



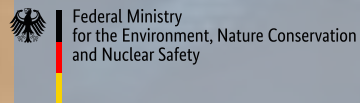
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TEEBAgriFood framework: Case of cocoa and coffee agroforestry value chains in Ghana and Ethiopia

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Agroforestry coffee value chain in Ethiopia

Agroforestry Coffee value chain in Ethiopia-Background

- Coffee production in Ethiopia constitutes; forest coffee 10%, semi-forest coffee 30%, garden coffee 50% and plantation coffee accounts 10%.
 - 95% of Ethiopia's coffee is produced by smallholder farms (<2 ha).
- Coffee processing can either be:
 - Dry processing
 - Wet processing: uses a lot of water and produces a lot of waste water-has higher environmental costs. Is becoming more common in Ethiopia due to high demand for wet processed coffee.
- Ethiopia's coffee is marketed either through the Ethiopian commodity exchange (ECX) or through co-operatives.
 - Proportion that is marketed through ECX is larger.
- About 40-50% of the coffee produced in Ethiopia is consumed domestically. The rest is exported.
 - Europe takes up the greatest proportion of the export (51%).

Benefits within coffee agroforestry value chain

Service	Visible benefit	Invisible benefits	For Whom (Farmer F, Rural community RC, Global community GC)	Value chain stage (Production P processing PR, Distribution & marketing D, Consumption C)	Monetary valuation
Coffee	X		F	P	X
Timber	X		F	P	X
Non-timber food products(NTFPs)	X		F	P	X
Carbon storage		X	F, GC	P	X
Biodiversity		X	F, GC	P	
Soil erosion control		X	F, RC	P	X
Soil formation		X	F, RC	P	X
Nutrient cycling		X	F, RC	P	X
Pollination services		X	F, RC	P	X
Water regulation & water treatment		X	F, RC	P	X
Biological pest control		X	F, RC	P	X
Profit margins	X		F, RC, GC	P, PR, D	X
Certification premium from shade trees	X		F	P, C	X

Costs within Agroforestry coffee value chain

Costs	Visible Costs	Invisible Costs	For Whom (Farmer F, Rural community RC, Global community GC)	Value chain stage (Production P, processing PR, Distribution & marketing D, Consumption C)	Monetary valuation
Labour costs	X		F	P	X
Capital costs	X		F	P	X
Water use during processing	X		RC	PR	X
Water footprint	X	X	RC	P, PR, D, C	X
Direct costs from farm gate to wholesalers/ECX	X		RC, GC	PR, D	X
Direct costs from wholesalers/ECX to export border	X		RC, GC	PR, D	X
Water pollution from coffee processing waste		X	RC	PR	X
Loss of aquatic life from processing waste		X	RC, GC	PR	
Health costs from processing waste		X	RC	PR	X
Greenhouse gases from coffee processing		X	GC	PR	X
Greenhouse gases from coffee transport		X	GC	D	X
Greenhouse gases post-export		X	GC	D, C	X

