Potential impacts of climate change on *Apis dorsata* populations in Cambodia

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Apis dorsata: life cycle and basic needs

Apis dorsata is a migratory bee.

The life cycle of *Apis dorsata* colonies consists of successive residence periods interspersed with migrations.

In general, periods of residence allow colonies to renew and increase their population and swarm before their next migration.

Migration

Migration

Swarming

Migration

Growth

Migration

Length of stay of colonies on a site (Chuttong and Burgett , unpublished):

- **a few weeks to more than a year.**
- **average: 5 to 6 months**

Apis dorsata: life cycle and basic needs

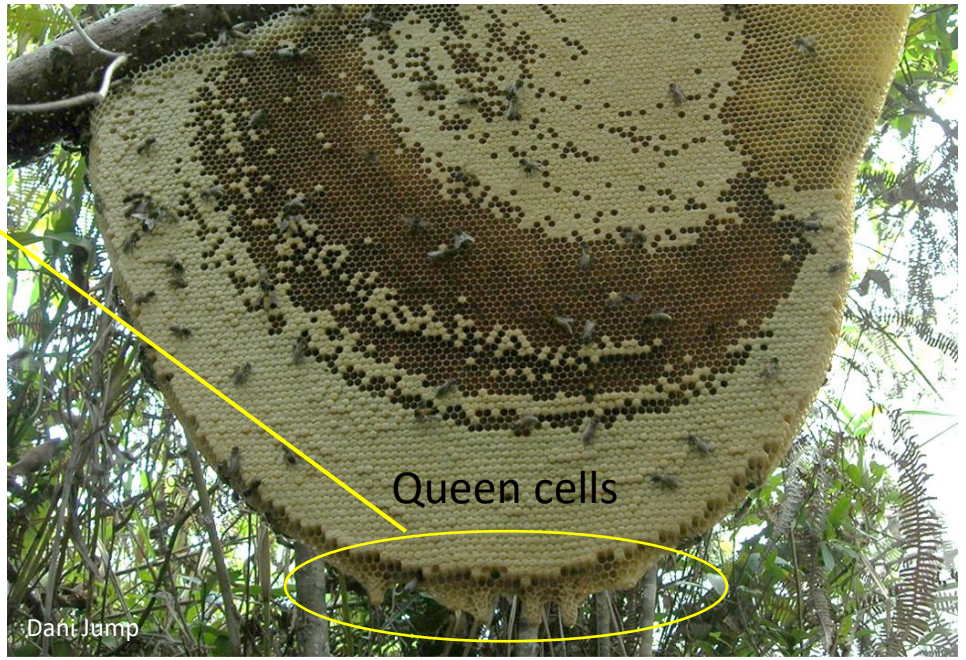
Migration

> 4 months (120 days)

Growth

Swarming

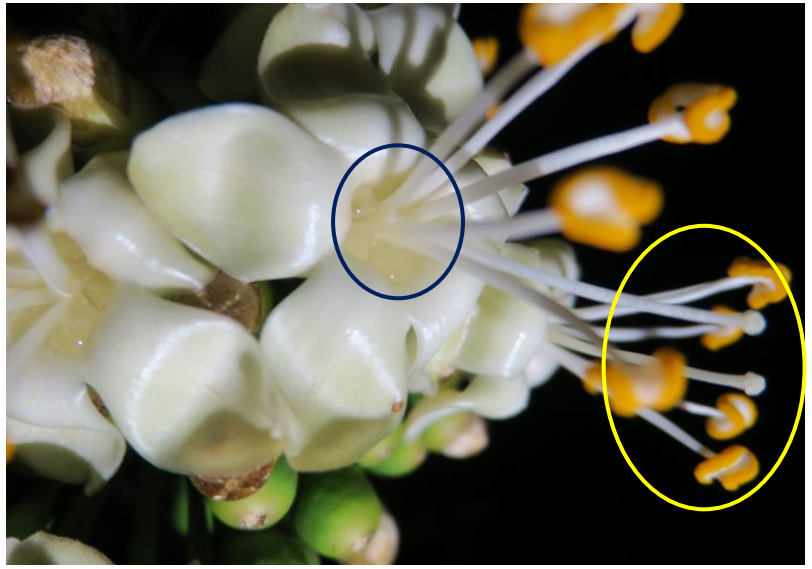
A colony needs to be at least **4 months** in residence before reproductive swarming takes place (production of drones and queens and reproductive swarming) (Chuttong & Burgett, unpublished).



