

Beekeeping Assistive Technology



Assistive technology enables beekeepers with medical impairments to manage hives and sell honey. There are many opportunities for sideline apiaries with 20 to 100 beehives to produce honey and provide pollination services to local farms. <https://bearcreekorganicfarm.com/pages/adopt-a-hive> These hives may be spaced over several miles at various farmers' fields. Revenue comes from renting out pollination hives and selling honey products at on-farm stores, community farmer markets, local retail outlets, or online.

Arthritis, back injury, carpal tunnel syndrome, amputation, paralysis, and other medical conditions restrict beekeepers from completing necessary tasks. Functional limitations include mobility to the hives, bending over to inspect frames, lifting hive bodies, grasping frames, moving hives, gripping hand tools, and hand cranking extractors. While specialized machinery exists for commercial beekeepers, smaller apiaries require more manual labor. It is just not 'worth it' to spend annual gross sales to purchase one machine.



Successful beekeepers inspect their hives regularly for bee health, pests, and honey production. This requires mobility across rough terrain to access the hives, then unstacking the hive bodies (weighing up to 90-pounds) and pulling out frames. The challenge of mobility and physical strain of inspecting hives reduces the will-power to do so, and could lead to failure of the enterprise.

This report recommends assistive technology helpful to beekeepers with medical impairments. It is not meant to replace an on-site apiary assessment and accommodations tailored to a specific beekeeper. Please call Michigan AgrAbility at 800-956-4106 to schedule an assessment if this would be helpful to you.

Income, Supporting Organizations, and Customer Contribution

Income from a common sideline beekeeper with 20 to 200 hives will range from \$0 to \$100,000 per year. A beekeeper's income will depend on how the apiary is managed, what the financial goals are, and the products sold. An average work week in spring, summer and fall could be 20-40 hours per week, while winter work will be much less. If the goal of the apiary is physical activity rather than employment, the scope of the enterprise will be much less as well as the hours of work.



Supporting organizations that assist workers with medical impairments in addition to AgrAbility include Michigan Rehabilitation Services (MRS), Disability Network of Michigan, Farmer Veteran Coalition, Veterans in Agriculture Network, and Michigan State University Extension (MSUE). Local businesses will often give special pricing when a beekeeper is a military veteran or has a disability. MRS specifically helps workers with medical impairments to find and keep jobs. They require medical documentation and that the apiary business generates at least minimum wage ½ time.

Disability Network can help identify other community resources, assist with accessibility in the home, and advocate for a person with a disability. Farmer Veteran Coalition and the Veterans in Agriculture Network help veterans returning to civilian life to learn about agriculture as a viable career. MSUE has vast resources and information on agricultural techniques and finances.



If direct funding cannot be secured for all the necessary equipment, low-interest loans for assistive technology are available through the Michigan Assistive Technology Loan Fund. Loans up to \$30,000 can be approved by the committee. Bad credit that is due to the consequences of a disability will be taken into consideration. For more information, visit www.michiganloanfunds.org or call 800-828-2714.

Customer contribution is critical when seeking other organizations to support the apiary. When beekeepers are investing their own money and time into the business, it indicates the purpose with which they are operating the enterprise. Customer contribution to the apiary are efforts being made personally to improve the accessibility of the beekeeping worksite. Examples are:

- Purchase of shallow or medium supers for easier lifting.
- Moving hives to locations accessible by vehicle.
- Purchase of an ATV to reduce walking.
- Purchase of a hive lift.
- A powered extractor instead of hand cranked.

Specific Recommendations for Apiary Accessibility

The specific beekeeping tasks limited by the impairments described above are addressed below with detailed recommendations. These are the necessary methods, plans, tools, equipment and accommodations needed by the beekeeper to continue working **because of the disabling condition**. This is not a comprehensive list, as apiary tasks are too numerous and varied to list in their entirety. However, by providing the recommendations listed below, a sideline beekeeper will be able to perform the most important tasks with greater efficiency and increase likelihood of long-term apiary success.

1. Ergonomics & Secondary Injury Prevention

DESCRIPTION: Working safely is always a high priority. When a beekeeper has medical impairments, it is especially important that safety measures be taken to prevent secondary injuries. Beekeepers should follow medical advice and participate only in those activities with a low risk of mishap. Always carry an emergency phone.

- Rank accessibility improvements with a **SMILE**:
 - **S**afety, both yours and your co-workers',
 - increased **M**oney earned or savings,
 - value of you **I**ndependently doing the task,
 - tasks you **L**ike doing, and
 - how **E**xpensive improvements would be.