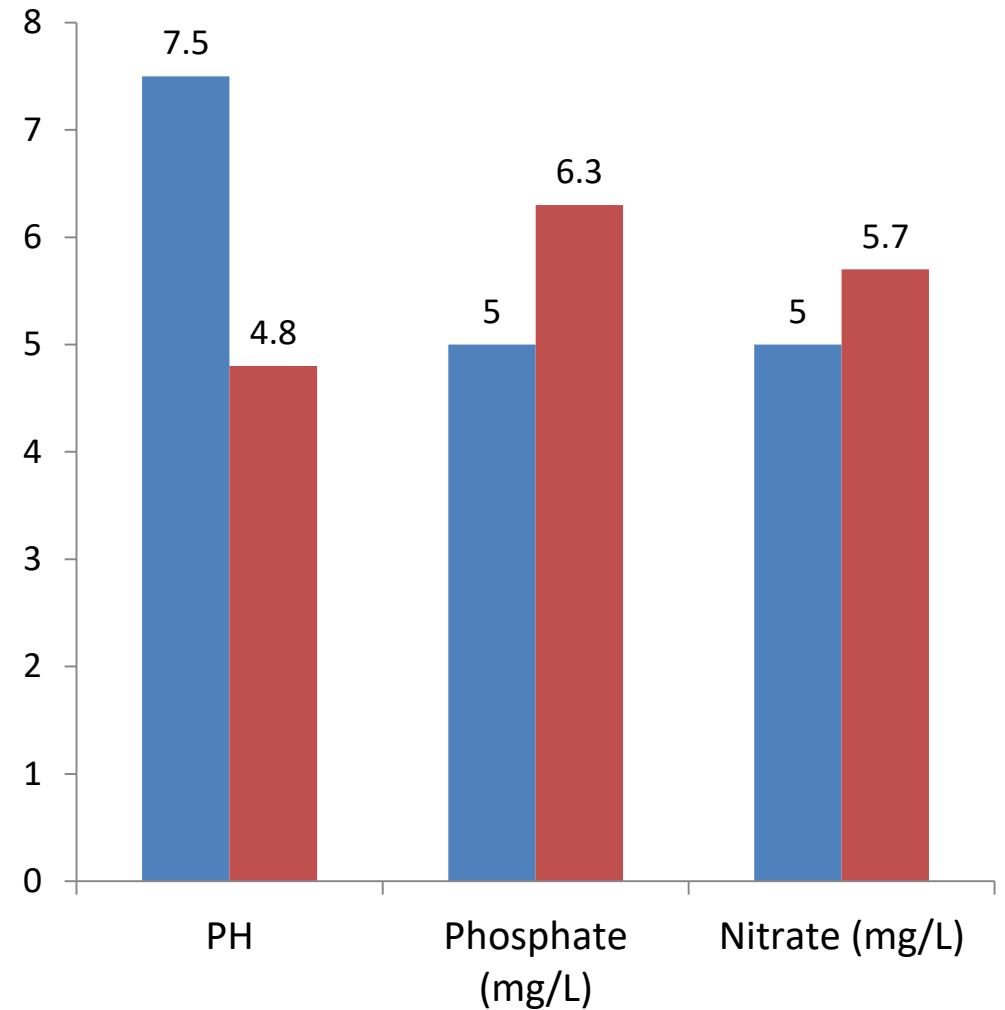
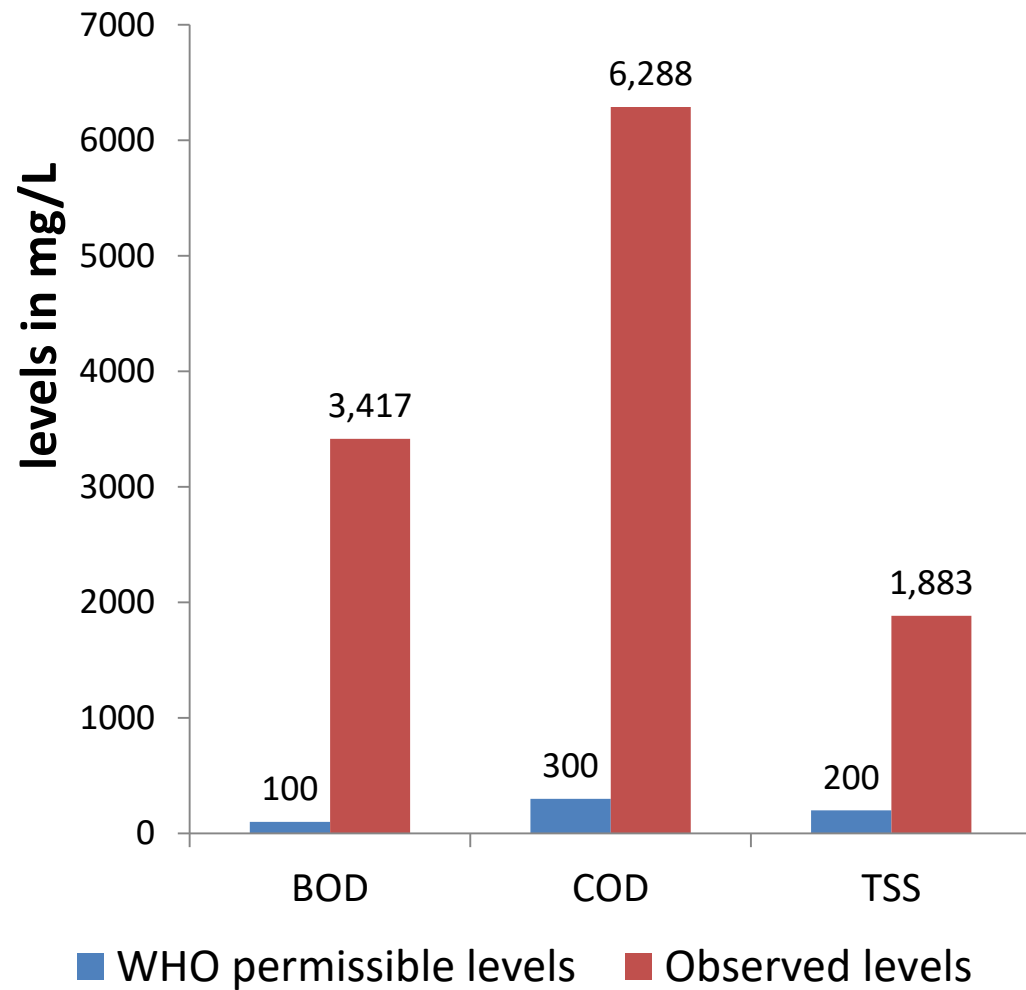
Data sources

- We used the benefit transfer method. Some of the data was sourced from studies conducted in Ethiopia while others were sourced from studies out of Ethiopia.
- Data on yields, food outputs and inputs were sourced from studies conducted in Ethiopia and valued at the current market price.
- Data on carbon stocks within production systems were sourced from studies within Ethiopia and valued at the market price and social price of carbon.

Carbon stocks within the coffee AF systems

	System	Average Quantity (tonnes C ha ⁻¹)	Value US\$ ha ⁻¹
Above ground carbon biomass	Semi-forest coffee	<i>208.1</i>	<i>4,964-31,314</i>
	Garden coffee	<i>158.8</i>	<i>3,788-23,892</i>
Below ground (soil) carbon	Semi-forest coffee	<i>94.5</i>	<i>2,254-14,219</i>
	Garden coffee	<i>123.3</i>	<i>2,940-18,545</i>

Comparison of observed water quality level in Ethiopia rivers with waste discharge with the WHO recommended levels



Some alternatives to treating waste water from coffee processing industries

Cost of treating waste water using a bioreactor

Cost component	Amount in USD from source	Real value 2017 (USD)	Annual treatment cost
Construction cost of bioreactor (2002) (life 25yrs)	8,210	58,902	2,356
Annual operating costs (2003)	475	2,998	2,998
Total cost			5,354

The annual treatment cost is the cost of processing 8 tonnes of coffee (24,000 litres of wastewater) per day

