

## Technology and Market Access Improve Livelihoods for Rural Ethiopian Beekeepers

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### 1. Abstract

WEEMA International, an NGO that organizes community-based development programs in Ethiopia, has been working with rural beekeepers since 2013 to improve livelihoods by increasing the profitability of honey production. Ethiopia is Africa's largest honey producer by a substantial margin, and the 9th largest honey producer in the world. Despite high overall output, per-capita productivity among Ethiopian honey producers remains persistently low due largely to the fact that more than 95% of beekeepers continue to use traditional hives and apiculture techniques rather than more efficient modern alternatives. Consequently, Ethiopia's current annual output of nearly 55,000 metric tons of honey represents just 10% of the Ethiopian government's estimate of national honey production capacity. Improving the efficiency of rural honey production will result in increased yields and incomes for many of the 1.5 million people directly involved with beekeeping in Ethiopia. Indirectly, ensuring a profitable and self-sustaining honey industry will improve prospects for growers of pollinator-reliant cash crops such as coffee, oilseeds, legumes, and flowers—four major crops which together account for more than 50% of Ethiopia's total exports. A well-managed and resilient bee population will help ensure the future viability of these and other crops, providing vital stabilization to Ethiopia's agricultural sector and the 82 million people it now employs. To establish an indicative model of successful transition to an improved rural apiculture system, WEEMA has spent the last five years working directly with communities in Ethiopia's Southern Nations, Nationalities, and Peoples' Region (SNNPR), an area home to 14.9 million inhabitants, 13.4 million (89.9%) of whom live in rural areas. After an initial community needs assessment, WEEMA defined and implemented targeted interventions designed to increase local beekeepers' income. These interventions consisted of: 1) training beekeepers to use modern apiculture techniques and equipment, 2) supplying upgraded hives and other equipment necessary for producing higher-quality honey, and 3) establishing and supporting local honey cooperatives. The third intervention was the product of recommendations made by graduate students from Columbia University's School of International and Public Affairs (SIPA) who researched honey production in Ethiopia and visited WEEMA project sites in early 2016. WEEMA's field staff have collected empirical evidence as well as anecdotal testimony that highlight program successes. Ongoing evaluation of program performance to date indicates that training and supplying beekeepers results in increased net income from honey sales, an effect that is compounded when beekeepers sell their honey as part of a producers' cooperative. However, this effect is diminished by short-term challenges including technical issues with hive management, problems with unit standardization of honey storage, and high input costs associated with producing at a smallholder household level (as opposed to community enterprises benefiting from economies of scale). Longer-term challenges include integrating rural honey production into larger markets, both domestically and internationally, as well as various threats posed by climate change.

## Introduction

With a population of 105 million people (2017), Ethiopia is the second most populous country in Africa after Nigeria and the twelfth most populous country in the world overall. With a significant proportion of its citizenry living in rural areas, this population remains highly dispersed, at approximately 101 residents per square kilometer (compared to Nigeria's average of 212 residents per km<sup>2</sup>).<sup>1</sup> Despite a growing urban population, overall rural-to-urban migration rates remain low in comparison with surrounding countries. Economic factors such as the desire for employment and environmental factors such as recurrent droughts do induce people from rural areas to move to cities, but overall a substantial portion of the country continues to live in the same rural area where they were born, and in many cases where their family has lived for generations.<sup>2</sup> Addis Ababa, Ethiopia's capital and largest city, represents only the 15<sup>th</sup> largest urban agglomeration in Africa with just 3.2 million residents (3% of the country's total population) living in the city proper and mixed-density adjacent regions.

Given the scattered and relatively static distribution of Ethiopia's population, as well as the relatively slow growth of Ethiopia's urban population centers, internal policymakers and external actors including NGOs are targeting rural poverty as a long-term challenge, rather than as a temporary condition which will be alleviated over time through urban population clustering. WEEMA International, an NGO based in Cambridge, Massachusetts, has been working in Ethiopia since 2011 to organize community-based development programs that address acute community needs in rural areas. WEEMA's work is geographically focused in the south-western quadrant of the country, in the Southern Nations, Nationalities, and Peoples Region (SNNPR), a state that is home to 14.9 million inhabitants, 13.4 million (89.9%) of whom live in rural areas.<sup>3</sup>

There are many challenges faced by rural communities in the SNNPR, but economic and food security are oftentimes foremost daily concerns for families living in the communities where WEEMA programs are based. 82 million people in Ethiopia are employed in agriculture, with the vast majority engaged in subsistence farming. Many families maintain small household plots which are just large enough to feed themselves. Droughts are a common occurrence in Ethiopia, and protracted shortages of rainfall can have devastating consequences for rural populations. Climate change poses a substantial threat to the future of rural smallholder agriculture in Ethiopia; as climate patterns shifts, traditional farming practices that sufficed for generations may suddenly be rendered untenable, potentially pushing millions of Ethiopians to the verge of famine. For WEEMA, ensuring that rural families have economic and food security is an urgent priority, particularly as the short-term effects of climate change become more apparent each year. WEEMA has been working with farmers in the SNNPR to adopt beekeeping as a supplemental agricultural practice which, if deployed effectively and on a large scale, may help communities to endure despite the challenges posed by climate change.

