The Economics of Ecosystems and Biodiversity: Promoting biodiversity and sustainability in the agriculture and food sector through economic valuation

Presented at TEEBAgriFood Regional Symposium

24-26 March 2021

Outline

1. Meet The Team
2. Background
3. Objectives
4. Methodology
5. Preliminary Analysis (a Snapshot)

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2. Background

The Map of Cocoa Production in Indonesia

Symbol	Range	Label
	0	None
	1 - 82	Low
	83 - 716	Middle
	717 - 36814	High
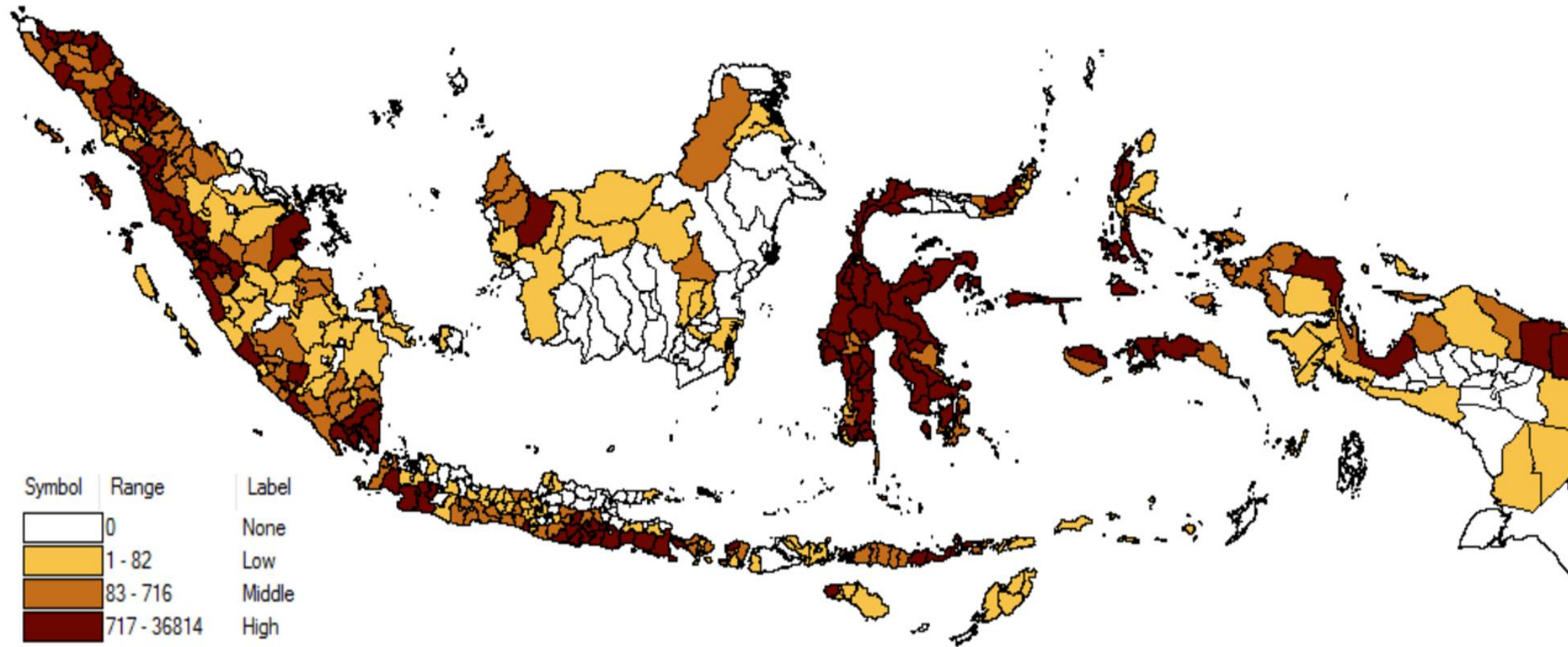
Center of Cocoa production in Indonesia are dominated by districts / cities in the Sulawesi Island.

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Productivity
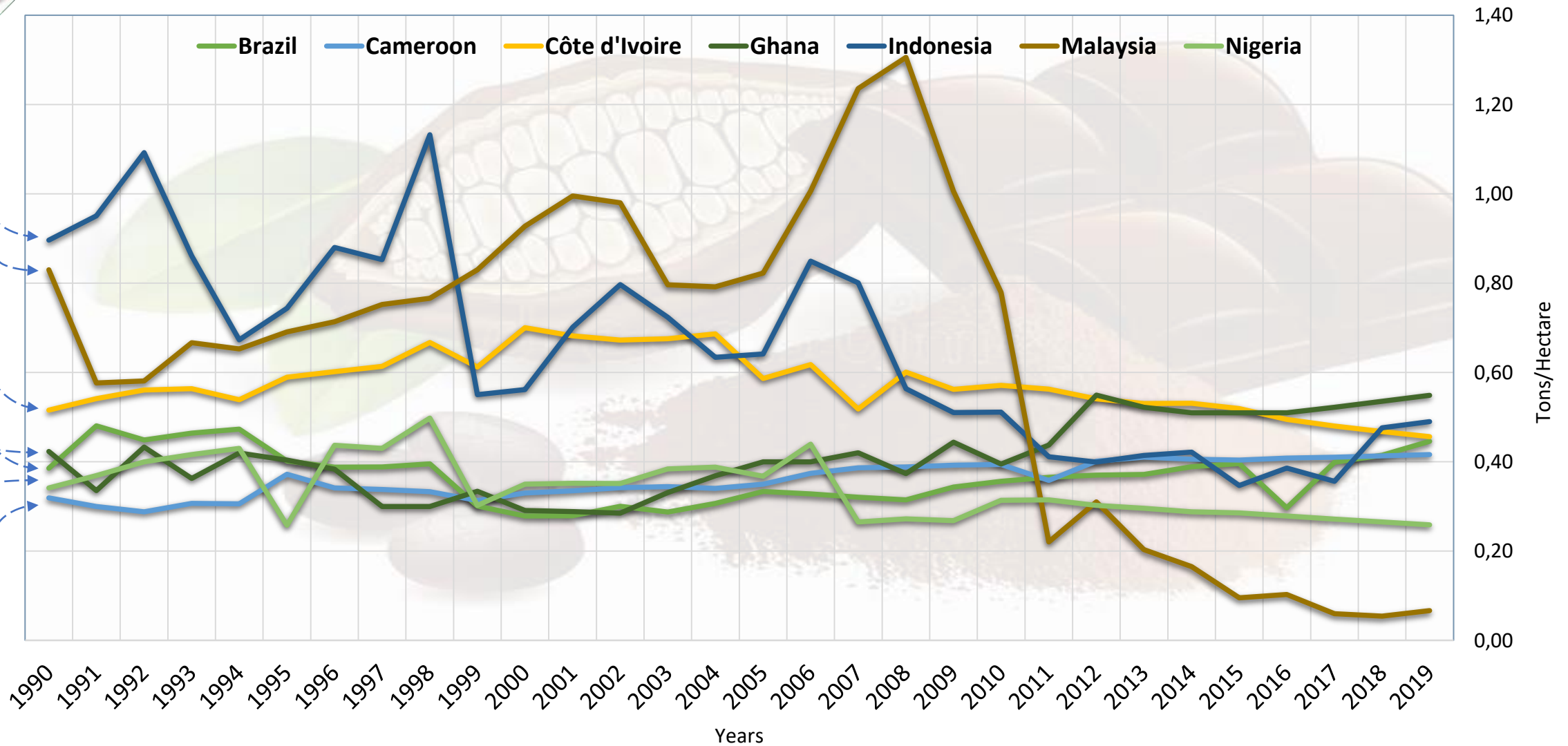
Indonesia's Export Products

Indonesia's Export Products:
Cocoa beans, whole/broken, raw/roasted

Year	Value (Millions USD)
2010	1190,74
2011	614,50
2012	384,83
2013	446,09
2014	196,49
2015	114,98
2016	83,97
2017	53,54
2018	72,44