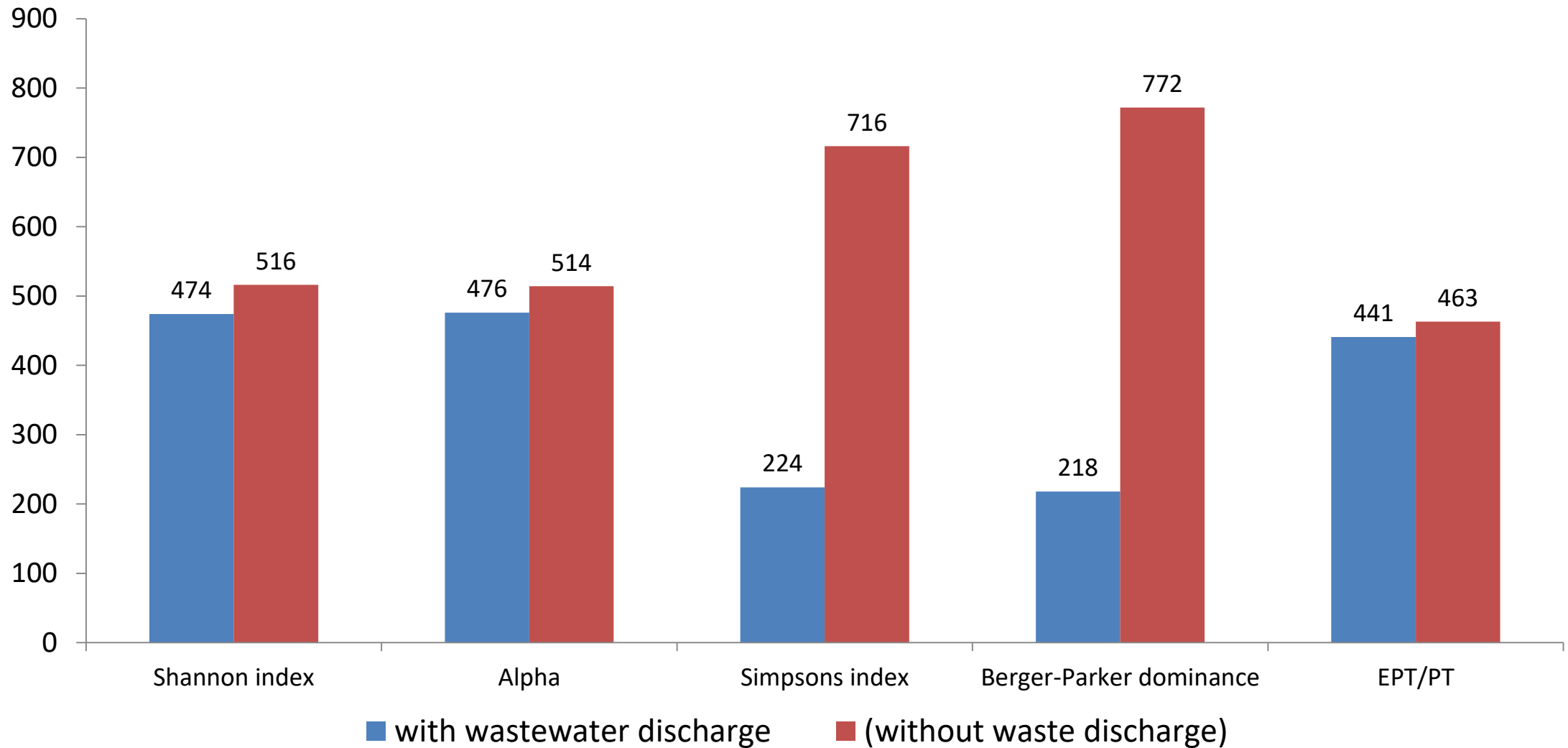
Producing bio-ethanol from processing waste

- Potential to produce bio-ethanol from the coffee waste instead of disposing it to the water bodies
 - It is an alternative energy source.
- Production cost estimated at US\$ 0.45 per litre of bio-ethanol.
- Benefit cost ratio of bio-ethanol production is estimated at >1.05.
- Currently there is no bio-ethanol production in Ethiopia's coffee industries. Can be explored further.

Health impacts from coffee waste water pollution on community members near the water bodies

