MEL monitoring evaluation and learning

ICARDA
Science for resilient livelihoods in dry areas

ICARDA Thematic Scoping Series:

Exploring opportunities for a data for M&E project in the beekeeping sector

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A report is a separately published record of research findings, research still in progress, policy developments and events, or other technical findings, usually bearing a report number and sometimes a grant number assigned by the funding agency. Also, an official record of the activities of a committee or corporate entity, the proceedings of a government body, or an investigation by an agency, whether published or private, usually archived or submitted to a higher authority, voluntarily or under mandate. In a more general sense, any formal account of facts or information related to a specific event or phenomenon, sometimes given at regular intervals. Source: COAR

Series overview

This report is the first in a new ICARDA Thematic Scoping Series. This series aims to provide decision-makers at ICARDA with both summarized and detailed information on a select topic across ICARDA countries. Readers can quickly access the latest information on the given topic and learn about challenges and opportunities for proposal development. The MEL team hopes to develop future reports in this series based on demand from country managers.

Disclaimer

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Introduction

This document includes analysis of data for M&E in the beekeeping sector to explore a future proposal. Potential areas for ICARDA's involvement are explored across 17 select countries, listed above. This information has been collected through (a.) rapid internet analysis and (b.) consultations with ICARDA country manager/staff, further described in the methods section below.

Methods

A. Rapid Internet Analysis

A rapid internet analysis was conducted, prioritizing information from academic journals, government websites, beekeeper associations, ICARDA MEL, and NGOs. When the aforementioned sources were not available, news articles and commercial databases were used. These sources were searched for the following information:

- ICARDA
    - Work related to beekeeping
    - Other country projects
- Beekeeping statistics
    - Number of beekeepers:
        - Number of small, medium, and largescale beekeepers
    - Average age of beekeeper:
    - Total number of hives in country:
    - Annual production:
    - Types of hives:
    - Types of beekeeping:
    - Types of honey:
    - Common pests:
    - Common pathogens:
    - Regions of country where beekeeping activities take place:
- Market
    - Annual production:
    - Amount consumed locally vs exported
    - Any other market stats/info
- Challenges
- Govt extension programs for beekeepers
    - Programs promoting beekeeping to youth
- Registration/certification processes
- Beekeeping associations
    - More information on what they do
    - Certification process
- IoT devices: any more details on what stage they're at, where they're collecting data, what data they're collecting
- Other stakeholders working in beekeeping sector
    - Any pain points or opportunities for a data for M&E project in the beekeeping sector to fit in
- Smartphone ownership: *note— this is calculated as percent of the population (not as a percent of adults)
    - Rural vs urban:
    - By geographic regions:
- Internet usage:
    - Rural vs urban:
    - By geographic regions:

B. Consultations: A total of 16 stakeholders were consulted over e-mail and/or Skype. ICARDA country managers or relevant scientists were prioritized, however, to fill information gaps, in a few cases external stakeholders were contacted. Consultations were completed for 14 of the 17 countries, see the table in Annex A for further information on individuals consulted and the questionnaire.

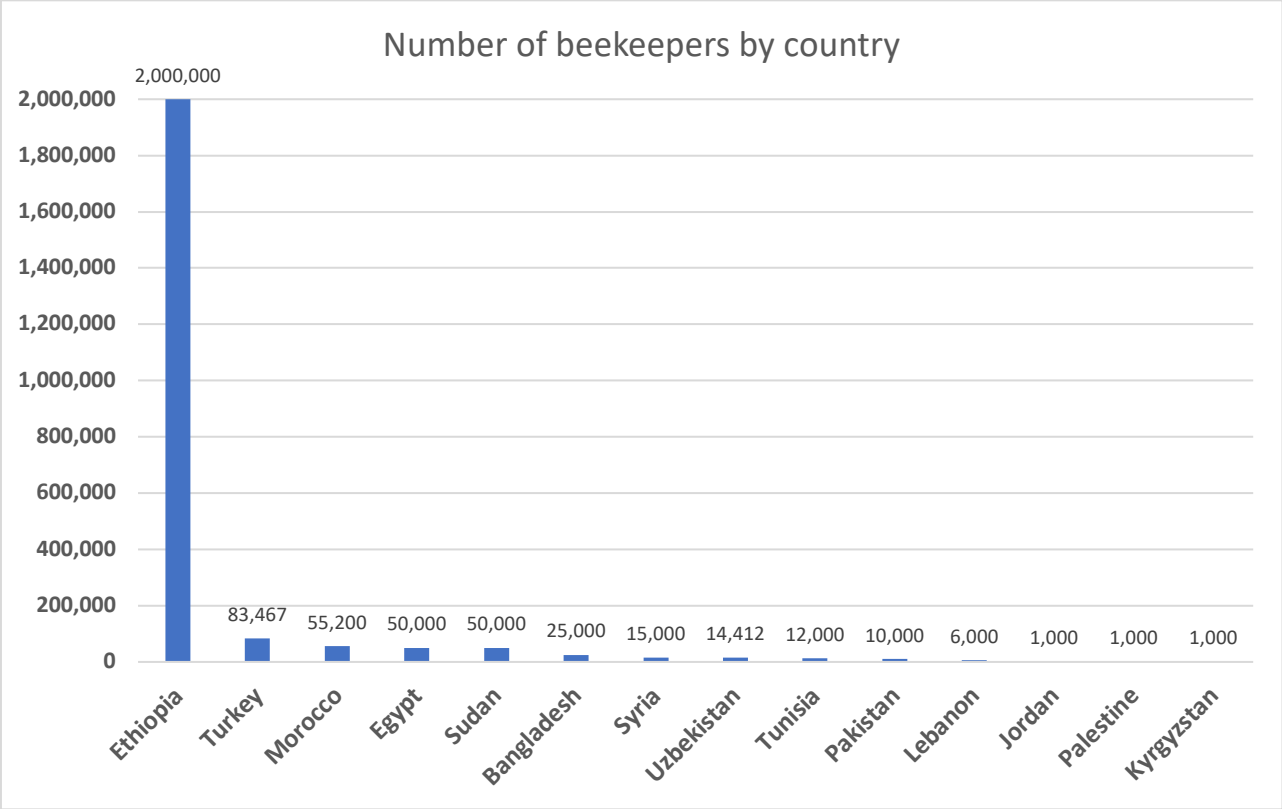
Cross-country snapshots

Across countries, country managers have shared the importance of beekeeping as:

- An alternative income source
- A method of job creation (particularly for women, youth, rural areas)
- A type of agriculture in post-conflict countries
- Essential to crop & insect diversity, including pollinator-dependent crops

To view key statistics across all countries in this study, this section includes data on (1) the number of beekeepers, (2) bee species richness, (3) pollinator dependent crops, (4) smartphone ownership, and (5) key ICARDA contacts. Details for all countries and specific data sources may be found in the next section: "All Country Information".

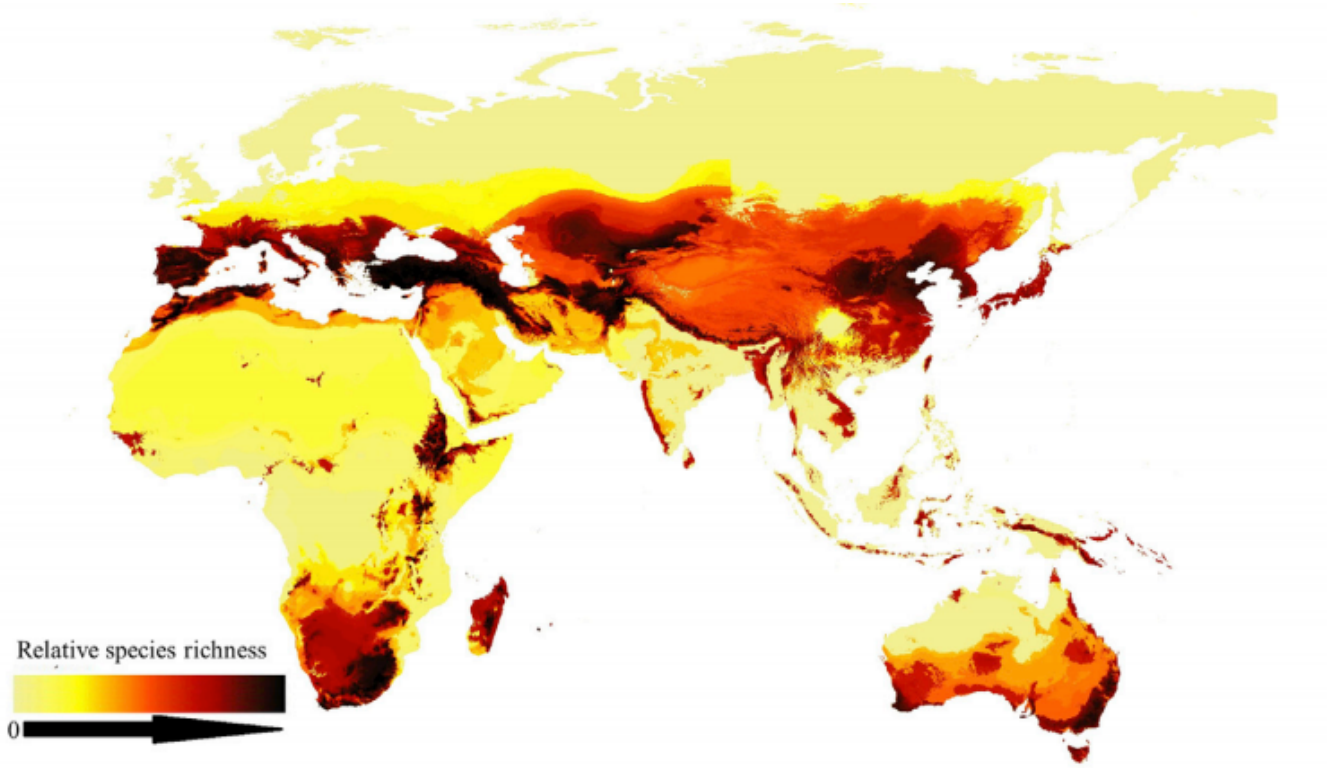
Number of beekeepers



Notes:

1. Data sources: Country governments; beekeeper associations; NGOs; news articles. See "All Country Information" section below for specific sources.
2. No data: Statistics were not found for the UAE and Tajikistan. India breaks down the number of beekeepers by individuals, companies, and firms, therefore their data is not at the individual level and thus is not comparable.
3. Data quality concerns: Some countries have outdated data (>10 years old). Some countries have better systems in place for registering beekeepers, while others have many unregistered beekeepers. Finally, the data are not all from the same source and methodology of collection.

Bee Species Richness



The above map demonstrates that several areas in the dry regions are hot spots for bee species richness, an important aspect of biodiversity to protect.

Data source: Orr et al., 2021, Current Biology 31, 1–8 February 8, 2021 ª 2020 The Author(s). Published by Elsevier Inc. https://doi.org/10.1016/j.cub.2020.10.053

Pollinator dependent crops

Country	Area harvested (ha)	Production (tons)	Yield (hg/ha)	**Grand Total**
India	99,391,157	284,893,061	2,883,829	**387,168,047**
Turkey	13,262,259	71,624,390	5,925,650	**90,812,299**
Pakistan	12,779,890	39,785,023	1,855,962	**54,420,875**
Egypt	3,279,096	36,478,129	4,718,457	**44,475,682**
Morocco	5,399,025	17,867,330	5,610,720	**28,877,075**
Ethiopia	6,434,501	16,973,138	1,068,583	**24,476,222**
Uzbekistan	1,801,952	13,547,915	5,389,687	**20,739,554**
Sudan	7,598,260	9,557,972	1,600,042	**18,756,274**
Bangladesh	1,456,589	8,271,590	1,481,925	**11,210,104**
Tunisia	2,010,632	5,712,248	3,385,502	**11,108,382**
Syrian Arab Republic	1,842,353	4,611,556	2,892,151	**9,346,060**
Jordan	101,166	1,724,194	5,657,441	**7,482,801**
Palestine	40,888	637,617	6,025,186	**6,703,691**
Lebanon	122,958	1,295,792	4,300,175	**5,718,925**
Tajikistan	484,568	2,789,692	1,917,045	**5,191,305**
Kyrgyzstan	647,283	2,569,484	1,764,044	**4,980,811**
United Arab Emirates	5,523	235,578	4,401,181	**4,642,282**
Grand Total	**156,658,100**	**518,574,709**	**60,877,580**	**736,110,389**

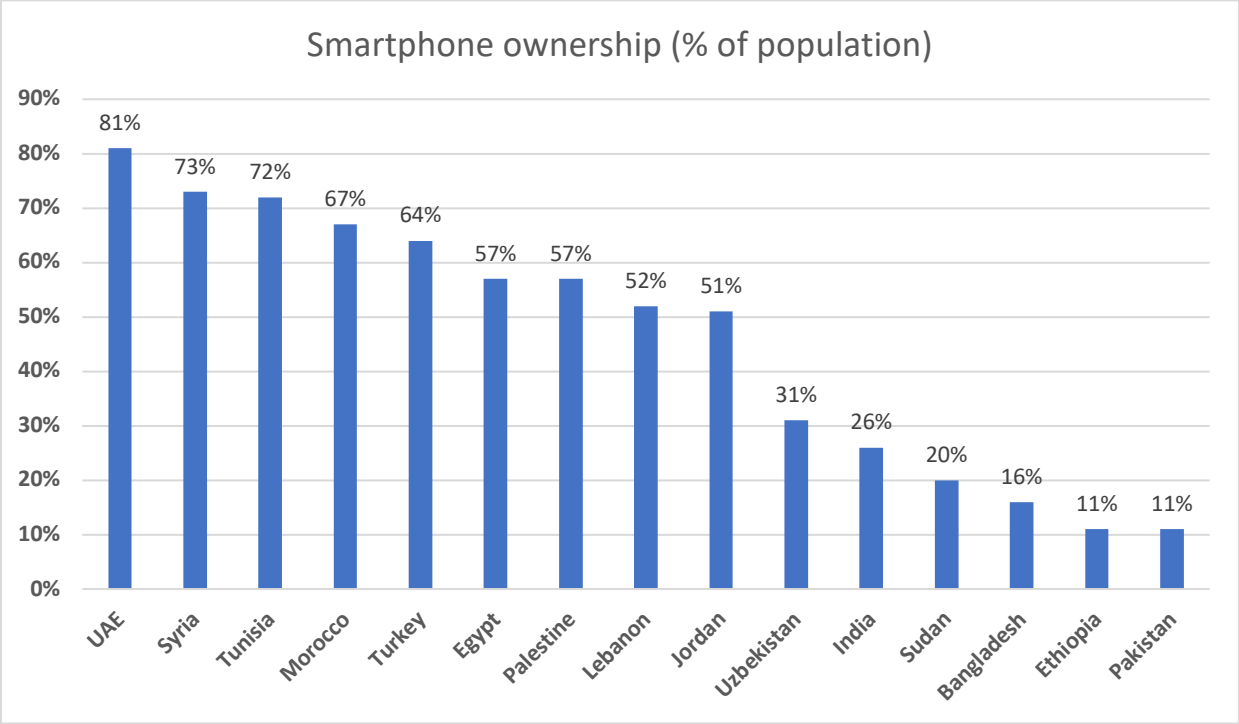
Data source: FAO 2018

Global Increase of Agricultural Dependency on Pollinators from 1961-2012

This map above demonstrates that while agricultural dependency on pollinators has increased worldwide, particularly in dry areas farmers have shifted to more pollinator dependent crops.

Data source: Source: Potts et al. 2016
Potts SG, Imperatriz-Fonseca V, Ngo HT, Aizen MA, Biesmeijer JC, Breeze TD, et al. The assessment report on Pollinators, Pollination and Food Production. Summary for Policymakers. Bonn: IPBES 2016 40p.
http://www.ipbes.net/sites/default/files/downloads/pdf/spm_deliverable_3a_pollination_20161124.pdf

Smartphone ownership



Notes:

1. Data sources: When available, data were pulled from research studies in the past 5 years (Pew Research; Oxford), otherwise commercial data repositories were used.
2. No data: Statistics were not found for Tajikistan and Kyrgyzstan.
3. Data quality concerns: Data is not all from the same source or year.

Key ICARDA Contacts

While ICARDA does not traditionally hold expertise in the beekeeping sector, there are two staff members who are currently working with this sector or have expertise in the pollinator sector.

Udo Rudiger (u.rudiger@cgiar.org) is the manager of the ICT2Scale project in Tunisia which tests different ICT technologies for extension, like sending SMS, collecting market prices, developing e-learning modules… One topic of interest is beekeeping, so ICARDA worked with a national partner to develop an **e-learning module on beekeeping**. ICT2Scale also collaborates with GIZ Apiservices cooperative to send **SMS messages to beekeepers**. He also managed the former Mind the Gap project from 2016-19 which aimed to shrink the gap between the innovative technologies developed under research and their adoption. After learning that participants wanted training on beekeeping, they partnered with national training institutes to provide a **3-month beekeeping training course**.

Stefanie Christmann (s.christmann@cgiar.org) has led the **Farming with Alternative Pollinators** approach across several ICARDA countries, which aims to conserve pollinator diversity to enhance the climate change resilience in an economically self-sustaining way. While this project could theoretically be a good entry point for a project on data for M&E project in the beekeeping sector, collaboration may not be possible due to low interest in an in-hive IoT device and app in the current farmer community involved with the project.

All Country Information

Morocco

Opportunities/angles for a data for M&E project in the beekeeping sector:

- Value chain approach: There are several areas of the value chain which need further support and development, including: hive productivity and pest and disease management, quality assurance, marketing channels, and regulations. Addressing these issues through a data for M&E project in the beekeeping sector would support government efforts to (1) achieve 16,000 tons of honey production by 2020, and (2) increase digitalization.