Legend: Value (Millions USD) — Quantity(1000 Tons)
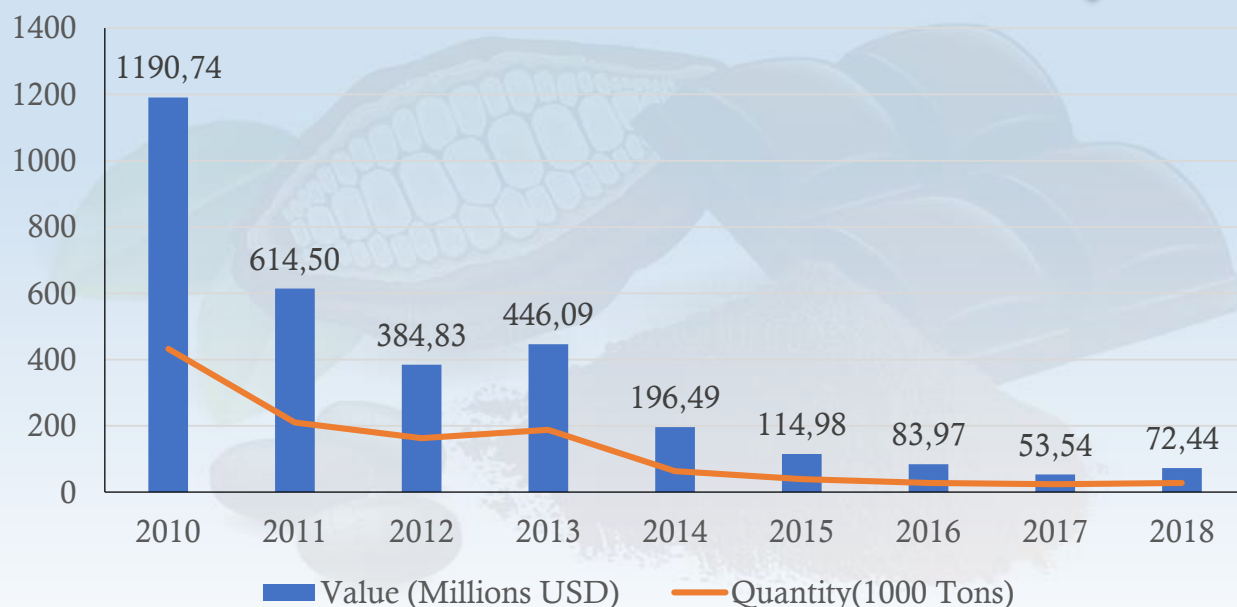
Indonesia's Export Products:
Cocoa shells, husks, skins and other

Year	Value (Millions USD)
2010	0,73
2011	2,59
2012	3,51
2013	3,78
2014	4,23
2015	3,30
2016	2,36
2017	2,71
2018	1,86

Legend: Value (Millions USD) — Quantity(1000 Tons)

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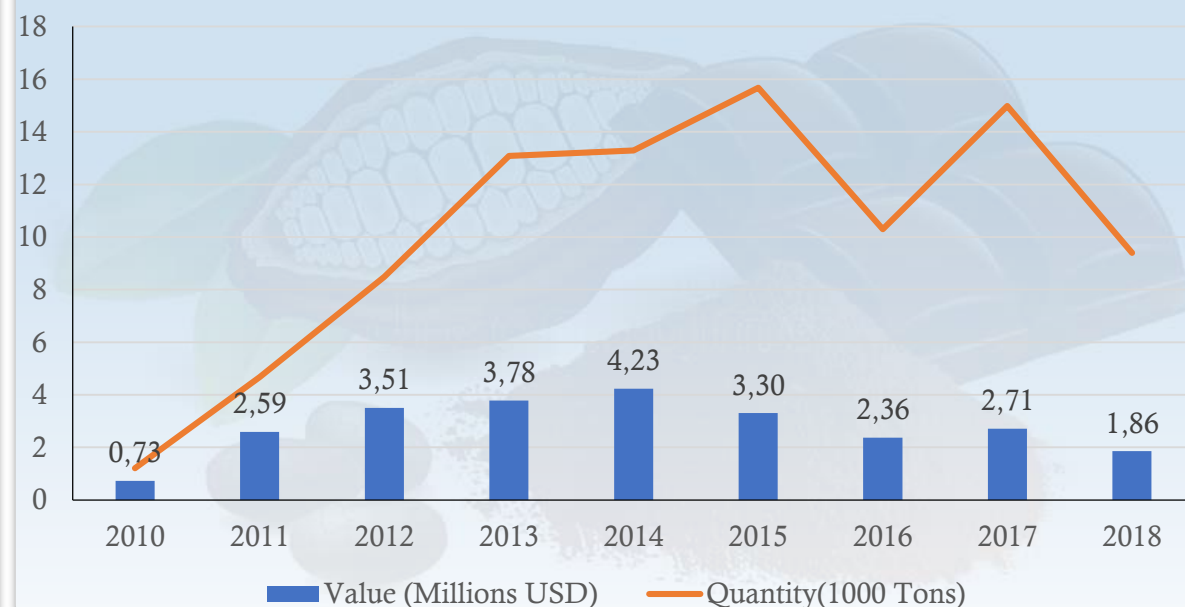
Indonesia's Export Products .. (2)

HS 1803

HS 1804

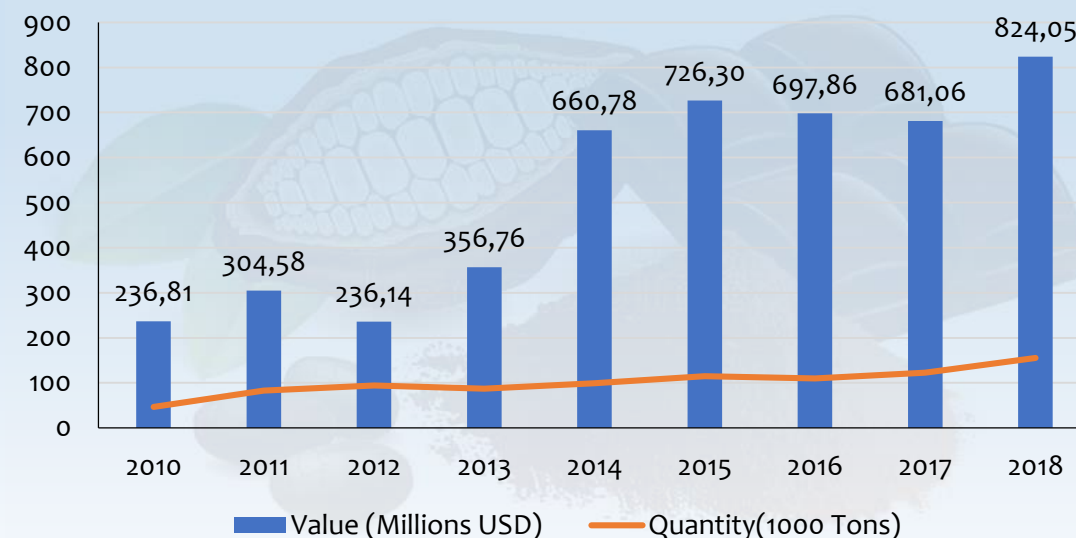Indonesia's Export Products:
Cocoa paste, whether or not defatted
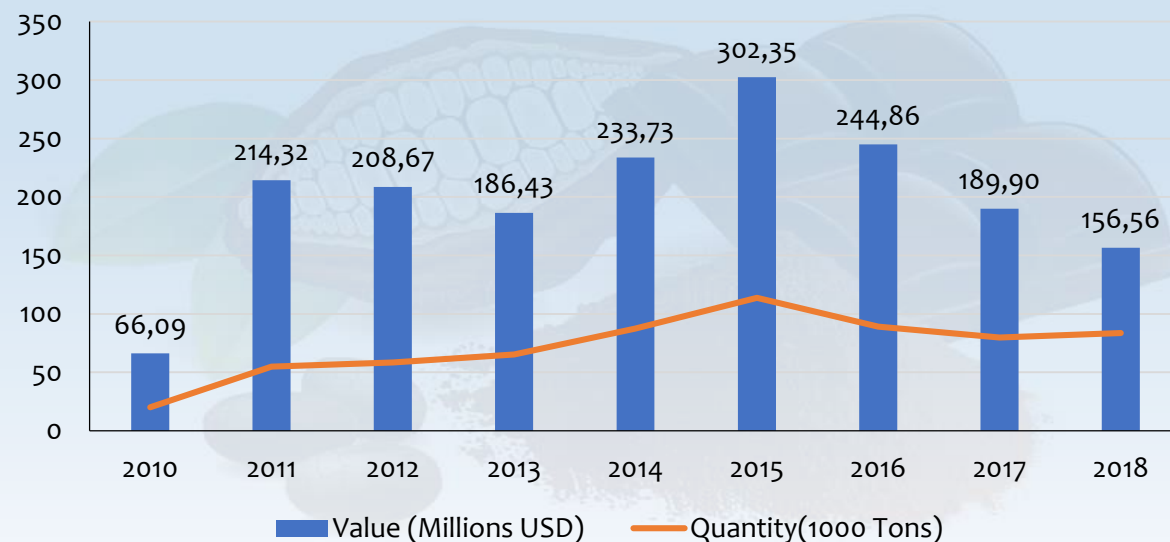
Indonesia's Export Products:
Cocoa butter, fat and oil