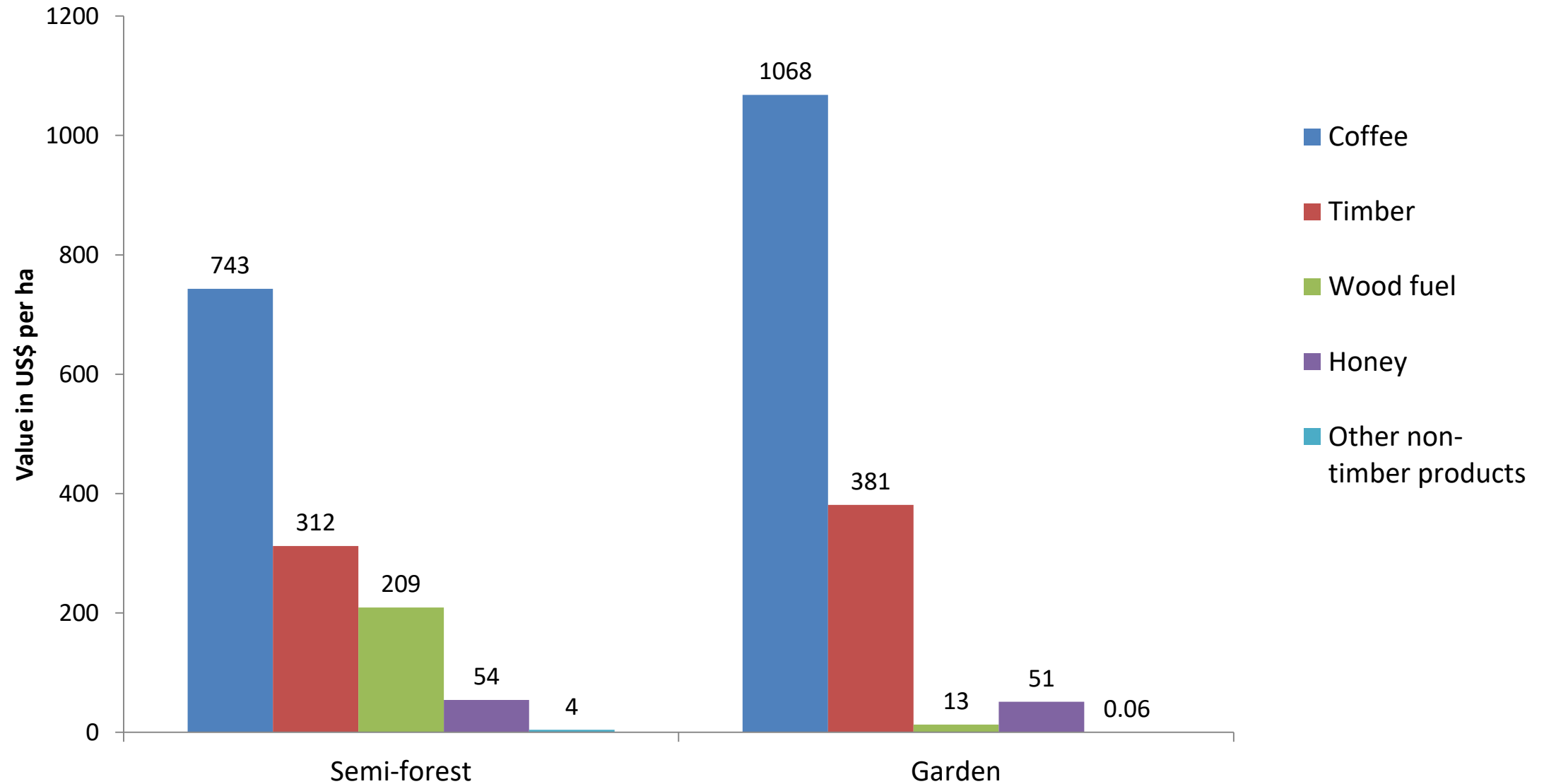
Impacts	% of population affected
Spinning sensation	89
Eye irritation	32
Skin irritation	85
Stomach problem	42
Breathing problem	75
Nausea	25
Estimated treatment cost per person per dosage	USD 54.19

Aquatic species diversity between polluted and unpolluted stream

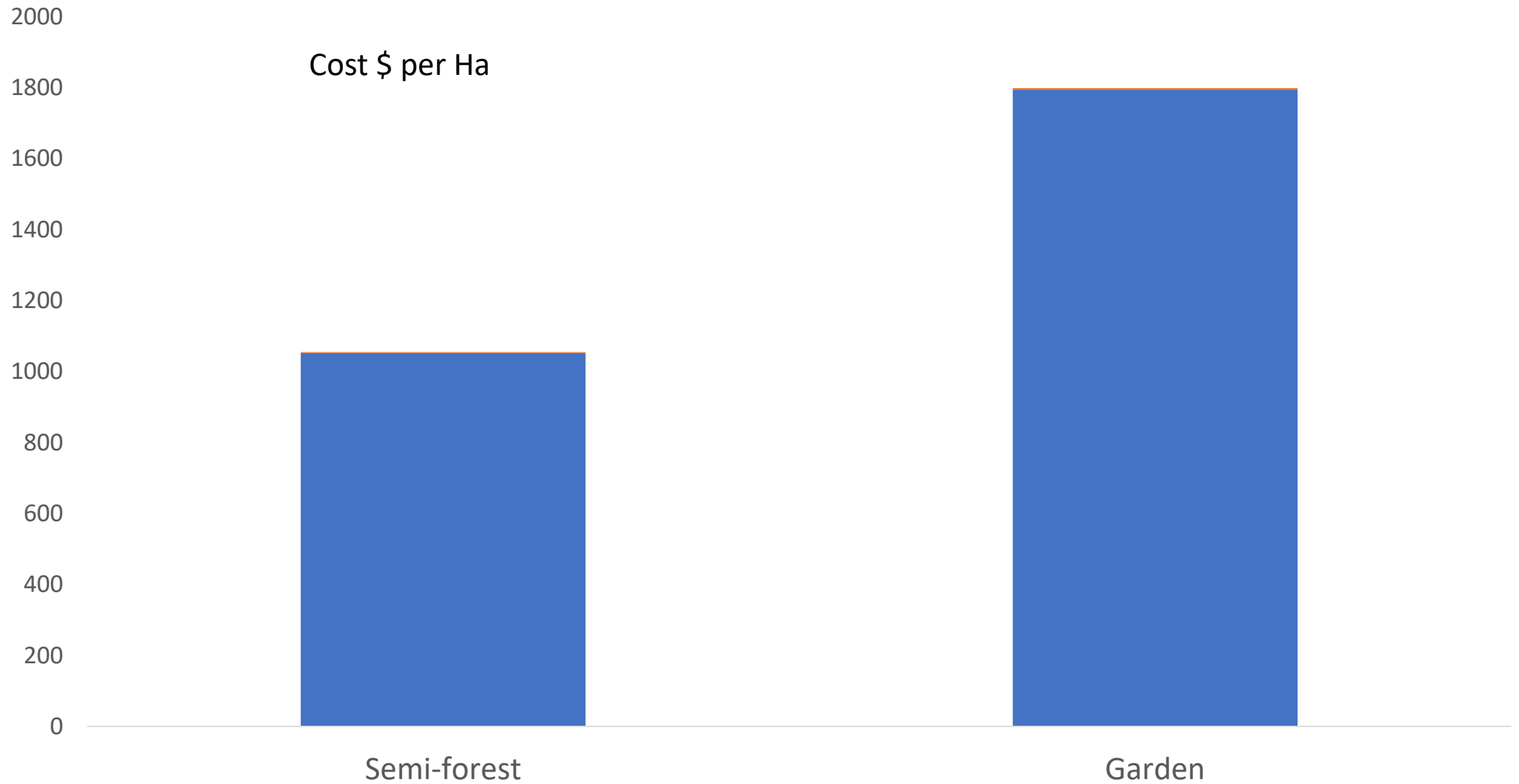


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Agricultural and food products between semi-forest and garden coffee in Ethiopia