Beekeeping is a traditional practice in many rural parts of Ethiopia, and honey production is already a well-established formal and informal industry in the country, although by the Ethiopian government's own estimate there is still substantial room for improvement. Ethiopia is the

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<sup>1</sup> "World Population Prospects 2017," United Nations DESA/Population Division, accessed July 9, 2018, <https://esa.un.org/unpd/wpp/DataQuery/>.

<sup>2</sup> Clark Gray and Valerie Mueller, "Drought and Population Mobility in Rural Ethiopia," *World Development* 40, no. 1 (January 2012): 134.

<sup>3</sup> "The 2007 Population and Housing Census of Ethiopia: Statistical Report for Southern Nations, Nationalities and Peoples' Region," Central Statistical Agency, Federal Democratic Republic of Ethiopia, July 2010.

largest honey producer in all of Africa by a significant margin, and is the ninth largest honey producer in the world. There are already approximately 1.8 million beekeepers working in Ethiopia, collectively managing more than 7.5 million bee colonies in hives, an average of 4.2 hives per beekeeper.<sup>4</sup> These hives generate an output of roughly 50,000 tons of honey a year—an impressive figure which is nonetheless just 10% of the Ethiopian government's estimate for total potential production capacity, which is 500,000 tons at the national level.<sup>5</sup> To increase total honey output will require more beekeepers working with more modern beekeeping techniques.

The general objective of WEEMA's beekeeping project is *to improve livelihoods among traditional beekeepers in Tembaro Woreda through education and provision of improved beekeeping materials.*

Specific objectives are:

1. To enhance the community beekeeping sector by providing education and assistance in beehive modernization
2. To incorporate more women into the beekeeping sector
3. To provide new income opportunities to participants by improving honey quality and yields and by developing other bee products suitable for market such as wax, pollen, and propolis (bee glue)
4. To Establish honey cooperatives to further increase quantity and quality of production, decrease costs of production, and gain access to larger markets

## **Field Methods**

SNNPR-based Ethiopian field staff conducted a baseline survey of Tembaro Woreda, the region where the beekeeping project first began as a pilot program. This survey established metrics which have informed WEEMA's approach to introducing modern beekeeping to the region. WEEMA's field staff found that, as of May 2016, there were 8,239 managed beehives in Tembaro Woreda, of which 93.4% were constructed in a traditional "basket" design.<sup>6</sup> The basket design allows bees to build honeycombs in a closed wicker structure. The structure cannot be opened until the beekeeper is ready to harvest the honey, a destructive process which involves the physical breaking of hive components and oftentimes the loss of many bees, if not the entire colony.

In the project design phase, WEEMA's staff considered the benefits and disadvantages of the Langstroth hive, the standard vertical hive design commonly employed in western-style beekeeping. Hanging-frame Langstroth hives are generally considered to be the most efficient style of hive available to amateur beekeepers, maximizing honey output while enabling frequent status checks to ensure bee health and honey quality.<sup>7</sup> Despite the advantages of the Langstroth hive, its adoption in Ethiopia and much of the developing world is limited by

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<sup>4</sup> This figure includes single hives managed by smallholder farmers, all the way to large plantations with dozens or hundreds of hives, managed by large staffs of professional beekeepers.

<sup>5</sup> Yiyi Dong, et al., "Final Report for WEEMA International: Improving Household Livelihoods with Modern Beekeeping and Honey Production in Ethiopia" (Dissertation, School of International and Public Affairs, Columbia University, 2016), 23.

<sup>6</sup> Bewchew, Tewodros, et al. 2017. *Improving Household Livelihoods with Modern Beekeeping and Honey Production: Annual Narrative Report*. Mudula, Ethiopia.

<sup>7</sup> Belie, T. 2009. "Honeybee production and marketing systems, constraints and opportunities in Burie District of Amhara Region, Ethiopia." MSc thesis, Bahir Dar University, Ethiopia.

prohibitive costs, a lack of knowledge regarding proper use and maintenance, and a lack of hive components available through local markets.

At WEEMA-organized beekeeping workshops, aspiring beekeepers are now given the opportunity to learn about Langstroth hives, but are also taught how to build and manage transitional hive models, which represent a technological midpoint between traditional “basket” hives and modern vertical hives. Transitional hives are often simple wooden boxes or square woven baskets that contain hanging frames. These hives can be opened from the top, allowing beekeepers to check on the insects inside. Unlike traditional hives, transitional hives can be reused, reducing annual costs for beekeepers while allowing bees to remain in place beyond one honey harvesting cycle, which substantially reduces colony stress. Unlike Langstroth hives, transitional hives can be constructed cheaply and with locally-available materials.