Cocoa paste chart (HS 1803):

Year	Value (Millions USD)
2010	66,09
2011	214,32
2012	208,67
2013	186,43
2014	233,73
2015	302,35
2016	244,86
2017	189,90
2018	156,56

Legend: ■ Value (Millions USD) — Quantity (1000 Tons)

Cocoa butter chart (HS 1804):

Year	Value (Millions USD)
2010	236,81
2011	304,58
2012	236,14
2013	356,76
2014	660,78
2015	726,30
2016	697,86
2017	681,06
2018	824,05

Legend: ■ Value (Millions USD) — Quantity (1000 Tons)

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Indonesia's Export Products .. (3)

HS 1805

Indonesia's Export Products:
Cocoa powder, not containing added

Values (Millions USD):
- 2010: 103,18
- 2011: 158,00
- 2012: 165,18
- 2013: 110,44
- 2014: 104,24
- 2015: 124,28
- 2016: 163,91
- 2017: 152,18
- 2018: 146,10

Legend: Value (Millions USD) — Quantity(1000 Tons)
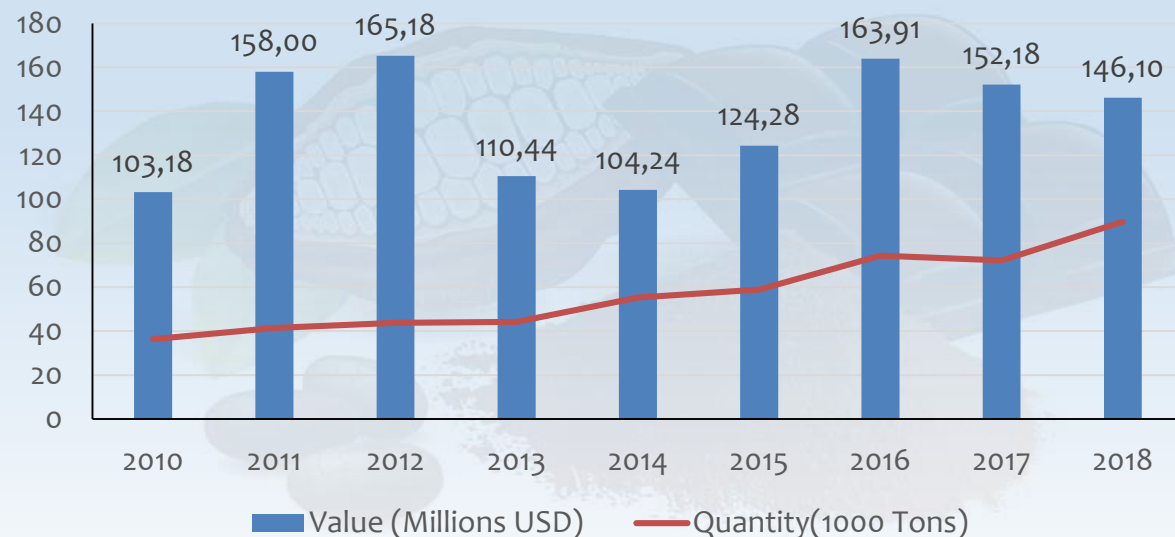
HS 1806

Indonesia's Export Products:
Chocolate and other food preparation

Values (Millions USD):
- 2010: 46,10
- 2011: 51,29
- 2012: 55,13
- 2013: 47,96
- 2014: 45,05
- 2015: 36,56
- 2016: 46,66
- 2017: 41,37
- 2018: 44,51

Legend: Value (Millions USD) — Quantity(1000 Tons)

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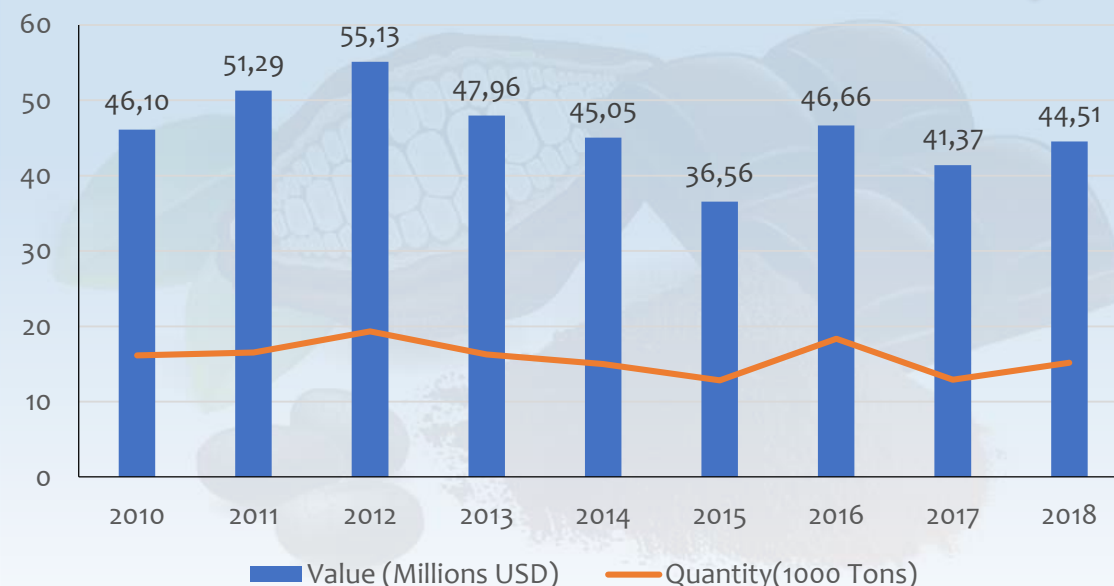
Multiplier Effect and Linkages of Cocoa in Indonesia

