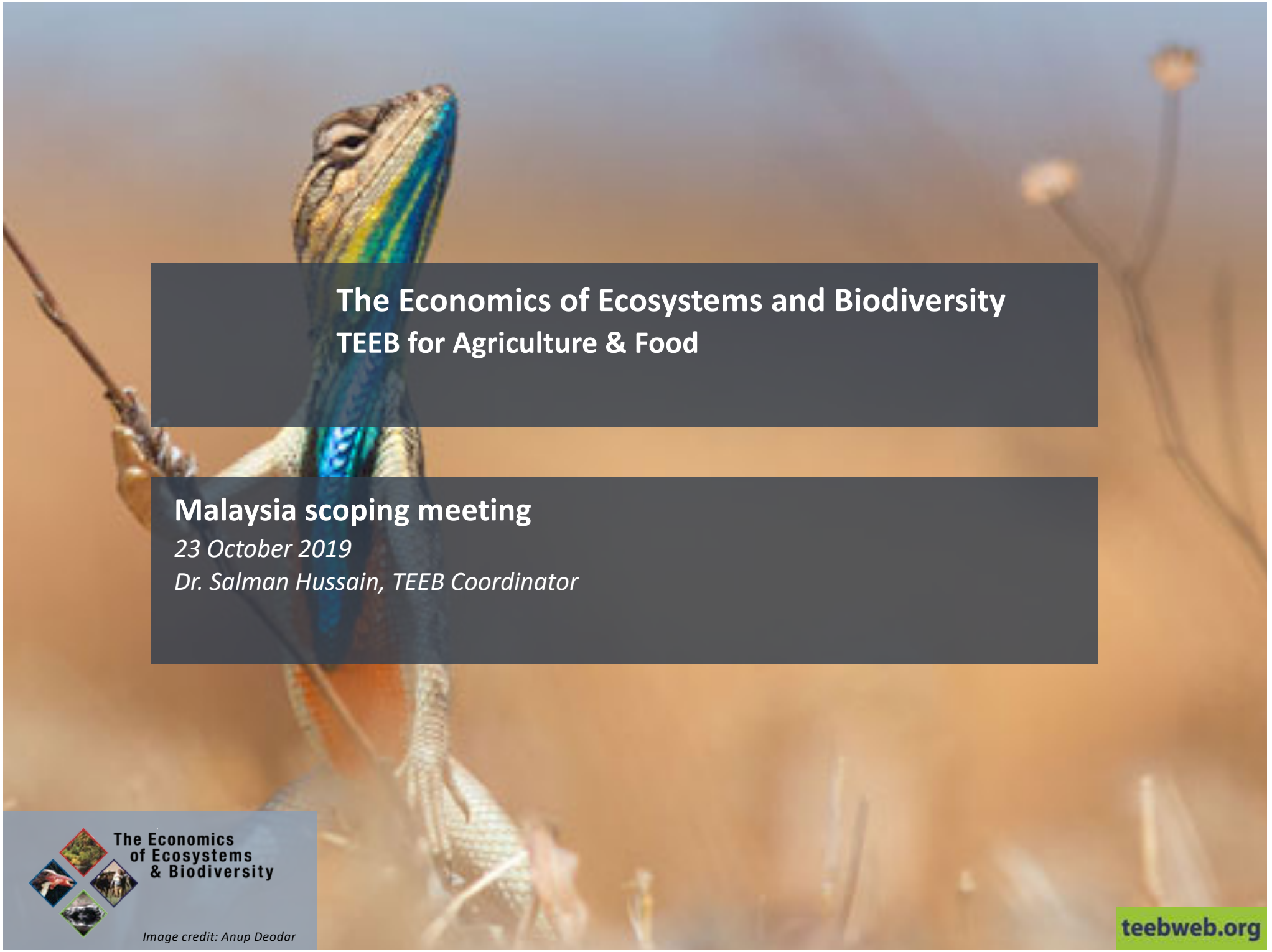


The Economics of Ecosystems and Biodiversity

TEEB for Agriculture & Food

Malaysia scoping meeting

23 October 2019

Dr. Salman Hussain, TEEB Coordinator

The Economics of Ecosystems & Biodiversity

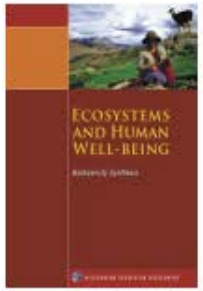
Image credit: Anup Deodar

teebweb.org

I Origins of TEEB and TEEBAgriFood

TEEB for Agriculture & Food

TEEB initiative (2008-2012)



Ecol./Env. Economics literature

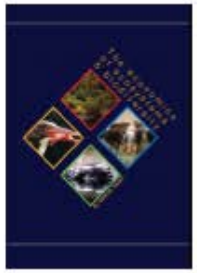
G8+5
Potsdam
2007

"Potsdam Initiative – Biological Diversity 2010"

The economic significance of the global loss of biological diversity….

Importance of recognising, demonstrating & responding to values of nature…

Interim Report



CBD COP 9
Bonn 2008

Climate Issues Update

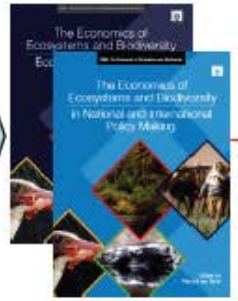
Input to UNFCCC 2009

TEEB End User Reports Brussels 2009, London 2010

India, Brazil, Belgium, Japan & South Africa Sept. 2010

TEEB Synthesis

TEEB Books



BD COP 10 Nagoya, Oct 2010

CBD COP11 India

National TEEB Work

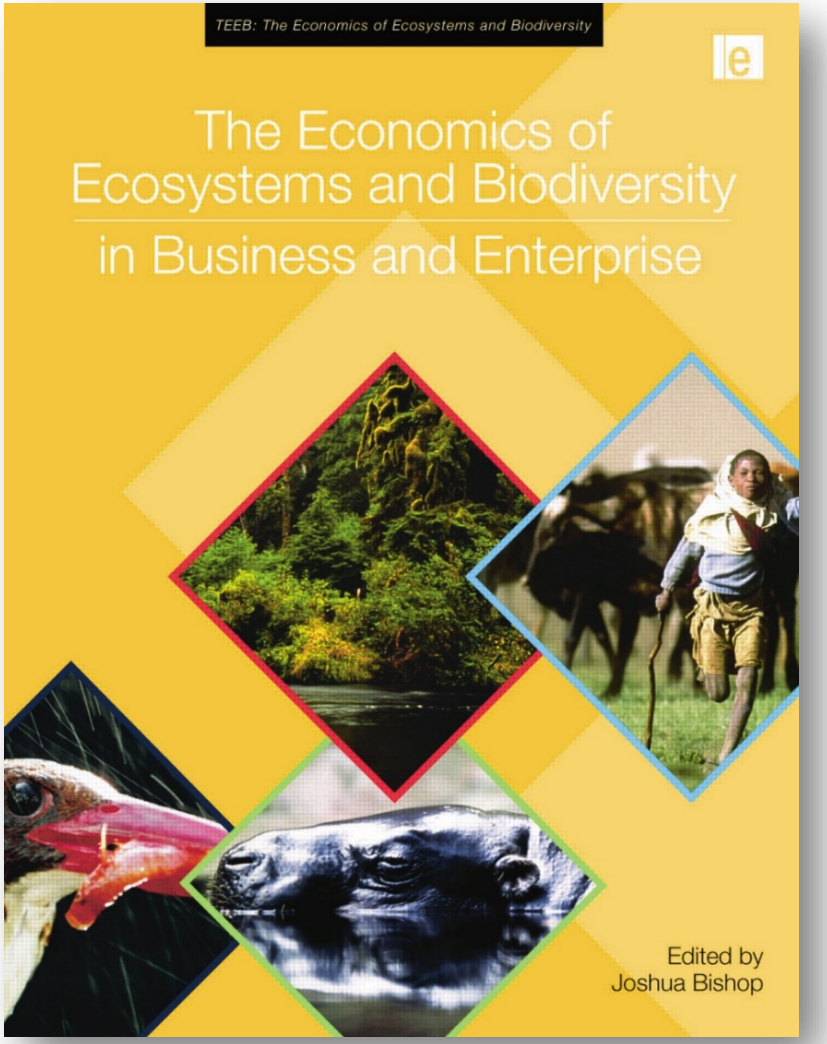
Sectoral TEEB Work

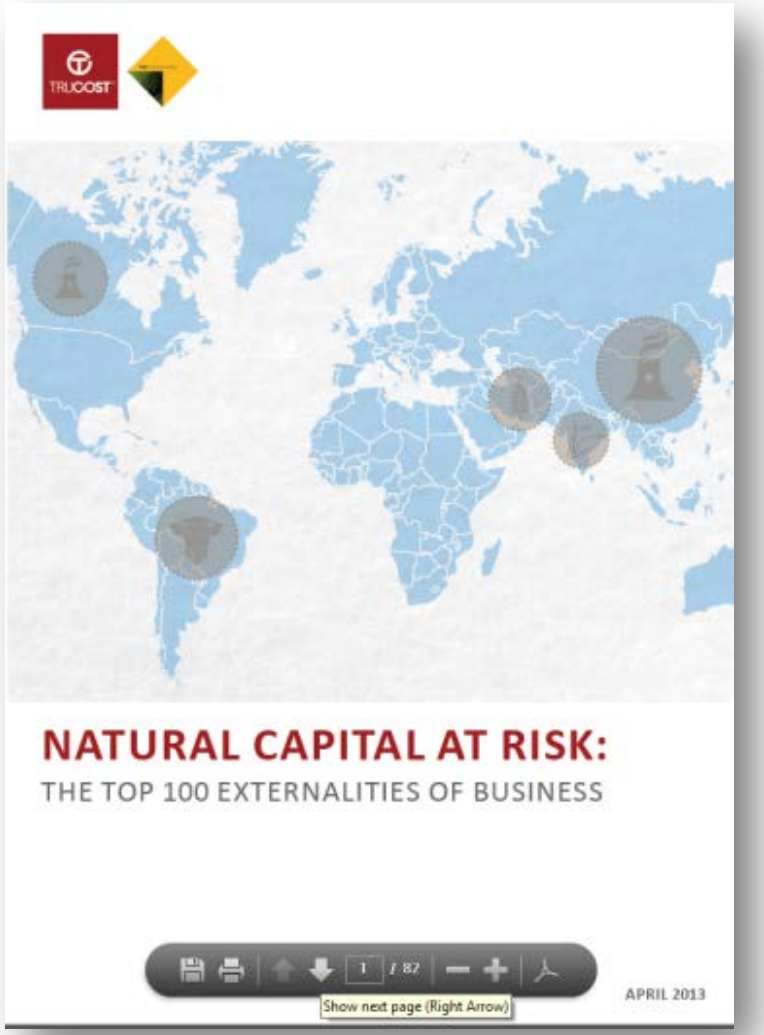
Business Externalities Work

Rio+20 Brazil

TEEB for Agriculture & Food

TEEB for Business





teebweb.org

Why select the Agriculture sector?

7.1.2 THE GLOBAL 20 REGION-SECTORS

Ranking of the 20 region-sectors with the greatest total impact across the 6 EKPIs when measured in monetary terms.

RANK	SECTOR	REGION	NATURAL CAPITAL COST, US$ BN	REVENUE, US$ BN	IMPACT RATIO
1	COAL POWER GENERATION	EASTERN ASIA	452.8	443.1	1.0
2	CATTLE RANCHING AND FARMING	SOUTH AMERICA	353.8	16.6	18.8
3	COAL POWER GENERATION	NORTHERN AMERICA	316.8	246.7	1.3
4	WHEAT FARMING	SOUTHERN ASIA	266.6	31.8	8.4
5	RICE FARMING	SOUTHERN ASIA	235.6	65.8	3.6
6	IRON AND STEEL MILLS	EASTERN ASIA	225.6	604.7	0.4
7	CATTLE RANCHING AND FARMING	SOUTHERN ASIA	163.0	174.0	0.8
8	CEMENT MANUFACTURING	EASTERN ASIA	147.0	5.8	23.0
9	WATER SUPPLY	SOUTHERN ASIA	111.7	14.1	7.9
10	WHEAT FARMING	NORTHERN AFRICA	100.1	7.4	13.6
11	RICE FARMING	EASTERN ASIA	99.3	91.2	1.1
12	WATER SUPPLY	WESTERN ASIA	86.7	18.4	4.7
13	FISHING	GLOBAL	86.1	136.0	0.6
14	RICE FARMING	NORTHERN AFRICA	84.2	1.2	69.6
15	CORN FARMING	NORTHERN AFRICA	80.4	1.7	47.8
16	RICE FARMING	SOUTH-EASTERN ASIA	79.7	41.0	1.9
17	WATER SUPPLY	NORTHERN AFRICA	76.4	3.4	22.2
18	SUGARCANE	SOUTHERN ASIA	75.6	6.0	12.5
19	PETROLEUM AND NATURAL GAS EXTRACTION *(excludes water and land use)*	EASTERN EUROPE	72.6	371.6	0.2
20	NATURAL GAS POWER GENERATION	NORTHERN AMERICA	69.4	122.7	1.0

‘The Good’

+ Agriculture employs 1 in 3 of the world’s economically active labour force, or about 1.3 billion people. For the 70 per cent of the world's poor living in rural areas, agriculture is the main source of income and employment.

+ Smallholder farms (i.e. less than 2 hectares) represent over 475 million of the world’s 570 million farms and, in much of the developing world, they produce over 80 per cent of the food consumed.

+ Food production systems produce approximately 2,800 calories per person per day which is enough to feed the world population.

‘The Bad’

- Eighty per cent of new agricultural land has replaced tropical forests since the 1980s, a trend resulting in significant biodiversity loss and ecosystem degradation.

- Crop and livestock farming produce between five and six billion tons of CO_2-equivalent in greenhouse gas (GHG) emissions each year, mostly in developing countries where the agricultural sector has expanded in recent years.

- The agricultural sector utilizes 70 per cent of the water resources we withdraw from rivers, lakes and aquifers, raising serious concerns in terms of sustainability and security.

TEEB for Agriculture & Food

Summary statement

The **TEEBAgriFood** study is designed to:

1. provide a comprehensive economic evaluation of the ***'eco-agri-food systems' complex***
2. demonstrate that the economic environment in which farmers operate is distorted by ***significant externalities***, both negative and positive, and a lack of *awareness of* ***dependency on natural, social and human capital***

The visible and invisible flows of agricultural production

COMMENT

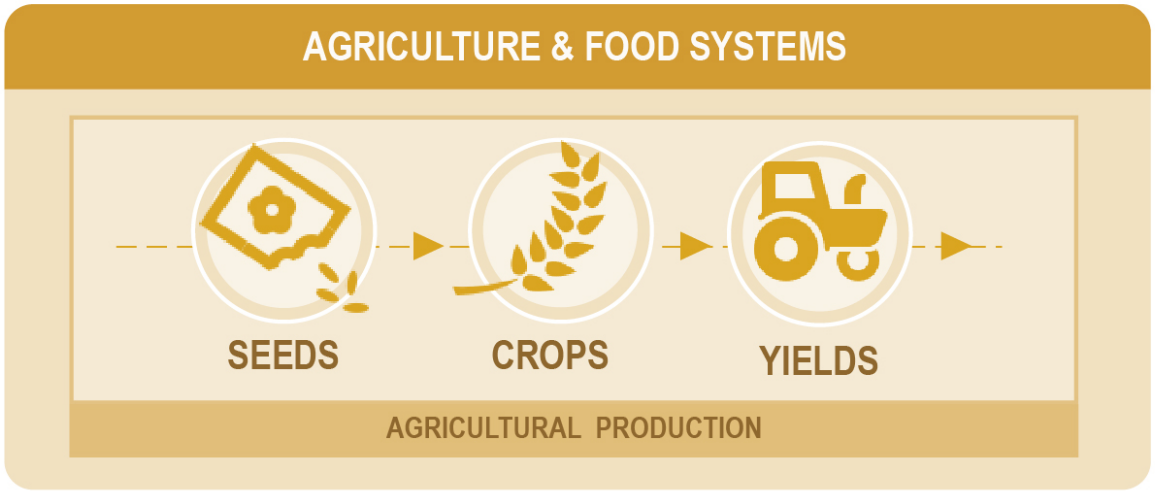
Nature (December 2016)

Drying red chillis under the sun provides one of the few sources of employment for women in an area of Bangladesh.