- Ergonomic principles are especially important to address awkward positions, high force tasks, repetitive motions, and vibrations.
 - Rest at regular intervals during the day & sit on a stool.
 - Alternate repetitive, awkward, and strenuous tasks.
 - Use proper workstation height and store items below shoulder level.
 - Keep commonly used items within 17 inches of the worker's body.
 - High-force hand tools should have 1 3/4" diameter handles.
 - Use long-handled tools to increase leverage and reduce stooping.
 - Add handles to containers and use carts to move quantities of materials.
 - Stand on anti-fatigue mats and wear boots with high-quality insoles.
 - Lift with correct posture, and do not twist while lifting.
 - Carry loads close to your body, and split into small loads.

- Universal Workstation Design Recommendations
 1. Step-free entry into buildings, and pathways free of clutter.
 2. Lever-style handles on doors instead of twist knobs.
 3. Store frequently used items 18 to 48" above the floor, keep mobile toolboxes near work stations, and no overhead racks requiring ladders.
 4. Use multi-height work benches with adjustable seating with switches and outlets at the front of the work bench.
 5. Floor-marking tape to organize storage areas & uncluttered work space.
 6. Label toolboxes and draw outlines of tools on racks for organization.



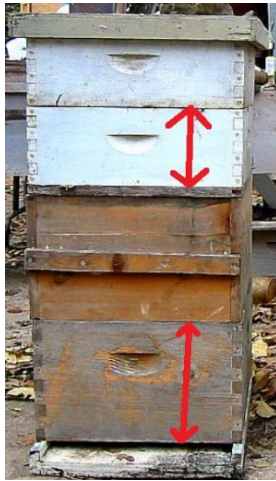
GlobalIndustrial.com sells an ergonomic workbench and tool balancer to support heavy tools. It is item #wg249497.



2. Lifting Hive Bodies

PHYSICAL LIMITATION: Lower & Upper Extremity, Endurance, Back

DESCRIPTION: Beekeepers with limited mobility, endurance, or back strength need to move hive bodies for inspection, transport, and honey harvest. Individual hive



The shallow and medium sized boxes are far easier to lift than the deep boxes at the bottom of this hive.

bodies can weigh up to 90-pounds when full of honey. The lower boxes are usually full of brood and the queen lives there laying eggs. The upper boxes are filled with honey during the spring and summer. Entire hives may be moved to different fields to aid in pollination, or individual may need to be lifted to inspect hives for pests or to harvest the honey.

Shallow Hive Bodies

The most basic assistive technology for lifting honey is to use smaller hive bodies. Shallow hive bodies are 5 3/4" tall instead of medium or deep hive bodies at 6 5/8" or 9 5/8" tall, respectively. Shallow hive bodies weigh around 40 pounds when full of honey, while deeps weigh over 70 pounds.

Studies of grape harvest workers found that decreasing harvest-tub size from 57 to 46 pounds reduced musculoskeletal injuries by 50%. Using smaller hive bodies will have the same impact. This will require more supers and frames to gather all the honey flow, but the health benefits are

significant. <http://www.bushfarms.com/beeseightframemedium.htm>

8 Frame Hive Bodies

Another way to reduce the lifting weight of hive bodies is to use 8-frame bodies instead of 10-frame bodies. These are narrower, and thus hold less honey, but are easier to lift. Adam Ingraio, director of the Heroes to Hives program at Michigan State University recommends 8 frame equipment for all veterans he works with that are dealing with back, neck, knee, and ankle injuries. The difference between a 10 and 8 frame deep can be up to 10 lbs.

Whole-hive Moving

Beehive lifts can be divided into two major categories: whole-hive lifts or individual hive body lifts. Whole hive lifts are simpler, less costly, and more limited in their usefulness. Individual hive body lifts can grip a hive body at any level and separate them at that level for very specific management tasks (in addition to moving the whole hive if desired). Whole-hive lifts require a ramp to load hives onto a trailer because they simply tilt-and-roll.

A heavy-duty, long-plate, two-wheel dolly with wide, all-terrain tires can be used to move whole hives. The hives need a solid bottom board and cleats 2-inches off the ground, so the dolly can be inserted under the hive before tilting and rolling to a new location. \$400

Hand hold dollies are whole-hive lifts with spring-loaded tongs that slide into the grips on both sides of the bottom super. When the dolly handle is pulled back, the bottom hive body lifts the entire hive. A ventilated bottom board can be used with hand hold dollies. \$560

Fork Hand Truck

Item# HTK-2351



This hand truck from HandTrucksRus.com would move whole hives.