Multiplier Effect

Output Multiplier 1,27

Labor Unit Multiplier 0,41

Income Multiplier 0,82

Forward Linkages
Direct 0.50
Indirect 1.42
Total 1.92

Backward Linkages
Direct 0.67
Indirect 1.37
Total 2.04
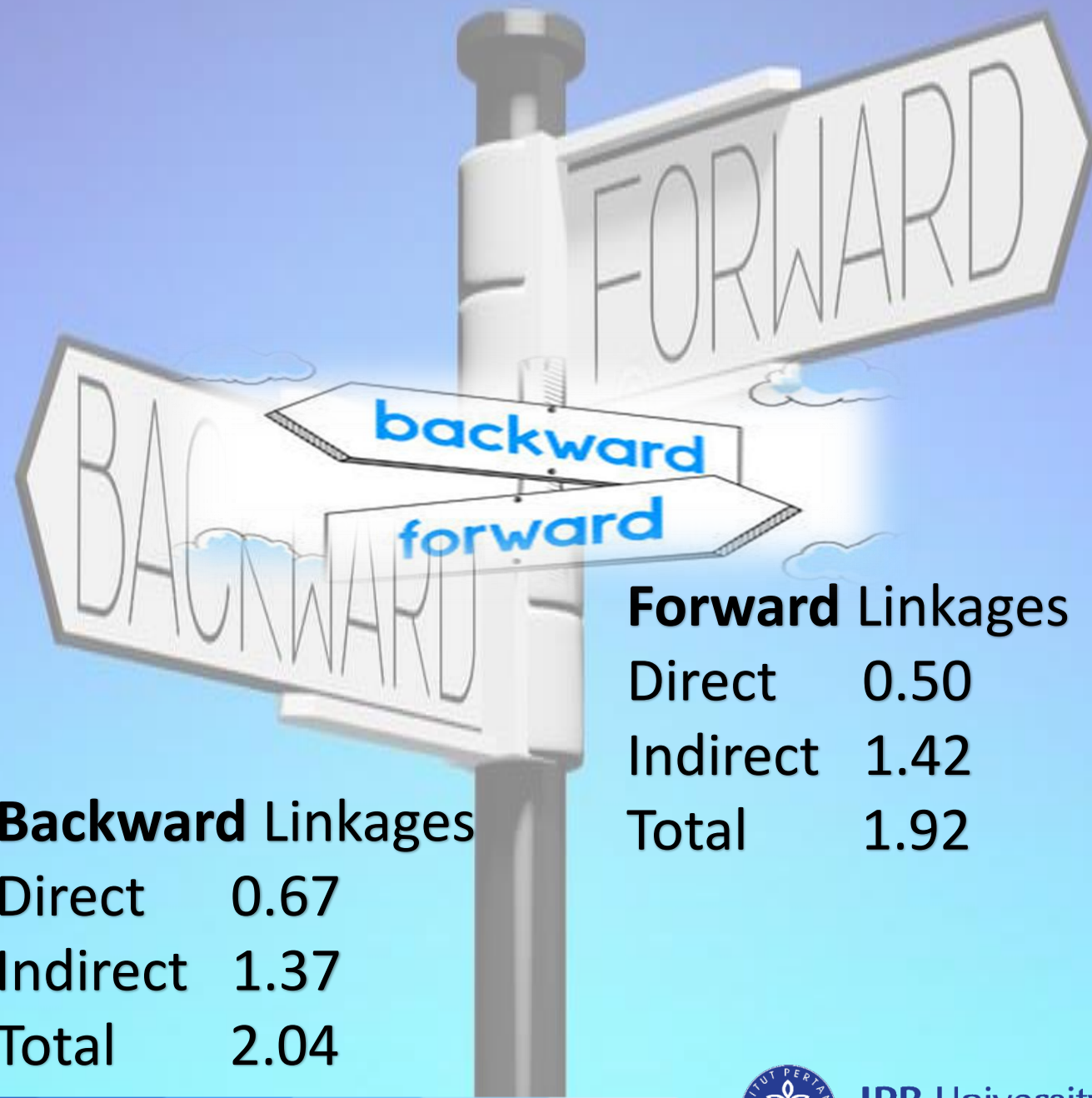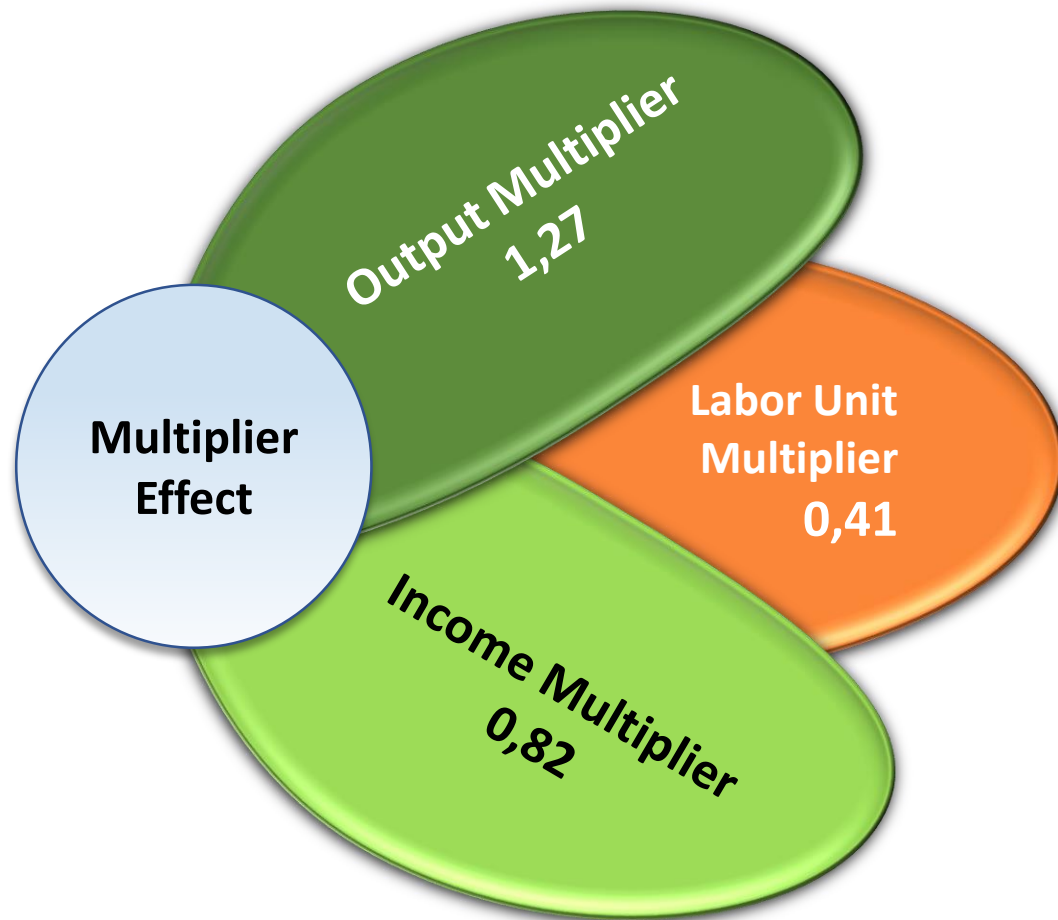
Source: Input and Output Analysis (Author's Estimation)

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3. Objectives

Study Objectives

Subject to further discussions, the objective of a full TEEBAgriFood analysis is to provide evidence to:

1) Inform policy, institutional and governance solutions that take a food systems approach as enshrined in Indonesian law (art. 13 law 22/2019), promoting coherence across policy domains (agri, health, trade, food policies);
2) Support spatial planning of agricultural production to maximize ecosystem services;
3) Evaluate the economic case for agroforestry production to reduce pressure to convert forest to agriculture and support increased tree cover in degraded areas;
4) Inform cacao value chain policy intervention scenarios, including policies to facilitate cacao agroforestry systems. This may include the identification of i) good agricultural practices to improve rural livelihoods, while reducing the risk of environmental impacts, including deforestation, ii) the potential for implementation of value-added processes on farm, such as pre-processing, ecolabeling and certification;
5) Increase the capacity of BAPPENAS staff to lead analysis for evidence-based agriculture and food system policies.