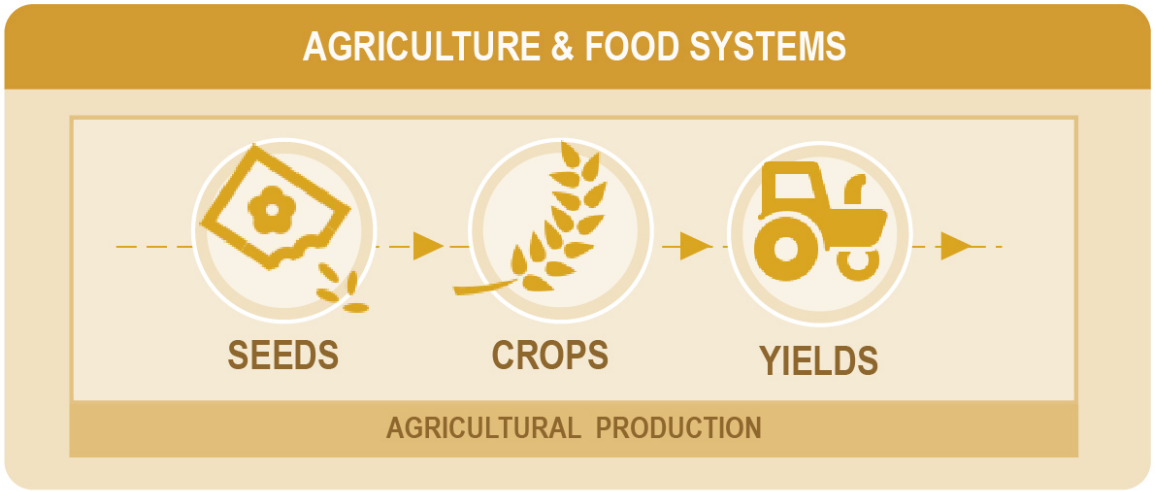
Fix food metrics

For sustainable, equitable nutrition we must count the true global costs and benefits of food production, urge **Pavan Sukhdev, Peter May** and **Alexander Müller**.

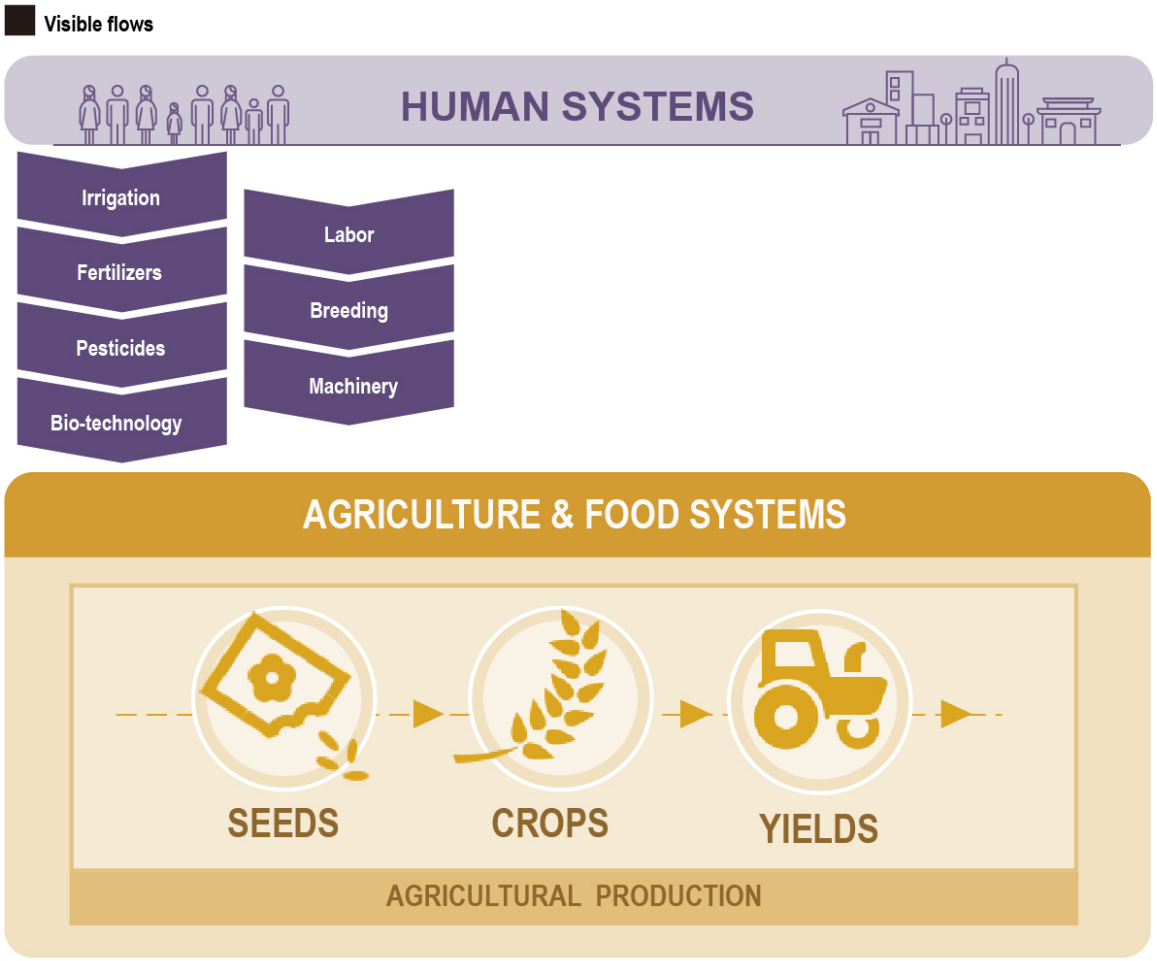
The visible and invisible flows of agricultural production



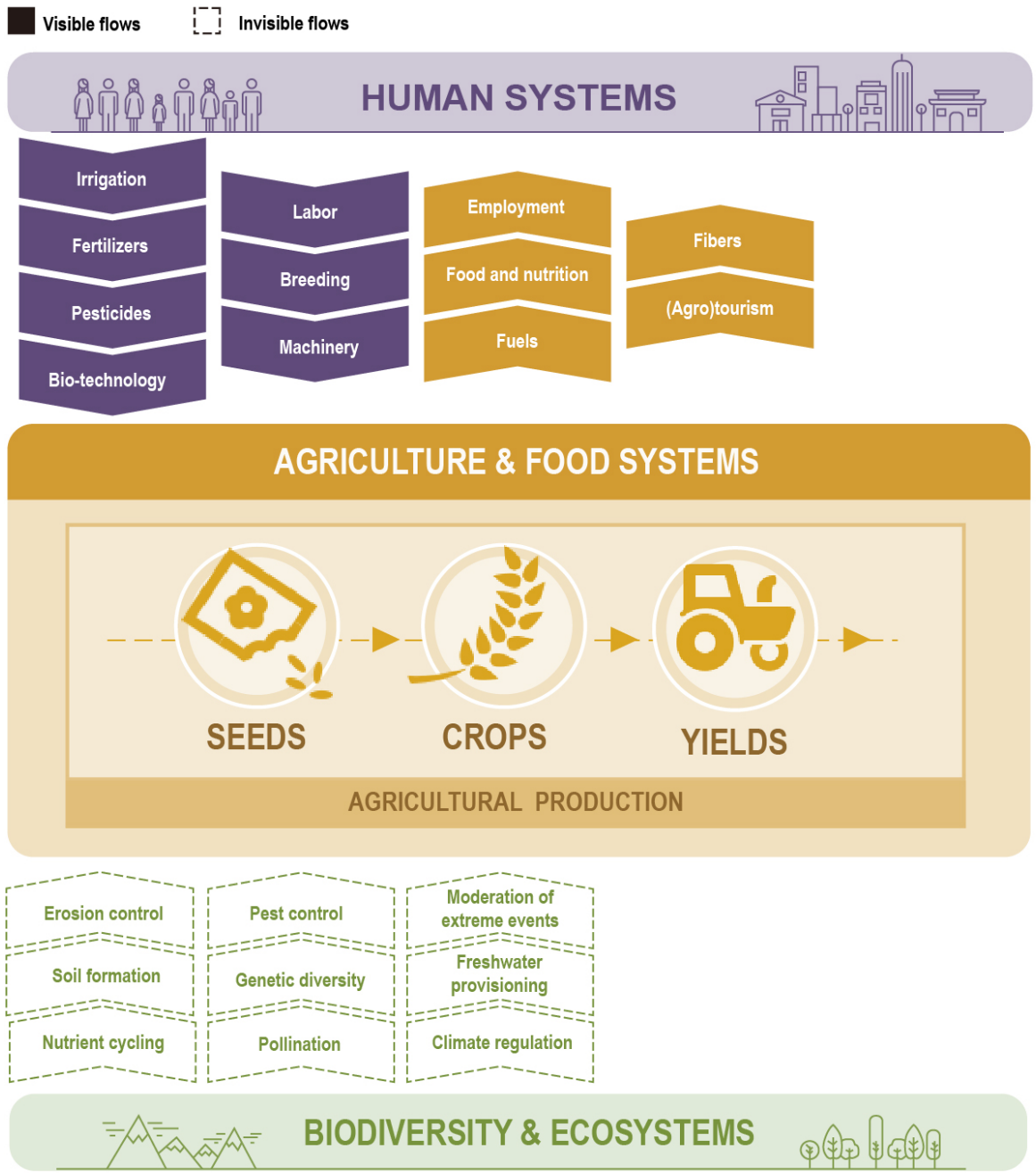
The visible and invisible flows of agricultural production



The visible and invisible flows of agricultural production

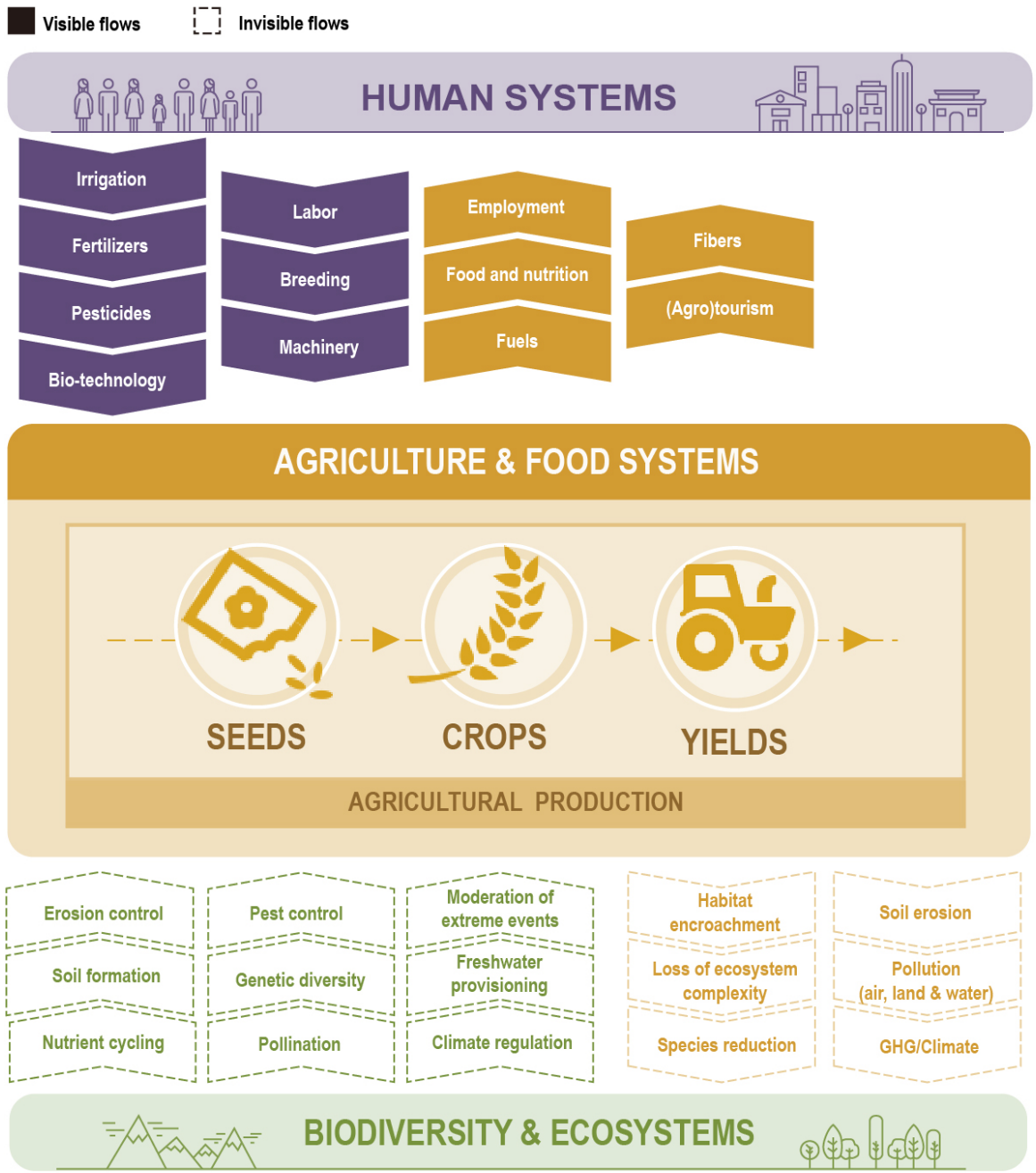


The visible and invisible flows of agricultural production



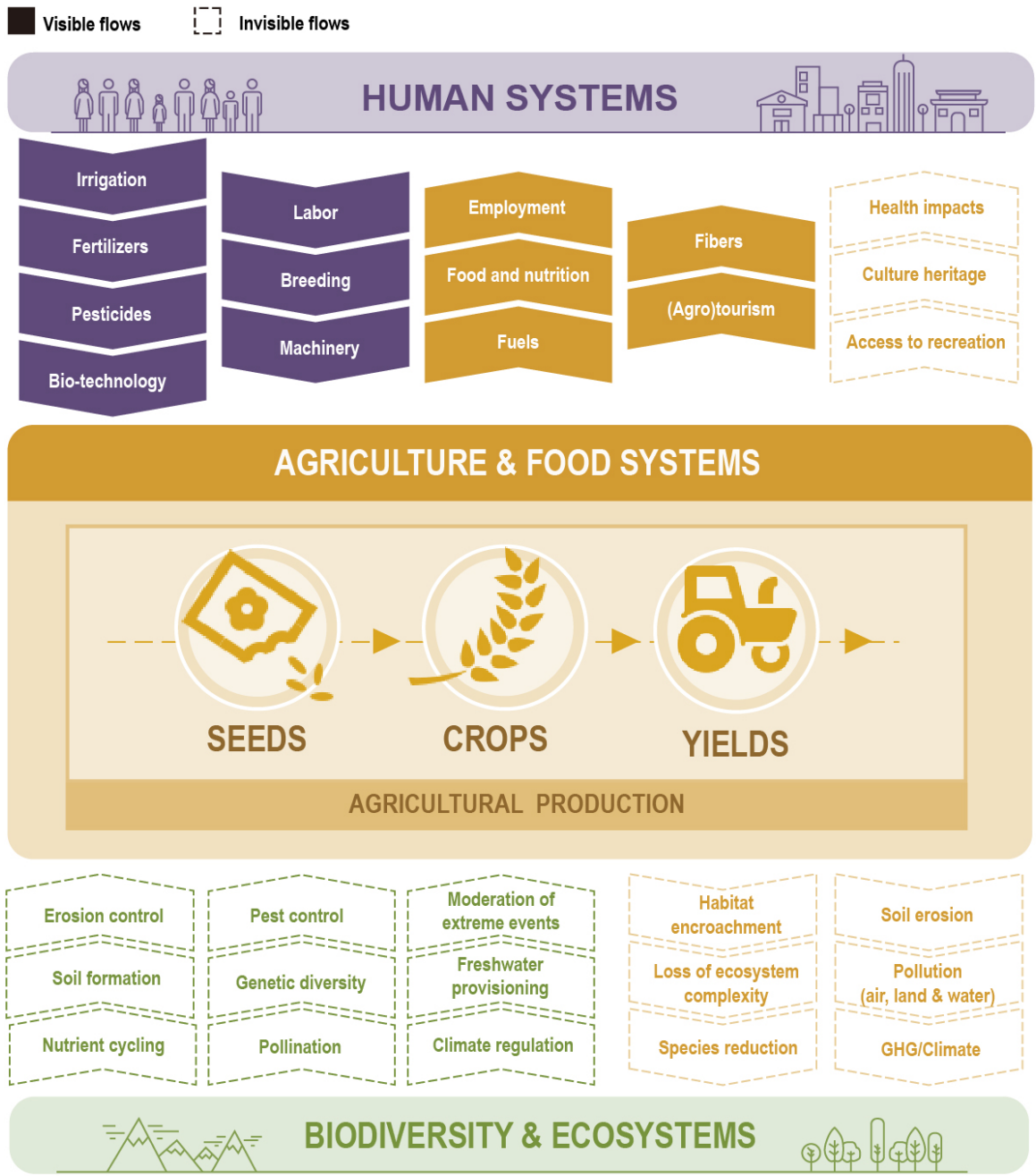
teebweb.org

The visible and invisible flows of agricultural production



teebweb.org

The visible and invisible flows of agricultural production



teebweb.org

TEEB for Agriculture & Food

teebweb.org/agrifood/home/scientific-and-economic-foundations-report/

TEEB for Agriculture & Food

An initiative of 'The Economics of Ecosystems and Biodiversity' (TEEB)