ICARDA

- Overall: IKI-FAP project would be our closest in-point and they collaborate with National Associations of Beekeepers of Morocco, however per other conversations collaboration may not be possible due to low interest in an IoT and app in the current farmer community involved with the project.
- Work related to beekeeping: NA
- Potentially relevant country projects
    - Farming with Alternative Pollinators (FAP): Allocates around 25 percent of every field for habitat enhancement with marketable plants, attracting more diverse pollinators, increasing crop yield, and thus increasing farmer income. In Morocco, this project also conducted a survey with beekeepers to understand their knowledge on the benefits of pollinators.
        - *Project manager: Stefanie Christmann*
    - Strengthening Innovation and Technology Adoption towards Sustainable Agricultural Productivity in Arab Countries: (2019-20) Delivers products, information and knowledge, and training services to increase farmer productivity and build capacity.
        - *Project manager: Seid Ahmed Kemal*
    - Moroccan Collaborative Grants Program (MCGP) (2005-20): provides support to develop synergies between INRA and ICARDA scientists and attract additional external assistance and funds. Under this initiative, five MCGP projects are developed to address genetic resources conservation, conservation agriculture, and biotechnology backstopping.
        - *Project manager: Ahmed Amri*

- **Beekeeping Statistics** (FED API MED Morocco page)
    - Number of beekeepers: 55,200 (32,600 modern, 22,600 traditional)
        - 20% amateur, 70% pluri-active, 10% professional
        - Number of small/large beekeepers: not found
    - Average age of beekeeper: 37.12±9.22 among a sample of 8 beekeepers who responded to a survey in 2013-15. (Al-Ghamdi et al 2016). Farmers average age is estimated to be around 40-55 based off of three studies. (Average ages were 55 in this study of Saffron farmers in Taliouine (Aziz & Sadok 2015); 58 in 2012 FAO study across 3 regions; and 38 in study of pesticide use in Meknes district (Imane et al 2016.)
    - Number of hives: 506,750 (348,500 modern, 162,200 traditional)
        - Average production per hive: modern hive: 10-15 kg/hive/year; traditional hive: 3-6 kg/hive/year
    - Types of hives: Dadant, Langstroth, traditional
    - Types of beekeeping: sedentary and transhumant
    - Types of honey: Orange, Eucalyptus, Bersim, Clover, Euphorbe , Origan, Lavender, Rosemary, Carob, Jujubier, Sunflower, Multiflower

- Common pests: V. destructor, varroa, and acarapis mites; beetles; flies; moths; ants; wasps; birds (Pirk et al, 2016). While not a direct pest to honeybees, psyllid insect is/was an issue because they infested eucalyptus trees, a common pollen source for honeybees, thus reducing honey production (CGTN Africa 2016).
- Common pathogens: AFB & EFB bacteria, fungi, viruses (Pirk et al, 2016).
- Regions of country where beekeeping activities take place: Countrywide

- **Market**: (Khaoula et al 2018)
  - Annual production: 4,500 tons (as of 2014)
  - Export: Estimated at only a few tons a year for fairs and exhibitions, however there are efforts to prepare Moroccan honey to access the European Market
  - Import: To meet high demand of honey during Ramadan, honey import increases during this time. On average, annually 1,300 tons per year are imported to Morocco from China, India, Egypt, Spain, and Argentina. The price of imported honey is usually 10-30% lower than domestically produced honey.
  - Consumption per capita: 1.5-2.5kg for most people (see figure)

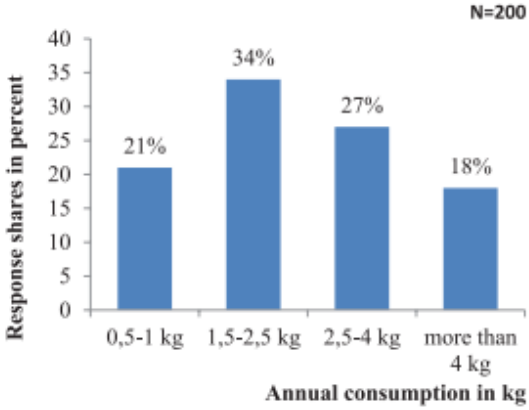


Figure 1. The frequency of annual consumption ($p < 0.001$)

  - Consumer preferences: Based on survey of 200 Moroccans from 11 regions in 2017. (Khaoula et al 2018)
    - The floral origin and taste of honey is considered as very important product features. The preferences of these consumers are based on creamy but spreadable honey packaged in glass jars.
    - Most people buy honey from beekeepers (45%); special markets (22%) were named on the second place and markets on the third place (11%).
    - According to the respondents, their major motives for purchasing and consuming honey were to use it as food (70%), medicine (15%), a sweetener (9%), or for other uses (6%)
    - Women consume honey at a higher frequency than men
    - Most people surveyed do not know about other apiary products such as bee propolis.
- **Culture**: During religious and traditional occasions, especially during Ramadan, Moroccan families increase their consumption of honey. (Khaoula et al 2018)

- **Challenges for beekeeping sector:** (Moujanni et al 2017)
  - the value chain it not so developed and there is potential for exploitation; need for improved regulations and marketing channels
  - pests & diseases
  - hive productivity
  - honey quality

- **State-supported extension programmes for beekeepers:**
  - INRA-Morocco used to have a full program of research on beekeeping and honey production. The activity is reduced now to provide training to **youth**, **children of farmers.** Further details on the training and curriculum were not found.
  - Through the Green Moroccan Plan, there is a goal to achieve 16,000 tons of honey production by 2020

- long-standing efforts by the government to increase digitalization through programmes such as Digital Morocco 2013 or the more recent Digital Morocco Plan 2020 (Source: Oxford Business)

- Beekeeping associations:
  - La Fédération Interprofessionnelle Marocaine des Apiculteurs (FIMAP): created in 2011 as a federation of 14 regional associations. Their objectives include (1) improving productivity, (2) introducing and developing new biotechnologies, (3) training and supervising beekeepers on apiary management, (4) encouraging organization of the sector at local and regional levels, (5) defending interests of beekeepers and the beekeeping industry. They also presented on treatments of bee diseases at the Mediterranean Beekeepers Association conference in 2015.
  - Union APINECTARDEV: Created in 2016, the association aims to safeguard the Saharan bee, conserve both biodiversity and natural resources, while contributing to improve the standard of living of the local population. Provides trainings, including conservation methods. They have been supported by project PPI-OSCAN II, from 2019-2021.
  - National Association of Beekeepers (UAPIM - Union des Apiculteurs au Maroc): They have a facebook page that doesn't seem active since 2018, and no website found. They are members of Apimondia.
  - Other associations include: L'association des apiculteurs du Haut-Atlas central, Coopérative Al Kahir; Association Apiculteurs de Tamezaght; Coopérative Agricole Chifae; Union des Coopératives et Associations Cercle Tétouan

- **Registration/certification processes:** Labeling requirements for honey do not require the mention of the place of production, but rather the place of conditioning (Khaoula et al 2018). Further information on beekeeping and honey certification and regulations not found.

- **IoT devices:** There were no projects identified that implement in-hive IoT device systems with beekeepers

- **Other projects/stakeholders working in beekeeping sector:**
  - IFAD: 2014-19 Rural Development program in the mountain zones promotes diversification into beekeeping and improve the quality of honey products and by-products
  - World Bank: 2013-2018 funded a project to develop beekeeping food chains and processing units. Activities included covering 4 communes, with 710 beneficiaries and 2,000 hives and a total investment of DH 34.7 million. 1 site, 2 UVs for production of wax, processing of honey and fabrication of beehives Results included official recognition of the Tiznit honey brand and of specific honey provenances, including honey from Al Houz.
  - Fert: Since 2014 in Taza province, Sfoap program has supported a beekeeping union through equipment provision and training. Improvements noted by union members include: better quality and cost of products and services – in particular on queen genetics, collective price negotiation, local recycling of wax, etc. Funded by IFAD.
  - PPI-OSCAN: works to strengthen civil society organizations in North Africa, and has been working to support the Union APINECTARDEV mentioned below. Also funded project to create Saharan bee nursery to support local beekeeper cooperatives. Funded by UICN, MAVA, and FFEM
  - ASAP-M project: (2015-19) project implemented by Swisscontact funded by Swiss Federal Dept of Foreign Affairs helped strengthen capacities of beekeeping association FIMAP, conducted training of trainers, set up platforms for exchange, and created a funding strategy.
  - Apiculteurs sans Frontières: (2017) details on activities not found.

- **ICT data** (Source: Oxford Business)
  - Mobile penetration rate: 127%, and 67% of mobile phones are smartphones
  - Internet penetration rate: 65% as of 2017
  - Notes on rural access: "4G rollout has been challenging in rural Morocco notably due to infrastructure project delays in 2016-17, lack of investor interest and unhealthy competition between Morocco's major telecoms providers," Abdellah Idrissi, CEO of Sicotel

- **Pollination dependent crops** (FAO 2018 data)
  - Total harvested area (ha): 5,399,025

- Total production (tons): 17,867,330
- Total yield (hg/ha): 5,610,720
- Top 3 crops with highest harvested area (ha): wheat (2.8 million), barley (1.5 million), almonds (186,255)

Tunisia

Opportunities/angles for a data for M&E project in the beekeeping sector:

- Scaling up and improving the IoT approach: There is already a Tunisian IoT device (IRIS technologies/Smartbee) being implemented that has received funding from GIZ. This could be a potential opportunity for collaboration or benefiting from their lessons learned for scale up the IoT approach in other regions of the country. There are many entry points with ICARDA due to active projects in 2 of the 3 main honey producing regions and current work with the Apiservices beekeeping cooperative, which the ICARDA researcher thinks may be interested in a project like this.
- Honey productivity: Average production per hive in Tunisia ranges from 5kg (traditional) to 12kg (modern), which is far below the average output in other Mediterranean countries. Improved management and knowledge from a data for M&E project in the beekeeping sector could improve this, leading to higher outputs and higher incomes.

ICARDA

- Overall: ICARDA doesn't have beekeeping expertise in Tunisia, but is working with the Apiservices beekeeping cooperative, implementing projects in 2 of the 3 main honey producing regions, and has experience with other SMS and smartphone application projects.
- Work related to beekeeping:
  - ICT2Scale: (2019-2021) In Northwest Tunisia (a key beekeeping region) this project tests different ICT technologies for extension, like sending SMS, collecting market prices, developing e-learning modules… One topic of interest is beekeeping, so ICARDA worked with a national partner to develop an e-learning module. ICT2Scale also collaborates with GIZ Apiservices cooperative to send SMS messages to beekeepers. Last year during an ICARDA ICT2Scale workshop, thirteen SMS messages with technical advice on beekeeping were crafted and sent out to help with production, and to remind farmers of key actions at appropriate times in the season. Additionally, Apiservices use the SMSs to notify farmers of equipment availability, weather warnings, and interest from wholesale customers (blog post).
    - An important learning from this project is that farmers sometimes just use phones for calling-- they don't always use apps or SMS.
    - *Project Manager: Udo Rudiger*
  - Mind the Gap: (2016-19) in Center-West Tunisia (another key beekeeping region) Aims to shrink the gap between the innovative technologies developed under research and their adoption. Learned that participants wanted training on beekeeping, so they partnered with national training institutes to provide a 3-month training course. Also in this project, they did a survey on what information farmers wanted to receive via SMS, and several mentioned beekeeping, which led to the SMS messages to beekeepers in the ICT2Scale project.
    - *Project Manager: Udo Rudiger*
- Other relevant work in Tunisia:
  - Plantix app: ICARDA is working on supporting and adjusting this GIZ-developed app for Tunisia; which identifies plant diseases and gives recommendations on how to treat. (App is already functional in several other countries.)
    - *Contact: Udo Rudiger*
  - CLCA II (2018-2022): Implemented in Northern Tunisia (Kef, Beja, Jendouba, Siliana, Zaghouan); Offers flexible technology packages to farmers to implement conservation agriculture.
    - *Project Manager: Mourad Rekik*
  - Silvopastoral restoration (2017-present): Implemented in Central Tunisia, focuses on revegetating degraded areas using indigenous herbaceous and woody species, resulting in improved afforestation and soil erosion rates.
    - *Project manager: Mounir Louhaichi*

Beekeeping Statistics (see the FED API MED Tunisia page for more)

- Number of beekeepers: 12,000 (Ministry of Agriculture 2016) to 16,000
  - 10% amateurs, 60% pluri-active, 30% professional
- Average age of beekeeper: 42.00±1.73 among a sample of 6 beekeepers who responded to a survey in 2013-15. (Al-Ghamdi et al 2016). Average age of farmer was 48 in the central east as of 2018 (Laarif et al 2018)
- Number of hives: 250,000 modern, 6,000 traditional
  - Average production per hive: 12 kg/modern hive and 5 Kg/traditional hive in normal years
- Annual production: 3,000 tons/year
- Types of hives: Langstroth
- Types of beekeeping: sedentary for traditional hives and small producers, transhumant for medium and large producers
- Types of honey: eucalyptus, rosemary, thyme, forest, multiflower, oranges
- Common pests: varroa and acaparis mites, flies, moths, ants, birds (Pirk et al, 2016)
- Common pathogens: AFB and EFB bacteria, fungi, viruses, Ascosphaera apis (Pirk et al, 2016), la loque americainne, la loque europenne (Nagara 2015)
- Regions of country where beekeeping activities take place: Northwest (forest area), Center West (dryer climate), Northeast

Market: (National Institute of Statistics via 2015 article)

- Annual production: 3,000 tons/year
  - predominantly consumed domestically (99%)
- Export: $52,500 annually, quantity unknown
- Import: imports $1.1 million of honey from China and Spain, quantity unknown
- Consumption per capita: not found

Challenges in beekeeping sector: (APINOV; IRIS Technologies; FED API MED Tunisia page)

- Lack of professional organizations
- Lack of technology for the valorization and transformation of the hive product
- Low hive productivity
- Expense and distribution of equipment
- Theft
- Management of beehives
- Beekeeping expertise
- Beehive collapse

State-supported extension programmes for beekeepers: The National Agriculture Extension and Training Service has 5 training stations for beekeeping across the country, a 3-month program. Further details on their work and the curriculum not found.

Registration/certification processes:

- A system is in place for certifying cooperatives, but it is quite demanding (as noted from experience with Apiservices cooperative)
- For honey quality, the Tunisian standard NT 56.12 sets the standards of honey quality in Tunisia, and in addition there are 6 to 7 areas classified as pilots by the Ministry of Agriculture for the production of IO honey, which at least 3 are in the SMSA installation area (Gloub Thiren, Khorgalia, Ain Soltan).
- A Tunisian law concerning bee wax is in progress.

Beekeeping associations:

- Apiservices cooperative: Works with ICT2 Scale project to send SMS messages to around 300 beekeepers in the Jendouba region. GIZ is very supportive of this initiative- they now have an office, employed staff, a factory for hives… ICARDA's ICT2Scale project manager believes this cooperative may possibly be interested in working with a data for M&E project in the beekeeping sector.

- *Societes mutuelles* (co-operative societies) include bee-keeping in their mandate. >10 of these exist and were established in 2010 focusing on organic products (Source: G-FRAS).
- list of farmer associations producing honey in North-Western part of Tunisia (shared by project staff):

SMSA/GDA	Zone d'intervention	Personne à contacter	Contact
Jendouba			
SMSA Falleh	Bousalem	Ridha ghazouani	20720105
GDA Gloub Thiren	Fernana	Houda hamdi	96249419
GDA Talla	Fernana	Hamza hezzi	95540463
GDA jeunes fernana	Fernana	Tarak aloui	96494705
GDA Asalna	Ain soltan	Rochdi stiti	https://www.facebook.com/intissar.apicultrice
GDA khemir	Ain drahem	Abd waheb	26453927
GDA Apipro	Tabarka	Saber yahyaoui	23897313
SMSA Apiservices	Fernana	Jalel chaabani	95327137
Beja			
GDA Apisvaga	Nefza		https://www.facebook.com/APISVAGA
Siliana			
Association wifak barguou	Barguou	Riadh yahyaoui	https://www.facebook.com/WifakBargou

IoT Device: IRIS technologies/Smartbee has developed an IoT device that is/was being implemented in 6000+ hives (around 2017) and is funded by GIZ, Oleax LD, and Eaquitas. Current stage of implementation is not verified.

- Data collected: GPS location, rainfall, outdoor temperature, hive temperature and humidity, bees' buzz, spring build-up/colony development, hive activity and foraging, queen mating, queen egg laying, swarm management

Other projects working with in the beekeeping sector in Tunisia:

- GIZ: has large agriculture project in Tunisia, and honey is one of their main value chains
- APINOV: conducted beekeeper training in Jendouba in 2017. (Source)
- Promotion de l'Elevage Apicole BIO: (2014-2017) project supported by PPI-OSCAN initiative, to promote organic beekeeping as an alternative to livestock breeding in order to promote reforestation of oak forests and ecotourism

ICT stats

- Smart phone ownership: As of 2018, 72% of Tunisians own smartphones (Source – Pew Research).
- Mobile phone ownership: 128 mobile-cellular subscriptions per 100 inhabitants
- Internet users: As of 2018, 64% of Tunisians use the internet (International Telecommunications Union)
- Disaggregations of these ICT stats by geographic region and rural vs urban not found.

Pollination dependent crops (FAO 2018 data)

- Total harvested area (ha): 2,010,632
- Total production (tons): 5,712,248
- Total yield (hg/ha): 3,385,502
- Top 3 crops with highest harvested area (ha): wheat (846,939), barley (699,262), almonds (193,036)

Egypt

Opportunities/angles for a data for M&E project in the beekeeping sector:

- Restoring Egyptian honey tradition through a value chain approach: The importance of honey in Egyptian culture dates back thousands of years and demand for honey in Egypt is rising, however the number of hives have been declining since 1990. There are many possible causes for this decline, the following which a data

for M&E project in the beekeeping sector could address: disease & pest monitoring; supporting a system for registration, inspection, and follow up of cells; monitoring bee behavior; and expert advice.

ICARDA

- Overall: In Egypt, the shop of honey production is big, there are a lot of people (research and producers) working on bees. ICARDA has a good link to ARC where there are likely many scientists working in this field.
- Work related to beekeeping: NA
- Potentially relevant country projects:
    - Farming with Alternative Pollinators (FAP): Allocates around 25 percent of every field for habitat enhancement with marketable plants, attracting more diverse pollinators, increasing crop yield, and thus increasing farmer income.
        - *Project Manager: Stefanie Christmann*
    - Strengthening Innovation and Technology Adoption towards Sustainable Agricultural Productivity in Arab Countries: (2019-20) Delivers products, information and knowledge, and training services to increase farmer productivity and build capacity.
        - *Project Manager: Seid Ahmed Kemal*
    - Innovative Agriculture for Small Holder Resilience (iNASHR): This project aims to out-scale a combination of technologies and agronomic practices in Egypt, including laser-leveling, mechanized raised bed, crop rotation, and water and land management strategies to sustainably increase wheat and faba bean production.
        - *Project Manager: Bezaiet Dessalegn*

Beekeeping statistics (see FED API MED Egypt page for more)

- Number of beekeepers: 50,000 (*likely outdated)
    - 20% amateur, 30% pluri-active, 50% professional
- Average age of beekeeper: 43.23±14.01 among a sample of 15 beekeepers responding to a survey in 2013-15 (Al-Ghamdi et al 2016)
- Number of hives: 905,000 (Mostafa et al 2018)
- Types of hives: Langstroth
- Types of beekeeping: ~60% transhumant beekeeping
- Types of honey: All savage flowers, chestnut, heater. Alfalfa, sweet alfalfa, sunflower, hijazi, apple, carrot, chestnut, citrus, cotton, henna blossom, mint (Mostafa et al 2018)
- Common pests: varroa and acaparis mites, beetles, flies, moths, ants, birds, V. destructor (Pirk et al, 2016)
- Common pathogens: fungi, viruses, Ascosphaera apis (Pirk et al, 2016)
- Regions of country where beekeeping activities take place: Not found

Market: (Mostafa et al 2018).