Hand-held dollies such as this one from MannLakeLtd.com lift from the sides of the hive bodies. Item #MH-105.

Individual Hive Body Lifts

A two-person hive lift has handles on both sides and tabs that catch on the hive hand-grips. Although it is typically used to lift whole hives, it can move individual hive bodies depending on what level it grips the hive. The handles are lowered around the hive, then as they are lifted by both workers, the tabs grip the hive and raise it up. This very low-cost accommodation divides the weight in half, but it requires two people. \$75



The two-person hive carrier is a low-cost accommodation that divides the weight in half. It is item #935C at BrushyMountainBeeFarm.com.

The Kaptar Lift at right moves entire beehives *and* lifts individual hive bodies. It can be a hand crank or electric lift and it rolls on two wheels. Once tilted against a hive, the grip pads are raised to the desired hive body, then squeezed tightly with a locking compression lever to grip the hive. The hive can then be lifted and moved to a trailer or vehicle without manual lifting. The challenge is the narrow wheel base which causes the lifted hive to be unstable when moving across rough terrain. Dual wheels or attaching the Kaptar Lift to the front of a cart would create a very stable platform for lifting hives. \$3000

<https://www.countryfields.ca/products/kaptar-lift-electric>



This image at left shows a beekeeper-designed lifter to move beehives or individual hive bodies. It can be custom fabricated at the apiary if there is access to a welder and tools. It operates like the Kaptar Lift, with a two-wheel dolly base. A cable winch raises arms that straddle and grip the supers. The grip arms are squeezed against the hive with a woodworking clamp. A tab on the arms slides into the hand holds on each side of the hive body. Components would cost about \$200 and it would take a fabricator about 6 hours to build this lifter. The total cost would be around \$650. Watch it work at the link below.

https://www.youtube.com/watch?time_continue=2&v=LHhpWHRvKsI

Cranes

Sideline apiaries can benefit from smaller versions of the truck-mounted cranes used by commercial beekeepers. Small manual or electric cranes are readily available to mount in the bed of a pickup truck for less than \$1000. Such cranes can be modified and installed on a small utility trailer also. The crane shown at right can reach 40-inches and lift 400 pounds. Industrial articulating cranes can reach 8-feet to the side, but cost four times more. <https://www.northerntool.com> Item# 52837.



The crane is the easy part, the hive-gripping attachment on the crane is a challenge. It is difficult to find a crane attachment to pick up the hive bodies individually or the whole hive. The attachment needs to lift such that the crane cable is directly centered over the top of the hive. This keeps the hive balanced upright while lifting. A scissors mechanism on the grip attachment causes the weight to 'squeeze' the arms against the hive while lifting. A home-made lift attachment is shown at right.



https://www.youtube.com/watch?v=dUIPsISK_UY
<https://www.youtube.com/watch?v=LXSW3aeJ9u8>

ESTIMATED COST: \$500 to \$3000



A crane option for hive-lifting tongs could be to modify an EZ Dual Changer from BiermanSales.com. Their item #51 costs \$360.

3. Hand Tools

PHYSICAL LIMITATION SERVED: Upper Extremity, Strength/Endurance

DESCRIPTION: Gripping tools to pry open hives is a challenge for beekeepers with arthritis, carpal tunnel syndrome, or hand injury. Using wood blocks to prop hive bodies apart during inspection so they don't re-stick on the propolis can reduce repetitive motions.

<https://www.twohiveshoney.com/blog/2017/3/14/ergo-ergonomics> Longer tool handles increase leverage and



decrease force on the hands. A Shizel tool allows the wrist to remain straight while prying hives. \$25



<https://www.shizeltool.com/beekeeping>

A giant hive tool is 14-inches long for extra leverage. The J-hook helps lift frames from the super after the pry-bar has been used to break the propolis seal between boxes. A frame grip allows a worker with weak fingers but strong hands to lift frames from supers. Both the frame grip and the giant hive tool can be found at <https://www.betterbee.com/beekeepers-tools-and-smokers/beekeeping-tools.asp> and cost about \$12 each.



