

# THE CATASTROPHIC ERUPTION

## BACKGROUND:

On January 15, 2022, the Hunga-Tonga Hunga-Ha apai volcano was responsible for a large-scale eruption. The eruption triggered tsunami warnings across the Pacific, and its impact was felt as far as Japan, Peru, and Chile. As a result, significant damage was inflicted on Tonga's environment and industry, prompting support from many countries to help rebuild. Further volcanic activity is anticipated as the volcano remains active.



Country / City China / Chongqing  
 University / School Chongqing University / College of Art  
 Academic year 2022 / 2023  
 Title of the project Disaster, Diverging Point  
 Authors Shuai JIANG, Ziyun YAN, Xinyue LIU, Yujing WU, Sibe DONG



## TECHNICAL DOSSIER

**Title of the project** Disaster, Diverging Point  
**Authors** Shuai JIANG, Ziyun YAN, Xinyue LIU, Yujing WU, Sibe DONG  
**Title of the course** Landscape architecture  
**Academic year** 2022 / 2023  
**Teaching Staff** Yang Ling  
**Department / Section / Program of belonging** Department of Environmental Design / College of Art  
**University / School** Chongqing University



### Written statement, short description of the project in English, no more than 250 words

MIRAB is a unique economic growth model of Pacific island countries, which mainly carries out self-financing through some international rescues. But some researches show that over-reliance can lead to aid traps.

On January 15, 2022, a serious volcanic eruption disaster caused Tonga to be fully covered with volcanic ash, accompanied by local phenomena such as the collapse of houses and the pollution in water and soil resources. In addition, invisible items have been destroyed also, such as industrial circle and surrounding ecological environment.

Our project takes volcanic eruption as a diverging point for Tonga's transformation, exploring all the reusability of volcanic ash in three land use (coastal, agricultural and urban area). Introduce a small industrial chain through volcanic ash to enhance the local economic resilience, while using products to enhance the local ecological resilience also.

The project cycle is roughly divided into three stages, the disaster stage, the post-disaster reconstruction stage and the long-term development stage. Deeply refine the urban part, we improve the transformation and ecological benefits of three stages. Finally, it will provide Tonga with a sustainable development path of economic and ecological coexistence, gradually reduce dependence on international support, and finally get rid of MIRAB aid trap.

For further information

**Landscape designers in China**

Contact via email at:  
jiangshuai4031@163.com / 1271904717@qq.com  
Tel: +86 18607176996

**Landscape designers in China**

Chongqing University  
Huxi Campus of Chongqing University  
401331

12th International Biennial Landscape Barcelona

Barcelona November 2023

**SCHOOL PRIZE**



# TONGA'S NEED FOR AID AND MIRAB DILEMMA

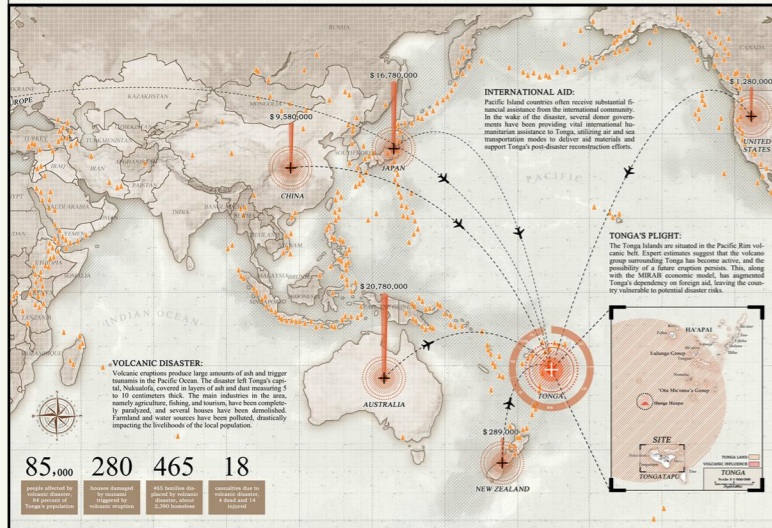
## AID DEMAND TO AID DEPENDENT

MANY PACIFIC ISLAND COUNTRIES ARE CAUGHT IN THE MIRAB TRAP

### MIRAB

MIRAB is a major potential economic structure for PIC Pacific Island countries, with four main elements:

- MIGRATION
- REMITTANCES
- AID
- BUREAUCRATISM



#### 1. MIGRATION AND REMITTANCES



##### MIGRATION

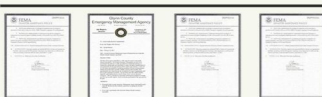
Go to other countries for better employment opportunities or higher income by participating in seasonal employment or immigration in other countries.

##### REMITTANCES

The remittances sent home by those who are employed outside the country contribute a lot of additional income to participating families each year.

**PROBLEM:** Migration and remittances contribute to income growth and development. But this could lead to a "remittance trap," which would leave economies trapped in low growth, high immigration. Countries receiving remittances may become dependent on exporting labor instead of goods produced with that labor, while leaving their countries short of working-age labor.

#### 2. AID AND BUREAUCRACY

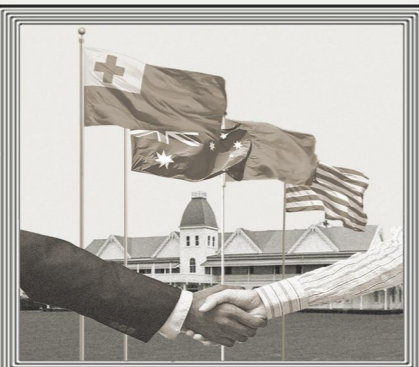


##### AID

Aid refers to the financial assistance and technical assistance provided by the international community to Pacific island countries.

##### BUREAUCRACY

High levels of international aid support high levels of public employment, raise wages in the public sector, and even involve governments in the production of private goods and services.



**PROBLEM:** Too much aid may reduce the government's incentive or need to address underlying economic problems and make necessary structural reforms. At the same time, public-sector pay and range inflation have undermined the ability of private firms to attract skilled workers at wages commensurate with their productivity. High levels of aid can even undermine good governance.

### MIRAB REFLECTION

MIRAB MODEL



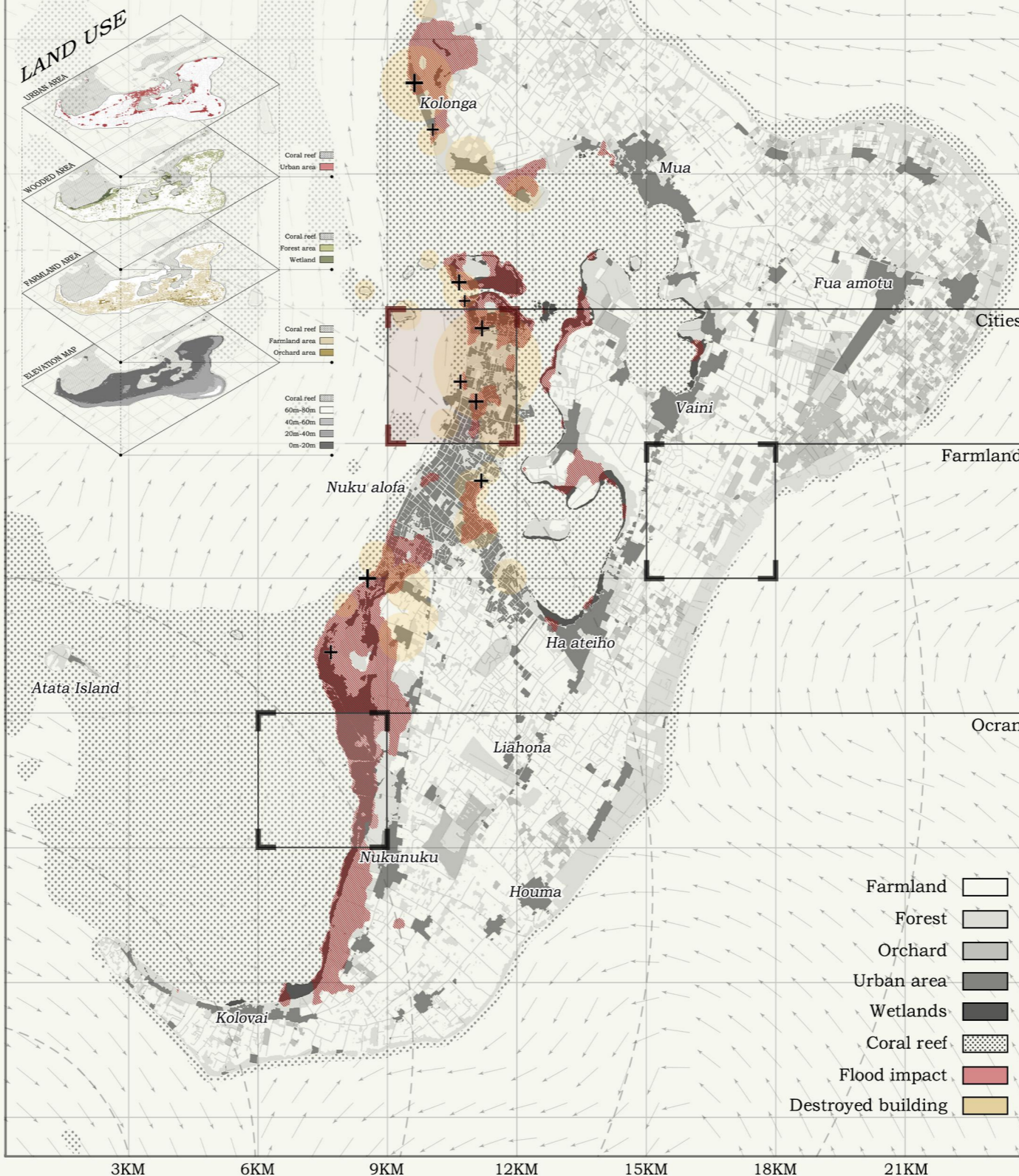
?

Is there no viable alternative?

The MIRAB economic structure has brought short-term economic growth to many Pacific island countries, including Tonga, but is reliance on aid, remittances and rents a healthy, sustainable and preferable model for the long-term economic growth and development of islands or any society in the long run? Is there really no viable alternative?