- Annual production: 30,000 tons honey according to FED API MED, however these studies from 2018 provided a much lower value of 5,196 – 5,700 tons of honey (Al-Ghamdi et al 2016) (Note that FED API MED stated 30,000 tons of honey annually, however this is believed to be outdated since these recent studies provide much lower values)
- Domestic consumption: 28,000 tons/year (according to FED API MED, but statistic may be outdated)
- Honey export: 1,630 tons in 2016 at a value of 5.1 million dollars
- Honey import: 120 tons in 2016 at a value of 0.6 million dollars
- Honey consumption per capita: not found
- Wax production: 105 tons, 2016
- Bee export: Egypt exports about 250 thousand parcels (bees are packed in kilos) to Saudi Arabia and about 16,000 (tire) shipments to the UAE and the same amount to Kuwait, in addition to small amounts to Jordan, Iraq, Lebanon and Libya. However, export to these markets were carried out at a very low price not less than 35 dollars per pack, i.e. about 10 million dollars, while international prices for the same parcels range from 100 dollars to 130 dollars. The reason for the difference in price is due to a lower quality from Egypt.
- Demand for honey was rising as of 2010 (El-Hazek 2010)

Culture: Egypt has a long history of beekeeping; honey and bees are depicted in hieroglyphs
Challenges:

- Diseases and insects (FED API MED Egypt page)
- Number of hives have been declining since 1990, possibly due to pests, loss of agricultural land, and pesticides (Naggar et al 2018). Others suggest that this may also be due to lack of queens and good productive breeds, lack of programs and training, lack of certification schemes (Mostafa et al 2018).
- Market related issues include: (Mostafa et al 2018)
  - The weakness of the Egyptian specifications of honey and the absence of specifications of parcels and other bee products.
  - Lack of a system for registration, follow-up and inspection of cells by the Ministry of Agriculture
  - Non-activation of the quarantine law and control of Egyptian exports of parcels and honey.
  - Lack of support for bee industry exports and lack of cooperation from national airlines to allocate aircraft freight from regional airports.
  - Lack of funding programs for beekeepers to modernize their equipment and cells and expand their activities.
- Issues affecting the volume of honey produced include: (Mostafa et al 2018)
  - Lack of plants or pasture, which represents a good source of nectar, especially after the abolition of the agricultural cycle in Egypt. This is in addition to the low cultivated areas of cotton and alfalfa, which represent major seasons for collecting honey
  - High costs of transporting apiaries to nectar sources, cell strengthening, buying queens and their scarcity
  - The use of several traditional practices, such as hives, honey extraction and storing, bottling, incubation in sunlight
  - The phenomenon of loss or escape of bees and the phenomenon of disorientation due to the presence of the apiaries on very narrow areas and high plants such as corn and the sunflowers among other unknown reasons
  - Poor quality tools
  - There is no place for the sorting and packaging process, where sanitary conditions and hygiene conditions are in place
  - Antibiotic use (which leaves a residue in the honey)

- Govt extension programs for beekeepers: It seems there is no country-wide extension service, as it was a recommendation of these papers to establish such a service (Mostafa et al 2018; Naggar et al 2018)
- Registration/certification processes: Not found
- Beekeeping associations: Association of Apiculture of El-Gharbiya. Details not found.

IoT device: No projects with in-hive IoT technology for beekeeping sector identified

Other stakeholders working in beekeeping sector:

- Egyptian bee conservation project: Implemented by SEKEM, includes 100 hives to conserve the Egyptian bee, and training 20 women in beekeeping.
- Makhad Trust Beekeeping Training Project 2015-2021 funded by Eva Crane trust, grew out of a need to find ways of providing self-sustaining employment for the Bedouin of South Sinai, specifically the Jebeliya mountain tribe. Small scale beekeeper training (to about 5 people) led by local tribe member.

ICT stats: (Mideast Media; Datareportal)

- Smartphone ownership: Estimated at 57% in 2017
- Internet penetration: 54% as of 2020
- The number of mobile phone connections correspond with 91% of the total population
- Urban/rural/regional breakdowns not found

Pollination dependent crops Crops that are fully dependent on pollinators, such as melons (including watermelons), citrus fruits, and aubergine (eggplant), are some of the biggest contributors to the Egyptian agricultural market. Some crops in Egypt that do not necessarily depend on animal pollination, but largely benefit from animal pollination

include three major ones that are widespread in Egypt: berseem which is known as Egyptian clover (Trifolium alexandrinum L.), cotton, and maize (Naggar et al 2018).
(FAO 2018 data)

- Total harvested area (ha): 3,279,096
- Total production (tons): 36,478,129
- Total yield (hg/ha): 4,718,457
- Top 3 crops with highest harvested area (ha): wheat (1.3 million), maize (935,778), tomatoes (161,702)

Sudan

Opportunities/angles for a data for M&E project in the beekeeping sector:

- Sustainable forest management: 87% of the honey produced in Sudan comes from forest trees, and deforestation is a concern. By supporting forest-based beekeepers, a data for M&E project in the beekeeping sector could help demonstrate the environmental and fiscal value of beekeeping and forests, of which the former receives little attention and support from the government.
- Filling data gaps: Most beekeeping data for Sudan either doesn't exist, or is outdated from before 2011-- thus including the land area of present-day South Sudan. Beekeeping data collected could support researchers, government administration, and development partners.

- **ICARDA**
  - Work related to beekeeping: NA
  - Other country projects:
    - Strengthening Innovation and Technology Adoption towards Sustainable Agricultural Productivity in Arab Countries: (2019-20) Delivers products, information and knowledge, and training services to increase farmer productivity and build capacity.
      - *Project Manager: Seid Ahmed Kemal*
    - AFESD Support for Enhancement of Food Security in Arab Region, Phase III: aims to enhance food and nutrition security, improve rural livelihoods, and protect natural resources, includes tech and knowledge dissemination
      - *Project Manager: Habib Halila*
    - Technologies for African Agricultural Transformation Wheat compact: aims at achieving transformational impact and sustainable increases in productivity and production for enhanced food security, economic growth, and poverty alleviation and reduce unsustainable overdependence on imports
      - *Project Manager: Zewdie Bishaw*

- **Beekeeping statistics**
  - Number of beekeepers: *50,000 as of 2000. * This statistic is outdated and also inaccurate as this included the land area of present-day South Sudan (Hussein 2000).
  - Average age of beekeeper: 31.25±5.74 among a sample of 4 beekeepers who responded to a survey in 2013-15. (Al-Ghamdi et al 2016)
  - Number of hives: Unknown
  - Types of hives: Langstroth (Elzaki & Tian 2020); tangel—a locally constructed hive in Darfur (UNDP video 2012)
  - Types of beekeeping: Mainly forest-based (El-Nebir et al 2013)
  - Types of honey: 87% of honey comes from from forest trees: Acacia spp, Ziziphus spp, Eucalyptus spp and Cordia spp; followed by 13% agricultural crops: sunflower and numerous wild herbs and grasses (El-Nebir et al 2013)
  - Common pests: Varroa destructor, beetles, flies, moths, ants, wasps, birds, mammals (Pirk et al, 2016). Varroa jacobsoni (data collected 2003, El-Niweiri)
  - Common pathogens: non-infective dysentery (data collected 2003, El-Niweiri)
  - Regions of country where beekeeping activities take place: In the southern part of the country: Al Gadarif, Sinnar, Blue Nile, White Nile, Southern Kordofan and Southern Darfur

- **Market**
  - Annual production: 750 tons (Tridge)
  - Export/Import: not found
  - Per capita honey consumption: 6.5kg ± 3.18 among a sample of 97 people from the Khartoum region in 2012 (Elzaki 2012)
  - Consumer preferences for honey: light color, also consider botanical origin. In particular, honey which originates from Ziziphus spp and Acacia spp, attracts many honey consumers in Sudan and most of the Arab countries (Elzaki 2012)
  - The annual incomes per hectare (US$/ha) from Acacia seyal, Acacia nilotica, Ziziphus spina Christi and Eucalyptus spp, respectively, are 224 US$/ha, 156 US$/ha, 315 US$/ha and 90 US$/ha. Inputs and outputs of investment in forest beekeeping for honey yield (US$/ha) are shown in Tables 2 and 3.
  - The ROIs of honey yield production from Acacia seyal, Acacia nilotica, Ziziphus spina-Christi and Eucalyptus spp are 46%, 29%, 69% and 12% respectively.
    - These percentages are considered low, to some extent, and that is due to the high input costs of initial investment of 401 US$ per hive compared to 250 US$

- **Challenges identified by beekeepers:** (Elzaki & Tian 2020)
  - productivity is a concern, produce fewer kg/hive/year than neighboring countries of Ethiopia and Zimbabwe. Reasons for low productivity: (1) beekeepers still lack sufficient experience to manage modern hives for optimum production, and (2) continued deterioration of bee forage
  - lack of experience in modern beekeeping
  - deforestation – including wildfires
  - Honey prices are controlled by the existing local retailers, which it is always at the lowest level.
  - Marketing

- **Govt extension programs for beekeepers:** No technical assistance provided by govt, and little interest from govt in general in this sector. (Elzaki & Tian 2020)

- **Registration/certification processes:** Not found

- **Beekeeping associations:** Bindizi Beekeepers Association, Darfur, supported by UNDP project below. 1,000 members as of 2012. Activities outside of this UNDP project and current status today not found.

- **IoT devices:** None found.

- **Other stakeholders working in beekeeping sector:**
  - Pro-poor value chain integration project: From 2011-13, Implemented by UNDP, funded by USAID, Swiss Development Cooperation, and UNDP. Aimed to improve livelihoods among displaced peoples through support to 100 beekeepers via training and the creation of Bindizi Beekeepers association. Via facebook it looks like UNDP is still supporting beekeepers in Darfur, funded by Swiss Development Cooperation (link to May 2020 post), possibly funded through this grant.
  - UNDP: 125 honeybee cells were provided to local beekeepers in 2010

- **ICT data:**
  - Smartphone ownership: 19.7% as of 2018 (Newzoo)
  - Internet usage: 31% as of 2020 (Datareportal)
  - Mobile usage: The number of mobile connections in Sudan in January 2020 was equivalent to 76% of the total population. (Datareportal)

- **Pollination dependent crops** (FAO 2018 data)
  - Total harvested area (ha): 7,598,260
  - Total production (tons): 9,557,972
  - Total yield (hg/ha): 1,600,042

- Top 3 crops with highest harvested area (ha): millet (3.7 million), groundnuts (3 million), wheat (226,000)

Ethiopia

Opportunities/angles for a data for M&E project in the beekeeping sector:

- IoT device for traditional hives: 95% of all hives in Ethiopia are traditional mud hives without internal frames, yet current IoT technology focuses on modern hives. This reveals a potential opportunity to involve a local start-up and/or university that works on IoT to develop one for traditional hives.
    - A question to consider is: why would we develop an IoT device for traditional hives, when their output is approximately one third of that of modern hives? Would this money be better spent investing in more modern hives? To counter this, there are a few pieces of research that critique projects that pushed modern hives and say that local practices and approaches were not adequately considered.
- Providing market information: Identified as a major deficit in research commissioned by the MoA conducted by ILRI. Suggestions were to improve this through (1) Developing an apiculture market price information system. (2) Typifying the characteristics of Ethiopian honey, including a geo-referenced production map showing floral resources and honey production. (3) Acquiring market intelligence for exporting. (ILRI MoA report 2013)
- Connecting researchers, extension services, and beekeepers: Poor coordination & The fragmented operation of individual beekeepers have been noted as challenges by several different studies and development projects. A smartphone app could serve as a means to connect these groups

As raised by the country manager of Ethiopia, one potential angle for all countries is "beekeeping as an alternative source of income" during/after COVID which has decreased the primary income of many individuals, and may further affect national economies.

- **ICARDA**
    - Overall: Country manager encourages us to consider COVID priorities, and notes that beekeeping is an alternative source of income which could be helpful in COVID times. Sees value of project & thinks project could be helpful. Jacques has met with ICIPE who is active in the beekeeping sector in Ethiopia (see further details on their projects below) and sees them as a possible future collaborator in this sector.
    - Work related to beekeeping: NA
    - Potentially relevant country projects
        - Designing effective extension service delivery systems for enhancing wider adoption of agricultural technologies (2016-19): aimed to alleviating the three main constraints of the adoption of improved agricultural technologies, namely poor information transfer mechanisms, lack of advisory systems and financial services, and unavailability of timely and adequate inputs.
            - *Project Manager: Yigezu Yigezu*
        - Stefanie Christmann (FAP project manager) previously organized a meeting in Addis from the biodiversity angle and there was strong interest in the beekeeping sector.
        - Technologies for African Agricultural Transformation Wheat compact: aims at at achieving transformational impact and sustainable increases in productivity and production for enhanced food security, economic growth, and poverty alleviation and reduce unsustainable overdependence on imports
            - *Project Manager: Zewdie Bishaw*
        - ILRI (also a CGIAR center) has done some research in 2009 (Ejigu et al 2009) in the Amhara region on constraints and opportunities in apiculture, in 2012 they were commissioned by the Ministry of Agriculture to develop an Apiculture Value Chain Vision and Strategy for Ethiopia, and in 2016 (Mehari 2016) on the value chain of movable hive frames in Tigray.

- **Beekeeping statistics** (Tefere 2018)
    - Number of beekeepers: 2 million (Central Statistic Authority 2009)
    - Average age of beekeeper: 40.5 years, from a sample of 332 beekeepers in Gomma district, South West Ethiopia (Kalayu et al 2017)
    - Number of hives: Estimates include: 5 million (Central Statistic Authority 2009); 6 million

- Types of hives: (Kalayu et al 2017; Ethiopian Institute of Agricultural Research 2017)
  - *95.73% Traditional*: constructed hives which are mostly cylindrical in shape (about 1-1.5 meter in length and 30-50-centimeter width) and single chamber fixed comb. This type of hive can be made from wood, mud/ clay. Average annual yield of 5-10.16 kg.
  - *1.3% transitional*: Kenya top-bar beehives, Tanzania top-bar beehive, Mud-block beehives and Ethio-ribrab hive). Average annual yield of 13.61 kg.
  - *3.3% modern*: Zandar, Langstroth, Dadant, Modified Zandar, and Foam beehives. Average annual yield of 23.32 kg.
- Types of beekeeping: Within traditional beekeeping (the predominant practice), there are 2 types:
  - *forest beekeeping* - mainly practiced in the south and south west parts of the country where there is high vegetation cover and high honeybee colonies
  - *backyard beekeeping* - practiced in the central, eastern and northern parts of the country where
  - there is intensive cultivated land with relatively low forest coverage.
- Types of honey: (1) Tigray, white honey from forage on mainly belonging to the labiates family (like sage) Becium grandiflorum locally called tebeb; (2) yellow honey, from multi-flora (3) Lalibela honey, produced in central Ethiopia mainly from acacia trees.
- Common pests: Small hive beetle, Bee Lice (Braulacoeca), wax moths, mice, birds, varroa destructor
- Common pathogens: chalkbrood, nosema, amoeba, death from poisonous plants
- Regions of country where beekeeping activities take place: Countrywide, top regions are Oromia, Amhara, SNNPR, and Tigray

- **Market** (Ethiopian Institute of Agricultural Research 2017)
  - Honey production: >54,000 tons/year as of 2017
  - Domestic consumption: 42,935 tons/year
    - 10% of the honey produced in the country is consumed by beekeeping households. The remaining 90% is sold for income generation; of this amount, it is estimated that 70% is used for brewing "tej"
  - Export: 900 tons annually. Ethiopia exports honey to the countries such as Sudan, Norway, Saudi Arabia, UK, Yemen, Japan, USA. Export value in 2009/10 was US$900,000
  - Import: Assumed to be 0 given that they produce 54,000 tons/year, consume 42,935 tons/year, and export only 900 tons/year
  - Honey consumption per capita: 0.53kg (Nega & Eshete 2018)
  - Beeswax production: 5,400 tons/year as of 2017
  - Other byproducts: as of 2012 commercialization of other high value bee products such as pollen, propolis and bee venom is non-existent (ILRI MoA report 2012).
  - Capacity: Some estimate a production potential of 500,000 tons of honey annually (Ethiopian Apiculture Board 2014), while others predict a lower value of maximum honey capacity at 150,000 tons/year.

- **Culture**: Long culture of beekeeping in country, honey also plays an important role in several customs, religion, and local medicine (Shiferaw et al 2008).

- **Challenges:**
  - Lack of extension services (particularly for beekeeping management), lack of research, and poor coordination between beekeepers, extension services, and researchers (ILRI MoA report 2013).
    - Poor coordination & The fragmented operation of individual beekeepers have also been noted noted as a challenge by the government and from the recently completed ASPIRE project, which stated this "caused difficulty to organize, train, do due diligence, and make them ready for the credit facility" (Ethiopian Institute of Agricultural Research 2017; ASPIRE Report 2017).
  - Lack of market information for both honey and beeswax: ILRI suggested improving this through (1) Developing an apiculture market price information system. (2) Typifying the characteristics of Ethiopian honey, including a geo-referenced production map showing floral resources and honey production. (3) Acquiring market intelligence for exporting. (ILRI MoA report 2013)
  - Pesticide use, poor harvesting practice, honey bee diseases, bee pests/predators, deforestation, lack of training, little influence over prices

- Lack of experience was correlated with a lower amount of honey supplied to the market, therefore one study suggested the value of farmer-to-farmer experience sharing (Giziew 2020). This could be facilitated by a smartphone app.
- In the late 2000s, several initiatives were implemented to introduce modern hives and beekeeping. While some studies document the benefit of increased income with these modern box hives (Abebe 2008), other studies criticize this initiative for not adequately integrating local knowledge and practices (Shiferaw et al 2008).