Frame Grip



14 inch Giant Hive Tool

Grip-eez gloves help workers with impaired grip strength to securely hold tools. They use Velcro to hold the hand in a fist without straining muscles. Hammers, hatchets, wrenches and other frequently used hand tools have small-diameter handles that are especially difficult to hold securely. This would help when holding a capping knife, pry bar, hammer or other tools for a long time.

<http://disabilityworktools.com/gripeeze-heavy-duty-trade-glove/> \$35



ESTIMATED COST: \$85 for all 4 tools

4. Bee Yard Mobility

PHYSICAL LIMITATION SERVED: Lower Extremity, Strength/Endurance

DESCRIPTION: When honey production is primary, then layout and pavement and location of bee yards are primary. Since the bees will typically be kept in the same yard year after year, locate the yard convenient to the apiary buildings. It is valuable to invest in accessible surfaces around the hives. If pathways about the apiary are difficult to use, the beekeeper will expend much energy walking before doing necessary tasks because of the rough terrain.



Woody Glover's bee yard (Stephen Clay McGehee)

Weed cloth around hives will be low-cost and keep the vegetation from growing, but may still be soft for operating a wheelchair on. \$250
<http://volusiabeekeepers.org>



Gravel pavement that is crushed and well compacted will also suppress weeds and would be more firm footing to walk on.
<http://burghbees.com/> Both weed cloth and gravel will require periodic maintenance. \$800

Although highest cost, concrete pathways allow people with mobility impairments to conveniently travel between buildings and around hives. Concrete pathways require no additional maintenance for future use. \$3000



VENDORS:

<http://www.greenhousemegastore.com/product/5902>

Local excavators and concrete suppliers

5. Beehive Access

PHYSICAL LIMITATION SERVED: Lower & Upper Extremity, Endurance, Back



DESCRIPTION: All-terrain mobility is a concern when renting out hives for pollination. Hives are moved to different places around fields with rough edges. It is a challenge getting to the site, then lifting hive bodies, moving hives, inspecting frames, filling feeders, and other tasks.

The simplest solution is to make sure hives are only set up on locations easily accessible by vehicle and on smooth flat ground. This is not a feasible situation for many sideline apiaries renting out hives for pollination services. The

market farmer down needs hives beside his vegetable fields ¼ mile back a long lane and off road. Now what? An ATV with supply rack would help. \$4000

A well-outfitted cart or all-terrain utility vehicle is a great solution for managing off-road beehives. The cart can be manually pushed, or power-driven. A push-cart can also serve as an all-terrain walker for workers with mobility challenges or poor balance. All necessary tools and supplies for the task at hand can be carried on the cart, eliminating multiple trips back and forth to get the correct tools. This helps workers with poor memory. \$200 <https://www.youtube.com/watch?v=SrqCs1duGuw>



A two-level cart can store tools and supplies on the lower level. The upper level can serve as a mobile work table to set hive bodies on during inspection. Hive tools can hang on pegs around the sides of the cart. A stool can be mounted directly to the side of the cart, or simply carried on the cart for use in the field. Sitting down to inspect hives on a work platform helps prevent awkward posture while searching for the queen and doing other beekeeping tasks.

A cart could even be equipped with a hive-lift mechanism if it were heavy enough. This much equipment and weight would be very difficult to push around on rough terrain. A powered cart with all-terrain wheels might be feasible in that situation. Powered carts cost around \$2000.



https://www.northerntool.com/shop/tools/product_200336958_200336958

6. Workshop

PHYSICAL LIMITATION SERVED: Lower & Upper Extremity, Endurance, Back

DESCRIPTION:

Heated Work Space

A shop heater helps people with limited strength and endurance to preserve energy while repairing equipment. A wood stove or propane heater would be most economical and practical for the apiary repair shop. Beekeepers spend winter days doing maintenance and repairs on equipment to prepare it for the next season. Insulation or partition curtains can help reduce heating costs in larger buildings used as equipment storage and repair shop together.

\$480

https://www.northerntool.com/shop/tools/product_200577749_200577749



Rolling adjustable stool

A rolling shop stool work seat allows a worker to work in an adjustable sitting position. Beekeepers often work in a sitting position for extended periods of time to do equipment repairs, fabrication projects and other maintenance work in the shop. This is a challenge for those who have poor balance and reduced strength and endurance. The rolling seat allows them to move from one position to another without standing up. \$175

<http://disabilityworktools.com/rolling-shop-stool/>



Adjustable height work table

Lift Table Carts can raise and lower heavy loads and be rolled from place to place around the workshop. Workers can use Lift Table Carts in several ways. First, when doing repair projects on the cart, they will be able to adjust the height of the table, so their back is not strained from working in awkward positions. Second, the cart can be used to unload heavy items from the back of trucks and trailers. For instance, an air compressor could be rolled from the truck onto the lift table cart, then lowered to within 15 inches of the floor. Finally, the lift table cart can be used lift and carry individual boxes and jugs from skids to shelves with very little manual lifting.