## SITE DAMAGE ANALYSIS

Through the analysis of the land use and disaster situation of Tonga's main island, we can know that various disasters caused by volcanic eruptions have had a serious negative impact on Tonga's environment, and buildings in many coastal cities have been damaged by tsunamis. Acid rain and volcanic ash pollute farmland and marine areas, and floating volcanic ash in the air can also threaten the lives and health of local people. Tonga's main industries are agriculture, fisheries and tourism, which were devastated in the wake of the disaster.



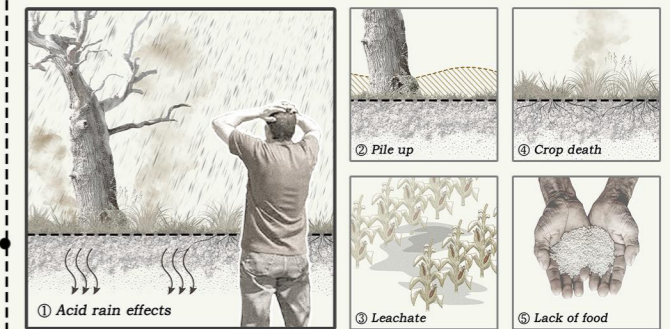
## DISASTER ANALYSIS

### Effects of volcanic eruptions on cities



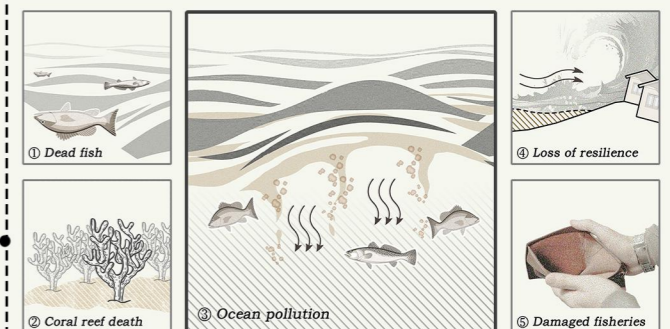
Volcanic ash from volcanic eruptions floats and accumulates in cities, posing a threat to the lives and health of local people. In addition, the tsunami caused by the volcanic eruption damaged infrastructure and buildings along Tonga's coast, leaving many people homeless.

### Effects of volcanic eruptions on farmland



Volcanic ash from volcanic eruptions can cause acid rain and leachate contamination, which can seriously threaten Tonga's fresh water supply and agricultural activities, and soil erosion makes the soil unsuitable for crop growth. Tonga's agriculture has been hit hard.

### Effects of volcanic eruptions on the ocean



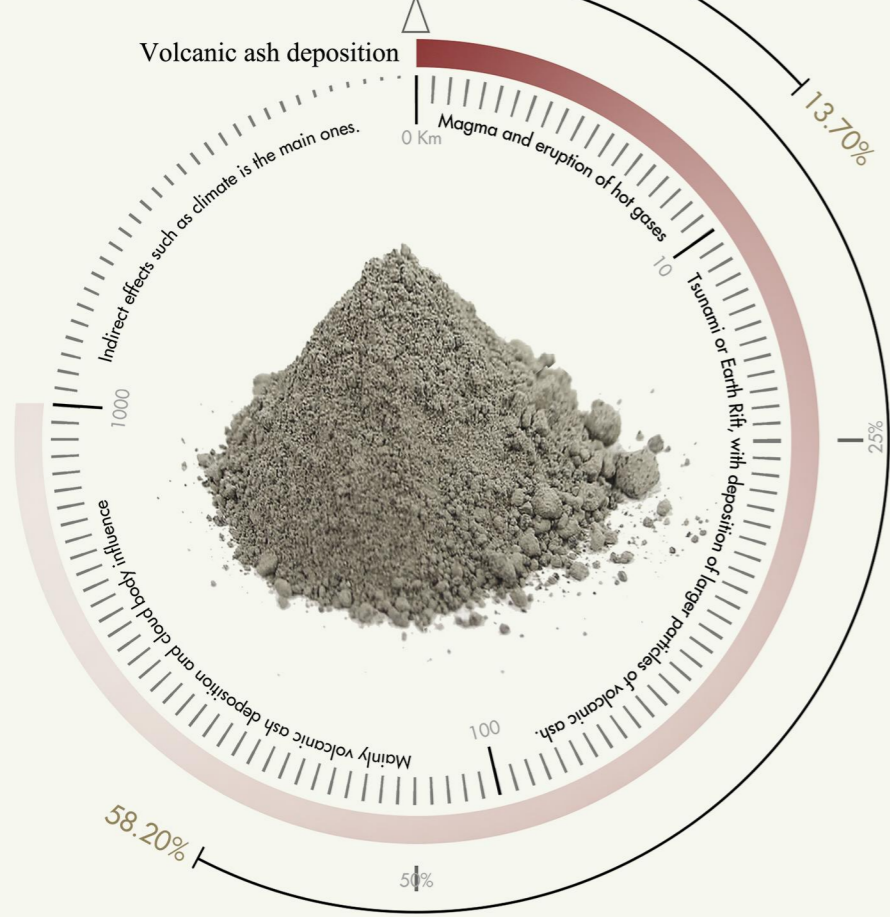
Volcanic disasters have caused serious damage to Tonga's marine ecosystem. The sea polluted by volcanic ash may lead to the death or migration of a large number of fish, while the death of coral reefs will further weaken Tonga's ability to cope with disasters in the future.



# PROCESS ABOUT VOLCANIC ASH

## VOLCANIC ASH COMPOSITION ANALYSIS & DISTRIBUTION RANGE

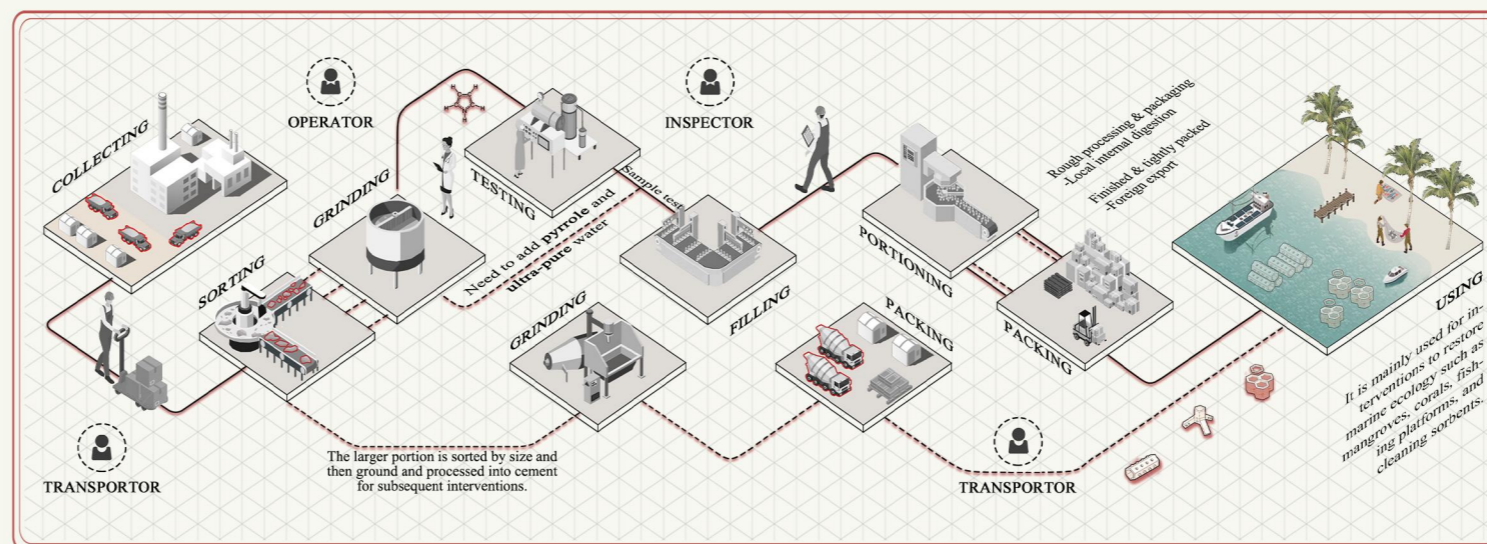
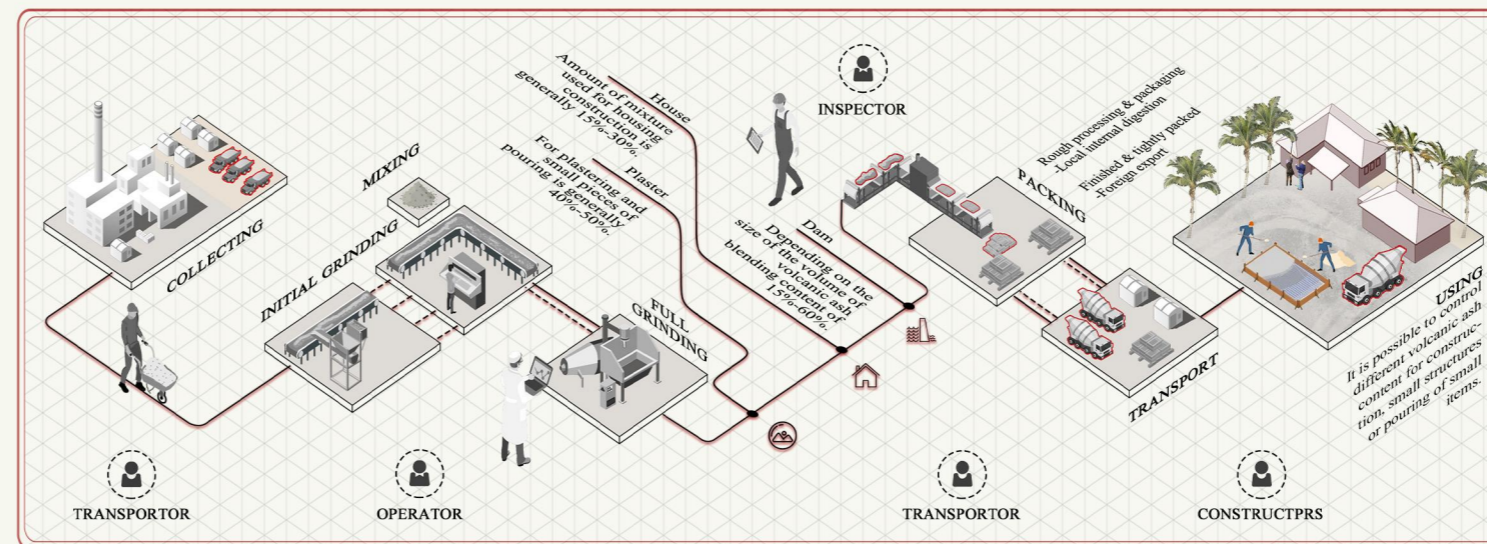
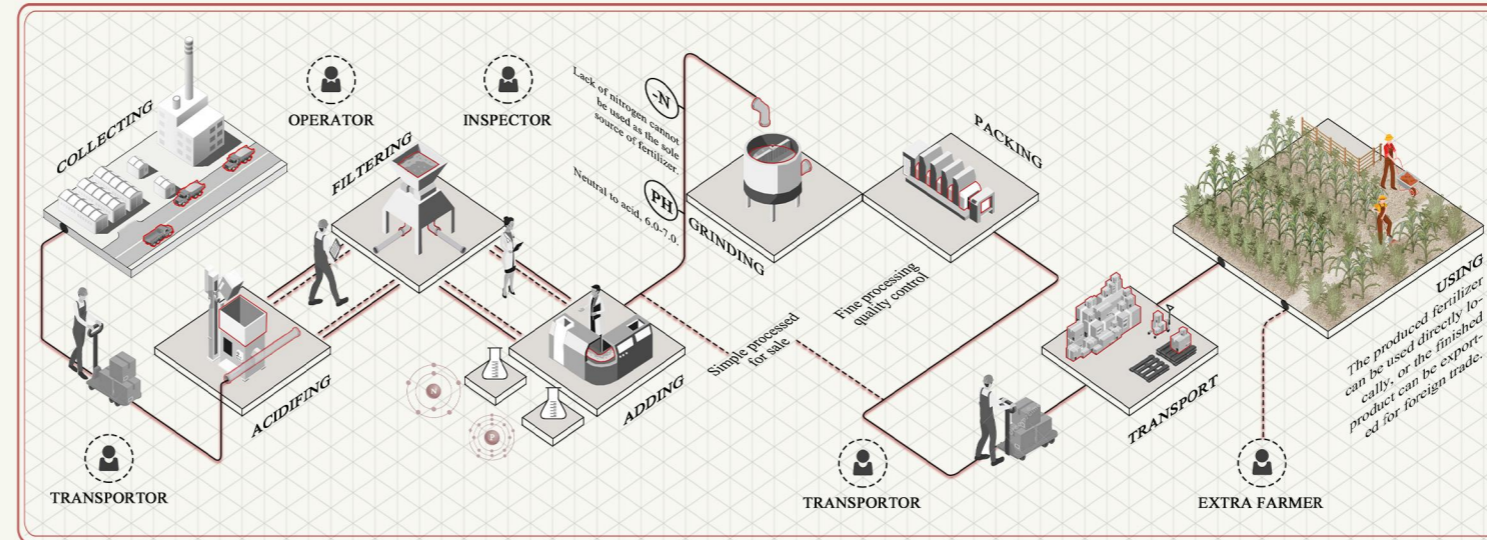
P	----- Anidride fosforica -----	0.80%
K	----- Potassium oxide -----	2.10%
Ca	----- Calcium oxide -----	4.65%
Na	----- Sodium oxide -----	4.75%
Mg	----- Magnesium oxide -----	6.55%
Fe	----- Ferric oxide -----	8.95%
Al	----- Aluminum oxide -----	13.70%
Si	----- Silicon dioxide -----	58.20%