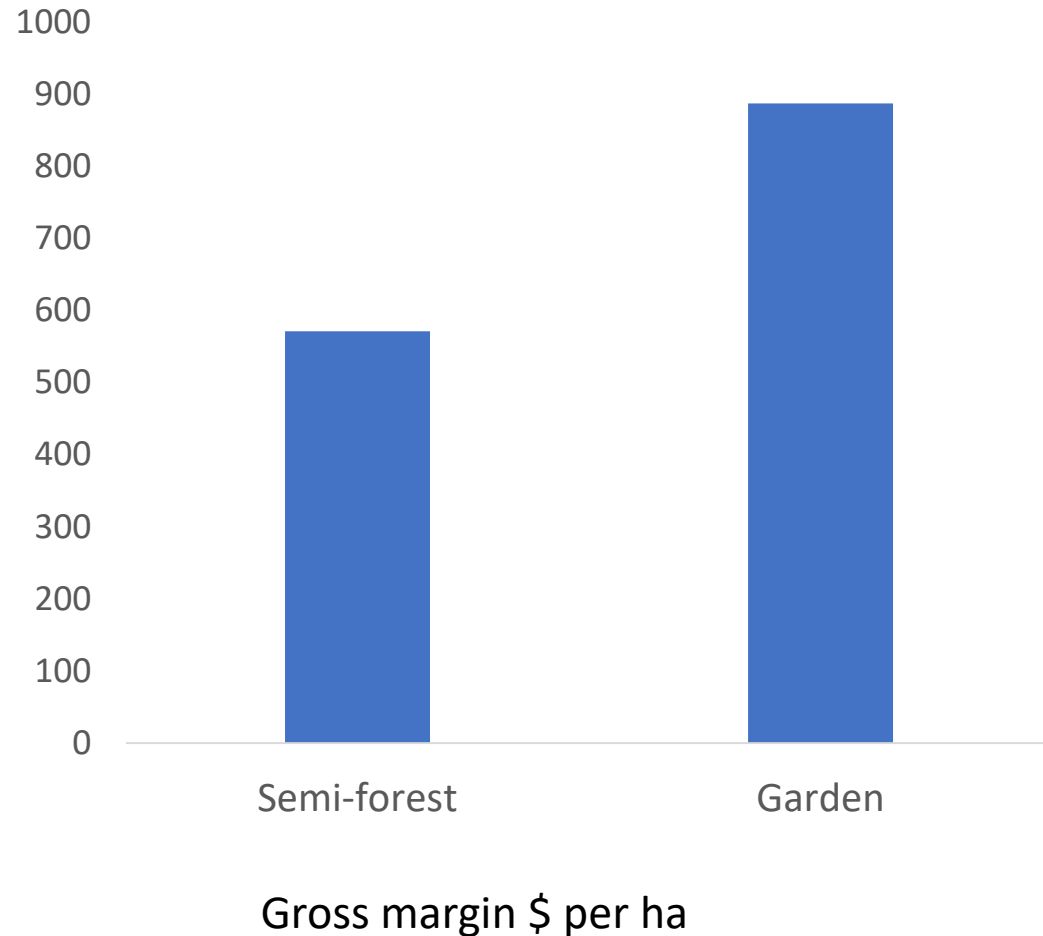


Inputs in different coffee production systems

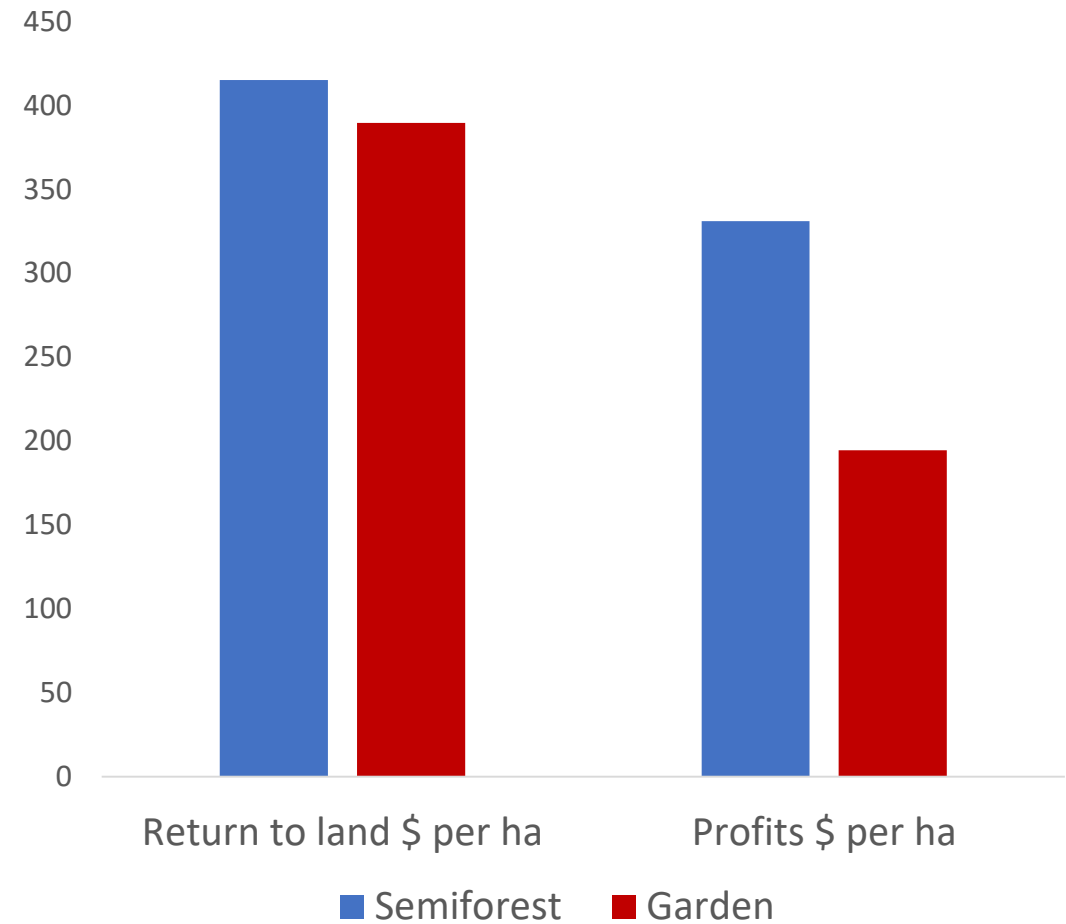


Profitability of the shaded vs. garden coffee production system

No certification premium (Namirembe et al. (2015))



With certification premium (Mitiku et al. (2018))



Agroforestry Cocoa value chain in Ghana

Agroforestry cocoa value chain in Ghana

- About half of Ghana's cocoa is under shaded systems- this has however been on a decline over the last decade.
- Cocoa sector in Ghana is partially liberalized but Ghana Cocoa Board (COCOBOD) still has a monopoly
 - COCOBOD), sets cocoa prices and minimum standards, and licences buying companies (LBCs).
 - Farmers sell cocoa beans to Licensed Buying Companies (LBCs), which transport it from villages to the marketing subsidiary of COCOBOD - Cocoa Marketing Company (CMC).
 - CMC exports cocoa and sells it to domestic processors.