Apis dorsata: life cycle and basic needs

At each residence site, *Apis dorsata* colonies need:

1. large branches under which to build their massive nest (up to 40 kg)
2. an abundance of flowers (nectar and pollen)
3. a perennial water source



A habitat that fails to meet these three conditions over a 4-month period will not allow full development and swarming of *Apis dorsata* colonies.

Cambodia's climate

Main features

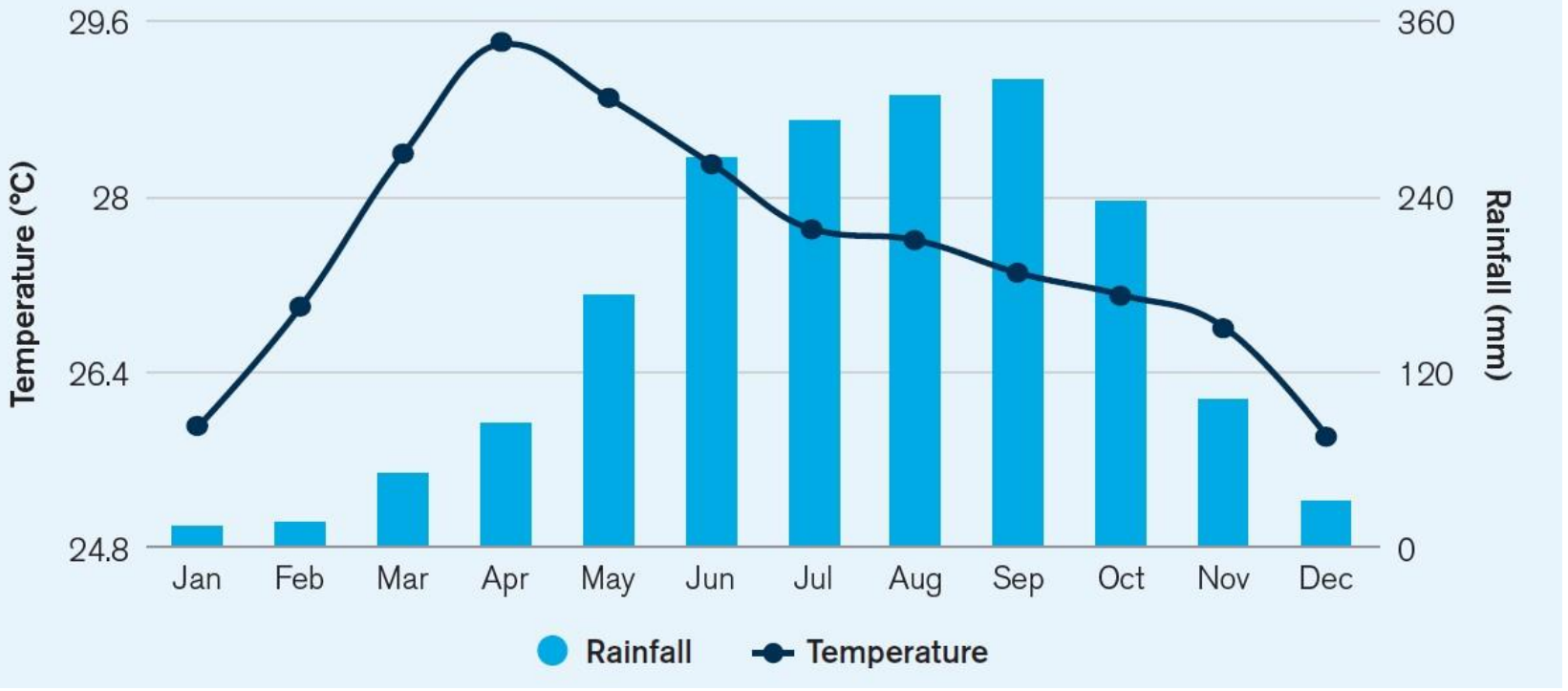
Cambodia's climate is tropical, with high temperatures, and two distinct seasons:

- a monsoon-driven rainy season (May-October),
- and a dry season (November-April).

Temperatures:

- Average annual temperature is around 28°C;
- Warmer period in the months preceding the rainy season (March to May);
- Cooler period after the end of the rainy season (mid-November to mid-February).