Govt extension programs for beekeepers

- Ethiopian Apiculture Board: Established in 2009, takes value chain approach to: increase production and productivity, ensure quality production and safety issues, enhance promotion and market linkage, and create a conducive policy environment. They're registered as a legal entity and have several regional chapters. They implemented the ASPIRE, BIPAZ, and BECEREL projects, mentioned below.
- There are extension services to provide information about bee management, post-harvest handling, and marketing of the product, provided by the public district Office of Agriculture and Rural Development. However, a recent study in Amhara revealed that about 59.5% of beekeepers participating in honey market and 21.4% of beekeepers *not* participating in honey market got access to extension service, but only 7.8 % of them got access to extension services regularly. (Giziew 2020)
  - One of the groups responsible for training is ATVETs (Agricultural Technical and Vocational Educational Training) are providing training to development agents on beekeeping as part of government efforts to transform rural agriculture through extension service (Ethiopian Institute of Agricultural Research 2017)
- Organized 207 beekeeper groups for 5,668 youth in the south Wollo administration zone, however a survey found that 40% of these are not functional and the remaining 60% aren't as productive as expected (Alebachew & Eshetie 2019)
- Activities in the 1990s and early 2000s to distribute modern hives and provide training, including 1614 frame hives, 8080 top bars, and and 20,450 local hive colonies from 1997-2002 (Ejigu et al 2009)
- Holeta Bee Research Center—currently involved with SAMS project, mentioned below.
-

- **Registration/certification processes:** In general, there is a lack of certification and regulatory schemes for authenticity, as well as a stringent quarantine system to regulate importation of genetic materials (Ethiopian Institute of Agricultural Research 2017)
  - To support export, In 2006, Ethiopia endorsed the 'Ethiopian Organic Agriculture Systems Proclamation' No. 488/2006, with aim of facilitating international acceptance and market access, value addition, ensuring traceability from farm to market through inspection, ensuring that product labels are genuine as well as the harmonization of organic production.
- **Beekeeping associations:**
  - Ethiopian Beekeepers' Association- unable to find any recent information on activities
  - The Honeys of Ethiopia network, founded by the Slow Food Foundation formed a beekeepers' cooperative here in 2014. Provides technical assistance to beekeepers and promotes byproducts
    - Wenchi Beekeepers Association is a subgroup of this initiative
  - Several women's cooperatives were active around 2010; participating women had higher incomes from honey than women outside the cooperatives. It is unclear if these groups are still active

- **Other stakeholders working in beekeeping sector:**
  - SAMS project: Funded by EU and GIZ, ending this year. SAMS is a multi-national, interdisciplinary project, with the goal to promote beekeeping in tropical regions by applying Internet of Things (IoT) systems and Information and Communication Technology (ICT). SAMS is currently implemented in the Oromia region, in SNNP regions and in Addis Ababa city. Project partners from Ethiopia are ICEADDIS IT Consultancy PLC and Oromia Agricultural Research Institute Holeta Bee Research Centre.
  - Beekeeping Integration Project in the Wheat Belts of Arsi Zone (BIPAZ): 2020-21, funded by BMZ GIZ, implemented by EAB. The overall objective of the project is to enhance the integration and promotion of apiculture and agriculture in to a single system thereby contributing to sustainable agricultural production for income generation and livelihood improvement for 1,300 small scale farmers of three

districts in Arsi Zone of Oromia Regional State for the period of 14 months. Implemented in three districts from Arsi Zone: 1. Ledo Hetossa, 2. Tiyyo, 3. Limmu Bilbillo. Project activities include:

- Baseline Data Collection and Familiarization Workshop
- Training of Trainers (ToT)
- Smallholder Farmers' Beekeeping Training
- Advanced Beekeepers Training
- bee Forage Development/Promotion of Agroforestry Practice
- Model Apiary Establishment
- Follow-up, Monitoring and Evaluation

- Beekeepers Economic Empowerment through long-Term Investments in Entrepreneurship and Value chain in Ethiopia (BEE-LIEVE): 2017-2022 implemented by Relief Society of Tigray (REST) and OXFAM, funded by EU. Works in 6 Woredas of Tigray with smallholder beekeepers, particularly women and landless youths, to boost honey production and expand market base by improving access to key inputs, finance and market. It focuses on improving the technical, business and entrepreneurial skills of small producers and other value chain actors and supporters.
- Promotion of wild coffee and honey as sustainable forest products: GIZ project from 2015-17, commissioned by German Federal Ministry for Economic Cooperation and Development (BMZ). supports the development of business relationships and product certification processes (for wild, organic and fair trade), while promoting value addition and quality improvements. It also carries out capacity building for local smallholder organisations, enabling them to manage the export process independently. More than 1,300 smallholder farmers from 10 cooperatives have received training, and have been given equipment, packaging materials and advice on honey processing.
- Young Entrepreneurs in Silk and Honey (YESH) project 2016-19 funded by Mastercard Foundation, implemented by ICIPE, aimed to benefit unemployed and out-of-school **youth** in Ethiopia. Generated jobs for 12,500 young men and women in the country through honey and silk enterprises; established functional marketplaces for honey and beeswax
  - ICIPE also launched a pilot beekeeping project supported by Biovision Foundation for Ecological Development, Switzerland, in Wag Himra Zone, Ethiopia. The goal is to draw lessons from the pilot phase to inform a planned beekeeping commercialisation cluster financed by the Government of Ethiopia in Tekeze valley, Amhara Region.
- Beekeeping for Environment Conservation and Enhancing Rural Livelihood (BECERL): 2018-19, funded by BMZ GIZ, implemented by EAB. The general objective of the project is to promote apiculture for sustainable self-employment to 800 small-scale farmers and thereby contribute to environmental and biodiversity conservation. Implemented in Two districts from Ilu Abba Bora Zone: 1. Yayo, 2. Hurrumu. Project activities include:
  - Baseline Data Collection and Familiarization Workshop
  - Training of Trainers (ToT)
  - Smallholder Farmers' Beekeeping Training
  - Advanced Beekeepers Training
  - Bee Forage Development/Promotion of Agroforestry Practice
  - Organizing youths and supporting them to establish apiary sites
  - Beeswax processing and market linkages creation
  - Model Apiary Establishment
  - Follow-up, Monitoring and Evaluation
- Apiculture Scale-up Programme for Income and Rural Employment (ASPIRE): Implementation dates unknown, implemented by the Ethiopian Apiculture Board and funded by the Netherlands. aims to contribute to poverty reduction in rural areas of Ethiopia through establishing a dynamic and sustainable apiculture sector. An extension of the project was planned in collaboration with NGO SNV, but has not received funding. Specific activities include:
  - Promotes technologies to improve productivity and quality at the smallholders level
  - Facilitates access to finance for the value chain participants by setting up Guarantee Fund (AGF) for loans;
  - Strengthens the Ethiopian Apiculture Board (EAB), Ethiopian Honey and Beeswax Producers and Exporters Association (EHBPEA), and Ethiopian Beekeepers Association (EBA) to sustain the sector's competitiveness;

        - Supports private sector companies to create market opportunities for beekeepers;
        - Enhances linkages between producer groups and honey processors and other purchasers, including international buyers;
        - Develops and shares knowledge and experience in supporting research and research institutions, knowledge sharing forum.
    - Ethio Wetlands: beekeeping project in South West area in relation to forest resource conservation.
    - ILO: funded trainings for beekeepers for a project in 2015-17
    - Bees for Development: Started work in Ethiopia in 2012, funded by UK Aid Direct and Rowse Honey. Runs trainings and facilitates market access, based in Bahir Dar, Amhara. Trained 400 youth how to make top bar hives and use them for beekeeping
    - Farm Africa, In 2013-14, funded by DFID and Irish Aid, worked directly with nearly 6,400 women and landless young people in Tigray's Ahferom woreda in a variety of agricultural activities to boost livelihoods, including beekeeping
    - SOS Sahel: ran several projects from 2003-11 (Bees Projects Trade Promotion Program, Bale Eco-Region Sustainable Management Programme) to introduce top bar hives and support the marketing of honey

- **ICT stats:**
    - Smartphone ownership: 11.2% as of 2018 (Newzoo).
    - Internet usage: 18.6% as of 2018 (International Telecommunications Union)
    - Mobile phone penetration: 36 mobile subscriptions per 100 inhabitants (International Telecommunications Union)
    - Lower mobile phone coverage in rural areas, see table for range in Oromia region, in which household ownership of mobile phones was lowest in Dewo district (26%) and highest in Sinana district (76%) in 2012. (Tadesse 2015)

- **Pollination dependent crops** (FAO 2018 data)
    - Total harvested area (ha): 6,434,501
    - Total production (tons): 16,973,138
    - Total yield (hg/ha): 1,068,583
    - Top 3 crops with highest harvested area (ha): maize (2.2 million), wheat (1.7 million), barley (970,053)

Lebanon

Opportunities/angles for a data for M&E project in the beekeeping sector:

- Increasing self-sustainability: Lebanon is a net importer of honey according to this 2018 assessment, however domestic honey production capacity is underexploited, and Lebanese consumers distrust the quality of imported honey and therefore primarily support the domestic market. There is a wide network of beekeeping associations that support the sector, however many are struggling to continue operations at full capacity. A data for M&E project in the beekeeping sector could support beekeeping associations by connecting stakeholders, supporting marketing, improving hive management, and providing transparency to consumers on honey quality.

ICARDA

- Overall: ICARDA is not doing much in this area in Lebanon, but we could connect with the Lebanese Agriculture Research Institute.
- Work related to beekeeping: NA
- Potentially relevant country projects:
    - Strengthening Innovation and Technology Adoption towards Sustainable Agricultural Productivity in Arab Countries: (2019-20) Delivers products, information and knowledge, and training services to increase farmer productivity and build capacity.
        - *Project Manager: Seid Ahmed Kemal*
    - Terbol Research Station: A PhD student here did some research on bumblebees for pollination. Generally does activities such as irrigation training and research, includes a genebank

- Social Stabilization through Comprehensive Agricultural Support for Refugee Host Communities: Within this project funded by the Govt of Japan, ICARDA provides support to farmers and refugees in Qab Elias, including trainings about rainfed crop management and improved irrigation systems
  - *Project Manager: Theib Oweis*
- GEF-ICARDA: (1999-2005): dealt with beekeeping and honey production as means for diversifying the incomes of farmers. Aim was to promote in situ conservation of dryland agrobiodiversity in Jordan, Lebanon, Palestine and Syria.

- **Beekeeping statistics** (See FED API MED page for more statistics and Lebanon Honey Value Chain report 2018 for a full value chain assessment)
  - Number of beekeepers: >6,000
    - 84% amatorial and pluri-active, 16% professional
    - **Majority are small-scale (<25 hives) beekeepers** These producers are mostly hobby beekeepers, and hive production per hives is usually lower than market-oriented production units. Honey is used for home consumption and sold to friends and networks of acquaintances.
    - **Medium-scale beekeepers** having between 26 and 49 hives – This category of beekeeper operate as small family businesses. A beekeeper with 40 hives can produce up to 1,200 Kg of honey per year and make a significant profit if honey is sold with at a price premium through a direct sale channel – which is difficult for such volumes. These producers may be linked to cooperatives for production aggregation.
    - **Unbranded large-scale beekeepers** with 50 hives or more – These producers exhibit many similarities to medium beekeepers. Virtually all large beekeepers will practice hive migration to yield at least two harvests per year. At this level of production, beekeepers need to develop specific sales strategy to be able to market their volume of production. These strategies are often built on business linkages and long-term cooperation with medium and large-scale companies – either directly or through the intermediary of a local lead beekeepers - whose role is to aggregate local production to reduce transaction and transport costs.
    - **Branded companies** (or cooperatives) with more than 200 hives – There a limited number of beekeepers in Lebanon with over 200 hives all of which have their own brands. This category of large beekeepers has invested in maintaining their own specialized retail outlets in Beirut and other urban centers to be able to access consumers in those areas. In addition, they rely on fairs and exhibitions stalls.
    - **Large branded companies** with more than 1,000 hives – There are two main players in this category. These actors developed brand names and control a significant share of the domestic market and most of the export market. However, they have different supply strategies, the first consists of increasing market share through outsourcing the majority of its production to other small beekeepers (directly or using local lead beekeepers), while the second sources most of its honey internally, making it the largest beekeeping operation in Lebanon.
  - Average age of beekeeper: 46.50±14.85 among a sample of 2 beekeepers responding to a survey in 2013-15 (Al-Ghamdi et al 2016). Average age of farmer from was 52 (n=102) (Chedid 2019)
  - Number of hives: ~250,000
    - Average production per hive = 15kg
  - Average # of hives/beekeeper: 41.6 (however note that majority of beekeepers are small scale <25)
  - Types of hives: Langstroth
  - Types of beekeeping: sedentary, transhumant. 70% of beekeepers are small-scale <25 hives; 14% are medium scale 26-45 hives; 16% unbranded large scale 50+ hives; and only 12 large scale branded companies in Lebanon. (FAO report 2016)
  - Types of honey: predominantly mountain poly-floral honey and orange blossom honey, followed by mille fleurs and oak tree honey
  - Common pests: Varroa mite parasite
  - Common pathogens: American foulbrood disease, Colony Collapse Disorder (CCD)
  - Regions of country where beekeeping activities take place: all regions of the country

Market (Lebanon Honey Value Chain report 2018)

- Annual production: 2,500 to 3,000 tons

- Primary market pathways: : i) interpersonal direct sales of what is view by consumers has high quality traditional honey, ii) retails market dominated by cheaper and lower quality imports and blended honey, iii) expansion of local high quality honey markets, iv) high opportunities for export.
    - Approximately 54% sold directly from beekeepers to customers, 35% to retail stores, with remaining amounts retailed by small companies or exported. In general, Lebanese consumers prefer to buy directly from beekeepers – and will pay a significant price premium for unbranded honey purchased from beekeepers or beekeeper cooperatives. (FAO report 2016).
- Exports: export market increased by 105% from US$ 163,000 to US$ 334,000 from 2007-11. In 2016, around 85% of Lebanon's honey exports were directed to the Gulf Council Countries. Quantity unknown.
- Import: Lebanon is a net importer of honey according to the Lebanon Honey Value Chain report 2018, however the 2016 FAO report stated that Lebanon only imported 16% of their domestic demand. Import values for honey increased by around 62.4% from 2007 to 2011, from US$ 936,000 to US$ 1,520,000. Quantity unknown.
- Honey consumption per capita: 0.7kg
- Consumer preference: although imported honey is generally cheaper, consumers distrust quality and therefore primarily support the domestic market

Challenges: lack of consumer awareness on honey quality standards, diseases and pests, management and productivity issues, marketing challenges, lack of laboratory tests and export tests, fraud, unregulated import, and disease detection (see SWOT analysis on page 17 for more details).

- Insight from former ICARDA PhD student: our main problem facing the environment is that the beekeepers are trying to find an alternative source of food for the bees and they landed on non native trees such as the eucalyptus tree (which can deplete Lebanese soil from water and cause desertification) preferably if in any case, you could tackle the alternative solutions for feed or do some experiments towards the eucalyptus trees.

Govt extension programs for beekeepers: There is a lack of govt extension services. For some time the government was supporting development of cooperatives to serve an extension-type role, however many are no longer functional (See more detail in cooperatives section below). Beekeepers must be registered with the Ministry of Agriculture in order to receive public extension services. Beekeeping promotion/projects for youth not identified.

Required registration/certification processes:

- Establishing a business: The agricultural sector remains an informal sector in Lebanon. There are no legal entry barriers for investment in the honey sector. Apart from mandatory registration for beekeepers, engaging in agricultural activities remains mostly informal. In regard to private agricultural mills, the registration of a company as well as the acquiring a proper industrial license is a must. e Investment Development Authority of Lebanon is the main body that promotes investment in Lebanon and has a "One-Stop Shop" that eases the process for investors, making it easier to receive permits and licenses.
- Domestically-sold honey must meet Lebanese Standards Institution (LIBNOR) and EU standards. Furthermore, as of 2015, a total ban on the use of antibiotic has been imposed.
- Export: requires several documents: an original commercial invoice, an export order, a quietus from the social security office, a certificate of origin from the Ministry of Industry that is certified by the Lebanese Customs Authorities, export licenses, agricultural health certificates, quality verification for all food products, and a declaration form based on the single administrative document.
    - Export Labelling: should include ingredients, production and expiration date, the product's net weight, and manufacturer. LIBNOR is the main acting body, under the Ministry of Industry, responsible for allotting, issuing, and correcting Lebanese standards. It also grants the Lebanese Conformity Mark. LIBNOR confirms to the WTO's technical barriers to trade, which is a code of good practice related to ensuring that standards are followed through.

Beekeeping associations: While many cooperatives were formed, many cease to function due to unsustainable financing, as the cooperatives either (a) were created as a means of vehicles for donors to distribute funds, but then stopped functioning after project funds used up, or (b) membership fees don't cover the cost of the cooperative operations (e.g. honey extraction, bottling, humidity reduction, etc.) Most of these cooperatives offer fee-based honey extraction with centrifuges and a handful of cooperatives offers marketing services for their members. Generally, the services provider provided by cooperatives include: input ordering, honey extraction, bottling, honey

humidity reduction, wax recycling, distributing anti-varroa treatments from the MoA, and extension. Few cooperatives are financially sustainable, and membership fees often do not cover the cost of operations, which include rent, machinery maintenance, and other expenses. (Source: Lebanon Honey Value Chain report)

- Syndicate of Beekeepers in South Lebanon, Union of beekeepers cooperatives in AKKAR, Cooperative Association of Beekeeping and Development of Honey Production, and Rachaya Beekeepers Association.
- Jabal Amel Beekeeping Cooperative Society in South Lebanon was established in 1986 and had 300 members as of 2009. aim is to help members increase their production and improve the quality of honey.
- تعاونية نحالي المتن الأعلى Nahida reslan +961 76 481 486

IoT Devices: Beehaus: (2019-present) A Lebanese-based start-up with an in-hive IoT device. "TheBeeHaus provides an IoT solution for the beekeeping industry to monitor, manage and optimize honey production. The startup combines technology with beekeeping expertise in order to better understand the behavior of bees and make relevant calculated decisions. Its products and services aim to help beekeepers monitor each hive in their apiary and take the correct action at the right time. Recorded actions will help the beekeepers better manage honey business operation and increase productivity. Stored and analyzed data will help beekeepers optimize and forecast future harvesting." Further information on specific datapoints collected and areas of implementation not found.

Other stakeholders working in beekeeping sector

- Support to Olive and Beekeeping Cooperatives in Lebanon project (2017-2019) Implemented in Akkar in the North, and Hasbaya, Tyr and Marjeyoun in South; by ACTED, funded by EuropeAid. Aimed to: i) Improve productivity and sustainability of honey and olive production in target districts; ii) Improve capacity of cooperatives to advocate, lobby and engage meaningfully with public and private sector actors through creation of mutually beneficial partnerships; and iii) Improving services available from cooperatives for beneficiaries, to increase their access to markets and create value-added goods (including provision of financial support through grants. Challenges identified for honey sector: need for increased competitiveness of agricultural production by increasing its productivity while ensuring conformity with international sanitary and phytosanitary requirements, and facilitating access to international markets.
- Lebanon Industry Value Chain Development (LIVCD) project (2012-19) implemented by DAI funded by USAID, focus on women and **youth**. Objective of improving the competitiveness and value of products and services in both local and export markets by increasing the quality, quantity, and consistency of Lebanese products and companies. Targeted improvements and expansion of honey testing are aimed to boost consumer confidence and increase access to powerful international markets. Moreover, strengthening vertical linkages between producers and commercial brands is tackled, in addition to improving technical and managerial practices that channel profits into rural communities and boost incomes of all stakeholders in the honey value chain.
- IRC: Provides beekeeping training to Syrian refugees in Akkar ~ 2017
- FAO: funded assessment of non-forest wood product value chains, including honey

ICT stats:

- Smartphone ownership: estimates range from 52% (Pew Research 2016) to 80% of the population in Lebanon (Statista 2018) Of the 52% who owned a smartphone,
    - 74% were between ages 18-34
    - 36% were age 35+
- Mobile phone ownership: 88% of the population as of 2016 (Pew Research 2016)
- Internet penetration: 78% as of 2020 (Datareportal)
- Urban/rural stats: Not found, however it is a documented issue of lower access in rural areas and cuts due to extreme weather or energy cuts. (Freedom House)

Pollination dependent crops (FAO 2018 data)

- Total harvested area (ha): 122,958
- Total production (tons): 1,295,792
- Total yield (hg/ha): 4,300,175
- Top 3 crops with highest harvested area (ha): wheat (40,216), barley (12,676), apples (9,842)

Jordan

Opportunities/angles for a data for M&E project in the beekeeping sector:

- General monitoring support: Jordan produces only a fifth of their domestic honey needs but has potential for expansion. Challenges identified that a data for M&E project in the beekeeping sector could support include hive monitoring, pest and pathogen monitoring, quality control, and marketing.