## VOLCANIC ASH

VOLCANIC ASH consists of fragments of rock, mineral crystals, and volcanic glass, created during volcanic eruptions and measuring less than 2 mm in diameter. Volcanic ash is formed during explosive volcanic eruptions when dissolved gases in magma expand and escape violently into the atmosphere.

## VOLCANIC ASH COMPOSITION ANALYSIS



### POSITIONS OFFERING

Newly introduced positions while creating the processing chain.

- COLLECTORS**  
A position that only appeared in the pre-stage.
- TRANSPORTERS**  
Transportation of volcanic ash and its output, etc.
- OPERATORS**  
Work mainly at the nodes of the processing chain.
- PACKERS**  
Responsible for packaging output and by-products.
- TRADE MERCHANT**  
The surplus produced can be sold by foreign trade.
- SERVICE STAFF**  
Mainly provide services after the transformation of the factory.

### RESILIENCE BOOST

Enhancing local resilience on multiple fronts.

- ECONOMIC RESILIENCE**  
A quick response to the short-term economy to keep society running.
- DISASTER RESILIENCE**  
Significantly reducing the damage caused by the next disaster occurrence.
- ECOLOGICAL RESILIENCE**  
Enhancing resilience to the next disaster through ecological ways.

DEPENDS ON MIRAB

### ① DISASTER EMERGENCY PHASE

By integrating transregional volcanic ash industry with local agriculture, fishery, and tourism, we create a sustainable industrial model that receives technical assistance instead of financial aid overseas and optimizes the industrial structure. Thus, such measures could bridge the employment gap and help local labor return.

### ② AFTER-DISASTER PHASE

The volcanic ash and its processed products are widely applied to the reconstruction process of Tonga and the restoration of the eco-environment through landscape intervention. It could not only reshape the resilience of successfully adapting to adversity, but also make it possible for the recovery of the local industries.

### ③ LONG-TERM DEVELOPMENT PHASE

As Tonga's pillar industries are revitalized in the ecological restoration process, we seek other directions of development, such as combining industries with the three pillar industries to form new economic models, as a way to ensure the sustainability of the chain.



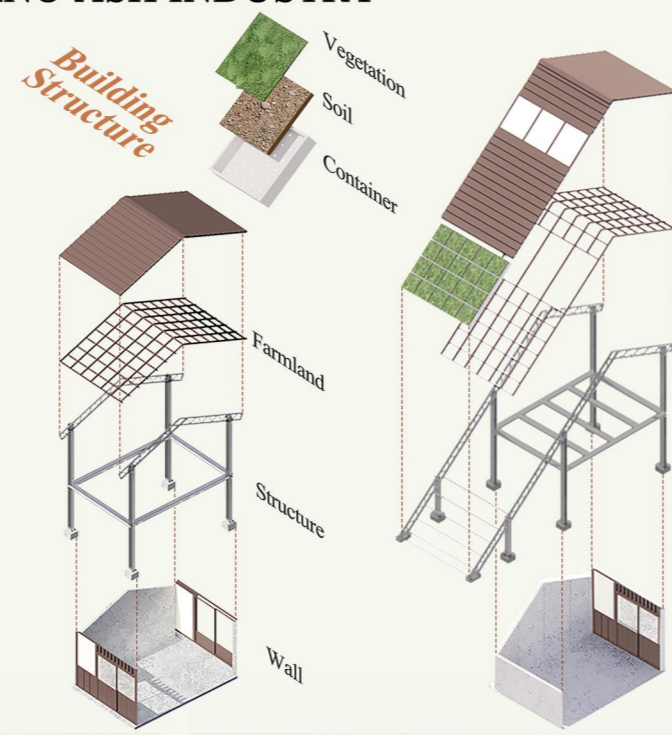
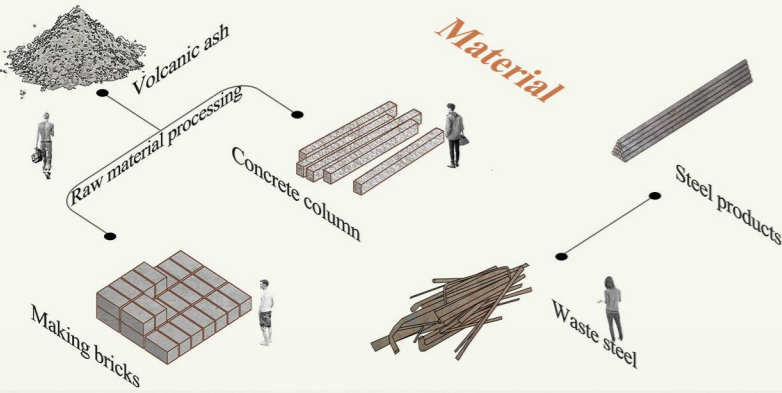
# A ROBUST ECONOMY BASED ON VOLCANO ASH INDUSTRY

## STRATEGY STATEMENT

Volcanic ash and other materials produced by the disaster are collected and roughly processed and become a shelter for people who have lost their homes in the process of post-disaster reconstruction. At the same time, different types of food supply modes are configured. After the disaster, the structures of these shelters will be preserved, and fields will be transformed into green spaces to carry out more functions.