FIGURE 2. Average monthly temperature and rainfall in Cambodia (1991–2020)[16]



World Bank Group & Asian Development Bank (2021). Climate risk country profile.

Cambodia's climate

Inter-annual variation (ENSO)

Inter-annual variations due to the El Niño Southern Oscillation (ENSO) influence the nature of monsoons in the region :

- El Nino: warmer and drier;
- La Niña: cooler and wetter.

The Phnom Penh Post
Fri Sep 29 2023 09:29:30 GMT+0700 (Indochina Time)

HOME NATIONAL BUSINESS LIFESTYLE SPECIAL REPORT TRAVEL SPORT OPINION INTE

Ministry says La Nina will bring heavy rain, flooding

Mom Kunthear | Publication date 27 August 2020 | 23:07 ICT

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Desperate Times for Cambodia's Farmers

After facing a long drought, Cambodian farmers now fear the arrival of La Niña and possible floods.

By **Ana Salvá**
August 09, 2016

PURSAT, CAMBODIA: The first rainfall this year did not arrive until early June to Pursat, a province located in the northwest of the country, where land looked bare and thirsty at the height of the planting season. The devastating drought, which the government has described as the worst since 1979, adds to poor rainfall last year, when peasants had to dip into the drinking water dispensed by the government to irrigate their crops.

Soy Hourn and her neighbors in Pursat say they do not remember anything like this in more than a decade. "The radio

Projected climate change trends for Cambodia

Projected climate change trends for Cambodia (World Bank & ADB, 2021) :

1. warming of 3.1°C by the 2090s (vs. 1986-2005) in the highest emissions trajectory (RCP8.5);
2. more severe floods and droughts.

Impacts of increased temperatures and more severe droughts

Food shortage (floral resources availability)

Drought has been shown to:

- reduce flower size (Halpern, Adler, & Wink, 2010) and the number of flowers per plant (Burkle & Runyon, 2016),
- result in flowers that produce less pollen (Waser & Price, 2016) and less nectar (Phillips et al., 2018),
- and affect floral volatiles, which can influence the attractiveness of flowers to pollinators (Burkle & Runyon, 2016).

Climate change

More severe droughts:

May impact bee colonies through decline in the availability of floral resources (Thomson, 2016).

Impacts of increased temperatures and more severe droughts

Food shortage (floral resources availability)

Reduced pollen and nectar resources could affect the **ability of colonies to grow and swarm**.

Growth

?

Smaller colonies

Swarming

?

Fewer colonies

Impacts of increased temperatures and more severe droughts

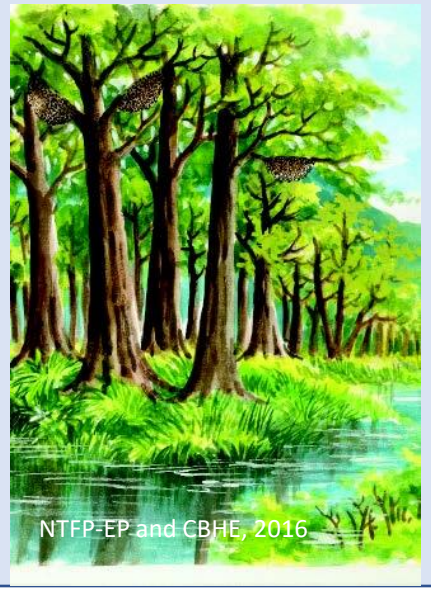
Food shortage (floral resources availability)

Reduced flower resources → **Fewer bee colonies**, **Smaller bee colonies**, **Reduced sources of nectar** → **Less honey produced** → **Loss of income for honey hunters**

Impacts of increased temperatures and more severe droughts

Water shortage

Bee colonies MUST nest near water!



Severe drought

Premature drying out of water supply points used by bees.

FLETCHER & BAYLIS / SCIENCE PHOTO LIBRARY

Trigger early bee migrations.

In 2019, honey hunters from Mondulkiri reported *Apis dorsata* colonies prematurely abandoning forest plots after ponds were dried out by severe drought while trees were still blooming in the area.

Impacts of increased temperatures and more severe droughts

Forest fires

Extended droughts and high unseasonal temperatures

WWF Cambodia. Nick cox

Increased forest fires in frequency and intensity

https://www.phnompenhpost.com/national/ministries-warn-public-about-wildfire-dangers

Over the past 20 years, forest fires have already intensified and spread over larger areas (ADB).