TEEBAgriFood | Information Materials | Events | Media | Team | TEEB | Contact

Scientific and Economic Foundations

Scientific and Economic Foundations Report

Measuring what matters in agriculture and food systems

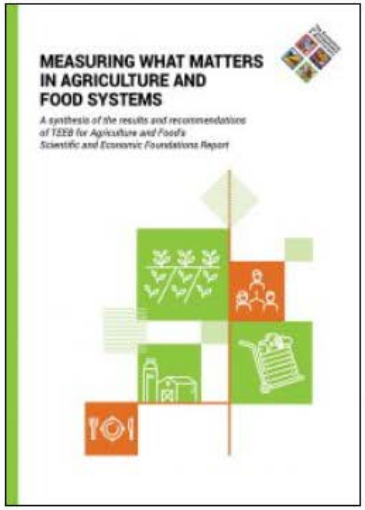
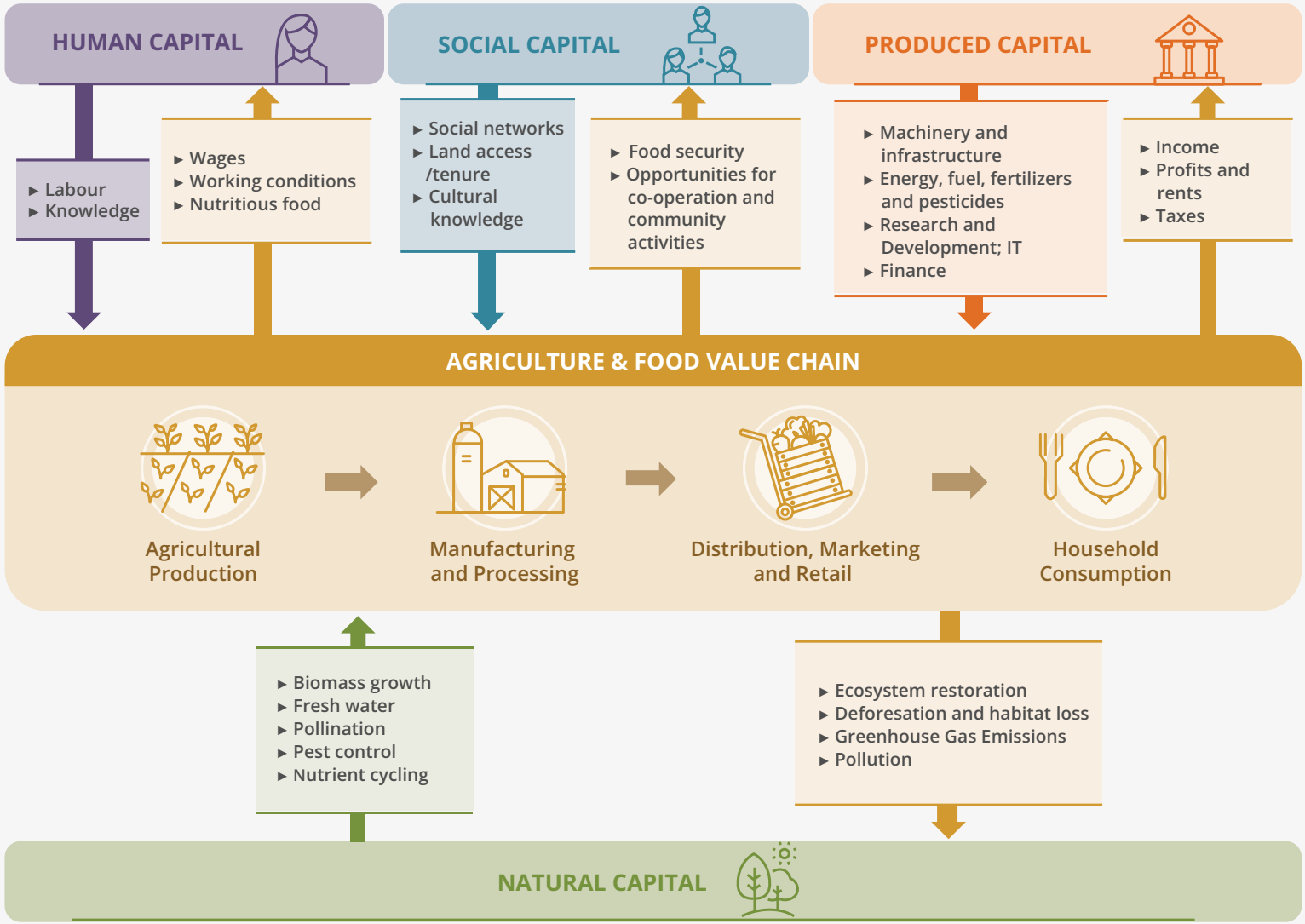


Figure 2.1 Capital stocks and value flows in eco-agri-food systems (Source: Hussain and Vause 2018)

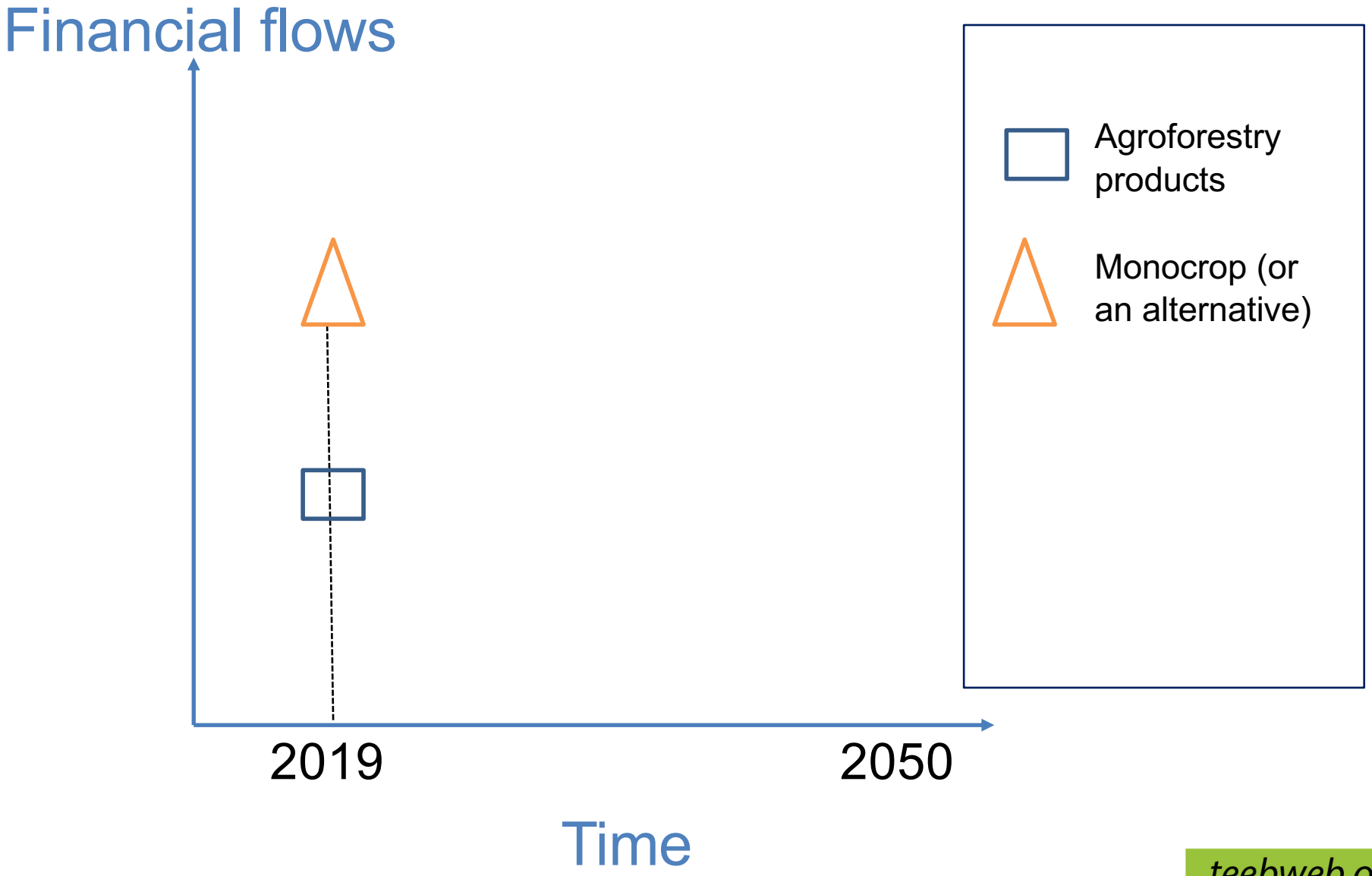


TEEB for Agriculture & Food

II TEEBAgriFood for Malaysia – hypothesis on 'invisibilities'