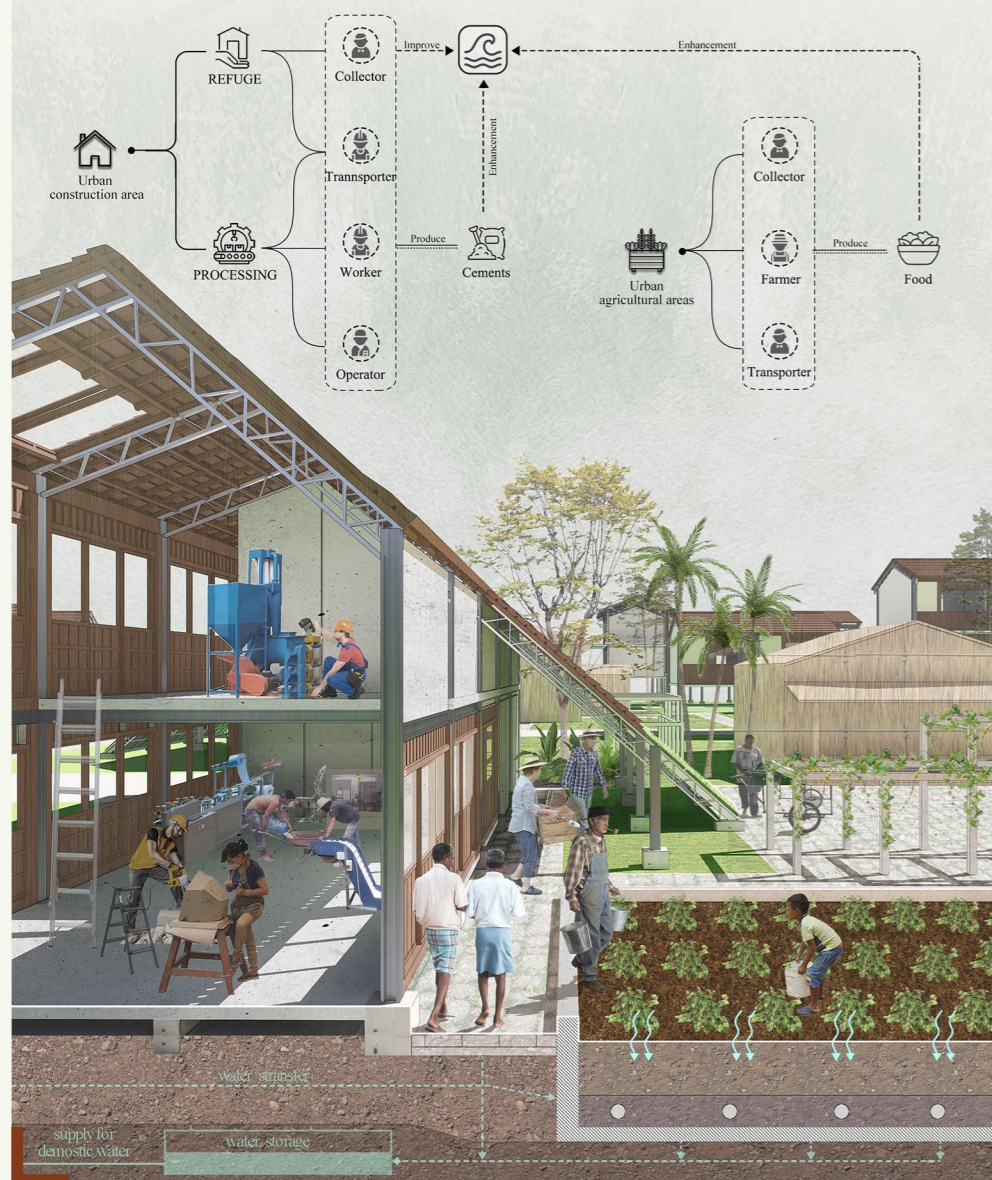
## VOLCANIC ASH UTILIZATION

The collected volcanic ash is made into customized bricks, which can be used to build the outer wall of the shelter. Another part of the collected volcanic ash can be used as pillars. In addition to forming structures such as shelters, it can also be used for planting pots. The waste steel produced by the destroyed houses can be used to support the structure of the shed after recasting.

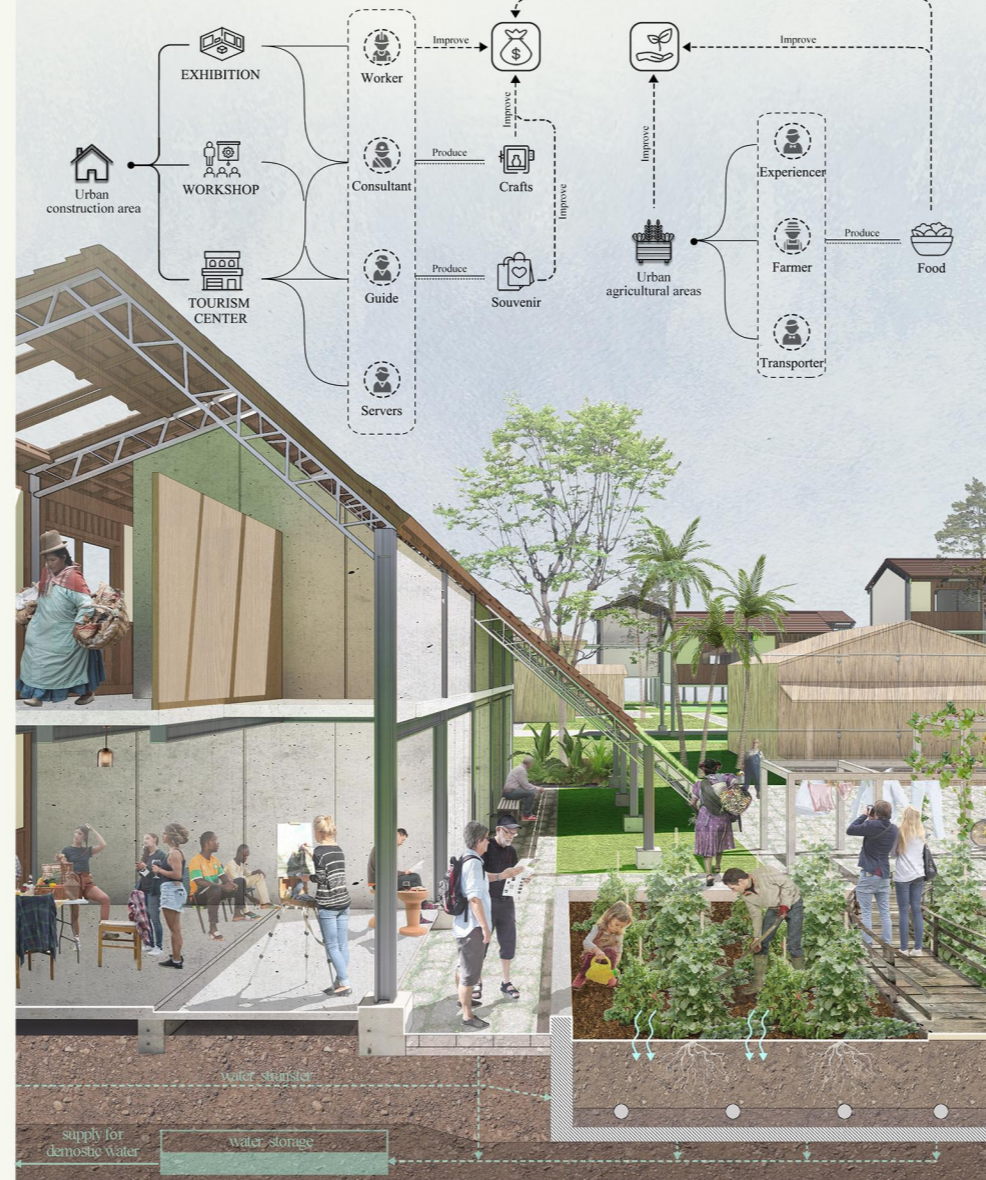


- DISASTER RESILIENCE
- ECONOMIC RESILIENCE
- ECOLOGICAL RESILIENCE

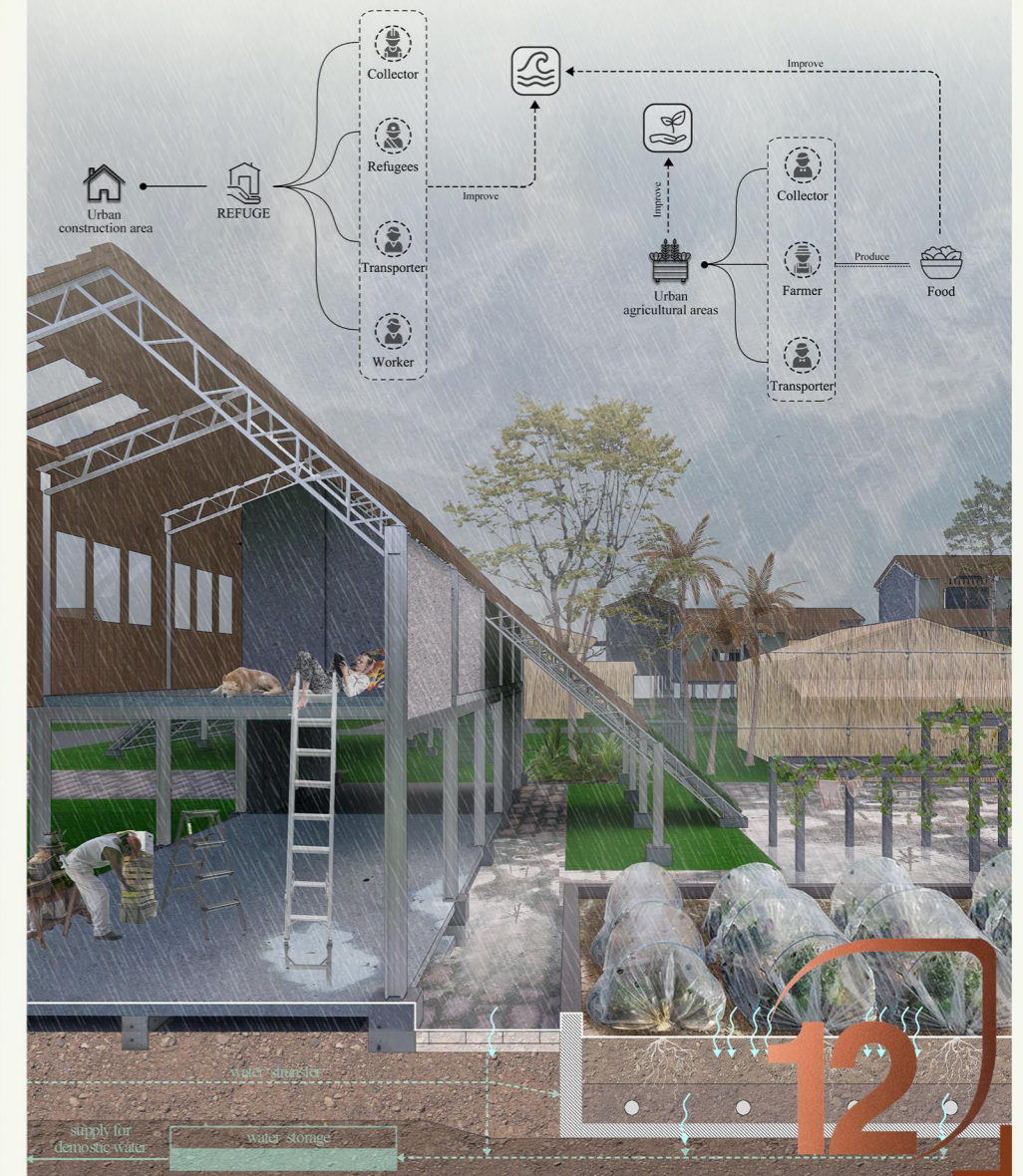
## PHASE 1: AFTER-DISASTER PERIOD



## PHASE 2: LONG-TERM SUSTAINABLE PLAN



## PHASE 3: DISASTER EMERGENCY OCCUR





# MELIPONA BEECHEII, FARMLAND AND FOREST

## Strategies for the construction of symbiotic systems of agriculture, bees and forests in Campeche State

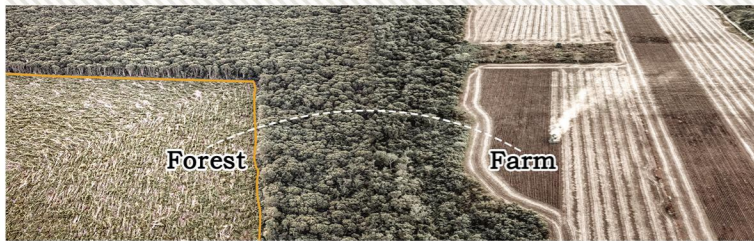


Mennonites

Mayan beekeeper

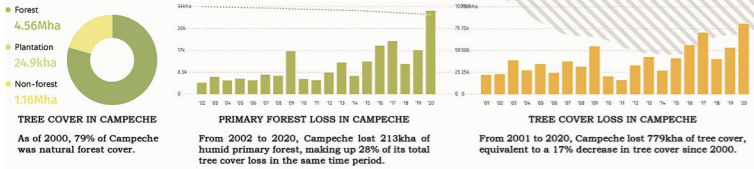
### The long history of Mayan beekeeping

