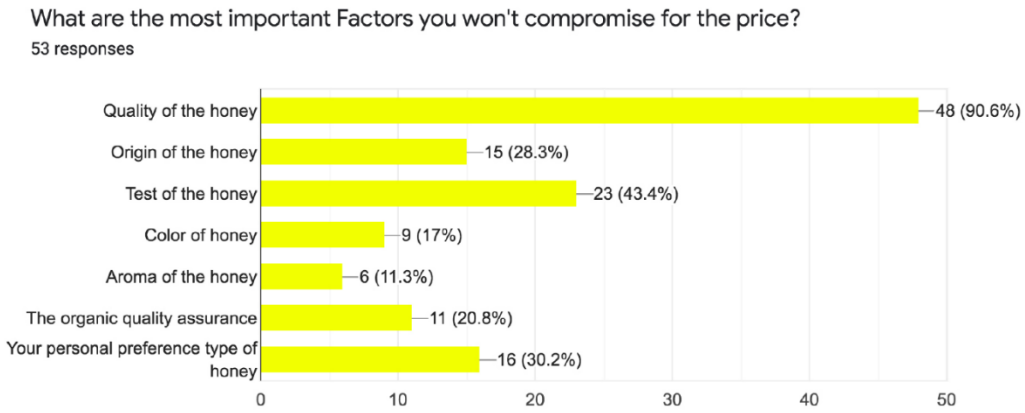

Figure 13 The Most Important Factor that Will Not Be Compromised for Price

2.1.2 Beekeepers

Beekeeping has a long tradition and history in Ethiopia, and it is Africa's leading honey and beeswax producer. Known as the most populated landlocked country with its high population underlines the importance of the development of the apicultural sector. A developed apicultural sector not only increases the country's natural food production, but also increases the incomes of not only professional beekeepers but also of farmers using bees to pollinate their agricultural plants.

Beekeeping in Ethiopia can be seen as additional income for families. There is no official data on the total number of beekeepers in Ethiopia, but Gupta (2014) estimated it to be more than 1 million. [23]

The number of beehives in the country (2016) is 6,189,329 (FAO 2018) [24], while the Ministry of Agriculture and Rural Development (2007) estimated the total number of honey bee colonies (hived and feral honey bee colonies) to be ~10 million (2007).[25] This makes Ethiopia the highest bee colony density in Africa and the third highest in the world.[26]

Beekeeping has a traditional root - the majority of beekeepers learned beekeeping skills from their parents and neighbours. The traditional way of beekeeping is usually practiced as a hobby to source one's own honey need. Due to low production capacity, it has a very little financial benefit for the traditional beekeepers, but it is very easy to maintain and has very low setup costs.[27]

Thus, about 95% of Ethiopian beekeepers use traditional hive-systems. Those hive types differ from area to area, based on locally available materials (clay, straw, bamboo, bark, logs etc.).[28] The remaining percentage of beekeepers use transitional (promoted since 1978) and modern hives.[29] [30] The used hive system differs from region to region: while 56% of traditional hives were found in the Oromia region which produces 40% of national traditional hive honey, only 19% of people in the Amhara, Tigray and SNNP regions use traditional hives. Latter contribute 27% of national traditional hive honey production.[31] A survey by Tesfaye & Tesfaye (2007) revealed reasons, why most beekeepers do not possess modern hives-systems: the starting costs are high, lack of managing skills, unavailability of modern bee hives in the particular area, need of adequate beeswax (mostly not available) or a combination of the mentioned issues.[32] Nevertheless, modern beekeepers appreciate the beekeeping activities as a side job – most of them work on their regular job during the day time and at night they go to their apiary.[33]

The reason that beekeeping is seen as side job is that beekeepers are suffering from lack of constant buyers, selling point, price fluctuation and ill functioned marketing system and only a very small portion of the product sold in the proper market. Generally, the honey market is not developed even though the sector is a best investment option in Ethiopia that contests with its natural and unemployment potential. Thus, the sector demands a transformative action to organize its production system, input supply, product supply and value chain upgrading. Particularly, application of SAMS modules based on planned business development to upgrade the honey value chain is the best option in Ethiopia. Thus, to use the production and

[23] Gupta, R. K., Reybroeck, W., van Veen, J. W., & Gupta, A. (2014): Beekeeping for Poverty Alleviation and Livelihood Security: Vol. 1: Technological Aspects of Beekeeping. Dordrecht: Springer Netherlands

[24] FAO (access: 12.06.2018): http://faostat.fao.org

[25] MoARD (2007). Ministry of Agriculture and Rural Development. Livestock Development Master Plan Study. Phase I Report – Data Collection and Analysis, Volume N – Apiculture. Addis Ababa, Ethiopia.

[26] https://africanbusinessmagazine.com/uncategorised/honey-ethiopias-liquid-gold/

[27] Interview with beekeepers

[28] Kigatiira, K. I. (2014): African Honeybee. Ncooro Academy, Nairobi, Kenya.

[29] Gidey, Y., & Mekonen, T. (2010): Participatory Technology and Constraints Assessment to Improve the Livelihood of Beekeepers in Tigray Region, northern Ethiopia. CNCS, 2(1), 76-92.

[30] Taye, B., Desta, A., Girma, C., & Mekonen, W.T. (2016): Evaluation of transitional and modern hives for honey production in the Mid Rift Valley of Ethiopia. Bulletin of Animal Health and Production in Africa, 64(1), 157–165.

[31] MoA & ILRI (2013): Apiculture value chain vision and strategy for Ethiopia. Addis Ababa, Ethiopia: Ministry of Agriculture and International Livestock Research Institute.

[32] Tesfaye, K., & Tesfaye, L. (2007): Study of honey production system in Adami Tulu Jido Kombolcha district in mid rift valley of Ethiopia. Livestock Research for Rural Development, 19(11), 1-9.

[33] Interview with beekeepers

market potential, developing SAMS business along the whole value chain (fair linkage with input supplier, financial sectors, coordinating business and export routine) is very import. One of the important approaches to achieve this is systematic clustering of the producers and co-linking with both input suppliers and output client.[34]

Modern beekeeping is mostly practiced in the southwestern and central highlands and since 1970, five movable frame hives were introduced to Ethiopia with Zander, Langstroth, and Dadant as the most common used hive systems, respectively.[35] [36] Popular transitional beehives are either the Kenyan top bar hive, or the locally made "Chefeka" hive.[37] In comparison, a modern beehive costs 30-40 Euro, a transitional one 5-8 Euro and a traditional beehive 0-1 Euro.[38]

Currently with support from beekeeping institutions like Oromia Agricultural Research Institute Holeta Bee Research Centre beekeepers began to adopt modern beehives and the usage of transitional hives. Based on the needs of local conditions, Holeta Bee Research Center in Ethiopia developed a possible standard hive system for future beekeeping in Ethiopia.[39]

Beekeepers believe technology is important and can improve their daily beekeeping activities. They mentioned they get a lot of support from Holeta like practical training and manual handbooks. Nevertheless, more than one fourth of Ethiopia's small family farms have access to financial support. The average annual credit borrowed of USD 58 barely covers expenditures for inputs that are usually around 2 % of the value of production.[40] Unless farmers are linked with Monetary Financial Institutions (MFIs), a large portion are not able to spend on technology products. Beehive monitoring systems can support the beekeeper to collect useful data and use it as a quick reference to tackle problems on beekeeping activities like identifying bee disease, record and predict harvest frequency, record colony transfer events and information about the diversity of flora distribution on a season. Moreover, it helps to reduce transportation costs to go to the apiaries to check the bee colonies. So far, if data is collected, it is partially collected manually and is mostly not very well documented.[41]

Besides, due to swarming and other related issues local beekeeper report on an average loss of colonies by 15%. Therefore, it is believed that a swarming control mechanism will reduce income losses.

This is a high potential for technologies like SAMS contributing to improve the beekeepers' colony management as currently there are no tools to predict swarm possibilities with usable accuracy available in Ethiopia.

[34] Information provided by researcher of Oromia Agricultural Research Institute Holeta Bee Research Centre
[35] Gupta, R. K., Reybroeck, W., van Veen, J. W., & Gupta, A. (2014): Beekeeping for Poverty Alleviation and Livelihood Security: Vol. 1: Technological Aspects of Beekeeping. Dordrecht, Springer Netherlands.
[36] Hailemichael, T. B. (2018): The status of beekeeping practices and honey production system in Ethiopia-a review. International Journal of Engineering Development and Research, 6(2), 581-585.
[37] Gemechis, L. Y. (2016): Honey Production and Marketing in Ethiopia. Agriculture And Biology Journal Of North America, 7(5), 248-253.
[38] https://africanbusinessmagazine.com/uncategorised/honey-ethiopias-liquid-gold/
[39] SAMSwiki (2018): Hive types. URL: https://wiki.sams-project.eu/index.php/Hive_types
[40] https://africanbusinessmagazine.com/uncategorised/honey-ethiopias-liquid-gold/
[41] Interview with beekeepers

2.1.3 Other customers and consumers

In Ethiopia, there are three beekeeping associations:[42]

- Ethiopian Apiculture Board (EAB) – supported by Ministry of Agriculture (MoA) and aiming to improve the honey production and productivity by ensuring quality production
- Ethiopian Society of Apiculture Science (ESAS)
- Ethiopian Honey and Beeswax Producers and Exporters Association (EHBPEA)

Furthermore, there are several beekeeping co-operatives, e.g. Selam association of beekeepers (Tigray), Wonchi beekeeping association (Oromia), Zembaba Cooperative (Amhara), Guji Bore cooperative (Oromia), Dawro beekeepers association (SNNPR), Shalala beekeepers association (SNNPR), Horde beekeepers association (SNNPR). Some cooperatives offer training, good materials and market information, assist members and improve methods of production and the main objective is to promote the market for honey bee products (e.g Zembaba Bee Products Development & Trade Promotion Cooperative Union in the Amhara region). Zembaba Union also exports honey to foreign markets. Union members have to have two years of experience as beekeepers and they provide an agreed amount of honey to the cooperatives, which sell it to domestic markets. Afterwards, they distribute the annual profit to all the members.[43]

Projects like ASPIRE (Apiculture Scaling up Program for Income and Rural Employment) and government initiatives like ATA (Agricultural Transformation Agency) aiming also the supporting of beekeeping interests. In addition, a lot of organizations (GOs and NGOs) and initiatives offer training on beekeeping every year. Despite all the efforts, the apiculture sector still develops very slowly.[44] [45]

Other bee projects in Ethiopia are e.g. Improving the Productivity and Market Success of Ethiopian Farmers (IPMS) project – funded by the Canadian International and implemented by ILRI, Facilitator for Change project implemented by Oxfam GB, Sustainable Land Management (SLM) commissioned by GIZ, German Federal Ministry for Economic Cooperation and Development, Young Entrepreneurs in Silk and Honey (YESH).
The Ministry of Agriculture (MoA 2013) also recognized the unused potential of the apiculture sector, which could boost Ethiopia to become one of the main honey producers in the world and lead to a better main income for farmers and beekeepers. Therefore, the MoA identified specific targets, e.g. increase annual honey and beeswax production, increase the annual honey and beeswax export, they want to achieve by 2025.[46] However, there are no activities

[42] Negash, B., Greiling, J. (2017): Quality Focused Apiculture Sector Value Chain Development in Ethiopia. Journal of Agricultural Science and Technology A, 7(2), 107-116.
[43] Mekonnen, S. (2008): Increasing marketing opportunities in Amhara Region Ethiopia. Bees for Development, 86, text on website. URL (access date: 14.11.2018): http://www.beesfordevelopment.org/documents/i/increasing-marketing-opportunities-in-amhara-region-ethiopia/
[44] ASPIRE (2018): Apiculture Scaling up Program for Income and Rural Employment. URL (access date: 11.06.2018): http://www.snv.org/project/apiculture-scale-programme-income-and-rural-employment
[45] ATA (2018): Agricultural Transformation Agency. URL (access date: 11.06.2018): https://www.ata.gov.et/
[46] Ministry of Agriculture (2013): Apiculture value chain vision and strategy for Ethiopia, International Livestock Research Institute, Addis Ababa, ISBN: 92–9146–410–4

to control the impact of pesticide chemicals on the bee colony by the government, and if the issue is not addressed as early as possible it will harm the apiculture industry soon. [47]

2.2 Indonesia

Potential customers of the different SAMS businesses in Indonesia are honey (and bee product) consumers on the one hand and beekeepers and other apiculture stakeholders, e.g. universities, businesses, communities, government and NGOs, potentially interested in beekeeping technology on the other hand. To learn more about Indonesian honey consumers a survey has been conducted from November 2019 until January 2020 – 445 people took part. In addition, a survey about the technology acceptance and its need in the beekeeping sector has been conducted among 46 apiculture stakeholders.

2.2.1 Honey consumers

In the Indonesian honey consumer survey 445 participants were involved, 429 (96%) of them turned out to be honey consumers.

Demographics

Based on the results of the conducted survey, the age distribution of honey consumers is respectively dominated by those aged 15-24 years (32%), 25-34 years (26%) and 35-44 years (22%). Indonesian population demographic data shows that 15-24 years (17%), 25-34 years (16%), and 35-44 years (15%) are the three largest age groups (besides the 0-14-year age group 25%).[48] Consumers within those age ranges tend to have purchasing power cause most of them are employed and have income. It is supported by Sumarwan (2004) statement that age influence consumer preference in choosing products.[49]

Based on gender, 53% of Indonesian honey consumers are male – based on demographic data of the Indonesian population, the Indonesian population consists of 51% men and 49% women.[50]

Most honey consumers in Indonesia live on the Java island, with 75% of the total consumers. Java itself is an island with the largest population in Indonesia, around 57% of Indonesia's population lives on the island of Java.[51] Besides, it is one of the three main honey producing islands.[52]

From the last education level, the majority of honey consumers in Indonesia respectively underwent bachelor's degree (43%), high school degree (31%), and master's degree (18%). Whereas Indonesian demographic data shows that the last education level of the majority is

[47] Interview with beekeepers

[48] Kementerian Perencanaan Pembangunan Nasional (Bappenas). Jumlah Penduduk Indonesia Menurut Kelompok Umur dan Jenis Kelamin (2019): 2018. URL: https://databoks.katadata.co.id/datapublish/2019/01/04/jumlah-penduduk-indonesia-2019-mencapai-267-juta-jiwa

[49] Sumarwan, U. (2004): Perilaku Konsumen Teori dan Penerapannya dalam Pemasaran. Ghalia Indonesia. Jakarta

[50] Kementerian Perencanaan Pembangunan Nasional (Bappenas) (2019): Jumlah Penduduk Indonesia Menurut Kelompok Umur dan Jenis Kelamin. URL: https://databoks.katadata.co.id/datapublish/2019/01/04/jumlah-penduduk-indonesia-2019-mencapai-267-juta-jiwa

[51] Badan Pusat Statistik (2018): Proyeksi Penduduk menurut Provinsi, 2010-2035 (Ribuan). URL: https://www.bps.go.id/statictable/2014/02/18/1274/proyeksi-penduduk-menurut-provinsi-2010---2035.html

[52] Badan Pusat Statistik (2018): Statistik Produksi Kehutanan 2017

unschooled (24%), or middle school level (22%).[53] By comparing the survey result and Indonesian demographic data about last education level, honey consumers in Indonesia are not the majority group. Thus, education is an essential factor in increasing honey consumption.[54] Other factors are occupation, and age, significantly influence consumers' perceptions of honey quality.[55]

Honey consumers in Indonesia are dominated by active students (26%), ranging from the education level of high school up to postgraduate. Other Indonesian honey consumers are government employees (16%), private employees (18%), and entrepreneurs (17%) with income around 5-10 million IDR (283-566 Euro in April 2020). The distribution of the types of jobs and activities of the Indonesian population according to BPS (Central Statistics Agency)[56] and BKN (State Personnel Agency)[57] shows that the majority of Indonesia's population does not work (include the elderly, retirees, minors but not in school, and freelancers).

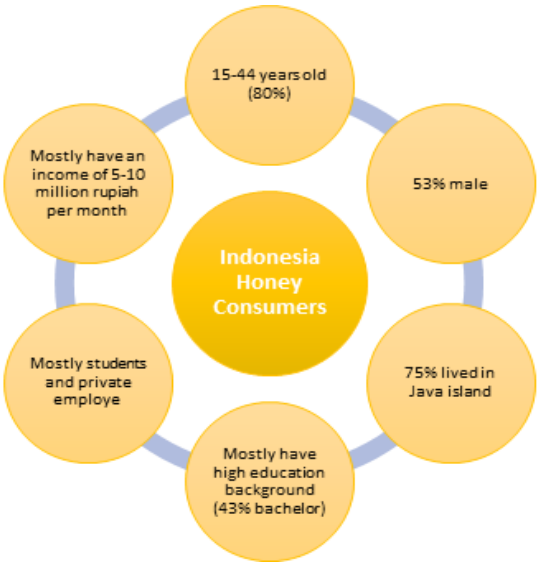

Figure 14 Indonesia Honey Consumers Demographic

2.2.1.1 Honey consumer behaviour and preferences

Consumer interested in honey can be explained by the high attention paid to natural products and alternative medicine.[58] Respondents claimed to tend to use honey for therapeutic purposes, not as a daily addition to food products consumed.[59]

According to the survey on honey consume medicine is the most popular reason for consuming honey, followed by lifestyle and nutrition fulfilment. Nevertheless, the figure below shows that in general each person has more than one reason for buying honey.

[53] Badan Pusat Statistik (2018): Statistik Indonesia 2018. URL: https://www.bps.go.id/publication/2018/07/03/5a963c1ea9b0fed6497d0845/statistik-indonesia-2018.html
[54] Bianca, Pocol Cristina, and L M Al. (2007): "Market Study About Honey Consumption in Romania." Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca - Animal Science and Biotechnologies 64: 398–401.
[55] Pocol, Cristina Bianca, Peter Šedík, and Elena Horská (2018): "Honey Consumption Patterns of Young People in Romania.": 435–66
[56] Badan Pusat Statistik (2018): Statistik Indonesia 2018
URL: https://www.bps.go.id/publication/2018/07/03/5a963c1ea9b0fed6497d0845/statistik-indonesia-2018.html
[57] Badan Kepegawaian Negara. URL: https://www.bkn.go.id/statistik-pns
[58] Pocol, Cristina Bianca, Peter Šedík, and Elena Horská (2018): "Honey Consumption Patterns of Young People in Romania": 435–66
[59] Żak, Natalia (2017): "Honey Market in the Opinion of Young Consumers." *Handel Wewnętrzny*366(1): 424–38.

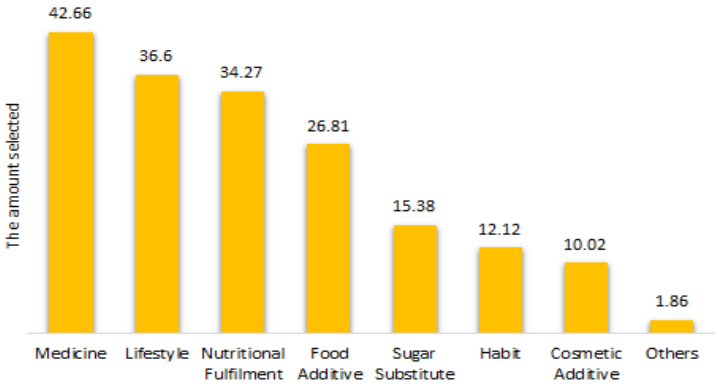

Figure 15 Reasons Consumers Consume Honey in Indonesia

(respondent can choose more than one option)

2.2.1.2 The Purpose of Consumers Buying Honey

Based on the figure below, self-consumption is the primary purpose of consumers to buy honey with a score of 89.51. It is then followed by the goal to buy honey for the family. Based on the results of the survey, most of the consumers who buy honey for self-consumption purchase it in small packages of about 250ml (Figure 20).

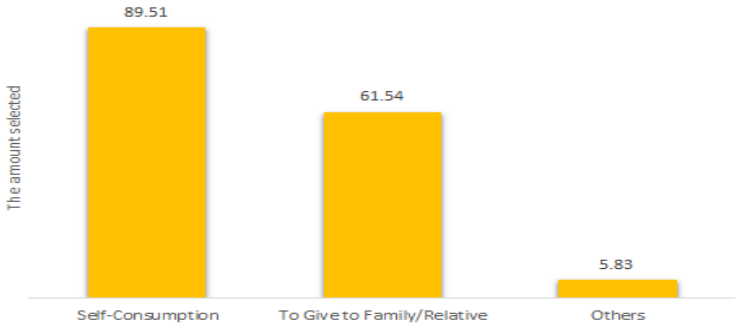

Figure 16 The Purpose of Consumers Buying Honey in Indonesia

(respondent can choose more than one option)

2.2.1.3 Frequency and Time of Honey Purchase

Based on the frequency of honey purchase data, most consumers buy honey once a month (30%), followed by consumers who buy honey once every three months (23%). There are few buying honey once every two weeks (10%) and others buying it not regularly. The buying frequency is related to the packaging size – the most purchased packaging size is 250ml (see Figure 20).

Honey must be promoted among children to create awareness on the benefits of honey and its related products and to develop a positive attitude towards consumption in their early years.[60] The purchasing preferences of young consumers are directly related to family traditions and the fact that respondents often consume honey.[61]

[60] Pocol, Cristina Bianca, Peter Šedík, and Elena Horská (2018): "Honey Consumption Patterns of Young People in Romania.": 435–66

[61] Żak, Natalia (2017): "Honey Market in the Opinion of Young Consumers." *Handel Wewnętrzny* 366(1): 424–38.

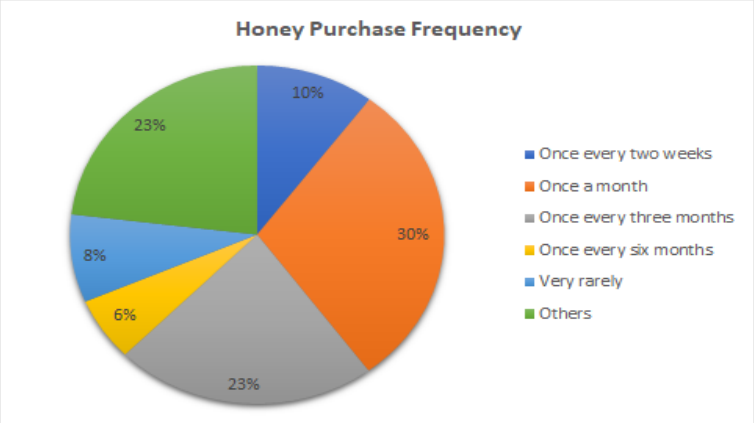

Figure 17 Honey Purchase Frequency in Indonesia

2.2.1.4 Source of Honey Products (Where to Buy Honey)

Honey consumers mostly buy honey in retail stores. The special beekeeping kiosk (available across Java) becomes the consumer's next choice, followed by online marketplaces. Based on these results, it can be concluded that retail stores are the most preferred and visited places to buy honey because it is easily accessible from home.

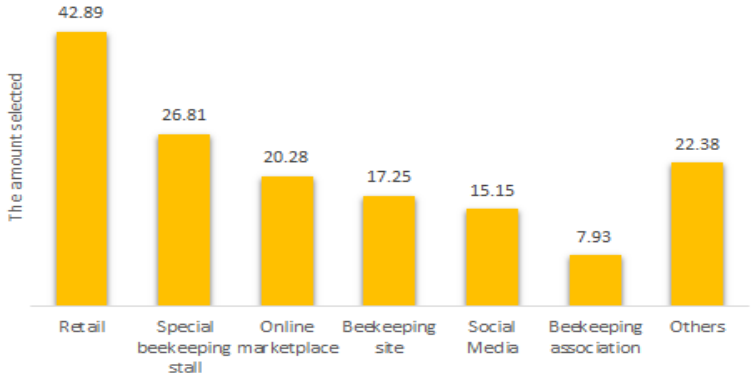

Figure 18 Source of Honey Products in Indonesia

(respondents chose more than one option)

2.2.1.5 Material and Shape of Honey Packaging & Packaging Size

The most preferred packaging material by consumers are glass bottles, followed by plastic bottles. According to the market survey with glass bottles as the most preferred packaging material but is only rarely available for beekeepers. This brings up opportunity to do business on glass bottles as packaging material for honey.

One of the reasons why consumers in general prefer glass bottles packaging is because it is environmentally friendly and can be reused, recycled and upcycled.[62] It is assumed that this is the case also for Indonesia because Indonesians started to reducing plastic usage since

[62] MARTÍNEZ, Ramón & Schvezov, Natasha & Brumovsky, Luis & Pucciarelli, Amada (2017): Influence of temperature and packaging type on quality parameters and antimicrobial properties during Yateí honey storage. Food Science and Technology. 38. 10.1590/1678-457x.17717.

Indonesia is one of the biggest contributors of plastic waste[63] and choosing glass packaging for honey is one of the ways to reduce it. The packaging quality is also considered as one of the most important criteria when buying honey. [64]

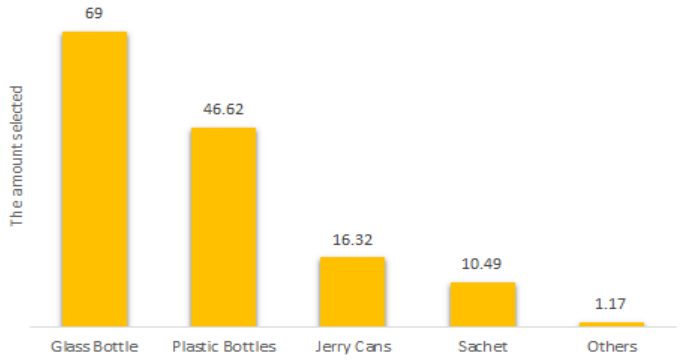

Figure 19 Material and Shape of Honey Packaging in Indonesia
(respondents chose more than one option)

According to the survey, the packaging size of 250 ml is the most purchased by consumers with a percentage of 38.93%, followed by 600ml packaging size (30.77%). 250 ml of honey is most likely the preferred one as it is the smallest and cheapest. Furthermore, its practical usage is quite attractive for consumers to consume. Investigating the psychological aspects of prices for honey consumers will enable small scale producers to target this price-sensitive segment more effectively.[65] Especially, older consumers consider the price, the manufacturer, and the size of the packaging.[66]

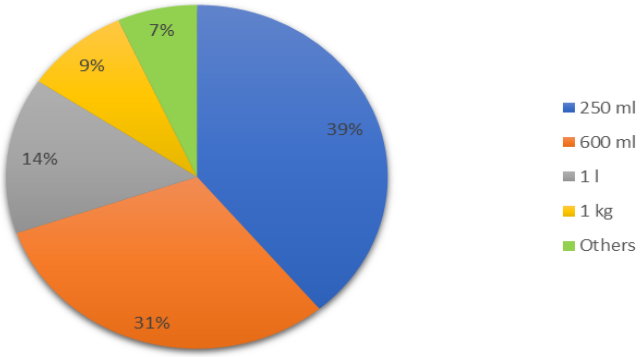

Figure 20 Preferred Honey Packaging Sizes

2.2.1.6 Local and Imported Honey

Regarding the selection of local honey and imported honey, honey consumers in Indonesia prefer local honey. Nevertheless, about 42% of the honey consumers are buying imported honey often, rarely or at least once (Figure 22).

[63] Ambari, M. (2019): Benarkah Produksi Sampah Plastik Indonesia Terbanyak Kedua di Dunia. Mongabay. Jakarta http://www.mongabay.co.id/2019/02/22/benarkah-produksi-sampah-plastik-indonesia-terbanyak-kedua-di-dunia/ (access date 15.05.2020)

[64] Ványi, Georgina Árváné, Zsolt Csapó, and László Kárpáti (2011): "Evaluation of Consumers' Honey Purchase Habits in Hungary." *Journal of Food Products Marketing*17(2–3): 227–40.

[65] O'Reilly, S., C. Cowan, and M. Henchion (2000): "Irish Consumer Preferences for Honey: A Conjoint Approach." *British Food Journal*102(8): 585–98.

[66] Ványi, Georgina Árváné, Zsolt Csapó, and László Kárpáti (2011): "Evaluation of Consumers' Honey Purchase Habits in Hungary." *Journal of Food Products Marketing*17(2–3): 227–40.

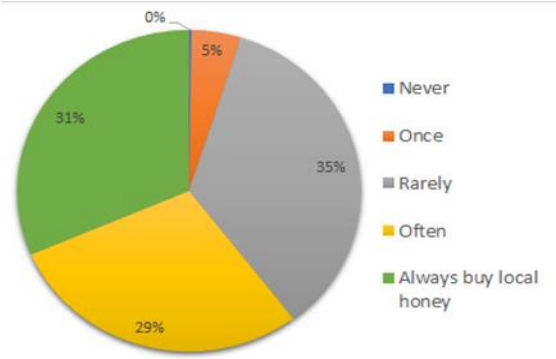

Figure 21 Frequency in Buying Local Honey

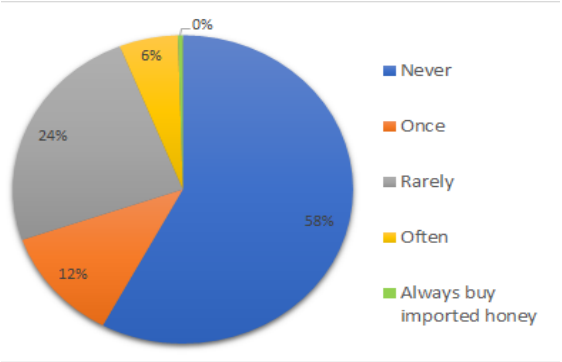

Figure 22 How Often to Buy Imported Honey in Indonesia

2.2.1.7 Knowledge of Honey Consumer about the Label Information

The relevance of product information was rated by survey participants according to their product information needs and based on the label information that is generally provided on honey product labels. Nevertheless, this information is not available on all honey labels. Moreover, labels do not always guarantee the promised quality, unless the certification for the label is obtained from SNI or BPOM for which specific regulations apply. Among the information on the honey packaging label, information about the best before date is the most desired one by consumers with a score of 43.36. The second most desired information is the composition of ingredients with a percentage of 42.66. Other information considered important are the legality (40.56), efficacy/usefulness of honey (40.09) and nutritional content (39.63).

Based on interviews with beekeepers, many honey producers put only limited information about the product on the label; some don´t include the packaging label at all. There are also honey producers, including big producers such as Madu Pramuka, that do not include production and expiry dates on their honey labels because they are confident that honey has long-term durability, in fact, honey also has a limited shelf life. In addition, composition and nutritional value might not be listed on the label because of the lack of producer knowledge about honey products. Despite a need for more information on honey labelling, honey with missing information is still being sold to consumers.

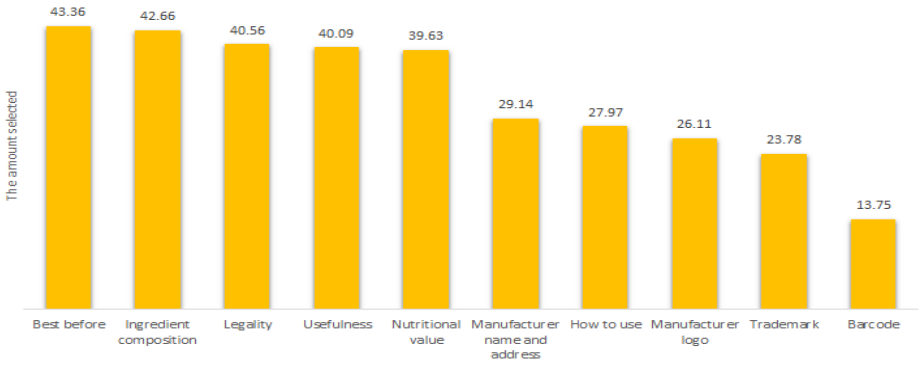

Figure 23 Important Information That Must Be in the Honey Package in Indonesia (respondent can choose more than one option)

2.2.1.8 Honey Type

In Indonesia, the type of honey is named after the nectar flowers name, which are the source of bee food. Usually, the honey type is listed on the packaging label.[67] Although specific reasons for preferences in the type of honey were not identified, it was found that the type of honey that is most preferred by consumers is forest honey. Furthermore, the figure below shows that there is often no specific type purchased.