- Ghana exports most of its cocoa as raw beans (about 80%)- most of it is exported to Europe.
- The rest is sold to domestic processors, after processing into semi-finished products (butter, powder, liquor)- export 95% and sell the rest to 5% locally.

Benefits within agroforestry cocoa value chain

Service	Visible benefit	Invisible benefits	For Whom (Farmer F, Rural community RC, Global community GC)	Value chain stage (Production P, processing PR, Distribution & marketing D, Consumption C)	Monetary valuation
Cocoa	X		F	P	X
Timber	X		F	P	X
Non-timber food products (NTFPs)	X		F	P	X
Biological pest control		X	F, RC	P	X
Pollination services		X	F, RC	P	X
Carbon storage		X	F, GC	P	X
Soil nutrient stocks		X	F	P	
Biodiversity		X	F, RC, GC	P	
Gross margins/ benefit share among actors	X		F, GC	P, PR, D	X
Certification premium from shaded cocoa	X		F	P, C	X

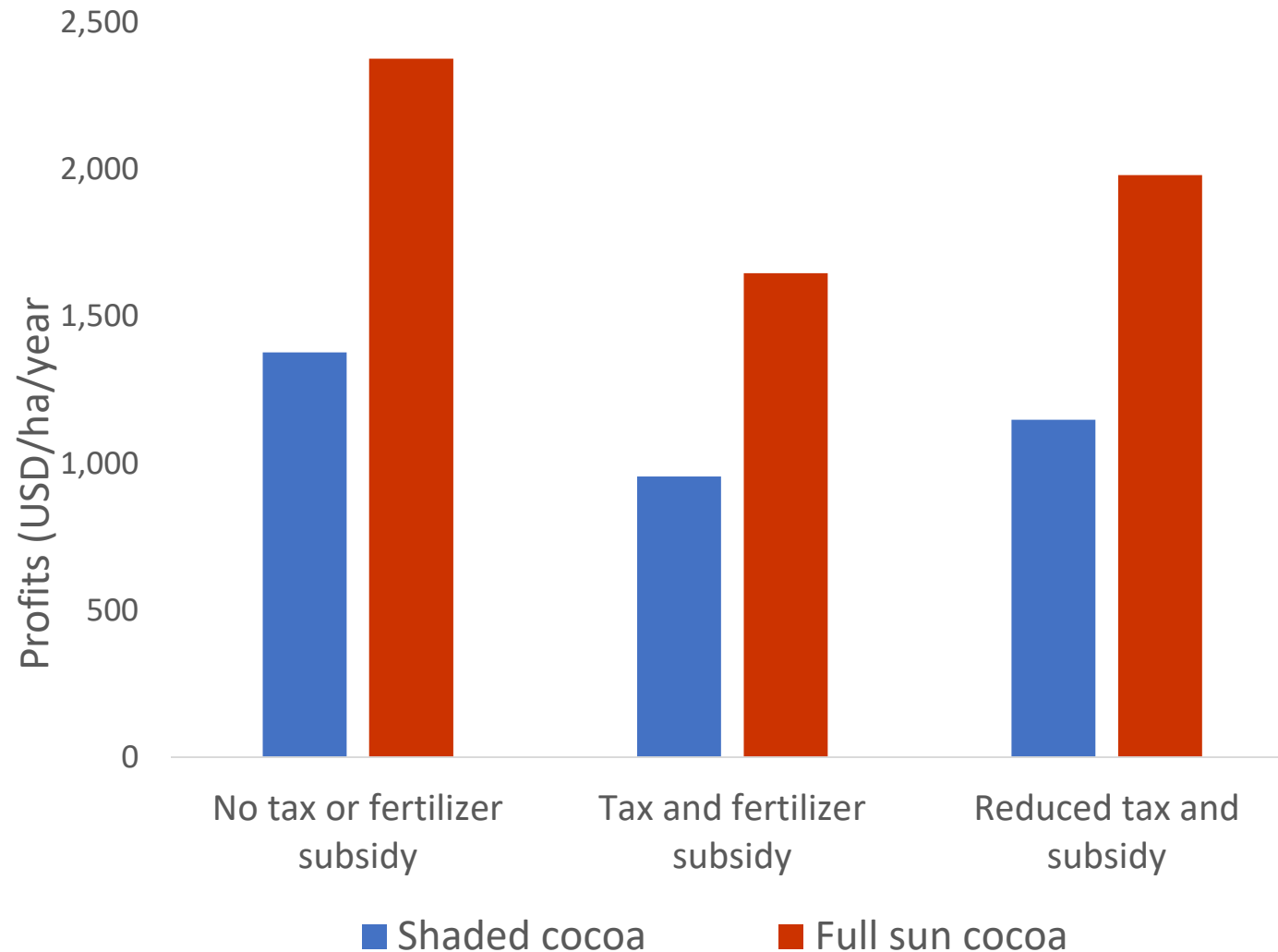
Costs within agroforestry cocoa value chain