- **ICARDA**
  - Overall: Other than FAP project, there's not much relevant ICARDA work, however we do have contacts at the national research center
  - Work related to beekeeping: NA
  - Potentially relevant country projects: Farming with Alternative Pollinators (FAP) identified as the key project in Jordan that may be an entry point. However, it may not be possible to collaborate with the FAP project due to low interest in an IoT and app in the current farmer community involved with the project.
    - Farming with Alternative Pollinators (FAP): Allocates around 25 percent of every field for habitat enhancement with marketable plants, attracting more diverse pollinators, increasing crop yield, and thus increasing farmer income.
      - *Project manager: Stefanie Christmann*
    - Watershed Restoration in Badia Areas of Jordan (2019-20): objectives are to ensure security, maintenance, and continued monitoring (vegetation development and survival rate); have helped reduce surface runoff and improve vegetation and biodiversity
      - *Project manager: Stefan Strohmeier*
    - Strengthening Innovation and Technology Adoption towards Sustainable Agricultural Productivity in Arab Countries: (2019-20) Delivers products, information and knowledge, and training services to increase farmer productivity and build capacity.
      - *Project Manager: Seid Ahmed Kemal*
    - GEF-ICARDA: (1999-2005): dealt with beekeeping and honey production as means for diversifying the incomes of farmers. Aim was to promote in situ conservation of dryland agrobiodiversity in Jordan, Lebanon, Palestine and Syria.

- **Beekeeping statistics** (further details on FED API MED Jordan page)
  - Number of beekeepers: 1,000
    - 10% amateur, 85% pluri-active, 5% professional
  - Average age of beekeeper: 39.40±14.04 among a sample of 4 beekeepers responding to a survey in 2013-15 (Al-Ghamdi et al 2016)
  - Number of hives: 60,000
    - Average production per hive: 8kg
  - Types of hives: Langstroth
  - Types of beekeeping: sedentary, transhumant
  - Types of honey: all savage flowers; chestnut, heater; multiflora honey
  - Common pests: Varroa destructor, Vespa orientalis, Galleria melonella, Dorylus fulvus, Braula orientalis, Merops apiaster, Hirundo rustica, Hirundo daurica and Merops orientalis (Al Majeed et al 2009). *Note that this list may be outdated, data was collected in 1999-2000; oriental wasp (FAO 2015)
  - Common pathogens: Israel acute paralysis virus (IAPV); Kashmir bee virus (KBV) (Al-Abbadi et al 2010)
  - Regions of country where beekeeping activities take place: countrywide
  - Average age of beekeeper: Not found. But the majority of farmers from Syria working in Jordan were in the 15-35 age group (ILO 2018), considering average age to be in the 26-35 age range.

- **Market**: (FED API MED Jordan)
  - Annual production: 500 tons
  - Domestic consumption: 2500 tons annually
  - Export: 5 tons annually
  - Import**:** Assumed to be ~2,000 tons as domestic consumption is 2500 tons annually
  - Per capita honey consumption: 0.35kg

- Royal Jelly production: 40-50kg annually
- Pollen production: 3-5 tons annually

- **Challenges:** Lack of training and skills in marketing and management, quality control issues (USAID LENS); pesticides, degradation of wild flora, introduction of new diseases through imported bees

- **Govt extension programs for beekeepers:** (FAO 2015) Current extension and research services in Jordan are poorly staffed and ineffective and lack the needed training skills, no clear strategy for the development of the beekeeping sector is available. However, the government has supported this sector in other ways:
  - The National Strategy for the year 2025 was focused on conservation of genetic resources for food and agriculture, honey bees was one of the main objectives as this sector is providing crucial impact on the ecosystem by pollination of agricultural crops and wild plants
  - There's also a Honey beekeeping Department at National Center for Agricultural Research and Extension (NCARE), which has a monitoring program for honeybees; does research on pests and pathogens (funded by USAID); had a project on honeybee conservation (funded by GIZ);
    - The collaboration between NCARE, MOA and the Jordanian Beekeepers Union had taken place during the last 5 years in order to plant honey bee forage plants, this initiative was through a project involved beekeepers in the plantation of trees and the trees were distributed for free by the forestry department (MOA). During the last 10 years this NCARE honey bee department distributed for free over 20,000 queens' cells which had helped in the conservation of this important honeybee genetic resource
  - Programs promoting beekeeping among youth not found

- **Beekeeping associations:** Jordan Beekeeping Association (page in Arabic)

- **Other stakeholders working in beekeeping sector:**
  - USAID Jordan Local Enterprise Support Project (LENS): worked to modernize hive management and honey processing, beekeeper training, and educating government officials on the importance and income potential of beekeeping. Funding from this project also helped establish the Jordan Beekeeping Association in Northern Jordan

- **IoT device:** Jordanian company WASSLZ develops IoT technology, however IoT devices specifically for beekeeping were not identified

- **ICT stats** (International Telecommunications Union)
  - Smartphone ownership: 51% (Pew Research, 2016)
  - Internet users: 67% 2018
  - Mobile phone users: 88 mobile-cellular subscriptions per 100 habitants as of 2018

- **Pollination dependent crops** (FAO 2018 data)
  - Total harvested area (ha): 101,166
  - Total production (tons): 1,724,194
  - Total yield (hg/ha): 5,657,441
  - Top 3 crops with highest harvested area (ha): barley (40,843), wheat (18,049), tomatoes (12,909)

Palestine

Opportunities/angles for a data for M&E project in the beekeeping sector: Difficult to operate in due to conflict. There is a small beekeeping community, no major partners currently working in this sector that we could connect with, and few ICARDA staff and entry points. However if Palestine is pursued, GIZ and IFAD have shown interest in the past few years in supporting the beekeeping sector there.

- **ICARDA**

- Overall: Country manager unable to visit Palestine. ICARDA does have representative there working on FAP project, but they are one of the few staff there, and in general operations can be difficult in Palestine due to the conflict and politics.
- Work related to beekeeping: NA
- Other country projects
  - Farming with Alternative Pollinators (FAP): Initially there were plans to expand this approach to Tunisia, but confirmation is needed. FAP allocates around 25 percent of every field for habitat enhancement with marketable plants, attracting more diverse pollinators, increasing crop yield, and thus increasing farmer income.
    - *Project manager: Stefanie*
  - GEF-ICARDA: (1999-2005): dealt with beekeeping and honey production as means for diversifying the incomes of farmers. Aim was to promote in situ conservation of dryland agrobiodiversity in Jordan, Lebanon, Palestine and Syria.

- **Beekeeping statistics** (Source: FED API MED Palestine page)
  - Number of beekeepers: 1,000
    - 70% amateur & pluri-active; 30% professional
  - Average age of beekeeper: 43.25±4.57 among a sample of 4 beekeepers responding to a survey in 2013-15 (Al-Ghamdi et al 2016)
  - Number of hives: 250,000
    - Average production per hive: 7kg
  - Types of hives: Italian, Italian Hybrid
  - Types of beekeeping: sedentary, transhumant
  - Types of honey: chestnut, heater, savage flowers
  - Common pests: A. woodi (Chantawannakul et al 2016), hornets, tracheal mites, varroa mites (Al-Ghamdi et al 2016)
  - Common pathogens: Not found
  - Regions of country where beekeeping activities take place: country-wide

- **Market** (FED API MED Palestine page)
  - Annual production: 1,250 tons
  - Domestic consumption: 100%
  - Export: none
  - Import: unknown
  - Per capita consumption: 12kg/year
  - Byproducts: no pollen production and quantity of royal jelly is not enough to sell commercially

- **Challenges for beekeeping sector:**
  - Decline of beekeeping tradition in the West Bank due to conflict
  - There is no coordination between farmers and beekeepers when a farmer sprays crops with pesticides

- **Govt extension programs for beekeepers:** Not found

- **Registration/certification processes**: Palestine Standards Institution is regulatory body

- **Beekeeping associations:**
  - Ramallah & Jenin Beekeepers Cooperative – were mentioned in this call for proposals, but further details on their activities not found
  - Cooperative Association for Beekeepers – Gaza Strip, further details not found

- **IoT devices:** A researcher from Palestine Polytechnic University presented the concept in 2016, but no evidence of plans to implement/current implementation of such a device for the beekeeping sector in Palestine

- **Other projects in beekeeping sector:** includes a few project proposals and peacebuilding projects

- GIZ: Released tender to fund beekeeping tools for Sayda cooperative in 2019; results not found
- IFAD – 2018 potential project that included providing beekeeping supplies and training. Current implementation status unknown
- Current projects not identified, however beekeeping has been used as part of several peacebuilding initiatives, including Bee Preservation as Peacemaking 2017, Bees for Peace
- ILO did capacity building activities and business planning with the Cooperative Association for Beekeepers, and FAO ran some beekeeping trainings for women pre 2011

- **ICT stats**
  - Smartphone ownership: 57% (Pew Research, 2016). the percentage of households in Palestine with a Smartphone is 52.1% in 2015, with 60.7% in the West Bank and 35.7% in Gaza Strip (Palestinian Central Bureau of Statistics)
  - Internet users: 66.4% of population as of 2018 (International Telecommunications Union)

- **Pollination dependent crops** (FAO 2018 data)
  - Total harvested area (ha): 40,888
  - Total production (tons): 637,617
  - Total yield (hg/ha): 6,025,186
  - Top 3 crops with highest harvested area (ha): wheat (15,413), barley (7,545), cucumbers (2,740)

Turkey

Opportunities/angles for a data for M&E project in the beekeeping sector:

- Pollination-dependent crops: Among countries in this analysis, Turkey had the highest yield from pollinator-dependent crops, at nearly 6 million hg/ha. This also appears to be a unique approach; none of the other projects identified have this focus.
- Consumer influencing: Several challenges in the sector relate to consumer behaviors and could potentially be addressed through a smartphone app, including (1) lack of consumer knowledge about high-quality honeys, (2) general marketing, and (3) negative social stigma around beekeepers.

- **ICARDA**
  - Overall: No current work related to beekeeping, closest is FAP project. We could get connected to government and beekeeping association.
  - Work related to beekeeping: NA
  - Other country projects:
    - Farming with Alternative Pollinators (FAP): Allocates around 25 percent of every field for habitat enhancement with marketable plants, attracting more diverse pollinators, increasing crop yield, and thus increasing farmer income.
      - *Project manager: Stefanie Christmann*
    - Works closely with the Ministry of Food, Agriculture, and Livestock on wheat improvement programs, has an office in Ankara and a research center in Izmir. Further details on past collaborations have been documented in this report.

- **Beekeeping statistics** (Source: Turkish Association of Beekeepers, 2015)
  - Number of beekeepers: 83,467
    - It is assumed that the number of hobby beekeepers are more than commercial/professional beekeepers. (Live and Let Bee)
  - Average age of beekeeper: 61% of the participants performing beekeeping activities were in the 40-60 age range in Kastamonu region (Altunel & Olmez 2019)
  - Number of hives: 7.7 million
  - Types of hives: Langstroth
  - Types of honey: flower honey, pine honey, chestnut honey, thyme honey, astragalus honey, citrus honey, cotton and sunflowers honey (USDA 2015)
  - Common pests: Varroa destructor, nosema (Bayrakal et al 2020)

- Common pathogens: Chronic bee paralysis virus (CBPV), Black queen cell virus (BQCV) (Gumusova et al 2010); ABPV, BQCV, DWV, Nosema ceranae, Trypanosomes (Tozkar et al 2015), chalkbrood disease (Bayrakal et al 2020), foulbrood disease (Live and Let Bee)
- Regions of country where beekeeping activities take place: The biggest honey producing provinces in Turkey are Mugla (15,282 MT), Ordu (15,016 MT), Adana (9,715 MT), Aydin (3,447 MT), Sivas (3,039 MT) and Mersin (2,884 MT) (USDA 2015).

- **Market** (USDA 2015)
  - Annual production: 107,665 tons
  - Domestic consumption: Nearly all of the honey produced within the country per year is consumed locally.
    - In a sample of 80 beekeepers from Northwest Turkey, 98.8% of the participants stated that they sell the produced honey directly to consumers, and very few of them stated that they sell it to intermediaries.
  - Exports: In 2014, Turkey exported approximately 5,000 tons ($20 million) honey mostly to Germany, the United States, Jordan, Hungary, Iraq, Saudi Arabia, Austria, Northern Cyprus, Belgium and Spain.
  - Imports: 13 tons in 2014 at value of $67,982. Although Turkey has no import ban on honey, the Turkish Ministry of Economy implemented a high custom tariff on imports, thus making it difficult for Turkish businesses to import honey.
  - Honey consumption per capita: 1.2kg
  - Other products: In addition to honey, beeswax, pollen and royal jelly is produced. Royal jelly has become commercially used within the past 5 years. (Live and Let Bee)
    - Turkish Apitherapy Association was established in order to support the improvement and modernization of apitherapy treatment methods. (Plan Bee 2020)

- **Challenges**:
  - The honey packers have the majority of control, not much power held by beekeepers
  - There's also a bit of a negative social stigma around beekeepers.
  - Post-production alteration of honey with glucose
  - Lack of consumer knowledge about high-quality honeys (IFAD)
  - Pesticide use
  - Contamination of honey with bacterial, fungal, and parasitological agents (Bayrakal et al 2020)

- **Govt extension programs for beekeepers:** Agriculture and Rural Development Support Agency (IPARD Instrument for Pre-Accession Assistance on Rural Development). The provision of consultancy services, which is required for feasibility studies, the purchase of essential machinery and equipment, and modernization of enterprises for producing, storing and processing of the beehive, honey and other bee products, are in the scope of support.
  - ORKÖY (the office of forest-village relations) distributed 30 beehives to 80 villagers with beekeeping certificates (in 2016 and 2017) and let them put their hives in the "honey forest" which was established in the region by the Forest Directorate (Altunel & Olmez 2019)
  - Note that Turkey also provides beekeeping assistance to other countries. For example: the Turkish Cooperation and Coordination Agency (TIKA) trained 140 women in flood-hit Pakistani northwestern region in beekeeping. TIKA sent experts to give a five-day training to the women in the region. They also gave the trainees more than 400 beehives, bee colonies, and useful equipment to start their beekeeping businesses (Plan Bee 2020)

- **Registration/certification processes:**
  - Beekeepers: For the year of 2015, 10 Turkish Lira (TL) per hive were given to beekeepers who registered with the Beekeeping Registration System (AKS) and 60 TL to beekeepers who use bumblebees registered with the Agriculture Greenhouse System (OKS). Since 2015, farmers have been subsidized if they have at least 30 hives and the hives have plates for traceability. According to MinFAL, 2.6 million TL was paid for 52,000 hives in 2011 within the scope of the subsidy payment program (USDA 2015). Beekeepers are also encouraged to register with the Turkish Association of beekeepers, discussed below.

- Honey: Turkish food codex Notification No. 2012/58 on honey. Sets forth the rules and procedures of and determine the standards for, hygienic and technically appropriate production, processing, conservation, transport, storage and marketing of honey. The Notification further sets forth the product features of honey and covers provisions related to food additives, pesticide residues, veterinary drug residues.

- **Beekeeping associations:**
  - Turkish Association of Beekeepers, within which exists predominantly beekeepers unions, as well as some honey producer unions. This association provides support to beekeepers through honey collection, processing, analysis, and bee research. As a member of the Association, beekeepers are automatically insured for all colonies, especially against transportation accidents in migratory beekeeping activities. They may also send honeybee samples to The Agriculture Administry Apiculture Research Ins. and Hacettepe University for laboratory analysis (diagnosis diseases or chemical analysis, pollen analysis of honey) for free. By being a member of the Association, beekeepers can take a loan from The Agricultural Bank of the Republic of Turkey (TCZB) for developing apiaries for colonies, and can also join seminars and education courses organized by the Association. All associations in the 81 Turkish provinces are managed by the Central Beekeeping Association in Ankara. In order to join the association, the beekeeper must attend a training by ISMEK. Financial sustainability of the association is a concern. (Ceyhan et al 2017; Live and Let Bee)
  - Sivas Beekeeping Association: Supported by IFAD project below, unclear which services they normally provide versus which services were only available because of IFAD project

- **IoT devices:** No active projects with IoT devices were found, however several researchers from Firat University wrote a paper presenting the concept of an IoT device for monitoring beekeeping. The paper only discussed the system and was not about a piloting project or IoT devices currently being implemented in Turkey (Balta et al 2017).

- **Other projects in beekeeping sector**
  - IFAD: Financed modern beehives (905 provided under the pilot project and 4,750 partially financed by the project, including pollen and propolis traps), tools and equipment were distributed to eligible beekeepers. Enabled training of 20 beekeepers from Sivas for one week at the Beekeeping Institute in Mersin on modern beekeeping practices and the breeding of queen bees., technical assistance, supported Sivas Beekeeping Association. Increases in the production of honey (from 5 to 15kg on average), pollen and propolis were registered.
    - Challenges: Poor quality honey and competition from inexpensive imported honey could make it difficult for producers supported by this project to continue in the future. Proper marketing infrastructure and effective quality control mechanisms are also needed to boost the sector's competitiveness.
  - Live and Let Bee: An EU-funded project focused on ecological beekeeping in Turkey, Macedonia UK, and the Netherlands. Project activities include trainings, providing public resources, and conferences
  - My Bee, My Honey, My Honeycomb: EU-funded project to build a high technology facility for production, storage and innovative marketing is built in Ordu for the utilization of honey producers in the region.
  - Balparmak: Through funds from the European Bank for Reconstruction and Development, this commercial honey producer is able to expand their product range and offer trainings with a focus on **youth** and women
  - Additionally, there is an official Apitherapy Certification Training Program in Turkey

- **ICT Stats**
  - Smartphone ownership: 64% of the population owns smartphones (Statista 2019)
  - Internet penetration: 74% of population as of 2020 (Datareportal)
    - As of 2013, 28.6% of rural households used the internet, in contrast with 58% of urban households (Center for American Progress 2016)
  - Mobile connections: The number of mobile connections in Turkey in January 2020 was equivalent to 92% of the total population (Datareportal)

- **Pollination dependent crops** (FAO 2018 data)
    - Total harvested area (ha): 13,262,259
    - Total production (tons): 71,624,390
    - Total yield (hg/ha): 5,925,650
    - Top 3 crops with highest harvested area (ha): wheat (7.3 million), barley (2.6 million), sunflower seed (734,190)

Syria

Opportunities/angles for a data for M&E project in the beekeeping sector:

- Restoring # of colonies**:** Syria has experienced an abnormal loss of colonies around 2017, thus a data for M&E project in the beekeeping sector could help improve monitoring and management of hives, pests, pathogens…
    - Note that several projects are already using beekeeping as a means of income-generation for returning displaced persons, however these projects aren't comprehensively reaching all potential participants and this angle could be considered.
- Beekeeping & crop pollination: The government is particularly interested in the benefit of bees for crop production; they have supported beekeepers through loans for hives, workshops, trainings, and plans for afforestation to support migratory beekeepers.

- **ICARDA**
    - Overall: ICARDA never worked in beekeeping in Syria before and this would be a good addition to our profile. ICARDA does work with farmers and has good relations with beekeeping stakeholders.
    - Work related to beekeeping: NA
    - Other country projects:
        - AFESD Support for Enhancement of Food Security in Arab Region, Phase III: aims to enhance food and nutrition security, improve rural livelihoods, and protect natural resources, includes tech and knowledge dissemination
            - *Project Manager: Habib Halila*
        - GEF-ICARDA: (1999-2005): dealt with beekeeping and honey production as means for diversifying the incomes of farmers. Aim was to promote in situ conservation of dryland agrobiodiversity in Jordan, Lebanon, Palestine and Syria.