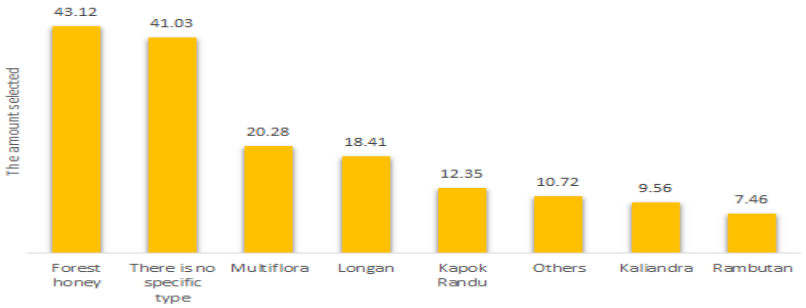

Figure 24 The Most Purchased Honey Type in Indonesia

(respondent can choose more than one option)

2.2.1.9 Knowledge of Honey Consumer about the Honey Quality

Ripe honey can affect the quality of honey, especially in terms of water content.[68] According to the discussion results of the Focus Group Discussions, in Indonesia, the problem of water content in honey has become a common issue for beekeepers because many of them harvest honey before it ripens thus the water content is still quite high.

According to the survey, in which the knowledge of the relationship between honey ripeness and honey quality was asked, the consumers do not understand its relationship (Figure 25). Thus, honey consumers in Indonesia still lack knowledge regarding this issue.

Moreover, consumers were asked about their known parameters of honey quality. The survey results show that the most influenced parameter of the quality of honey chosen by consumers is its thickness or moisture content with a score of 81.82. If comparing the results regarding the knowledge of honey ripeness with the parameters of honey quality, the honey consumers are ignorant of factors that affect the quality of honey and it becomes clear that consumers do not understand the link between those two (Figure 26).

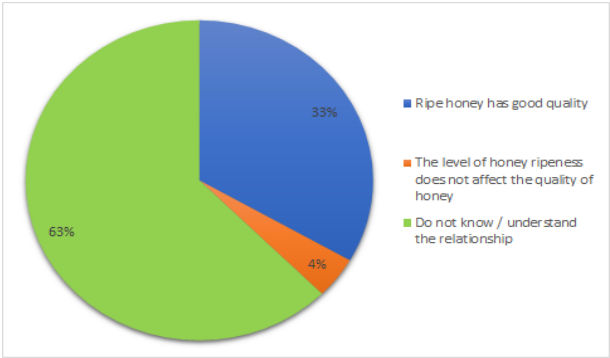

Figure 25 Consumers Knowledge Regarding the Relationship between Honey Ripeness and Honey Quality in Indonesia

[67] Jaya, Firman (2017): Produk-produk Lebah Madu dan Hasil Olahannya. UB Press. Malang

[68] Hutagalung, James S. (2016): Rumah Lebah from Traditional to Modern Medicine. Airlangga University Press. Surabaya

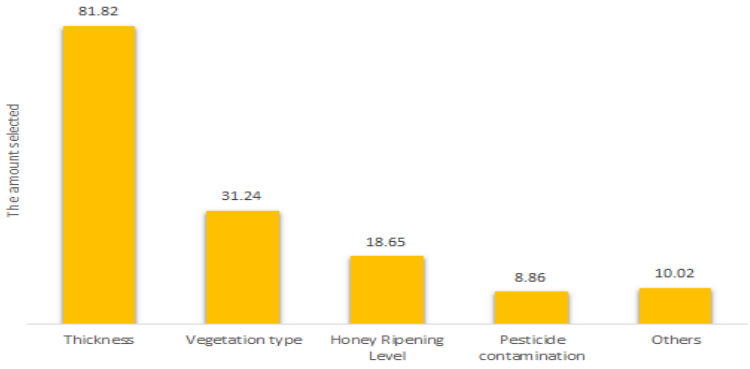

Figure 26 Honey Quality Parameters that Consumers Understand in Indonesia

(respondent can choose more than one option)

2.2.1.10 Consumer Perception of Honey in the Market

Indonesian honey consumers mostly do not have enough ability to trace where their honey comes from – 68.76% of the respondents are still not sure about the authenticity of the honey. Only 31.24% of honey consumers are sure that the honey they purchase is authentic honey. According to interviews with consumers, most of them use an existing network with beekeepers, a selling network or trust in recommendations to make sure to buy authentic honey. A few respondents perceive the honey authenticity only from the label and brand (Figure 30). Nevertheless, labels do not always guarantee the promised quality, unless the certification for the label is obtained from SNI or BPOM.

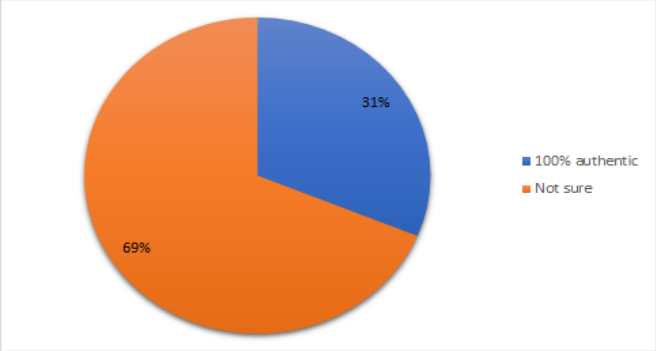

Figure 27 Indonesia Consumer Perception about Honey Originality in the Market

2.2.1.11 Honey authenticity and traceability

Most honey consumers agree that there is a need of a guarantee about the authenticity (92.54%) and traceability (42%) of honey (Figure 28, 29) because honey is very prone for counterfeiting which causes the decline of consumers' confidence in Indonesian honey. The lack of trust in certifications may be enhanced due to the lack of implementation of government regulations and government supervision[69] and the fact that labels do not always guarantee the promised quality, unless certified by SNI and BPOM. There is a lack of labelling businesses and institutions which ensure the quality and traceability of honey.

[69] Analisa Daily (201): Indonesia Paling Rawan Pemalsuan Produk. URL: https://analisadaily.com/berita/arsip/2017/7/11/375489/indonesia-paling-rawan-pemalsuan-produk/

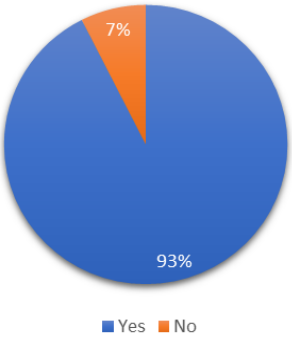

Figure 28 The Need for Guaranteed Authentic Honey in Indonesia

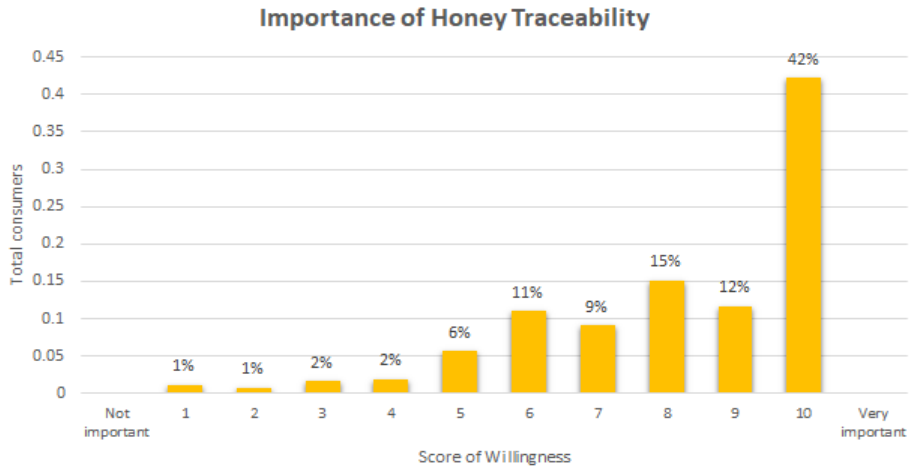

Figure 29 Honey Traceability

2.2.1.12 Factors that influence consumers in buying honey

In general, the most important criteria when buying honey are quality, price, type of honey, and packaging quality.[70] The main factor considered by young people who buy honey is the price, then the sensory characteristics of honey.[71]

Despite the fact that most consumers do not know specific criteria for the quality of honey, the survey results for Indonesia showed that the quality of honey is perceived as the most important attribute prioritized for buying honey with a score of 86.95. It is followed by the price with a score of 50.82.

Interestingly, honey consumers consider quality as the main parameter for buying honey. Nevertheless, the difficulty in tracing its authenticity makes the opportunity for marketing fake honey widely open coupled with price parameters as the second consideration. Cheaper honey offers opportunities for the fake honey market as cheap prices can indirectly affect the level of consumer confidence. This statement corresponded with Soares statement in a journal about honey authenticity that honeys are generally perceived as high-quality products and, consequently, the most susceptible to be adulterated through incorrect labelling and fraudulent

[70] Ványi, Georgina Árváné, Zsolt Csapó, and László Kárpáti (2011): "Evaluation of Consumers' Honey Purchase Habits in Hungary." *Journal of Food Products Marketing*17(2–3): 227–40.
[71] Żak, Natalia (2017): "Honey Market in the Opinion of Young Consumers." *Handel Wewnętrzny* 366(1): 424–38.

admixing with lower-cost and low-quality honeys.[72] Nevertheless, there is no exact minimum price that can be used as parameter for indicating good quality of honey.

What is also interesting is the consumers priority between product quality parameters and traceability of the honey itself. Supposedly, the expected higher quality of honey products is directly proportional with its traceability (product license). Thus, their rank should be similar. But the survey result shows a quiet different rank between both factors. It indicates honey consumers do not fully understand that honey traceability is inseparable from/ resembles the quality of honey itself.[73]

Other decision-making factors for buying honey are hygiene and aroma (with a score about 30), licensing (27.04), packaging, type of bee, product license, honey thickness, and brand (each with a similar score). For instance, hygiene can be seen through residue in honey such es bee wings, hive flakes and packaging.

The hygiene of honey products means that the honey products do not contain biological, chemical, and other foreign substances which can interfere with, harm and endanger health. Amongst other factors, low hygiene standards in honey can be identified by examining residues from packaging and honey such as bee wings, hive flakes. Honey hygiene is not only essential for consumers but also for producers since it also determines the merits of honey.[74]

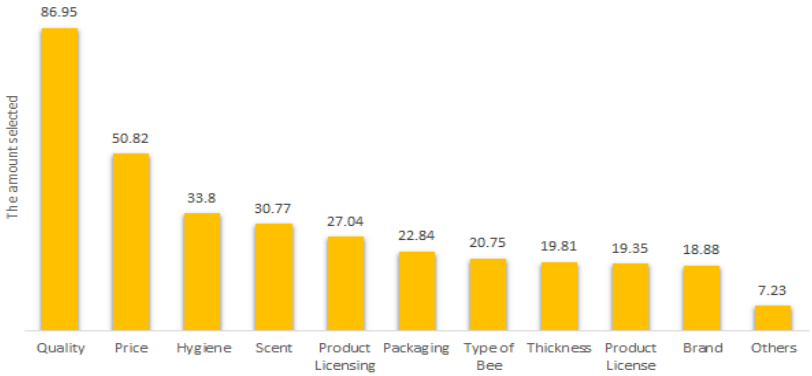

Figure 30 Factors Affecting the Selection of Honey in Indonesia

2.2.1.13 Experience of consuming bee products other than honey

The most widely consumed bee product other than honey is propolis followed by royal jelly (34.03) and bee pollen (23.54). Beeswax and bee venom are bought very rarely. Table 1 also shows that the number of honey consumers only purchasing honey and no additional products is high (respondent can choose more than sources available).

Table 1 Other Bee Products in Indonesia

Other bee products	Selected by Respondents	Score
Propolis	191	44.52
Bee Pollen	101	23.54

[72] Soares, Sonia at all. (2017): A Comprehensive Review on The Main Honey Authentication Issues: Production and Origin. Volume 16. Issues 5. Pages:1072-1100. URL: https://onlinelibrary.wiley.com/doi/full/10.1111/1541-4337.12278
[73] Liu, Shengping & Zhu, Yeping & Li, Shijuan (2011): Research on Agent-Based Bee Product Traceability Platform and Barcode System. IFIP Advances in Information and Communication Technology. 368. 445-454. 10.1007/978-3-642-27281-3_50.
[74] Afrilifehoney (2019): Quality of Honey. URL: https://afrilifehoney.com/2019/08/16/quality-of-honey/

Royal Jelly	146	34.03
Bee Wax	24	5.59
Bee Venom	8	1.86
Didn't buy other products	171	39.86
Total	**471**	
Total Respondents	**429**	

2.2.2 Beekeepers

In Indonesia beekeeping is still considered to be “second class farming” and therefore the beekeeping sector is still small. Official data on the total number of beekeepers or numbers on the amount of hives for Indonesia do not exist. The Indonesian Central Bureau of Statistics (BPS) provided information on beekeeping with *Apis mellifera* in West Java – according to this data the number of hives in West Java was 7,141 hives in 2016.[75]

According to a local scientist from University Padjadjaran, Indonesia, most beekeepers construct their own hives by experience. Some buy their hives from other beekeepers. Traditional hives consist (similarly to Ethiopia) of various, simple and locally available materials. Despite there is no officially standardized size for beehives or research on what hive types fit best for the two different *Apis* species in Indonesia, the national State Forest Own Company (PERHUTANI) provides their own hive type for *Apis cerana* colonies and a large number of beekeepers try to copy the PERHUTANI beehive-size for their own constructions.[76]

In addition, there is a lack of know-how on proper beekeeping.[77] Most of the Indonesian beekeepers use the Asian endemic species *A. cerana* for beekeeping. However, according to studies in Asia and Australia this honey bee species is known to be less productive than *A. mellifera* and show increased absconding behavior.[78] [79] [80] [81]

Based on the conducted interview activities within User Centred Design, information about the beekeepers' character in Indonesia is depicted in the figure below:

[75] BPS – Badan Pusat Statistik Indonesia (2008): URL: https://www.bps.go.id/ (access: 12.06.2018)
[76] Perhutani. (1992): Petunjuk Praktis Budidaya Lebah Madu (*Apis Cerana*). Jakarta.
[77] Amir, A., & Pengembangan, Y., U. M. (2002): Forest-Dependent Community Development Through *Apis Cerana* Beekeeping Programm. Apiacata, 4, 1-4.
[78] Oldroyd, B. P., & Nanork, P. (2009): Conservation of Asian honey bees. Apidologie, 40(3), 296–312.
[79] Amir, A., & Pengembangan, Y., U. M. (2002): Forest-Dependent Community Development Through *Apis Cerana* Beekeeping Programm. Apiacata, 4, 1-4.
[80] Crane, E. (1990): Bees and beekeeping: science, practice, and world resources. Ithaca, N.Y.: Comstock Pub. Associates.
[81] Peluso, N. L. (1992): Rich Forests, Poor People: Resource Control and Resistance in Java. Berkeley, Los Angeles, Oxford, University of California Press.

Figure 31 Indonesian Beekeepers Characteristic

(source: UNPAD)

According to the figure above, concluded from surveys and interviews with beekeepers, beekeeping is traditional and generally done by senior citizens – the number of young beekeepers is still quite small. Beekeeping activities that are carried out by the younger generation are generally held because of hereditary inheritance. Beekeeping has not been able to promise a good future compared to other types of professions or animal husbandry because the heyday of beekeeping in Indonesia was in the 1980s until the early 1990s and the current state of beekeeping in Indonesia can be described as a suspended era. In the 1990s the number of beekeepers dropped due to a monetary crisis in Indonesia and has not recovered. Besides, as beekeeping business is mostly carried out by small farmers with limited capital, the banks do not trust in the business of beekeeping and do not provide credits.[82]

Based on interview with beekeepers and governmental representatives (West Java Agency of Forestry), beekeeping conditions in Indonesia are also being threatened by the functional shift of land that is quite massive. Many of the orchards that feed bees have begun to misfunction as residential areas, factories, or roads. Aside from orchards functional shift, beekeeping conditions in Indonesia are affected by erratic changes in the weather due to global climate change. These unpredictable weather conditions cause a shift in seasons, which causes the flowering season to become unpredictable and consecutively impacts the honey harvest time as well as the productivity of colonies. This phenomenon was experienced by *Apis mellifera* beekeepers in Subang. In previous years the beekeepers were able to harvest Rambutan flower around August or September, but in 2019 Rambutan honey harvesting activities could only be carried out around October.

[82] Embassy of the Argentine Republic Indonesia. Natural Honey

Beekeepers and beekeeping experts also mention that beekeepers in Indonesia must pay farmers to have “access” to their flowers for the bee colonies so that the cost of renting land is one form of maintenance costs for the colony. This shows that knowledge gaps not only occur for consumers and beekeepers but also for farmers who rely on the pollination service to be able to harvest fruit or similar natural products. Thus, pollination business is no potential revenue stream in Indonesia unless awareness has been created among farmers.

In the recent survey about technology conducted by UNPAD, it turned out that the intervention of technology is considered as important by the five asked beekeepers (two stated it as very important, one as important and two as quite important). Besides, four of the five beekeepers stated that they are interested in receiving a monitoring technology for beekeeping (two are very interested, one is interested, and one is quite interested) if there were institutions that provide funds on purchasing and maintaining such systems. This makes the role of investors or capital donor stakeholders important, so that farmers can implement and use technology for beekeeping.

The beekeepers assume that there are some farmers who are not interested to use a monitoring technology because, as their business is a relatively small business unit, they need proof of the success of such technology in increasing their income. Apart from capital constraints, moving to a modern beekeeping system does require time and an adaptation process with intensive guidance and assistance. Besides adopting such technology, based on observations and interviews brought to light that beekeepers will consider two things, namely the benefits they will receive and the ease of use of such technology. By considering the beekeepers’ diverse level of understanding such technic, the technology must have a simple, friendly and easy-to-use interface. It is more beneficial if the beekeepers are young or youth, because they adapt to technology easier and their level of technology knowledge is quite high. For them technology is not a foreign thing/ good anymore since smartphone penetration and utilization from urban to rural areas are started to widespread.[83]

When asking about the willingness to become a partner in the monitoring technology research, four out of the five beekeepers agreed (two are very willing, one is willing, and one is quite willing). Based on the expected form of partnership, two beekeepers want to be guided in the field of beekeeping and two want to be suppliers in the research data needed. Nevertheless, beekeepers’ awareness and doubts in beekeeping technology monitoring are high obstacles to overcome.

Table 2 Overview of beekeepers’ acceptance of technology for beekeeping

Importance of intervention of technology for beekeeping					
	Not important	Not too important	Quite important	Important	Very important
Person (total)	0	0	2	1	2
Level of interest in a monitoring technology for beekeeping					

[83] Bada Pusat Statistik (2019): Indeks Pembangunan Teknologi, Informasi, dan Komunikasi 2018. URL: https://www.bps.go.id/publication/2019/11/29/0328ba9a85b461816e917291/indeks-pembangunan-teknologi-informasi-dan-komunikasi-2018

	Not interested	Less interested	Interested enough	Interested	Very interested
Person (total)	1	0	1	1	2
Willingness to become research partner					
	Not willing	Less willing	Pretty willing	Willing	Very willing
Person (total)	1	0	1	1	2
The expectation of research partnership					
	Only Supply Research Data	Being guided in the field of beekeeping	Others	Do not want to	
Answers (total; (respondents could choose more than one option)	2	2	1	1	

2.2.3 Other customers and consumers

There are several Indonesian beekeeping organizations aiming the education of the domiciled beekeepers:

- PUSBAHNAS (National Apiary Center)[84]
- API Indonesia (Indonesian Apicultural Association)[85] – sub-organization of Asian Apicultural Association (AAA)
- Asian Apicultural Association (AAA) - aiming to "promote the exchange of scientific and general information relating to honeybee sciences and apiculture in Asia, and to encourage international co-operation in the study of problems of common interest"[86]
- The Indonesian Forest Honey Network or Jaringan Madu Hutan Indonesia (JMHI) - established in 2005 and is an umbrella organisation of 10 indigenous communities in Indonesia (Kalimantan, Sumatra, Sulawesi, Java, Flores and Timor Islands) with the objective to promote sustainable honey hunting by teaching a hygienic and environmentally safe harvesting system; the organisation works together with a social enterprise which is involved in marketing the harvested honey products throughout Indonesia and the profit is distributed between honey collectors[87]

In addition, there are numerous projects (e.g. FAO assistance beekeeping project in Parung Panjang, Bogor 1991) working on the improvement of the apicultural sector. However, projects

[84] PUSBAHNAS (2018): National Apiary Center, Indonesia. URL: https://pusatperlebahannasional.blogspot.co.at/ (access date: 14.05.2018)
[85] API Indonesia (2018): Indonesian Apicultural Association, Indonesia. URL (access date: 14.05.2018): https://apiindonesia.com/
[86] AAA (2018): Asian Apicultural Association. URL (access date: 14.05.2018): http://asianapiculture.org/
[87] JMHI (2018): Jaringan Madu Hutan Indonesia. URL (access date: 20.11.2018): http://www.jmhi.info/

always have an expiring date and beekeeping research programs of the past mostly lacked well coordination as well as the limited number of researchers, facilities, infrastructure and research funding. Besides, there are only few universities (e.g. Institut Pertanian Bogor, Pusat Studi Perlebahan Lembaga Penyakit Tropis Universitas Airlangga (LPT Unair)) and other scientific institutions (e.g. Pusat Penelitian Biologi LIPI) who deal with beekeeping. [88] Nevertheless, there are conservation areas like TAHURA National Park Juanda which help beekeepers around by providing a location for them to store their colonies.

Other stakeholders of the Indonesian apiculture sector are government, businessmen, universities/ research institutions, communities and NGOs. They have been asked about their opinion and interests in technology for beekeeping, e.g. SAMS technology usefulness and its data utilization, monitoring technology becoming an institutional activity, supporting a monitoring system for beekeeping via funding, becoming a research partner. Most of the stakeholders whom participated in the survey are not directly linked to apiculture sector. Stakeholders who are directly linked are Perhutani (Indonesia Forest Company) and API (Indonesian Apiculture Association).

The 19 government representatives involved are from Bappelitbang Kota Bandung (research and Development agency of Bandung City), Bappelitbang Kabupaten Bandung Barat (Research and Development agency of West Bandung regency), ten are from Dinas Kehutanan Provinsi Jawa Barat (Forestry agency of West Java Province), Dinas Perkebunan Provinsi Jawa Barat (Plantation agency of West Java Province), Dinas Perkebunan Provinsi Riau (Plantation agency of Riau), Dinas Pertanian Provinsi Banten (Agriculture Agency of Banten Province), Disbudpar Kota Bandung (Cultur), Pemerintah Daerah Kabupaten Pangandaran (Regional Government of Pangandaran Regency), Pemerintah Kota Cimahi (Cimahi City Government), Perhutani (Indonesia Forest Company).

The six business representatives involved are from CV Primary Indonesia, Pas Solving, Telekomunikasi, Yoriz and Telkomsel (two representatives).

The five representatives of universities/ research institutions involved are from UGM (Universitas Gadjah Mada), UNPAD (University Padjadjaran) and ITB (Institut Teknologi Bandung) (three are ITB representatives). The involved universities/ research institutions are familiar with the beekeeping sector and have conducted research related to beekeeping (one more than 10 papers, one 6-10 papers, three 1-2 papers). Four of the five stated that the SAMS technology is related or very related to the research they did.

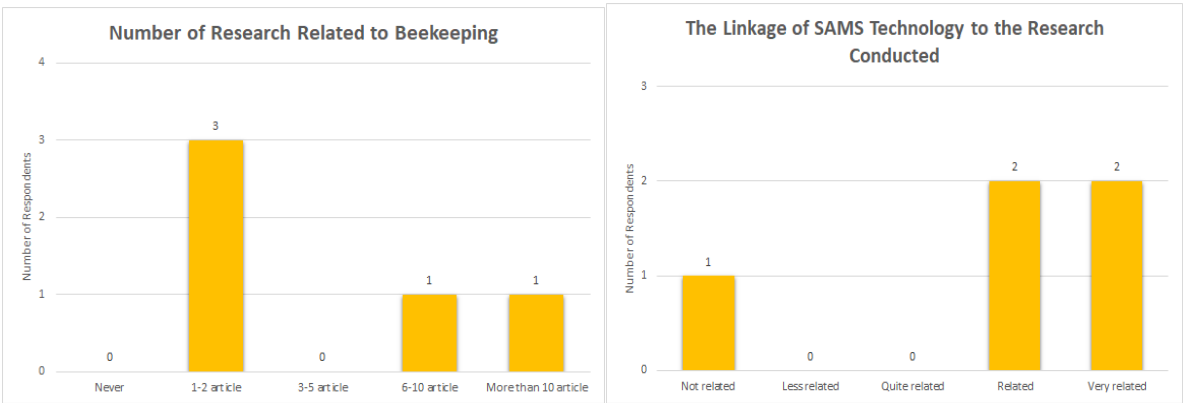

Figure 32 The percentage of research related to beekeeping

[88] Embassy of the Argentine Republic Indonesia (2014): Natural Honey. Market Review.

The seven NGOs involved are AMAN, Rumah zakat, The Samdhana Insitute, Yayasan Darussalam (Darussalam Foundation), Yayasan Dharma Bhakti Astra (Dharma Bhakti Astra Foundation), Yayasan IBU (IBU Foundation), Yayasan Konservasi Alam Nusantara (The Nature Concervancy Indonesia).

The four communities involved are: Asosiasi Perlebahan Indonesia (API), Bumi Inspirasi, Earth Hour Bandung, and Jendela Ide. Two communities do not have a link to monitoring technology nor beekeeping (Bumi Inspirasi and Earth Hour Bandung), one community states that they are quite related (Jendela Ide), and another one that the research is very related to the community's activities (API).

The SAMS technology and its data utilization is considered useful by all above mentioned stakeholder groups (it was not asked for which kind of activities the data is/ will be useful or how they will process and reuse such data but especially the government and the universities/ research institutions see a potential in data utilization). Only the government Riau Department of Plantation considers it less useful. Also, for two business representatives it seems less useful/ useless and one NGO stated it is useless. However, four of the six asked business representatives consider the SAMS data useful (two stated very useful, one useful, one quite useful) and as many as three NGOs think it is useful and another three that it is quite useful. Each of the four involved communities has another opinion about the data utilization - one stated that the data is very useful, one that it is useful, another one that it is less useful and one that it is useless.

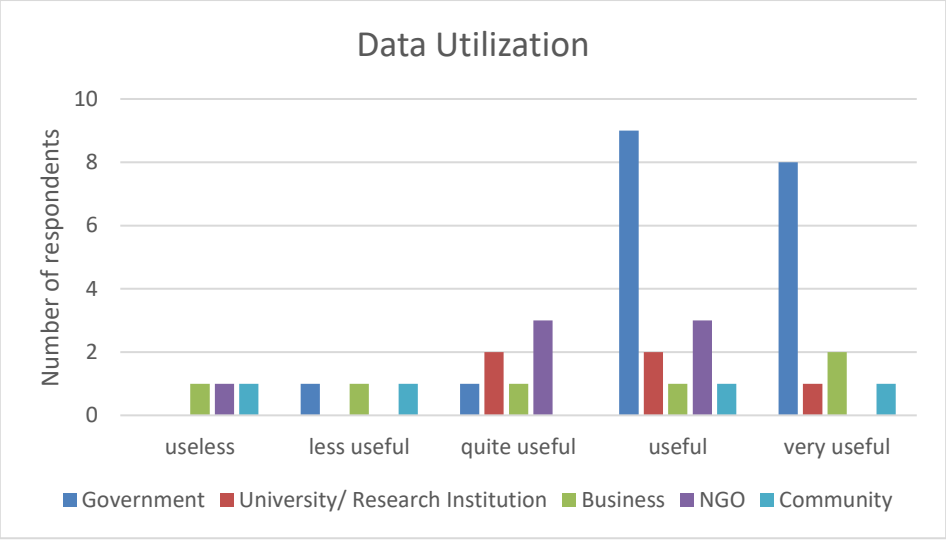

Figure 33 Data Utilization by different beekeeping stakeholder groups

Regarding the relevance of the data generated by SAMS technology for the universities/ research institutions the complete honeycomb weight data, the humidity data from one air humidity gauge sensor, and the environmental temperature data from a temperature sensor outside the hive are considered more relevant than the acoustical data and the temperature data inside the beehive (Figure 34) due to the fact that they are more related to environmental research aspects. Universities/ research institutions primarily prefer raw data extraction. Graphic data visualization is the least preferred form.

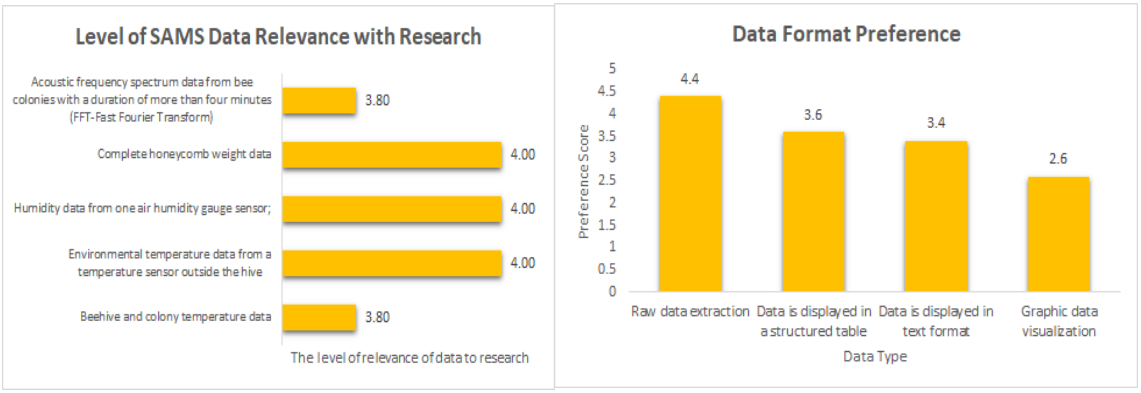

Figure 34 Relevance of SAMS data & preference of data form

Under this fact it was also requested if research in monitoring technology would be considered to become an institutional activity and answers show that such activities seem possible for them. It is likely to become a government activity (four representatives consider it very possible, eight as possible, four as possible enough, three stated that it is less possible/ impossible) or a university/ research institutes' activity. To deal with the research in monitoring technology is on the one hand seen as great opportunity for some businesses, NGOs and communities and on the other hand as less impacting possibility for some others. Especially, as two communities are not related to monitoring technology, it is not likely to become their activity.

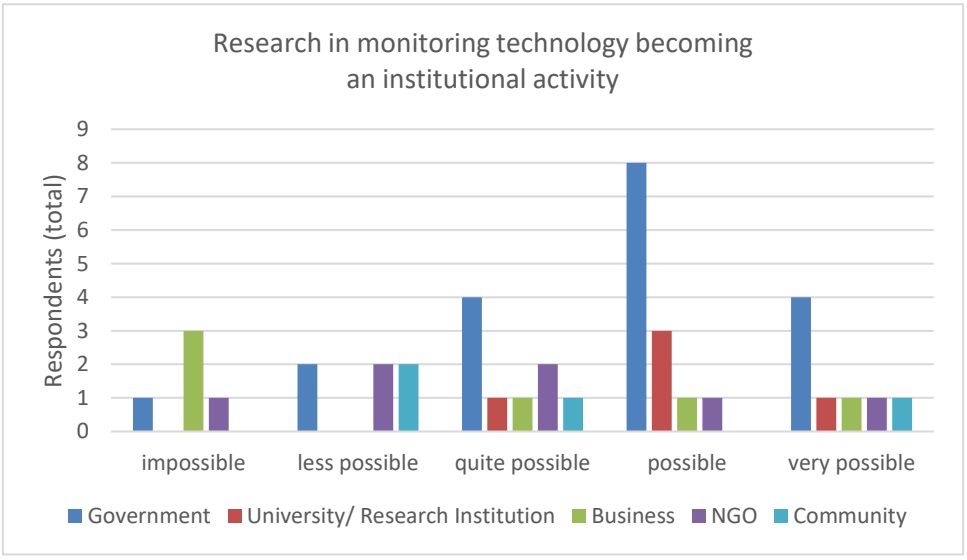

Figure 35 Research in monitoring technology becoming an institutional activity per stakeholder group

The most likely stakeholder who would provide funding/ invest in related implementation activities are Universities/Research Institutes, while for businesses and NGOs such funding for implementation of the monitoring system seems less possible.