Costs	Visible Costs	Invisible Costs	For Whom (Farmer F, Rural community RC, Global community GC)	Value chain stage (Production P, processing PR, Distribution & marketing D, Consumption C)	Monetary valuation
Fertilizers	X		F	P	X
Agrochemicals	X		F	P	X
Labour	X		F	P	X
Energy costs	X		GC	PR	X
Water footprint	X	X	F, GC	P, PR, D, C	X
FOB cost share	X		F, RC	P, D	X
Transport cost	x			D	X
Human health effects from pesticides and processing waste		X	F, RC	P, PR	

Costs within agroforestry cocoa value chain

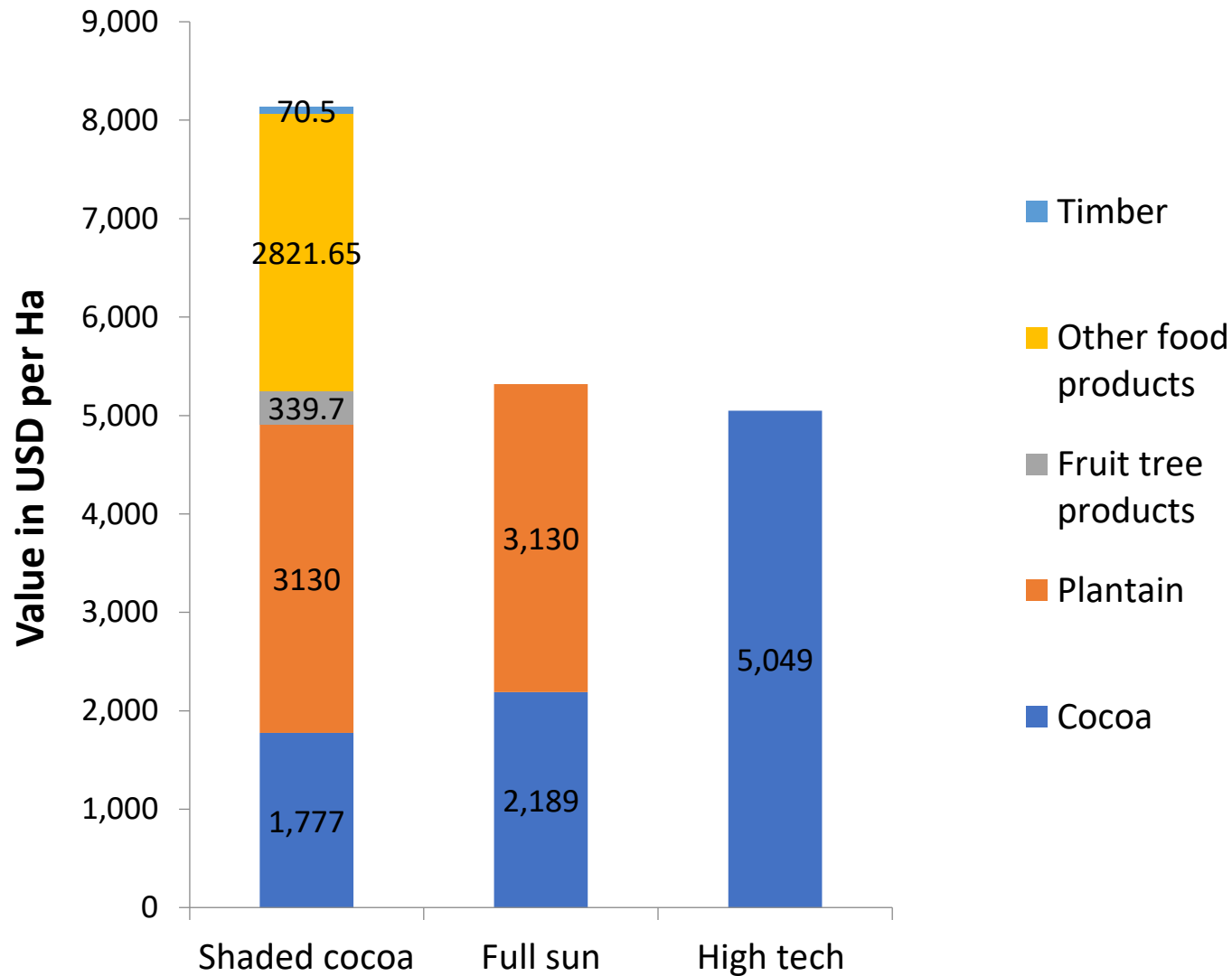
Costs	Visible Costs	Invisible Costs	For Whom (Farmer F, Rural community RC, Global community GC)	Value chain stage (Production P, processing PR, Distribution & marketing D, Consumption C)	Monetary valuation
Child labour effects	X	X	F, RC	P	
Greenhouse gases from production		X	GC	P	X
GHGs emissions from processing		X	GC	PR	X
GHGs emission during transport		X	GC	D	X
GHGs emissions during packaging		X	GC	C	X
Water pollution from pesticides & cocoa processing waste		X	RC	P, PR	
Water pollution (Eutrophication)		X	RC	P	
Waste emissions to soil from pesticide use		X	RC	P	