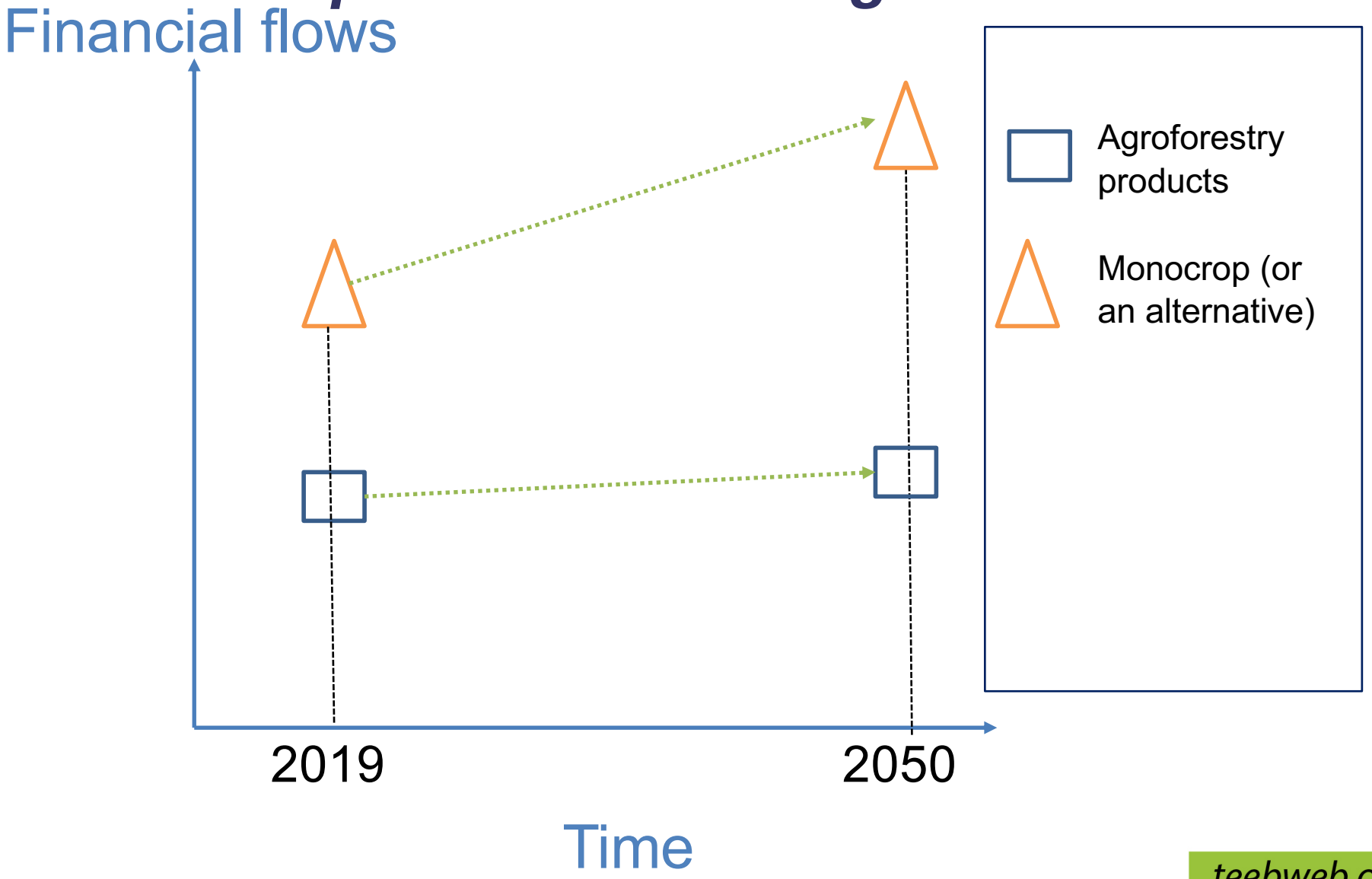
TEEB for Agriculture & Food

Agro-forestry versus monoculture: *current assumption*



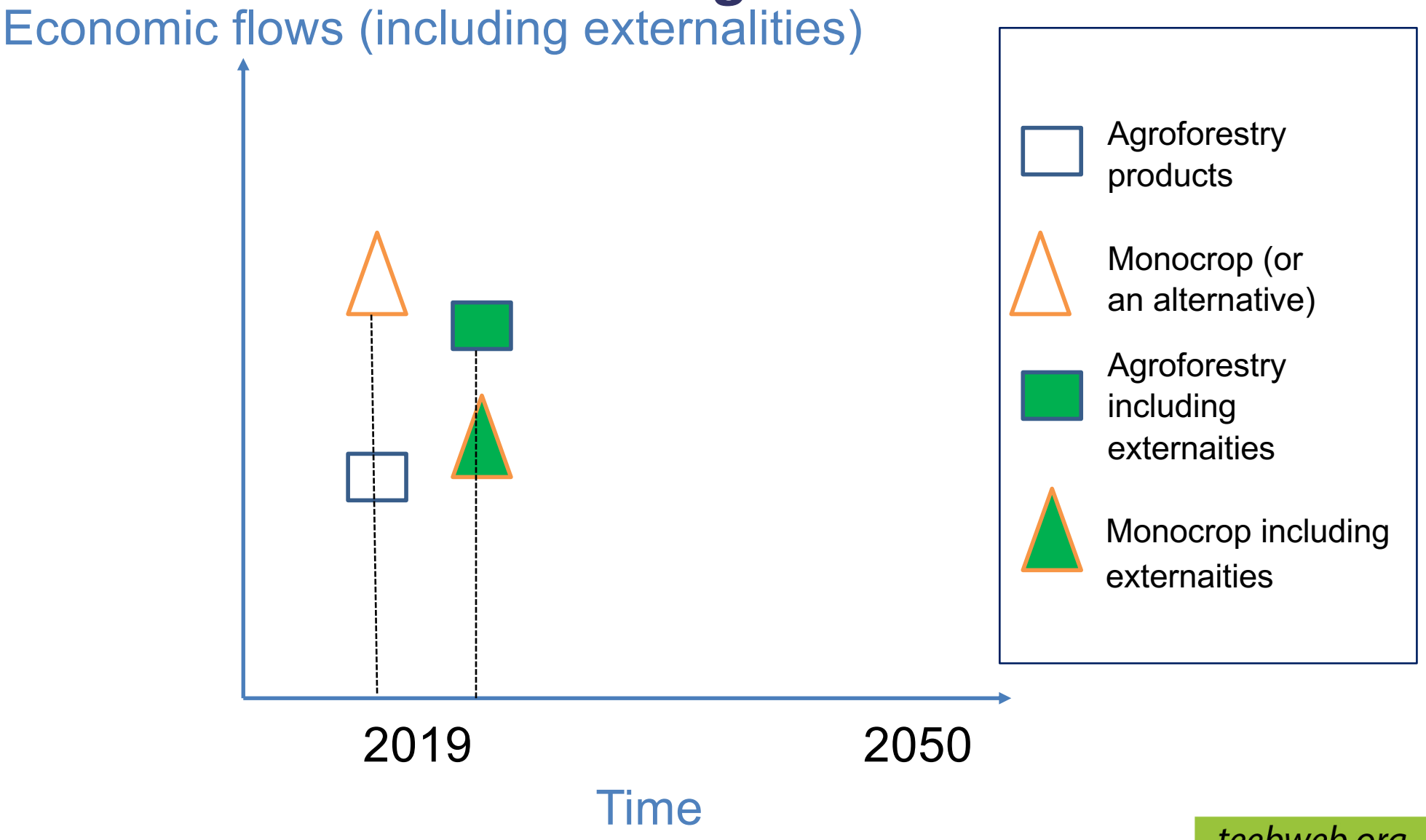
TEEB for Agriculture & Food

Agro-forestry versus monocrop: *Assumption about changes over time*



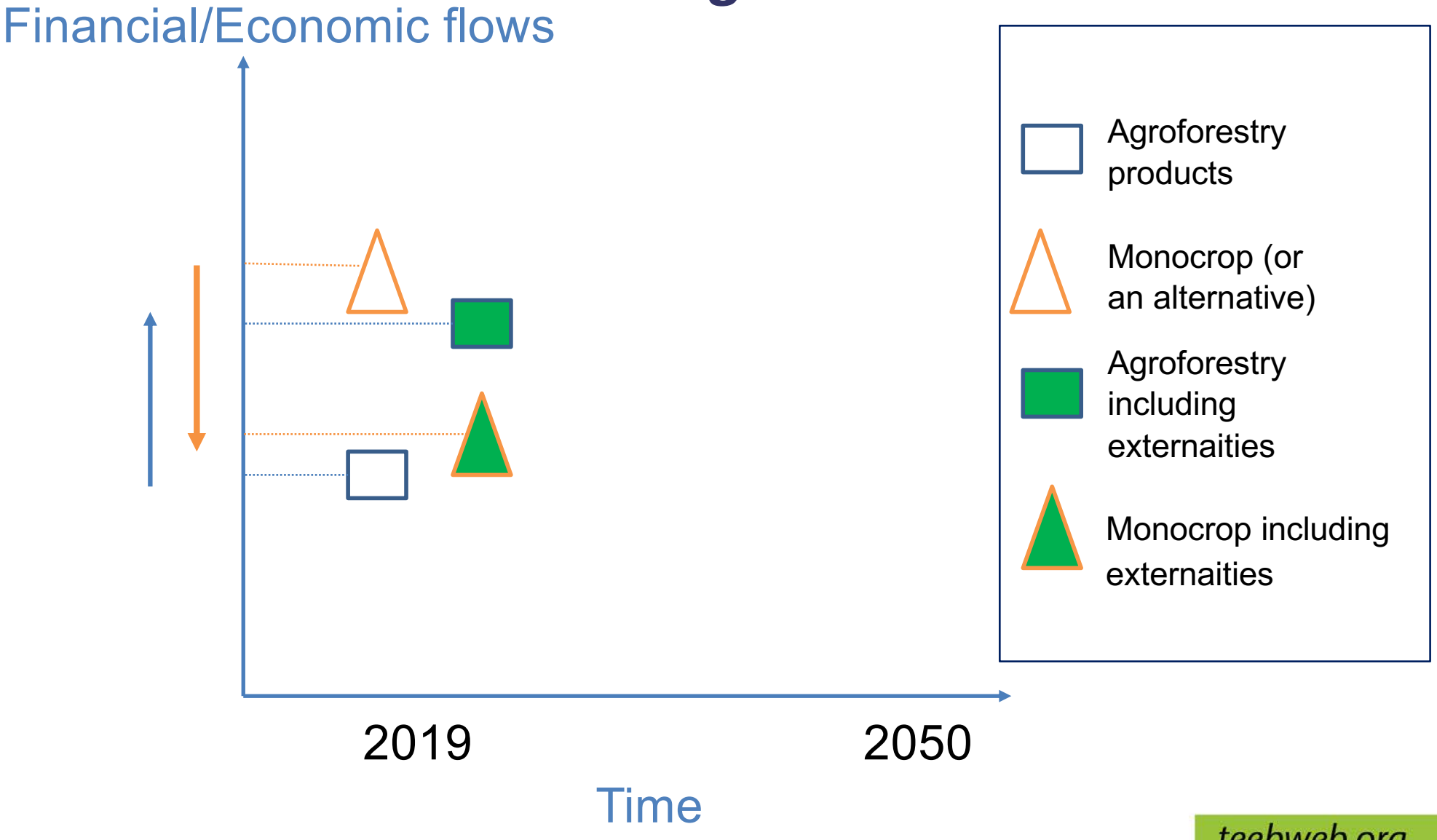
TEEB for Agriculture & Food

Agro-forestry versus monocrop: *2019 including externalities*



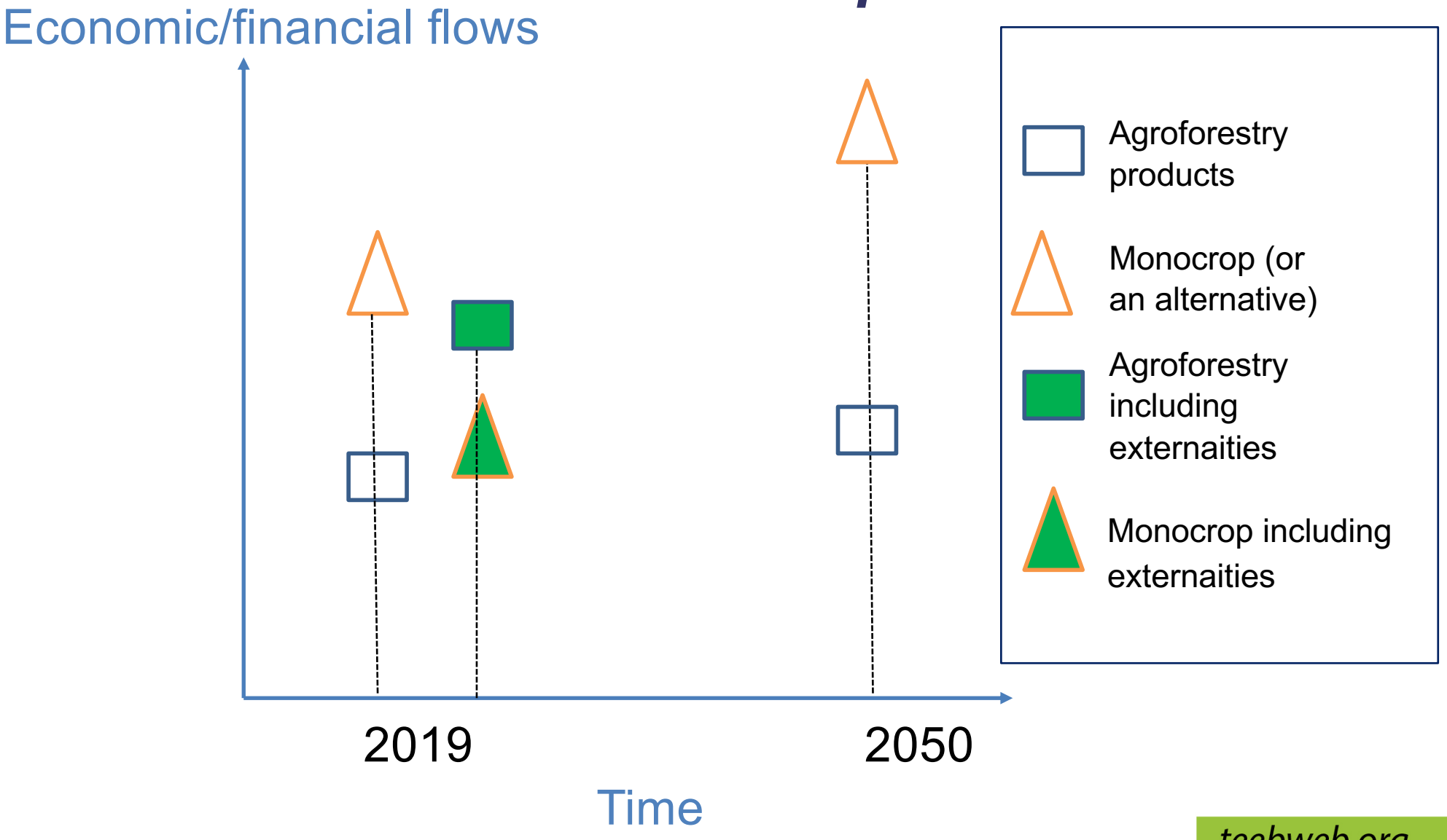
TEEB for Agriculture & Food

Agro-forestry versus monocrop: *2019 including externalities*



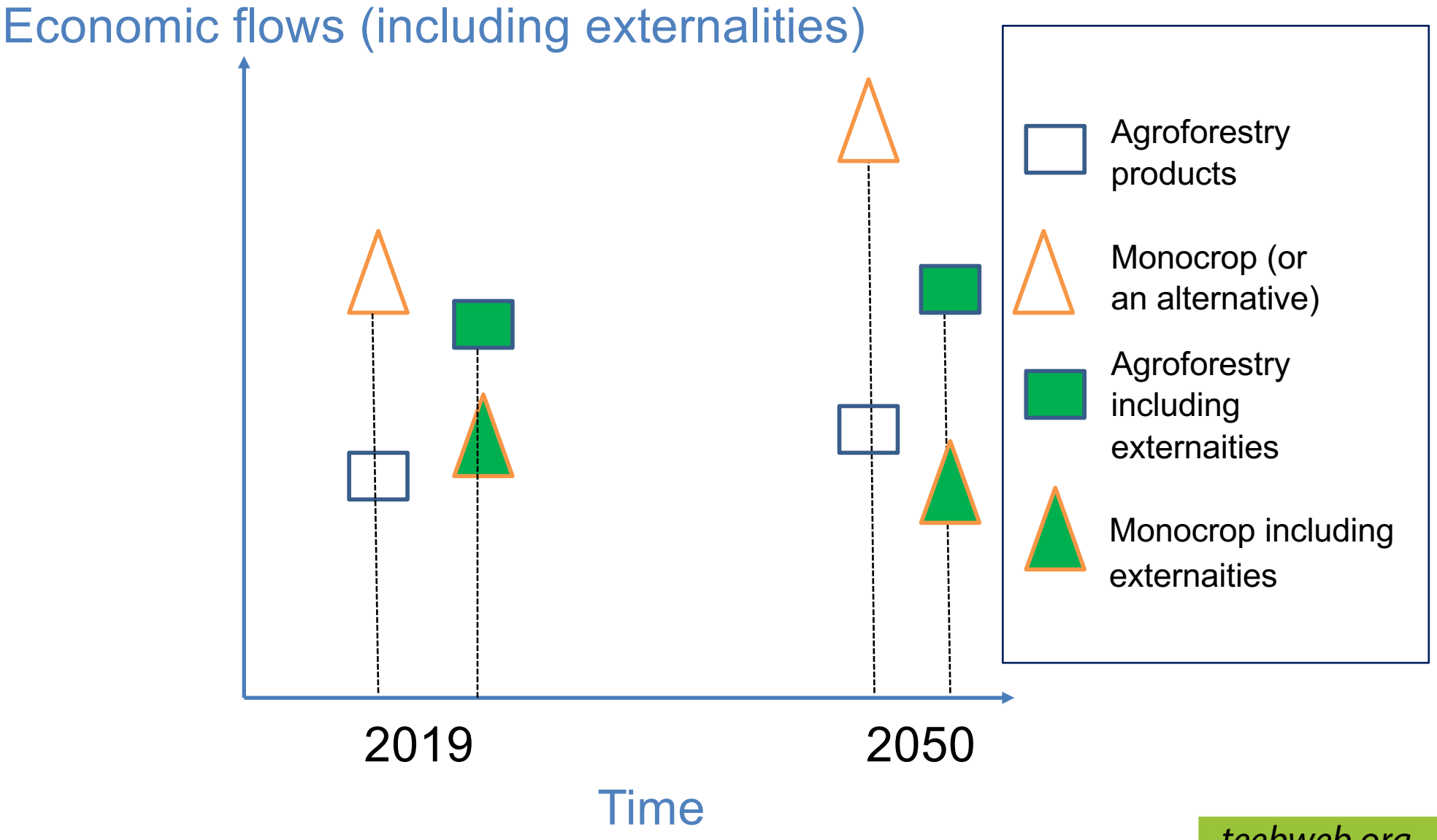
TEEB for Agriculture & Food

Agro-forestry versus monocrop: *current assumption*



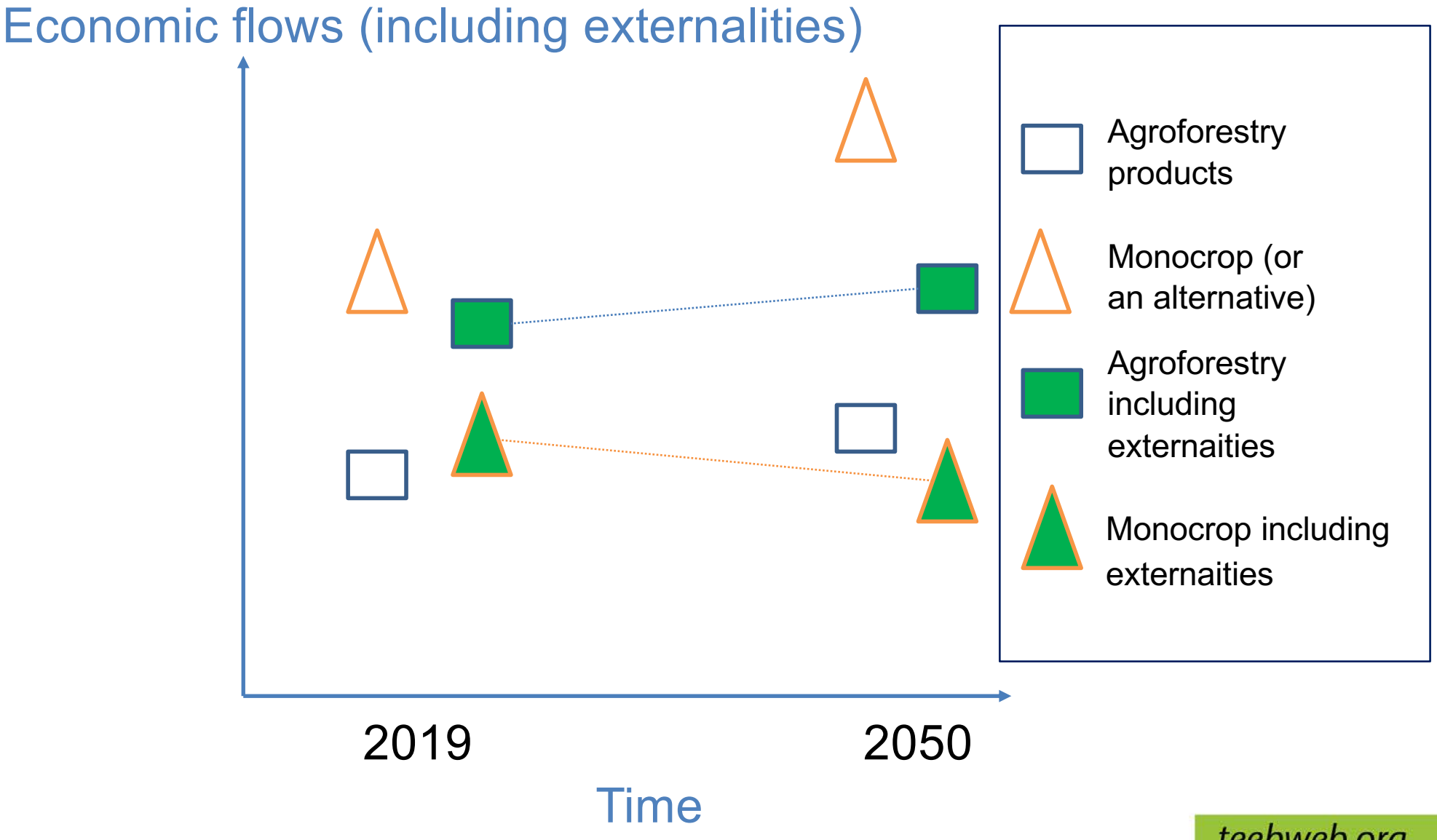
TEEB for Agriculture & Food

Agro-forestry versus monocrop: *2019/2050*



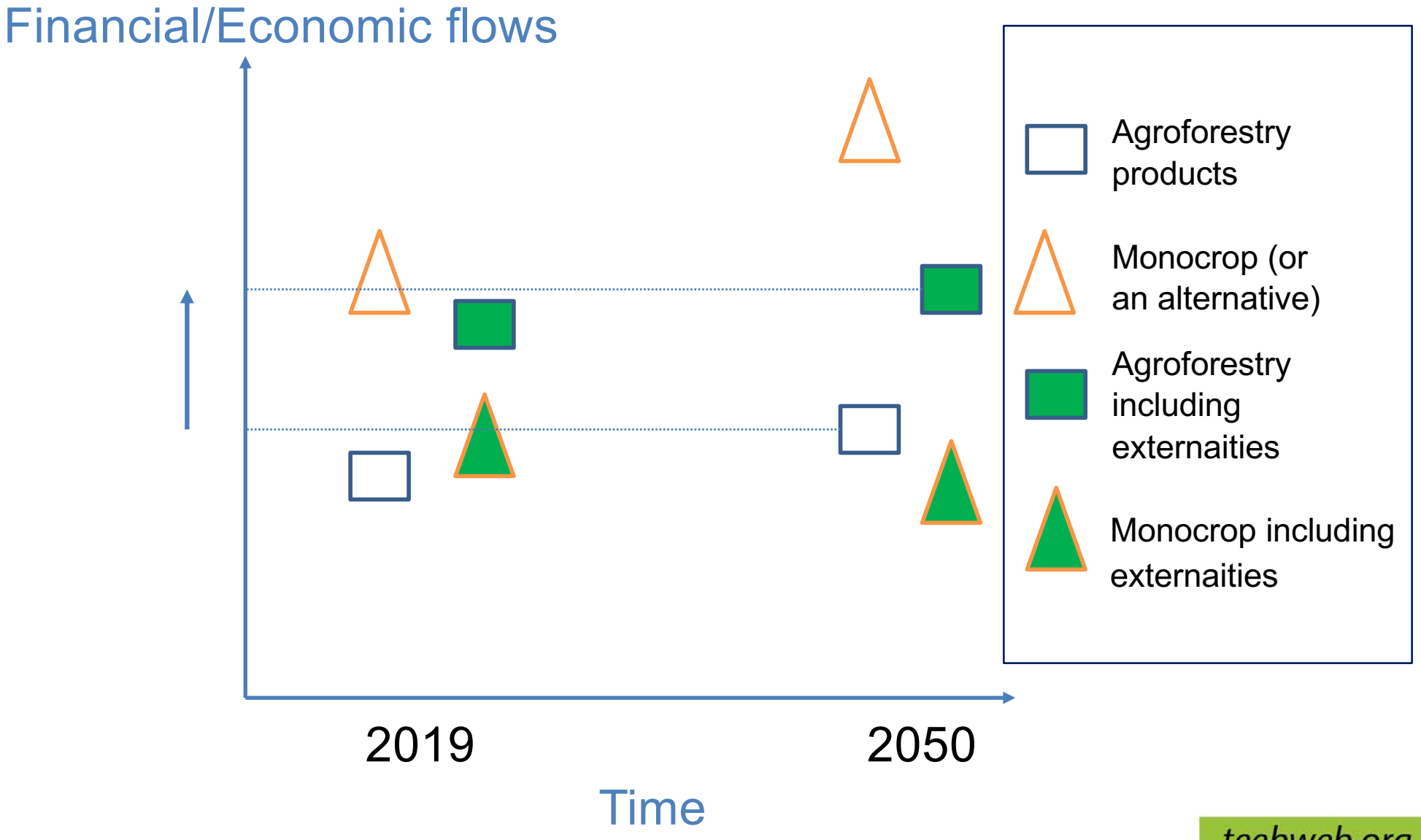
TEEB for Agriculture & Food

Agro-forestry versus monocrop: *Situation worsens for monocrop over time*



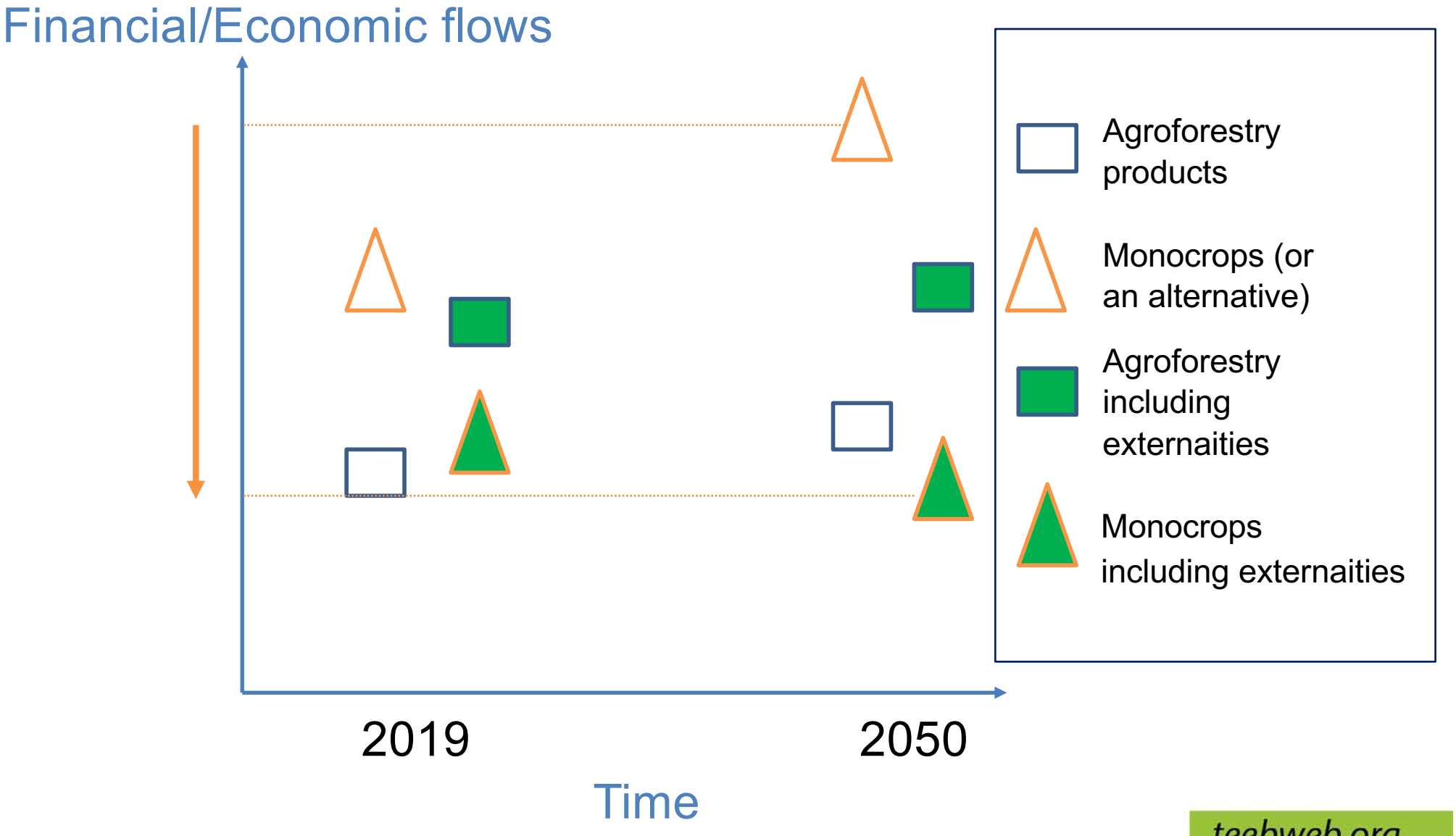
TEEB for Agriculture & Food

Agro-forestry versus monocrop: *2050 for agro-forestry*



TEEB for Agriculture & Food

Agro-forestry versus monocrops: *2050 for the monocrop*

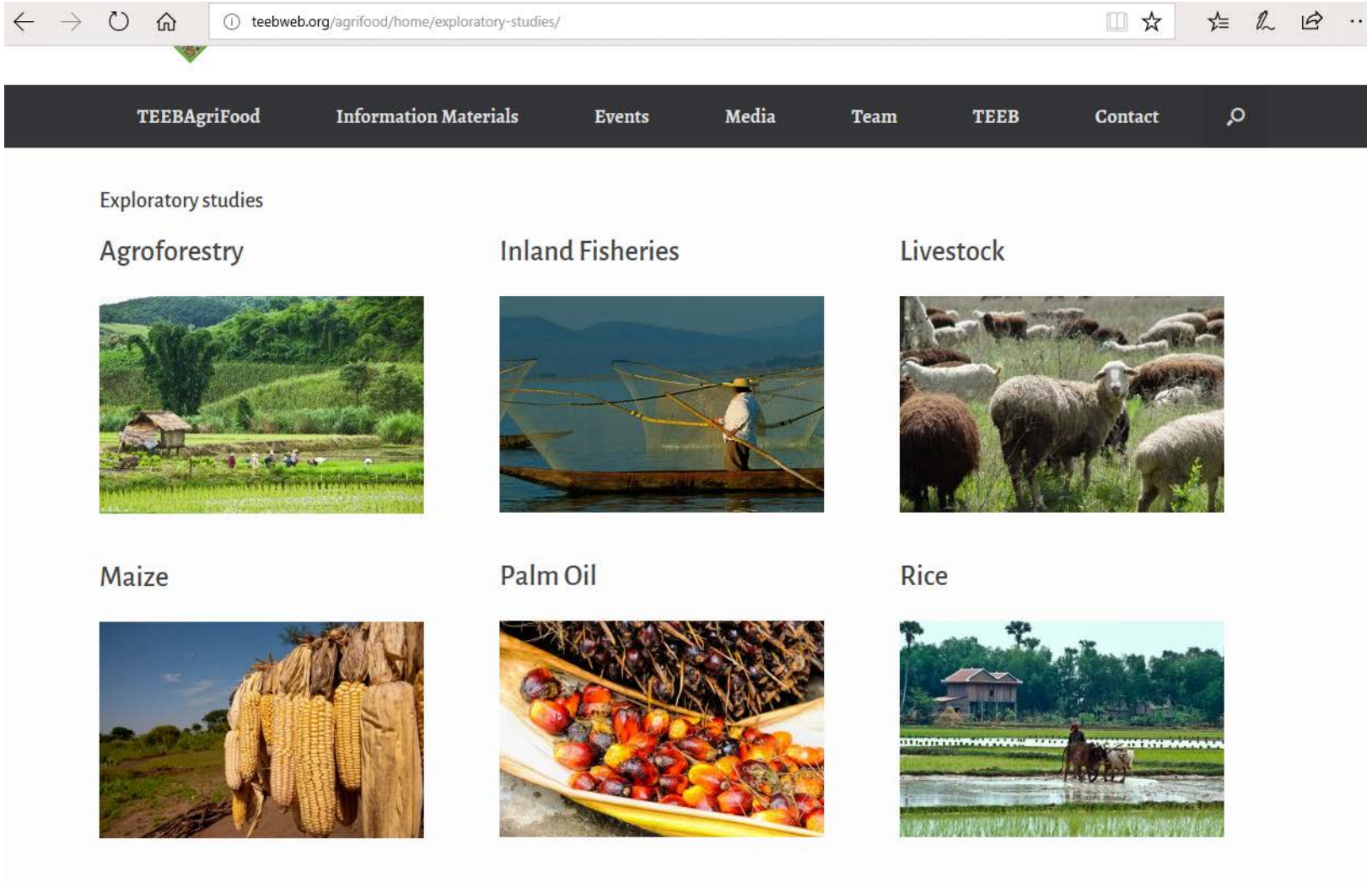


teebweb.org

III TEEBAgriFood and Agro-forestry – work already completed

TEEB for Agriculture & Food

2014-2016 ‘Exploratory studies’



teebweb.org

TEEB for Agriculture & Food

Agro-forestry

- Agroforestry is a practice involving the **deliberate integration of trees or shrubs in farming landscapes** involving crops or livestock in order to obtain benefits from the interactions between trees and/or shrubs the tree and crop or livestock component

TEEB for Agriculture & Food

Agro-forestry case studies

Selection criteria	Cocoa agroforestry Ghana	Coffee agroforestry Ethiopia	Ngitili system Tanzania
Trend of agroforestry system	Increased by about twice the area in the 1990s to about 1.6 million ha (FAOSTAT 2013)	Increased by 100% since the 1990s to about 520,000 ha (FAOSTAT 2013)	Increased from **600 ha in 1986 to >350000 ha in 2003** (Mlenge 2004)