The Mayan beekeepers saw the native bees as a link to the spiritual world and a gift from the gods of honey, these bees are called *Melipona beecheii*, a stingless bee. It is said that the Maya have been keeping these bees for 3,000 years and their honey is a highly prized food and medicine for the Maya. The dense trees on the Yucatan Peninsula were originally a haven for the *Melipona beecheii*. But with the arrival of the Mennonites, the bee homes and bees are disappearing.



Forest

Farm

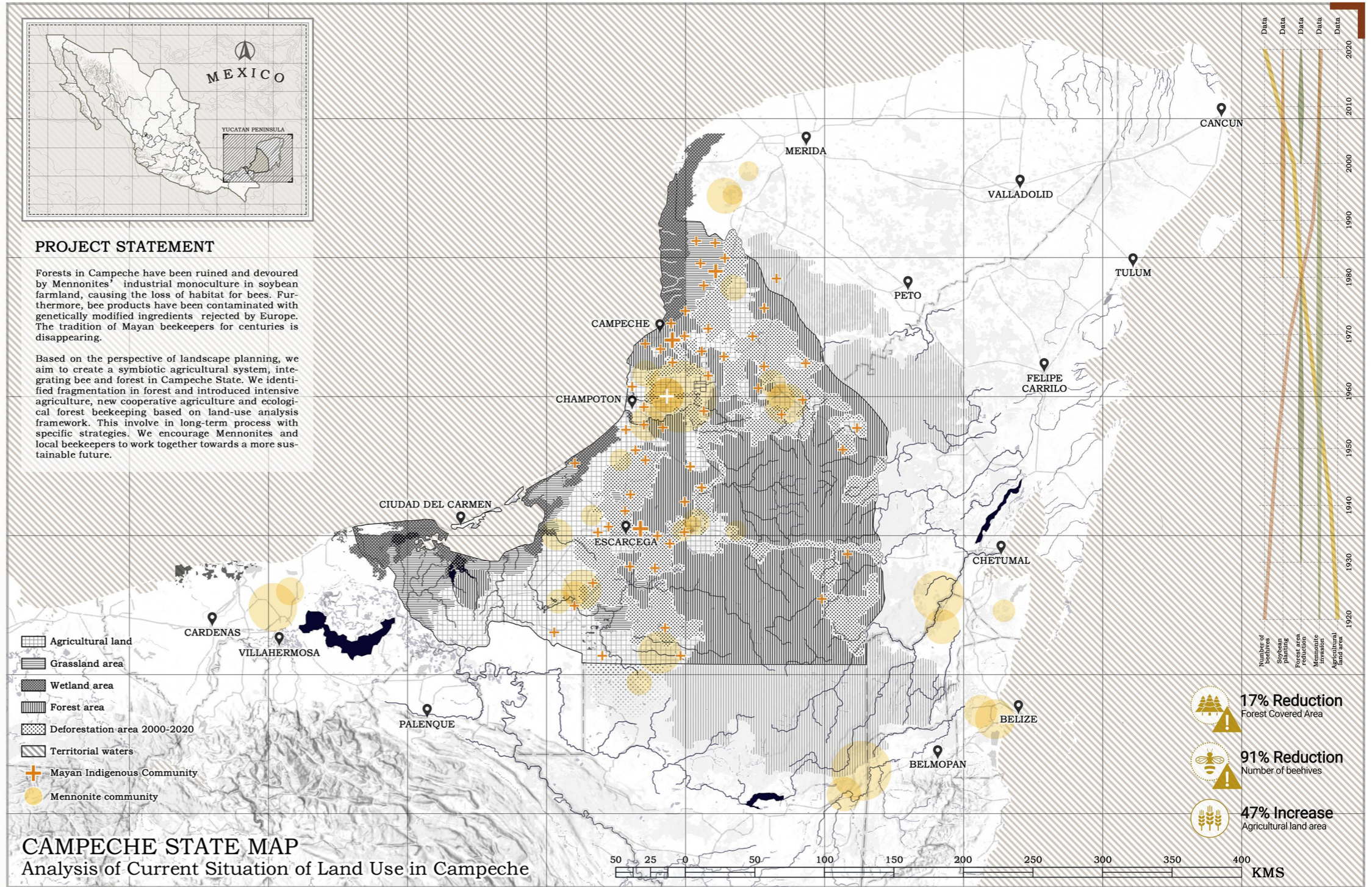


### Conflict between beekeepers and Mennonites

Mennonites are deforesting to expand agriculture and using pesticides to grow genetically modified crops. However, the reduction in forest cover has led to the gradual loss of bee space, the use of pesticides and insecticides threatens the lives of bees, and bee products tainted with genetically modified ingredients are rejected by Europe, all of which have led to a deterioration in the situation of Mayan beekeepers, many of whom have stopped keeping bees and have lost their millennia-old beekeeping traditions.



livelihood dilemma



Country /City China / Chongqing

University / School Chongqing University / College of Art

Academic year 2022 / 2023

Title of the project Melipona beecheii, Farmland and Forest

Authors Shuai JIANG, Tianwei LIAO, Hanyu HU



## TECHNICAL DOSSIER

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**Authors** Shuai JIANG, Tianwei LIAO, Hanyu HU  
**Title of the course** Landscape architecture  
**Academic year** 2022 / 2023  
**Teaching Staff** Yang Ling, Menghan ZHANG  
**Department / Section / Program of belonging** Department of Environmental Design / College of Art  
**University / School** Chongqing University



### Written statement, short description of the project in English, no more than 250 words

Since the 1930s, Mayan beekeepers have made Campeche, covered with the largest virgin tropical forest with very delicate ecosystems in Mexico, a world-class honey producer. However, then the Mennonites came with genetically modified soy, pesticides and large machines, and started to deforest large parts of land where the bees feed. Campeche's forests were devoured by Mennonite monoculture soybean fields, and bees lost their habitat. Furthermore, the widespread rejection for bee products contaminated with genetically modified ingredients has been threatening the livelihoods of Mayan beekeepers. Thus, it destroyed everything of bee culture from millennia back.

Based on the perspective of landscape planning, we aim to create a symbiotic agricultural system, integrating bees and forests in Campeche. Based on the land use analysis, we identified various land-use modes according to the degree of forest fragmentation. Therefore, we introduced intensive agriculture, new cooperative agriculture and ecological forest beekeeping, involving a long-term, complex process with specific strategies. We encourage Mennonites and local beekeepers to work together towards a more sustainable future.

For further information

**Landscape designers in China**

Contact via email at:  
jiangshuai4031@163.com / 1271904717@qq.com  
Tel: +86 18607176996