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Policy Question and Research Question

Farm level management practice comparison

Policy question: *What policies can make cocoa agroforestry economically viable and desirable (relative to other commodities)? What policies will encourage positive farm level practices that can support value addition in the cocoa value chain, improve livelihoods, and protect biodiversity and ecosystem services?*

Research questions: *How can farm-level practices increase long-run incomes? What are the ecosystem service impacts of increasing productivity per hectare? What are biodiversity impacts? Can they be applied to degraded areas?*

Landscape assessment and land-use planning

Policy question: *How can managed expansion of cocoa agroforestry landscapes increase cocoa yield AND maximize outcomes for natural, human, and social capital? Where should cocoa expand and intensify?*

Research questions: *Where is cocoa production most likely to expand or contract under business-as-usual policies? What are expected impacts on land-use dynamics and provision of ecosystem services from expanding cacao production? What would be the impacts on natural, human and social capital if cacao expansion was managed, planned, or regulated?*

Value Chain Assessment

Policy question: *What policies influence farm level practices and processing that can support value addition in the cocoa value chain that support economy, biodiversity and support livelihoods?*

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4. Methodolgy

Methodological framework of Land Use Land Cover Change Modelling and Future Scenarios (2050)
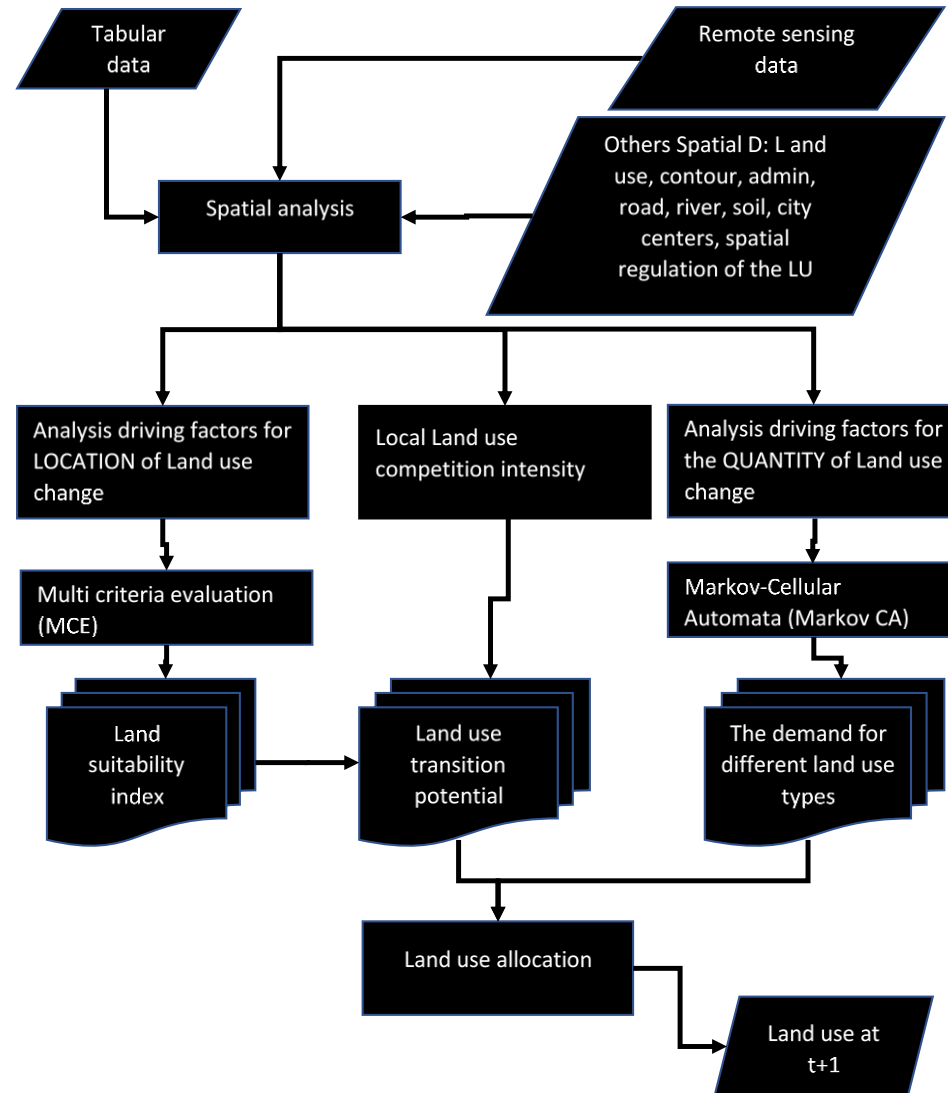

Figure 1. General structure of the local land use competition cellular automata (LLUCA, after Yang et al. 2016)
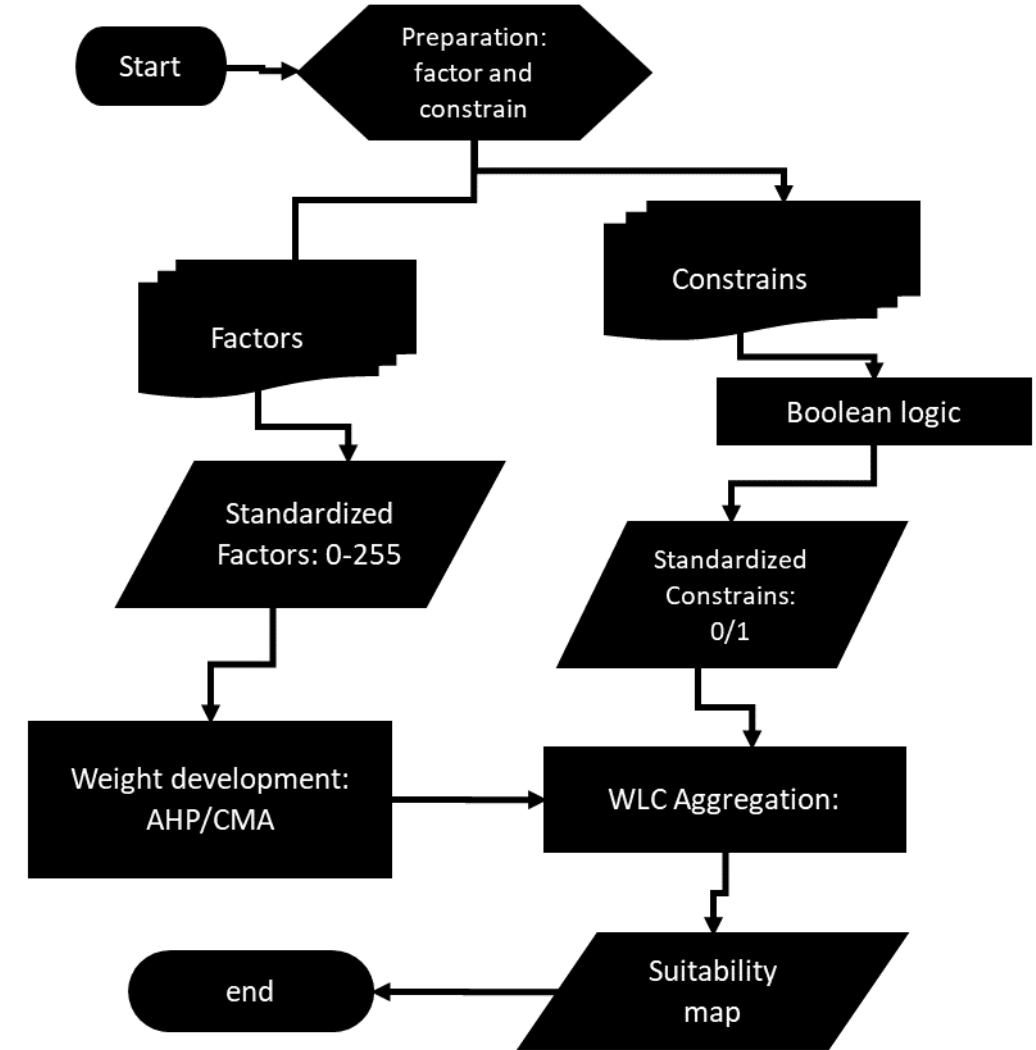
Figure 2. Steps for developing a suitability map