Profitability of cocoa production systems in Ghana



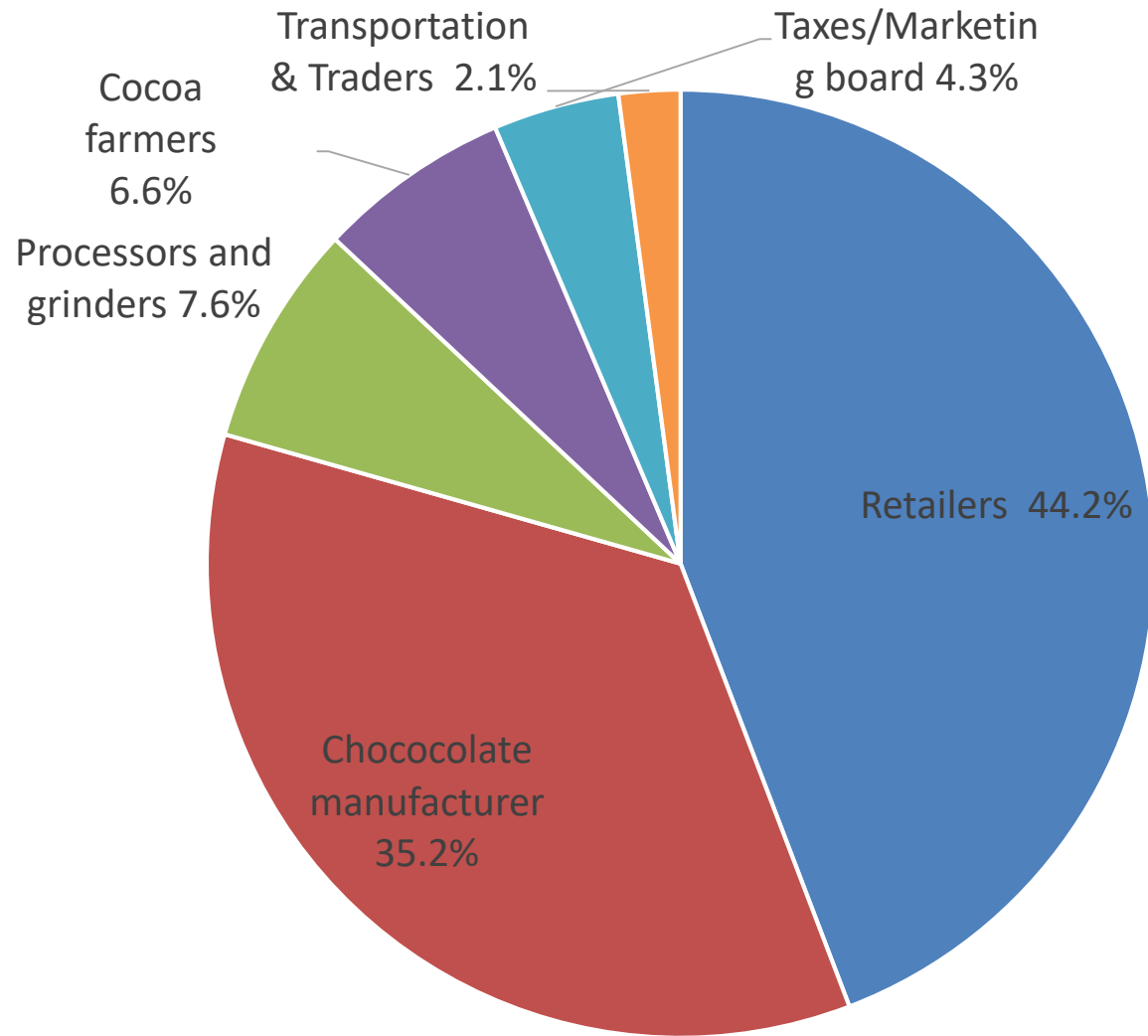
- Low cocoa yields within the agroforestry cocoa system contributes to the lower profits.
- Certification premiums paid to agroforestry cocoa farmers is too low about \$15 per tonne of cocoa.
- Even when tripled, the AF cocoa will not be as profitable as the full sun

Other benefits from shaded cocoa systems



- Other provisioning services- timber, food products and so on.
- Other ecosystem benefits:
 - Higher biodiversity within shaded cocoa systems
 - Better soil fertility
 - Soil erosion control
 - Biological pest control
 - Water regulation and treatment
 - Pollination services

Share in sale revenue per tonne of sold cocoa



- Most of the chocolate manufacturers and retailers are based in Europe.
- Ghana is missing out on the largest share
- Cocoa farmers in Ghana get only 6.6% of total chocolate revenue.

Child labour in Ghana's cocoa farms- Tulane University (2015)

Population	2008/09	2013/14	% change
All children aged 5-17 years (number)	2,160,878	2,236,124	
	%	%	
Children working in cocoa production	46.2%	42.8%	-4.0%
Child labourers working in cocoa production	43.9%	41.1%	-3.1%
Children working in cocoa sector in hazardous work	43.1%	39.3%	-5.6%
Ratio of cocoa produced to working children (tons per child)	0.7 tonnes per child	0.9 tonnes per child	

- Child labour leads to health effects among the children due to injuries sustained while working.
- About 10% of the child labourers do not attend school and are deprived off education.
- Existing certification standards discourage child labour in cocoa production.
- No single label can guarantee the chocolate was made without exploitative child labour.

Thank you all!