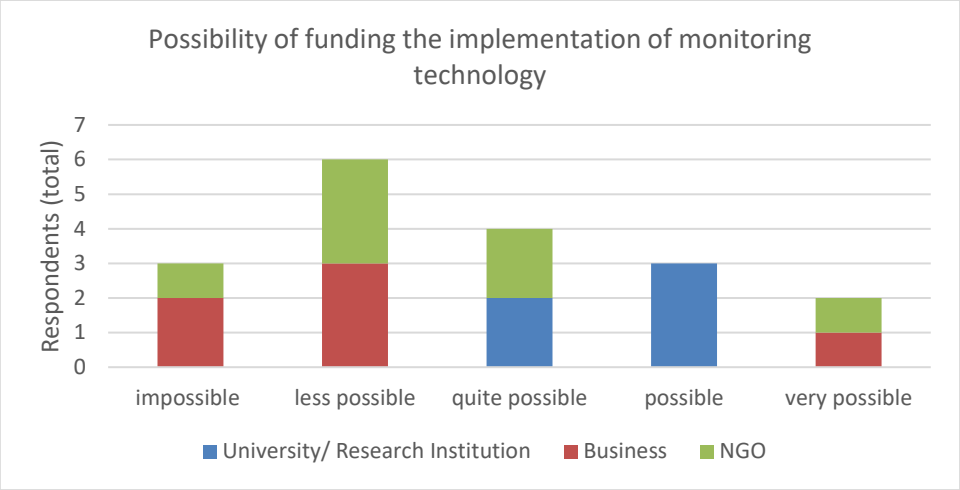

Figure 36 Possibility of funding the implementation of monitoring technology

Some businesses and NGOs are willing to become a research partner and expect the following cooperation options:

Table 3 Willingness to become a research partner and expectation of a research partnership

Willingness to become research partner	Business	NGO
Not willing	2	0
Less willing	0	2
Quite willing	2	3
Willing	1	1
Very willing	1	1
The expectation of research partnership	**Business**	**NGO**
Only Supply Research Data	2	1
Become coach	1	1
Being forteres in business development and marketing	2	3
Providing facilities and infrastructure	1	0
Preparing the fostered community	2	5
Become a funder	0	2
Collaborative Partners	4	3
Policy Partners	0	1

3. Bee product landscape

Bees are pollinating insects that produce various types of products. The most commonly known beekeeping product is honey. Nevertheless, bees also produce several other products like bee pollen, royal jelly, propolis, beeswax, and bee venom. There are also products in the

form of services, such as pollination services, beekeeping trainings, apitherapy, eco-tourism, bee colony providers, bee-queen producers as well as producing and selling beehives.

The most common bee product found on the Ethiopian and Indonesian market is honey. Based on the comparison of the import and export values (honey and beeswax), Ethiopia can be categorized as a net-export-country, while Indonesia is considered as net-import-country.[89]

In the following chapter the current state of bee products, the related processing industries in Ethiopia and Indonesia and where it is heading to is described – starting from honey, followed by other beekeeping products and in a wider perspective by bee related products as well as services to the supply chain pathways.

3.1 Ethiopia

A review of Ethiopian beekeeping practices indicates honey bees can grow across all regions in Ethiopia although the sector is underperforming.[90] In Ethiopia, beekeeping is an important agricultural activity and is part of the Ethiopian cultural identity. The considerable resources in the country, coupled with the culture of beekeeping, ranked Ethiopia one of the largest honey producers – 1st in Africa and 10th in the world.[91]

Ethiopia is the fourth biggest beeswax producer in the world next to China, Mexico and Turkey and number one in Africa with approximately 5,000 tons produced per year.[92]

3.1.1 Honey and bee related products including services

Ethiopia's main market for honey is traditional honey wine – called *tej*. Since this local brew does not require high quality honey, crude honey is the major type of honey produced in Ethiopia. The issue of quality has therefore never become a priority among Ethiopian producers and that has become one of the problems for the sector. Referencing per capita honey consumption in Ethiopia between 1997 to 2005 varies between 0.23 kg and 0.42 kg which implies there is no significant growth despite population growth from ~57 million to ~76 million during this time respectively.

As the number of national Central Statistical Agency of Ethiopia indicated, the export share of both honey and beeswax from the total production is not more than 2 % in Ethiopia. So far, the country is also limited only to honey, *tej* and beeswax production. UN COMTRADE ITC statistics indicated that between 2012-2016, Ethiopia imported natural honey from different countries with the total value of $149,000 in which some amounts may be re-imported. Honey and beeswax are among the growing export commodities with good potential. Other products like propolis, pollen, royal jelly and bee venom are not in production scale, although there is initial supply of these materials for international market. The development of these products is supported by Holeta Agricultural Research Institute.

[89] SAMSwiki (2018): Import/ Export of Honeybee Products.
URL: https://wiki.sams-project.eu/index.php/Import/Export_of_honey_bee_products
[90] https://www.researchgate.net/publication/330111227_Status_of_Beekeeping_in_Ethiopia-_A_Review
[91] Haftu K, Gezu T (2014): Survey on the honey production system, challenges and opportunities in selected areas of Hadya zone, Ethiopia. Journal of Biotechnology and Sustainable Development. Academic Journal 6(6): 60-66
[92] https://medcraveonline.com/JNHFE/a-review-on-crude-beeswax-mismanagement-and-lose-opportunities-for-collection-processing-and-marketing-in-ethiopia.html#:~:text=Beeswax%20production,-Bees%20need%20wax&text=The%20major%20world%20producer%20is,major%20producer%20with%2031%2C000%20tons

3.1.1.1 Honey production and use

The position of Ethiopia as the largest honey producers in Africa and as 10th in the world is due to bimodal rains, so that honey can be harvested at least twice a year.[93] [94] [95] The annual honey production was estimated to 43,000 t/year with a potential of about 550,000 t/year.[96] [97] This was estimated based on a potential nationwide modernization of the bee sector (modern hive, increased number of hives/ beekeeper etc.). However, approximately, 95% of beehives in Ethiopia are traditional with low productivity[98] with around 5-8 kg of honey [99] [100], while the average honey yield in modern hives ranges from 15-20 kg.[101] [102] According to FAO[103], the average amount of honey per hive over 24 years (1993-2016) was 7.55 kg (see Figure below).

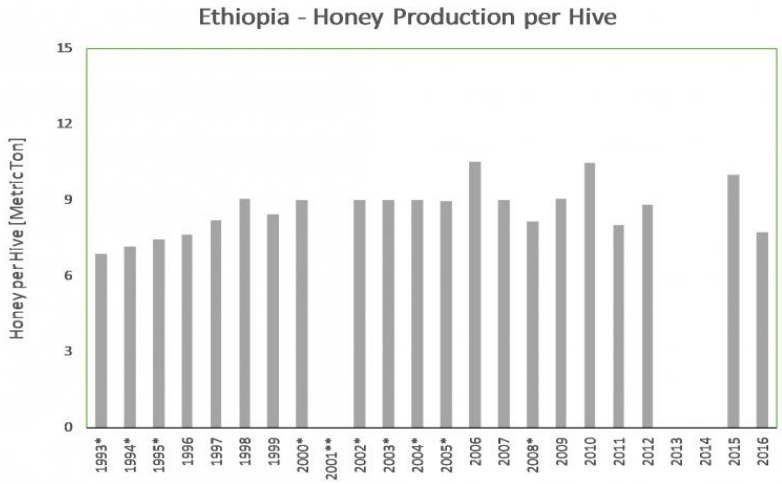

Figure 37 Honey yield per hive in Ethiopia (1993-2016); *Data is based on estimations of the Food and Agriculture Organization of the United Nations (FAO); **Data is not available.

The total volume of produced honey between the years of 1993 and 2004 increased constantly, but fluctuated afterwards: 24,000 t in 1993, 28,000 t in 1998, 40,900 t in 2004, and 42,000 t in 2008, 45,905 t in 2012, ~53.000 t[104] in 2013, 55.000 in 2014, 59.16147 in 2015,47.706 t in

[93] Adeday, G., Shiferaw, M., & Abebe, F. (2012): Prevalence of Bee Lice Braula coeca (Diptera: Braulidae) and Other Perceived Constraints to Honey Bee Production in Wukro Woreda, Tigray Region, Ethiopia. Global Veterinaria, 8(6), 631-635.
[94] https://medcraveonline.com/JNHFE/JNHFE-08-00307.pdf
[95] MoA & ILRI (2013): Apiculture value chain vision and strategy for Ethiopia. Addis Ababa, Ethiopia: Ministry of Agriculture and International Livestock Research Institute.
[96] MoARD (2007): Ministry of Agriculture and Rural Development. Livestock Development Master Plan Study. Phase I Report - Data Collection and Analysis, Volume N - Apiculture. Addis Ababa, Ethiopia.
[97] Taye, B., Desta, A., Girma, C., & Mekonen, W. T. (2016): Evaluation of transitional and modern hives for honey production in the Mid Rift Valley of Ethiopia. Bulletin of Animal Health and Production in Africa, 64(1), 157–165.
[98] Negash, B., & Greiling, J. (2017): Quality Focused Apiculture Sector Value Chain Development in Ethiopia. Journal of Agricultural Science and Technology A, 7(2), 107-116.
[99] MoARD (2007): Ministry of Agriculture and Rural Development. Livestock Development Master Plan Study. Phase I Report - Data Collection and Analysis, Volume N - Apiculture. Addis Ababa, Ethiopia.
[100] Gemechis, L. Y. (2016): Honey Production and Marketing in Ethiopia. Agriculture And Biology Journal Of North America, 7(5), 248-253.
[101] Taye, B., Desta, A., Girma, C., & Mekonen, W. T. (2016): Evaluation of transitional and modern hives for honey production in the Mid Rift Valley of Ethiopia. Bulletin of Animal Health and Production in Africa, 64(1), 157–165.
[102] Gidey, Y., & Mekonen, T. (2010): Participatory Technology and Constraints Assessment to Improve the Livelihood of Beekeepers in Tigray Region, northern Ethiopia. CNCS, 2(1), 76-92.
[103] FAO (2018): FAOSTAT database collections. Food and Agriculture Organization of the United Nations. Rome. Access date: 23.04.2018. URL: http://faostat.fao.org
[104] Assumed based on Data from 2012 ~ 47.000t and 2014 ~60.000t

2016; 53.970t in and 63.119t in 2018. As in the figure below, official data of FAO statistics (2018) also showed a honey production of 0 t in the years 2013 and 2014.[105] In 2015 it was estimated that Ethiopia only taps its potential of honey production by 8,6%.[106] Reasons for the fluctuation are e.g. drafts, quality of honey and more as stated by a national researcher from the Oromia Agriculture Center.

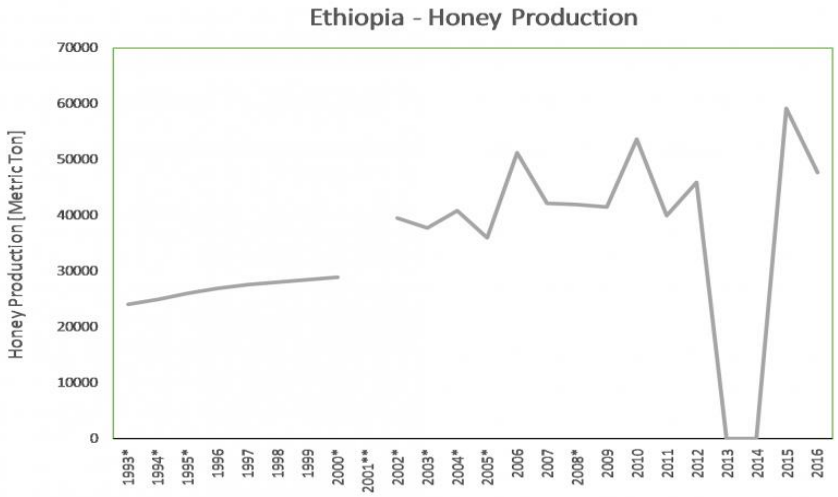

Figure 38 Honey production in Ethiopia (1993-2016); *Data is based on estimations of the Food and Agriculture Organization of the United Nations (FAO); **Data is not available.

10% of honey is consumed directly by the beekeeping households.[107] 70-80% of produced honey is used to produce *tej* (traditional beverage) and the remaining percentage is sold as table honey.[108] [109] [110] However, the beekeepers have no stable customers and trade-faire agreement. As a result, the beekeepers are suffering from lack of constant buyers, selling point, price fluctuation and ill functioned marketing system and only a very small portion of the product is sold in the proper market. Generally, the honey market is not developed even though the sector is a best investment option in Ethiopia that contests with its natural and unemployment potential. Thus, the sector demands a transformative action to organize its production system, input supply, product supply and value chain upgrading.[111]

In the domestic honey market value chain of Ethiopia, crude honey is sold to collectors (nearest town/ village markets) by small scale beekeepers. They pass on a great amount of the product to whole sellers in bigger cities and to local *tej* breweries. The whole sellers act as distributors and sell the honey to retailers, *tej* houses, processors and consumers.[112] Some beekeepers

[105] FAO (2018): FAOSTAT database collections. Food and Agriculture Organization of the United Nations. Rome. Access date: 23.04.2018. URL: http://faostat.fao.org
[106] Serda,B., Zewudu, T., Dereje,M., Aman, M. (2015): Beekeeping Practices, Production Potential and Challenges of Bee Keeping among Beekeepers in Haramaya District, Eastern Ethiopia (ResearchGate)
[107] Gemechis, L. Y. (2016): Honey Production and Marketing in Ethiopia. Agriculture And Biology Journal Of North America, 7(5), 248-253.
[108] Gidey, Y., & Mekonen, T. (2010): Participatory Technology and Constraints Assessment to Improve the Livelihood of Beekeepers in Tigray Region, northern Ethiopia. CNCS, 2(1), 76-92.
[109] Legesse, G. Y. (2014). Review of progress in Ethiopian honey production and marketing. Livestock Research for Rural Development 26(1), 1-6.
[110] SNV/Ethiopia (2005): Strategic intervention plan on honey & beeswax value-chains, snv support to business organizations and their access to markets (boam).
[111] Information provided by researcher of the Oromia Agricultural Research Institute Holeta Bee Research Centre
[112] Gemechis, L. Y. (2016): Honey Production and Marketing in Ethiopia. Agriculture And Biology Journal Of North America, 7(5), 248-253.

form marketing and producing cooperatives collect crude honey from members and sell the semi-processed product to processing companies or distributors. In 2013 there were nine registered honey processor companies in the country and some of them are also engaged in honey production.[113]

As in Ethiopia there is a lack of “good beekeeping practice”, the cooperatives do not underlie quality controlling bodies, nor do they have business concepts and therefore suffer from quality loss and cannot compete with bigger companies (lack of proper collection, storage and transportation facilities etc.). One major quality problem is the high moisture level of honey. Samples from all over the country revealed moisture content between 15.25% and 30.45%. The outcome varies with the type of used hives (traditional hives have 1.5-3.0% higher moisture content than modern hives) and the sample region (highly humid areas are more affected).[114] In addition, the domestic honey market has several problems: the smuggle and adulteration of honey bee products, complaints of consumers about increasing prices of honey products, while the beekeepers have the feeling that the business is not rewarding.[115]

Nevertheless, Ethiopia can be categorized as a net-export-country. The total volume of exported honey between the years of 2000 and 2013 increased constantly: 1 t in 2000, 19 t in 2004, 196 t in 2008 and 904 t in 2013. With increasing honey export quantity, the export volume of Ethiopia reached more than 3.25 million USD (figure below).[116]

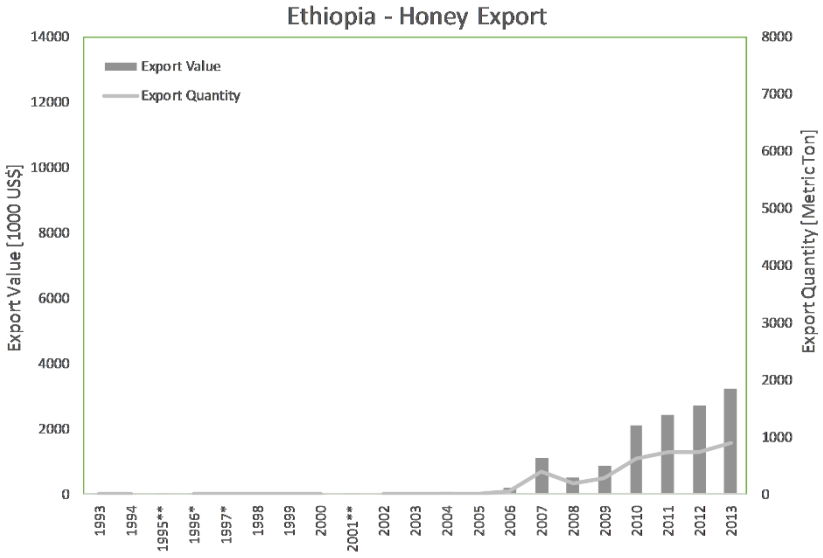

Figure 39 Export data of honey-Ethiopia (1993-2013); *Data is based on estimations of the Food and Agriculture Organization of the United Nations (FAO); **Data is not available.

The volume and value of honey exported from about 40 registered companies in Ethiopia[117] was in an increasing trend till 2013 but then it began to stagnate/ decline. There are a number

[113] MoA & ILRI (2013): Apiculture value chain vision and strategy for Ethiopia. Addis Ababa, Ethiopia: Ministry of Agriculture and International Livestock Research Institute.
[114] Gemechis, L. Y. (2016): Honey Production and Marketing in Ethiopia. Agriculture and Biology Journal Of North America, 7(5), 248-253.
[115] Gemechis, L. Y. (2016): Honey Production and Marketing in Ethiopia. Agriculture and Biology Journal Of North America, 7(5), 248-253.
[116] FAO (2018): FAOSTAT database collections. Food and Agriculture Organization of the United Nations. Rome. Access date: 23.04.2018. URL: http://faostat.fao.org
[117] http://www.mot.gov.et/documents/20181/23063/Honey-and-Beewax-Producers-and-Exporters-Association/6679b9e4-99f3-44f8-a7f4-5d5eb31f0ab5

of reasons for this – continuous honey quality deterioration mainly due to adulteration and fraud are the major contributing factor for the decline of exported honey. The other challenges in the country which include but are not limited are illegal cross border honey trade, the recurrent drought which affects the supply line and increase the price of honey in the local market. Laboratory service costs usually demand foreign currency and continuously increase in price. Currently these factors are affecting the export market negatively.

Compared to the honey production of the country, Table 4 shows how much tons of honey remain in the country and how many are exported (also expressed in percent). The related use of honey is also indicated in tons and percent to point out the further processing of honey and its importance.

Table 4 Overview of Ethiopian Honey Production Export and Remain in Ethiopia

Year	Honey Production	Export (% of production)	Remain in ET		
			Tej (70%)	Consumed by beekeeping household (10%)	Table honey (20%)
2000	30,000 t	1 t (0%)	~21,000 t	~3,000 t	~6,000 t
2004	40,900 t	19 t (0,05%)	~28,617 t	~4,088 t	~8,176 t
2008	42,000 t	196 t (0,5%)	~29.263 t	~4.180 t	~ 8.361 t
2013	53.000 t	904 t (1,7%)	~36.467 t	~5.210 t	~10.419 t
2014	55.000	1.100 t (2%)*	~37.730 t**	~5.390 t**	~10.780 t**
2015	59.161	1.183t (2%)*	~40.584 t**	~5.798 t**	~11.595 t**
2016	47.706	954t (2%)*	~32.726 t**	~4.675 t**	~9.350 t**
2017	53.970t	1.080t (2%)*	~37.023 t**	~5.289 t**	~10.578 t**
2018	63.119t	1.262t (2%)*	~43.299 t**	~6.185 t**	~12.371 t**

*no real data - estimated percentage for export base on previous year

**no real data - based on estimated export

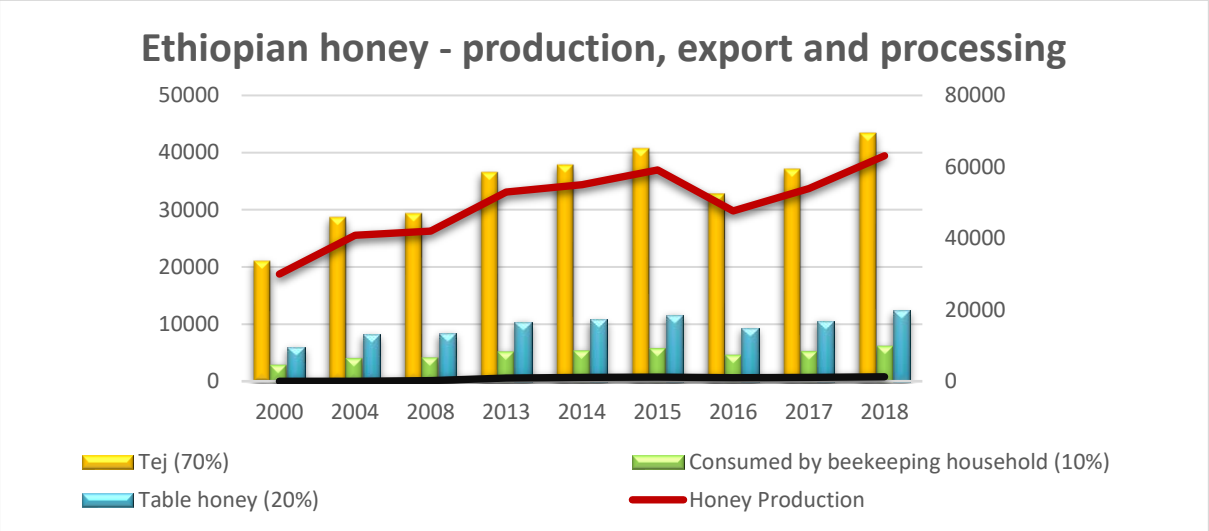

Figure 40 Ethiopian honey – production, export and processing

The increasing honey production and export rate shows a trend and the big potential for the Ethiopian economy and the apiculture sector.

Honey from traditional hives is sometimes a mixture of pollen, wax and honey, because for some local beekeepers it is not common to separate table honey from beeswax and other ingredients. But during the *tej*-brewing process, beeswax is separated as a byproduct that is passed on to beeswax collectors and exporters. Hence, they serve as important stakeholders in the beeswax business.[118]

Most imports to Ethiopia are further processed and packaged honey products (e.g. specialty honey products) that usually make it to few urban supermarkets and high-end hotels. Most of these products are imported by importers in the urban areas. These serve a small niche market of household consumers and hotels, who value good packaging or alternative brands. In the years between 2004-2008, Ethiopia imported around 24 tons of honey from France, England and Egypt. Compared to the local production, imported honey products only serve few urban segments. According to a study on the quality of imported honey, a survey indicated there are 10 honey importers supplying to supermarkets and high-end hotels (Sheraton Addis) although the quality and safety is not inspected by the concerned bodies. It also showed that most of the similar establishments are using local products (of a tested quality). It can be concluded that the effects of imported honey are not significant as the majority of users have developed trust in local honey as opposed to other imported products.

However, the prevalence of low quality or mixed honey remains an issue primarily due to differential pricing. Beekeepers do not receive higher prices for good quality honey, and therefore do not have an incentive to produce the quality of honey demanded at the national and international level. As beekeeping in the country is dominated by traditional hives, the type of honey harvested is likely to be unripe and mixed with broods and dead bees.

However, there is a market for such types of honey (i.e. local traders) so beekeepers are not inclined to invest in modern or transitional hives to produce quality honey, as the price difference is insignificant and requires equipment that is inaccessible. Furthermore, low

[118] SNV/Ethiopia (2005): Strategic intervention plan on honey & beeswax value-chains, snv support to business organizations and their access to markets (boam).

awareness of quality grade specifications, lack of measurement by aggregators, and the lack of a certification labelling system lead to low quality apiculture products and facilitate illegal practices such as adulteration. Consumers in Ethiopia prefer to buy honeycomb from farmers due to the frequency of adulteration. Thus, beekeepers are unable to find a market for extracted honey.

3.1.1.2 Beeswax Production

Not only the honey, but also the beeswax business has great potential in Ethiopia. Ethiopia is the fourth biggest beeswax producer in the world. Globally, China is leading in beeswax production followed by Mexico and Turkey. Whereas, Ethiopia is number one in Africa with approximately 5,000 harvested t/year, while the experts estimate the production potential at 50,000 t/year.[119] [120] The current production rate per beehive is 0.95 kg/year, with the major yield of beeswax out of the crude harvest of honey and other bee products from traditional hive (wax portion: 8.0-10.0%) rather than modern hives (0.5-2.0%).[121] Despite the greater amount of beeswax yield in traditional hives, it is from lower quality, due to the more difficult purification process (increased amount of foreign material). Ethiopian beeswax' quality from all over the country was evaluated, and in general, the quality is at a similar level as the rest of the world, but adulteration of the product constantly increases. The reasons are not only processing companies with unsuitable facilities for beeswax processing, but also the adulteration with cheaper fats (e.g. animal fat, plant oil and paraffins).[122] Another quality-lowering factor are *tej*-breweries. Many of the Ethiopian beekeepers do not know the value of beeswax, and/or do not have the needed processing materials to sell the beeswax.[123] Thus, most of the harvested honey goes directly into *tej*-brewing and during the process, beeswax is separated as a byproduct (*sefef*) and will be sold to beeswax exporters and collectors, but the quality of this byproduct is low. Nuru and Edessa (2006) found, that the processing of crude beeswax with modern techniques is almost twice as efficient than using traditional methods to gain pure beeswax.[124] In 2005, there were 16 registered companies who export beeswax, but only 4 of them were active, due to a lack of supply, not to a lack of international need. However, there are 52 honey and beeswax producers and exporters in the association's database.[125] So far, there is no published data on the use of beeswax in Ethiopia, but it is believed, that a significant amount of beeswax is used to produce candles – known as "tuaf" for orthodox churches. [126]

From 1993 until 1998 the total volume of exported beeswax increased constantly (247 t in 1993 and 956 t in 1998), while the year after, until 2001, the export quota declined (267 t in 1999 and 53 t in 2001). Ever since, the total amount of exported beeswax is fluctuating: 233 t in

[119] Gupta, R. K., Reybroeck, W., van Veen, J. W., & Gupta, A. (2014): Beekeeping for Poverty Alleviation and Livelihood Security: Vol. 1: Technological Aspects of Beekeeping. Dordrecht, Springer Netherlands.
[120] Negash, B., & Greiling, J. (2017): Quality Focused Apiculture Sector Value Chain Development in Ethiopia. Journal of Agricultural Science and Technology A, 7(2), 107-116.
[121] SNV/Ethiopia (2005): Strategic intervention plan on honey & beeswax value-chains, snv support to business organizations and their access to markets (boam).
[122] Gemechis, L. Y. (2014): Beeswax production and marketing in Ethiopia: Challenges in value chain. Agriculture, Forestry and Fisheries, 3(6), 447-451.
[123] Serda, B., Zewudu, T., Dereje, M., & Aman, M. (2015): Beekeeping Practices, Production Potential and Challenges of Bee Keeping among Beekeepers in Haramaya District, Eastern Ethiopia. J Veterinar Sci Technol, 6(255), 1-5.
[124] Nuru, A., Edessa, N. G. (2006): Profitability of processing crude honey. EBA 5th annual conference proceedings. Conference Paper. 91-100.
[125]http://www.mot.gov.et/documents/20181/23063/Honey-and-Beewax-Producers-and-Exporters-Association/6679b9e4-99f3-44f8-a7f4-5d5eb31f0ab5
[126] Gemechis, L. Y. (2014): Beeswax production and marketing in Ethiopia: Challenges in value chain. Agriculture, Forestry and Fisheries, 3(6), 447-451.

2002, 402 t in 2003, 321 t in 2006, 372 t in 2007, 365 t in 2012 and 341 t in 2013. In 2013 the export volume of Ethiopian beeswax reached more than 2.69 million USD. Thus, according to FAO, the export value has almost doubled within 7 years (1.42 million USD in 2006), although the export quantity has not increased significantly (figure below).

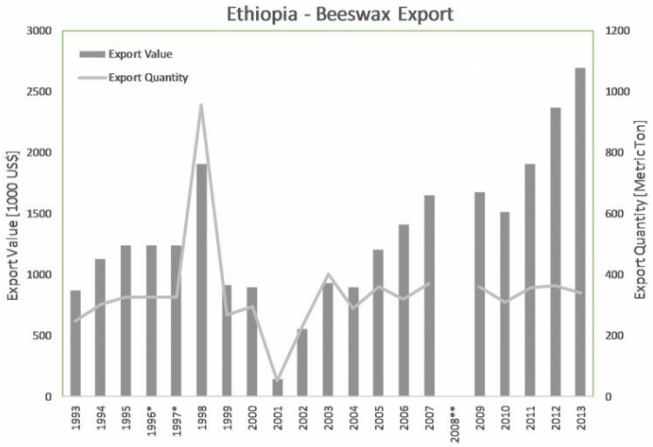

Figure 41 Export data of beeswax-Ethiopia (1993-2013); *Data is based on estimations of the Food and Agriculture Organization of the United Nations (FAO); **Data is not available

Table 5 Overview of Ethiopian Beeswax Production Export and Remain in Ethiopia

Year	Beeswax Production	Export (% of production)	Remain in ET
2002	4.400t	233 t (05.0%)	4.167t
2003	3.700t	402 t (11.0%)	3.498t
2006	4.900t	321 t (07.0%)	4.579t
2007	4.750t	372 t (08.0%)	4.378t
2012	5.000t	365 t (07.0%)	4.635t
2013	5.100t	342 t (07.0%)	4.758t

The leading honey and beeswax producing regions in Ethiopia include Oromia (41%), SNNPR (22%), Amara (21%) and Tigray (5%).[127]

3.1.1.3 Pollen

Regarding pollen, there exists no classical pollen business in Ethiopia, where the beekeepers install pollen traps to collect and sell exclusively the pollen product.[128] But the pollen plays an important role in the *tej*-production (fermentation process).[129]

[127] SNV/Ethiopia (2005): Strategic intervention plan on honey & beeswax value-chains, snv support to business organizations and their access to markets (boam).
[128] Communication with the Holeta Bee Research Center (2019)
[129] Serda, B., Zewudu, T., Dereje, M., & Aman, M. (2015): Beekeeping Practices, Production Potential and Challenges of Bee Keeping among Beekeepers in Haramaya District, Eastern Ethiopia. J Veterinar Sci Technol 6(255), 1-5.