Number of people benefiting from the system	Between 1.9 million (Coulombe & Wondon 2007) to 6 million people (Anthonio and Aikins, 2009) - 700,000 smallholder farmers (Kolavalli & Vigneri 2011)	**7 million to 15 million people** (Petit 2007); 95% of the coffee produced by smallholder farmers About 4.5 million smallholder farmers (Central Statistical Agency 2013)	No data available, but estimated about 1500 households employed in Shinyanga's formal and informal forestry sector, in which ngitili products play a major role
Contribution to national economy	18.9% of the agricultural GDP; 8.2% of the Ghana's GDP and 30% of total export earnings (GAIN, 2012)	**36% of national export income in 2006/07** (Ejigie 2005) *Approximately* 10% of national GDP (Economic Report on Africa 2013)	No data available but estimated to contribute approximately 0.43% of Shinyanga region's GDP

www.teebweb.org/agriculture-and-food/agroforestry

Developing scenarios

- In Ethiopia, the rate of deforestation is estimated at **1-1.5% per year** (Teferi et al. 2013), mostly driven by smallholder coffee expansion (Davis et al. 2012)
- Coffee profitability is very low in smallholder agroforestry systems in Ethiopia, mostly due to **volatility in global market prices**
- Climatic predictions show that areas bioclimatically suitable for coffee production may **reduce by 65%** (Davis et al. 2012)

Developing scenarios

- In Ethiopia, the rate of deforestation is estimated at **1-1.5% per year** (Teferi et al. 2013), mostly driven by smallholder coffee expansion (Davis et al. 2012)
- Coffee profitability is very low in smallholder agroforestry systems in Ethiopia, mostly due to **volatility in global market prices**
- Climatic predictions show that areas bioclimatically suitable for coffee production may **reduce by 65%** (Davis et al. 2012)

Scenarios plausible?