**Landscape designers in China**

Chongqing University  
Huxi Campus of Chongqing University  
401331

**12th International Biennial Landscape Barcelona**

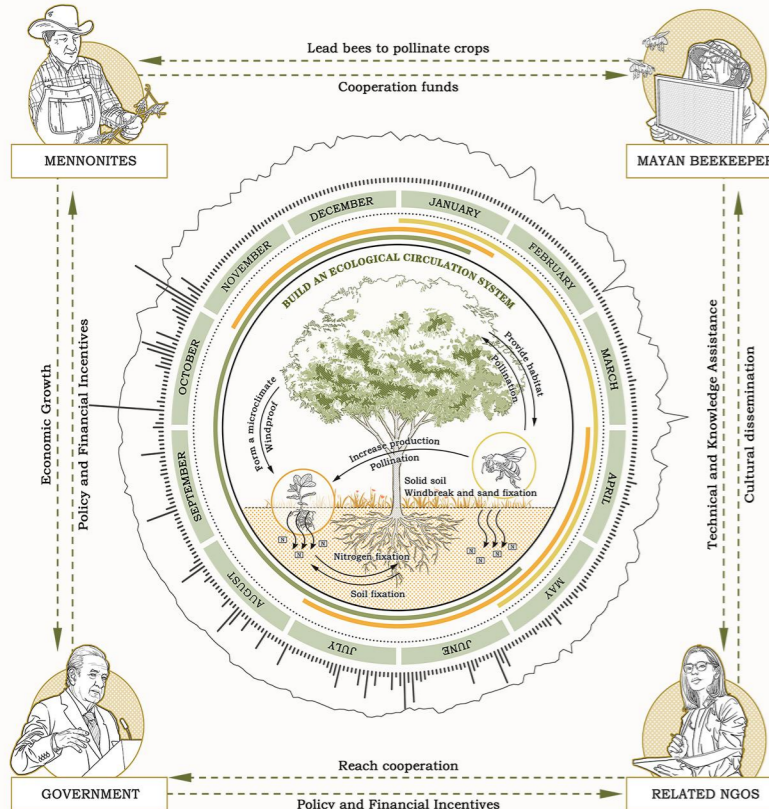
**Barcelona November 2023**

**SCHOOL PRIZE**



## PROGRAM GOALS

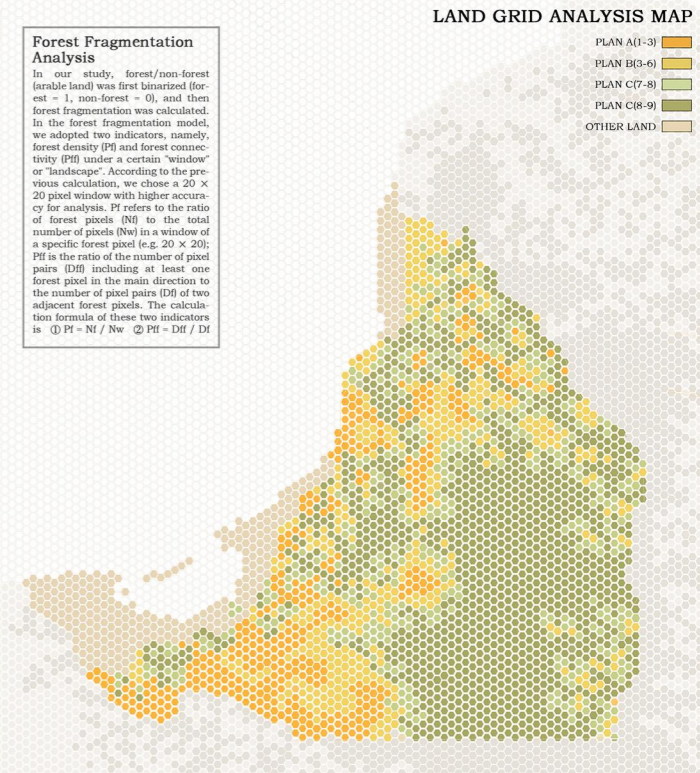
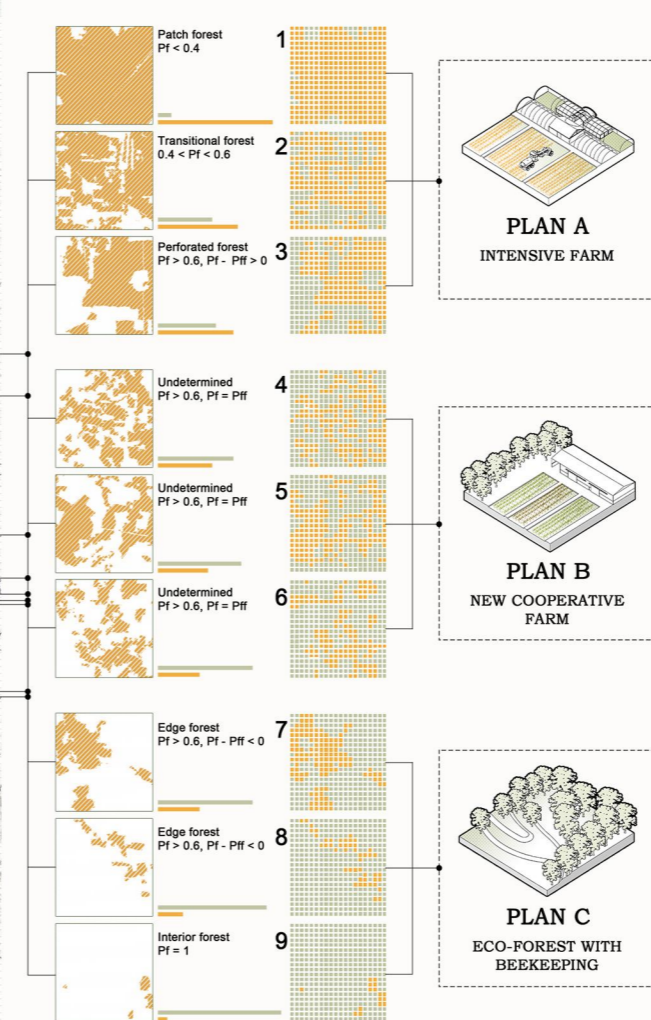
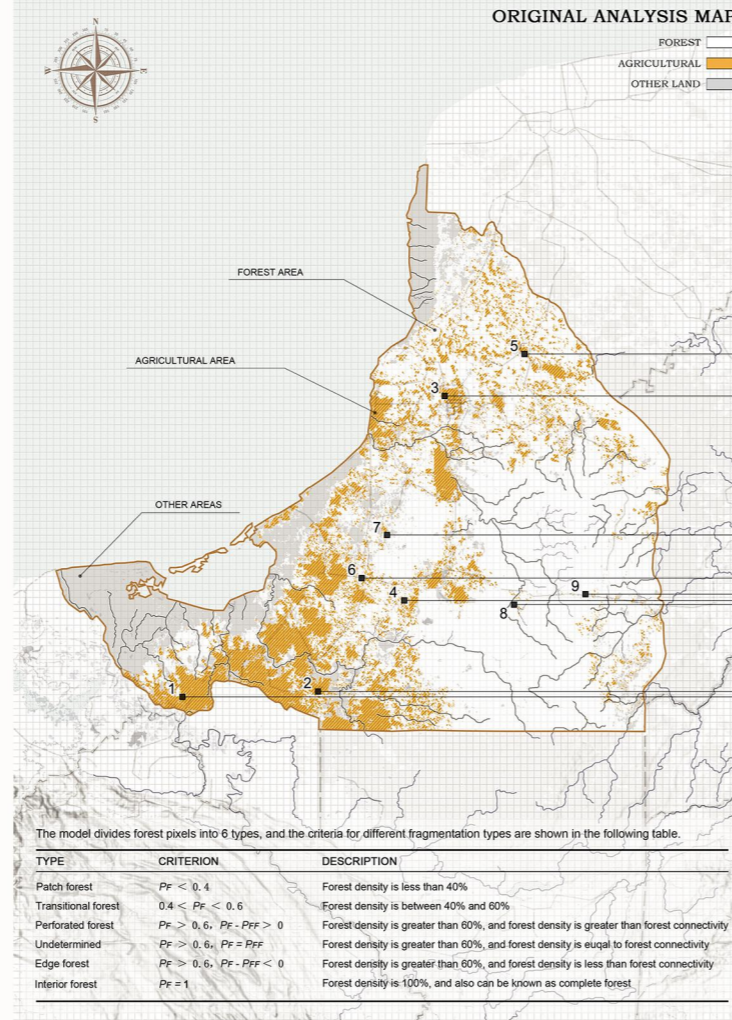
The inner circle constructs a cyclic symbiosis system among agriculture, bees and forests, and the outer circle constructs a collaborative system of socially related groups.



- Suitable for planting
- Suitable for farming
- Suitable for beekeeping
- Annual rainfall map
- Annual humidity map

We find a co-benefit between agriculture, bees and forests, and incorporate this mutually beneficial pattern into the design site to promote natural cycles and sustainable development. At the same time, the social activities are arranged according to the appropriate time for each kind of work, and the collaboration between various social groups is promoted, so as to build a double cycle system of ecology and society.

## LAND-USE FRAMEWORK



**Forest Fragmentation Analysis**  
 In our study, forest/non-forest (arable land) was first binarized (forest = 1, non-forest = 0), and then forest fragmentation was calculated. In the forest fragmentation model, we adopted two indicators, namely, forest density (Pf) and forest connectivity (Pff) under a certain "window" or "landscape". According to the previous calculation, we chose a 20 × 20 pixel window with higher accuracy for analysis. Pf refers to the ratio of forest pixels (Nf) to the total number of pixels (Nw) in a window of a specific forest pixel (e.g. 20 × 20); Pff is the ratio of the number of pixel pairs (Df) including at least one forest pixel in the main direction to the number of pixel pairs (Dw) of two adjacent forest pixels. The calculation formula of these two indicators is ①  $Pf = Nf / Nw$  ②  $Pff = Df / Dw$

**CONTENT STATEMENT**  
 We assign scores to each area ranging 1-9 points and correspondingly classified them in to different land-use modes. Considering our strategies of landscape intervention, there are three major development models targeted to various land-use modes: A. Intensive Farm, B. New Cooperative Farm, C. Eco-forest with Beekeeping, with specific design on each. From the perspective of ecological landscape planning, we purpose is to solve the contradiction between the natural forest and monocultural land of the whole site by embedding unique models into different land-use modes, allowing for more reasonable and scientific design.

**Mennonite invasion**  
A large invasion of Mennonites led to the division of the land.

**Deforestation**  
Mennonites began clearing forests to expand their farms.

**Over-use of pesticides**  
Mennonites began large-scale mechanized farming, pesticides began to be used.

**Farm expansion**  
Much land has been converted into farmland for growing crops.

**Bees losing their habitat**  
With the loss of forests and the use of pesticides, the living conditions of bees have become worse.

**Forest beekeeping**  
The lush forests of the Yucatan Peninsula are a haven for the *Melipona beecheii*.

**Mayan beekeeping tradition**  
The Mayans have kept bees for thousands of years as a gift from the gods.

**AGRICULTURE**

**FORESTRY**

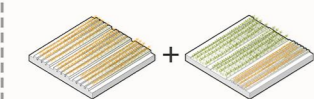
The farm income is not enough and the farm area needs to be expanded

The forest is constantly being cut down for farmland and there is no place for the bees to survive.