3.1.1.4 Honey hunting and bee maintaining

Besides the classical beekeeping, there are two other apicultural activities. On the one hand there is the traditional “honey hunting” which consist of trace and rob of wild honey bee colonies to make profit out of their products.[130] [131] [132] It is an unsustainable way to obtain honey bee products, which led to the decrease of feral stingless bee species not only in Ethiopia but also in Africa.[133] One the other hand, there is the activity of “bee maintaining" which is defined as an intermediary stage of beekeeping where humans guard wild living colonies and provide artificial nesting sites.[134] In Ethiopia, there exists "forest beekeeping" which is the utilization of feral honey bee colonies (*A. mellifera*) as a resource without manipulating it. Honey collectors provide traditional nesting sites made of local available materials and harvest honey and beeswax two times per year. The provided nesting sites are placed in trees and the beekeeper has no influence on the quantity of the yield nor the harvest time. To increase the honey product yield, the number of nesting sites must be increased. Focusing on the absence of hive manipulation, forest beekeeping may be categorized as "bee maintaining" instead of classical beekeeping.[135]

3.1.1.5 Migratory beekeeping

There is almost no information available on migratory beekeeping in Ethiopia, but it is considered a rare practice.[136] It is known, that in a region called Gojjam, simple migratory beekeeping is practiced. It is done for additional income, instead of increasing pollination. Farmers close the traditional baskets with fresh cow dung and carry the hives on the shoulders to the selected fields.[137]

3.1.1.6 Pollination services

While the knowledge on the importance of bees as pollinators exists in Ethiopia, there is no pollination business.[138]

[130] Fichtl, R., & Adi, A. (1994): Honeybee Flora of Ethiopia. Margraf Verlag Germany.
[131] Gemechis, L. Y. (2016): Honey Production and Marketing in Ethiopia. Agriculture And Biology Journal Of North America, 7(5), 248-253.
[132] Anguilet, E. C. F., Nguyen, B. K., Ndong, T. B., Haubruge, E., & Francis, F. (2015): Meliponini and Apini in Africa (Apidae: Apinae): a review on the challenges and stakes bound to their diversity and their distribution. Biotechnol. Agronom. Soc. Environ., 19(4), 382-391.
[133] Dietemann, V., Pirk, C. W. W, & Crewe, R. (2009): Is there a need for conservation of honeybees in Africa? Apidologie, 40, 285–295.
[134] Bradbear, N., & Food and Agriculture Organization of the United Nations (FAO) (2009): Bees and their role in forest livelihoods: a guide to the services provided by bees and the sustainable harvesting processing and marketing of their products. FAO, Rome, Non-Wood Forest Products, 19, 1-194.
[135] Lowore, J., Meaton, J., & Wood, A. (2018): African Forest Honey: an Overlooked NTFP with Potential to Support Livelihoods and Forests. Environmental Management, 62, 15–28.
[136] Kibebew, W. (in press): Investigating the effect of migratory beekeeping on honey production in East and west Shewa Zones of Oromia. (status: 11.06.2018).
[137] Fichtl, R., & Adi, A. (1994): Honeybee Flora of Ethiopia. Margraf Verlag Germany.
[138] Communication with Holeta Bee Research Center (2019)

3.1.1.7 Queen breeding and selling

There is no known queen breeding and selling structured businesses in Ethiopia. Whereas, beekeepers themselves provide breed and sell it to other beekeepers. In Amhara region there is one public center called *Nib mabagna center* which breeds and provides it to the farmers.

3.1.1.8 Bee colony selling

Bee colony selling is common in most central, North West, North and Eastern parts of the country but there are no companies or legally registered traders selling bee colonies. Like for queen breeding, beekeepers multiply their colonies and sell them to other beekeepers. For this informal market process, in the northern part of the country, for instance, there is a market place called *Inticho* and up to 2000 bee colonies can be sold on the market per day (only one day per week).[139]

3.1.1.9 Beehive construction

Beehive construction is increasing as an attractive business in Ethiopia. In Jimma zone for instance Dedesa metal & woodwork produces up to 1,500 beehives annually and sell it to the local market. The beehive construction is carried out in Ethiopia mainly by public institutions like in Bako, Asella, Wolayeta Sodo, Bahirdard. The most notable private workshop is from Selam technical college (Addis Ababa) one of the major for profit based private company beehive constructor. In the region as well, there are small workshops providing beehive construction. In Oromia about 20 active beehive construction workshops exists. In summary the workshops are Apinec workshop, Bako Agricultural Engineering Center, Wolayita Sodo Rural Technology Center, Selam TVET center, federal small and medium technology development Enterprise, ETHIO BEEHIVE and Kekros. Beekeeping input suppliers can be named the following, e.g. Biotech PLc, Workinesh Kebede bee equipment, Wogelu Endale beekeeping inputs business, Goggle PLC and Neway PLC.

3.1.1.10 Bee Venom

There are no known bee venom businesses in Ethiopia nor available in public institution.

3.1.1.11 Royal Jelly

There is no known royal jelly business in Ethiopia though it has been tested on Holeta research institute level. Currently, it is not viable in Ethiopia.

3.1.1.12 Propolis

The Holeta Bee Research Center and the Ministry of Agriculture and International Livestock Research Institute communicated that there is no business for propolis, but beekeepers sometimes harvest it for home consumption (medical use).[140] Nevertheless, it is well known in Ethiopia that propolis can be harvested from every hive type. While the yield of propolis is higher in traditional hives, the quality is lower due to a contamination of pure propolis with

[139] Communication with the Holeta Bee Research Center (2020)

[140] MoA & ILRI (2013): Apiculture value chain vision and strategy for Ethiopia. Addis Ababa, Ethiopia: Ministry of Agriculture and International Livestock Research Institute.

beeswax, hive debris or body parts of bees. Recently there is FDI (Foreign Direct Investment) effort to bring in foreign companies to Ethiopia, such process has already started in Amhara region.

Nuru et al. (2002) conducted a study, where propolis production was induced in traditional and in modern hive-systems. They exposed the hives to external environmental conditions, by creating gaps within the hive. Bees show the behavior of filling those openings and, as prior expected, the propolis yield was higher in manipulated hive-systems. They found not only a correlation between the data of local weather stations and the propolis production, but also a significantly higher amount of harvested propolis in traditional, compared to modern bee hives. The authors claim, that small, cost effective methods can help to increase the outcome significantly. [141] Thus, this simple method may be used to increase the propolis yield of small-scale beekeepers.

3.1.1.13 Training

A private sector Technical and Vocational Education and Training (TVET) provider exists in Kefa zone, called ApiNeg technical college. Yet the training provision is provided by public TVET colleagues (predominately passed TVET college). Notable TVET in Adwa, Tigray, Alage, Misrak Shewa, Agarfa and Holeta

3.1.1.14 Honey supply chain and actors

In order to characterize the marketing system and market structure and to identify the impacts of domestic honey marketing system on export marketing, and to identify the major opportunities and challenges of honey marketing, a value chain analysis is currently conducted by Oromia Agricultural Research Institute Holeta Bee Research Centre in Ethiopia. Questionnaires for the survey have been answered by 270 beekeepers, 30 honey traders, 7 honey processors and 3 honey and in total 310 individuals were interviewed in this study. The preliminary result indicated that the sectors is dominated by traditional production system with the sources of bee colonies to start beekeeping by beekeepers are swarm catching with about 35%, 5% of the beekeepers purchase colony and the rest majority obtain the colonies either from parents or relatives. In marketing the bee products (particularly honey), different actors in the market chain are identified. Producers, retailers, big retailers, cooperatives, *tej* houses, exporters, and consumers are identified as the market chain actors in Ethiopia. Beekeepers are the first actors who are accountable for honey production. The beekeepers harvest honey from their different beekeeping systems (traditional, transitional and modern) and mix honey from different production systems or keep separated and sell it mostly to consumers, retailers, and cooperatives. Sometimes, there are also village honey collectors who buy honey from the beekeepers. These village collectors collect honey at the farm gate or local market near the beekeepers. Retailers most of whom are established along the main road to the nearest big towns or cities maintained a long-term relationship with consumers from other areas and with big retailers from cities and big towns. Some of the retailers processed honey before selling to big retailers and consumers, while others sold honey as it collected from the producers particularly to *tej* houses. In spite of the fact that retailers bought honey from producers, they determine the price and the price producers get and prices consumers/end users pay for the

[141] Nuru, A., Hepburn, H. R., & Radloff, S. E. (2002): Induction of propolis production by *Apis mellifera bandasii* in traditional basket and Langstroth movable-frame hives in Ethiopia. Journal of Apicultural Research, 41(3-4), 101–106.

product has greater differences with the profit margin for the retailers very high. In some areas, bee products marketing and development cooperatives are established to collect quality honey from the producers, processing and selling it to consumers. The cooperatives obtained income by selling processed honey to better prices (still lower than the prices by retailers) and by selling of beeswax obtained from honey processing. Cooperatives can sell the honey they collect from producers to Unions based on the volume they can collect and the union further processes, packs to sell the honey to consumers or sell the processed honey in bulk to honey exports or the domestic market suppliers like super markets. In some areas where honey production potential is higher like in south and western parts of the country, a large amount of honey goes from beekeepers to *tej* houses through retailers and also from producers directly to big retailers.[142]

3.1.2 Technology industry

National policies and initiatives (e.g. globally competitive honey sector development policy)[143] are rolled out to support the honey value chain, particularly processing businesses. Such support is given by the Ethiopian Agricultural Transformation Agency among others. The Ethiopian Agribusiness Accelerator Platform[144] is a platform that identifies and addresses company-specific and systemic challenges, and aims to build a high-quality, sustainable supply chain for partners across the value chain and create a market driven, business-building model for participating entrepreneurs.

There are different agriculture technology initiatives; but the key ones are led by ATA and its partners. Globally, technologies such as Internet of Things (IoT) and Blockchain support the agricultural sector. IoT allows farmers to monitor their production and its use is growing at only ~30% per year in Africa due to devices being expensive whereas, blockchain allows Fair Trade labels, traceability, and better (cheaper) payment mechanisms to be implemented.

There are no sensor and integrated board manufacturing companies in Ethiopia but recently, based on SAMS, two start-ups (Anabi, Kekros) started to develop remote monitoring systems for beekeeping. All components related to remote sensing technologies need to be imported to Ethiopia.

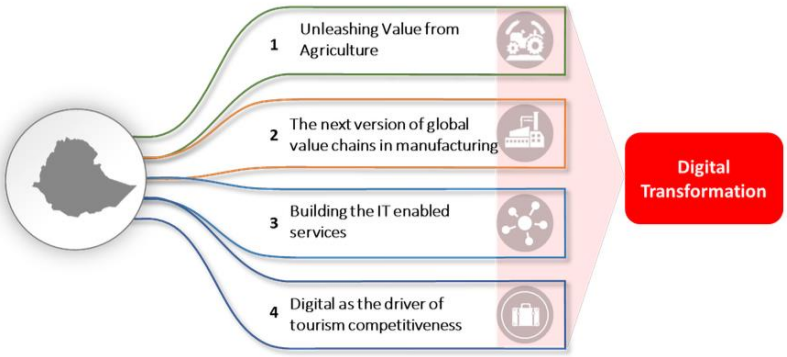

Figure 42 Four pathways of Ethiopian digital transformation strategy

[142] Information provided by Researcher of Oromia Agricultural Research Institute Holeta Bee Research Centre
[143] http://emdidi.org/wp-content/uploads/2016/12/Strategic-Plan-to-Develop-a-Globally-Competitive-Honey-Industry-in-Ethiopia-v.1-Jan-2015-Reported.pdf
[144] "Agricultural Transformation Agency." http://www.ata.gov.et/.

However, Ethiopia set up a digital transformation strategy. Unleashing value from Agriculture is one of the four pathways. Two specific opportunities identified for Ethiopia to succeed on this pathway are: building a Digital Agriculture platform (an integrated system that offers new insights that enhance the ability to make decisions and subsequently implement them) and supporting and incentivizing Ag-tech entrepreneurship as these will ensure innovations, jobs, export in agriculture and related sectors, and inclusivity within the thriving Ag-tech entrepreneurship sector in Ethiopia.[145]

3.2 Indonesia

The Indonesian honey market has a potential for growth due local occurrence of various types of honey-producing bees. Besides, Indonesia also has vast amounts of flowering plants. Not only honey, but also other bee products such as pollen, royal jelly, propolis, and beeswax have market potential – especially, to produce bee related products, e.g. food and beverage, health products, cosmetics. These bee related products can increase the added value of honey bee products.

3.2.1 Honey and bee related products including services

3.2.1.1 Honey production and use

Based on official data from BPS-Statistics Indonesia, honey production data in Indonesia (2018) reached 147,274.03 litres[146] mainly produced by traditional beekeepers for local and national market. However, certain data on the honey production of Indonesia is not available because most small and traditional beekeepers and honey hunters do not record their honey harvest amount/sales or are not able to routinely record their production results.[147]

Nevertheless, De Jong (2000) estimated the honey production in the region of Kalimantan between 53 kg and 267 kg per beekeeping operation (family) per year.[148] Shouten et al. (2019) assessed the beekeeping situation on 4 islands of Indonesia and found, that the mean annual honey yield from *A. cerana* beehives ranges from 0.5 kg to 5 kg per hive and strongly depends on the season. One surveyed beekeeper mentioned a three times higher honey yield when harvesting in the wet season compared to a dry season's yield – but as beekeepers rarely keep records this has to be further elaborated.[149]

Beekeeping in Indonesia is still considered to be a “part time farming activity” and therefore the beekeeping sector is still small. There are various forms of gaining honey, for example working with small colonies of stingless bees, or the practice of honey hunting of *A. dorsata*,

[145] Digital transformation strategy, MInT 2020

[146] Subdirektorat Statistik Kehutanan. (2018): *Statistik Produksi Kehutanan 2018*. URL: https://www.bps.go.id/publication/2019/11/29/dc8c58a7c1c467126c285d2e/statistik-produksi-kehutanan-2018.htm

[147] SAMSwiki (2018): Honey. URL: https://wiki.sams-project.eu/index.php/Honey

[148] De Jong, W. (2000): Micro-differences in Local Resource Management: The Case of Honey in West Kalimantan, Indonesia -a Brief Comment. Human Ecology, 28(4), 631-639.

[149] Shouten, C. N., Lloyd, D. J., & Lloyd, H. (in press): Beekeeping with the Asian Honey Bee (*Apis cerana javana* Fabr) in Indonesia. (status: 10.11.2018)

where the forest honey is often consumed locally and therefore the data on the amount of harvested honey is not passed on for statistical assessments.[150]
It is estimated, that Indonesia needs 3,750 t of honey per year, while there is a supply of only 500-2,000t per year.[151] Thus, Indonesia is categorized as a net-import country[152] with fluctuations in the import quota of honey: 8 t in 1965, 124 t in 1970, 37 t in 1975, 97 t in 1980, 56 t in 1985, 217 t in 1990, 577 t in 1995, 747 t in 2000, 776 t in 2005, 15,595 t in 2010 and 2,177 t in 2013. An observable trend of an increasing amount of imported honey and the import volume of honey of over 8.33 million USD in 2013 is seen in the Figure below. [153]

Figure 43 Import data of honey-Indonesia (1961-2013); *Data is based on estimations of the Food and Agriculture Organization of the United Nations (FAO)

Table 6 Import data of honey-Indonesia (1961-2013)

Year	Honey Imported (ton)
1965	8
1970	124
1975	37
1980	97
1985	56
1990	217
1995	577
2000	747
2005	776
2010	15,595
2013	2,177

*Data is based on estimations of the Food and Agriculture Organization of the United Nations (FAO)

[150] De Jong, W. (2002): Forest products and local forest management in West Kalimantan, Indonesia: implications for conservation and development. Wageningen: Tropenbos International.
[151] Widiatmaka, W., Wiwin, A., Chandrasa, E. S., & Lailan, S. (2006): Geographic Information System and Analytical Hierarchy Process For Land Use Planning of Beekeeping in Forest Margin of Bogor Regency, Indonesia. Jurnal Silvikultur Tropika, 7(3), 50-57.
[152] SAMSwiki (2018): Import/ Export of Honeybee Products.
URL: https://wiki.sams-project.eu/index.php/Import/Export_of_honey_bee_products
[153] FAO (2018): FAOSTAT database collections. Food and Agriculture Organization of the United Nations. Rome. Access date: 23.04.2018. URL: http://faostat.fao.org

On average, the total amount of exported honey between the years of 2000 and 2012 increased but decreased again in 2013: 1,270 t in 2004, 2,000 t in 2008, 765 t in 2012 and 207 t in 2013. There is a tremendous peak in 2009 with 7,355 t of exported honey. According to FAO, the data was officially provided, nevertheless there is a lack of information, how such a high increase can be explained. In 2013 the export volume of Indonesian honey reached 2.35 million USD (figure below).[154]

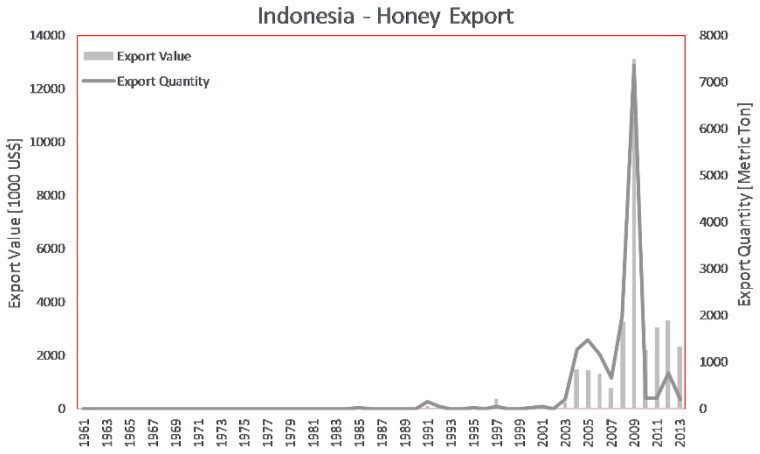

Figure 44 Export data of honey-Indonesia (1961-2013); *Data is based on estimations of the Food and Agriculture Organization of the United Nations (FAO)

Table 7 Export data of honey-Indonesia (2000-2013)

Year	Honey Exported (ton)
2000	32
2004	1270
2008	2000
2012	765
2013	207

*Data is based on estimations of the Food and Agriculture Organization of the United Nations (FAO)

In 2017, the export volume of honey in Indonesia was 370,454 kg with an export value of US$ 1,730,019. Compared to 2016 with export volume of 192,373 kg and export value of US$ 505,026 Indonesia honey export and value have increased. While the import volume in 2017 was 1,635,591 kg with an import value of US$ 5,828,359, have decreased compared to 2016 of 1,499,948 kg with an import value of US$ 5,167,879.[155] Most of the honey exported goes to Singapore with a value of around 63%, other export destination countries are Bangladesh, Malaysia, and United Arab Emirates.[156]

Local honey has lower quality and quantity of production due to the high humidity, and the provision of beekeeping production facilities in the form of colonies of bees, queen bees,

[154] FAO (2018): FAOSTAT database collections. Food and Agriculture Organization of the United Nations. Rome. Access date: 23.04.2018. URL: http://faostat.fao.org

[155] Directorate General of Livestock and Animal Health, Ministry of Agriculture. (2018): Livestock and Animal Health statistics. Jakarta

[156] Honey Indonesia. (2017): URL: https://www.tridge.com/products/honey/ID?q=indonesia%20honey

equipment, and drugs for eradication of pests is still limited.[157] There is less current information on the quality of Indonesian honey, but a study in 1988 revealed high moisture content between 20.7 and 36.3% (22 samples from Sumatran village markets) and adulteration with sucrose (cane sugar, or sugar syrup) in most of the samplings. In addition, some of the investigated honey samples were boiled to evaporate the water for a higher viscosity of the product, which led to a high hydroxymethylfurfural (HMF) content.[158] A not yet published study bei Shouten et al. (in press) describes a mean moisture content of 24%.[159]

According to a local scientist (Yadi, University Padjadjaran, Indonesia), Indonesian beekeepers sell their honey in two different forms, table honey (common honey packed in a glass jar) and honeycomb, called “madu sarang” (honey sold including the whole comb). Selling honeycomb is gaining more attractiveness, as it is used by the beekeepers as a strategy to differentiate pure honey from fake honey, due to the widespread of honey adulteration. In the Focus Group Discussions, it was mentioned that this problem raised in the last five years in Indonesia and caused a decrease in consumer trust in honey products.

Besides, in the Focus Group Discussions, the Indonesian beekeeping potential was mapped – divided into products and services (figure below):

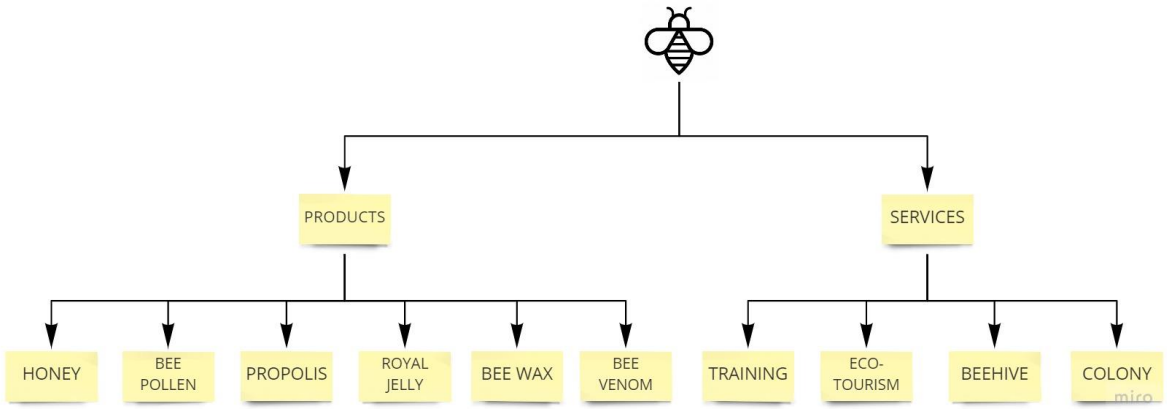

Figure 45 Bee Products in Indonesia

(source: UNPAD Team)

In the FGD it was stated that honey, pollen, propolis and royal jelly can be found easily in grocery stores, mini markets, supermarkets, malls, or herbal shops. Beeswax and bee venom can only be found in particular locations such as herbal shops.

3.2.1.2 Beeswax Production and use

According to the results of the Focus Group Discussions and the results of the market survey, beeswax is not very popular in Indonesia. Most beekeepers in Indonesia do not widely understand beeswax processing technology and beekeepers have not found many markets to sell it. Even so, the beauty industry in Indonesia has begun to use it a lot and some of the small-scale refined products developed by beekeepers include beeswax, e.g. lip balms,

[157] Embassy of the Argentine Republic Indonesia. Natural Honey.

[158] White, J. W., Platt, Jr. J. L., Allen-Wardell, G., & Allen-Wardell, C. (1988): Quality Control for Honey Enterprises in Less-Developed Areas: An Indonesian Example, Bee World, 69(2), 49-62.

[159] Shouten, C. N., Lloyd, D. J., & Lloyd, H. (in press): Beekeeping with the Asian Honey Bee (Apis cerana javana Fabr) in Indonesia. (status: 10.11.2018)

cosmetics, soap, scrubs, crayon dyes, children's toys, packaging, food coatings, furniture, leather lining, honeycombs, insect repellents, handcrafts, and gums (Figure 46).

Besides the beauty industry, the chemical industries are making various types of candles and in the textile industry beeswax is used as ‘malam’ (a clay/ play dough) and for batik. Thus, raw materials are imported from other countries (Figure 47).

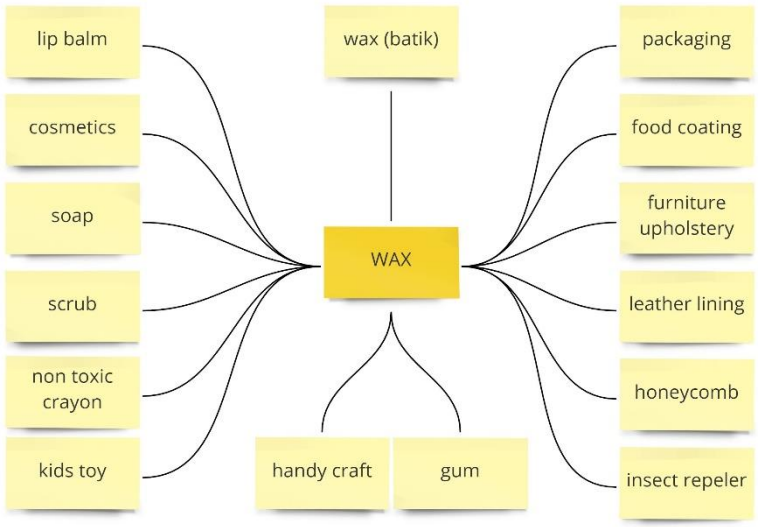

Figure 46 Beeswax and its Products in Indonesia

(source: UNPAD Team)

While the beeswax export quota of 1997 until 2013 are only based on estimations of the FAO, official data is available from 1961 to 1996. There are three major peaks in the years 1965 with 156 t, 1979 with 647 t and 1990 with a total amount of 1009 t. In the remaining years, the total volume of exported beeswax fluctuated. The export volume of Indonesian beeswax reached 401,000 USD in 1979, while the FAO estimated no export of beeswax at all between the years 1997 and 2013 (0 USD).[160]

[160] FAO (2018): FAOSTAT database collections. Food and Agriculture Organization of the United Nations. Rome. Access date: 23.04.2018. URL: http://faostat.fao.org

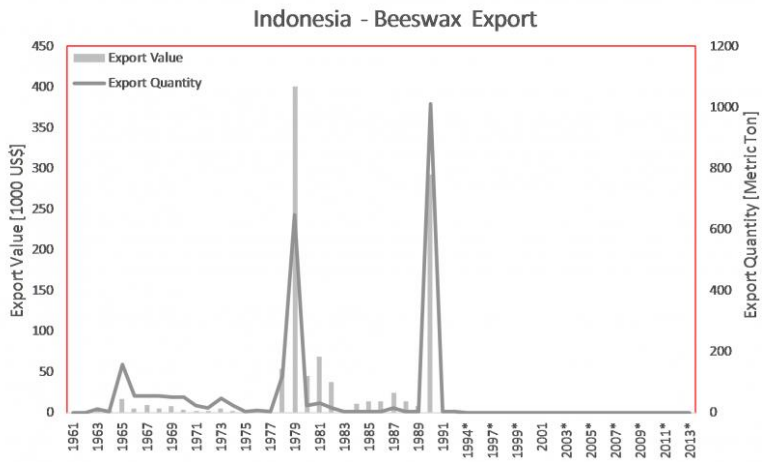

Figure 47 Export data of beeswax-Indonesia (1961-2013); *Data is based on estimations of the Food and Agriculture Organization of the United Nations (FAO)

Table 8 Export data of beeswax-Indonesia (1965-1990)

Year	Beeswax Exported (ton)
1965	156
1979	674
1990	1009

*Data is based on estimations of the Food and Agriculture Organization of the United Nations (FAO)

While the beeswax import quota of 1996 until 2013 is only based on estimations of the FAO, official data was provided from 1961 to 1995. Indonesians' import of beeswax fluctuated between 1961 and 1995, but in general, there is an observable trend of increasing demand on beeswax: 0 t in 1965, 7 t in 1970, 62 t in 1975, 27 t in 1980, 28 t in 1985, 107 t in 1990 and 82 t in 1995, with peaks in 1978 (102 t) and 1990 (107 t).[161] Regarding the import value of beeswax, there is a high variance within years: in the year 1975 Indonesia payed 29,000 USD for a total amount of 62 t of beeswax, while the import value reached 490,000 USD for 82 t in 1995 (figure below).

[161] FAO (2018): FAOSTAT database collections. Food and Agriculture Organization of the United Nations. Rome. Access date: 23.04.2018. URL: http://faostat.fao.org

Figure 48 Import data of beeswax-Indonesia (1961-2013); *Data is based on estimations of the Food and Agriculture Organization of the United Nations (FAO)

Table 9 Import data of beeswax-Indonesia (1965-1995)

Year	Beeswax Imported (ton)
1965	0
1970	7
1975	62
1978	102
1980	27
1985	28
1990	107
1995	82

*Data is based on estimations of the Food and Agriculture Organization of the United Nations (FAO)

3.2.1.3 Pollen

Besides, within the Focus Group Discussions it became clear that honey-bee pollen is becoming known by the public. Its use began to spread and utilized in various industries such as antibiotics, toddler food, supplements, and herbal medicine. However, there is no official data on the pollen business in Indonesia. Beekeepers collect the product with a pollen trap and harvested pollen is divided into two categories: pure pollen, and mixed pollen (mixed with honey, and/or royal jelly). The products are found at online marketplaces as well as in herbal stores. [162] The utilization of bee pollen in Indonesia can be optimized further.

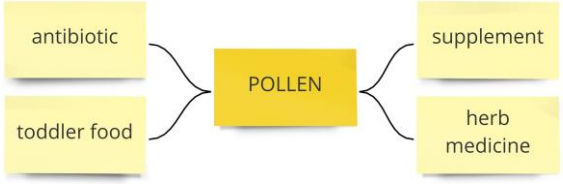

Figure 49 Bee Pollen and its Products in Indonesia (source: UNPAD Team)

[162] Communication with University of Padjadjaran

3.2.1.4 Royal Jelly

Based on interviews with several beekeepers and beekeeping experts, royal jelly has a relatively high level of popularity among seniors. Among young people, this product is not very well known. Royal Jelly, in the 1980s, during the golden era of honey in Indonesia was widely known to the public. Some honey-based product industries use royal jelly as a raw material for cosmetics, Viagra, soap, eye drops, healthy foods, and women's fertility-boosting drink. In the beauty industry, royal jelly is usually used as a cosmetic ingredient because its antioxidative, antibacterial, anti-inflammatory and wound healing effects make royal jelly an ideal component of cosmetics and skin care products.[163]

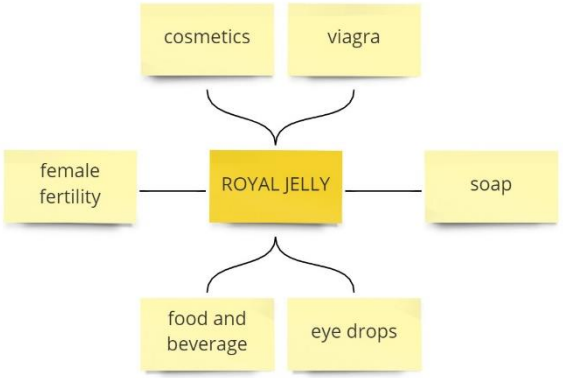

Figure 50 Royal Jelly and its Products in Indonesia

(source: UNPAD Team)

3.2.1.5 Propolis

Propolis market in Indonesia is dominated by Trigona propolis.[164] Propolis can be used as bio coating/edible coating for post-harvest fruits to extend shelf life[165]. Propolis also can be used as medicine. Propolis consumption as tuberculosis therapy by joint consumption with drugs can accelerate patient's recuperation since it contains combination of antioxidant and *alpha D. Glucopyranoside* which exhibit anti-tuberculosis activity (Mahani 2019).[166]

Moreover, propolis categorized by National Agency of Drug and Food Control (BPOM) as traditional/herbal medicine and medical drugs in consideration of its active substances and functions. Thus, propolis cannot be carelessly produced and more strictly regulated compared to honey and bee pollen which categorized as food and traditional medicine.[167]

[163] Pavel, Crenguţa I., et al. (2011): Biological Activities of Royal Jelly - Review. Scientific Papers: Animal Science and Biotechnologies, 2011, 44 (2)

[164] Pertanianku (2016): Produksi Propolis Tinggi Dengan Lebah Trigona. URL: https://www.pertanianku.com/produksi-propolis-tinggi-dengan-lebah-trigona/

[165] Fathurrahman, I and Putra, R.E. (2015): Efficacy of Bee Propolis Trigona sp.as Edible Coating Materials for Post-Harvest Protection of Ambon Lumut Banana (Musa acuminata L.). Agrotechnology Journal. Vol. 10 No.01. URL: https://jurnal.unej.ac.id/index.php/JAGT/article/view/4337

[166] Trobos Livestock (2019): Lebah Madu untuk Masa Depan Pangan dan Kesehatan Manusia. URL: http://troboslivestock.com/detail-berita/2019/09/26/57/12100/lebah-madu-untuk-masa-depan-pangan-dan-kesehatan-manusia

[167] Trobos Livestock (2019): Lebah Madu untuk Masa Depan Pangan dan Kesehatan Manusia. URL: http://troboslivestock.com/detail-berita/2019/09/26/57/12100/lebah-madu-untuk-masa-depan-pangan-dan-kesehatan-manusia

Some expert also stated that they will only conduct propolis production training to a traditional/herbal medicine & medical drugs licensed producer or to beekeeper that has partnership with licenced propolis industry.[168]

Concluded from the Focus Group Discussions and the market survey, propolis currently has a very high popularity. In Indonesia, propolis has been widely developed with various business models. One business model is a Multi-Level Marketing (MLM) sales system. Propolis gets people's attention because it is believed to have excellent properties for health recovery. Some products processed from propolis include eye drops, food, drinks, wound medicine, soap, fertilizer, mouthwash.[169] The growing popularity of propolis in Indonesia has resulted in an increasing number of interested people in raising bees, especially the Trigona species. These results were obtained based on FGD activities with beekeepers, people in the honey business, academics, and bee experts.

