Life cycle assessment of natural farming: Case study of green tea production in Nara prefecture, Japan

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Background

- Natural farming is one of the environmentally conscious farming designed to avoid “unnatural” practices

  →No input from outside of farm such as chemical fertilizer, manure, and agrochemicals, other than composts derived from vegetable matter

- Some studies has been argued “environmentally friendly” farming, such as organic farming, may not be economically and environmentally (e.g. fossil energy) sustainable from a life cycle perspective in some conditions.

Objective

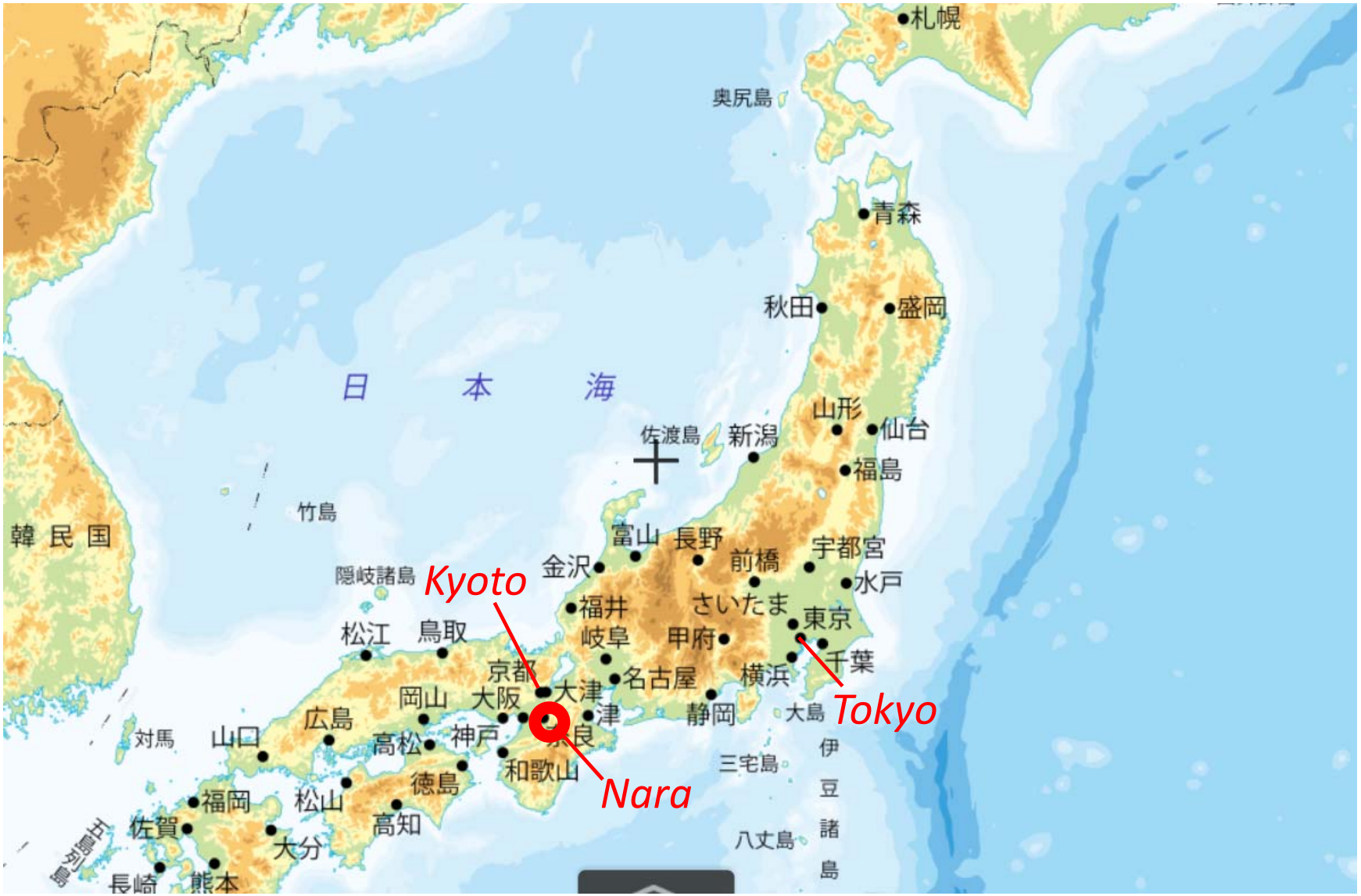
Is there any advantage in natural farming?