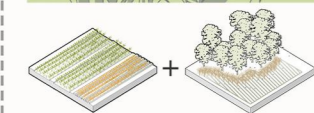
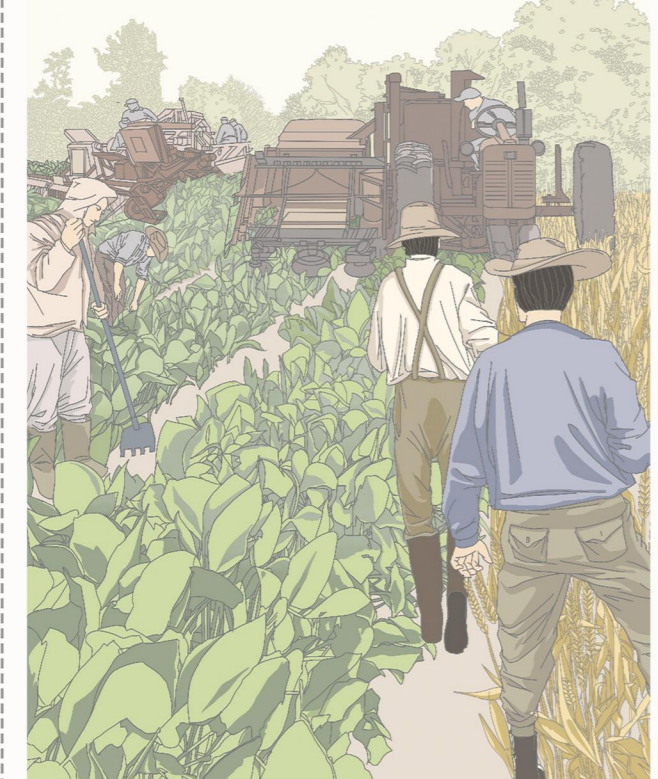
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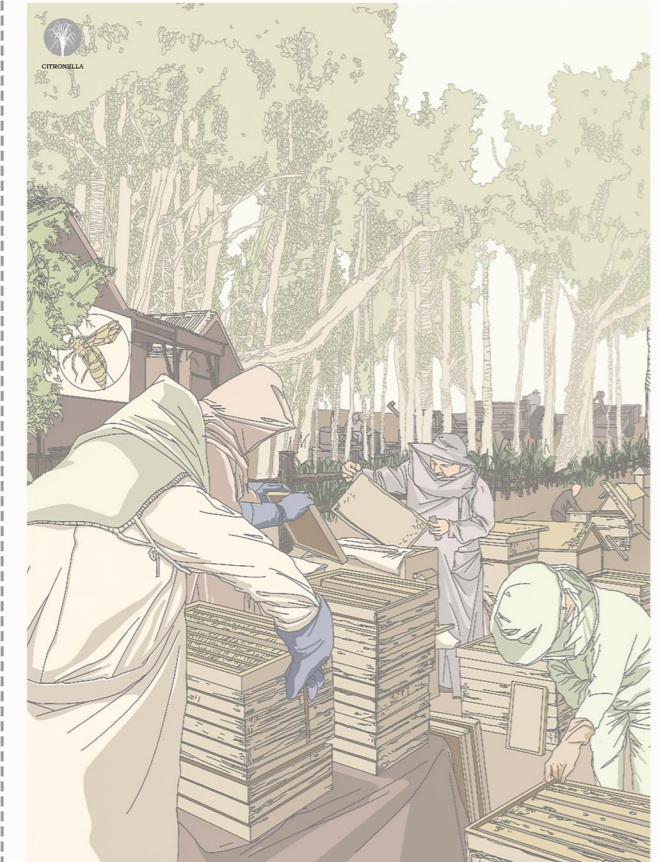
**PLAN A — INTENSIVE FARM**



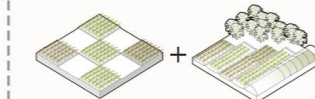
**Improved intensive agriculture**  
This area retains the large-scale mechanized cropping pattern and allows GM soya to continue to be grown, but other suitable or soil-rehabilitating crop types need to be introduced each year to slowly replace GM soya, thus achieving a more sustainable agricultural pattern.



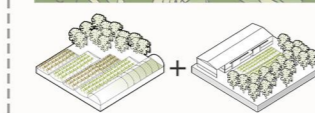
**Beekeeping protected by buffer zone**  
As the intensive agricultural area is temporarily reserved for the cultivation of GM soybeans, a buffer zone is designed to prevent bees from entering in order to protect the living environment of bees and the livelihood of beekeepers in order to prevent bees from being exposed to GM crops and pesticides.



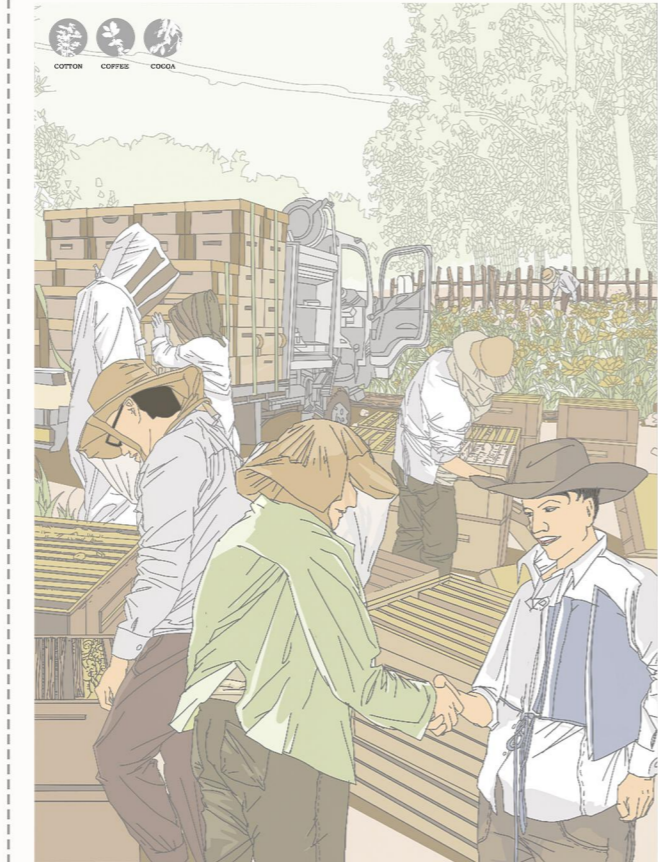
**PLAN B — NEW COOPERATIVE FARM**



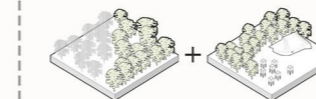
**Intercropping & crop rotation**  
The introduction of a variety of locally appropriate cash crops and the replacement of the previous large-scale monoculture farming model with a new agricultural model of crop rotation and intercropping will help to increase crop yields and provide protection against pests.



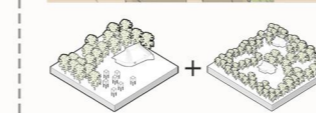
**Establishment of partnership**  
The new farming model has a stronger pest control capability, and when pesticides are no longer used, beekeepers can enter into a partnership with Mennonites, leading bees to pollinate crops to improve crop yields and quality, in return for a profit.



**PLAN C — ECO-FOREST WITH BEEKEEPING**



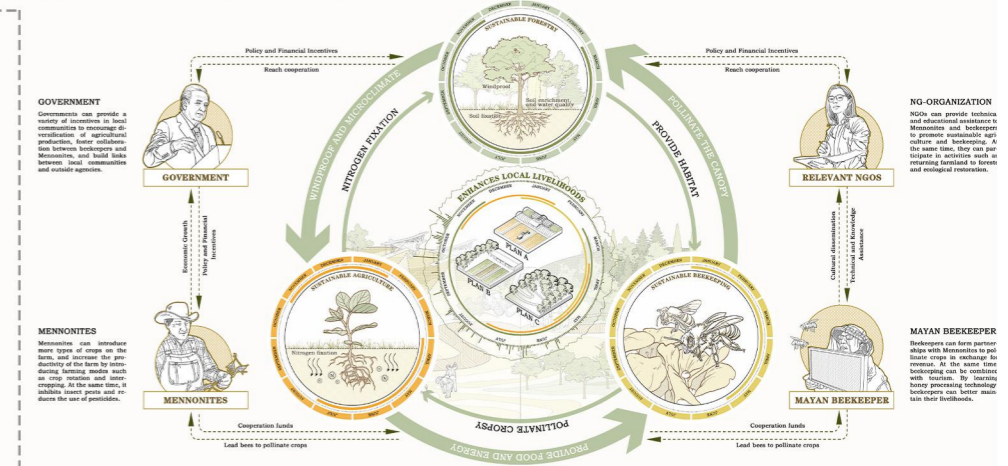
**Restoration of forest**  
This is an ecologically sensitive area at the edge of the forest that is unsuitable for agriculture and where government incentives and community activities are used to guide the local people to restore the forest and rebuild the bees' home.



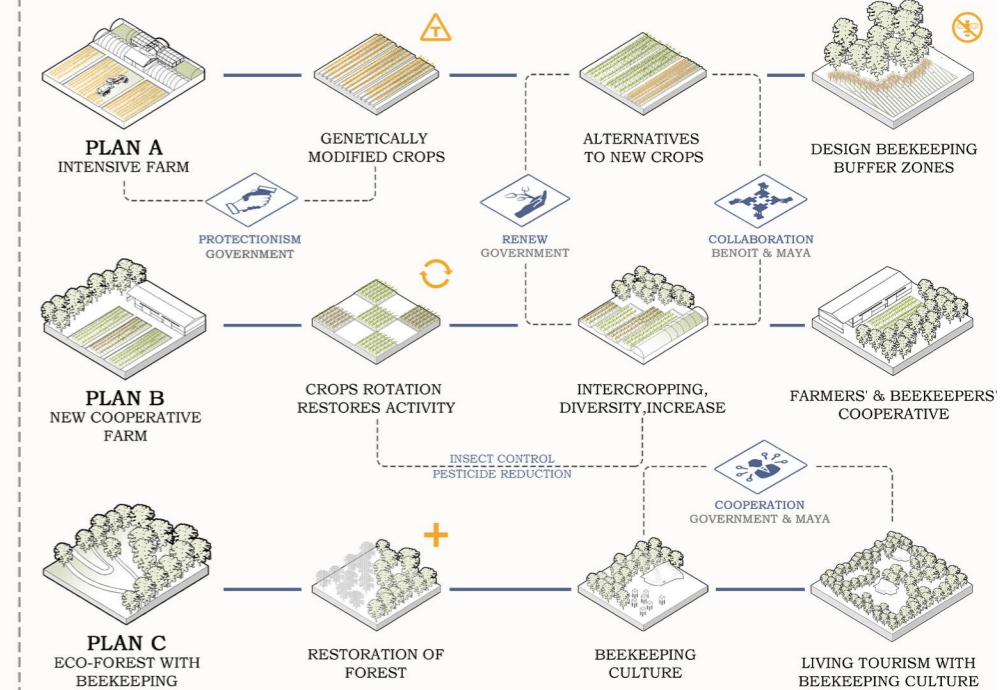
**Tourism with beekeeping culture**  
The Mayan beekeeping industry can be transformed by combining beekeeping in the forest with cultural tourism, which can lead visitors to experience the culture of beekeeping and promote economic growth and cultural dissemination.