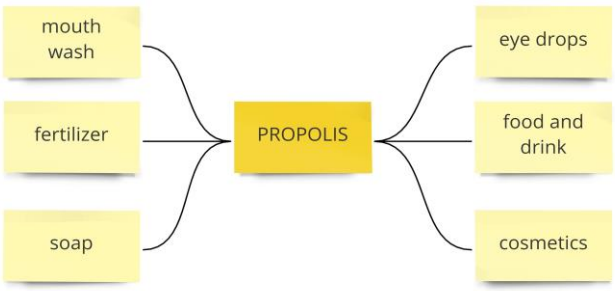

Figure 51 Propolis and its Products in Indonesia

(source: UNPAD Team)

3.2.1.6 Bee Venom

Bee venom is an enzyme with a complex composition, protein and amino acids, transparent liquid, with a sweet and a bitter taste.[170] Used in cosmetics and skin care products it has entered the Indonesian market. There are several local producers that offers skin care products such as Janeeta Bee Venom and Larissa and there are also some imported bee venom skincare products such as Alpha Lipid™ Bee Venom from New Zealand, bee venom series from Nature Republic (Korea), and bee venom age defy series from Safi – a skincare brand from Malaysia that has a factory in Indonesia as well.[171]

[168] Trobos Livestock (2019): Lebah Madu untuk Masa Depan Pangan dan Kesehatan Manusia. URL: http://troboslivestock.com/detail-berita/2019/09/26/57/12100/lebah-madu-untuk-masa-depan-pangan-dan-kesehatan-manusia

[169] Hasan, A. E. Z., Mangunwidjaja, D., Sunarti, T. C., Suparno, O., & Setiyono, A. (2013): Optimasi Ekstraksi Propolis Menggunakan Cara Maserasi Dengan Pelarut Etanol 70% Dan Pemanasan Gelombang Mikro Serta Karakterisasinya Sebagai Bahan Antikanker Payudara. Jurnal Teknologi Industri Pertanian, 23(1), 13-21.

[170] Hutagalung, James S. (2016): Rumah Lebah from Traditional to Modern Medicine. Airlangga University Press. Surabaya

[171] Safi Indonesia. (2019): Rahasia Cantik dan Awet Muda Ada di Bee Venom. URL: https://www.safiindonesia.com/article/read/rahasia-cantik-dan-awet-muda-ada-di-bee-venom

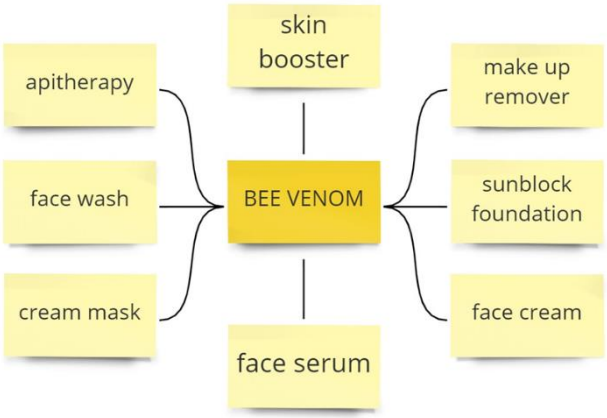

Figure 52 Bee venom and its products

(source: UNPAD Team)

3.2.1.7 Beekeeping Services

In addition to producing and selling honey, few groups of beekeepers have other sources of income from beekeeping, e.g. selling and trading bee colonies, beehive construction as well as maintenance services, honey harvesting training, educational tours for children and family members or pollination activities/ service for various plantations. However, these services are rare and rather potential ones since so far, no official market structure nor official numbers exist. For instance, pollination service is not yet a business, because in Indonesia it is more common that beekeepers pay landowners to get access to flowers, and there is no beehive manufacturing business yet.

Bees also have the ability as a natural biosensor that is often used by beekeepers and bee researchers or environmental researchers as a natural analysis tool used to detect chemicals, which combine biological components with physicochemical detectors.

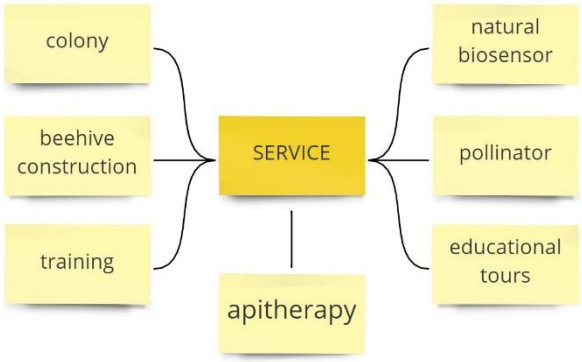

Figure 53 Beekeeping Services in Indonesia

(source: UNPAD Team)

3.2.1.7.1 Colony trading

Beekeepers and beekeeping experts interviewed explained that the sale of bee colonies is one of the activities carried out by some beekeepers in Indonesia, especially by beekeepers who have expertise in breeding colonies. The sale of these colonies is usually done in a package

with beehive sales. The strength or number of bees from the colony sold usually determines the price of the colony.

Based on observation, when a bee colony transaction has taken place, usually the process of moving the bee colony to the location is done at night. This is done to ensure that the whole colony returned to the hive. All holes in the beehive will be closed to prevent bees from coming out during the trip. Then the transfer is done carefully not to disturb and create stress to the bee colony. If the trip takes a long time, usually the colony is given forage.

Based on interviews, one of the reasons beekeepers buy bee colonies is the beekeeper's urgent need for bee colonies when the flowering season suddenly starts. The purchase of colonies is usually made by new beekeepers who are still unable to do bee colony reproduction. Thus, in Indonesia, the sale of bee colonies and beehives is always seen as a source of income for beekeepers.

3.2.1.7.2 Pollination

Bee pollination in Indonesia is still very rarely found in Indonesia because in general beekeepers must pay landowners to get access to flowers. This makes the pollination service business not yet an existing business, but a potential business that can be developed as a source of income for beekeepers in the future when the awareness of landowners of the importance of bees' pollination raises.

3.2.1.7.3 Beehive constructions

Most beekeepers construct their own hives of various, simple and locally available materials, for example, hollowed logs, mud pots, bamboo pits, coconut shells, wooden boxes, or pottery vessels[172] because there is no officially standardized size for beehives or research on what hive types best fit the two different *Apis* species in Indonesia. Nevertheless, the national State Forest Own Company (PERHUTANI) provides its own hive type for *Apis cerana* colonies and a large number of beekeepers try to copy the PERHUTANI bee hive-size for their own constructions.[173]

Besides making their own beehives, beekeepers also usually buy beehives from other beekeepers. Aside from being a form of business, the reason for beekeepers selling beehives is because the number of beehives exceeds the number of colonies owned due to various reasons, one of them is because of the death of bee colonies. Sales of beehives usually accompany colony sales. This activity can be carried out by beekeepers on a regional scale or by national scale beekeeping, such as the "Honey Scout" beekeeping, as stated on its website.

3.2.1.7.4 Training

Beekeeping training in Indonesia is not only carried out by the government but also by beekeeping organizations/companies and beekeepers. In addition to increasing the capacity of beekeepers, training is also conducted for new beekeepers who need knowledge in beekeeping. Some of organizations that conduct beekeeping trainings are Madu Bina Apiari

[172] Gupta, R. K., Reybroeck, W., van Veen, J. W., & Gupta, A. (2014): Beekeeping for Poverty Alleviation and Livelihood Security: Vol. 1: Technological Aspects of Beekeeping. Dordrecht, Springer Netherlands.
[173] Perhutani. (1992): Petunjuk Praktis Budidaya Lebah Madu (*Apis Cerana*). Jakarta.

(https://madubinaapiari.co.id/), Madu Pramuka (https://madupramuka.co.id/), ILMI (Ikatan Lebah Madu Indonesia/Indonesian Honey bee Association), etc.

3.2.1.7.5 Educational tour

The education tour is one of the incomes that bee farmers receive from their beekeeping business. Not only carried out by beekeepers (individuals or companies or groups) but also carried out by government agencies that have involvement in beekeeping (e.g. Balai Litbang Teknologi Serat Tanaman Hutan (BP2TSTH) Kuok). The types of bees used in educational tours are usually *Apis cerana*, *Apis mellifera*, and *Trigona*.

3.2.1.8 Beekeepers' key revenues

The results of the focus group discussion also showed which products give the highest income for beekeepers in Indonesia. The beekeepers' key revenues were then compared to the popularity of honey products from consumers perspective. This data illustrates that there are potential market development gaps as described below.

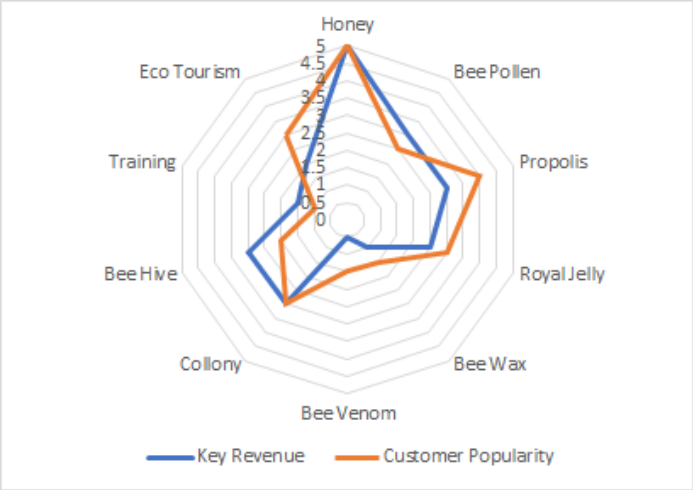

Figure 54 Honey Products Popularity Vs Beekeepers Revenue Sources in Indonesia

(source: UNPAD team)

In Figure 54, there are some gaps in the ability of beekeepers to develop popular markets for the customers. This graphic shows other key revenues beside honey; such as propolis and royal jelly which have high popularity for customers and therefore strong potential as additional income. On the contrary to this potential, there is a gap between the production capacity and product demand. Based on interviews with beekeepers and surveys, some bee products that are well-known in the community are not necessarily followed up as potential revenue for beekeepers. This is also related to the low mastery of bee product management skills, and good business model mastery. The problem is still pretty much focused on honey production rather than other products.

The results of the Focus Group Discussions with beekeeping experts, beekeepers, academics, researchers, the government, and AB members showed that honey and other bee products on the domestic market are often used to produce further products, e.g. beverage, animal feed, snack food, honey powder, body care, cosmetics, fertilizer and health products, and can also increase the added value of honey bee products.

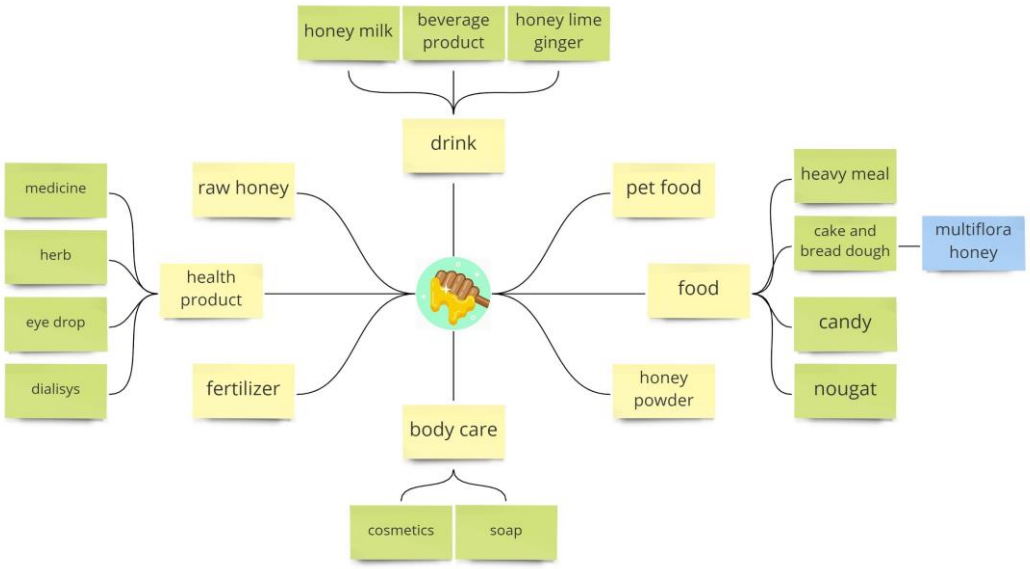

Figure 55 Honey Related Products

3.2.1.9 Honey Supply Chain and Actors

Indonesian consumers recognize honey as a product ready-for-consumption and as an additional ingredient in food and drinks, or body and skin care products. The fulfillment of honey consumers' needs or demands depends on the availability of honey on the market. Therefore, a supply chain scheme of honey products is needed to bridging consumer demand and the relationship between honey businesses in the marketing system. Research related to the supply chain has been conducted through interviews with beekeepers in West Java (Bandung Regency, Bandung City, Sukabumi, Cianjur, Majalengka, Bogor), and some Indonesia beekeepers outside West Java and the honey supply chain structure has been analysed. It became clear that there are several actors in the honey business in Indonesia:

- Honey Hunter: beekeeping actors who work as honey seekers; hunting honey produced by wild bee colonies, mostly from Apis Dorsata bees in the forest; this honey is hunted by residents and sold to consumers or collectors
- Core Beekeeper: do beekeeping activities and provide training to new beekeepers; honey produced by these new beekeepers is usually sold to the core beekeeper; core beekeepers typically provide assistance and venture capital for the beekeeper groups that they form; core beekeepers can also play a role as a companion, trainer, and financier for fostered beekeepers
- Fostered Beekeepers: member beekeepers who are activated, trained, and assisted by core beekeepers and receive training in honey bee farming; usually honey produced is sold to core beekeepers and directly to consumers
- Traditional Beekeepers: individuals or groups who stand independently or have inherited skills/beekeeping business from their parents or ancestors; some traditional beekeepers get capital from investors but do not get assistance to increase the ability in beekeeping, and the honey is sold to investors
- Distributor: person who buys honey from beekeepers or Honey Hunters in large quantities for resale

- Resellers: people who buy honey products from honey beekeepers of distributors, which then resell them to end customers by repackaging it or acting as a sales intermediary
- Investors: people who give capital to/invest in beekeepers to develop their business, and in return beekeepers must sell the produced honey only to them. Investors can be individual investors or business investors
- Industry: company that buys honey from suppliers (beekeepers, distributors, or other honey producers to be processed into honey-derived products or food and beverage additives
- Consumers: people who consume or use honey products

The Indonesian honey supply chain with its different actors – from producers to end-consumers – has been evaluated and described in the research process through interviews with beekeepers, and FGDs with honey experts and stakeholders:

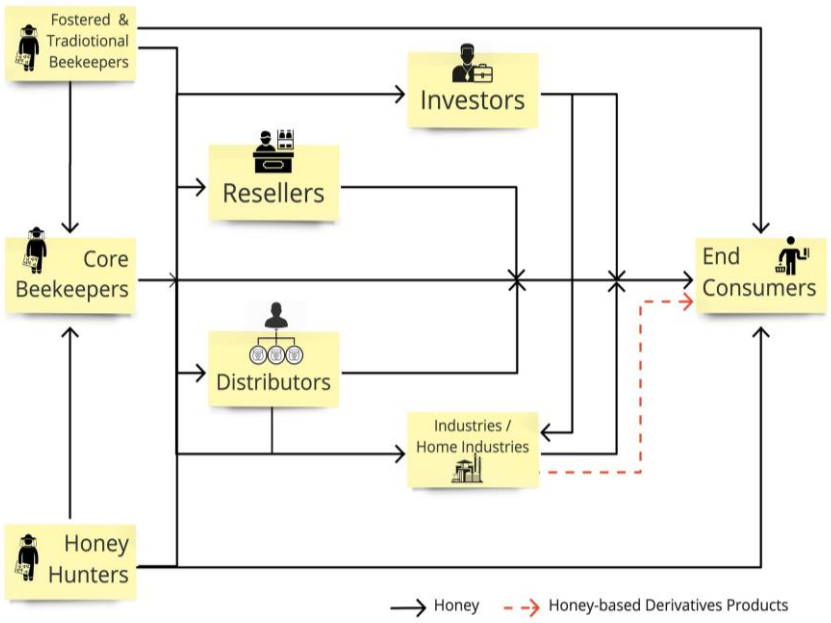

Figure 56 Indonesian Schemes on Honey Supply Chain

(source: UNPAD team)

At a macro level, the honey supply chain in Indonesia is described in Figure 56. The beekeepers consist of three categories (core beekeepers, honey hunters and fostered traditional beekeepers), each beekeeper has a sales channel that has the same opportunity to sell it directly to resellers, distributors, investors, industries, or even straight to consumers. If the supply chain path is through distributors or resellers channels, the honey product will usually be rebranded and resold at a higher price. Nevertheless, honey is also supplied to large industries or home industries. This industry gives added value to honey by processing it. These processed products are then traded to consumers in the market.

On a micro level there are two schemes of local honey supply. The first scheme is divided into two chains. In the first chain, the honey hunter is the primary actor in the honey supply chain. Hunters have an essential role in the honey supply chain because the honey supply in

Indonesia is still mostly derived from forest honey produced by *Apis dorsata* and *Apis cerana*. Honey hunters usually sell their hunted honey to the core beekeeper (or group leader), who sell it to distributors. From them, honey is sold to the food or beverage industry or resellers and finally to the consumers. In the second chain, supply chain fostered beekeepers, who breed honey bees, sell their honey to core beekeepers (or group leaders) who have provided guidance and training. The honey is sold to distributors and then resold to industries or resellers, from which it arrives the end consumer.

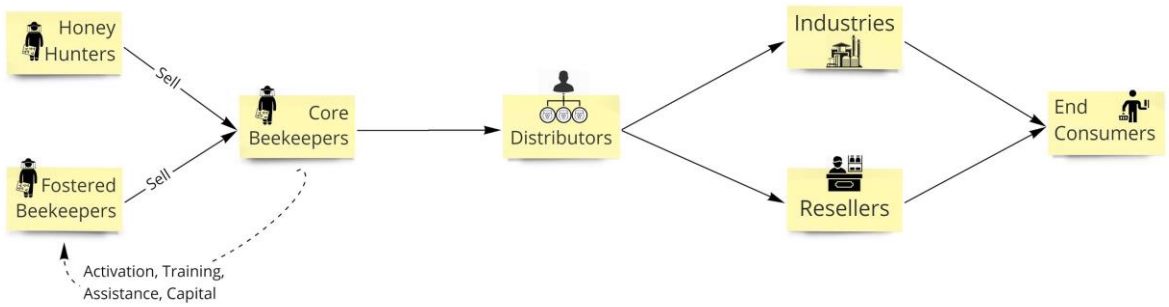

Figure 57 Honey Supply Chain - Scheme I

(source: UNPAD Team)

In the second scheme, investors are involved. Beekeepers sell honey mostly to investors who fund their beekeeping business. Investors usually have their customers or markets to sell honey obtained from beekeepers. In the second supply chain, beekeepers can also sell their honey to resellers and from resellers to end consumers.

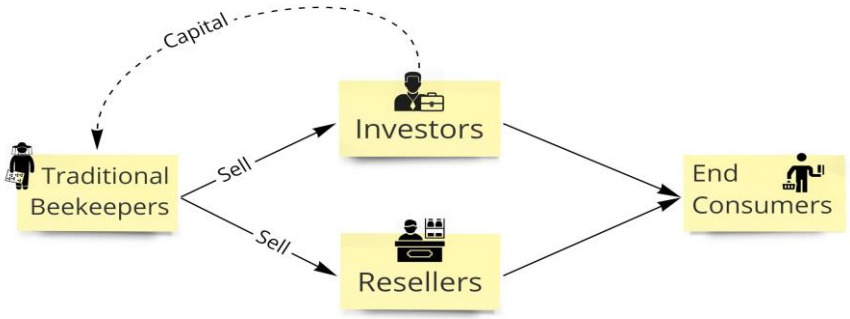

Figure 58 Honey Supply Chain - Scheme II (Investor Involvement)

(source: UNPAD Team)

The actors involved in the supply chain, both from the first and the second scheme, can directly sell their honey to consumers. Usually, they already have their respective customers who are relatives or the community around their neighbourhood. Fostered beekeepers and core beekeepers often use social media (e.g. WhatsApp and Facebook) to sell honey products directly to consumers.

The length of the supply chain can affect the selling price of honey products that reach consumers. The less actors involved in the supply chain the lower the costs to consumers, and the more actors the higher the price.

3.2.2 Technology Industry

Indonesia has committed to build a strong and sturdy manufacturing industry. To revitalize the manufacturing industry Indonesia devoted to accelerating the Fourth Industrial Revolution (4IR) implementation. 4IR covers advanced technology such as artificial intelligence (AI), internet of things (IoT), wearables, robotics, and 3D printing. As per initial step in implementing 4IR, Indonesia focuses on 5 main sectors, i.e. (i) food and beverage, (ii) textile and apparel, (iii) automotive, (iv) chemical and (v) electronics (Figure 58). These sectors were chosen to be the focus subsequent to an evaluation of economic impacts and implementation eligibility criteria that include measures of GDP, trade, potential impacts on other industries, investment size, and speed of market penetration. Indonesia will evaluate the strategy of each sector every three to four year to observe the progress and overcome the challenges of its implementation.[174]

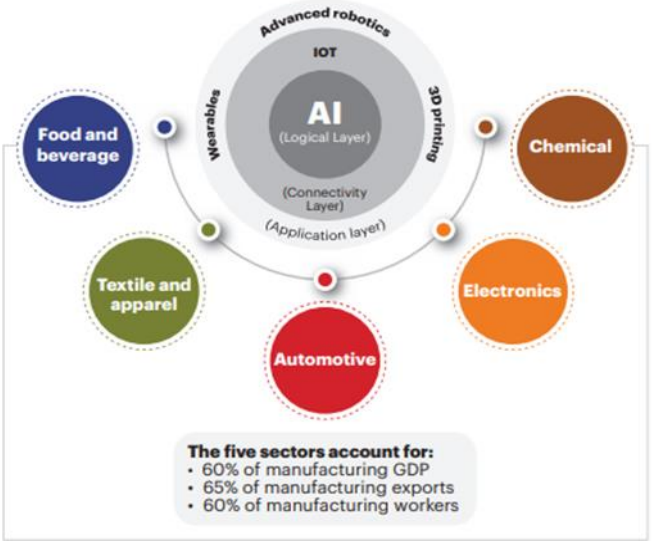

Figure 59 Overview of Technology Industry in Indonesia

The IoT market share in Indonesia is expected to develop rapidly and its value will reach 444 trillion IDR by 2022. The estimated value is contributed from content and applications amounting to 192.1 trillion IDR, followed by platforms with 156.8 trillion IDR, IoT devices with 56 trillion IDR, and network and gateways 39.1 trillion IDR.[175]

In the same period, based on Indonesia IoT Association data, there are likely around 400 million sensor devices to be installed[176], of which 16% are in the manufacturing industry, 15% percent in the health sector, 11% in insurance, 10% in banking and securities, as well as 8% of each retail, wholesale, and computer repair sector. Furthermore, around 7% are in the government, 6% are transportation, 5% are utilities, along with real estate and business services, and agriculture are 4% of each, and the remaining 3% are for housing, etc[177].

[174] Ministry of Industry. URL: https://www.kemenperin.go.id/download/18384

[175] Kemenperin. (2018): Teknologi IoT Solusi Pengembangan Industri Masa Depan. URL: https://www.kemenperin.go.id/artikel/19902/Teknologi-IoT-Solusi-Pengembangan-Industri-Masa-Depan

[176] Asosiasi Internet of Things Indonesia. (2019): Press Release: Penyedia Solusi Internet of Things (IoT) Indonesia Butuhkan Lebih Banyak Makers Lokal Hadapi Permintaan Pasar. URL: http://www.asioti.org/press-release/

[177] Kemenperin. (2018): Teknologi IoT Solusi Pengembangan Industri Masa Depan. URL: https://www.kemenperin.go.id/artikel/19902/Teknologi-IoT-Solusi-Pengembangan-Industri-Masa-Depan

The Indonesian IoT ecosystem has initiate various start-up establishment in IoT field, IoT start-ups in agriculture are i.e.:

- **Calakan*:*** Inspired by the SAMS project and its monitoring system, engaged in the production and development of technology that focuses on developing application-based systems and IoT especially in the field of weather – recently developed an IoT monitoring system for beehives, using local components and components that are easily available in Indonesia. The prototype has been implemented at Bandung Bee Sanctuary and has to be further developed. Other beekeeping IoT monitoring systems do not exist in Indonesia.
- **eFishery**: An automatic fish feeder; this tool not only automates scheduled feeding with the right dosage, but also records every feeding in real time; users can access feeding data anytime and anywhere.[178]
- **Hara**: An IoT product which was developed to solve the agriculture and food problems such as land potential matters, agriculture optimization, as well as prevention of growth of pests and plant diseases; this blockchain-based IoT product's main feature is among smartphone apps for data collection, web-based analytic, and yield prediction accompanied by recommendations for farmers (e.g. what kind of fertilizer that should be used).[179]
- **KerabaTani**: A Trigonal Smart Management Agricultural System-based application which connect Zenbox as the main sensor and apply Ubiquitous Environmental Characteristic System with Cloud Computing and results the output as recommendation about the soil condition such as planting schedule, nutrition supply, detection of bugs infection, and harvest schedule.[180]

The Indonesia's technology industry is dominated by foreign capital holders. Thus, the Indonesian industry depends on imported raw materials and components. The condition of raw materials and core components supply of the electronics industry in Indonesia is still lag behind other countries in ASEAN. In raw materials supply (steel, resin, copper, aluminium, craft), Indonesia is on level 13 which means less competitive compared to Thailand (level 20) and Malaysia (level 16). As for core components supply (compressor, heat exchanger, electronics components, motor, PCB) Indonesia is on level 12.[181] Thus, most of the components e.g. for the SAMS monitoring system are available in Indonesia but must be imported. Few components with a certain brand (WittyPi by UUGear, load cell by Bosche and solar charge controller by Phocos ECO) are unavailable but can also be ordered in international online marketplaces or can be substituted by ones that have the exact/ similar specification.

As IoT and the technology are growing rapidly, the Indonesian market needs more and more technology and electronic components. The Ministry of Industry recorded the high demand for imports and semiconductor goods and other electronic components from 2012-2017.[182] Thus, the government declared to optimize the TKDN (Domestic component level). This policy was

[178] eFishery (2017): About Us. URL: https://www.efishery.com/aboutus.html
[179] Hara (2018): About Us. URL: https://haratoken.io/about_us.html
[180] KerabaTani (2019): About Keraba Tani. URL: http://kerabatani.com/index.php?lang=id
[181] Warta Ekonomi (2018): Mencari Asa Bangun Indusrti Komponen Elektronika. URL: https://www.wartaekonomi.co.id/read172672/mencari-asa-bangun-industri-komponen-elektronika
[182] Kemenperin. (2018): Perkembangan Impor Kelompok Semi Konduktor dan Komponen Elektronik Lainnya. URL: https://kemenperin.go.id/statistik/barang.php?ekspor=&kode=202026002

made to increase domestic manufacturing industry thereby encouraging increased exports activity and is regulated on Minister of Industry Regulation No. 29 of 2017 concerning provisions and procedures for calculating domestic component vevel values for cellular telephone, handheld computer, and tablet computer products.[183] With this regulation, there will be a 'moral' obligation of Foreign Capital Holders to utilize local component products while building them as suppliers that meet industry standards.

4. Competition

This chapter describes competitors of SAMS businesses – honey and bee product related competitors and technology related ones – and their positioning, strengths, and weaknesses.

4.1 Ethiopia

4.1.1 Honey and bee related products

The volume and value of honey exported from about 40 registered companies in Ethiopia[184] was in an increasing trend till 2013 but then it began to decline. There are several reasons for this – continuous honey quality degradation is mainly influenced due to adulteration and fraud and therefore also influences the export of honey. Other challenges are illegal cross border honey trade, the recurrent drought which affects the supply line and increase the price of honey in the local market. Laboratory service costs usually demand foreign currency and continuously increase in price. Currently these factors are affecting the export market negatively.[185] However, honey and other apiculture products (i.e. beeswax, propolis, pollen, royal jelly and bee venom) are among high potential products for export though these materialized yet.

Imported honey is not a major competitor for local honey products. As already mentioned, when asked for preference of local honey vs. imported honey, the survey indicated preference for local honey.

Despite Ethiopia's significant position in the world, the honey sector is faced with many issues. Low production capacity, inconsistent production data, changes in weather patterns and poor hive management are the common challenges.[186]

[183] Kemenperin. (2019): Perkuat Sektor Elektronik Kemenperin Bidik Investasi Industri Semikonduktor. URL: https://kemenperin.go.id/artikel/21084/Perkuat-Sektor-Elektronik,-Kemenperin-Bidik-Investasi-Industri-Semikonduktor

[184] http://www.mot.gov.et/documents/20181/23063/Honey-and-Beewax-Producers-and-Exporters-Association/6679b9e4-99f3-44f8-a7f4-5d5eb31f0ab5

[185] https://www.researchgate.net/publication/331037935_Review_of_Ethiopia's_Global_Position_in_Honey_and_Other_Bee_Products_Production_and_Marketing_Analysisof_Sectoral_Opportunities_and_Limitations

[186] https://static1.squarespace.com/static/57be2f5e893fc0b6f3592200/t/58209844c534a5888d1ad4bf/1478531149930/Final+Report+-+WEEMA+International.pdf

Table 10 Prioritized bottlenecks, Agricultural Commercialization Cluster Strategy | Amhara region [187]

Value Chain Stage	Priority Bottlenecks		Affected Parties
Research, Input supply & distribution	1	Low availability of beekeeping inputs; inadequate bee colony supply and lack of active bee forage development	Smallholder beekeepers, cooperatives, common interest groups, unions, development partners
	2	Ineffective integration of apiculture with natural resource management (NRM) programs	Common interest groups, cooperatives, unions
Commodity Production	3	Weak extension system, including inadequate number of skilled experts and lack of best practice sharing among beekeepers	Smallholder beekeepers, cooperatives, unions
Aggregation & Transport	4	Low incentives for quality due to non-differential pricing, lack of measurement by aggregators	Smallholder beekeepers, cooperatives , unions, buyers
Processing & Value addition	5	Low availability of quality packaging materials	Processors, unions and buyers
Domestic & Export marketing	6	Limited marketing, branding and promotion of bee products at the national and the international level	Processors and unions
Cross cutting	7	Limited financial capacity of common interest groups, primary cooperatives, and unions	Common interest groups, cooperatives and unions
	8	Lack of business and technical skills amongst common interest groups, primary cooperatives and unions	Common interest groups, cooperatives and unions

Despite the identified and prioritized bottlenecks of the Amhara region in the table above, there are some companies dealing with business related to beekeeping and beehive supply. Registered beehive manufacturers are e.g.:

- Apinec workshop,
- Bako Agricultural Engineering Center,
- Wolayita Sodo Rural Technology Center,
- Selam TVET center,
- Federal small and medium technology development Enterprise,
- ETHIO BEEHIVE
- Kekros

Beekeeping input suppliers are, e.g.