WEEMA's beekeeping project is conducted at a local level, with field staff working either with small groups of residents, or one-on-one in cases where special assistance may be required. Field staff are engaged in activities including:

- Purchasing raw materials to build transitional hives and shelters (large structures that house dozens of hives together)
- Building hives and shelters for new beekeepers
- Collecting and distributing protective gear to beekeepers (suits, boots, gloves, etc.), with appropriate instruction in safe practices
- Collecting and distributing beekeeping equipment to beekeepers (honey filters, barrels, storage containers, smokers, wax printers, etc.), with appropriate instruction in proper use
- Documenting baseline information and collecting data for all project participants
- Conducting beekeeping training and workshop sessions for local participants, including dedicated time for hive construction
- Working with beekeepers to form honey production cooperatives
- Supporting honey cooperatives through the marketing process
- Providing basic office supplies including stationary to honey cooperatives

Program activities are planned in advance and are recorded as they are carried out. Interventions vary between sites depending on specific local contexts, including demonstrated capacity and needs of local beekeepers.

## **Results**

The beekeeping project has, by and large, successfully facilitated the introduction of modern beekeeping equipment and techniques into Kembata Tembaro. Success of the project at a local level provides a useful reference model for scaling-up facilitated beekeeper trainings beyond the project's current geographical bounds.

The following results represent data collected during the most recent year of the multi-year project period (January – December 2017).

In 2017, WEEMA trained 78 new beekeepers in Kembata Tembaro, a training session overenrollment of 11 percent which, according to reports from trainers, is due principally to

honey cooperatives' openness to accepting new members which are sent for training, despite beekeepers' personal incentives to restrict the number of competing local producers.<sup>8</sup>

### New WEEMA-Trained Beekeepers in Kembata Tembaro, 2017

Male	Female	Total
42	36	78

Of the 78 beekeepers trained in 2017, 36 (46%) were female. While the proportion of new female beekeepers is still less than half of the total, this figure nonetheless represents substantial progress in a field that continues to be dominated by men at the national level.

100 percent of the 78 new beekeepers were provided with training, protective gear, and equipment. All 78 beekeepers were also directly involved in the process of creating local honey cooperatives, which enable beekeepers to work together to share risks and pool profits while maintaining favorable bargaining positions relative to larger honey markets.

All beekeeping trainees from 2017 have reported that they now are achieving a profit at least 10 Ethiopian Birr (ETB) per month (\$0.36 USD) from beekeeping, with many saving much more. No beekeepers have incurred a financial loss due to beekeeping. Many beekeepers who are currently breaking even or who are making a small profit expect to increase the profitability of their beekeeping operations in the future as they gain more experience and invest in new hives and equipment. Some beekeepers did not sell honey produced during the last year, but instead harvested honey on a small scale for in-home consumption. In all cases, beekeeper profit is calculated as the market value of all honey harvest and consumed or sold, minus the cost of beekeeping equipment, if any.

$$P = \frac{M(Q_S \cdot Q_C) - E}{T}$$

*Formula for calculating beekeeper profit, where P is profit, M is the market price of honey, Q<sub>s</sub> is the quantity of honey sold, Q<sub>c</sub> is the quantity of unsold honey consumed at home, E is expenses associated with honey production, and T is the time period under review. This formula does not account for the value of pollination as an environmental service.*

During the course of the last year of the beekeeping project, WEEMA's staff identified a number of remaining challenges that, if addressed effectively, may improve the average profitability of beekeeping for new beekeepers. These challenges included:

1. Bees leaving hives in swarms to settle elsewhere. This problem may be attributed to unfavorable in-hive conditions, a lack of nearby food sources for bees, overcompetition for food with other colonies, or a preferable nesting site located within a short distance from the hive. Beekeepers can prevent hive loss by monitoring in-hive behavior and adjusting conditions appropriately.
2. Delays in the purchasing of beekeeping equipment and supplies. The inconsistency of what goods are available for purchase through local markets threatens beekeepers'

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<sup>8</sup> Belachew, et al., 11.

ability to manage their hives. As demand for beekeeping equipment grows, suppliers may be incentivized to offer a more reliable selection of goods.

3. A lack of government capacity to monitor and offer support to beekeepers can hinder honey production efforts in cases where such help is expected but not ultimately offered. As rural tax collection and public administration systems gradually improve, WEEMA expects that the quality of such government support will improve as well.
4. Standardization of hives and of honey containers would make producing and marketing honey easier, but a lack of supplies continues to make a standardization difficult, especially for producers with only a small number of hives.