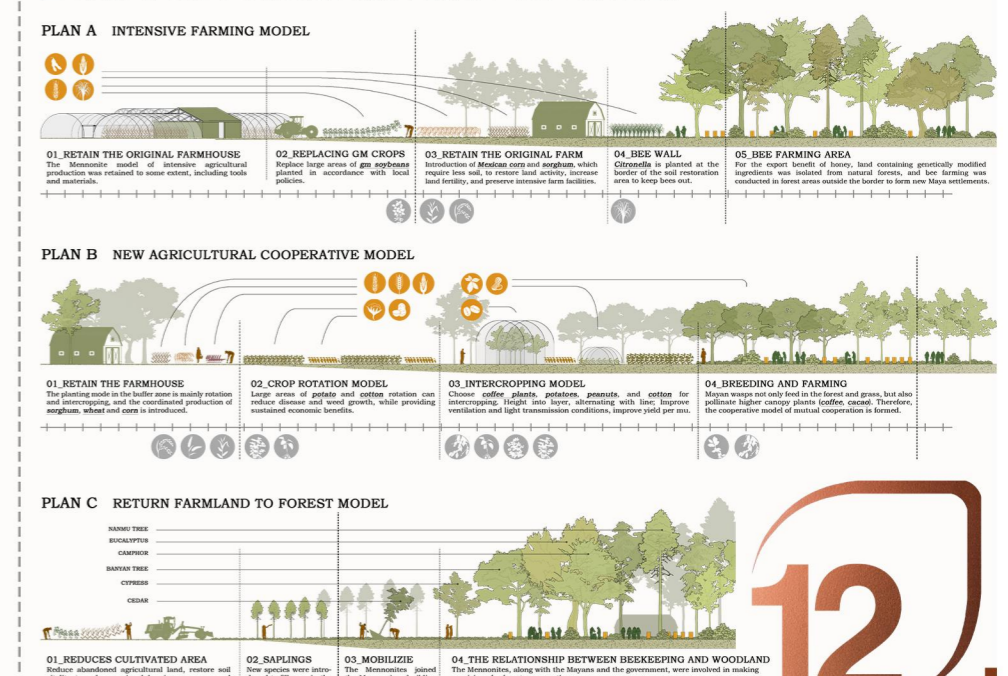
**OVERALL STRATEGY**



**STRATEGY FOR DIVERSE LAND-USE MODES**

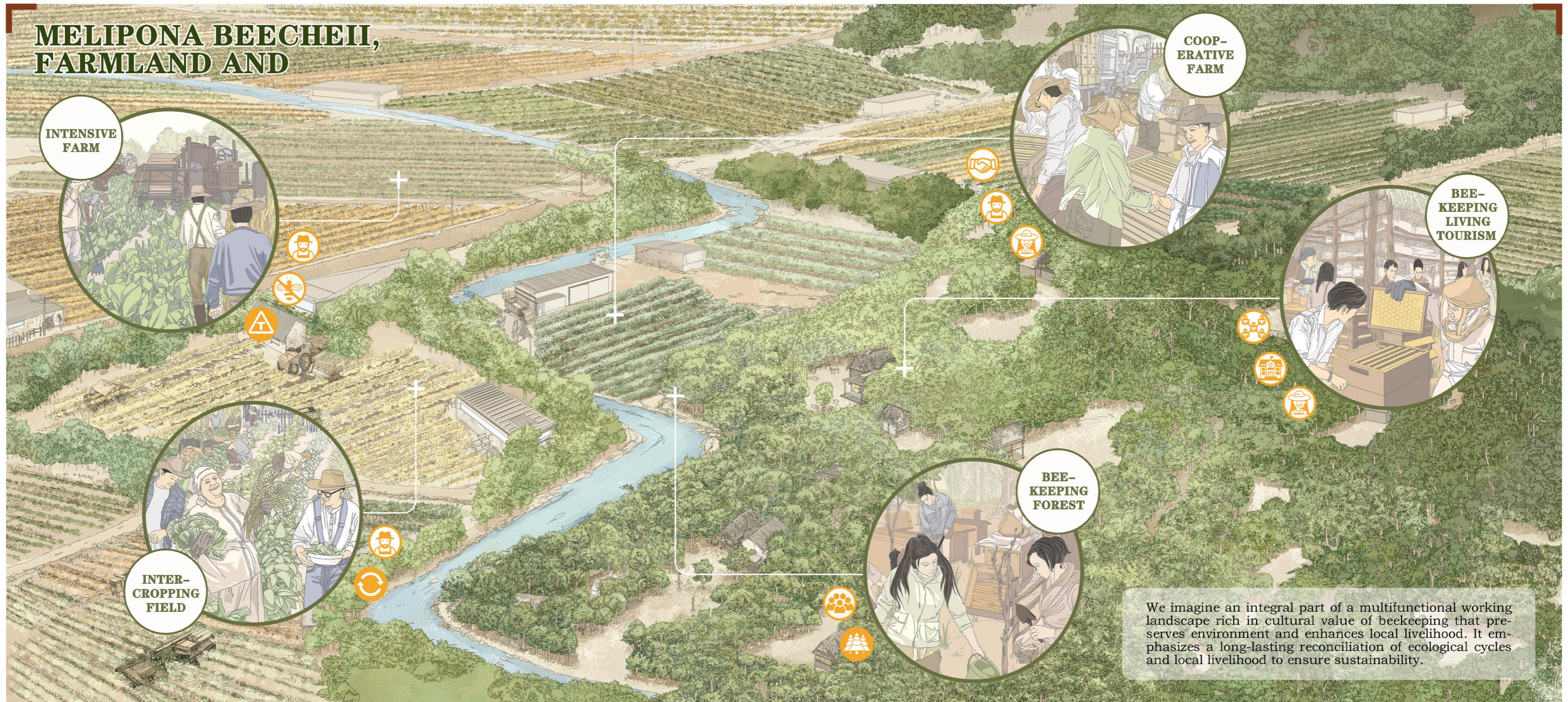


**PROCESS FOR DIVERSE LAND-USE MODES**



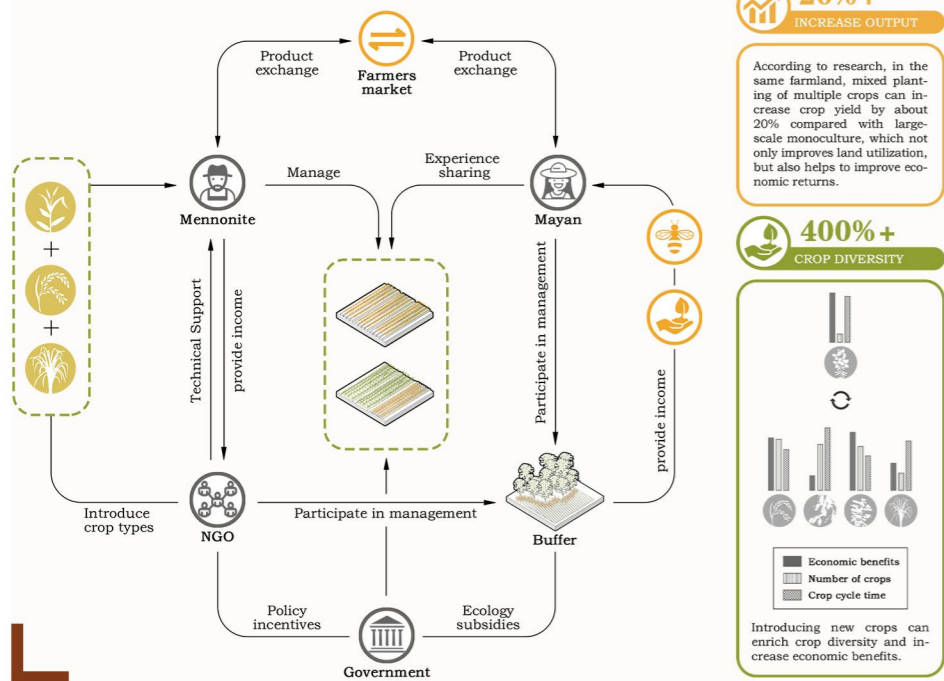


# MELIPONA BEECHEII, FARMLAND AND

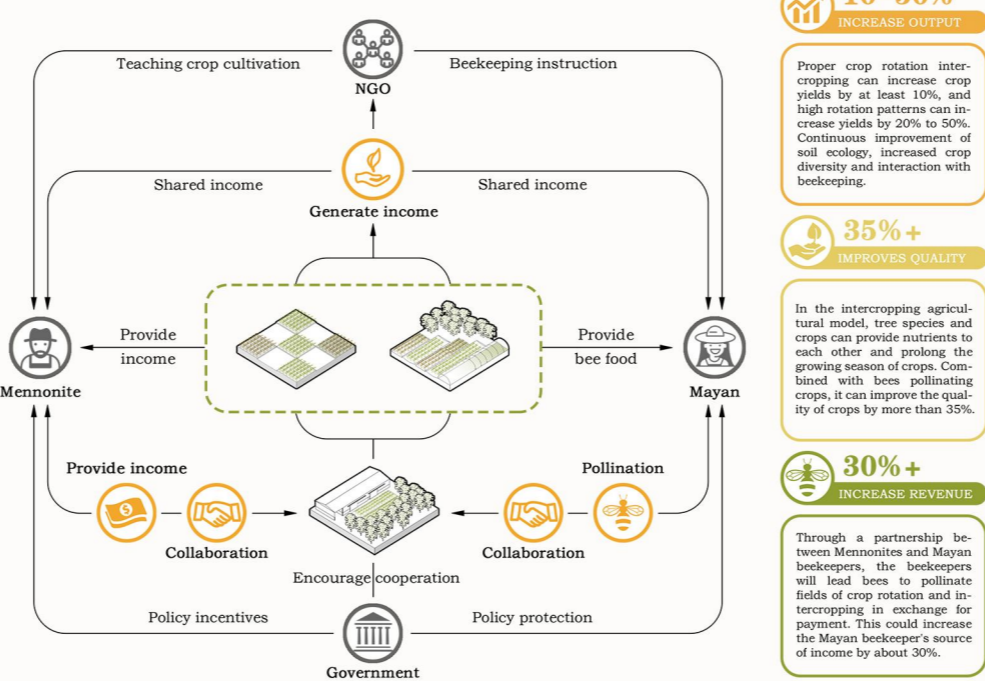


We imagine an integral part of a multifunctional working landscape rich in cultural value of beekeeping that preserves environment and enhances local livelihood. It emphasizes a long-lasting reconciliation of ecological cycles and local livelihood to ensure sustainability.

PLAN A — SOCIAL FRAMEWORK OF STAKEHOLDERS



PLAN B — SOCIAL FRAMEWORK OF STAKEHOLDERS



PLAN C — SOCIAL FRAMEWORK OF STAKEHOLDERS