- Biotech PLC, Workinesh
- Kebede bee equipment
- Wogelu Endale beekeeping inputs business
- Neway PLC
- Goggle Trading PLC

Bee colony selling is common in most central, North West, North and Eastern parts of the country but there are no companies or legally registered traders selling bee colonies. It is rather a small business by beekeepers who received training on queen bee rearing – they multiply their colonies and sale them to other beekeepers. In north part of the country, there is a market place called Inticho and up to 2000 bee colonies can be sold on the market day (only one day per week).[188]

4.1.2 Technology

The leading organization implementing key agricultural technology is ATA. Some of the key initiatives are the Ethiopian Soil Information System (EthioSIS), the Shallow Ground Water mapping, ATA's National Market Information System, and the 8028-farmer hotline. Whereas,

[187] Agricultural Commercialization Cluster Strategy, Region Amhara, ATA
[188] Interview with HOLETA expert Kibebew Wakjira (2020)

ATA has not introduced digital technology implementation in the apiculture industry in Ethiopia so far. Even the existing agricultural technology initiatives are hampered by several challenges, especially connectivity, the lack of enabling regulations, appropriate finance, and skilled human capital. [189]

Recently, with the support of the SAMS project, the interest to apply digital solutions on beekeeping activities to improve production and predict the harvest raises. Thus, two digital start-ups (Anabi - http://www.anabi.co/ and Kekros - http://www.kekros-ethiopia.com/) started to develop monitoring systems in the last two years. These start-ups are in early stage and not operational in the market. Anabi uses sensors and cloud data warehouse to monitor the beehives and send feedback with communication devices to the beekeeper. Kekros uses sensors and locally installed unit to give alerts for the beekeepers on the apiary site. Both start-ups use imported hardware technologies for their service provision, since they are start-ups, they do not have mechanism to import hardware components in large quantity at this time.

4.2 Indonesia

4.2.1 Honey and bee related products

In Indonesia, one competitor for natural honey is artificial honey. It can be classified into three modes (Saepudin R, 2014)[190]: amount forgery (by adding other ingredients, such as fructose, savings, syrup and thickening ingredients), quality forgery (by modifying the water content; thus this honey often has a very high-water content, about 22% - 30%) and complete forgery (by making ingredients that resemble honey and does not contain pure honey). [191]

All three modes are considered as fake honey. The issue of fake honey has spread in the Indonesian society in the past five years according to Focus Group Discussions with experts. Fake honey is produced by beekeepers/ SME (mostly home-industries) because of the growing demand for honey. Some other things that are considered in, the Focus Group Discussions as the cause of the rise of fake honey are that there is no official honey certification and no proper label information (honey is traded in the name of its raw material, not its origin), that there are several new honey consumers who lack of knowledge about honey quality and that honey selling has a high value. However, selling fake honey is prohibited and honey according to the Indonesian National Standard (SNI) 01-3545-2004 is defined as a natural liquid that generally has a sweet taste produced by honey bees from floral nectar or other parts of plants (extra floral nectar) or insect excretion.[192] The strength of fake honey is that it is cheaper (approximately 100,000 IDR (6,2 EUR) for 1 litre fake honey).[193] The weakness is that it is not well accepted by consumers – the effect is that consumer confidence in the authenticity of honey has declined. The consumers' confidence is also affected by the lack of regulations by government institutions in Indonesia that can be guarantors and determinants of quality.

[189] Digital Transformation Strategy, MInT 2020
[190] Saepudin, R., Sutriyono and Saputra, R.O. Kualitas Madu yang Beredar Di Kota Bengkulu Berdasarkan Penilaian Konsumen dan Uji Secara Empirik. Jurnal Sain Peternakan Indonesia Vol. 9, No 1. Januari – Juni 2014
[191] Feronica, Inessya. Kajian Kemurnian Madu Komersial Di Kota Bogor Dengan Menggunakan Berbagai Metode Pengujian (2012): Departemen Ilmu Produksi Dan Teknologi Peternakan Fakultas Peternakan Institut Pertanian Bogor
[192] BSN (2004): Standar Nasional Indonesia Madu SNI 01-3545-2004.
[193] Banjarmasin Post (2019): Polis Berau Tangkap Pengooplos Madu, Amankan Ratusan Liter Madu Palsu. URL: https://banjarmasin.tribunnews.com/2019/10/28/polres-berau-tangkap-pengooplos-madu-amankan-ratusan-liter-madu-palsu?page=2

There only exists the Indonesian constitution number 8 of 1999 concerning consumer protection and constitution number 18 of 2012 concerning food.

There are several companies producing honey products, one of the market leaders is PT Madu Pramuka (https://madupramuka.co.id/). The strength of PT Madu Pramuka is that it is well-known as one of the modern bee-centres in Indonesia, which was established by the central government in the 1970s. Another strength is availability of raw materials, various certified pure honey products ranging in size and type of honey as well as non-honey products such as trainings and tourism services. While the weaknesses are non-optimal product management and marketing (website, promotion), products quality (not tested periodically and honey water content is quite high) and the equipment used is still simple. Other honey product producing companies are listed below:

Table 11 Honey Producer in Indonesia

Name	Bee Products						Export
	Honey	Bee Pollen	Propolis	Royal Jelly	Bees Wax	Bee Venom	
Madu Pramuka, PT	x	x	x				
Madu Murni Nusantara, PT	x						
Madu Bina Apiari	x	x	x	x			
Ultra Sakti, PT (Madu TJ)	x	x (mixed with honey & royal jelly)		x (mixed with honey & royal jelly)			
Madurasa Unggulan Nusantara, PT	x	x (mixed with honey & royal jelly)		x (mixed with honey & royal jelly)			x (Asia, Afrika, Middle East)
Madu Perhutani	x						
Kembang Joyo Sriwijaya, PT	x	x	x	x			
Beema Honey	x	x	x				x

*Data based on their website

Imports of honey can also be considered as competitor within the Indonesian market. Importing companies are:

Table 12 Honey Importer and Exporter in Indonesia

Name	Location	Import of Honey	Distributor of Honey	Producer of bee related products

Elang Biru Indonesia, PT http://elangbiru.co.id	Jakarta, Business Line	X	X	
Fermanto Bevfoods, CV www.fermantobevfoods.co.id	Jakarta, Business Line	X	X	X (Honey and other food & beverage)
Gautama Indah Perkasa, PT www.gautamaip.com	North Jakarta, Business Line	X	X	
Interfood Sukses Jasindo, PT www.interfood.co.id	Jakarta, Business Line	X	X	
Kartikawira Adisukses, PT www.kartikawira.com	West Jakarta, Business Line	X	X	
Mitra Bersaudara, PT www.mitrabersaudara.com	East Jakarta, Business Line	X	X	
Nirwana Lestari, PT www.nirwanalestari.com	West Java, Business Line	X	X	
Pandurasa Kharisma, PT www.pandurasa.co.id	North Jakarta, Business Line	X	X	
Safarindo Internusa, PT www.safarindo.com	South Jakarta, Product	X	X	
Sukanda Djaya, PT www.sukandadjaya.com	Bekasi, Business Line	X	X	
Epicure Boga Prima, PT	Jakarta, Business Line		X	
Harmoni Dinamika Indonesia	Jakarta,	X	X	X (beauty product, personal health care,)
Vita Shopindo, PT	West Jakarta	X	X	

Some imported honey types are not originally available in Indonesia since they come from a type of plant that does not exist in Indonesia (e.g. manuka honey, dates honey, clover honey, etc.) and some of them have a good antibacterial activity towards some bacteria e.g. salmonella typhimurium, Escherichia coli and pseudomonas aeruginosa[194] - for instance,

[194] Astrini, D., Wibowo, M. S., & Nugrahani, I. (2014): Aktivitas Antibakteri Madu Pahit Terhadap Bakteri Gram Negatif dan Gram Positif Serta Potensinya Dibandingkan Terhadap Antibiotik Kloramfenikol, Oksitetrasiklin dan Gentamisin. Acta Pharmaceutica Indonesia, 39(3 & 4), 75-83. URL: http://journals.itb.ac.id/index.php/acta/article/download/5252/2789

manuka honey can be used as antibacterial since it contains methylglyoxal.[195] Besides, based on interviews with some consumers they perceive imported honey is safer from honey counterfeiting. However, local honey is found to provide healing effects that are faster than imported honey[196] and according to the market survey local honey is preferred by honey consumers (see chapter 2.2).

4.2.2 Technology

Regarding businesses referring to the SAMS technology, there are almost no competitors in Indonesia. There is only the start-up Calakan who recently started to build an IoT monitoring system for beehives inspired by the SAMS technology (see also chapter 3.2). The prototype of the IoT monitoring system has been implemented at Bandung Bee Sanctuary but needs to be further elaborated. The start-up is not specialized on the beekeeping sector and on smart bee monitoring but on IT in general – it is a technology production house, specialized in research and innovation in information technology that focuses on developing systems (web, mobile & API) and emerging technologies (Internet of Things, big data, etc.)

Another existing Indonesian start-up with a similar technology concept and similar products but engaged in the agriculture sector is KerabaTani. Products of KerabiTani are data utilization for observing soil conditions, planting schedule, pest management, and harvest schedule. KerabiTani is also not specialized in the beekeeping sector.

Nevertheless, on the global market there are several market-ready IoT monitoring systems. Each of them has its own strength and weaknesses. Some of the start-ups specialized in smart bee monitoring system offer their services globally while others offer only domestic services. Some of these start-ups are:

- IoBee (Spain, Europe) https://io-bee.eu/
- Osbeehive (BuzzBox) (USA) https://www.osbeehives.com/
- BeeSensing (Japan) http://bee-sensing.com/eng/

The strength of *IoBee* is that it offers an integration system between beekeepers and a beekeeping representative association. EU countries using this system can share their data at a transnational level between themselves and the European Food Safety Authority (EFSA), other authorities (e.g. EEA), and professional networks (e.g. Bee2Bees and COLOSS), establishing the first EU Bee Health surveillance network. However, this service is suitable only for EU countries. It won't be useful for the Indonesian market and is not recommended to enter it.[197]

Osbeehive (BuzzBox) offers a complete service worldwide (199 USD compared to SAMS system with a price for Indonesia of about 285 USD/ 250 EUR). It is available open source consisting of files of Osbeehive kits to be built by anyone and anywhere with the concept 'Pay

[195] Arumsari, Anggi. Uji Aktivitas Antibakteri Beberapa Jenis Madu Terhadap Pseudomonas Aeruginosa Dan Staphylococcus Aureus Dengan Metode Difusi Agar. Jurnal Ilmiah Farmasi Farmasyifa Volume 2 No 1 page 26 – 32. URL: https://ejournal.unisba.ac.id/index.php/Farmasyifa/article/download/Anggi%20Arumsari%2C%20Diar%20Herawati%2C%20Muhammad%20Afrizal/pdf

[196] Mustafa, Nikita Tenritojang (2019): Perbandingan Pemberian Madu Lokal Bunga Cengkeh (Syzygium aromaticum) dan Madu Impor Bunga Manuka (Leptospermum scoparium) Secara Topikal Terhadap Penyembuhan Luka Sayat Pada Mencit Putih (Mus musculus). Jurnal Pharmascience. Vol 6, No 2. Page. 25-32. URL: http://garuda.ristekbrin.go.id/documents/detail/1212779

[197] IoBee (2018): How IoBee Works. URL: https://io-bee.eu/

what you want' – that means it is available even with no cost at all. Moreover, beekeepers are connected globally and can interact with each other. The database is also connected globally. The system is suitable for English-literate beekeepers and English-speaking countries. Since Indonesian beekeepers are dominated by senior beekeepers who mostly do not understand English this system is not suitable for the Indonesian market.[198]

BeeSensing is only offered domestically in Japan. Although, the tracing of honey through smart bee monitoring system is the strength of it. Bee Sensing informs the honey customers about e.g. who produced the honey, when and what flowers were around the apiary.[199]

As there is no IoT technology implemented for bee colonies in Indonesia[200] and globally offered monitoring systems can be suitable only when available in Bahasa Indonesia and adjusted to the Indonesia beekeeping system, conditions and action.

The SAMS system is seen as a pioneer.

5. Pricing and forecast

To determine the position of the SAMS business opportunities in the market and the portion of the market the business might get, this chapter provides information about pricing and forecast. On the one hand prices for honey and other bee products, and on the other hand prices for beekeeping technology are named. Forecasts are also given for honey and bee products as well as the technology aspect of SAMS.

5.1 Ethiopia

As most imported products in Ethiopia, electronics are expensive. This includes all essential components for the SAMS system. The foreign currency shortage has led to long delays in accessing foreign currency to import materials and services and businesses do not always receive their full foreign currency request. Delays are expected to be between 4-12 months for essential imports and up to 3 years for non-essential imports.[201]

5.1.1 Honey and bee related products

Pricing

In 2015, the average honey and colony prices were 131 Ethiopian Birr (ETB)/kg (6.34 USD) and 667 ETB/colony (32.28 USD), respectively.[202] According to a local scientist (Holeta Bee Research Center, Ethiopia), the prices increased (2018) to 260 ETB/kg (9.45 USD) for honey

[198] Osbeehive (BuzzBox): Osbeehive Official Website. URL: https://www.osbeehives.com/
[199] BeeSensing: Bee Sensing Official Website. URL: http://bee-sensing.com/eng/
[200] Kemenperin (2016): Perkembangan Impor Kelompok Semi Konduktor dan Komponen Elektronik Lainnya. URL: https://kemenperin.go.id/statistik/barang.php?ekspor=&kode=202026002.
[201]https://assets.publishing.service.gov.uk/media/5c90aa9240f0b633fc95f6d4/BERF_Ethiopia_Foreign_Exchange_for_Businesses_.pdf
[202] Yetimwork, G., Berhan, T., & Desalegn, B. (2015): Honeybee production trend, potential and constraints in Eastern Zone of Tigray, Ethiopia. Agriculture and Biology Journal of North America, 6(1), 22-29.

and to 1,200 to 1,500 ETB (43.64 USD to 54.55 USD) for new colonies. The price for 1 kg of purified beeswax was 250-300 ETB (25-30 USD) in 2014.[203]

Nevertheless, honey prices differ by region and type of honey. The most expensive is Eastern Tigray's white honey, where the current retail price is 4.7 Euro/ kg (174.84ETB, 5.15USD). Lower retail prices are around 1.5 – 2.50 Euro/kg (55.80 - 93 ETB, 1.64 - 2.74USD), red honey is also sold at retail prices of around 1.5 – 2.50 Euro/ kg.[204]

Honey adulteration: in the urban market it is common to find adulterated honey usually with sugar. The market value of honey in the urban area is much higher than the honey production places in the rural area. The honey market supply chain is not organized to cope with the honey demand in the urban market. This gives opportunity for illegal honey merchants to mix other substances with honey and sell it on the market as normal honey. This impacts the honey consumers trust negatively and decries the interest to buy honey from the market.

Beeswax is another valuable by-product of beekeeping that serves beekeepers as a source of income. It does not require careful packaging, is easy to store and transport. The market value of beeswax is around 8.06 Euro (300 ETB, 8.83USD). *Tej* has a market value of 50ETB/liter in the rural area and 150ETB - 200ETB/liter in the urban area.

Other beekeeping products have high price different ranges and the price itself is heavily influenced by the product type. As there exists neither a classical pollen business in Ethiopia nor a business for propolis[205], no official data about pricing is available. Modern beehive costs 30-40 Euro, a transitional one 5-8 Euro and a traditional beehive 0-1 Euro.[206]

In summary, the domestic price for honey at different market points is higher than the export price, indicating the impact of domestic honey marketing on export marketing.[207]

Forecast

Domestic honey consumption is increasing due to the highly increasing demand for *tej*. In most urban areas, consumption of processed table honey increased that results in higher honey demand in the local industries.[208]

A high portion of the honey is sold for income generation. The domestic honey market starts at the smallholder bee keeper's level, who majorly sells crude honey to collectors in the nearest town/village markets. Beekeepers of the country sell the largest proportion of their honey during harvest at low price mainly to meet their demand for cash to pay taxes, debts and other is also governed by different factors such as distance from the market (28%), quality of honey (25%), consumers 'preference (20%), the color of honey (15%,), and the test of honey (12%).

Ethiopia's love for honey is unlikely to change, and the demand is likely to increase as global population grows and purchasing power increases. If the country is going to increase its export

[203] Gemechis, L. Y. (2014): Beeswax production and marketing in Ethiopia: Challenges in value chain. Agriculture, Forestry and Fisheries, 3(6), 447-451.

[204] https://www.researchgate.net/publication/330111227_Status_of_Beekeeping_in_Ethiopia-_A_Review
[205] Communication with the Holeta Bee Research Center (2019)
[206] https://www.researchgate.net/publication/330111227_Status_of_Beekeeping_in_Ethiopia-_A_Review
[207] https://www.tandfonline.com/doi/pdf/10.1080/23311932.2019.1620153
[208] https://www.researchgate.net/publication/330111227_Status_of_Beekeeping_in_Ethiopia-_A_Review

earnings, the nature of production will have to change[209]. As *tej* accounts 70% of the current domestic honey consumption, and as modern "tej bars" increasingly becoming common in urban areas, it is likely that the demand of *tej* will increase in parallel.

However, beekeeping expansion has been showing low growth due to some constraints such as improper harvesting, bee diseases, pests and predators, poisoning due to agro-chemicals and deforestation etc.[210] But as the Ministry of Agriculture (MoA 2013) also recognized the unused potential of the apiculture sector, which could boost Ethiopia to become one of the main honey producers in the world and lead to a better main income for farmers and beekeepers, the MoA identified specific targets, e.g. increase annual honey and beeswax production, increase the annual honey and beeswax export, they want to achieve by 2025.[211]

Forecast about beeswax and other bee products are not available.

5.1.2 Technology

Pricing

The current price for the SAMS device in Ethiopia is above 100 EUR (3,870 ETB); most beekeepers are not able to afford the system without financial support instruments (e.g. loans from MFIs, Pay-as-you-go systems).

Forecast

Interviewed beekeepers express their interest in digital tools supporting them to collect useful data and tackle problems on beekeeping activities like identifying bee disease, record and predict harvest frequency, record colony transfer events and information about the diversity of flora distribution on a season. Beekeepers in our recent interview report that on average 15% of the colonies will fail by various factors (e.g. swarming) but beekeepers believe with proper swarm control mechanisms and keeping the health of bees a reduction is possible (see also chapter 2.1).

5.2 Indonesia

Official data on prices do not exist in Indonesia but the demand of honey increases year by year. The demand for beekeeping technology has also been identified through the survey.

5.2.1 Honey and bee related products

Official prices for honey and bee products do not exist in Indonesia but the price for honey depends on the location, type of honey, availability of certification and packaging.

Pricing

Indonesia does not have an official price for honey products or other beekeeping products, because there is no government regulation. However, based on interviews conducted by local

[209] https://gro-intelligence.com/insights/articles/ethiopian-honey
[210] https://www.researchgate.net/publication/330111227_Status_of_Beekeeping_in_Ethiopia-_A_Review
[211] Ministry of Agriculture (2013): Apiculture value chain vision and strategy for Ethiopia, International Livestock Research Institute, Addis Ababa, ISBN: 92–9146–410–4

researchers (University Padjadjaran, Indonesia), the price for 1 kg of table honey is around 120,000 – 200,000 IDR (8.52 - 14.20 USD in 2018; 7.5 - 12.11 Euro in 2020).[212] Four Indonesian islands were questioned, revealed high regional prize differences and high fluctuations of prizes at the same location. In Nusa Penida for example, the beekeeper gets up to 500,000 IDR (35 USD in 2015) for a 750 ml glass bottle of honey. This price can range from 400,000 to 1,2 million IDR. These fluctuations are based on the availability of honey. In remote areas throughout Java and Sumbawa, beekeepers have not only difficulties to sell their honey, they also get lower prizes, usually not more than 70,000 IDR/kg (4.80 USD in 2018; 4.31 Euro in 2020.[213] Despite of fluctuating honey price in some region, based on observation from marketplaces and retail stores, honey in the market relatively sold at stable price. Based on interviews and surveys with beekeepers, the selling price of honey varies depending on the type of honey following below:

Table 13 Price of type of honey in 1 kg[214]

Honey Type	Price (IDR)	Price (Euro)
Forest	~132,000	~8.25
Multiflora	~120,000	~7.50
Calliandra	~180,000	~11.25
Kapok	~155,000	~9.69
Longan	~190,000	~11.87
Rambutan	~175,000	~10.94
Rubber	~165,000	~10.31

Honey consumers are willing to pay around 30% higher price than the average market price per kilogram of Fruska Gora lime honey, which has a good quality and is certified.[215] The price also depends on the packaging size (volume) and packaging material used. The table below describes the range of sizes, material and prices based on interviews with beekeepers.

Table 14 Size, Material and Price Range of Honey

Volume	Packaging Material	Packaging Form	Prices (IDR)	Prices (Euro)
100 ml	Plastic	Bottle	20,000 – 46,000	1.25 - 2.9
100 ml	Glass	Bottle	35,000 – 50,000	2.2 - 3.12
250 ml	Glass, Plastic	Jar, Bottle	50,000 – 90,000	3.12 - 5.6
600 ml or 650 ml	Glass, Plastic	Bottle	100,000 – 190,000	6.25 - 11.87
1 litre	Plastic	Jerry cans	180,000 – 250,000	11.25 - 15,6
1 kg	Plastic	Jerry cans	120,000 – 200,000	7.5 - 12.11

(Source: Interview with beekeepers and marketplace observation)

* There are different types of honey that affect prices

The most favourite market size of 250 ml (see chapter 2.2) using glass or plastic bottles with a price range of 50,000 IDR to 90,000 IDR (3.12 - 5.6 Euro). Artificial honey produced by the industry (mostly home industries) is cheaper than pure honey (see chapter 4.2).

[212] SAMS wiki (2018): Prizes. URL: https://wiki.sams-project.eu/index.php/Prizes#cite_note-1
[213] Shouten, C. N., Lloyd, D. J., & Lloyd H. (2019): Beekeeping with the Asian Honey Bee (*Apis cerana javana* Fabr) in Indonesia.
[214] Madu Pramuka (2020): URL: https://madupramuka.co.id/shop/ (accessed on May 18, 2020)
[215] Ciric, Maja, Svetlana Ignjatijevic, and Drago Cvijanovic (2015): "Research of Honey Consumers' Behavior in Province of Vojvodina." *Ekonomika poljoprivrede*62(3): 627–44

Besides, the length of the supply chain can affect the selling price of honey and other bee products. The less actors involved in the supply chain the lower the costs to consumers and the more actors involved the higher the price. In addition to honey product information, there are also information about beekeeping products and services as follows.

Table 15 Other Bee Products and Services

Bee Products / Services	Size / Volume	Form / Packaging / Information	Prices (IDR)
Bee Pollen	1 kg	granule	150,000 – 200,000
	50 capsules	capsule	50,000 – 80,000
Propolis	100 ml	liquid	45,000 – 100,000
Beeswax	1 kg	block	~250,000
Bee Venom			Not available
Bee colony	1 colony	Apis mellifera	1,000,000 – 1,500,000
	1 colony	Apis cerana	500,000 – 1,000,000
Beehive construction	1 beehive	Apis mellifera	350,000 – 750,000
		Apis cerana	500,000 – 1,000,000
Edu-tourism	1 person (min. 30 students)	Students only	~ 20,000

(Source: Interview with beekeepers, SAMSwiki, marketplace observation)

Forecast

The local production of honey is not enough to meet Indonesia's demand. The consumption is increasing year by year due to the raising awareness to consume honey as a supplement apart from as medicine. Besides, the upper middle-class population is growing (about 134 million people that means 56,5% of population) and they are interested in a healthy lifestyle. Thus, the demand for natural products – one of them is natural honey – increases and will further do.[216] The honey consumption per person per year with 15 g was very low[217] but the raising public awareness of healthy lifestyles increases the demand for honey from 10-15 grams to 15-20 grams per capita.[218]

Other bee products such as propolis, royal jelly and bee pollen which are considered as top three popular bee products beside honey (based on market survey results) have relatively good market potential as their benefits becomes known.

[216] Embassy of the Argentine Republic Indonesia (2014): Natural Honey. Market Review.
[217] Widiatmaka, W., Wiwin, A., Chandrasa, E. S., & Lailan, S. (2006): Geographic Information System and Analytical Hierarchy Process For Land Use Planning of Beekeeping in Forest Margin of Bogor Regency, Indonesia. Jurnal Silvikultur Tropika, 7(3), 50-57.
[218] Kurniawan AT, Pahlevi A. Rafiq A. (2015): Permintaan Meroket, Petani Madu Pakai Cairan Gula. in Disa, Arsy Annasla, Rita Nurmalina, dan M. Faiz Syuaib. Analysis of Business Model Development of Honey Products Using Business Model Canvas Approach. URL:

Propolis market in Indonesia is dominated by Trigona propolis.[219] Propolis can be used as bio coating/edible coating for post-harvest fruits to extend shelf life.[220] Propolis also can be used as medicine. Propolis consumption as tuberculosis therapy by joint consumption with drugs can accelerate patient's recuperation since it contains combination of antioxidant and *alpha D. Glucopyranoside* which exhibit anti-tuberculosis activity (Mahani, 2019).[221]

Moreover, propolis categorized by National Agency of Drug and Food Control (BPOM) as traditional/herbal medicine and medical drugs in consideration of its active substances and functions. Thus, propolis cannot be carelessly produced and more strictly regulated compared to honey and bee pollen which categorized as food and traditional medicine.[222]

Some expert also stated that they will only conduct propolis production training to a traditional/herbal medicine & medical drugs licensed producer or to beekeeper that has partnership with licenced propolis industry.[223]

Propolis industry in Indonesia is dominated by PT. Melia Sehat Sejahtera with 'Melia Propolis' brand. They offer 6 mL, 30 mL and 55 mL propolis. According to their employee, Melia Propolis is counterfeited by irresponsible parties, but they have a strict regulation in selling their product. They only sell the products directly to the customer and has registered number for every product sold. The propolis used by PT. Melia Sehat Sejahtera is imported, this indicate local propolis producers have rather less market. Beekeepers needs to be encouraged and trained about propolis production and regulation to broaden local propolis market.

Producing royal jelly and bee pollen as additional revenue stream for beekeepers are more preferable since categorized as food and traditional medicine. Beekeepers also can easily start a business on royal jelly and bee pollen compared to propolis.

Currently, the pollination service is not a source of income for beekeepers. Due to the current condition in Indonesia that beekeepers pay landowners to put up their hives. However, this does not rule out the possibility that in the future pollination services can be a source of income for beekeepers, when the awareness of landowners of the importance of pollination raises.

The sale of colonies and bee hives is quite common among beekeepers in Indonesia. Sales of beehives usually accompany colony sales, but there are also separate beehives sales. This activity can be carried out by beekeepers on a regional scale or by national scale beekeeping, such as the Madu Pramuka, as stated on its website. Based on interviews, one of the reasons beekeepers buy bee colonies is the beekeeper's need for bee colonies in a short time when entering the flowering season. Also, the purchase of colonies is usually made by new beekeepers who are still unable to do bee colony reproduction. So, in Indonesia, the sale of bee colonies and beehives will always be able to be a source of income for beekeepers.

[219] Pertanianku (2016): Produksi Propolis Tinggi Dengan Lebah Trigona. URL: https://www.pertanianku.com/produksi-propolis-tinggi-dengan-lebah-trigona/

[220] Fathurrahman, I and Putra, R.E. (2015): Efficacy of Bee Propolis Trigona sp.as Edible Coating Materials for Post-Harvest Protection of Ambon Lumut Banana (Musa acuminata L.). Agrotechnology Journal. Vol. 10 No.01. URL: https://jurnal.unej.ac.id/index.php/JAGT/article/view/4337

[221] Trobos Livestock (2019): Lebah Madu untuk Masa Depan Pangan dan Kesehatan Manusia. URL: http://troboslivestock.com/detail-berita/2019/09/26/57/12100/lebah-madu-untuk-masa-depan-pangan-dan-kesehatan-manusia

[222] Trobos Livestock (2019): Lebah Madu untuk Masa Depan Pangan dan Kesehatan Manusia. URL: http://troboslivestock.com/detail-berita/2019/09/26/57/12100/lebah-madu-untuk-masa-depan-pangan-dan-kesehatan-manusia

[223] Trobos Livestock (2019): Lebah Madu untuk Masa Depan Pangan dan Kesehatan Manusia. URL: http://troboslivestock.com/detail-berita/2019/09/26/57/12100/lebah-madu-untuk-masa-depan-pangan-dan-kesehatan-manusia

5.2.2 Technology

Technology in the beekeeping sector is not well known and used in Indonesia (see chapter 3.2.2). Official data is not available. However, current information about pricing and forecast have been gained through the technology market survey.

Pricing

A monitoring system, like the SAMS system, which supports the beekeeper in his/ her daily activities is affordable for Indonesian beekeepers for 1,000,000 IDR (57 EUR) or maximum 2,000,000 IDR (114 EUR). The price range for other apiculture stakeholders differs (see Table 6). It is notable that none of the involved NGOs gave a precise answer about the minimum or maximum price. This might be since there has not been any beekeeping monitoring technology in Indonesia – neither developed ones nor used ones. Some beekeepers also do not know about the minimum and maximum price affordable for them. Considering all the answers the most favoured and affordable price range for a monitoring system is between 1 million IDR (57 Euro) and the 2 million IDR (114 Euro).

Table 16 Prices for a monitoring system affordable by different stakeholders

Minimum price willing to pay for a monitoring system for beekeeping							
	Do not know	1 million IDR (€ 57)	2 million IDR (€ 114)	3 million IDR (€ 171)	4 million IDR (€ 228)	5 million IDR (€ 285)	6 million IDR (€ 342)
Beekeepers	3	2	0	0	0	0	0
Government	0	10	2	3	2	2	0
University / Research Institute	0	4	0	1	0	0	0
Business	0	2	1	2	1	0	0
NGO	7	0	0	0	0	0	0
Community	0	0	0	0	0	0	0
Total	**10**	**18**	**3**	**6**	**3**	**2**	**0**
Maximum price willing to pay for a monitoring system for beekeeping							
	Do not know	1 million IDR (€ 57)	2 million IDR (€ 114)	3 million IDR (€ 171)	4 million IDR (€ 228)	5 million IDR (€ 285)	6 million IDR (€ 342)
Beekeepers	3	0	2	0	0	0	0
Government	0	0	8	3	1	5	2
University / Research Institute	0	0	3	1	0	1	0
Business	0	0	2	1	2	0	1
NGO	7	0	0	0	0	0	0
Total	**10**	**0**	**15**	**5**	**3**	**6**	**3**

Forecast

Indonesian policy is focusing on the 4IR (Fourth Industrial Revolution) to revitalize the domestic manufacturing industry and not to be dependent on imported material. Priority lies on food and beverage, textile and apparel, automotive, chemical and electronics. 4IR covers advanced technology such as artificial intelligence (AI), internet of things (IoT), wearables, robotics, and 3D printing.[224] IoT start-ups have been established, also in the agriculture sector and the IoT

[224] Ministry of Industry. URL: https://www.kemenperin.go.id/download/18384

market has already been growing rapidly, its value is expected to reach 444 trillion IDR (27 billion Euro, May 2020) by 2022.[225]

Besides the policy focus on technology, beekeepers consider technology for beekeeping as important. According to the survey they are interested in using a monitoring system and to become partner in the implementation of the SAMS monitoring system. Nevertheless, the adaption of technology in the apiculture sector needs time because most of the beekeepers are senior ones and not familiar with technology and beekeeping in Indonesia is still traditional. The technology is more favourable for young beekeepers since they are more familiar with technology. A proof of the monitoring system's benefits is expected to speed up the adaption, and usability of the monitoring system is seen as an important factor.

Other stakeholders of the apiculture sector consider technology and the data utilization of monitoring systems useful for beekeeping. Referring to the survey, it is likely that some stakeholders (e.g. government, universities/ research institutions) will devote the research on monitoring systems or support it as a partner.