Impact *Apis dorsata* populations

1. colony destruction,
2. bee forage depletion,
3. and the subsequent decline in swarms.

Impacts of increased temperatures and more severe droughts

Forest fires (El Niño years: a foretaste of what awaits Cambodia's forests in the decades to come)

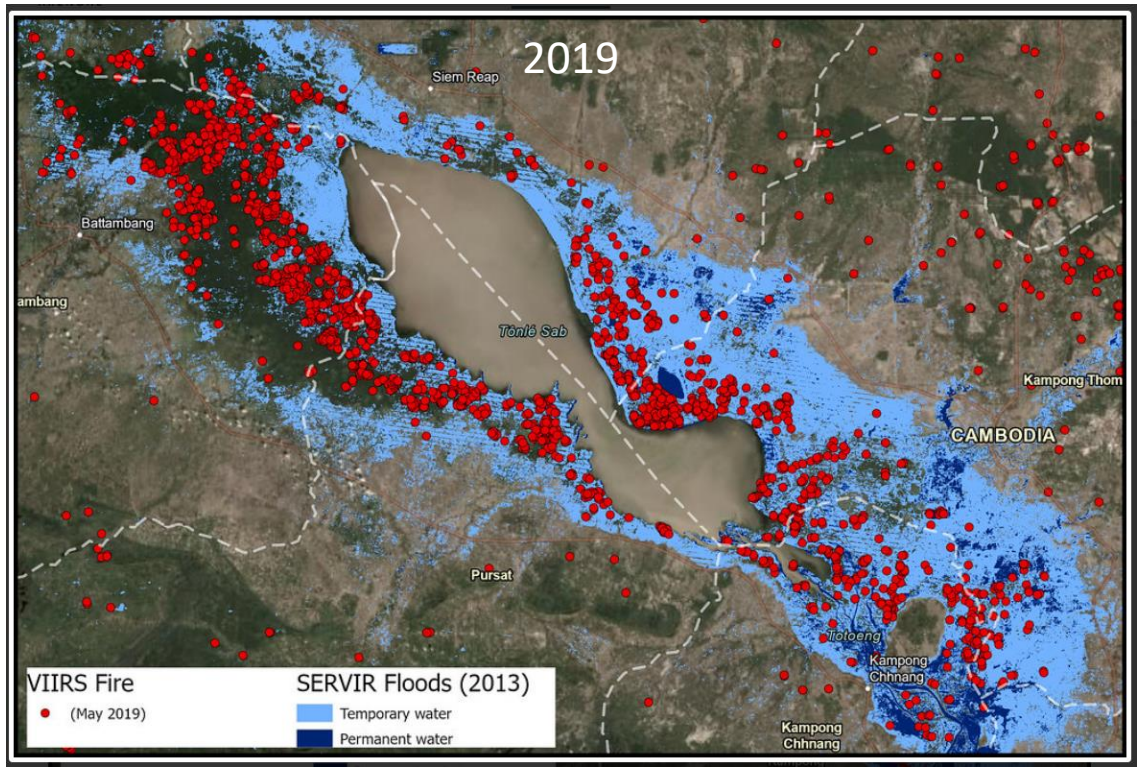
The El Niño years may give us an idea of what forest fires and their consequences on bee populations could be like in a degraded climate.

In Southeast Asia, peak years for wildfire coincide with severe El Niño-induced droughts.

In 2016, an El Niño year, around **a third of the Tonle Sap flooded forest**, or 250,000 hectares, was ravaged by fire.

In the areas of the Tonle Sap Biosphere Reserve most affected by forest fires, honey hunters estimate the **decline of *Apis dorsata* population at 70-80%.**

In 2019, another El Niño year, the Tonle Sap flooded forest was again devasted by dramatic forest fires.



Impacts of increased temperatures and more severe droughts

Forest fires

The complete **restoration of a bee ecosystem** following a forest fire can take **several years, even decades**.

While the early stages of forest regeneration may already provide an abundance of food for bees, the **absence of large trees** can prevent bee colonies from nesting for many years.

Flooded forests burning at the Prek Toal bird sanctuary in Battambang Province in 2016.

5 years later, the secondary forest provides an abundance of food for bees, but it will be many years before bee colonies can nest again.

