A Review on the Aspect of Beekeeping and Economic Efficiency
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ARTICLE INFO
Keywords: Beekeeping, Honey Production, Pollinator, Income, Producer, Apiculture

ABSTRACT
Beekeeping is an occupation which produce natural compound as medicine include honey, beeswax, royal jelly, bee venom, pollen and bee gum. Beekeeping has a significant role in rural development in a lot of countries in the world. The purpose of this research is to show the benefits of beekeeping, bee products, market opportunity and income of beekeepers. Bees are special pollinators in agriculture and ecosystem. Pollination by honeybees has improved the crop yield and quality of Fruits. Especially, Products from bees are used in food, candles, skincare, cosmetics, and medicine. The amount of honey produced globally, which varies by continent, reached a total of 1.7 million tons. Asia is thought to be the world's largest producer of natural honey, with an output of 859 thousand tons. After the Americas, which have about 345 thousand tons, Europe has about 383 thousand tons, Africa has about 151 thousand tons, and Oceania has about 32 thousand tons. China is well known as the world biggest honey producer. Moreover, apiculture have high income which earn more than $5000 per month from selling honey. So, farmers should feed honey bees in their farm and learn new technique from beekeeping experts in order to get high quality honey and increase crop yield.
INTRODUCTION

Beekeeping or apiculture is a process of feeding honey bees which related to science and art of controlling bees with a centuries-old tradition (Sarford & Tew, 2002). The activity of living substances is important in apiculture such as queen and drone that product honey, pollen, royal jelly, beeswax, bee gum and bee venom by using herbal sources, bee and labor together (Ören et al., 2010; Aydin et al., 2019). Beekeeping is relied on nature due to the lifestyle of the honey bees and the gathering of the raw materials of the products from nature. Beekeeping plays important role in rural development in Cambodia and many countries. Bees are kind of insects that living together in hive. It was called colony. The queen is the largest female bee that is living in swarm of bee and laying many eggs in hive. She is response in managing, caring and growth of bees in family. In swarm of bee had workers that had more than 100 thousand. They are not fully developed bees or we can call atrophied females. In the nest of bees has a few males and not usually live in nest. They are disappearing when the nectar flow (honey flow) ceases. They’re among differently from a few hundred to a few thousand (Warre et al., 2007). The first beekeepers began as hunters who were finding wild nests of honey bees and mostly were destroyed to collect the sweet reward, called honey. As potential in honey bees grew, entomological and biological knowledge have been developed to better maintain colonies of Apis mellifera. The innovations by using modern technology allowed beekeeping to arise and previously developed in the 19th century. It is the big changes of beekeeper in a half century later which using helpful instruments such as centrifugal extractor, moveable-frame hive and smoker (Sarford & Tew, 2002).

In process of apiculture, there are many problems that most of beekeepers are facing such as bee disease, chemical pesticide, predators, parasites and bee pasture where bees are gathering pollen. Feeding equipment and method are also the major issue that beekeepers should learn more. Bee pasture is really important for producing quality and quantity of honey. All of beekeepers normally have collaboration and solution in bee pasture and stop deforestation. Moreover, in growth region must avoid using chemical hazardous substance in agriculture land because it reduces number of bees in hive.