I: Conversion to maize monocrop - drivers include price volatility, climate change, allocation of land to investors for biofuel

II: Conversion existing agroforestry coffee to heavy shade grown coffee – drivers: ongoing Climate Resilience Green Growth Strategy, the national REDD+ program, certification programs and improvements in land tenure conditions.

III: Conversion and further expansion of heavy shade grown coffee – drivers: contingent on success of scenario II

TEEB for Agriculture & Food

Agro-forestry: Scenarios and modelling

- The **WaterWorld model** was also used to model ecosystem services change
  - freshwater provision and runoff
  - increased water quality
  - above ground carbon stock
  - reduction of soil erosion

Agro-forestry valuation methods

Ecosystem Service	Agroforestry System			Valuation Method
	Cocoa	Coffee	Ngitili	
Provisioning				
Cash Crops	***	***	N/A	Market price[16]
Food Crops	***	***	***	Market price
Tree Crop Products	***	***	N/A	Market price
Medicines	*	*	***	Shadow price[17], replacement cost
Wild Food and all other NTFP	*	***	***	Shadow price
Timber and Poles	***	***	***	Market price
Energy (Wood fuel and Charcoal)	*	***	***	Market price, shadow price, replacement cost
Regulating and Supporting				
Soil and biomass C stocks	***	***	***	Market price, avoided cost
Erosion control	ND	***	ND	Contingent valuation, replacement cost
Soil fertility (Soil N also P and K where available)	**[18]	**	***	Replacement cost
Biological Pest Control	**	**	ND	Insufficient data for benefit transfer
Pollination	**	**	N/A	Insufficient data for benefit transfer
Biodiversity	**	**	**	Insufficient data for monetary valuation
Avian Diversity	**	**	**	Insufficient data for monetary valuation
Vegetative Diversity	**	**	**	Insufficient data for monetary valuation
Other mammalian diversity	**	ND	ND	Insufficient data for monetary valuation

*** Sufficient data for biophysical quantification and monetary valuation;
** Quantitative biophysical data available, but insufficient data for monetary valuation;
* Qualitative information available; ND No relevant data available; N/A No applicable

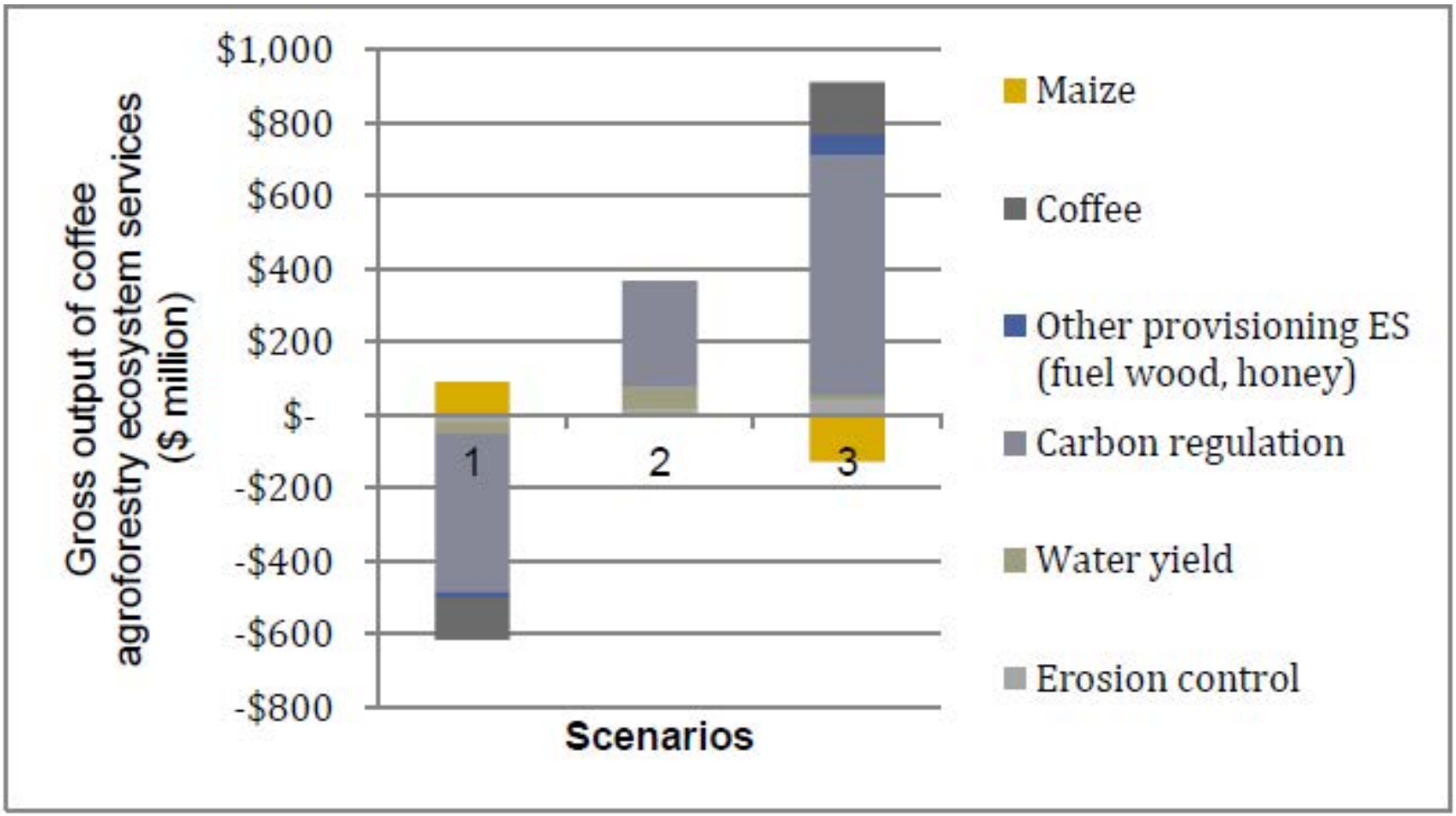
TEEB for Agriculture & Food

Agro-forestry Scenario analysis

Ecosystem service	Scenario 1: Converting to Maize monoculture (million $/y)	Scenario 2: Canopy cover ≥ 30% [due to REDD+ or certification incentive] (million $/y)	Scenario 3: Canopy cover ≥ 30% & expansion of agroforestry to all areas bar: (I) urban; (II) priority land use such as forests; and (III) wildlife reserves (million $/y)
Increase in system extent (ha)	-202,342	0	+286,852
Provisioning	**-38.4**	**No change**	**73.4**
Coffee	-115.9	No change	+143.9
Maize	+90.5	No change	-128.3
Other ES (fuel wood, honey)	**-13.0**	**No change**	**+57.9**
Carbon regulation	**-435**	**+292**	**+655**
Other regulating	**-19**	**+74.5**	**+54.3**
Water yield	-34.9	+58.6	+10.7
Soil erosion	+15.9	+15.9	+43.6

TEEB for Agriculture & Food

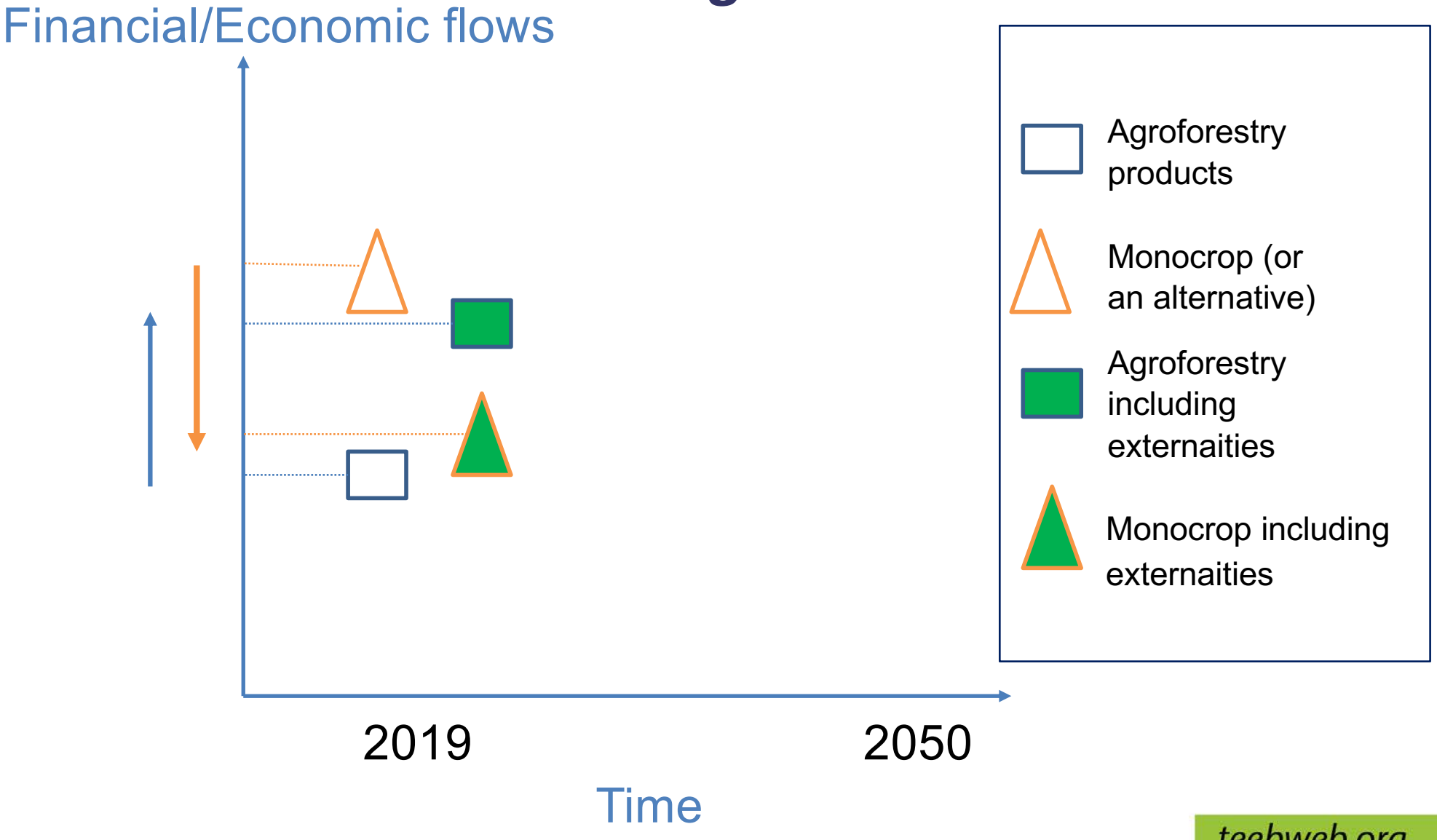
Agro-forestry Scenario analysis



www.teebweb.org/agriculture-and-food/agroforestry

TEEB for Agriculture & Food

Agro-forestry versus maize in Ethiopia: *2019 including externalities*



TEEB for Agriculture & Food

Agro-forestry versus maize in Ethiopia: a partial analysis

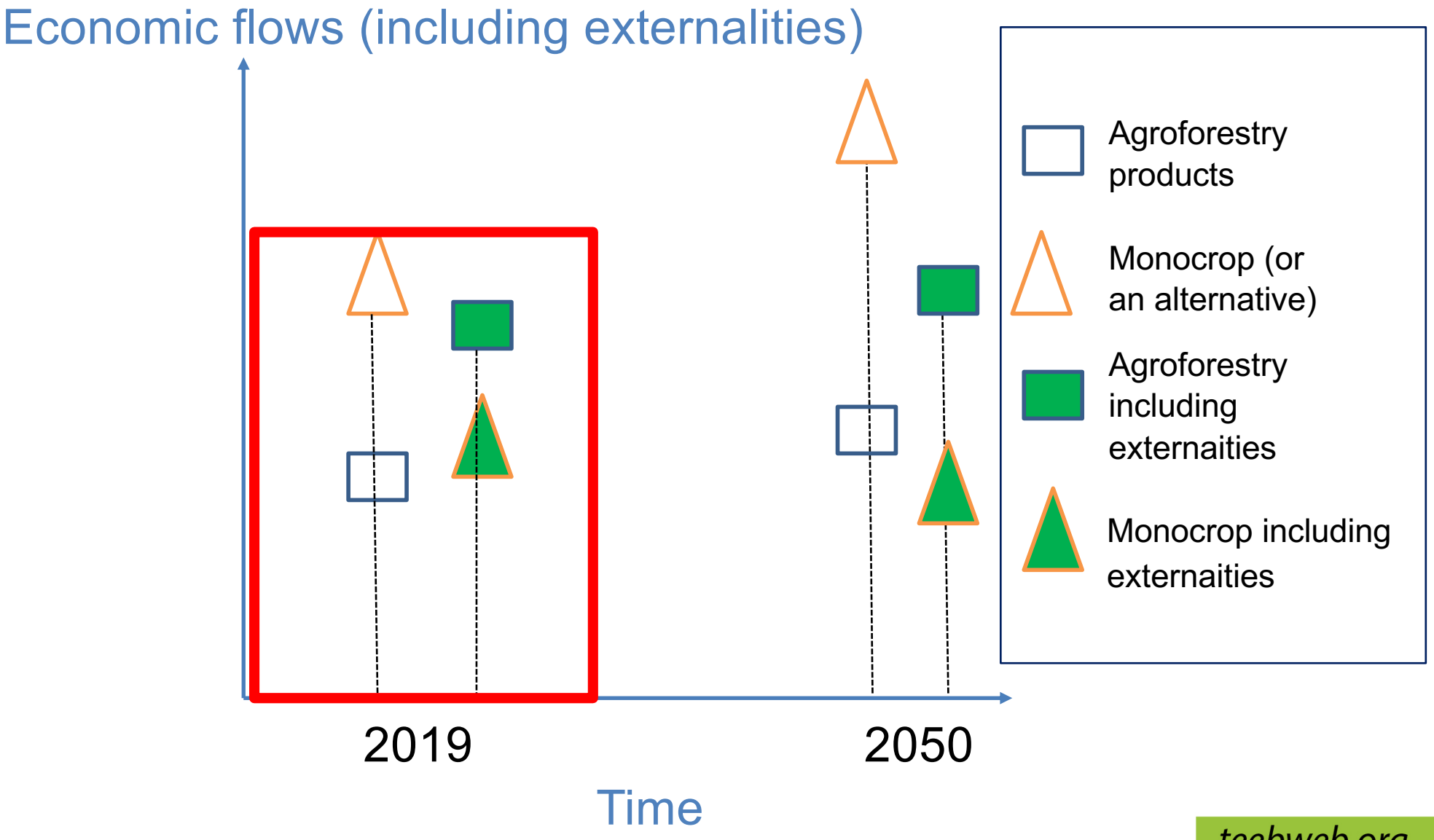
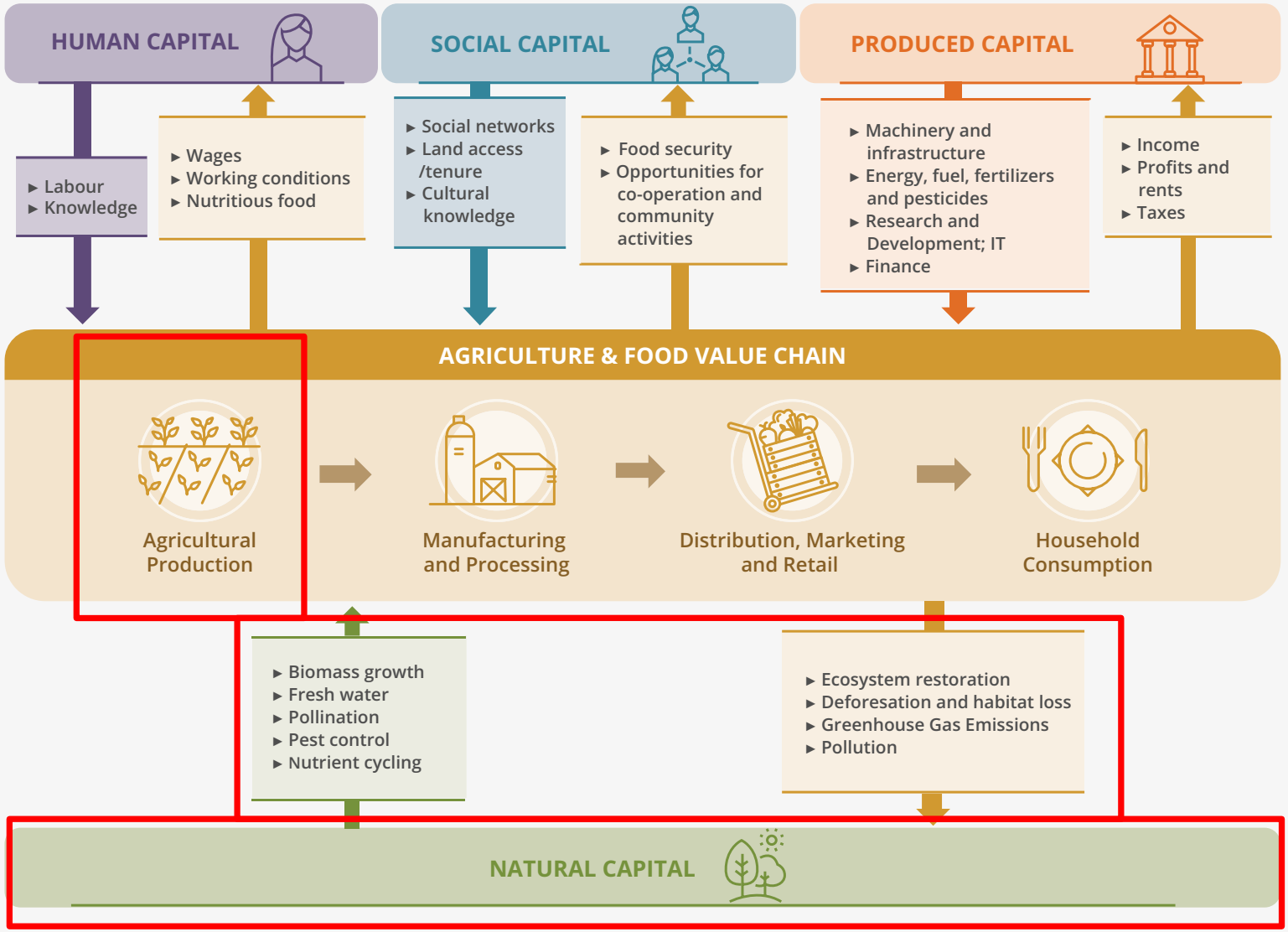