Because of challenges with household accounting and personal financial literacy, average figures for income and net profitability for beekeeping vary depending on how the variables for the profit formula are populated. Anecdotally, WEEMA-trained beekeepers report that their income per transitional hive harvested ranges from 800 to 1600 ETB (\$29 to \$58 USD) with a total yield of between 45 and 60 kg of honey. Using traditional hives, the same producers estimate that they only yielded 5 to 7 kg of honey, which they sold for a revenue of just 150 to 300 ETB (\$5.40 to \$10.80 USD).

## Analysis

The average Ethiopian household consumes 10kg of honey a year.<sup>9</sup> Consisting mostly of sugar, honey is not a nutritionally dense food, though it does contain trace amounts of iron, calcium, magnesium, phosphorus, and a dozen or so various other vitamins and minerals. As sustenance, honey's primary value comes from its high energy content, at approximately 304 kcal per 100g.<sup>10</sup> Honey also stores safely at room temperature for very long periods; if sufficiently sealed from the external environment, honey can preserve for many years after it has been harvested. Thus, for Ethiopia, a country that is already prone to drought and famine, and which now faces increased food insecurity due to climate change, honey produced at a local household level has the potential to serve as a lifesaving emergency food which can provide vital caloric energy during periods of acute hunger. Families can store honey easily in clay jars and other readily-available storage containers. During periods of food shortages, this honey can be accessed and used to sustain life until relief is available.

As a means to improve economic resilience, honey production has also demonstrated significant potential within WEEMA's test group of 78 newly-trained beekeepers. The fact that no beekeeper reported a financial loss due to beekeeping within the project period is highly encouraging, particularly considering that many of the beekeepers were working with brand new hives, tools, and methods.

WEEMA will continue to monitor individual beekeepers as well as honey producers' cooperatives to track data pertaining to the profitability of beekeeping in Kembata Tembaro. Field staff are particularly interested to learn whether profitability increase over time as beekeepers become more comfortable working with their hives and as local honey markets become better integrated with national markets.

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<sup>9</sup> Dong, et al. 16.

<sup>10</sup> "National Nutritional Database for Standard Reference: Basic Report (Honey)," Agricultural Research Service, United States Department of Agriculture, released in April 2018, <https://ndb.nal.usda.gov/ndb/foods/show/19296>

The data suggest that the market price of honey is highly variable, ranging from approximately 17 to 42 ETB per kilogram (\$0.61 to \$1.51 USD), dependent on factors such as location, time of year, competition, and quantity of honey being sold. If the market price of honey becomes more consistent over time it will improve beekeeper's ability to plan their expenses and save money. For now, the cooperatives fulfill this function, enabling beekeepers to sell honey throughout the year and across multiple markets without exposing themselves to losses due to price fluctuations.

## **Conclusion**

WEEMA's work with novice beekeepers in Kembata Tembaro, SNNPR, Ethiopia has demonstrated the viability of transitional hives as a powerful tool to improve the livelihoods of rural families. The style of transitional hives introduced by WEEMA's staff increase honey yields by a substantial margin, multiplying revenue from honey sales by a factor of more than 5, on average, compared with revenue earned from traditional "basket" style hives. While invariably not as efficient as modern Langstroth hives, the transitional hives have the advantage of being cheap to build and maintain, all using locally-available materials and relatively simple techniques. These hives can be used and reused year after year, with bees producing honey continually for many growing seasons while beekeepers monitor colony health and productivity. WEEMA's beekeeping program demonstrates that training and equipping beekeepers is a simple yet effective way to rapidly improve a rural family's food and economic security, an ever-more pressing challenge as climate change threatens to disrupt traditional agricultural systems and may lead to more frequent drought and famine in rural areas.

Beyond these direct benefits, beekeeping in rural Ethiopia can also yield environmental benefits. WEEMA's field staff work with beekeepers to plant bee-friendly crops, which ensure that colonies have access to a minimum quantity of food to sustain themselves. Beyond this immediate food source, bees forage for food across large cultivated areas, pollinating crops as they go, and increasing annual harvest yields. Indirectly, ensuring a profitable and self-sustaining honey industry will improve prospects for growers of pollinator-reliant cash crops such as coffee, oilseeds, legumes, and flowers—four major crops which together account for more than 50% of Ethiopia's total exports.<sup>11</sup> A well-managed and resilient bee population will help to ensure the future viability of these and other crops, providing vital stability to Ethiopia's agricultural sector and to the 82 million people it now employs. Higher yields from bee-pollinated crops will improve performance across Ethiopia's agricultural sector, increasing national wealth and helping to ensure the long-term food security and economic resilience of rural populations.

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<sup>11</sup> Alexander Simoes, "OEC: The Atlas of Economic Complexity," Massachusetts Institute of Technology, accessed 7/15/2018, <https://atlas.media.mit.edu/en/>.

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