LITERATURE REVIEW

The best pollination insect is bee that lives on earth for many million years. These insects spread into European settlement such as Americas and Australia. Nowadays, species of bees are living on all continents and every environment. Although products form bees are still essential and higher nutrients value. At least 10,000 years ago, people began to attempt to maintain colonies of wild bees in artificial hives made from hollow logs, wooden boxes, pottery vessels, and woven straw baskets known as skeps. Depictions of hunter collecting honey from wild bees’ date to 10,000 years ago (Dams, 1977). Human started beekeeping in pottery vessels approximately 9,000 years ago in North Africa. Traces of beeswax have been discovered in potsherds throughout the Middle East beginning about 7,000 BCE. Domestication of bees was expressed in Egyptian art from around 4,500 years ago (Crane, 1999). Simple hives and smoke were used, and honey was kept in jars, some of which were seen in the tombs of pharaohs such as Tutankhamun. In the 18th century, European used to study on bees’ colonies
and understand their biology which allowed the construction of the movable comb hive so honey could be harvested without damaging the entire colony. In swarm of bees have individual growing stages base on character. The first bee is called queen who take 3 days in egg, 5 days living as larva and 8 days as a pupa. The queen hatches form pupa after 16\textsuperscript{th} days. She is fertilized about seven days and starts to lay egg for 2 days, not less than 25 days, regularly 30 days, after the egg was laid. The second is bee worker, the egg stage is 3 days, larva stage is 5 days and pupa stage is 13 days. Bee workers appear after 21 days in pupa. And then she lives in nest as a nurse or wax producer around 15 days. She starts to forage 30 or 36 days after the egg was laid. The third bee is male that spends 3 days at the egg stage, larva is 6 and a half days, hatching on the 24 days. After 5 days hatching from pupa male bee can reproduce or about 30 days from egg. Queen of bee can live for four to five years. It is about 50 times longer than the life-cycle of bee workers born at the beginning of the nectar flow. It is the same as chickens, queen can produce more egg in two year later (Warre et al., 2010).

Bees are potential insect that can produce honey, beeswax, propolis, pollen, royal jelly, and honeycomb (Hall, 2023). Honey can be used in food, beverages, candle, medicine and cometic. The most common honey was used as favorable ingredient in food, Jams, Jellies and beverage. Honey is an important source of carbohydrates and natural sugar. Especially, it is safety to use if compared to glucose and sucrose. Nowadays, honey is popularly used as healthy diet and beauty products. Moreover, honey consists a large of medical characteristics, including the ability to boost metabolic activity, lower the risk of diabetes, reduce blood pressure and even treat burn wounds (Grand View Research, 2023). There are several research articles have shown the efficiency of honey as an alternative medicine; some have even expressed that honey is as a best medicine as conventional medicine. Using different types of honeys had anti-inflammatory effect very similar to the conventional drug and can be used as an alternative medicine in the treatment of illness or infection. Honey can also be used to control or destroy microorganism as anti-inflammatory agent, antibacterial, antifungal antivirals, antioxidants and anticancer. However, there are not in enough in researching of honey. Scientists need to research more on honey, especially in its potential as a medicine and also a dissemination of this knowledge to the population and the medical community. So, this powerful compound will be useful in near future (Ferreira da Cruz et al., 2019). Honey is the best ingredient for skincare and cosmetic products because mold can’t grow on it. Beeswax is the natural secretion from honey bees that make from their wax glands on the sides of their bodies. It usually uses as furniture polishing products, skincare product, candles, and more. Bee pollen is a product from the male seeds of flower blossoms which honeybees gather and then combine with their digestive enzymes. It contains antiviral, antibacterial and many health properties that make it popular as a tonic for athletes. Propolis is made when honeybees chew the buds of trees and conifers and combine them with their saliva. It has antibacterial, antifungal, antiviral, anti-inflammatory and antioxidant. the queen honeybee’s food is Royal jelly. It is produced of a mixture of secretions from the worker bees’ salivary glands. Its potent antioxidant properties made it popular as a health supplement as well as an ingredient for skincare products. Honeycomb pollen is also known as Bee bread. It is made from pollen combined
with honeybees’ digestive fluids and nectar. It is used as a health supplement against digestive issues, cholesterol, hepatitis, anemia, insomnia, memory problem, and stress (Hall, 2023).

Beekeeping can provide an important source of income for many rural livelihoods by selling products from bees. Bees’ products play important role in food, medicine, pollination, and religious which improve social life. The greatest benefit of honey bees to agriculture isn’t their products at all. But, the important thing is crop pollinators which can improve crop yield and quality of fruit. Beekeeping is useful in agricultural management practice Pollinators affect 35% of global agricultural land, supporting the production of 87 of the leading food crops worldwide (Matias DM et al., 2017).

