Increasing efficiency of honey extracting through innovative technology as exemplified by a small agricultural producer

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Abstract. Honey and wax production in Russia is considered a traditional branch of agriculture, which enables to produce valuable biologically active food for the population and raw materials for the industry. Many sources speak for a rapid annual decrease in the number of bees. One of the factors in reducing the number of bees is a somewhat tough way of collecting honey, in which a small percentage of the hive dies. The paper discusses the possibility of using innovative Australian FlowHive technology designed to allow honey to flow down freely. With this technology, honey is extracted without disturbing the bees as in normal extraction. The pivotal technological secret of a FlowHive beehive is durable plastic mobile honeycombs. By turning a special knob, the vertical gaps are offset by one half of a cell, allowing the honey to flow down through the cells into a channel at the base of each frame and out into a collection vessel. The paper presents a set of data for calculating the effectiveness of innovative beehives in small agricultural production. It establishes that, once applied, innovative hives not only increase profits, but also decrease costs for basic production.

1. Introduction
Today, about 5 thousand enterprises and 300 thousand enthusiastic beekeepers, farmers and individual entrepreneurs are engaged in honey production. About 50 thousand tons of honey sold is produced annually in Russia (the data has varied over the past 19 years). Agricultural reforms contributed to a sharp decline in beekeeping production by farm category. The core commodity producers are households, rather than agricultural enterprises [1].

As early as 2006, there was a significant seven-fold decrease in the number of bee colonies in agricultural enterprises in comparison with the previous decade, and the figure continues to decline rapidly. Comparing actual consumptions of honey in Russia (0.4 kg per inhabitant) with economically developed foreign countries (more than 2 kg per inhabitant), it becomes noticeable that beekeeping at the present stage cannot meet the needs of the population. In addition, with insufficient honey harvests, provoked by unfavorable weather conditions, and the global extinction of bees in recent years, the price of honey has risen considerably.

Honey production in Tambov region is widespread, but at the expense of small household producers [1-3].

According to 2017 data, the region produced about 1,178 tons of honey and took 3rd place in the Central Federal District that is the first in the production of honey in the country, after Belgorod and Voronezh regions. In 2019, Tambov beekeepers collected over 1,355 tons of honey from their apiaries.
This exceeds last year’s figures by 4.1%. These three entities of the Federation are located in the Central Black Earth economic region characterized by suitable conditions encouraging the beekeeping industry.

Figure 1. The amount of honey produced in the Central Federal District, tons.

2. Materials and methods
The paper aims to prove the effectiveness of replacing familiar, conventional hives in Tambov region with the Australian technological FlowHive system enabling automatic honey extraction.

The paper discusses the implementation of innovative technology in small agricultural enterprises. In particular:
- the use of hives based on Australian technology,
- integration of the Flow Hive system;
- increasing the production efficiency of small agricultural enterprises.

The following research methods were used in the paper, including monographic, statistical, economic, abstract-logical and others.

3. Results and Discussion
The Tambov region is one of the most successful regions for honey production in terms of location [2, 4]. Weather conditions and fertile soil nourish agriculture, which means that there are many honey plants for bees during the season.

According to the Tambov Society of Beekeepers, Tambov region produces 6 times more honey than the residents of the region consume, so you can buy Tambov honey not only at agricultural fairs attracting guests from all over the country, but also on the websites of beekeepers and specialized resources.

For the last several years, the state has been paying great attention to the beekeeping industry. The Ministry of Agriculture assists beekeepers in the establishment of cooperatives, provides grant support. Today, more than 1.6 thousand bee herders are registered in Tambov region. Over the past two years, 6 Tambov residents received grants for the development of beekeeping farms in the region [4].

As part of the framework program of the Russian agro-industrial exhibition “Golden Autumn – 2020”, the Ministry of Agriculture of Russia carried out an online round table on Resultant Activities
Carried out in the Beekeeping Sub-industry in Russia. It gathered the delegates from the Department of Agriculture of the Tambov Region and the Tambov Society of Beekeepers [5-8].

The participants were concerned about the death of bees from pesticides. They also proposed to amend the Federal Law on the Safe Handling of Pesticides and Agrochemicals [6].

More than 30 apiaries participated in the annual honey fair in Tambov this year. Beekeepers traded in various types of honey and other products – propolis, pollen, royal jelly, dead bees, wax, etc.

Honey production depends on two key factors – the number of colonies in the region and their productivity.

In 2016, the All-Russian Agricultural Census was carried out resulting in the information on bee colonies in the Federal Districts to be adopted. The Central Federal District that includes Tambov region takes the 2nd place, after the Volga Federal District and accounts for 19% of the total number of bee colonies in the country [3, 9].

The use of novel innovative technology will allow Tambov region to increase the amount of honey produced, with a possibility of further expanding the sales market in the region.

Both a gradual replacement of existing hives and emerging new small forms of organizations using the Flow Hive will be equally effective.