Impacts of early rainy season and prolonged periods of rain

Early rainy season and prolonged periods of rain

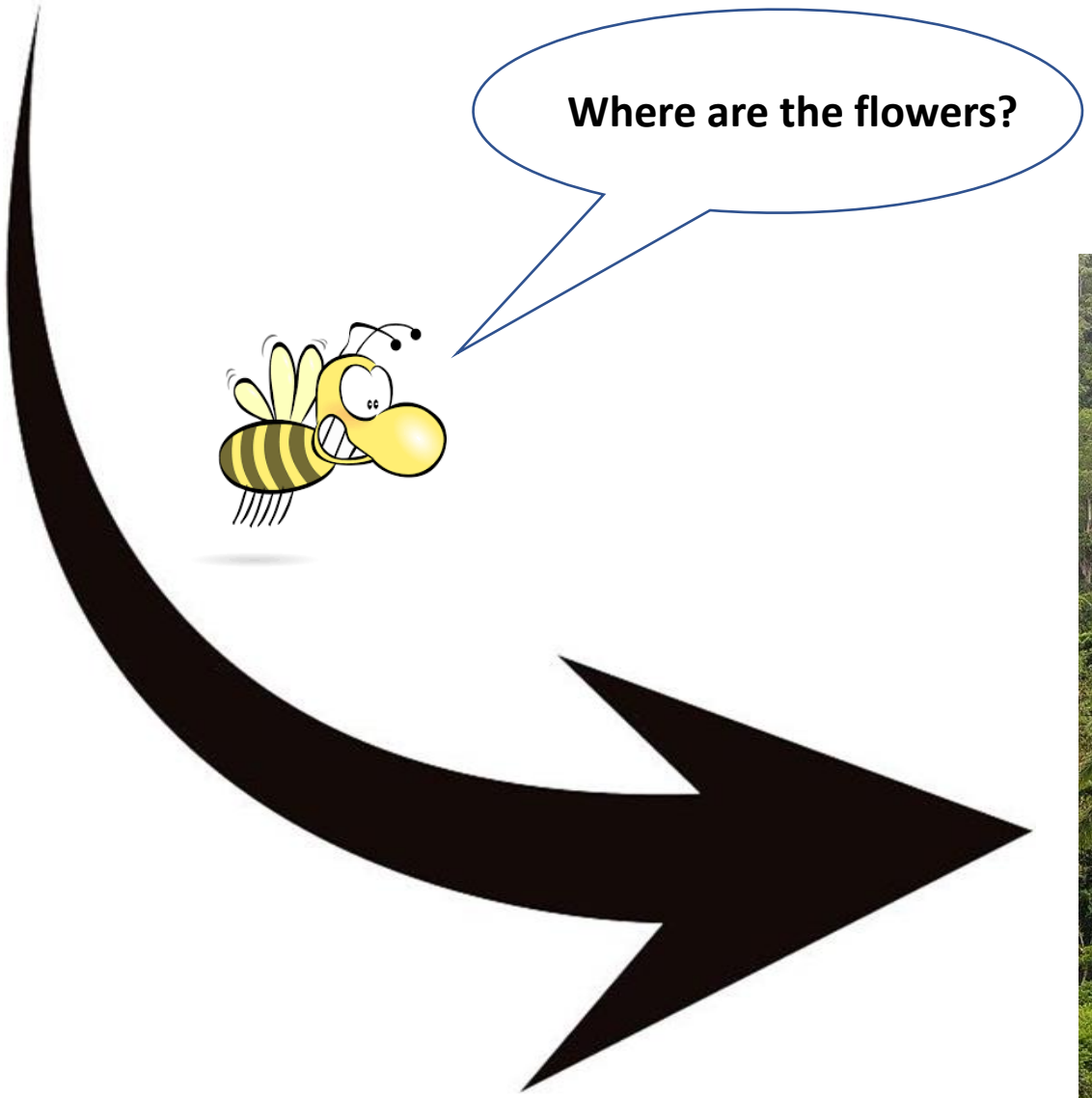
Climates conditions, **becoming wetter** than normal may also result in a decline in bee forage (IPBES, 2018).

Honey hunters from Mondulkiri reported very low honey yields in May 2022 despite an abundance of *Apis dorsata* colonies, which they associate with an early rainy season.

Early rains may have washed nectar from leaves and flowers, depriving bee colonies of a resource usually abundant at this time of year.