Methodological framework of Land Use Land Cover Change Modelling and Future Scenarios (2050)
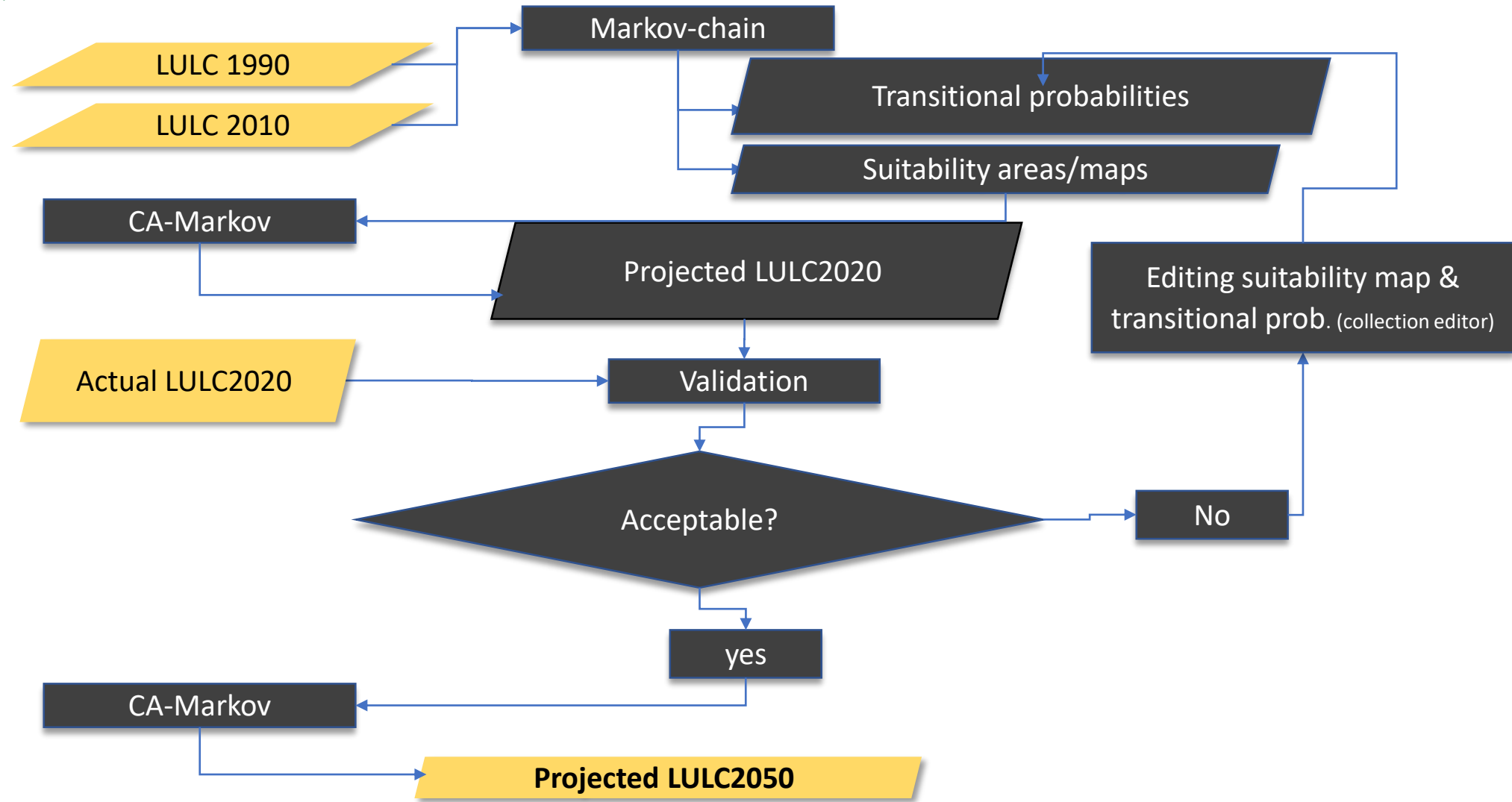
Figure 3. Flow-chart of Markov-CA Modelling for predicting LULC in 2050

Data Requirements for Land Use Land Cover Change Modelling and Future Scenarios (2050)

1. Multidate satellite data (1990, 2000, 2010, 2020)
2. Land use and Landcover (1990, 2000,2010, 2020)
3. Vector format files: e.g., stream, topographic layer, river networks, administrative layer, catchment boundaries. The list of Data required are listed in Table.

No	Name of data	Type of data	Source
1	Data SPOT 1990, 2010,2020	Raster (digital)	LAPAN/Vendor
2	Land use and Landcover 1990, 2010, 2020	Vector (digital)	MoEF
3	Catchment boundaries	Vector (digital)	BPDASHL
4	Contour lines	vector (digital)	BIG
5	Administrative boundaries (up to districts level)	vector (digital)	BIG
6	Forest and non-forest territory	vector (digital)	MoEF
7	Soil types boundary	vector (digital)	Puslitanak
8	Suitability class	vector (digital)	Puslitanah& Agroclimatic

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POSSIBLE EVALUATION METHODOLOGIES
Cocoa Farm level management practice comparison

1. **Cost Benefit Analysis**
   - to compare the economic benefits and economic costs generated by each cocoa farm-level practice for multiyear implementation.
   - to identify the most feasible scenario (farm-level practices) which can achieve cocoa agroforestry both economically viable and environmentally desirable.
   - Time horizon [2020, 2050]
   - Beneficiaries: farmers and local community
   - Identification and monetizing of tangible & intangible benefits & costs within a selected watershed
     - Economic valuation techniques will be applied to estimation intangible benefits and costs e.g. ecosystem services
     - Considering spatial and temporal distribution of benefits and costs e.g. among cacao farmers, and cacao farmers to other crops farmers

2. **Multi-Criteria Analysis**
   will be employed in cases where multiple objectives and decision criteria exist (e.g. economic growth, employment creation and environment improvement) ~ *to be decided in later stages*

3. **Cost-Effectiveness Analysis**
   - will be applied if a given physical goal as desirable.
   - narrower than a CBA and excludes any valuation of benefits, focusing instead on the costs of attaining a given target
   - not needing explicit benefit estimates

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Scope of works

1st scope work: Ecosystem Services analysis in BAU condition (under status quo - no incentives and policy shift)

- *Predict the spatial distribution of cacao AF until 2050.*
- Estimate ecosystem servicers benefit across all value chain.

2nd scope work: policy scenario promoting AF up-scaling

- To promote this up-scalling Bappenas/Goverment need intervention policy.

- In this case we need cost-benefit analysis as a basis for this policy intervention.

- IPB provide Bapenas cost-benefit anaylsis and busines plan for this policy intervention

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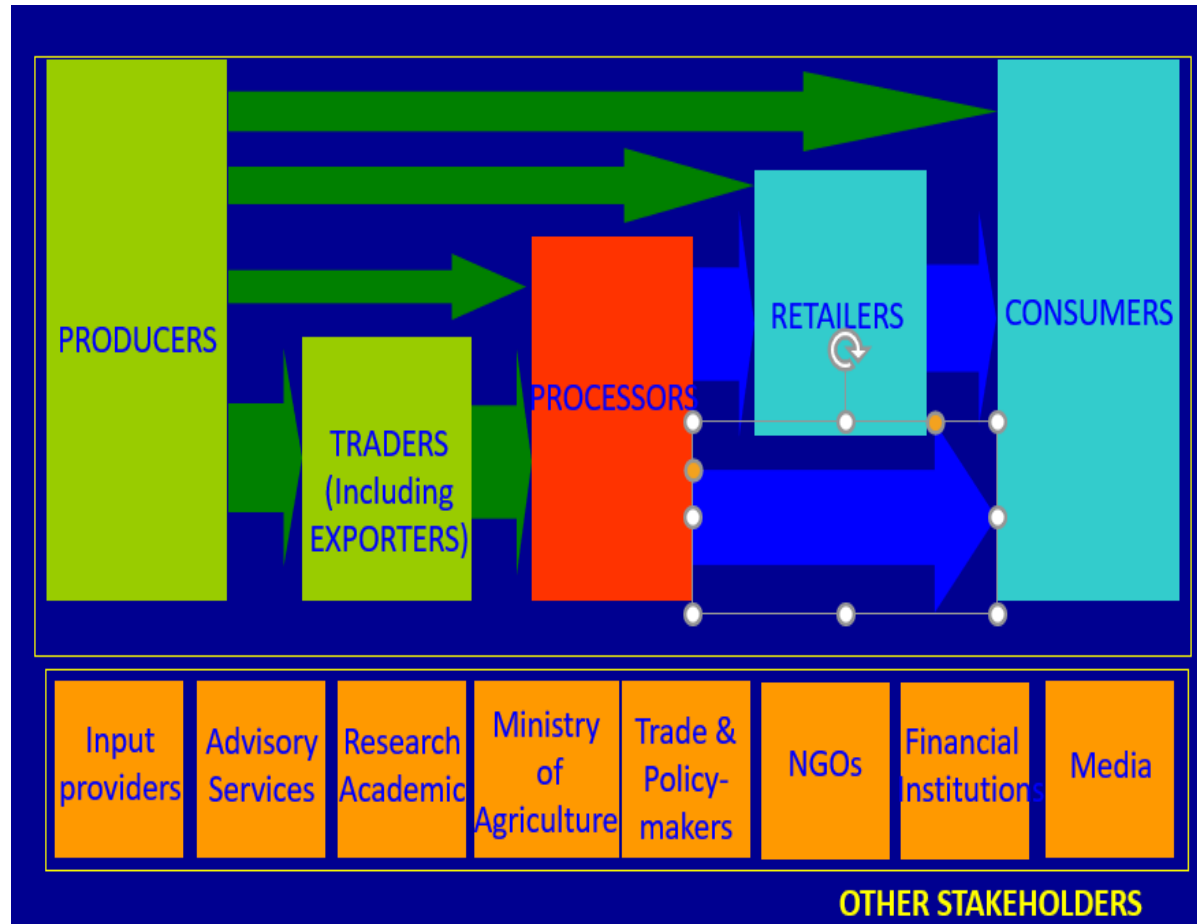
Value Chain