The Australian Flow Hive technology with automatic honey extraction. Flow’s patented split cell technology uses partially formed comb that the bees complete, fill in the cells with honey and cap them off. To collect ready-made honey, it is enough to turn a special key without opening the hive. When the mechanism is activated, the vertical gaps are offset by one half of a cell, allowing honey to flow down through the cells into a channel to the base of each frame and out of the hive through the tube into a collection vessel. Meanwhile, the bees remain undisturbed and behave calmly.

After collecting the honey, the key must be put back in starting position to reset the system. This will allow the bees to refill the honey cells.

One of the sides of the frame is transparent, which allows beekeepers to observe the life of the hive. Watching the life of bees is very amusing not only for children, but also for adults. Besides, you can see the size of the bee colony and timely notice various disturbances in the work of the bee colony.

Let us consider the efficiency of innovative hives integrated into an already functioning agricultural production with thirty conventional, 16-frame hives. Every year a beekeeper has about 1,050 kilograms of honey for sale and the final profitability for the season makes up 262,500 rubles. Excluding all costs, which include the payroll – 97,650 rubles, utility bills for water and electricity – 3,000, taxes – 1,761 rubles and other expenses, the net profit for the season is 150,089 rubles.
The price for one fully equipped hive is about 15,000 rubles, which is very expensive for such a small enterprise. Hence, the technology should be introduced gradually.

Let us examine a situation where, from 2021 to 2022, an enterprise will gradually replace existing hives. The amount of honey produced in innovative hives is 1.5 times higher due to the reduced time for the construction of wax honeycombs by the bees. Consequently, 1 hive will yield about 53 kilograms of honey per season. Moreover, there is no need to hire new staff, since this technology can significantly reduce and simplify the method of harvesting honey.

| Table 1. Implementation of innovative hives in existing production |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                          | 2020 | 2021 | 2022 | 2023 |
| Revenue, rub.            | 262,500 | 262,500 | 397,500 | 397,500 |
| Costs, rub.              | 112,411 | 112,411 | 187,322 | 202,144 |
| Profit on sales, rub.    | 150,089 | 150,089 | 210,178 | 195,356 |
| Procurement of hives, rub.| -   | 225,000 | 225,000 | -   |
| Ultimate profit, rub.    | 150,089 | -74,911 | -14,822 | 195,356 |

On average, a kilogram of honey costs 250 rubles in the target region. Therefore, one innovative hive will yield 12,150 rubles, and provided that honey is collected three times in 1 season – 36,450 rubles, whereas a conventional hive yields 24,300 rubles.

The costs for each year the technology is implemented will additionally amount to about 10,000 rubles due to the need to purchase additional bee packages and veterinary drugs.

After analyzing the data in the table, we can see that with innovative FlowHive beehives, the profit of this beekeeping farm increased by 30.2% and amounted to 195 thousand rubles, and they paid off in the final year of their implementation.

If the enterprise decided to implement conventional hives rather than innovative FlowHives, then the cost would increase by 72,780 rubles per year attributed to the need for an additional employee. In this situation, the profit would decrease by 32.2% and amount to 57,539 rubles, but, despite their cheap cost compared to the innovative FlowHive, they would pay off in the final implementation year as well.

| Table 2. Production of conventional hives for existing production |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                          | 2020 | 2021 | 2022 | 2023 |
| Revenue, rub.            | 262,500 | 262,500 | 262,500 | 262,500 |
| Costs, rub.              | 112,411 | 185,191 | 194,961 | 204,961 |
| Profit on sales, rub.    | 150,089 | 77,309 | 67,539 | 57,539 |
| Procurement of hives, rub.| -   | 75,000 | 75,000 | -   |
| Ultimate profit, rub.    | 150,089 | 2,309 | -7,461 | 57,539 |

When different hives were implemented in 2023, the difference between the profits was 137,817 rubles, which is not so significant, but we should not forget about innovative hives, as a place in which, while the honey is harvested, the bees feel more comfortable, do not need to be put to sleep and are not disturbed as in normal extraction.

Definitely, it would not be advisable to completely abandon conventional hives, since the innovative FlowHives do not boast an ability to collect honeycombs.

4. Conclusion

On the example of a small agricultural producer, it was clearly shown that normal hives should be partially replaced with their more breakthrough counterparts. This would be an efficient solution, not only from profitability considerations, but also because of the lower costs for the basic production.
After all, the FlowHive system is much easier to use and requires much less effort and time to be maintained.

The high cost of the Australian FlowHive automatic system is offset by high production volumes, ease of use and possibilities to keep the bees undisturbed when the honey is extracted. After all, it is an irreplaceable resource in all beekeeping activities.

The region is working towards the establishment of a company aimed at the production of honey, beekeeping products, as well as the development of various honey-based products. This will promote the competition in the interregional market.

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