The special pollinators are bees because most of their life span is collecting pollen, a source of protein. When a bee lands on a flower, the hairs of bees’ body attract pollen grains and easily attack to stigma of one flower or transfer to another flower of the same species. Many plants require cross-pollination which contribution by bees, in order to produce viable seeds. In ecosystem bees are playing important role as pollinators for a lot of trees in forest and create diversity of genetic. They improve trees growth, developing flowers, and many plants, which serve as food and shelter for creatures big and small. Bees provide a lot of advantages for wildlife, interconnected ecosystems that create a diverse number of different species to appear on earth (Thomas, 2021). In apple and strawberry farm had increased the yield and quality because of pollination by bees. They also enhance the fruit quality and decrease immature fruit drop in peach, apple, orange, and plum trees (Verma and Dulta, 1987; Partap et al., 2000).

METHODOLOGY

A qualitative approach and a clear explanatory strategy are used in this research article. Many quality reports, books, journal articles, regulation and policies, and news from online media are the main sources of the information. The data collection techniques include identifying, examining and acquiring which are essential materials in this study. Information can be found by looking through perusing books or e-books, research databases, case ponders, online media, valid institution websites, and online media websites. The method of information examination includes perusing, making notes, portraying, expounding, and coming to conclusions.

RESULTS AND DISCUSSION

Beekeeping economic has been investigated in turkey, according to research by Subasi et al in 2019 showed the average honey price in the region was 5.30 $/kg. The mean number of hives was 179.06 and the yield was 12.3 kg per hive a year. The mean annual gross production value was 25029 and net profit was 19882 $. The mean relative profit was calculated as 2.70 $ per year. According to research by Tosun and Oguz in 2021 stated that mean gross production cost was 45,931.08 $. The honey production variable had been determined as 49.21 $ per hive, as an average enterprise. It has been showed that total fixed cost was 28.07 $ per year after enterprises was examined. Another result expressed that Gross profit was 22,902.47 $ per enterprise and Net profit per enterprise was 20,684.16 $. In cost analyzing and evaluation illustrated that the ratio of variable
costs was 63.68% and 36.32% of fixed costs. In average enterprise, the cost of 1 kg of honey had been set as 4.16$. Mr. Ly Hour (2021) is a beekeeper who live in Cambodia express that he has experience four years in beekeeping, he decided to start raising bees in his hometown with 100 hives for the first step. He received honey yield around 450 liters, and honey price in the market is 25$ per liter, but the wholesale price isn’t stable. So, in a month he can earn more than $ 5000 from selling honey (Radio Veritas Asia, 2021).

Honey yield depend on species of bee and technique to manage bee hives. According to research by Aydin et all in 2019 show that Average yield amount per hive was 16.24 kg and production cost was 53.32 $ per hive. The price of honey is not stable between 2.04 to 3.54 $. According to research in Ethiopia afar regional state expressed that the yield of honey per beehive vary from 4 to 17 kg depend on flowering season. It had 9.66 kg as average annual production. Honey can be harvested two times per year normally, while 18%, 19%, and 14.2% of the respondents harvest 3, 4 and 5 times per year separately. It depends on the special floral season of local tropical plants. 67.5% of respondents supplement with their colonies during dry season. On average, beekeepers sold 77.86 kg per year, with a range from 0 to 353 kg (Reda et al., 2018). Miklyeav et al. in 2013 showed that modern beehive can increase yields around 20kg higher than traditional hive with yield only 6-8 kg. The total annual honey yield was 32.5 kg from the five traditional beehives, after using three modern beehives honey yield reached 60 kg in total. Honey yield can be lost cause by some insects (ants) that reduce 3.25 kg of honey every year. For beekeepers who have Certificate of food safety have higher income from selling quality honey which collect from local honey bee species. Especially, in Pa Khoang village had 1.2 to 3.6 million/beehive (Nghiem Xuan Hung, 2020). Mr. Quang Van Hung in Vang Village kept 3 beehives and get 60 litters of honey and earn 469 $ in 2019 (February to June), while the other households who still used traditional beehives can get 27-64$ per hive/year. So, the beekeepers’ income has improved from 1.7 to 2.4 times compared to old practice of beekeeping.