Methodology:

1. Stakeholder engagements Kick off Meeting

2. Collecting secondary and primary data:

3. Primary data:
   - Interview with the actors along the value chain
   - Focus group discussion
   - Simulations: policies that can support the value addition in the cocoa value chain and its sustainability.

Value Chain

1. **Interview:**
   Using a structure questionnaire with actors throughout cacao value chains, as well as those involved in policy relating to the cacao system.
   Current practices conduct by actors along the cacao value chain, challenges and opportunities face by them.

2. **Focus group discussion:**
   Obtain more insight related to the policy interventions that would lead to improve the functioning of cacao value chains that *support economy, biodiversity and support livelihoods of farmers.*

3. **Data analysis:**
   When the information has been collected, the next step is to simulate policy interventions and drivers to be added for the cacao value chains.
   - A) Baseline
   - B) Environmental Certification (Agroforestry) or "ecolabeling" analogous to RSPO for palm oil to promote circular economy.

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5. Preliminary Analysis

Covid 19 Impacts on Agrifood in Indonesia: A CGE Approach

Covid-19 Pandemic Timeline

Barua, Suborna, Understanding Coronanomics: The Economic Implications of the Coronavirus (COVID-19) Pandemic (April 1, 2020). Available at SSRN: https://ssrn.com/abstract=3566477 or http://dx.doi.org/10.2139/ssrn.3566477

A COVID-19 pandemic timeline

Pandemic begins → Post-pandemic

Short term	Short to Medium term	Short to Medium term	Long term	Long term
First wave Localized direct impacts	**Second wave** Impact internationalized	**Third wave** Macroeconomic impacts	**Fourth wave** Macroeconomic impacts	**Fifth wave** Macro-relational impacts

First wave: Initial Production shock; Initial Demand shock; Distortion to supply chain; Interruption of human flows

Second wave: Distortion to Trade flows; Interruption of capital flows

Third wave: Aggregate supply shock; Aggregate demand shock; Price level shock; Loss of employment and income; Exchange rates volatility; Rise in financial risk and instability

Fourth wave: Reduced economic growth

Fifth wave: Recession to depression; Shifts in international cooperation

The waves and the specific impacts are interrelated and interact in a complex way, eventually affecting economic growth and the nature of economic cooperation between governments and international institutions

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Indonesia *Computable General Equilibrium (CGE) Model*

- A comparative static CGE model

- The model shows the interdependence between macro and micro.

- Economic relations exist between industries, households, investors, governments, importers and exporters in different markets

- Structurally it is a combination of the INDOF model - Indonesian Forecasting Model (Oktaviani, 2001 and Oktaviani, 2009), WAYANG model for Indonesian Economy (Warr, 1998), and ORANI general equilibrium model of the Australian economy (Dixon, et al. 1982).

- The model uses the Indonesian Input-Output (I-O), Indonesian Social Accounting Matrix (SAM), and other parameters.
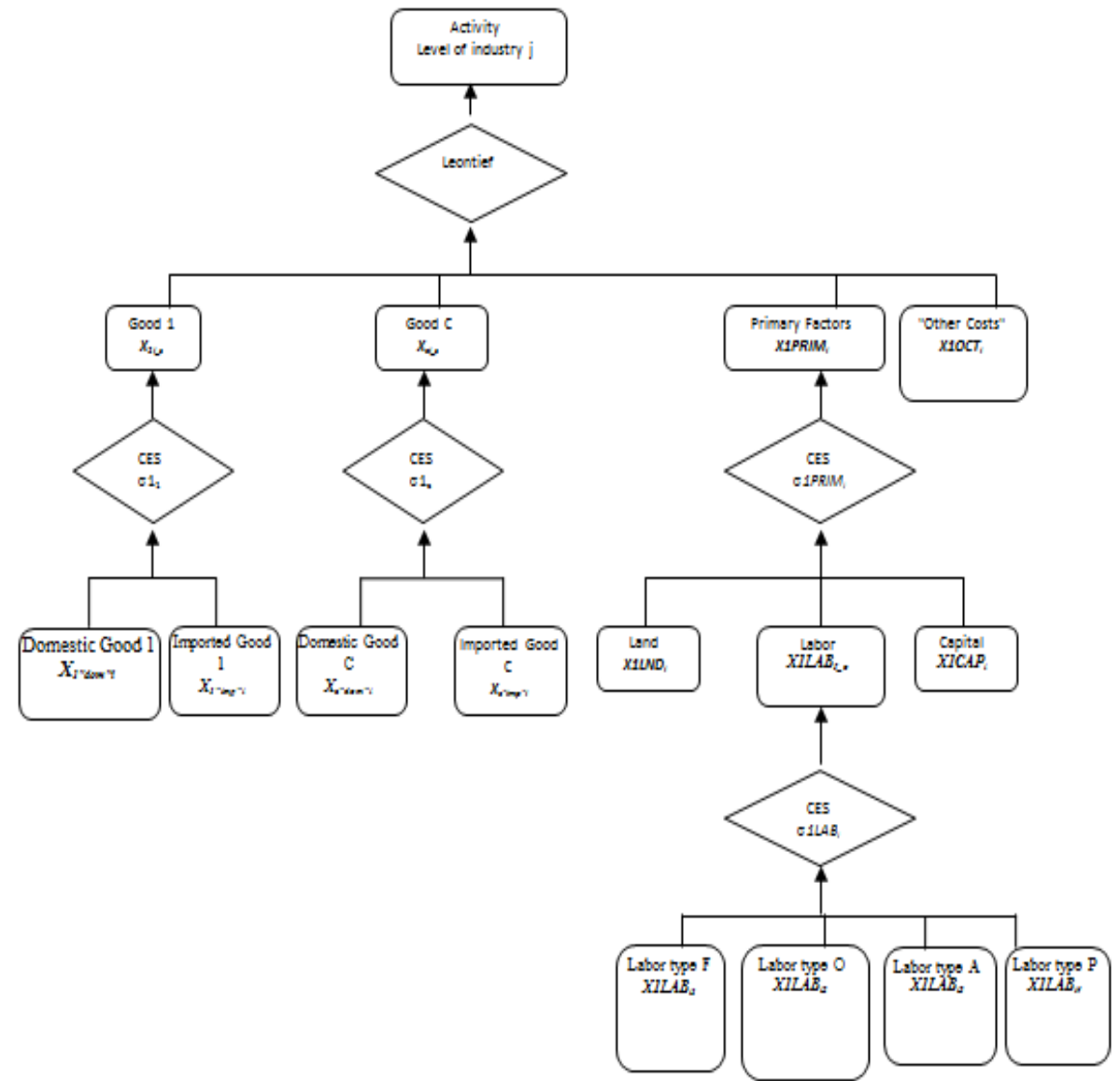
Structure of Production (Oktaviani, 2001)

Sectors, Labourers, and HH Disagregation

Sectors: 52 corresponding Sectors

Labourers: Farmers, Operator, Technician, Manager

Rural household groups

- Rural 1: agricultural labor.