- **Beekeeping statistics** (Bees for Development)
    - Number of beekeepers: 15,000
        - 5,000 are professional
    - Number of hives: 365,000 hives (likely outdated statistic from 2003)
    - Types of hives: Majority (80%) Langstroth; traditional hives include cork tree trunk hives and the terracotta hives
    - Types of beekeeping: sedentary, migratory
        - Migratory produces average of 20-25kg honey
    - Types of honey: anise, Citrus, cotton, Eucalyptus, Euphorbia spp, fruit trees (almond, apple), heathers Erica and Colluna, mountain herbs (G'sfus, rosemary, thistles, thyme) and sunflowers.
    - Common pests: Varroa, bee-eaters (Merops apiaster and Merops superciliosus); jackals; Zombie fly (Apocephalus borealis) (Assad 2018)
    - Common pathogens: Deformed wing virus DWV, Acute bee paralysis virus ABPV, Chronic bee paralysis virus CBPV and Sacbrood virus SBV (Barhoum et al 2017); black queen cell virus BQCV, AMFV, nosema ceranae (Kubaa 2018); american foulbrood (Mahmud et al 2013)
    - Regions of country where beekeeping activities take place: countrywide

- **Market**: (Bees for Development)
    - Honey Annual production: 1,750 tons, growth in the past 5 years.
    - Honey retail price: 7 Euros/kg for cotton or sunflower honey to 24 Euros/kg for thyme honey
    - Domestic consumption: Primarily
    - Export: ~30 tons/ year of "fine honeys" like Thyme to Gulf countries

- Import: Unknown
- Per capita consumption: not found
- Royal jelly annual production: 300kg/year
- Royal jelly retail price: 2 Euros/gram

- **Challenges**:
  - Varroa is fought with either acetic acid or Bayvarol. The presence of bee-eaters (Merops ap/asfer and Merops supera'/iosus} is a real problem, and the beekeepers sometimes have to move apiaries. In the southern region of Suweida and in the border region with Iraq, jackal attacks on hives can cause damage comparable to those made by badgers in East Africa. With regard to the high number of wasps, problems occur only with the imported bees and their hybrids, and they do not affect the indigenous Syrian honeybees which are perfectly adapted to their environment and can get rid of the wasps. (Bees for Development)
  - Abnormal loss of colonies (Barhoum et al 2017)
  - (2020 interview) – n=1
    - These projects aren't reaching everyone, for example a beekeeper in Latakia province notes there is no NGO support in his area
    - Depreciation of Syrian pound
    - Current conflict & distrust of western aid

- **Govt extension programs for beekeepers:** Govt is particularly interested in supporting this sector to improve crop pollination. They have supported beekeepers through loans for hives, workshops, trainings and supporting the WFP project providing beekeeping kits listed below. They hope to afforest the mountain areas with Acaa'a and Eucalyptus trees and these new areas of melliferous plants to increase the migratory beekeepers' season, and have 500,000 colonies to pollinate crops. (Bees for Development)
  - About 100 experts in beekeeping teach new apiculture methods in 20 specialised centres. They breed bees and sell swarms for 30 Euros and stocked hives for 50 Euros. These 20 centres can have up to 300 trainees a year
  - The aim of the government is to eventually have 500,000 colonies spread out on the crops in order to guarantee good pollination and to help 15,000 **young beekeepers** to start in apiculture, in a country where unemployment reaches over 30%.
  - Ministry of Agriculture and Agrarian Reform (MAAR): a development of apiculture project from 2011-15 to provide equipment to 20 beekeepers.

- **Registration/certification processes**: Not found

- **Beekeeping associations:**
  - Honey producers' committee
  - Union of the Association of Beekeepers
  - Free Beekeepers Association, Aleppo, or "The Beekeepers' Chamber – Aleppo Branch". Seeks to provide services to beekeepers in northern and eastern Aleppo, and to organize scientific and practical seminars in which problems are raised, and methods of beekeeping are introduced.

- **IoT devices:** None found

- **Other stakeholders working in beekeeping sector**
  - Beekeeping kits: A current FAO project in partnership with the Arab Beekeepers Union, funded by DFID provides beekeeping kits to displaced people returning to Syria
  - Beekeepers' livelihood project: WFP project started in 2017 also in partnership with Arab Beekeepers Union and supported by Syrian Agricultural Chambers Federation, also provided beekeeping kits.
  - Apiculteurs sans Frontieres: Their mission ranges from the popularisation of basic beekeeping techniques - such as the production of honey in traditional hives - to the breeding of queen honeybees and the teaching of instrumental insemination. The aim is to develop and make the most of the region's beekeeping resources while at the same time respecting local customs (Bees for Development)

- The Syrian Bee Centre: specific details not found, but they're associated with this informative article: (Bees for Development)

- **ICT stats**
  - Smartphone ownership: 73% (Year unknown, Refworld)
  - Internet users: 66.8% of population as of 2018 (International Telecommunications Union)
  - Mobile penetration: 88 mobile subscriptions per 100 people
  - Disaggregations by urban/rural and region not found

- **Pollination dependent crops** (FAO 2018 data)
  - Total harvested area (ha): 1,842,353
  - Total production (tons): 4,611,556
  - Total yield (hg/ha): 2,892,151
  - Top 3 crops with highest harvested area (ha): barley (780,000), wheat (600,000), almonds (72,000)

UAE

Opportunities/angles for a data for M&E project in the beekeeping sector:

- Filling data gaps: There is very little publicly accessible beekeeping data; beekeeping data collected by a data for M&E project in the beekeeping sector could support researchers, government administration, and development partners.
- Migrant workers: Migrant workers to the UAE commonly experience unfair pay and this has been exacerbated by COVID, in which many have lost jobs. Introducing/supporting beekeeping as a supplementary source of income could be considered.

- **ICARDA**
  - Work related to beekeeping: NA
  - Potentially relevant country projects: NA

- **Beekeeping statistics**
  - Number of beekeepers: Not found
  - Average age of beeekeeper: Not found, however average age of farmer was almost 60 years in 2016. (Qaydi 2016)
  - Number of hives: Not found
  - Types of hives: Not found
  - Types of beekeeping: majority commercial beekeepers (UAE Beekeepers Association)
  - Types of honey: Acacia, Sidr, Samar, Frangula alnus, and Ghaf, Acacia tortilis
  - Common pests: bee eater birds, ants, Death-Head Hawkmoths, wax moths, geckos, varroa destructor, nosema, chalkbrood, foulbrood
  - Common pathogens: Not found
  - Regions of country where beekeeping activities take place: Not found

- **Market**
  - Annual production: 800 tons (2018, news article)
  - Export: AED 14 million in 2017; major export markets included Oman, Saudi Arabia, Yemen, Maldives, while Oman, Kuwait and Iraq were major markets for re-exports of honey. Up from 4.7 million in 2011.
  - Import: AED 126 million in 2017 (Dubai Chamber of Commerce and Industry). Primarily Saudi Arabia, Australia, Germany and India. Annual growth rate of 14%.
  - Per capita consumption of honey: not found
  - Demand: growing; increased honey consumption. Also used in the beauty industry.

- **Challenges for beekeeping sector:** Heat

- **Govt extension programs for beekeepers:** Extension services not identified, however the Abu Dhabi Agriculture and Food Safety Authority (ADAFSA) supports beekeeping research and development, including the breeding of the Emirati Bee; hosts Beekeeper meetings; Helped host the Apimondia expo this year in Abu Dhabi

- **Registration/certification processes:** Honey is required to comply with UAE Assessment Scheme.

- **Beekeeping associations:** UAE Beekeepers Association: activities include: education and advocacy to the public and government, promote best practices and provide education to beekeepers, promote UAE honey in the global market,

- **Other stakeholders working in beekeeping sector**
    - Abu Dhabi Agriculture and Food Safety Authority (ADAFSA): supports beekeeping research and development, including the breeding of the Emirati Bee. Helped host the Apimondia expo this year in Abu Dhabi
    - ANHB: a major commercial stakeholder in the sector, supports MyHive initiative described below

- **Honey culture & market:** There seems to be a strong and diverse market for honey (in both food and beauty industries), and beekeeping seems to be well-respected based on the hobby beekeepers in the Beekeepers Association, numerous commercial enterprises, and hosting the Apimondia expo. Furthermore there is a "MyHive" initiative which basically gives a partial experience to non-beekeepers in which they sponsor a hive, get honey, visit it 3x a year, and may monitor the hive via an app (news article)

- **ICT stats**
    - Smartphone ownership: One of the highest in the world, 80.6% (Newzoo)
    - Internet usage: 98.45% of population (International Telecommunications Union)
    - Mobile phone penetration: 208 mobile subscriptions per 100 inhabitants (International Telecommunications Union)
    - Disaggregation by region and urban/rural not found

- **Pollination dependent crops** (FAO 2018 data)
    - Total harvested area (ha): 5,523
    - Total production (tons): 235,578
    - Total yield (hg/ha): 4,401,181
    - Top 3 crops with highest harvested area (ha): tomatoes (1,113), almonds (811), cucumbers (764)

Uzbekistan

Opportunities/angles for a data for M&E project in the beekeeping sector:

- Supporting government initiative: The government issued a decree "On Measures to Further Develop the Beekeeping Industry in the Republic of Uzbekistan" to develop and expand the beekeeping industry from 2017-21. One of the outputs of this decree was the establishment of the Uzbekistan Beekeepers' Association, which has regional associations across the country and is responsible for both technical extension services as well as a legal/policy role.
- Income generation: This angle has been successfully implemented by UNDP in former farming areas affected by the Aral Sea disaster. Furthermore, recent ICARDA research on ecosystem services discovered that there is excellent scope for expanding beekeeping in Uzbekistan.

ICARDA

- Overall: FAP work is the closest thing ICARDA has done to beekeeping sector in Uzbekistan; as long as technical beekeeping knowledge is not needed, ICARDA could implement this. Since increasing the number of pollinators is a priority, ICARDA should expand work in this area. Recently, an ICARDA study on Valuation of Ecosystem Services in a pilot research site found that there is an excellent scope of expanding beekeeping.
- Work related to beekeeping:
    - A study was recently completed on Valuation of Ecosystem Services in a pilot research site, where it was discovered that there is an excellent scope of expanding beekeeping

    - ICARDA worked with an FAO project in 2019-2020 that planned to provide beehives to couple of farmers in the community (in small settlement in desert areas), however it is unknown if this was achieved. ICARDA's role in the project was to conduct farmer field schools.
- Potentially relevant country projects:
    - Establishing Best-practices and Approaches for Climate-adapted and Biodiversity-friendly Integrated Natural Resource Management (INRM) Farmer Field Schools (FFS) in Cold Winter Deserts CWD (2019-2020): implemented activities related to establishment and implementation of Farmer Field Schools (FFS) for sustainable land use management at two pilot sites: Chuya village of Nurota district in Navoi region and Durmon Village of Korakol District in Bukhara region.
        - *Project manager: Ram Sharma*
    - FAP: the Farming with Alternative Pollinators project was successfully piloted in Uzbekistan
        - *Project manager: Stefanie Christmann*
    - Has implemented several agriculture projects in the Fergana valley region.

- **Beekeeping statistics** (Uzbekistan Beekeepers' Association, 2019)
    - Number of beekeepers: 14,412
        - Disaggregation by small/large scale not found
    - Average age of beekeeper: Not found, but the average age of male farmers in 2007 across 8 regions was 46 (FAO)
    - Number of hives: 846,000
    - Types of hives: Not found
    - Types of beekeeping: Not found
    - Types of honey: Not found
    - Common pests: Philant, or bee wolf; Golden bee eater bird; hornet; wax moth; praying mantis; dragonflies; earwigs; spiders; Ktyri flies; wasps; ants;
    - Common pathogens: American and European foulbrood, sac brood, ascospherosis (calcareous brood), hafniasis (paratyphoid), septicemia, nosematosis, amoebiosis, cenotainosis, varroatosis, braulosis, meleosis.
    - Regions of country where beekeeping activities take place: countrywide

- **Market** (Uzbekistan Beekeepers' Association, 2019)
    - Annual production: 19,100 tons
    - Domestic consumption: assumed to be predominant due to low export quantity; stats not found
    - Honey export: 42.4 tons for $1 million
    - Bee export: 245 thousand PCs in 2019
    - Honey import: not found
    - Honey import tax: In accordance with the Decree of the President of the Republic of Uzbekistan No. 4243 "On measures for further development and support of the livestock industry" dated March 18, 2019 for beekeepers wandering with bees, for the first time, a privilege was introduced for paying customs duties on imported honey, which will undoubtedly contribute to the development of beekeeping in the republic and the strengthening of international cooperation between beekeepers.

- **Culture:** Honey has long been part of Uzbekistan cuisine, and honey from medicinal plants is thought to have healing properties (Abdiniyazova et al 2016)

- **Challenges:** Not identified

- **Govt extension programs for beekeepers:** it appears that the branches of the Uzbekistan Beekeepers' Association (which were established due to decree from president) fill an extension role. The government has also supported beekeeping through:
    - President of Uzbekistan Shavkat Mirziyoyev signed a decree "On Measures to Further Develop the Beekeeping Industry in the Republic of Uzbekistan" on 16 October 2017. Includes a program of measures for the comprehensive development of the beekeeping industry for the period from 2017 to 2021. The adopted program provides for an increase in honey production and processing, as well as the introduction of modern technologies in the honey making process.

- A procedure for the transportation and placement of honey bees in the Republic of Uzbekistan has been developed and implemented, according to which, during the honeybees collection, at the applications of the association, beekeeping farms - members of the association are granted free use of forest land, protected natural areas (with the exception of state reserves, protected zones of biosphere reserves), mountain and foothill zones, natural pastures, and also agricultural lands.
- Developed and amended the Administrative Code on the falsification of honey, which, when considered in the Cabinet of Ministers, was expanded to include all food products and industrial products produced in the republic. Work is underway to improve the standards for bee products, introduce international standards and join Uzbekistan to the Interstate Committee for the Standardization of Bee Products.

- **Registration/certification processes:** Not found

- **Beekeeping associations:**
  - Uzbekistan Beekeepers' Association: An NGO established due to decree from President on 2017 to promote beekeeping. Under this initiative there are regional associations. They are an Apimondia member. Roles and responsibilities include:
    - development of a legal framework for beekeeping;
    - preparation and implementation of industry development programs;
    - pursuing a unified scientific and technical, technological, investment and export policy;
    - training and retraining of personnel on the basis of higher, secondary special vocational educational institutions, including foreign ones;
    - strengthening of food supply, reasonable use of natural resources.
    - Organizing exhibitions and seminars
  - Tashkent City Society of Beekeepers

- **IoT devices:** None found

- **Other projects/stakeholders working in beekeeping sector:**
  - UNDP: Project in area affected by Aral Sea disaster, includes 48 beekeeping demonstration plots, delivery of 210 beehives, 2 honey canning shops, 1 wax production shop, and business trainings. Partner is Govt of Turkey. (Additional article)
  - FAO: In partnership with government, numerous experiments have been carried out on sowing honey trees and plants in the regions. Planned work is underway to organize the Experimental Station on beekeeping and attracting foreign scientists; a project has been prepared for implementation jointly with the UN FAO, which provides for a grant of $ 350,000 to train specialists and scientific personnel for beekeeping in Uzbekistan.
  - Fergana State University: In 2018, for the first time, 20 applicants were recruited to the faculty in the specialty "zootechnician-beekeeper" at the Fergana State University and the Samarkand Institute of Veterinary Medicine. In all areas at colleges organized one-year training courses with secondary special zootechnical education for the apiculture industry. Foreign specialists held seminars for college teachers on how to learn the course of beekeeping.
  - ICARDA staff provided this list of companies and organizations dealing with beekeeping and honey production:
    - Asalchi-Apis Ltd
    - Apiline
    - Bio-plant Ltd
    - Gold Honey
    - Aristocrat
    - Jaxogir Shoxruh Farm
    - Sarvarani Sara Asali Private Enterprise
    - Uzfergana Pchelka Private Enterprise
    - Zomin Asali Ltd
    - Mir Myoda
    - Navoiy Asalarichiligi Ltd
    - Suhrobjon Agro Gold Ltd

        - Gulomkhuja Asalchiligi Farm

- **ICT stats**
    - Smartphone ownership: 31.3% as of 2018 (Newzoo)
    - Internet penetration: 55% as of 2020
    - Mobile connections: The number of mobile connections in Uzbekistan in January 2020 was equivalent to 76% of the total population. (Datareportal)

- **Pollination dependent crops** (FAO 2018 data)
    - Total harvested area (ha): 1,801,952
    - Total production (tons): 13,547,915
    - Total yield (hg/ha): 5,389,687
    - Top 3 crops with highest harvested area (ha): wheat (1.3 million), apples (98,117), barley (90,231)

Tajikistan

Opportunities/angles for a data for M&E project in the beekeeping sector: While the beekeeping sector here is growing and the government had a development program for beekeeping from 2006-11, specific "pain points" or angles were not identified; there is a lack of data and few actors currently working in this space.

- **ICARDA**
    - Work related to beekeeping: NA
    - Other country projects:
        - Recently a former ICARDA staff (now head of CARITAS office) requested Stefanie the rights to translate the FAP video in Tajik Language

- **Beekeeping statistics**
    - Number of beekeepers: Not found
    - Average age of beekeeper: Not found, however average age of population is 22.4 years (Worldometer)
    - Number of hives: 228,000 (MoA, 2019)
        - Increase of 8000 hives in 2018-19 (2019 news article)
    - Types of hives: Soviet "chest" style beehive (article)
    - Types of beekeeping: some mobile apiaries,
    - Types of honey: wildflower
    - Common pests: Not found
    - Common pathogens: Not found
    - Regions of country where beekeeping activities take place: Sughd, Rasht Valley, Zerafshan Valley

- **Market**
    - Annual production: 4,100 tons in 2018
    - Domestic consumption: statistic not found
    - Import/Export: Statistics not found, however Russia, Kazakhstan, Afghanistan and the United Arab Emirates are the main purchasers (2019 news article)

- **Culture**: Honey, propolis, and royal jelly believed to help with certain health conditions (2019 news article)

- **Challenges**: Not found

- **Govt extension programs for beekeepers**: Government development program for beekeeping 2011-16: budget of 400 thousand somoni. During this program, production of honey increased from 1200 to 2700 tons. Activities included:
    - implementation of modern technologies, including creation of the shop on production of vosk and ensuring needs of beekeepers with these types of products;
    - due to import of breeding queen bees by means of selection and breeding works improvement of breed of the bees divorced in the republic;

- implementation of veterinary actions for content of bee families healthy;
- studying of the best practices of beekeeping of other countries and their implementation in farms of beekeeping and beekeepers - fans;
- organization of seminars and carrying out rates of retraining of specialists of beekeeping;
- organization and carrying out breeding, research works on control of purity of breeds of bees and to their division into districts.
- A 2019 news article notes that "There are three beekeeping development programs adopted in Tajikistan, which are aimed to expand honeybee colonies and honey production in all categories", it is assumed that these are government programs, however further information was not found.

- **Registration/certification processes:** Registration of bee hives is done by municipalities in accounting books of jamias of form No. 1. once a year in the spring (in March).

- **Beekeeping associations:** Rasht Valley Beekeepers Association- active in 2012/13 according to some blog posts. Details and current status not found.