Beekeeping is a new business in Cambodia. Not all of Khmer farmers know about beekeeping techniques. Even though, honey has been sold in high price in Cambodia. Most of the local beekeepers produce fermented honey. So, one liter of low moisture honey weigh between 1.2 to 1.4 kg. Honey price can be change between $15- 25/kg depending on quality and season. Wholesale price is $12/kg in quantities over 100 kg. An average yield of honey in conservation region is 30 kg in one colony. For transferring hives in orchards all year, honey yield can be up to 90 kg (Radio Veritas Asia, 2017).

The worlds production of honey reached 1.7 million tons in 2021. Based on the continent regions. Asia region still become the biggest producer with output of natural honey reached 859,000 tons, and then Americas with production around 345,000 tons, Europe with production around 383,000 tons, Africa with 151 000 tons and Oceania with 32,000 tons. China is the biggest producer of honey in the world. Most common bee species in China are Apis mellifera and Apis cerana that can provide high yield of honey. The main province with highly production of honey is Zhejiang which had more than 1 million bee hives expand over 15,000 beekeeper’s local household. Turkey is the largest second producer of honey located in Europe that has a lot of products collecting from honey bees.
provinces of this country have highest honey production such as Mula, Ordu, Adana, Aydin, Sivas and Mersin. In rural area of Turkey had many beekeepers which have more than 104,709 beekeepers and 6 million beehives in household. Iran is a third honey producer located in Asian region. There are some provinces that have highest honey production such as west Azarbaijan, Azandaran and Ardabil. There are a lot of beekeepers spread across these provinces and have more than 6 million beehives (The Science Agriculture, 2023).

![Graphic 1. Raking of the World Largest Honey Producers’ Countries from the Science Agriculture in 2023](image)

The size of global honey market was calculated at USD 8.58 billion in 2021 and it is expected to expand at a compound annual growth rate (CAGR) of 5.2% from 2022 to 2030. Honey is the best source of numerous nutritional ingredients including vitamins, antioxidants, calcium, and minerals. High market demand for healthy food products is a prominent factor driving the market, as more and more people are understanding about advantages of living a healthy lifestyle (Grand View Research, 2023). The major country that imports a lot of honey in 2020 was USA about 196,641 million tones and cost $ 441 million. Followed by Germany which imported around 92,234 million tones and price $ 280 million. Japan was the third country that imported natural honey about 49,345 million tones and cost $ 174 million (Agri exchange, 2020)

<table>
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<tr>
<th>Rank</th>
<th>Country</th>
<th>Quantity in MT</th>
<th>Value in US $ million</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>USA</td>
<td>196,641</td>
<td>441</td>
</tr>
<tr>
<td>2</td>
<td>Germany</td>
<td>92,234</td>
<td>280</td>
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<tr>
<td>3</td>
<td>Japan</td>
<td>49,348</td>
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<td>4</td>
<td>France</td>
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<td>6</td>
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CONCLUSIONS AND RECOMMENDATIONS

Beekeeping is the good practice in agriculture because bees are special pollinators in orchard and play important role in ecosystem. Bees can increase crop yield and quality of fruits. Moreover, products from bees have high economic value and their nutrition are essential for human. Honey have been used as food, cosmetic and medicine because of the high antioxidant and special sugar that is good for keeping healthy. Furthermore, beekeeping can increase rural income and reduce poverty. So, farmers should feed honey bees a few or more hives in their farm and learn new technique from other beekeepers in order to get high quality honey and better price. We should protect bees and other pollinators for efficiency pollination in agriculture.

ACKNOWLEDGEMENT

I would like to express my sincere thanks to Assoc. Prof. Dr. Serey Mardy from Svay Rieng University for his warmhearted, valuable advice and skillful guidance with vital comments during my research, even though he has a busy schedule.

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