Impacts on bee migration

Phenological overlap between flower blooms and honey bee migrations



Climate change may also modify the phenological overlap between flower blooms and honey bee migrations, leading to a deficit of food for bees and pollinators for forest ecosystems (IPBES, 2018).

Impacts of a decrease in agricultural yields due to climate change

Climate change:

- significant variations in rainfall patterns,
- increased incidence of severe weather events,
- rising temperatures,
- climate-associated pests and diseases.

Decline in agricultural production

Expansion of farmland to the detriment of natural ecosystems, particularly forests

https://scandasia.com/tag/deforestation-in-cambodia/

Loss of bee habitat

Cambodia could face some of the highest net rice yield losses in Southeast Asia, as a result of climate change (Li et al., 2017; World Bank & ADB, 2021).

Impact of a contraction in gross domestic product due to climate change

Not only agriculture but the whole economy could be affected by climate change.

The Covid 19 epidemic is a recent example of the impact of an economic crisis on Cambodia's ecosystems.

NTFP-EP and CBHE, 2016

Impact of Covid-19 epidemic on ecosystems and wildlife in Cambodia (1)

Millions of migrant workers returning to rural areas after losing their jobs in the cities or neighboring countries

Desperate search for money and food

Increased rates of deforestation and poaching

Loss of bee habitat (deforestation)

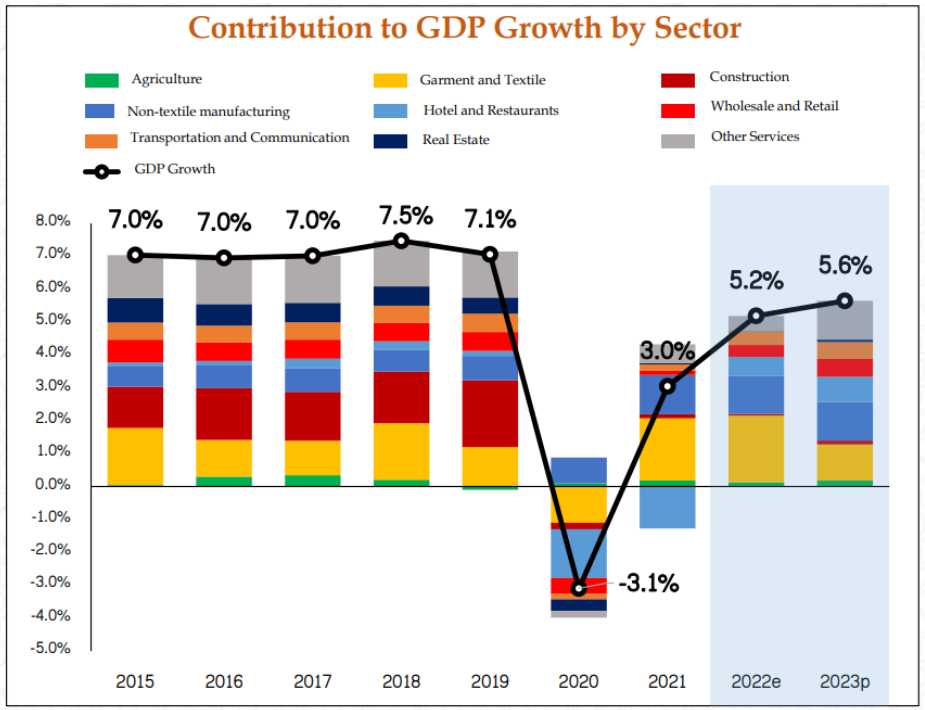
Bee colony destruction (increased number of unsustainable honey collectors)

NTFP-EP and CBHE, 2016

(1) https://www.undp.org/cambodia/news/protect-biodiversity-reduce-future-pandemics.

Impact of a contraction in gross domestic product due to climate change

Covid-19



Source: National Institute of Statistic (2015-2020) and Ministry of Economy and Finance (2021-2023)

https://www.jica.go.jp/Resource/jica-ri/news/topics/sgjqgc0000007l29-att/PumHuot.pdf

Projected climate change trends
(World Bank & ADB, 2021) :

1. Cambodia's GDP to drop by nearly 10% by 2050,
2. Many households in Cambodia have a high probability of falling into extreme poverty.

What would be the impact on *Apis dorsata* populations of an economic shock potentially stronger and longer-lasting than covid 19?


Thank you!
Eric Guerin