- **IoT device:** None found

- **Other stakeholders working in beekeeping sector:**
  - UNDP: Livelihood Improvement of Rural Population (LIRP) project in Lakhsh District, provides beehives. Also ran LITACA II project from 2014-17, funded by JICA, which focused on livelihoods improvement, and gave Carpathian bee colonies, necessary equipment, and trainings to 17 women.
  - National Association of Dekhan Farmers of the Republic of Tajikistan (NADF RT) & ILO: In two years (~2008-09), over 20 training workshops in "Beekeeping and entrepreneurship" reached over 1,000 new bee-keepers who increased their annual income by an average of USD 1,000. That same year, the NADF RT built a second BeeKeepers Support Centre in another part of the honey valley that is larger and provides additional services such as a packaging machine and accommodation for trainees.
  - Welt Hunger Hilfe: 2013-16 Provided beekeeper training in Zerafshan Valley
  - IFAD – 2017 potential project to develop viable value chain systems for smallholder farmers
  - and associated rural enterprises, including beekeeping. Current implementation status unknown.
  - ILO – 2007 Funded by Finland. Start and Improve Your Business project in the Talvidara district of Tajikistan to hold 4 trainings for the families of migrants (60 people), 45 beekeeping businesses were established.

- **ICT stats**
  - Smartphone ownership: Not found
  - Internet penetration: 22% as of 2018 (International Telecommunications Union)
  - Mobile phone connections: 108% of population (Datareportal)

- **Pollination dependent crops** (FAO 2018 data)
  - Total harvested area (ha): 484,568
  - Total production (tons): 2,789,692
  - Total yield (hg/ha): 1,917,045
  - Top 3 crops with highest harvested area (ha): wheat (255,549), barley (72,279), apples (42,226)

Kyrgyzstan

Opportunities/angles for a data for M&E project in the beekeeping sector:

- General monitoring & education for beekeepers: ICARDA staff suggested Kyrgyzstan as they are a major honey producer and exporter in the Central Asia region and there is major potential for growth: honey production used to be much higher in the early 1990s when still a part of the Soviet Union (12,000 beekeepers, 446,000 beehives, producing 12,000 tons of honey a year). A project could support the following issues experienced by beekeepers:
  - Lack of capacity-building opportunities & information on national standards (providing information)
  - Theft (GPS tracking)
  - Cold weather fluctuations (temperature monitoring)

- Stakeholder & beekeeper association connections: There are many projects currently being implemented by development partners and there is a Kyrgyz Union of Beekeepers which provides extension support. Perhaps a data for M&E project in the beekeeping sector could help link these groups with each other and beekeepers

ICARDA

- Overall: Originally Kyrgyzstan was not on our priority list of countries to review, however ICARDA staff suggested adding as Kyrgyzstan is the country in Central Asia that produces and makes it export product. Including it in the list would be beneficial too.
- Work related to beekeeping: NA
- Other country projects: Development of a Central Asia Regional Climate Information Platform 2019-20, the project is expected to make available comprehensive and up-to-date relevant data and information, linking with high-quality datasets (including time series and spatial information) from global, regional, and local sources, provide analytical tools and interfaces for the visualization and interpretation of data and information (e.g. mapping tools to layer data and map hotspots and areas at risk, screening tools, etc.).
    - *Project manager: Enrico Bonaiuti*

Beekeeping statistics

- Number of beekeepers: 1000 (news article)
    - Number of small & large scale beekeepers: not found.
- Average age of beekeeper: As of 2010, most farmers are 30-59 years, closely followed by 15-29 years (FAO)
- Total number of hives in country: Estimates range from 50,000 (Kyrgz Association of Beekeepers 2019) to 90,000 (news article)
- Types of hives: Soviet "chest" style beehive
- Types of beekeeping: Not found
- Types of honey: white honey
- Common pests: varroa destructor
- Common pathogens: deformed wing virus, black queen cell virus, sacbrood virus, slow bee paralysis virus, chronic bee paralysis virus (Radzevičiūtė et al 2017)
- Regions of country where beekeeping activities take place: Honey from at-Bashy region is most popular in Kyrgyzstan, however beekeeping is practiced countrywide.

Market

- Annual production: 3000 tons as of 2019
- Amount consumed locally vs exported: 35-40% of the produced honey is exported. In 2017, honey exported in the amount of $ 2.9 million or 1.1% of total exports of agro-industrial products or 0.1% of the world honey export. Exports of honey reached 704.1 tons. Main kind of honey to export is white honey received esparzet or sainfoin. There are also new exporting countries like China (23%), Saudi Arabia (10,5%), UAE (6%) etc. (Kyrgz Union of Beekeepers 2019)
- Other market info: Honey production used to be much higher in the early 1990s when still a part of the Soviet Union (12,000 beekeepers, 446,000 beehives, producing 12,000 tons of honey a year) so there is potential for growth (news article)

Culture: growing popularity for beekeeping profession (news video)

Challenges:

- Lack of capacity-building opportunities
- Theft
- Cold weather fluctuations
- Export challenges (not specified)
- Lack of information on national standards
- Import of bee medications from China without translated labels (news article; blog)

Govt extension programs for beekeepers:

- Training: There is some sort of centralized training scheme, however the name and further details were not found (news video)
- Programs promoting beekeeping to youth: Not found

Registration/certification processes
- Licenses are required for beekeeping, further details not found (UNHCR)
- International Organization for Standardization (ISO) certification standards for international export of honey

Beekeeping associations: Kyrgyz Union of Beekeepers:
- a voluntary association that promotes bee products, aims to improve technologies to produce bee products; supports social and legal protection of beekeepers; and provides Information and material support beekeepers. Specific services include: services including: exchange of wax honeycombs on orders and sales of beekeeping equipment; grinding sugar powdered sugar; recycling and waste management comb of bees; the realization of preparations for the prevention and treatment of bees with pollen processing combs in beebread. (Karaketov 2015)
- With funding & support from FAO, they released beekeeping "how to" videos and a manual in 2016. Content included: different bee species and their characteristics, apiary management, breeding and seasonal care of bees, how to increase honey yield, and prevention and treatment of diseases.

IoT devices: None found

Beekeeping projects:
  - Food for Training project: Currently implemented by WFP, provides trainings for beekeepers on how to build an apiary, how to take care of bees and how to effectively store the honey. >440 trained since 2018.
  - Integrated Development of Osh province: December 2019 3-day training implemented by UNDP and funded by Russian Federation for >100 new and existing beekeepers to learn best practices of Russian beekeeping in Uzgen, Kara-Kulzha and Nookat districts of Osh province
  - Farmer to Farmer: 2013-23, implemented by ACDI VOCA and funded by USAID. Included an assessment and analysis of the current situation of the beekeeping industry in Osh and Issyk-Kul oblasts. These assignments helped the hosts to develop strategies for long-term sustainability and to adopt modern technologies in beekeeping.
  - USAID: purchased equipment for Aman GreenFood LLC company, a Kyrgyzstani business specialized in the production of natural honey and honey-based products. The donation will allow the company to automate and increase its production, improve safety standards, and reach new markets.
  - Sustainable Land Management in the High Pamir and Pamir-Alai Mountains (PALM) project: A UNEP project funded by Global Environment Facility, supports beekeeping network
  - UNDP: 2014 "buffer zone" for bee breeding, preservation of the species that in the apiary of queen bees and bee colonies, and improvement of the marketability of resulting bee products. This was part of a wider livelihood improvement project
  - Bees for Development: Implemented project until 2014 funded by UK Darwin Initiative to promote beekeeping as a sustainable and environmentally beneficial livelihood for young herders in the northern Kyrgyzstan pastures of Chon-Kemin and ensure beekeepers' rights to access pastures are recognized in law and practice.
  - Any pain points or opportunities for a data for M&E project in the beekeeping sector to fit in

ICT stats
- Smartphone ownership: Not found.
- Mobile phone penetration: 122.57 Mobile-cellular subscriptions per 100 inhabitants as of 2018
  - Rural vs urban: Not found
  - By geographic regions: Not found
- Internet usage: 38% as of 2018 (International Telecommunications Union)
  - Rural vs urban: Not found
  - By geographic regions: Not found

Pollination dependent crops (FAO 2018 data)

- Total harvested area (ha): 647,283
- Total production (tons): 2,569,484
- Total yield (hg/ha): 1,764,044
- Top 3 crops with highest production area: wheat (253,804), barley (191,854), maize (105,063)

Pakistan

Opportunities/angles for a data for M&E project in the beekeeping sector:

- Value chain support: Traders cannot meet domestic demand for honey, and Pakistan honey is popular in the Middle East, suggesting opportunity for expansion of the current market. Particular challenges that could be taken on include:
    - Education on modern production & rearing techniques
    - Pest & pathogen management
    - Quality assurance
    - Connecting and beekeepers with each other and the Pakistan Agricultural Research Council, the main provider of extension services

- **ICARDA**
    - Overall: ICARDA's experience would give an advantage in implementation in Pakistan; ICARDA is currently implementing projects with the farmers, government institutions, NGOs and other private sector in all provinces of Pakistan.
    - Work related to beekeeping: NA
    - Other country projects
        - Pakistan Agricultural Innovation Program (AIP) (2013-17): Funded by USAID and ILRI, this project worked to increase agricultural productivity and incomes in the agriculture sector through the development and dissemination of new agriculture technologies.
            - *Project manager: Barbara Rischkowsky*
        - Improving groundwater management to enhance agriculture and farming livelihoods in Pakistan: (2016-20) Works to develop a shared knowledge of sustainable groundwater use for agriculture and the need for improved management in three different provinces: Balochistan, Punjab and Sindh.
            - *Project manager: Usman Khalid Awan*

- **Beekeeping statistics** (Bees for Development 2019)
    - Number of beekeepers: 10,000
    - Average age of beekeeper: Among 80 beekeepers in Federally Administered Tribal Areas of Pakistan, 33%, 24%, 28% and 15 % respondents lie in the age group of 20 to 30 years, 31 to 40 years, 41 to 50 years, and in above 50 years, respectively. Thus most beekeepers age ranged from 20 to 40 years. (Khan et al 2017)
    - Number of hives: 600,000
    - Types of hives: Langstroth, traditional *katore* hives in Kalash valley
    - Types of beekeeping: predominantly migratory
    - Types of honey: Acacia sp, Brassica sp, Citrus sp, clover (Melilotus officinalis), Eucalyptus sp , garranda/currant bush (Carissa opaca), kalongi (Nigella sativa), loquat (Eriobotrya japonica), mosquite (Prosopis juliflora), Robinia pseudoacacia, shain, sheesham (Dalbergia sissoo), sunflower (Helianthus annuus), Ziziphus sp
    - Common pests: Tropilaelaps clareae mite, Varroa destructor
    - Common pathogens: American Foulbrood, chalkbrood
    - Regions of country where beekeeping activities take place: Most beekeeping practices are focused in Khyber Pakhtunkhwa and central and north regions of Punjab (Bees for Development 2019)

- **Market** (Bees for Development 2019; (ICIMOD 2017)
    - Annual production: 12,000 tons.

- Domestic consumption: Most of the honey is used for personal consumption or sold locally. In the Kalash valley 79% of the beekeepers sell honey directly to consumers and only 21% of the beekeepers sell it to middlemen. (ICIMOD 2017)
- Export: Honey produced in Pakistan enjoys a good reputation in the Middle East due to its unique taste and quality. Pakistan exports about 4,000 tons of honey to Arab countries every year (worth US$23, €21 million)
- Import: 400 tons. Natural Honey from Germany (48% of total import) Saudi Arabia, Indonesia, France and UAE. (Memon 2016)
- Consumption per capita: not found
- Demand is rising, traders cannot meet demand for honey

- **Challenges:(**ICIMOD 2017)
  - Lack of quality assurance system, thus cannot export to EU, Japan, US… etc. (Partap et al 2012)
  - Expensive inputs, pest attack, lack of modern production and rearing techniques, and trainings in Federally Administered Tribal Areas of Pakistan, based on a sample of 80 beekeepers. (Khan et al 2017)
  - In Kalash valley in southern Chitral:
    - Beekeepers are not organized and there are no beekeepers' associations in the area. These beekeepers work on an individual basis and have received very little support from government and non-government organizations for the development of beekeeping.
    - Lack of honey processing facilities in Kalash valley
    - Poor management of hives
    - Only use traditional *katore* hives because they believe bees do not like modern hives

- **Govt extension programs for beekeepers**
  - Pakistan Agricultural Research Council, which includes the Honeybee Research Institute (HBRI) est 1976, offers trainings upon request. In total, they have organized Organized 17 national and 72 regional beekeeping training courses which trained about 7000 beekeepers, out of these 2600 beekeepers are maintaining more than 3,00,000 honeybee colonies in modern Langstroth hives.
    - Services provided by HBRI include: provision of wax foundation sheets, provision of queens, byproduct sales, training
    - One 5-day training (15-07-2019 to 19-07-2019) was arranged by HBRI, NARC with collabroation of API, NARC on beekeeping to Youth Entrepreneurs of Khyber Pakhtunkhwa to start up business under "Impact Challenge Program" of Directorate of **Youth** Affairs, Government of Khyber Pakhtunkhwa, Peshawar by the approval of DG, NARC. A total of 12 (4 participants from Directorate of Youth Affairs) and eight Internees from (Abdul Wali Khan University, Mardan) attended this five days beekeeping training at HBRI. Curriculum included honey bee colonies management for diseases and pests, pollination and quality honey production and assessment.

- **Registration/certification processes**: Pakistan follows the Codex standards for honey for export. The Quality Control Centre of the Ministry of Science and Technology is responsible for the monitoring of honey quality standards. (Partap et al 2012)

- **Beekeeping associations:**
  - Beekeeping.PK: has this education webpage and appears to be a beekeeping association, but their mandate and activities are not clear. They have a contact page to get in touch with experts.
  - Bee keepers Association, Tarnab Peshawar
  - Pakistan Beekeepers Federation, Islamabad
  - Pakistan Beekeepers and Honey Traders Association

- **IoT Devices:** None identified.

- **Other program implementers in beekeeping sector:**
  - Hashoo Foundation: Has implemented several projects in the beekeeping sector, such as Plan Bee, which provided beekeeping training, hives, and production kits to women. From this, small businesses were started in the remote areas of Gilgit-Baltistan, Mansehra, Chitral and AJK. Another project, funded by

IFAD, focused on improving indigenous livelihoods through beekeeping. It is not clear if any of these projects are still running.
        - Note that recipients of one of their previous projects in Kalash Valley who received training were unsuccessful and lost their colonies (ICIMOD)
    - Pakistan Agricultural Research Council Honeybee Program: an apiculture research program which authored this publication (Bees for Development 2019) works on technology development, and has a strong network with the beekeeping community.
    - Turkish Cooperation and Coordination Agency (TIKA): trained 140 women in flood-hit Pakistani northwestern region in beekeeping. TIKA sent experts to give a five-day training to the women in the region. They also gave the trainees more than 400 beehives, bee colonies, and useful equipment to start their beekeeping businesses (Plan Bee 2020)
    - Shah Farms: A commercial beekeeping operation, offers trainings
    - ICIMOD: Conducted research in 2017 on beekeepers in the Kalash valley of Chitral district

- **ICT stats** (Pew Research, 2016)
    - Smartphone ownership: 11% of adults as of 2015
        - Disaggregated by age: 13% of 18-34 year olds, and 7% of people 35+ own smartphones
        - Disaggregated by gender: 6% of women, 15% of men own smartphones
    - Internet usage: 15% of adults report using the internet at least occasionally or owning a smartphone
        - Among these internet users, 41% report only using the internet once a week or less
        - Disaggregated by gender, this accounts for 9% of women and 22% of men

Pollination dependent crops (FAO 2018 data)
- Total harvested area (ha): 12,779,890
- Total production (tons): 39,785,023
- Total yield (hg/ha): 1,855,962
- Top 3 crops with highest harvested area (ha): wheat (8.8 million), maize (1.3 million), chickpeas (976,580)

India

Opportunities/angles for a data for M&E project in the beekeeping sector:
- Addressing administrative and communication gaps in current beekeeping strategy: The government has a 2018-20 Beekeeping & Honey Mission, however there are many implementation and administration challenges. A smartphone app could improve communication between government and beekeepers and provide easier access to information on beekeeper registration and export requirements.
- Supporting pollination-dependent crops: Among countries in this analysis, India has the greatest area harvested (nearly 1 billion ha) and the highest production (285,000 tons) from pollinator-dependent crops. The country manager also sees the connections to the farming system.
- Joining "Digital India" efforts: India generally has value and demand for data-driven solutions, in part due to the Government's Digital India initiative to improve citizen's access to digital services and improve digital governance. This initiative includes goals to improve connectivity in rural areas, which could go hand in hand with some beekeeping populations

- **ICARDA**
    - Overall: No direct beekeeping work, but there is a very good value chain for beekeeping in India, and through our government and NGO connections we could get involved.
    - Work related to beekeeping: NA
    - Other country projects:
        - Most work is research related to pulses, wheat, and cropping systems. However within the farming system bees are an important component so we could link in this way.
        - Some ICARDA projects do use ODK data, platform is in Central India. Colleagues use smartphones to collect and compile plant and soil parameters with smartphones.

- **Beekeeping statistics**

- Number of beekeepers: As of 2014, there are 4,618 individual beekeepers, 11 beekeeping companies, and 26 beekeeping firms in India.
- Average age of beekeepers: The majority of beekeepers (48%) were 41-50 years, in a sample of 600 beekeepers from Tamil Nadu in 2017 (Kumar & Joy 2017)
  - Despite most beekeepers being age 41-50, the age group reporting the most marketing problems was the >60 age group
- Number of hives: 1.5 million total as of 2017. 675,064 owned by individual beekeepers as of 2014.
- Types of hives: Langstroth hive for A. mellifera, BIS hive (Bureau of Indian Standards) for A. mellifera and A. indica and Newton hive and Marthandam hive for A. cerana. (Mitta et al 2017). Traditional hives in northeast India (Beekeeping Development Committee Report 2019)
- Types of beekeeping: Variety – some migratory, some forest based… Also see breakdowns on commercial vs individual beekeeping above.
- Types of honey: Multiflora, eucalyptus, ajwain, sage, litchi, Jamun… further information by region in this Beekeeping Development Committee Report 2019. Country manager also notes litchi as an example, which blooms in February/March, and has a good honey price. Another example is Mustard flower, which blooms in Rajasthan in Dec/Jan.
- Common pests: wax moth, ants, wasps, hornets, bee scorpion, reptiles, birds, mammals, varroa destructor, varroa jacobsoni, Euvarroa sinhai, Tropilaelaps spp., Acarapis woodi, Neocypholaelaps; Varroa jacobsoni
- Common pathogens: american foulbrood, european foulbrood, sac-brood, nosema,
- Regions of country where beekeeping activities take place: highest honey producing states include Uttar Pradesh, West Bengal, Punjab and Bihar which account for more than 50% of total honey production in India (Fig. 35). Rajasthan, Himachal Pradesh and Haryana also produce considerable amounts of honey (Beekeeping Development Committee Report 2019)
- Average beekeeper age: Rough estimate of 35 based on two studies. In a small Rajasthan study (n=18), most beekeepers were age 18-35 (Verma et al 2018), and in a study in Assam (n=60) most beekeepers were age 36-40 (Sharma & Das 2018).