- Rural 2: agricultural entrepreneurs.

- Rural 3: low-class non-agricultural households in rural areas, namely low-class free entrepreneurs, administrative workers, traders, free workers in the transportation sector, individual services, and manual labor.

- Rural 4: non-labor force in rural areas, which includes non-workforce and unclear groups in rural areas

Urban households groups:

- Urban 1: lower class non-agricultural households in urban areas, which include low-class free entrepreneurs, administrative workers, mobile traders, free workers in the transport sector, individual services and manual labor.

- Urban 2: non-labor force in urban areas, including non-labor force and unspecifies groups.

- Urban 3: upper class non-agricultural households in urban areas, such as upper-class free entrepreneurs, non-agricultural entrepreneurs, managers, military, professionals, technicians, teachers, administrative workers, and upper class sales

Justification of Simulation

Sim 1	Sim 2	Sim 3
• Covid 19 Scenarios • Decreasing productivity of agrifood and non agrifood sectors • Based on historical data in 2020-2021 • Decreasing export demand • Using Export Value Index (BPS) in 2020-2021	• Sim 1 • Climate Change impacts on Yield from DEWI Model (IFPRI, 2019) • Labour migration from urban to rural areas	• Sim 2 • Cacao Agroforestry

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Justification of Simulation

Sim 1

No	Sectors	Output Productivity	Agri Export Demand
1	Food Crops	2.30%	3.26%
2	Horticulture	2.71%	-5.08%
3	Cocoa	-3.69%	3.81%
4	Other Plantation Crops	0.87%	-7.89%
5	Livestock	-0.21%	0.50%
6	Forestry	-0.02%	-20.59%
7	Fishery	0.47%	-1.74%
13	Food and Beverage	1.03%	0.14%
14	Tobacco Products	-3.76%	-1.41%

Sim 2

No	Sectors	Output Productivity	Agri Export Demand	CC Yield Impacts	Migration
1	Food Crops	2.30%	-5.36%	-1.28%	-5.00%
2	Horticulture	2.71%	3.19%	-0.61%	-5.00%
3	Cocoa	-3.69%	0.60%	-0.61%	-5.00%
4	Other Plantation Crops	0.87%	-5.88%	-0.61%	-5.00%
5	Livestock	-0.21%	-2.30%	-0.82%	-5.00%
6	Forestry	-0.02%	-4.30%	-0.80%	-5.00%
7	Fishery	0.47%	-0.40%	-0.85%	-5.00%
8	Food and Beverage	0.14%			
9	Tobacco Products	-1.41%			

Sim 3

No	Sectors	Output Productivity	Agri Export Demand	CC Yield Impacts	Migration	Agroforestry Yield Impact
1	Food Crops	2.30%	-5.36%	-1.28%	-5.00%	
2	Horticulture	2.71%	3.19%	-0.61%	-5.00%	
3	Cocoa	-3.69%	0.60%	-0.61%	-5.00%	27.50%
4	Other Plantation Crops	0.87%	-5.88%	-0.61%	-5.00%	
5	Livestock	-0.21%	-2.30%	-0.82%	-5.00%	
6	Forestry	-0.02%	-4.30%	-0.80%	-5.00%	
7	Fishery	0.47%	-0.40%	-0.85%	-5.00%	
8	Food and Beverage	0.14%				
9	Tobacco Products	-1.41%				

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Macroeconomic Impacts of Covid -19 Pandemic (1)

	Real GDP	Trade Balance	CPI	Real Wage
Sim 1: Covid 19 Scenarios	-0.97 %	-0.81 %	1.82 %	-1.99 %
Sim 2: Covid 19 Scenarios + Climate Change+Labour Migration	-1.94 %	-0.50%	1.28%	-0.58 %
Sim 3: Covid 19 Scenarios + Climate Change+Labour Migration+ Cocoa Agroforestry	-1.77 %	-0.37 %	1.21 %	-0.51%

Source: Authors Calculation

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Macroeconomic Impacts of Covid -19 Pandemic (2)

	Consumption	Investment	Gov Exp	Export	Import
Sim 1: Covid 19 Scenarios	-0.38 %	-0.83 %	0.38 %	-3.89 %	1.09 %
Sim 2: Covid 19 Scenarios + Climate Change+Labour Migration	-1.53 %	-1.79 %	1.53%	-3.95 %	0.78 %
Sim 3: Covid 19 Scenarios + Climate Change+Labour Migration+ Cocoa Agroforestry	-1.52 %	-1.64%	1.52 %	-2.31%	0.78 %

Source: Authors Calculation

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Microeconomic Impacts of Covid -19 Pandemic: Agrifood Output

	Food Crops	Horticulture	Cocoa	Other Plantation Crops	Livestock	Agricultural Services	Forestry	Fishery
Sim 1	3,53	3,66	0,42	4,42	2,19	0,15	0,88	2,33
Sim 2	-2,94	-1,52	-10,11	-2,16	-2,79	-4,84	-1,71	-3,35
Sim 3	-3,03	-1,63	22,00	-2,27	-3,00	-4,83	-1,84	-3,51

Chart labels: Cocoa; 22,00 — Food Crops; -3,03 — Horticulture; -1,63 — Other Plantation Crops; -2,27 — Livestock; -3,00 — Agricultural Services; -4,83 — Forestry; -1,84 — Fishery; -3,51

Y-axis: Percentage Change (%)

Source: Authors Calculation

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Microeconomic Impacts of Covid -19 Pandemic: Agrifood Output

	Food Crops	Horticulture	Cocoa	Other Plantation Crops	Livestock	Agricultural Services	Forestry	Fishery	Food and Beverage	Tobacco Products
■ Sim 1	0,05	2,93	6,36	6,63	0,44	-0,83	0,08	2,65	0,11	-2,29
■ Sim 2	-2,57	0,39	-2,05	2,34	-1,90	-0,45	6,11	0,47	-3,06	-4,07
■ Sim 3	-2,72	0,21	5,93	2,14	-2,11	-0,38	5,99	0,18	-1,99	-4,07

Source: Authors Calculation

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Impacts of Covid -19 Pandemic on Income and HH Consumption

HH	Real Income			HH Consumption		
	Sim 1	Sim 2	Sim 3	Sim 1	Sim 2	Sim 3
rural1	-3.37	-2.62	-2.38	-1.55	-1.34	-1.17
rural2	-3.05	-2.67	-2.46	-1.23	-1.40	-1.25
rural3	-1.01	-2.99	-2.98	0.81	-1.72	-1.77
rural4	-1.68	-2.66	-2.55	0.14	-1.38	-1.34
urban1	1.42	-2.93	-3.09	3.24	-1.65	-1.88
urban2	1.42	-3.15	-3.34	3.24	-1.88	-2.13
urban3	1.93	-3.17	-3.38	3.75	-1.90	-2.17

Source: Authors Calculation

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Impacts of Covid -19 Pandemic: Agrifood Trade

Sector	Export			Import		
	Sim 1	Sim 2	Sim 3	Sim 1	Sim 2	Sim 3
Food Crops	8.00	3.07	0.97	-17.35	-6.38	-5.82
Horticulture	28.36	-5.00	-7.45	-11.05	-0.11	0.88
Cocoa	0.80	-37.37	94.53	1.11	10.11	-30.28
Other Plantation Crops	12.32	-27.37	-30.45	-4.08	0.60	0.99
Livestock	17.07	-5.96	-7.40	-8.00	-1.36	-0.75
Agricultural Services	-2.30	-2.30	-2.30	-16.63	0.45	1.96
Forestry	29.29	-39.74	-42.90	-13.76	13.93	15.16
Fishery	11.93	-12.94	-13.97	-8.25	6.74	7.42
Food and Beverage	-42.35	-42.90	-40.94	12.70	10.84	9.77
Tobacco Products	8.15	14.13	13.83	-4.03	-8.79	-8.62

Source: Authors Calculation

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Thank You …