\$285 <http://disabilityworktools.com/lift-table-cart/>



Floor cushions

Floor cushions in the apiary shop provide padding to stand on while doing maintenance and making repairs on tools and equipment. Standing and walking on concrete surfaces for long duration causes fatigue and stress to a person's legs and back joints. A padded floor would cushion the effects of standing for so long each day. \$30



https://www.northerntool.com/shop/tools/product_200306089_200306089

ESTIMATE COST: \$970 for one of each item

VENDORS: www.NorthernTool.com
www.DisabilityWorkTools.com
www.GlobalIndustrial.com

7. Honey Extraction Powered Extractor & Heated Knife

PHYSICAL LIMITATION SERVED: Lower Extremity, Back, Strength/Endurance

DESCRIPTION: Aside from purchasing a \$20,000+ automatic extraction system, there are several good options to reduce the physical strain. First, and most simply, work with honey in a warm room so it flows. The shop heater shown in the workshop section of this report can be used to warm the room with the frames to be extracted, and the process will be much less difficult. Depending on location, there may be a beekeeper's co-op with rental equipment or facilities to extract honey. A commercial apiary may 'custom extract' honey for smaller beekeepers for a fee.

If these are not options, then a powered extractor is better than a hand cranked extractor. One sideline beekeeper used a cordless drill to extract honey in five-gallon pails. https://www.youtube.com/watch?v=_RbsGjrF6Ng It is not feasible for extracting honey from more than a few hives with either a drill-powered or hand-cranked extractor. Small powered extractors can be purchased for \$850 and will relieve the beekeeper with arthritis of turning a crank for hours at a time.



The other important tool is a heated knife. With hand impairments, reducing the force needed and the time spent gripping a knife to remove the honey cap will be very important. The heated knife will slice the wax much easier.

<https://www.dadant.com/catalog/extracting/extractors/m00401-ranger-radial-extractor-power>

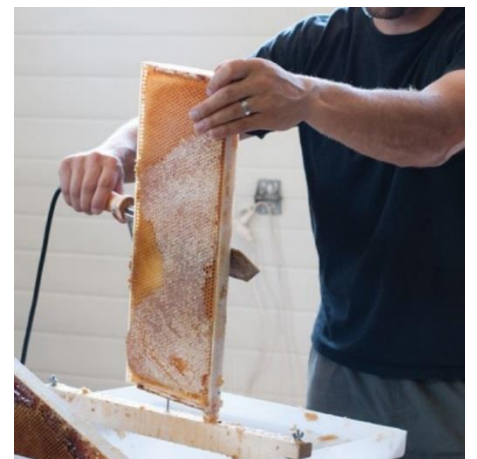
ESTIMATED COST: \$1000 heated knife & extractor

VENDORS:

http://greatlakesgeneralstore.com/Speed-King-Electric-Uncapping-Knife_p_755.html

<https://www.dadant.com>

<https://www.betterbee.com>



Summary of Recommendations

Farmsite Recommendation	Estimated Cost	Frequency	Longevity
	\$ (for quantity shown)	Uses per year	useful years
Safety & Secondary Injury Prevention		1000+	Life-long
Lifting Hives	\$75 to \$3000	1000+	10
Hand Tools	\$85	1000+	10
Bee Yard Mobility	\$300-\$3000	1000+	3 to 20
Beehive Access	\$200-\$2000	1000+	5
Workshop	\$970	1000+	10
Honey Extracting	\$1000	1000+	20

Conclusion

Assistive technology in the apiary will increase the likelihood of success for a beekeeper with medical impairments. Beekeeping is a very satisfying enterprise, and can be done by workers with medical impairments. Modified tools and equipment enable tasks that would otherwise be impossible or unhealthy for the worker.

This report provides a general description of each idea or product presented to aid in understanding its operations and or construction. These descriptions, however, are solely intended to improve comprehension and are not to be viewed as either a set of plans or a substitute for plans. Prior to actual design or fabrication of a complex or potentially hazardous modification, it is recommended that a professional engineer be consulted.

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