- **Challenges for beekeepers:**
  - Non-availability of honey boxes to the beekeepers, lack of honey marketing facilities, and inadequate training in the management of apiary (Singh 2019)
  - (Many typical challenges, pesticides, habitat loss, high cost, more income received by honey retailers than producers… etc.)
  - For exporting honey, most of the commercial beekeepers are troubled by the international standards as the beekeepers have poor knowledge of the standards (Mitta et al 2017)
  - Transporting honey due to covid 19 travel restrictions (news article 2020)
  - Lack of genetically superior queens

- **Market**
  - Annual production: 64,900-105,000 tons (Beekeeping Development Committee Report 2019). Production has been growing over the past decade (Tridge)
  - Domestic consumption: 53,900 tons of honey produced consumed domestically in 2017-18.
  - Export: 51,500 metric tons exported in 2017-18. The major markets for Indian honey are Germany, the USA, UAE, Saudi Arabia, Bangladesh, UK, Japan, France, Italy, Spain, Canada.
  - Import: overall statistic found, however 500-700 tons were imported from Bangladesh in 2017
  - Per capita honey consumption: 0.02 kg as of 2013

- **Culture**: Honey is also part of Ayurvedic medicine

- **Govt extension programs for beekeepers**
  - National Bee Board: est. 2000. Provides loans, trainings, insurance… however it is noted that this may not cover all issues (like floods, theft) (Beekeeping Development Committee Report 2019). Training curriculum not found.
  - National Beekeeping & Honey Mission (NBHM) for years 2018-20, established by government for the overall promotion and development of scientific beekeeping as a mission to achieve the goal of "Sweet

Revolution" in the nation by giving a boost to the capacity building and training with a special focus on women, input support for the promotion and production, creating and operating Integrated Beekeeping development Centers (IBDCs), Digitization or online registration, processing of honey, value addition, market support, etc. This also includes trainings in all states of India, in 150 of 739 districts.
    - Note that in response to COVID, there was a government declaration that "Rs. 500 crore is to be spent on beekeeping initiatives, to benefit 2 lakh beekeepers in rural areas" (ILO)

- **Registration/certification processes:** (Beekeeping Development Committee Report 2019)
    - Registration form for membership with National Bee Board, however many are not registered as this process is inaccessible.
    - Food Safety Standards Authority of India (FSSAI) has food safety standards for honey as of 2018, however India lacks the facilities to conduct the mandated testing
    - Agricultural Products Export Development Authority (APEDA)

- **Beekeeping associations**
    - All India Beekeepers' Association
    - Marthandam beekeepers co-op: 1,363 members. Purchases, processes, and sells honey from beekeepers

- **IoT device:** Gobuzzr –in-hive IoT device and app system. They started project without charging farmers, followed by a SaaS model which depends upon the number of beehives they have and maintain. Their clients include 100+ home-based small beehive horticulture to 50,000+ large scale companies" (2019 article). Location of IoT device use unknown, however they have offices in Chennai and California.
    - Data collected includes: weight, temperature, humidity, productivity, sudden hive deaths, GPS location,

- **Other projects/stakeholders working in beekeeping sector**
    - GIZ –2019 project to support Business Models for Beekeeping. Around 4,101 low income rural households from 400 mountain villages in the Garhwal region of Uttarakhand have taken up bee keeping on a commercial scale through farmer producer organizations.
    - JICA: Funding project in Uttarakhand, supported by Uttarakhand Forest Resource Management Project (UFRMP). Implemented in 850 forest villages spread across eight hill districts of the state, focuses on livelihoods and income generation, including support to two beekeeping cooperatives.
    - IFAD – through ILSP project, helping beekeepers in northern India during lockdown (transport, technical support)
    - Under The Mango Tree (UTMT): UTMT Society works in Gujarat, Madhya Pradesh, and Maharashtra with small farmers in tribal communities on beekeeping with indigenous bees. Specific actions include bee resource centers, trainings of trainers and beekeepers, queen rearing Supported by several donors, including ICARDA donors Australian Aid & the World Bank.
    - Arya Gramodyog Sansthan: An NGO registered with National Bee Board, runs an apiary, research, and 7 Day Trainings for Farmers, beekeepers, and unemployed **youth**.
    - Madhu Shakti: Started 2019, partners include Krishi Vigyan Kendra, Narayangaon and the Central Beekeeping Research & Training Institute (CBRTI) and funders are Bee Positive and PHD-Rural Development Foundation, New Delhi. Provided beekeeping kits and training to 100 women.
    - Indira Ghandi University: Offers a 6 month course for a Certificate in Beekeeping. Curriculum includes practical training on management of bees across seasons, management of pests and diseases, queen rearing, honey extraction, bee biology, and the the history and economics of beekeeping. Program fee as of 2010 was Rs. 1500, and courses are taught in English, and sometimes Hindi and Khasi
    - Several commercial operations offer trainings: Indigenous Honey; IGNOU is offering "Certificate in Bee Keeping (CIB)"; Bharat Honeybee Centre training Program (Avinissery, Thrissur, Kerala); Sahara Gramudyog Sansthan, Saharanpur (U.P); Khadi and Village Industries Commission

- **ICT stats**
    - Smartphone ownership: 26.2% as of December 2018 (McKinsey 2019 report)
    - Internet users: 34% (International Telecommunications Union 2018)

        - Internet penetration and GDP per capita are strongly correlated; states with lower GDP per capita (Bihar, Jharkhand, Madhya Pradesh, and Uttar Pradesh) have the lowest internet penetration rates
    - Mobile phone penetration: 86.9 mobile subscriptions per 100 inhabitants (International Telecommunications Union)
    - Digital India: the Government's flagship program to improve citizen's access to digital services and improve digital governance. Under this program, there are several goals to improve connectivity in rural areas, including:
        - To provide broadband connectivity in rural areas via optical-fibre cable to gram panchayats; more than 110,000 have been linked so far
        - Expand mobile coverage to generate demand for mobile services in rural areas and attract private-sector telecoms and internet service providers. Mobile services already cover 554,530 of the country's 597,608 villages
        - Offer public internet access at Common Services Centres and post offices. Currently, service is available at almost 300,000 of the country's 546,286 CSCs, which are physical facilities for delivering government of India e-services to rural and remote locations where availability of computers and Internet used to be negligible or mostly absent. About 800 CSCs offer Wi-Fi.4

Pollination dependent crops (FAO 2018 data)

- Total harvested area (ha): 99,391,157
- Total production (tons): 284,893,061
- Total yield (hg/ha): 2,883,829
- Top 3 crops with highest production area: wheat (29.5 million), chickpeas (11.9 million), soybeans (11.4 million)

Bangladesh

Opportunities/angles for a data for M&E project in the beekeeping sector:

- Benefits to farmers: The major type of honey produced in Bangladesh comes from mustard flower, however 50% of beekeepers said that farmers believe bees make mustard flowers "weak", and therefore will not allow hives in their cropping field. Despite this belief among farmers, the Minister of Agriculture and government recognize this relationship, and have given a push to collect honey from mustard fields and have provided funding to make hives. A data for M&E project in the beekeeping sector could join the effort to improve the mutually-beneficial relationship between beekeepers and mustard flower farmers, and/or focus on top pollinator-dependent crops of maize, wheat, rapeseed, and fruit
- Value chain for domestic honey market: Bangladesh produces 1,500-6,000 tons of honey, which is far less than country demand of 30,000 tons. There are several challenges along the value chain that could be taken on by a data for M&E project in the beekeeping sector:
    - Pest & pathogen management
    - Supporting development of a local brand
    - Quality assurance
    - Marketing
    - Consumers do not trust the quality of local honey and prefer branded honey

- **ICARDA**
    - Overall: No direct beekeeping work, but India country manager has connections to Minister of Agriculture, a beekeeping advocate.
    - Work related to beekeeping: NA
    - Other country projects:
        - Sustainable Management of Soil Health to Enhance Yields and Farmers' Incomes Under Resilient Production System in Bangladesh; Resulting in Food and Nutrition Security, Improved Health and Livelihoods: (2018-21) Funded by Funded by Morocco's Office Chérifien des Phosphates (OCP) Foundation. Works directly with farmers to disseminate agricultural practices and inputs

- **Beekeeping statistics**
    - Number of beekeepers: 25,000 (Pro-poor value chain integration project)

        - In Chittagong Hill Tracts, a beekeeper usually has 1 to 3 colonies (on average 1.6) of Apis cerana in modern movable frame hives and produces 7 to 11 kg of honey (average 10.3 kg) per year
    - Average age of beekeeper: In a sample of 58 beekeepers from Tangail and Gopalgonj districts in 2009, most (61%) were in the age group of 31 to 59 years; 37% were age 15-30. (Moniruzzaman & Rahman 2009)
    - Number of hives: unknown
    - Types of hives: "natural" (i.e., not by culture), and modern (cultured in a certain type of wooden box by apiculture Apis cerana and Apis mellifera) (Moniruzzaman & Rahman 2009)
    - Types of beekeeping: forest (Sundarban mangroves) and field based in the plains regions
    - Types of honey: Mustard flower
    - Common pests: wax moth, hornets, spiders, wasps, ants, cockroaches, mites
    - Common pathogens: Dysentery
    - Regions of country where beekeeping activities take place: Sundarban is the top producing district, and other high-producing districts include Gazipur, Tangail, Mymensingh, Sherpur, Savar, Dinajpur, Rajshahi, and Barguna (2019 news article)

- **Market**
    - Annual production: Estimates range from 1,500 tons (Bangladesh Institute of Agriculture) to 6,000 tons (Bangladesh Small and Cottage Industries Corporation), which is far less than country demand of 30,000 tons.
    - Domestic consumption: local honey has penetrated only 30% of the domestic market, while imported honey has captured 70% of the market.
    - Export: main export destinations being India, Japan, Slovenia, the Middle East, and the European Union (EU).
        - Exported 500-700 tons to India in 2017, but less in 2018 because honey prices were similar in both countries
    - Per capita honey consumption: 0.2 grams
    - Other products: Honey from mustard flower may have beneficial bacterial properties (Hossain et al 2019) and is used in the pharmaceutical industry as well

- **Challenges:**
    - Market side: (2019 news article) (Pro-poor value chain integration project)
        - Customers do not trust local honey, one shopkeeper stated "People prefer branded honey to local non branded honey as there is an allegation against the latter of selling substandard product"
        - Beekeepers sell honey to wholesalers, pharmaceutical companies, or exporters at low prices because no big brand has developed locally yet.
        - **this is different in the mountainous regions, where honey quality is known to be better, and majority is sold to the local community
        - Lack of quality assurance system, thus cannot export to EU, Japan, US… etc. (Partap et al 2012)
    - Production side: (Moniruzzaman & Rahman 2009) (Pro-poor value chain integration project)
        - Initial high-cost of beekeeping supplies
        - In this study, 50% of beekeepers said that farmers believe bees make mustard flowers "weak"—and therefore would not allow beekeepers to put hives in the cropping field
        - 30% of beekeepers believe more training is needed
        - 20% reported that hives had been stolen
        - Among beekeepers in the Chittagong Hill Tracts:
            - generally lack equipment for harvesting honey (many squeeze by hand)
            - received training, but it was inadequate, or there was no follow up
            - honey traders in this region said problems included low honey supply, inadequate packaging (beekeepers use plastic bottles, then honey traders transfer to glass jars)
            - lack of knowledge on pests and pathogens, including management techniques

- **Govt extension programs for beekeepers:**

- Bangladesh Institute of Apiculture: responsible for extension activities such as training; apiculture programs; research; equipment; quality control; marketing; Beekeepers Co-operative Association (BCA). Established in 1981, but started a new year-long pilot program in 2016 to promote apiculture in low-income rural areas (starting in Kurigram and Lalmonirhat District) through the previously listed services. Aiming to have supported 100 beekeepers and that beekeepers with >10 year experience will have nursery. Documentation on project results or continuation were not found.
- BSCIC: providing training, necessary equipment and technical and financial assistance to the beekeepers. (Pro-poor value chain integration project) Arranges "honey fairs" to build locals' trust in locally produced honey

- **Registration/certification processes:** The Bangladesh Standards and Testing Institution (BSTI) is responsible for setting quality parameters for honey in Bangladesh. Honey is listed as one of 64 food and agricultural products "brought under mandatory certification marks scheme" with standard BDS CAC 12:2007 being the standard for honey. (Partap et al 2012)

- **Beekeeping associations**
  - Beekeepers Co-operative Association (BCA)
  - Khagrachari Beekeepers Association, which is supported by UNDP

- **IoT device:** No active projects with in-hive IoT systems found, however several Bangladeshi researchers wrote a paper proposing the use of an IoT device "Moushak", however evidence of plans to implement were not found. (Mahamud et al 2019)

- **Other stakeholders working in beekeeping sector:**
  - ICIMOD: has supported beekeepers through several projects, first with UNDP, then funded by Austrian Development Cooperation (ADC). Focused on building the capacities of partner institutions and potential beekeepers with bee management, honey production, and market linkages. The incomes of these beekeepers have increased by up to 30% in several ICIMOD project sites. They've also produced this manual for beekeeping trainers.
    - Pro-poor value chain integration project: conducted study in the Chittagong Hill Tracts with 485 beekeeping households to understand honey value chain.
  - Bangladesh Association for Social Advancement (BASA): History of work in this sector, including trainings on pollen collection and use (funded by Palli Karma-Sahayak Foundation (PKSF)) in 2016. BASA built 118 pollen traps and distributed them among 118 beekeepers.
  - Proshikkhan Shikkha Karmo (PROSHIKA): introduced a number of new technologies to modernize apiculture practice in Bangladesh (Moniruzzaman & Rahman 2009)
  - Mouchas Unnayan Sangstha (MUS)

- **ICT stats**
  - Smartphone ownership: 16.1% *of population* (Newzoo)
    - 59% *of rural households* don't have access to a smartphone (n=6,500) (BRAC)
  - Internet usage: 15% *of population* as of 2018 (International Telecommunications Union)
    - 54% *of rural households* lack internet access (n=6,500) (BRAC)
  - Mobile phone penetration: 97 mobile subscriptions per 100 residents (International Telecommunications Union)

Pollination dependent crops (FAO 2018 data)
- Total harvested area (ha): 1,456,589
- Total production (tons): 8,271,590
- Total yield (hg/ha): 1,481,925
- Top 3 crops with highest harvest area (ha): maize (400,478), wheat (351,228), rapeseed (307,516)

Regional search

- Mediterranean Beekeepers Association: The Mediterranean Beekeepers Association is the first trade association which offers assistance, consultancy, technical and professional support from a local to an international level. Aim to increase and improve the organizational level of beekeepers' associations and cooperatives, support production, protect beekeeping, and facilitate collaboration across people interested in beekeeping.
    - Countries involved from our list: Tunisia; Morocco; Egypt; Turkey; Lebanon; Palestine; Jordan
- Arab Beekeepers Union: Aims to consolidate cooperation between Arab beekeepers, defend their rights, and coordinate the exchange of information, experience, and research among them. Works to achieve these objectives by: holding activities and events, surveying diseases and pests, convening businesses and executive bodies, and supporting research and publications.
    - Countries involved from our list: Egypt, Tunisia, Sudan, Jordan, Lebanon, Syria, Palestine
- Mediterranean CooBEEration (2014-17): Aimed to (1) Strengthen technical, organizational and lobbying skills of Mediterranean beekeepers and their networks; (2) Advance knowledge on the strategic role of bees and beekeeping for food security and biodiversity; (3) Spread a new vision of Beekeeping as "Global Common Good", through the realization of an international awareness raising campaign in the countries involved.
    - Countries involved from our list: Lebanon, Morocco, Palestine, Tunisia
- ApiTrade Africa: a non-profit, membership organization specializing in developing trade in bee products from Africa and promoting market development. Other activities include: investment promotion, policy development, and lobbying & advocacy.
    - Countries involved from our list: Ethiopia

Annex A: Consultations

Consulted stakeholders

#	Country	Stakeholder org.	Stakeholder Role	Name	Notes
1	Morocco	ICARDA	Principal Scientist, Head of Genetic Resources Section	Ahmed Amri	
2	Tunisia	ICARDA	Agricultural Innovation Specialist	Udo Rudiger	
3	Tunisia	ICARDA	Technology Scaling Specialist	Zied Idoudi	
4	Egypt	ICARDA	Acting - Regional Coordinator-Nile Valley & Red Sea	Aladdin Hamwieh	
5	Ethiopia	ICARDA	Senior Scientist and acting regional coordinator for Sub-Saharan Regional Program	Zewdie Bishaw	
6	Ethiopia	Ethiopia Apiculture Board	General Manager	Negash Bekena	
7	Ethiopia	Ethiopia Apiculture Board		Talila Keno	
8	Lebanon, Jordan, Palestine	ICARDA	Lebanon Country Manager	Hassan Machlab	
9	Lebanon	NA	Former ICARDA PhD student	Wael Yammine	Consulted due to his former work on bumblebees
10	Turkey	ICARDA	Turkey Country Manager	Mesut Keser	
11	Syria	ICARDA	Head of government liaison	Majd Jamal	
12	Uzbekistan & Tajikistan	ICARDA	Head of the PFU, CGIAR Program for CAC and the Regional Coordinator/Breeder	Ram Sharma	
13	Uzbekistan & Tajikistan	ICARDA	Senior Scientist – Sustainable Land Management	Akmal Akrankhanov	
14	Uzbekistan & Tajikistan	ICARDA	Deputy Head of Representative Office	Rustam Ibraginov	

15	Pakistan	ICARDA	ICARDA Pakistan Office	See notes	Received comments from the ICARDA Pakistan Office, exchanged e-mails with Muhammad Aslam and Abdul Majid
16	India & Bangladesh	ICARDA	Head of the ICARDA-Food Legume Research Platform and coordinator of the South Asia and China Regional Program	Ashutosh Sarker	

Notes:

1. Unable to connect with Sudan country manager for consultation.
2. Kyrgyzstan was added to the analysis later per suggestion from Uzbekistan and Tajikistan staff, thus a consultation was not conducted.
3. Consultation with UAE Country Manager was not sought due to de-prioritization per desk research findings.

Questionnaire

Background: The MEL Team plans to develop a short concept note on data-driven and blockchain-backed management and monitoring system for the beekeeping sector.

In an existing smartphone app, beekeepers record data such as management actions, and outcomes such as honey production, hive survival, and pollination effectiveness. Additionally, a sample of in-hive remote sensors (e.g. temperature and humidity sensors, weight sensors, etc.), provide information to the beekeeper through the phone app to help them manage their hives. Beekeepers may also use the app to connect with other members of the beekeeping community and obtain information on other resources, such as national training schemes and honey regulations. This app can also be used by consumers to verify the quality and origin of the honey purchased, and by government stakeholders to receive actionable insights.

The goal of this concept note is to implement a blockchain-backed apiary management and monitoring system to evaluate its feasibility in tracing and authenticating honey, supporting beekeepers, stimulating local and rural economies, and strengthening biodiversity.

Our objective is to assess ICARDA's potential areas for involvement in the proposed management and monitoring system in 17 select countries. In order to understand opportunities for ICARDA's potential engagement with this project in your country, it would be great to hear your thoughts on the following items on a call or via e-mail.

1. Do you believe ICARDA's experience and network through _____ project(s) may give ICARDA an advantage in implementing this project?
2. Is ICARDA currently working on or planning to work on any projects related to beekeeping in Tunisia? If yes please describe.
3. Do you know any of the following stakeholders in Tunisia?
    a. Beekeeping experts (Govt, NGO, academic…)
    b. Beekeeping cooperatives

Any other comments or questions?