Figure 2.1 Capital stocks and value flows in eco-agri-food systems (Source: Hussain and Vause 2018)



Selecting and combining evaluation methods

- **Agronomic or soil models** (e.g. CROPWAT) - *What areas are most suitable for what crops? How do land use practices depend upon or impact soil?*
- **Hydrologic models** (e.g. SWAT) – Models of seasonal water budgets under different land use scenarios

Selecting and combining evaluation methods

- **Agronomic or soil models**
- **Hydrologic models**
- **Ecosystem services models** (e.g. InVEST) – Programs to model other services such as carbon sequestration, water pollution (siltation and nutrient loading), or habitat, or biodiversity
- **Ecosystem services valuation –** *Revealed preference, stated preference etc.*

Selecting and combining evaluation methods

- **Agronomic or soil models**
- **Hydrologic models**
- **Ecosystem services models**
- **Ecosystem services valuation**
- **Economic impact modelling or livelihoods analysis** (input/output, CGE, SLF)
- **Social and Human Capital impacts** (e.g. Network Analysis, health, education) –
  - Agriculture and environment research teams are traditionally biophysical scientists.
  - *Have the researchers conducted human or social capital analysis? How can we pair this with the biophysical analysis?*

IV Linking TEEBAgriFood to Malaysian policy

TEEB for Agriculture & Food

Biodiversity

- Malaysia is recognized as one of the **twelve mega diverse countries** in the world
  - over 170,000 species of flora and fauna,
  - Accounts for 16% of the worlds classified species (1)
- **IUCN Red List** (2) of threatened species - many of these iconic biological resources are increasingly under threat
  - 686 plants and 225 animals in Malaysia are at risk of extinction
  - 256 are at least critically endangered
  - Malaysia third in the list of countries with the largest number of threatened species

1. Norowi, M. (2012). National strategies and action plans on agricultural biodiversity conservation and sustainable utilisation. Malaysian Agricultural Research and Development Institute, Retrieved from: http://www.fao.org/3/a-bc259e.pdf
2. http://www.iucnredlist.org

Conserving natural heritage and biodiversity

- Part of **Vision 2030** (1)
  - Vision 2030's objective will be geared toward a new economic model which advocates **shared prosperity**
  - 11th Malaysia Plan (2016-2020) and the 12th (2021-2025) both emphasize **green growth** that is resource-efficient, clean, and resilient.
  - The green growth strategy aims to significantly reduce greenhouse gas emissions; **improve conservation of terrestrial and inland water**, as well as coastal and marine areas including its ecosystems; **intensified the conservation of natural resources**, **including biodiversity** and promote **sustainable consumption and production practices** (2).

1. Prime minister office. (2019, July 11). Malaysia a True Entrepreneurial Nation by 2030. https://www.pmo.gov.my/2019/07/malaysia-a-true-entrepreneurial-nation-by-2030/.
2. GOVERNMENT OF MALAYSIA. (2015). Eleventh Malaysia Plan 2016-2020. Anchoring Growth on People. https://www.talentcorp.com.my/clients/TalentCorp_2016_7A6571AE-D9D0-4175-B35D-99EC514F2D24/contentms/img/publication/RMKe-11%20Book.pdf.

Conserving natural heritage and biodiversity

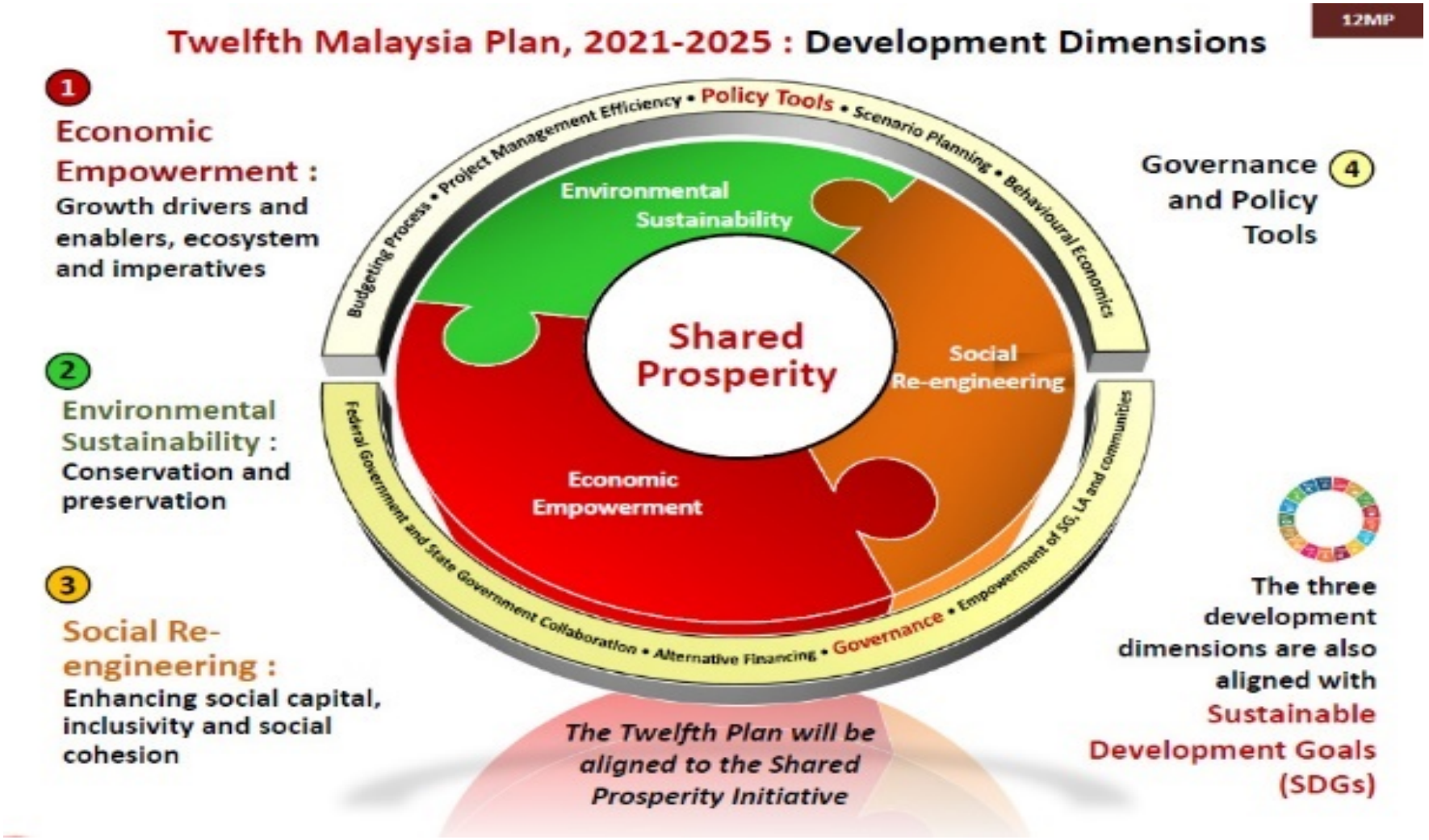
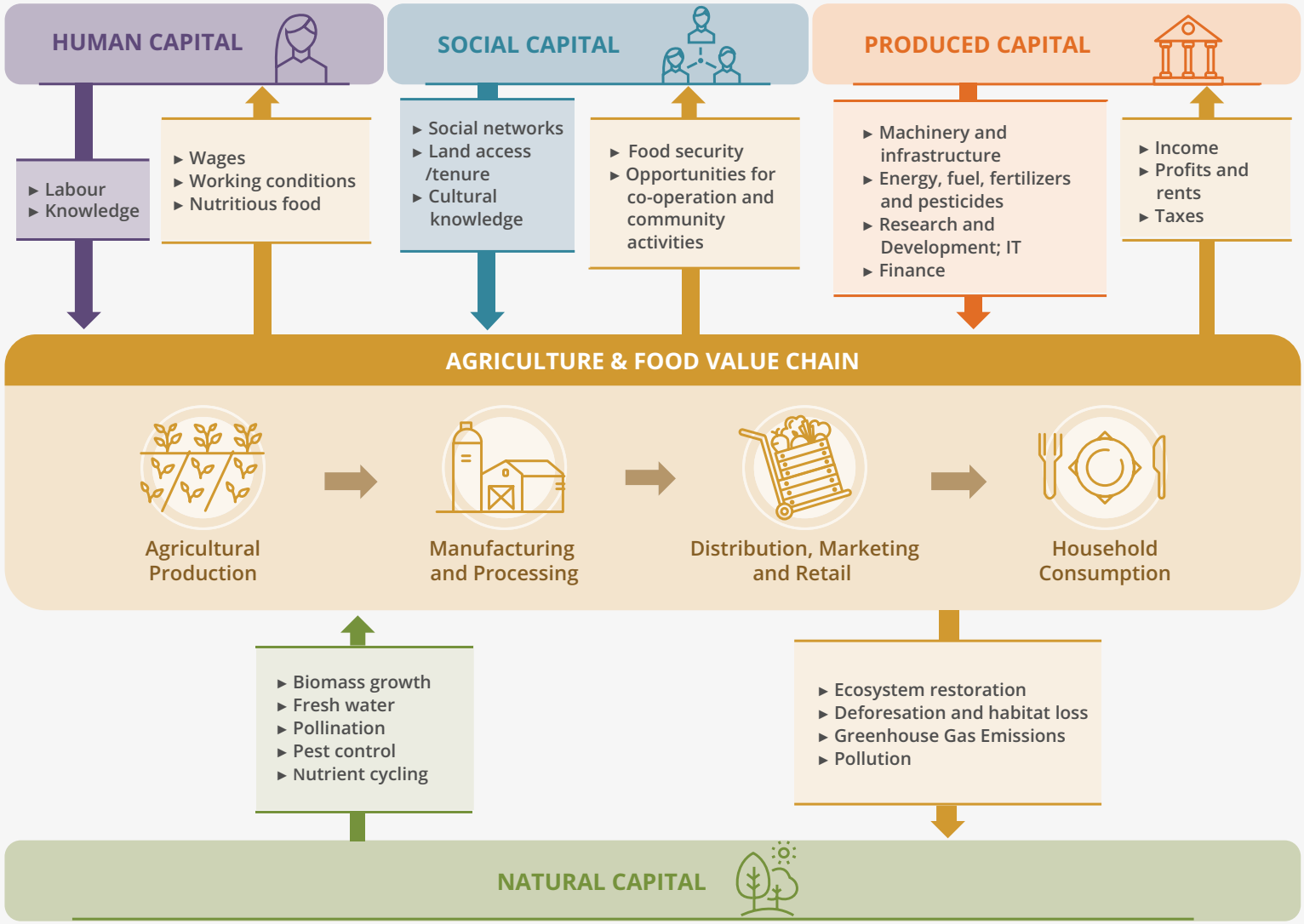


Figure 2.1 Capital stocks and value flows in eco-agri-food systems (Source: Hussain and Vause 2018)