In general, the stakeholders expressed their interest in beekeeping technology in Indonesia, the need of each directly or indirectly involved stakeholder in the beekeeping sector differs:

- Beekeepers need
  - technology that helps beekeepers in managing bee feed
  - technology that reduces the likelihood of colony/honey theft
- Government need
  - technology that can provide data about air humidity
  - technology that can help in estimating honey harvest time
- Universities / Research Institutions need
  - technology that can detect diseases and pests in bee colonies
  - technology that can provide data related to the flowering season that can help with bee feed problems
- Businessmen need
  - technology that reduces the likelihood of colony/honey theft
  - technology that can help in estimating honey harvest time
- NGOs need
  - technology that can help in estimating honey harvest time
- Communities need
  - technology that can provide rainfall data

The overall beekeeping data needed in Indonesia can be seen in the following table:

[225] Kemenperin (2018): Teknologi IoT Solusi Pengembangan Industri Masa Depan. URL: https://www.kemenperin.go.id/artikel/19902/Teknologi-IoT-Solusi-Pengembangan-Industri-Masa-Depan

Table 17 Beekeeping Technology Needs for Stakeholders

No	Criteria	Score (Not Important 1 - 5 Important)						
		Beekeepers	**Government**	**University / Research Institute**	**Business**	**NGO**	**Community**	**AVERAGE (total)**
1	Ambient temperature	3.80	4.26	4.00	2.83	3.43	2.75	3.52
2	Beehive Manufacture	-	-	3.40	3.00	-	-	3.2
3	Colony Management	3.40	4.00	4.40	3.00	3.71	3.00	3.58
4	Feed Management	**4.40**	4.11	4.20	3.17	3.57	3.00	3.74
5	Flowering season	3.20	4.16	**4.60**	3.00	-	-	3.74
6	Harvest time	4.00	**4.37**	4.00	**3.50**	**4.14**	3.00	3.83
7	Humidity	3.80	**4.42**	4.00	3.00	3.57	2.75	3.59
8	Know the time of breaking up the colony	3.40	-	4.20	-	3.43	3.00	3.51
9	Knowing the presence of pests and diseases	3.80	4.16	**4.80**	-	4.00	3.00	3.95
10	Prevention of escape of bee colonies	4.00	-	4.40	-	4.00	3.00	3.85
11	Rain fall	3.40	4.32	4.40	3.00	4.00	**3.25**	3.73
12	Theft prevention	**4.20**	4.00	4.40	**3.83**	3.57	2.25	3.71

Bold = most important criteria per stakeholder group
Highlighted ones = top five criteria in total (average)

As described in the table above the top five criteria for beekeeping in Indonesia are technology for knowing the presence of pests and diseases, providing prevention of bee colonies escape, giving information about harvest time and flowering season as well as feed management of honeybees.

6. European Market

Referring to information in SAMS Deliverable D2.1. Report on Needs Assessment and Evaluation and existing overview on honey market, EU honey consumer demands are still higher than the EU market can cover, although being the second biggest honey producer in the world (around 230000t). Overall, as stated by European Commission[226], the EU is only 60% self-sufficient in honey, therefore honey import is needed to cover domestic demands.

[226] European Commission (2019): Honey Market Presentation. URL: https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/animals_and_animal_products/presentations/market-presentation-honey_en.pdf (access: 15.01.2020)

This has led to imports from countries like China (~40%) and Ukraine (~20%). As a result, the whole EU honey trade balance is negative – more honey is imported than exported. European Parliament publication[227] states that production costs are relatively high for EU beekeepers compared to their competitors and honey exports are priced higher than imports (more than twice per kg in 2016).

Imported honey must comply with according legally binding requirements. Imported products must be traceable, hygienic and fulfil certain control aspects (General Food Law of the European Union - Regulation (EC) No 178/2002). Imported honey must also be accompanied by a signed and stamped health certificate (issued by a veterinary officer who is authorized by the according authorities form the exporting country (Regulation (EC) 1664/2004)). Besides that, the imported honey should be within the limits of the EU Maximum Residue Levels (MRLs) for pesticides in food products (Regulation 396/2005).

EU defines specific rules applicable to honey and its use in foodstuff[228]. The Council Directive 2001/110/EC of 20 December 2001 not only sets the rules on honey composition and definition, but also specifies honey product types placed on the market – given names, compliance with labelling rules, presentation and information on origin. The directive (2001/110/EC) supplements the general EU rules (Regulation (EU) No 1169/2011) on food labelling.

The major composition criteria[229] for honey (when placed on the market or in other products intended for human consumption) includes the following:

- sugar content
- moisture content
- water-insoluble content
- electrical conductivity
- free acid and diastase activity and hydroxymethylfurfural (HMF) content

There are also EU regulations (Regulation 503/2013) regarding the importing of honey that has traces of pollen from genetically modified crops. Special attention should also be paid when labelling honey and its products (originated countries: EU, non-EU) – Directive 2014/63/EU clarifies the needed requirements. Besides, there are several other EU market's import rules and requirements – available under the EU Trade helpdesk.

To strengthen the beekeeping sector, EU has funds available for apiculture activities, including research, monitoring etc. Between 2017 and 2019 the EU provided 216 million EUR to facilitate sustainable activities to ensure food use and feed law, animal health and welfare rules, plant health and plant protection products (Regulation (EU) 2017/625). In the EU around 240 million EUR will be spent on national apiculture programmes for the years 2020-2022. It is an increase of 11% of the funds compared to 2017-2019. Half of the funds comes from the EU budget, the other half – EU countries (https://ec.europa.eu/info/food-farming-fisheries/animals-and-

[227] Key facts about Europe's honey market (infographic) (2018): URL: https://www.europarl.europa.eu/news/en/headlines/economy/20180222STO98435/key-facts-about-europe-s-honey-market-infographic (access: 15.01.2020)

[228] EU labelling rules for honey (2015): URL: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Al21124a (access: 15.01.2020)

[229] COUNCIL DIRECTIVE 2001/110/EC (2002): URL: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32001L0110&from=EN (access: 15.01.2020)

animal-products/animal-products/honey). Mentioned funds are approved by EU implementing decision 2019/974. The funding allocation depends on the number of beehives in each EU country.

More information about EU directives, regulations and laws regarding honey, its products and its sale is also provided in deliverable D2.1 Report on Needs Assessment and Evaluation.

EU countries that provide the largest honey production are mainly Southern European countries (such as Romania, Spain, Hungary, Germany, Italy) where the climatic conditions are more suitable for beekeeping activities. In the year of 2018 the EU honey production was ~209000t just slightly more than year before (~207000t), where the majority was produced by Romania (~30900t), Germany (~28700t), Hungary (~26000t) and Poland (~22300t). Regarding the average yield of honey (in kg) per beehive, in 2018 it was estimated as ~22kg in the EU.

With over 17 million beehives and more than 600000 beekeepers (on average 21 hive per beekeeper in the whole EU) the beekeeping sector is still considered small, but very important (due to pollinating crops and wild plants) for agriculture, food security and biodiversity. Importance of pollination is also emphasized by some authors[230] stating that living organisms pollinates around 90% of all flowering plants. In Europe only insects fill the role of pollination, furthermore, *Apis mellifera* remains the most economically valuable pollinator of crop monocultures worldwide.[231]

Honey is not the only product provided by the apiculture sector in Europe. Although other products are difficult to study and as stated by report[232] it would be almost **impossible to find any statistics** about products like, propolis, royal jelly, due to the fact that they are not defined and registered.

Products besides honey, include:

- beeswax - can be used in cosmetics, pharmaceuticals and candles and as a material to renew hive frames
- propolis - has anti-bacterial, anti-virus and anti-fungal properties, therefore is used in naturopathic treatments
- pollen - mostly used as food additive due to the fact that it contains proteins, amino acids and B vitamins
- royal jelly - also used in naturopathy for its strengthening effects and anti-depressive properties
- venom - acts as neurotoxins and has positive effects on health. Although not quite recognised in Europe yet, it is used in “apitherapy” procedures to deal with multiple sclerosis, rheumatisms and sciatica

[230] ECPA/ELO/RifCon/E-Sycon (2013): Pollinators and agriculture. Agriculture productivity and pollinator protection.
[231] Part II: Overview of the apiculture sector (2013): Evaluation of the CAP measures related to apiculture Agriculture and Rural Development DG- Final Report. URL: https://ec.europa.eu/agriculture/sites/agriculture/files/evaluation/market-and-income-reports/2013/apiculture/chap3_en.pdf (access: 15.01.2020)
[232] Part II: Overview of the apiculture sector (2013): Evaluation of the CAP measures related to apiculture Agriculture and Rural Development DG- Final Report. URL: https://ec.europa.eu/agriculture/sites/agriculture/files/evaluation/market-and-income-reports/2013/apiculture/chap3_en.pdf (access: 15.01.2020)

Technology – **monitoring systems** – can add value to beekeeping and be used as a tool to help identify causes to bee colony decline by providing reliable data sets. As it is reported[233], since 2003 there have been several research projects aimed at studies of bee colony decline. In order to gain, improve knowledge (also develop standards for monitoring), prevent large scale honey bee colony losses and improve the well-being of bees, COLOSS network (https://coloss.org/) was created.

The variety of research projects[234] and programs funded by EU include studies focused on, e.g.

- quantifying the declines in insect pollinators (ALARM project), losses of bees (pesticides, invasive species climate change)
- reducing the potential sources of honey contamination (BEE-SHOP) (pesticide impact, treatments used to combat pests and pathogens in the hive)[235]
- improving honey bee colony health (Bee DOC) by gaining more knowledge in honey bee pests, diseases, CCD (Colony Collapse Disorder) phenomenon (http://www.bee-doc.eu/)
- the development of a monitoring tool in order to detect changes in honey bee colony activity within the beehive (SWARMONITOR)

There are many actual market ready products - monitoring systems - that can be used to assist the beekeeper in his/ her beekeeping activities. The webpage https://colonymonitoring.com provides a list including systems worldwide. Several of them are also located in Europe, such as Arnia, BeeWise, B-Keep, Connected Beehive, to name a few.

For gaining insights into the use of SAMS data for stakeholders from the scientific field, a Survey for Scientists was conducted form April 29th to July 31st of 2019. The survey was completed by 43 scientists from 22 countries, most of them from the EU. The participants were from different scientific disciplines related to beekeeping, environmental sciences and environmental management, agriculture, policy, and engineering. The survey showed that data related to measurement of brood hive temperature, environmental temperature and weight of beehive is seen as useful and relevant for scientists of different disciplines. Moreover, it showed that different sciences might require differing levels of data precision, which comes down to different forms of data measurement, particularly concerning length of recording frequencies. The results of the survey will be described in depth in the D6.3 Transfer Study for Data Management and Utilization.

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[233] Part II: Overview of the apiculture sector (2013): Evaluation of the CAP measures related to apiculture Agriculture and Rural Development DG- Final Report. URL: https://ec.europa.eu/agriculture/sites/agriculture/files/evaluation/market-and-income-reports/2013/apiculture/chap3_en.pdf (access: 15.01.2020)

[234] Part II: Overview of the apiculture sector (2013): Evaluation of the CAP measures related to apiculture Agriculture and Rural Development DG- Final Report. URL: https://ec.europa.eu/agriculture/sites/agriculture/files/evaluation/market-and-income-reports/2013/apiculture/chap3_en.pdf (access: 15.01.2020)

[235] Welcome to BEE SHOP. URL: http://www2.biologie.uni-halle.de/zool/mol_ecol/bee-shop/index.html (access: 03.02.2020)

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Annexes

Ethiopia

a) Honey Consumer Questionnaire Ethiopia

Dear Respondents,

The data in this form is collected by iceaddis; a business development partner for SAMS project(https://sams-project.eu/) to improve the local honey production capacity and meet the consumer's demand with regard to their expected qualities.

SAMS is a multinational, interdisciplinary three-year project, whose goal is to apply IoT technology for precision apiculture in beehives located in tropical regions in order to achieve active monitoring for beekeeping improvements. It enhances international cooperation of ICT and sustainable agriculture between the SAMS partners from Ethiopia, Indonesia, Latvia, Austria and Germany since January 2018.

Iceaddis is an innovation hub and co-creation space which facilitates technological innovations, creative projects, and startups support. iceaddis provides young entrepreneurs, local and visiting creatives with professional support and consultancy.

It will take 5-7 min to fill in the form. We appreciate your valuable response until 5th of January, 2020. Please also share the form to relevant partners & stakeholders.

Thank You

Iceaddis & SAMS Team

Do you consume honey?

◯ Yes, I include Honey on my daily diet

◯ Yes, Few days per week

◯ I rarely eat honey

◯ No, I don't eat honey at all

Who do you buy or get honey for?

▢ For my own consumption

▢ For family consumption

▢ I buy honey for others

▢ For commercial use

▢ I don't buy honey

Where do you buy or get your honey?

▢ I have my own bee hive

▢ Directly from beekeepers

▢ Corner shops near me

▢ Supermarkets

▢ Home delivery honey retailers

▢ Others buy it for me

▢ Other:

How regularly do you buy or use Honey?

◯ 100g or less / per month

◯ 250g or less / per month

◯ 500g or less / per month

◯ 1KG or less / per month

◯ More than 1KG / per month

For which purpose do you buy or get honey?

▢ As alternative to sugar

▢ As table honey

▢ As alternative medicine

▢ As food and beverage ingredient

▢ For home made cosmetics ingredient

▢ To produce commercial products

▢ Other:

Do you buy imported or local honey?

◯ Local

◯ Imported

◯ Both

◯ I don't buy honey

◯ I get honey from my own bee hive

Among the common honey forms exist in the market. Which types do you buy or get?

▢ Comb honey

▢ Finely crystallized (creamed honey)

▢ Extracted liquid honey

▢ Other:

What factors influence your decision when you buy honey?

▢ Quality of the honey

▢ Price of the honey

▢ Origin of the honey

▢ Test of the honey

▢ Color of the honey

▢ Aroma of the honey

▢ The organic quality assurance

▢ Your personal preferred type of honey

▢ Other:

What are the most important Factors you won't compromise for the price?

▢ Quality of the honey

▢ Origin of the honey

▢ Test of the honey

▢ Color of honey

▢ Aroma of the honey

▢ The organic quality assurance

▢ Your personal preference type of honey

▢ Other

Which honey containers do you appreciate to buy or store your honey?

▢ Any see-through containers will do fine

▢ Drink bottles

▢ Plastic containers

▢ Glass jar

▢ I don't care about the containers.

▢ Other:

Is the design and accuracy of the Honey Label important to you?

◯ Yes, it is very important

◯ It is nice to have

◯ Not that important

◯ I barely notice it

Have you noticed a negative impact on current honey production in Ethiopia? If Yes please mention which aspects have contributed for the negative impacts in your opinion.

How many different types of honey are there in Ethiopia that you know? And how many types do you consume? And please also mention why do you prefer one over the other?

b) Additional official information about Ethiopian honey export

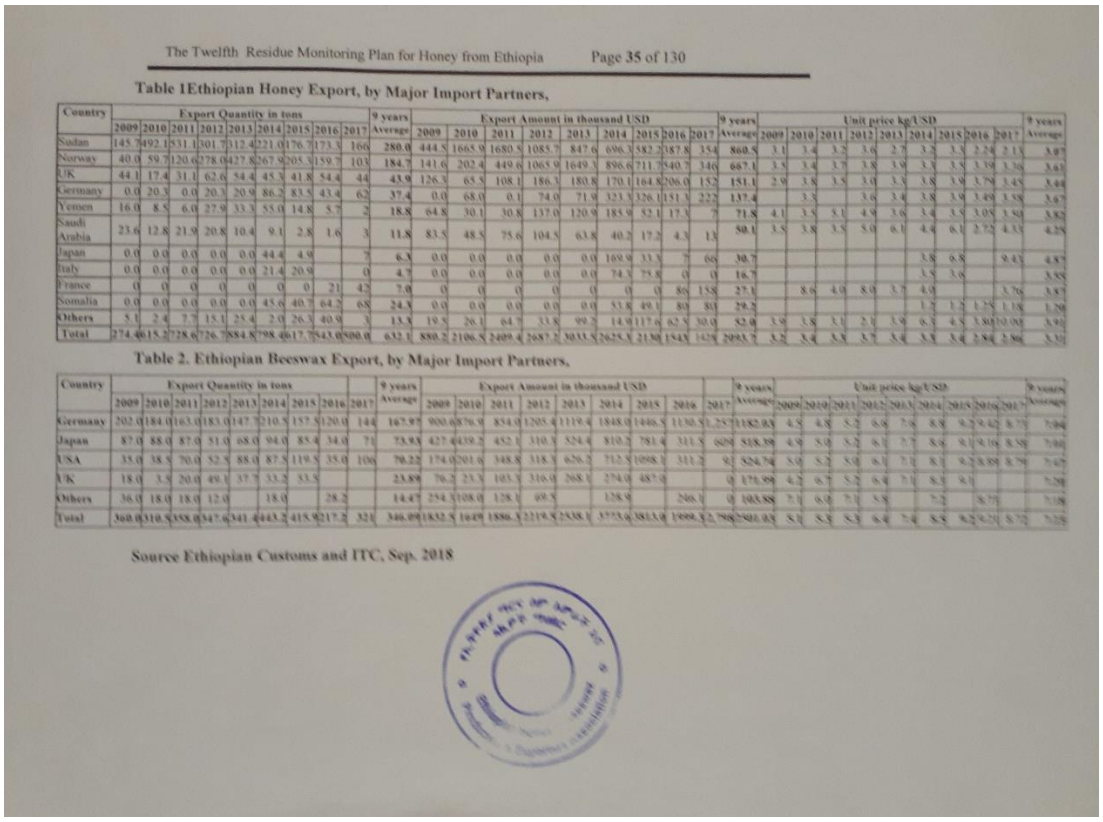

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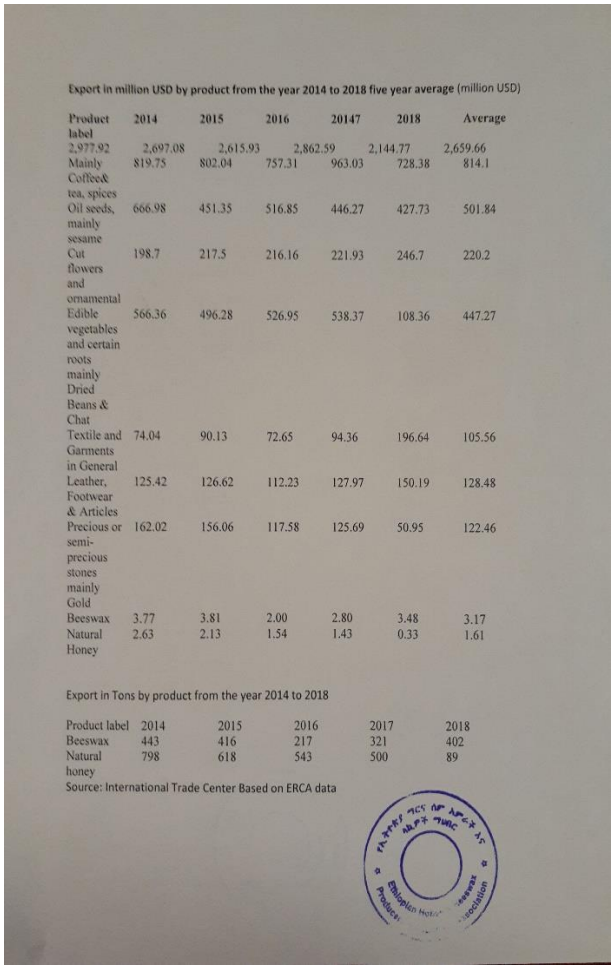
Table 1Ethiopian Honey Export, by Major Import Partners,

Country	Export Quantity in tons									9 years Average	Export Amount in thousand USD									9 years Average	Unit price kg/USD									9 years Average
	2009	2010	2011	2012	2013	2014	2015	2016	2017		2009	2010	2011	2012	2013	2014	2015	2016	2017		2009	2010	2011	2012	2013	2014	2015	2016	2017	
Sudan	145.7	492.1	531.1	301.7	312.4	221.0	176.7	173.3	166	280.0	444.5	1665.9	1680.5	1085.7	847.6	696.3	582.2	387.8	354	860.5	3.1	3.4	3.2	3.6	2.7	3.2	3.3	2.24	2.13	3.07
Norway	40.0	59.7	120.6	278.0	427.8	267.9	205.3	159.7	103	184.7	141.6	202.4	449.6	1065.9	1649.3	896.6	711.7	540.7	346	667.1	3.5	3.4	3.7	3.8	3.9	3.3	3.5	3.39	3.36	3.63
UK	44.1	17.4	31.1	62.6	54.4	45.3	41.8	54.4	44	43.9	126.3	65.5	108.1	186.3	180.8	170.1	164.8	206.0	152	151.1	2.9	3.8	3.5	3.0	3.3	3.8	3.9	3.79	3.45	3.44
Germany	0.0	20.3	0.0	20.3	20.9	86.2	83.5	43.4	62	37.4	0.0	68.0	0.1	74.0	71.9	323.3	326.1	151.3	222	137.4		3.3		3.6	3.4	3.8	3.9	3.49	3.58	3.67
Yemen	16.0	8.5	6.0	27.9	33.3	55.0	14.8	5.7	2	18.8	64.8	30.1	30.8	137.0	120.9	185.9	52.1	17.3	7	71.8	4.1	3.5	5.1	4.9	3.6	3.4	3.5	3.05	3.50	3.82
Saudi Arabia	23.6	12.8	21.9	20.8	10.4	9.1	2.8	1.6	3	11.8	83.5	48.5	75.6	104.5	63.8	40.2	17.2	4.3	13	50.1	3.5	3.8	3.5	5.0	6.1	4.4	6.1	2.72	4.33	4.25
Japan	0.0	0.0	0.0	0.0	0.0	44.4	4.9		7	6.3	0.0	0.0	0.0	0.0	0.0	169.9	33.3	7	66	30.7						3.8	6.8		9.43	4.87
Italy	0.0	0.0	0.0	0.0	0.0	21.4	20.9		0	4.7	0.0	0.0	0.0	0.0	0.0	74.3	75.8	0	0	16.7						3.5	3.6			3.55
France	0	0	0	0	0	0	0	21	42	7.0	0	0	0	0	0	0	0	86	158	27.1		8.6	4.0	8.0	3.7	4.0			3.76	3.87
Somalia	0.0	0.0	0.0	0.0	0.0	45.6	40.7	64.2	68	24.3	0.0	0.0	0.0	0.0	0.0	53.8	49.1	83	83	29.2						1.7	1.2	1.29	1.15	1.29
Others	5.1	2.4	7.7	15.1	25.4	2.0	26.3	40.9	3	13.5	19.5	26.1	64.7	33.8	99.2	14.9	117.6	62.5	30.0	52.0	3.9	3.8	3.1	2.3	3.9	6.3	4.5	3.80	10.00	3.93
Total	274.4	615.2	728.6	726.7	854.8	798.4	617.7	543.0	500.0	632.1	880.2	2106.5	2409.4	2687.2	3033.5	2625.3	2150	1543	1425	2993.7	3.2	3.4	3.5	3.7	3.4	3.5	3.4	2.86	2.96	3.35

Table 2. Ethiopian Beeswax Export, by Major Import Partners,

Country	Export Quantity in tons									9 years Average	Export Amount in thousand USD									9 years Average	Unit price kg/USD									9 years Average
	2009	2010	2011	2012	2013	2014	2015	2016	2017		2009	2010	2011	2012	2013	2014	2015	2016	2017		2009	2010	2011	2012	2013	2014	2015	2016	2017	
Germany	202.0	184.0	163.0	183.0	147.7	210.5	157.5	120.0	144	167.97	900.6	876.9	854.0	1205.4	1119.4	1848.0	1440.5	1130.5	1.25	1182.83	4.5	4.8	5.2	6.6	7.6	8.8	9.2	9.42	8.77	7.04
Japan	87.0	88.0	87.0	51.0	68.0	94.0	85.4	34.0	71	73.93	427.4	439.2	452.1	310.3	524.4	810.2	781.4	311.5	605	518.39	4.9	5.0	5.2	6.1	7.7	8.6	9.1	9.16	8.58	7.03
USA	35.0	38.5	70.0	52.5	88.0	87.5	119.5	35.0	106	70.22	174.0	201.6	348.8	318.3	626.2	712.5	1098.1	311.2	95	524.74	5.0	5.2	5.0	6.1	7.1	8.1	9.2	8.89	8.79	7.47
UK	18.0	3.5	20.0	49.1	37.7	33.2	53.5			23.89	76.2	23.3	103.3	316.0	268.1	274.0	487.0		0	171.99	4.2	6.7	5.2	6.4	7.1	8.5	9.1			7.20
Others	36.0	18.0	18.0	12.0		18.0		28.2		14.47	254.3	108.0	128.1	69.5		128.9		246.1	0	103.88	7.1	6.0	7.1	5.8		7.2		8.77		7.19
Total	368.0	318.5	358.0	347.6	341.4	443.2	415.9	217.2	321	346.09	1832.5	1649	1886.3	2219.5	2538.1	3773.6	3813.0	1999.3	2.798	2981.83	5.1	5.5	5.5	6.4	7.4	8.5	9.2	9.21	8.72	7.25

Source Ethiopian Customs and ITC, Sep. 2018



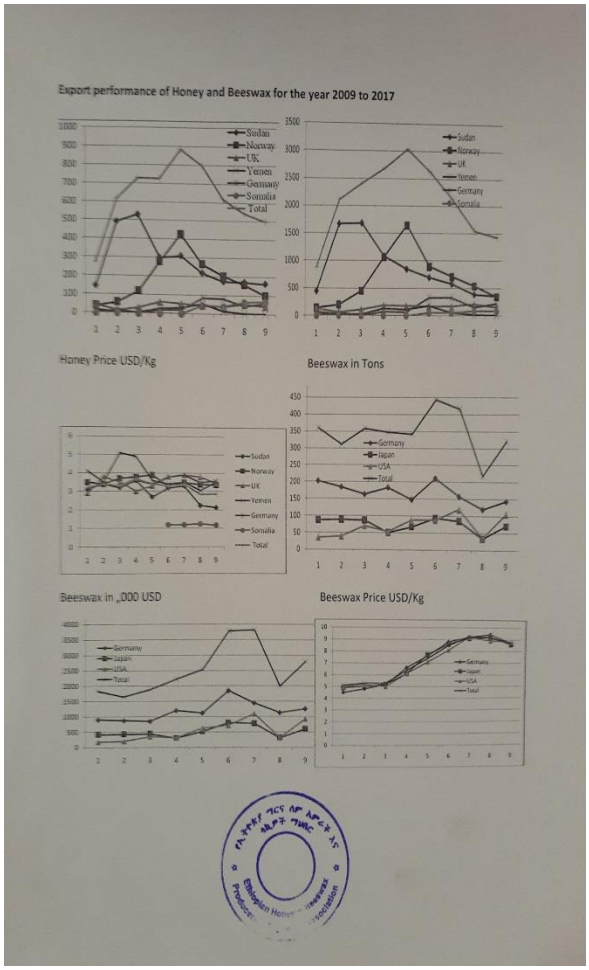
Export in million USD by product from the year 2014 to 2018 five year average (million USD)

Product label	2014	2015	2016	20147	2018	Average
2,977.92	2,697.08	2,615.93	2,862.59	2,144.77	2,659.66	
Mainly Coffee& tea, spices	819.75	802.04	757.31	963.03	728.38	814.1
Oil seeds, mainly sesame	666.98	451.35	516.85	446.27	427.73	501.84
Cut flowers and ornamental	198.7	217.5	216.16	221.93	246.7	220.2
Edible vegetables and certain roots mainly Dried Beans & Chat	566.36	496.28	526.95	538.37	108.36	447.27
Textile and Garments in General	74.04	90.13	72.65	94.36	196.64	105.56
Leather, Footwear & Articles	125.42	126.62	112.23	127.97	150.19	128.48
Precious or semi-precious stones mainly Gold	162.02	156.06	117.58	125.69	50.95	122.46
Beeswax	3.77	3.81	2.00	2.80	3.48	3.17
Natural Honey	2.63	2.13	1.54	1.43	0.33	1.61

Export in Tons by product from the year 2014 to 2018

Product label	2014	2015	2016	2017	2018
Beeswax	443	416	217	321	402
Natural honey	798	618	543	500	89

Source: International Trade Center Based on ERCA data



Indonesia

a) Honey Consumer Questionnaire Indonesia (in Bahasa Indonesia)

Apa itu Proyek SAMS dan Mengapa kami melakukan survei ini?

Selamat datang di Survei kami.

Proyek Smart Apiculture Management Services (SAMS) memanfaatkan teknologi sensor jarak jauh untuk memonitor sarang & koloni lebah agar dapat menunjang pengelolaan peternakan lebah skala kecil di daerah tropis. Teknologi SAMS memungkinkan pemantauan aktif dan penginderaan jarak jauh untuk memantau kesehatan lebah serta pengelolaan peternakan lebah dengan mengembangkan piranti teknologi informasi & komunikasi (TIK) tepat guna yang mendukung manajemen kesehatan lebah, produktivitas lebah dan kualitas produk lebah yang dihasilkan. Salah satu kegiatan proyek SAMS ini adalah melakukan survei pasar madu dan produk lebah lainnya di Indonesia.

Privasi Data

Data yang akan didapatkan tidak akan kami publikasikan dengan mengaitkan secara langsung kepada Anda tanpa persetujuan Anda.
Data pribadi yang Anda isikan akan menjadi data referensi kami disaat kami membutuhkan komunikasi lebih lanjut dengan Anda.

Apakah Anda bersedia mengikuti survei mengenai market produk perlebahan ini?

- ○ Ya
- ○ Tidak

Apakah Anda pernah membeli atau mengkonsumsi madu?

- ○ Pernah
- ○ Tidak pernah (Anda tidak perlu melanjutkan pengisian kuesioner ini)

Apakah Anda saat ini berusia lebih atau berusia 15 tahun?

- ○ Ya
- ○ Tidak, usia saya kurang dari 15 tahun (Anda tidak perlu melanjutkan pengisian kuesioner ini)

1. Nama (hanya jika Anda bersedia mengisinya)

2. Kontak Anda? (hanya jika bersedia mengisinya)

Pastikan Anda mencantumkan domain email anda (misal: xxx@gmail.com)

Jika Anda tidak memiliki alamat email, Anda bisa mengisinya dengan nomor telepon

Email/Nomor Telepon

3. Usia Anda

- ○ 15 – 24 tahun
- ○ 25 – 34 tahun
- ○ 35 – 44 tahun
- ○ 45 – 54 tahun
- ○ 55 – 64 tahun
- ○ Lebih dari 64 tahun

4. Jenis kelamin

- ○ Laki-laki
- ○ Perempuan

5. Pendidikan terakhir Anda

- ○ Tidak sekolah
- ○ SD
- ○ SMP
- ○ SMA
- ○ Diploma
- ○ Sarjana
- ○ Magister
- ○ Doktoral

6. Alamat Anda tinggal

Provinsi

Kabupaten/Kota

7. Pekerjaan Anda saat ini?

- ○ Tidak bekerja
- ○ Pensiunan
- ○ Siswa / Mahasiswa
- ○ Pegawai Negeri Sipil
- ○ Pegawai Swasta
- ○ Wirausaha
- ○ Pegawai honorer/Extension worker
- ○ Lainnya (sebutkan dengan jelas),

8. Penghasilan per bulan

- ○ Kurang dari Rp 500.000
- ○ Rp 500.000 – Rp 1.000.000
- ○ Rp 1.000.000 – Rp 3.000.000
- ○ Rp 3.000.000 – Rp 5.000.000
- ○ Rp 5.000.000 – Rp 10.000.000
- ○ Lebih dari Rp 10.000.000

9. Akun media sosial mana yang Anda miliki?

Boleh memilih lebih dari satu jawaban

- ☐ Tidak memiliki akun media sosial
- ☐ Instagram
- ☐ Facebook
- ☐ Twitter
- ☐ Lainnya (sebutkan)

10. Apa alasan Anda membeli madu?

Boleh memilih lebih dari satu jawaban

- ☐ Sebagai obat
- ☐ Untuk gaya hidup sehat
- ☐ Kebiasaan sejak dahulu
- ☐ Pemenuhan gizi
- ☐ Pengganti gula
- ☐ Sebagai bahan tambahan makanan dan minuman
- ☐ Sebagai bahan tamabahan kosmetik
- ☐ Lainnya

11. Untuk siapa Anda membeli madu?

Boleh memilih lebih dari satu jawaban

- ☐ Untuk dikonsumsi sendiri
- ☐ Untuk diberikan kepada keluarga/kerabat
- ☐ Lainnya (sebutkan)

12. Apakah membeli madu sudah menjadi kebutuhan rutin anda dan keluarga?

- ○ Sudah
- ○ Belum

13. Seberapa sering Anda membeli madu?

- ○ Dua minggu sekali
- ○ Sebulan sekali
- ○ Tiga bulan sekali
- ○ Enam bulan sekali
- ○ Sangat jarang
- ○ Lainnya (sebutkan)

14. Faktor apa yang paling mempengaruhi Anda saat pembelian/pemilihan madu?

Boleh memilih lebih dari satu jawaban

- ☐ Harga
- ☐ Kualitas
- ☐ Kekentalan
- ☐ Aroma/Jenis madu
- ☐ Higienitas
- ☐ Merek
- ☐ Kemasan
- ☐ Jenis lebah penghasil madu
- ☐ Perijinan produk (PIRT/BPOM/lainnya)
- ☐ Lisensi produk
- ☐ Lainnya (sebutkan)

15. Dimana Anda biasanya membeli madu?

Boleh memilih lebih dari satu jawaban

- ☐ Peternakan lebah madu
  tuliskan lokasinya
- ☐ Marketplace online
- ☐ Media sosial
- ☐ Asosiasi Perlebahan
- ☐ Kios khusus produk perlebahan
- ☐ Retail
- ☐ Lainnya (sebutkan)

16. Apa alasan Anda membeli madu di tempat tersebut?

Boleh memilih lebih dari satu jawaban

- ☐ Lokasi mudah dijangkau
- ☐ Pelayanannya bagus
- ☐ Harganya lebih murah
- ☐ Persediaannya banyak
- ☐ Variasi produknya banyak
- ☐ Lainnya (sebutkan)
  tuliskan alasannya

17. Faktor apa yang mempengaruhi Anda untuk membeli dari merek atau peternak yang sama?

Boleh memilih lebih dari satu jawaban

- ☐ Harga
- ☐ Kepercayaan
- ☐ Kualitas
- ☐ Brand
- ☐ Lainnya (sebutkan)

18. Madu dalam kemasan apa yang paling sering Anda beli?

Boleh memilih lebih dari satu jawaban

- ☐ Botol kaca
- ☐ Botol plastik
- ☐ Jerigen
- ☐ Sachet
- ☐ Lainnya (sebutkan)

19. Apakah anda membeli madu impor atau lokal?

- ○ Madu Lokal
- ○ Madu Impor
- ○ Keduanya

20. Seberapa sering Anda membeli madu lokal

Pilih kondisi yang sesuai dengan Anda

Tidak pernah	Pernah membeli sekali	Jarang	Sering	Selalu membeli madu lokal
○	○	○	○	○

21. Seberapa sering Anda membeli madu impor

Pilih kondisi yang sesuai dengan Anda

Tidak pernah	Pernah sekali	Jarang	Sering	Selalu membeli madu impor
○	○	○	○	○

22. Madu ukuran berapa yang biasa Anda beli?

Tuliskan juga harganya

- ○ 250 ml — tuliskan harganya
- ○ 600 ml — tuliskan harganya
- ○ 1 L — tuliskan harganya
- ○ 1 Kg — tuliskan harganya
- ○ Lainnya (sebutkan ukuran dan harganya) — ukuran dan harganya

23. Informasi penting apa yang Anda inginkan tertera (ada) pada kemasan madu yang ingin Anda konsumsi?

Boleh pilih lebih dari satu

- ☐ Komposisi bahan
- ☐ Bar Code
- ☐ Legalitas produk
- ☐ Tanggal kadaluarsa
- ☐ Nilai gizi
- ☐ Aturan pakai
- ☐ Merek dagang
- ☐ Khasiat madu
- ☐ Logo produsen
- ☐ Nama dan alamat produsen

24. Apakah anda tahu jenis-jenis madu yang ada di Indonesia?

- ○ Ya
- ○ Tidak tahu

25. Jenis madu yang biasanya Anda beli?

Boleh memilih lebih dari satu jawaban

- ☐ Tidak ada jenis khusus
- ☐ Multiflora
- ☐ Kaliandra
- ☐ Kapuk Randu
- ☐ Kelengkeng
- ☐ Rambutan
- ☐ Madu hutan
- ☐ Lainnya (sebutkan)

26. Apakah Anda tahu cara membedakan madu yang memiliki kualitas baik?

- ○ Ya, dengan cara ...
- ○ Tidak

27. Bagaimana persepsi Anda terhadap keaslian madu yang beredar?

- ○ Yakin 100% asli
- ○ Ragu, karena ...

28. Manakah dari beberapa parameter kualitas madu yang Anda pahami?

Boleh memilih lebih dari satu jawaban

- ☐ Kekentalan/Kadar air
- ☐ Tingkat kematangan
- ☐ Cemaran pestisida
- ☐ Jenis vegetasi (misal: multiflora/randu/lainnya)
- ☐ Lainnya (sebutkan) .....

29. Apa yang Anda ketahui mengenai hubungan tingkat kematangan madu dengan kualitas madu?

- ○ Madu yang matang memiliki kualitas yang baik
- ○ Tingkat kematangan madu tidak mempengaruhi kualitas madu
- ○ Saya tidak mengetahui/mengerti akan hubuungan tingkat kematangan madu dengan kualitas madu

30. Seberapa besar ketertarikan Anda untuk membeli produk madu yang dijaga cemaran pestisidanya?

Pilih posisi titik yang sesuai bagi Anda

	Tidak tertarik									Tertarik
Tingkat ketertarikan	○	○	○	○	○	○	○	○	○	○

31. Apakah Anda berharap madu yang beredar memiliki/jaminan tentang keaslian dan kualitasnya?

- ○ Ya, karena ... tuliskan alasannya
- ○ Tidak

32. Apakah Anda bersedia membeli madu yang berlisensi dengan harga lebih mahal?

Pilih posisi titik yang sesuai dengan Anda

	Tidak Bersedia									Bersedia
Kesediaan membeli	○	○	○	○	○	○	○	○	○	○

33. Apakah ketelusuran asal madu penting bagi Anda?

Pilih posisi titik yang sesuai dengan Anda

	Tidak Penting									Penting
Tingkat Kepentingan	○	○	○	○	○	○	○	○	○	○

34. Apakah ada produk perlebahan lainnya yang Anda beli?

Boleh memilih lebih dari satu jawaban.

- [ ] Propolis
- [ ] Bee Pollen
- [ ] Royal Jelly
- [ ] Bee Wax
- [ ] Bee Venom
- [ ] Tidak Ada

35. Dimana Anda biasanya membeli produk tersebut?

Boleh memilih lebih dari satu jawaban

- [ ] Tidak membeli produk lainnya
- [ ] Peternakan lebah madu
- [ ] Marketplace online
- [ ] Media sosial
- [ ] Asosiasi Perlebahan
- [ ] Kios khusus produk perlebahan
- [ ] Retail
- [ ] Lainnya (sebutkan)

b) SAMS Technology Survey Questionnaire Indonesia (government part only; in Bahasa Indonesia)

Apa itu Proyek SAMS dan Mengapa kami melakukan survei ini?

Selamat datang di Survei kami

Proyek Smart Apiculture Management Services (SAMS) memanfaatkan teknologi sensor jarak jauh untuk memonitor sarang & koloni lebah agar dapat menunjang pengelolaan peternakan lebah skala kecil di daerah tropis.

Teknologi SAMS memungkinkan pemantauan aktif dan penginderaan jarak jauh untuk memantau kesehatan lebah serta pengelolaan peternakan lebah dengan mengembangkan piranti teknologi informasi & komunikasi (TIK) tepat guna yang mendukung manajemen kesehatan lebah dan produktivitas lebah, serta upaya pengembangan model kerja sama internasional yang efektif.

Versi pertama dari teknologi sensor SAMS yang akan diterapkan di Indonesia (Jawa Barat) dan Ethiopia tahun ini akan menyediakan data sebagai berikut:

- Pemantauan suhu sarang & koloni lebah dari 1 s/d 10 titik sensor temperatur;
- Pemantauan suhu lingkungan dari 1 sensor temperatur di luar sarang lebah;
- Pemantauan kelembaban relatif dari 1 sensor di luar sarang lebah untuk mengukur kelembaban udara;
- Pemantauan berat sarang lebah secara lengkap;
- Pemantauan spektrum frekuensi akustik dari koloni lebah dengan durasi lebih dari 4 menit (FFT-Fast Fourier Transform).

* Interval perekaman data: 4x setiap hari untuk semua parameter;
* Jika terhubung dengan sistem catu daya, perekaman data permanen sangat dimungkinkan

Semua data akan bersifat open source dan akan menjadi sistem pendukung pengambilan keputusan (decision support system/ DSS) yang menggabungkan data-output berbasis sensor dengan sumber informasi lain serta model prediksi untuk mengukur, menganalisis, dan/atau menggambarkan berbagai keadaan koloni lebah. Informasi tentang kondisi kesehatan koloni lebah, termasuk diantaranya vitalitas, produksi, dll., juga akan disiapkan dalam proyek ini.

Tujuan dari survei ini adalah untuk mengetahui:

- Mengetahui kebutuhan konsumen terhadap teknologi SAMS
- Potensi pasar dari teknologi SAMS
- Tipe segmen pasar teknologi SAMS
- Strategi pemasaran teknologi SAMS yang sesuai kondisi pasar (B to B or B to C or B to G)

Informasi lebih lanjut mengenai SAMS Project bisa Anda temukan di: https://sams-project.eu/

Ketentuan dan Keamanan Data

- Data yang didapatkan dari kegiatan survey ini merupakan data yang bersifat **RAHASIA.**
- Data pribadi Anda tidak akan dipublikasi.
- Data hasil survey yang dipublikasikan tidak akan dikaitkan secara langsung kepada responden secara pribadi.
- Responden berkewajiban mengisi data dengan sebenar-benarnya.
- Pelaksana survey memiliki hak untuk melakukan pengolahan terhadap data yang dihasilkan survey ini.
- Keamanan platform bukan menjadi tanggung jawab pelaksana survey.

Saya mengerti dan menerima ketentuan yang berlaku dari survei ini

- ○ Ya
- ○ Tidak

1. Nama

2. Nomor telepon

3. Email
(jika tidak punya, tuliskan "Tidak Punya")

4. Jenis kelamin

- ◯ Laki-laki
- ◯ Perempuan

5. Usia Anda

- ◯ kurang dari 20 tahun
- ◯ 21 – 30 tahun
- ◯ 31 – 40 tahun
- ◯ 41 – 50 tahun
- ◯ 51 – 60 tahun
- ◯ lebih dari 60 tahun

6. Nama institusi/organisasi

nama institusi

7. Jenis institusi Anda

- ◯ Peternakan Lebah
- ◯ Pemerintah
- ◯ Lembaga Riset
- ◯ Pendidikan Tinggi
- ◯ Swasta/Bisnis
- ◯ Komunitas
- ◯ NGO

8. Alamat institusi/organisasi

Provinsi

Kabupaten/Kota

Kecamatan

Desa/Kelurahan

9. Kontak institusi/organisasi

Nomor telepon — nomor telepon

Email — Alamat email

10. Potensi Pengembangan Budidaya di Wilayah Binaan Institusi Anda

Buruk	Kurang	Cukup	Baik	Baik Sekali
○	○	○	○	○

11. Inovasi teknologi monitoring koloni lebah dibutuhkan oleh institusi Anda dalam membuat kebijakan?

Tidak penting	Kurang penting	Cukup penting	Penting	Sangat penting
○	○	○	○	○

12. Inovasi teknologi pengamatan lingkungan dibutuhkan oleh institusi Anda dalam membuat kebijakan?

- ○ Tidak penting
- ○ Kurang penting
- ○ Cukup penting
- ○ Penting
- ○ Sangat penting

13. Jenis data dan seberapa pentingkah data dibawah ini bagi institusi Anda

1 <---Tidak penting---------Sangat penting---> 5

	1	2	3	4	5
Suhu lingkungan					
Kelembapan udara					
Curah hujan					
Mengetahui adanya hama dan penyakit					
Pencegahan pencurian					
Manajemen koloni					
Manajemen pakan					
Kondisi madu siap panen					
Pasar/Market					
Harga madu					

Data peternak

1	2	3	4	5

Logistik

1	2	3	4	5

Pelatihan

1	2	3	4	5

Informasi pakar

1	2	3	4	5

Pengolahan produk turunan

1	2	3	4	5

Alat dan Mesin

1	2	3	4	5

Ekonomi Masyarakat

1	2	3	4	5

Alat dan mesin

1	2	3	4	5

Musim pembungaan

1	2	3	4	5

14. Apakah institusi Anda memiliki kerjasama dengan institusi ini dalam mengembangkan perlebahan?

1 <---Tidak ada----------Sangat insten bekerjasama---> 5

Jika dirasa tidak ada keterkaitan bisa Anda lewati pertanyaan ini dan akan kami anggap bernilai 1.

Kelompok peternak

1	2	3	4	5

Asosiasi peternakan lebah

1	2	3	4	5

Mandiri

1	2	3	4	5

Universitas

1	2	3	4	5

Pemerintah

1	2	3	4	5

Perseorangan

1	2	3	4	5

Lembaga riset

1	2	3	4	5

NGO

1	2	3	4	5

Komunitas

1	2	3	4	5

15. Apakah institusi Anda aktif memberika informasi terkait lebah atau lingkungan pada saluran media ini?

1 <---Tidak pernah---------Sangat intens--> 5

Youtube

1	2	3	4	5

Google

1	2	3	4	5

Whatsapp group

1	2	3	4	5

Seminar

1	2	3	4	5

Facebook

1	2	3	4	5

Instagram

1	2	3	4	5

Twitter

1	2	3	4	5

Televisi

1	2	3	4	5

Buku

1	2	3	4	5

Booklet

1	2	3	4	5

16. Seberapa tinggikah atensi institusi Anda dalam melakukan kajian mengenai hal-hal di bawah ini

1 <---Tidak diperhatikan---------Sangat diperhatikan---> 5

Lingkungan

1	2	3	4	5

Produktivitas madu

1	2	3	4	5

Cuaca

1	2	3	4	5

Hama dan penyakit lebah

1	2	3	4	5

Pestisida

1	2	3	4	5

Bentuk/modifikasi kotak sarang

1	2	3	4	5

Waktu pembungaan

1	2	3	4	5

Kesejahteraan masyarakat pembudidaya

1	2	3	4	5

Kesejahteraan penduduk sekitar lahan

1	2	3	4	5

17. Bagaimana pendapat Anda mengenai kualitas dan kuantitas madu saat ini di Indonesia?

Atensi kebijakan institusi Anda pada isu lingkungan dalam 2-3 tahun terakhir

Penurunan Drastis	Penurunan	Tetap	Naik	Sangat Lebih Baik

Atensi kebijakan institusi Anda pada isu pemberdayaan masyarakat dalam 2-3 tahun terakhir

Penurunan Drastis	Penurunan	Tetap	Naik	Sangat Lebih Baik

Atensi kebijakan institusi Anda pada penggunaan teknologi berbasis informasi dan internet dalam 2-3 tahun terakhir

Penurunan Drastis	Penurunan	Tetap	Naik	Sangat Lebih Baik

Atensi kebijakan institusi Anda pada pengembangan usaha baru dalam 2-3 tahun terkahir

Penurunan Drastis	Penurunan	Tetap	Naik	Sangat Lebih Baik

Penurunan Drastis	Penurunan	Tetap	Naik	Sangat Lebih Baik

18. Upaya/aktivasi apa yang Institusi Anda lakukan dalam memajukan usaha lebah madu di Indonesia?

(boleh memilih lebih dari satu jawaban)

- ☐ Tidak ada
- ☐ Pelatihan usaha
- ☐ Kebijakan khusus
- ☐ Pengembangan teknologi
- ☐ Penelitian/Kajian
- ☐ Pelatihan produk
- ☐ Koordinasi intansi lain
- ☐ Mendorong usaha baru
- ☐ Kerjasama usaha
- ☐ Pelatihan budidaya
- ☐ Penanaman bibit
- ☐ Lainnya

19. Kendala kontribusi kebijakan dalam pengembangan lebah madu?

1 <---Sangat Mudah Diatasi---------Sangat Sulit Diatasi--> 5

Visi pemerintah

1	2	3	4	5

Tidak ada leading sector

1	2	3	4	5

Anggaran

1	2	3	4	5

Tidak populer

1	2	3	4	5

Tidak ekonomis

1	2	3	4	5

Isu sosial

1	2	3	4	5

Isu budaya

1	2	3	4	5

Kendala waktu yang dibutuhkan

1	2	3	4	5

Jejaring kerjasama

1	2	3	4	5

Perijinan

1	2	3	4	5

Daya ungkit ekonomi yang ditimbulkan

1	2	3	4	5

Akses pada ahli

1	2	3	4	5

Sarana prasarana

1	2	3	4	5

Penguasaan keterampilan budidaya

1	2	3	4	5

Penguasaan teknologi oleh masyarakat

1	2	3	4	5

Jarak tempuh/aksesbilitas

1	2	3	4	5

Birokasi

1	2	3	4	5

20. Adakah kegiatan edukasi mengenai isu lingkungan kepada anggota masyarakat?

- ○ Tidak ada
- ○ 1-2 kali/tahun
- ○ 2-5 kali/tahun
- ○ 5-10 kali tahun
- ○ 10-15 kali tahun

21. Adakah edukasi mengenai teknik pelebahan kepada anggota masyarakat?

- ○ Tidak ada
- ○ 1-2 kali/tahun
- ○ 2-5 kali/tahun
- ○ 5-10 kali tahun
- ○ 10-15 kali tahun

22. Menurut Anda pakah budidaya lebah memiliki prospek yang baik pada masa depan?

- ○ Tidak prospektif
- ○ Kurang prospektif
- ○ Cukup prospektif
- ○ Prospektif
- ○ Sangat prospektif

23. Jenis kegiatan apakah yang paling institusi Anda minati untuk dikembangkan atau dibantu dari budiaya lebah madu?

- [ ] Menjual madu
- [ ] Menambah jumlah koloni
- [ ] Menjual produk hasil lebah lainnya (pollen/propolis/royal jelly/wax/venom)
- [ ] Membuat produk turunan madu
- [ ] Membuat jasa pelatihan budidaya lebah madu
- [ ] Membuka jasa pengobatan melalui sengat lebah
- [ ] Menjual koloni dan kotak sarang (stup)
- [ ] Menjual peralatan budidaya lebah
- [ ] Wisata
- [ ] Lainnya...

24. Jika teknologi monitoring lebah madu memberikan keuntungan berupa peningkatan kualitas madu, apakah Institusi Anda bersedia mendukungnya?

- ○ Tidak bersedia
- ○ Kurang bersedia
- ○ Cukup bersedia
- ○ Bersedia
- ○ Sangat bersedia

25. Jika teknologi monitoring lebah madu dapat meningkatan keamanan dari kehilangan stup lebah, apakah Institusi Anda bersedia mendukungnya?

- ○ Tidak bersedia
- ○ Kurang bersedia
- ○ CUkup bersedia
- ○ Bersedia
- ○ Sangat bersedia

26. Jika teknologi monitoring lebah madu membantu pembudidaya memonitor stup dari jarak jauh, apakah Institusi Anda bersedia mendukungnya?

- ○ Tidak bersedia
- ○ Kurang bersedia
- ○ CUkup bersedia
- ○ Bersedia
- ○ Sangat bersedia

27. Jika teknologi monitoring lebah madu memberikan informasi kesehatan koloni lebah kepada pembudidaya, apakah Institusi Anda bersedia mendukungnya?

- ○ Tidak bersedia
- ○ Kurang bersedia
- ○ CUkup bersedia
- ○ Bersedia
- ○ Sangat bersedia

28. Jika teknologi monitoring lebah madu mampu memprediksi ketersediaan pakan lebah, apakah Institusi Anda bersedia mendukungnya?

- ○ Tidak bersedia
- ○ Kurang bersedia
- ○ CUkup bersedia
- ○ Bersedia
- ○ Sangat bersedia

29. Jika teknologi monitoring lebah madu mampu memprediksi waktu panen atau tingkat kematangan madu, apakah Institusi Anda bersedia mendukungnya?

- ○ Tidak bersedia
- ○ Kurang bersedia
- ○ CUkup bersedia
- ○ Bersedia
- ○ Sangat bersedia

30. Apakah data olahan teknologi SAMS diatas bermanfaat bagi Institusi Anda?

- ○ Tidak bermanfaat
- ○ Kurang bermanfaat
- ○ Cukup bermanfaat
- ○ Bermanfaat
- ○ Sangat bermanfaat

31. Jika teknologi monitoring lebah madu mampu memberikan informasi BIG DATA terkait isu lingkungan, apakah Institusi Anda bersedia mendukungnya?

- ○ Tidak bersedia
- ○ Kurang bersedia
- ○ CUkup bersedia
- ○ Bersedia
- ○ Sangat bersedia

32. Jika seluruh manfaat di atas dapat dirasakan, berapa harga MINIMUM yang sanggup dianggarkan untuk mengadopsinya oleh Institusi Anda?

- ○ 1 juta
- ○ 2 juta
- ○ 3 juta
- ○ 4 juta
- ○ 5 juta

33. Jika seluruh manfaat di atas dapat dirasakan, berapa harga MAKSIMAL yang sanggup dianggarkan untuk mengadopsinya oleh Institusi Anda?

- ○ 2 juta
- ○ 3 juta
- ○ 4 juta
- ○ 5 juta
- ○ 6 juta

34. Jika bermitra dalam penelitian, bentuk kemitraan apa yang Anda harapkan?
(dapat memilih lebih dari satu jawaban)

- ☐ Hanya menyuplai kebutuhan data penelitian
- ☐ Menjadi pembina di bidang budidaya lebah
- ☐ Menjadi pembina dalam pengembangan bisnis dan pasar
- ☐ Menyediakan sara-dan prasarana
- ☐ Menyiapkan masyarakat binaan
- ☐ Penyandang dana
- ☐ Mitra kolaborasi
- ☐ Mitra kebijakan
- ☐ Lainnya...

35. Apakah riset teknologi monitoring lebah madu memiliki kaitan dengan program Institusi Anda saat ini?

- ○ Tidak berkaitan
- ○ Kurang berkaitan
- ○ Cukup berkaitan
- ○ Berkaitan
- ○ Sangat berkaitan

36. Jika terkait perlebahan, tujuan utama apakah yang menjadi motivasi utama Institusi Anda untuk terlibat?

(boleh memilih lebih dari satu jawaban)

- ☐ Ekonomi
- ☐ Politik
- ☐ Lingkungan
- ☐ Keamanan
- ☐ Sosial Budaya
- ☐ Teknologi
- ☐ Hukum
- ☐ Lainnya...

37. Aspek apa yang memiliki keterkaitan dengan Riset Teknologi Monitoring Lebah ini bagi Institusi Anda?

(boleh memilih lebih dari satu jawaban)

- ☐ Ekonomi
- ☐ Politik
- ☐ Lingkungan
- ☐ Keamanan
- ☐ Sosial Budaya
- ☐ Teknologi
- ☐ Hukum
- ☐ Lainnya...

38. Apakah riset teknologi monitoring lebah madu kami dapat menjadi bagian dari kegiatan di Institusi Anda?

- ○ Tidak memungkinkan
- ○ Kurang memungkinkan
- ○ Cukup memungkinkan
- ○ Memungkinkan
- ○ Sangat memungkinkan

39. Saran Anda terhadap teknologi SAMS dan/atau survei ini

c) Raw data – demographics of participants survey on honey consumers

Table 18 Demographics survey on honey consumers ID

Characteristics		Total	
		Person	%
Age			
	15 – 24 years old	137	32
	25 – 34 years old	113	26
	35 – 44 years old	94	22
	45 – 54 years old	54	13
	55 – 64 years old	26	6
	More than 64 years old	5	1
Gender			

	Men	228	53
	Women	201	47
Address			
	Java	335	77.86
	Sumatra	34	7.93
	Kalimantan	4	0.93
	Papua	12	2.80
	Sulawesi	1	0.23
	Bali & Nusa Tenggara	37	8.62
	No mention the location	6	1.40
Last education			
	Didn't go to school	0	0
	Elementary School	4	1
	Junior High School	4	1
	Senior High School	111	31
	Diploma	18	5
	Bachelor	176	42
	Master	77	18
	Doctoral	10	2
Occupation			
	Didn't work	30	7
	Retired	8	2
	Student	111	26
	Government official	69	16
	Private employee	76	18
	Entrepreneur	75	17
	Extension worker	14	3
	Others	46	11
Income per month			
	Less than 500.000 IDR	81	19
	500.000 – 1.000.000 IDR	47	11
	1.000.001 – 3.000.000 IDR	76	18
	3..000.001 – 5.000.000 IDR	78	18
	5.000.001 – 10.000.000 IDR	104	24
	More than 10.000.000 IDR	43	10

d) Raw data – Results survey on honey consumers

Table 19 Honey Consumer Purchase Motive in Indonesia

Consumer Motivation for Consuming Honey	Selected by Respondents	%
1. Medicine	252	42,66

2. Lifestyle	212	36,60
3. Habit	68	12,12
4. Nutritional Fulfilment	182	34,27
5. Sugar Substitute	91	15,38
6. Food Additive	151	26,81
7. Cosmetic Additive	54	10,02
8. Others	10	1,86
Total Motives Chosen	**1020**	
Total Respondents	**429**	
Total Motives Available	**8**	

* The table above shows that each respondent choice more than one material and form of honey packaging

Table 20 Material and Shape of Honey Packaging in Indonesia

Material and Form of Honey Packaging	Selected by Respondents	%
Glass Bottles	296	68,75
Plastic Bottles	200	46,62
Jerry Cans	70	16,32
Sachet	45	10,49
Others	5	1,17
Total	**616**	
Total Respondents	**429**	

* The table above shows that each respondent choice more than one material and form of honey packaging

Table 21 Local and Imported Honey in Indonesia

Local and Imported Honey	Response	Number of respondents	Percentage (%)
Local	Never	1	0,23
	Once	20	4,66
	Rarely	149	34,73
	Often	124	28,90
	Always buy local honey	135	31,47
Total		**429**	**100%**
Import	Never	248	57,81
	Once	51	11,89
	Rarely	104	24,24
	Often	24	5,59
	Always buy Imported honey	2	0,47
Total		**429**	**100%**

Table 22 Honey Packaging Size in Indonesia

Packaging Size	Number of respondents	Percentage (%)
250 ml	167	38,93
600 ml	132	30,77
1 l	63	14,69
1 kg	38	8,86
Others	29	6,76

Total	**429**	**100%**

Table 23 Label Information in Indonesia

Label Information	Selected by Respondents	%
Ingredient composition	183	42,66
Barcode	59	13,75
Legality	174	40,56
Best before	186	43,36
Nutritional value	170	39,63
How to use	120	27,97
Trademark	102	23,78
Usefulness	172	40,09
Manufacturer logo	112	26,11
Manufacturer name and address	125	29,14
Total	**1403**	
Total Respondents	**429**	

*The table above shows that each respondent chose more than one choice label information which respondents' thought is important

Table 24 Honey Type in Indonesia

Honey type	Selected by Respondents	%
There is no specific type	176	41,03
Multiflora	87	20,28
Kaliandra	41	9,56
Kapok Randu	53	12,35
Longan	79	18,41
Rambutan	32	7,46
Forest honey	185	43,12
Others	46	10,72
Total	**699**	
Total Respondents	**429**	

*The table above shows that each respondent chose more than one choice honey type that preferred.

Table 25 Honey Quality and quality parameters in Indonesia

Honey Quality	Number of respondents	Percentage (%)
Ripening honey has good quality	143	33,33
The level of honey ripeness does not affect the quality of honey	18	4,20
Do not know/understand the relationship	268	62,47
Total	**429**	**100%**
Honey Quality Parameters for Consumers	**Selected by Respondents**	**%**
Thickness	351	81,82
Honey Ripening Level	80	18,65
Pesticide contamination	38	8,86

Vegetation type	134	31,24
Others	43	10,02
Total	**646**	
Total Respondents	**429**	

* The table above shows that each respondent chose more than one choice honey quality parameters.

Table 26 Indonesia Consumer Perception about Honey Originality in the Market

Consumer Perception	Number of respondents	Percentage (%)
100% authentic	134	31,24
Not sure	295	68,76
Total	**429**	**100%**

Table 27 The Need for Honey License and Traceability in Indonesia

Honey license and traceability	Number of respondents	Percentage (%)
Yes	397	92,54
No	32	7,46p
Total	**429**	**100%**

Table 28 The Scale of Interest in Honey Traceability in Indonesia

Scale	Number of respondents	Percentage (%)
Not important		
1	5	1,17
2	3	0,70
3	7	1,63
4	8	1,86
5	24	5,59
6	47	10,96
7	39	9,09
8	65	15,15
9	50	11,66
10	181	42,19
Very important		
Total	**429**	**100%**

Table 29 Factors that Influence Indonesia Consumers in Buying Honey

Factors that Influence Consumers in Buying Honey	Selected by Respondents (Respondent can choose more than sources available)	%
Price	218	50,82
Quality	373	86,95

Thickness	85	19,81
Scent	132	30,77
Hygiene	145	33,80
Brand	81	18,88
Packaging	98	22,84
Type of Bee	89	20,75
Product Licensing	116	27,04
Product License	83	19,35
Others	31	7,23
Total	**1115**	
Total Respondents	**429**	

e) Raw data – Results survey on technology

Table 30 Willingness to support by different beekeeping stakeholders

Criteria		Total				
1	Willingness to support if technology can improve honey quality					
		Not willing	Less willing	Quite willing	Willing	Very willing
	Beekeepers	1	0	1	1	2
	Government	0	0	1	10	8
	University / Research Institute	0	0	0	2	3
	Business	1	1	2	1	1
	NGO	1	0	3	3	0
	Community	1	0	0	2	1
2	Willingness to support if technology can improve the safety of beehives from theft					
		Not willing	Less willing	Quite willing	Willing	Very willing
	Beekeepers	1	0	1	1	2
	Government	1	0	0	11	7
	University / Research Institute	0	0	1	2	2
	Business	1	0	2	2	1
	NGO	2	0	3	2	0
	Community	1	0	0	2	1
3	Willingness to support if technology can help beekeepers monitor their colonies remotely					
		Not willing	Less willing	Quite willing	Willing	Very willing
	Beekeepers	1	0	1	1	2
	Government	1	0	1	12	5
	University / Research Institute	0	0	1	2	2
	Business	1	1	1	2	1
	NGO	2	0	3	2	0
	Community	1	0	0	2	1
4	Willingness to support if technology can provide bee colony health information to beekeepers					
		Not willing	Less willing	Quite willing	Willing	Very willing
	Beekeepers	1	0	1	1	2
	Government	1	1	1	10	6
	University / Research Institute	0	0	0	3	2
	Business	0	0	0	0	0

	NGO	2	0	2	3	0
	Community	0	0	0	3	1
5	Willingness to support if technology can provide bee feed availability information to beekeepers					
		Not willing	Less willing	Quite willing	Willing	Very willing
	Beekeepers	1	0	1	1	2
	Government	1	0	3	8	7
	University / Research Institute	0	0	0	3	2
	Business	1	1	1	2	1
	NGO	2	0	3	2	0
	Community	1	0	0	2	1
6	Willingness to support if technology can provide beekeepers with prediction of honey harvest time					
		Not willing	Less willing	Quite willing	Willing	Very willing
	Beekeepers	1	0	1	1	2
	Government	1	1	1	9	7
	University / Research Institute	0	0	0	0	0
	Business	0	0	0	0	0
	NGO	0	0	0	0	0
	Community	0	0	0	0	0
7	The level of usefulness of SAMS technology					
		Useless	Not useful	Quite useful	Useful	Very helpful
	Beekeepers	0	0	0	0	0
	Government	0	1	1	9	8
	University / Research Institute	0	0	2	2	1
	Business	1	1	1	1	2
	NGO	1	0	3	3	0
	Community	1	1	0	1	1
8	Willingness to support if technology can provide big data information related to environmental issues					
		Not willing	Less willing	Quite willing	Willing	Very willing
	Beekeepers	0	0	0	0	0
	Government	0	0	0	9	10
	University / Research Institute	0	0	1	2	2
	Business	1	0	2	2	1
	NGO	0	1	3	3	0
	Community	0	0	1	2	1

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