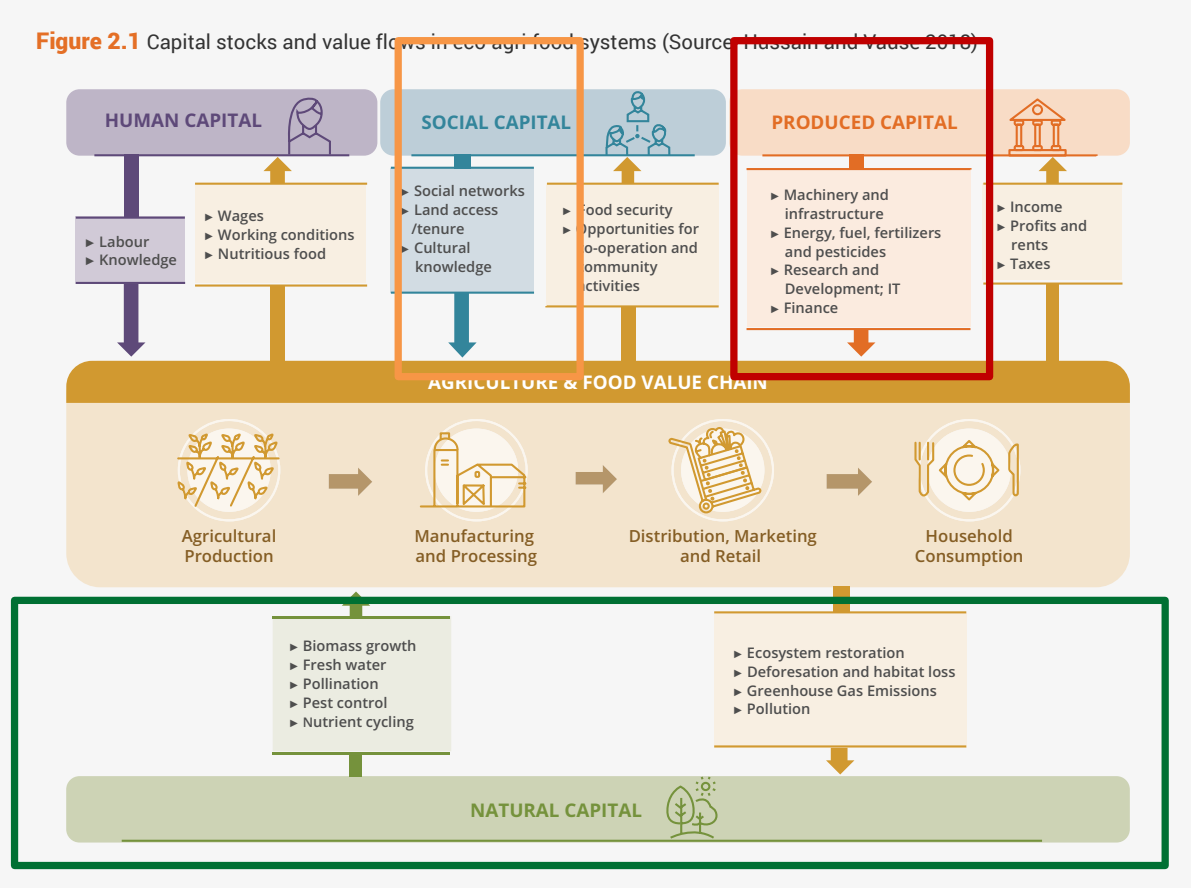


Figure 2.1 Capital stocks and value flows in eco agri food systems (Source: Hussain and Vause 2018)

1. Economic empowerment
Growth drivers and enablers, ecosystems and imperatives

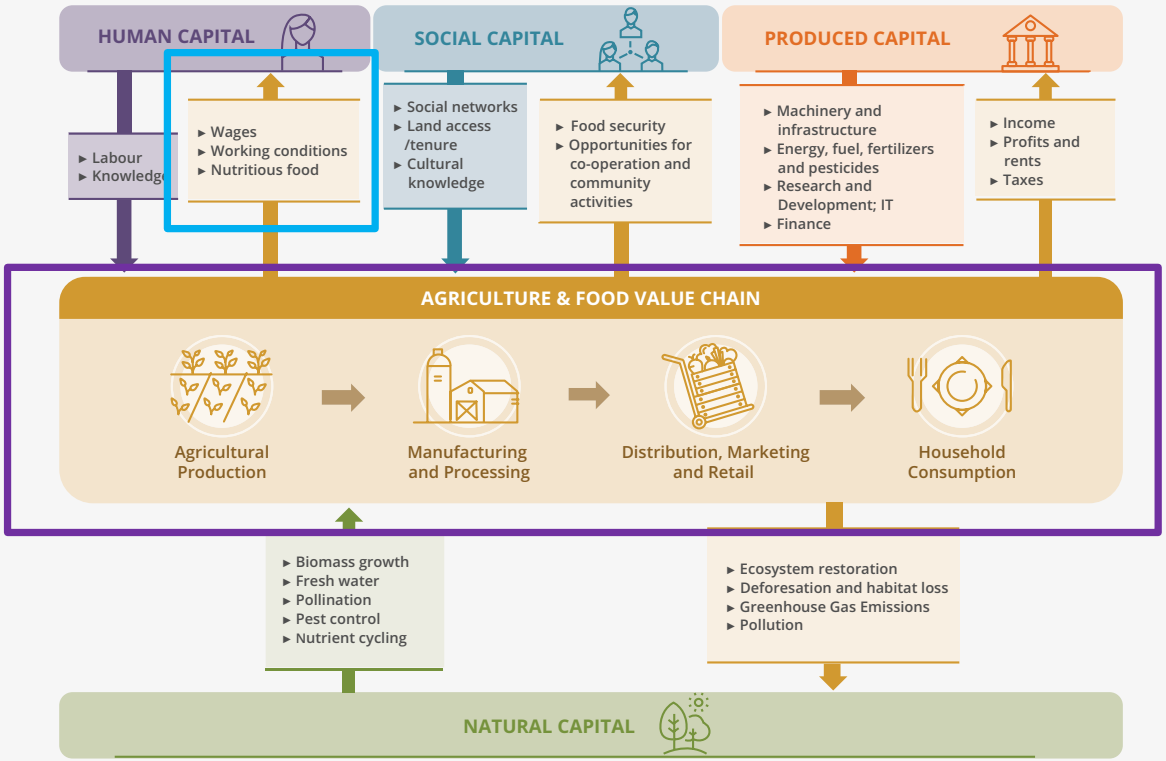
2. Environmental Sustainability –
conservation and preservation

3. Social re-engineering –
enhacing social capital, inclusivity, and social cohesion

Coherent (linked) policies

1. The **National Agro-food Policy** (2011-2020), has as key policy objective to “tackle the issue of sustainable agriculture and the competitiveness of the agro-food industry with food safety and nutrition aspects along its value chain”

Figure 2.1 Capital stocks and value flows in eco-agri-food systems (Source: Hussain and Vause 2018)



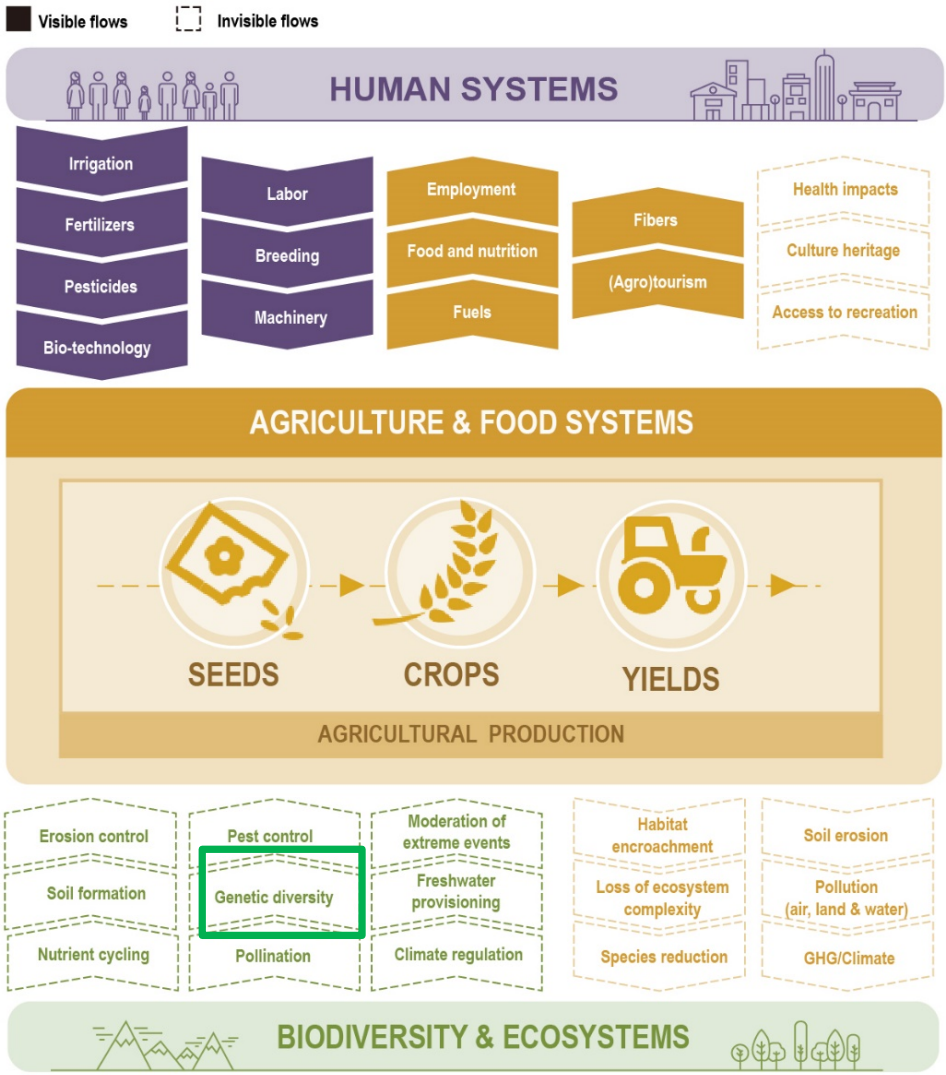
The National Agro-food Policy (2011-2020), has as key policy objective to "tackle the issue of **sustainable agriculture** and the competitiveness of the agro-food industry with **food safety and nutrition** aspects along its **value chain**"

Coherent (linked) policies

2. The **National Strategies and Action Plans on Agricultural Biodiversity Conservation and Sustainable Utilization**

- Mainstreaming the Convention on Biological Diversity (**CBD**) objectives into the development of the agriculture sector in Malaysia.
- The Government of Malaysia recognizes the huge potential biodiversity holds as a **reservoir of future food**,
- **natural gene bank** harboring the key ingredients for developing new varieties for better yield and also to meet the potential impacts of climate change (1)

1. MOA. 2012. National Strategies and Action Plans on Agricultural Biodiversity Conservation and Sustainable Utilization. Ministry of Agriculture and Agro-based Industry. Retrieved from http://www.fao.org/3/a-bc259e.pdf



1. **CBD**
2. huge potential biodiversity holds as a reservoir of future food, **natural gene bank** harboring the key ingredients for developing new varieties for better yield and also to meet the **potential impacts of climate change**

Coherent (linked) policies

3. The **National Policy on Biological Diversity (NPBD) 2016-2025**

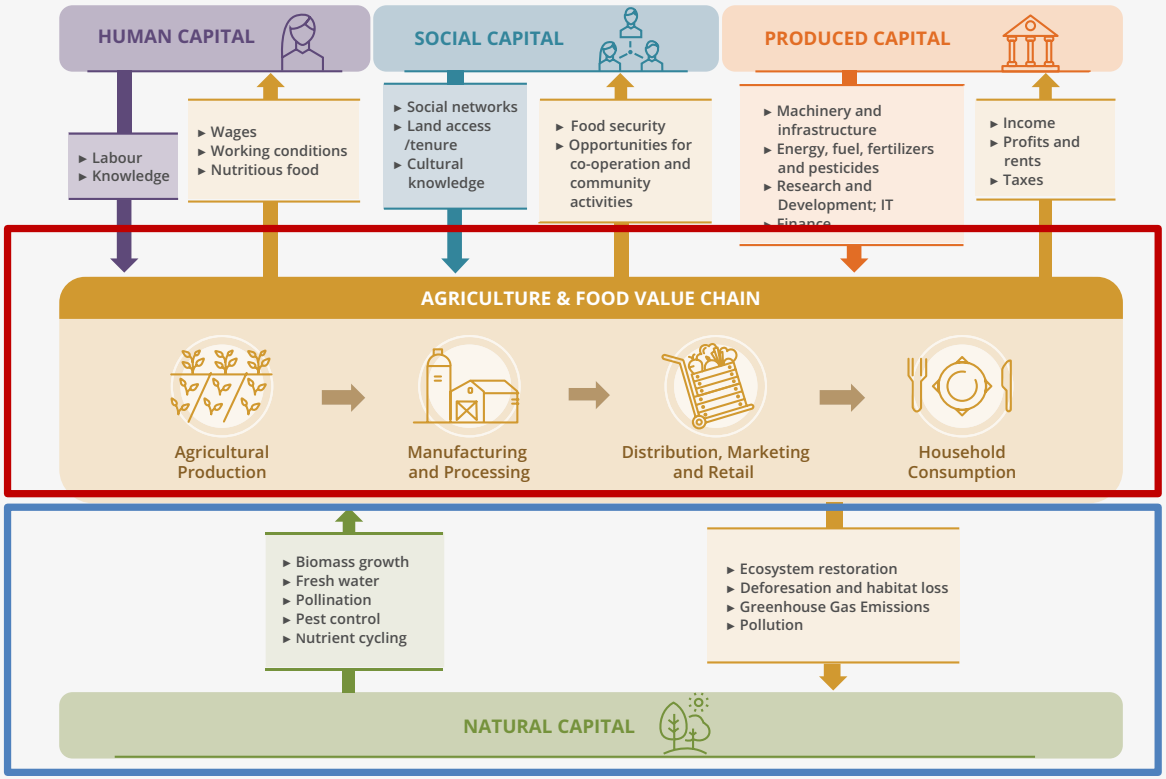
- NPBD provides a general and overarching strategies and action plans with the vision of transforming Malaysia into a world centre of excellence in conservation, research and utilization of tropical biological diversity by 2020.
- current NPBD 2016-2025 specifies **5 national goals and 17 national biodiversity targets** to be implemented by all segments of stakeholder and society

Coherent (linked) policies

3. The **National Policy on Biological Diversity (NPBD) 2016-2025**

- Target 1: By 2025 more Malaysians are aware of the **values of biodiversity** and the steps they can take to conserve and use it sustainably.
- Target 2: By 2025, the contributions of **indigenous peoples and local communities, civil society and the private sector** to the conservation and sustainable utilisation of biodiversity have increased significantly.
- Target 3: By 2025, biodiversity conservation has been **mainstreamed** into national development planning and sectoral policies and plans.
- Target 4: By 2025, our production forests, **agriculture production and fisheries** are managed and harvested sustainably.

Figure 2.1 Capital stocks and value flows in eco-agri-food systems (Source: Hussain and Vause 2018)



National Policy on Biological Diversity (NPBD) 2016-2025

Targets 1-3

Target 4

TEEB: The Economics of Ecosystems & Biodiversity

V TEEBAgriFood in Malaysia – process and next steps

teebweb.org

UNEP-TEEB experience in applications

1. Global Alliance funding (July 2019)
   - Haripriya Gundimeda (Wheat value chain **North India**)
   - Peter May (Cattle and Soy in **Amazon**)
2. TEEBAgriFood DEVCO Africa (April 2019)
   - Livestock (**Tanzania**), cocoa (**Ghana**), coffee (**Ethiopia**), rice (**Senegal**)
3. IKI studies (December 2019)
   - **Colombia:** Putumayo Department - includes Amazon lowlands, highland forests, Colombian plateau and several important water basins
   - **Kenya,** options are two upper Basin areas (Tana Basin and Ewaso Njiro Basin), the Mau catchment area/ Mara River Basin and the drainage basin from Mt Suswa to Lake Magadi
   - **Thailand** – organic production for rice
   - **Tanzania** - Southern Highlands

TEEB for Agriculture & Food

The current project

Year		Year 1				Year 2				Year 3				Year 4			
	Work Packages and activities	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
WP 1	Country specific analysis – lessons learned from previous interventions																
WP 2	Policy mapping																
WP 3	Determine and refine the case studies																
WP 4	Engaging agri-business with NCP																
WP 5	Scenario Analysis																
WP 6	Develop a roadmap of concrete steps to implement a change																
WP 7	Deliver the change and ensure project sustainability																
WP 8	Communicating biodiversity benefits and mainstreaming																

The Role of the Lead Ministry

- The project would be implemented by the TEEB Office
  - Staff and consultants in Geneva, Nairobi, Bangkok and Brazilia
  - Seven country pilots: Brazil, China, India, Indonesia, Malaysia, Mexico, Thailand

- The roles of the lead line Ministry is:
  - To invite agencies/individuals to the **Inception Workshop**
  - To chair and then to convene a series of Steering Committees (around one per year)
  - To provide a policy steer, to ensure that the policy question being assessed is relevant

TEEB: The Economics of Ecosystems & Biodiversity

Dr. Salman Hussain

salman.hussain@unep.org

UNEP TEEB Office

teebweb.org