→Evaluate environmental and economic life cycles impact of natural farming

Case study

Green tea production in Nara prefecture, Japan

A farm producing by natural farming and small tea factory using wood biomass in main processes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Overview of tea production scenarios

	Conventional farming (*CF*)	Natural farming, 1year(*NF1y*)	Natural farming, 3years (*NF3y*)
Chemical fertilizers use	yes	no	
Organic fertilizer	yes	no	
Nitrogen application (kg-N/ha, incl. crop residue)	904	192	115
Weed control	Herbicide	Manual (weeds are applied to the farm)	
Harvesting	Several times a year		Once per 3 years
Yield(kg/ha/year)	4500	3000	3200

Tea processing

Roasting, rolling and drying by iron kiln using firewood – simpler process than conventional green tea

CF&NF1y—tea leaves with stem

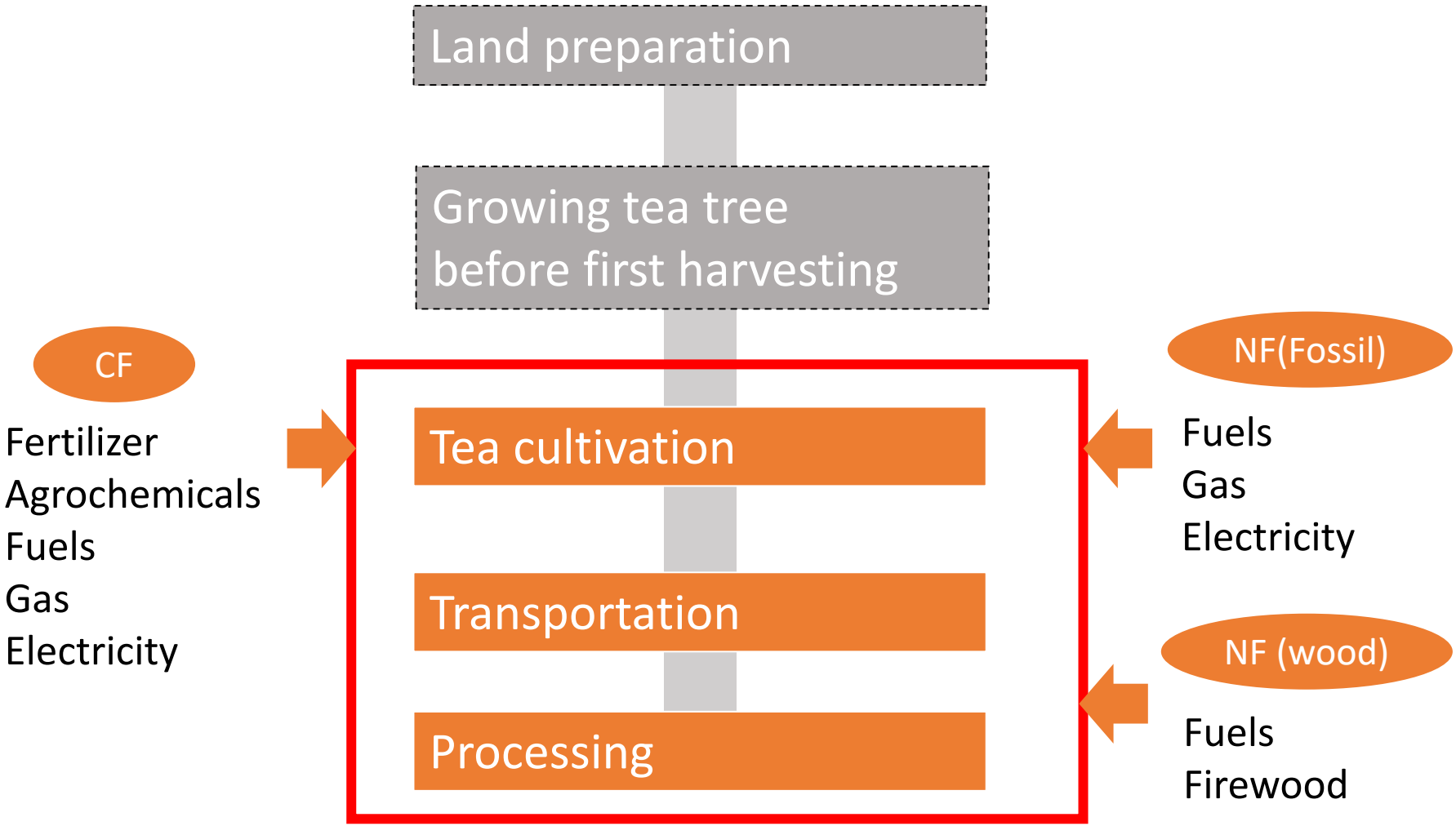
NF3y—tea leaves with branches

Tea processing

NF1yNF3y—Roasted tea “Bancha”

Conventional green tea: steamed & dried

System boundaries



Data collection

CF

Assuming to be typical situation in Japan

Inventory data based on existing survey and statistics

NF（fossil)　NF (wood)

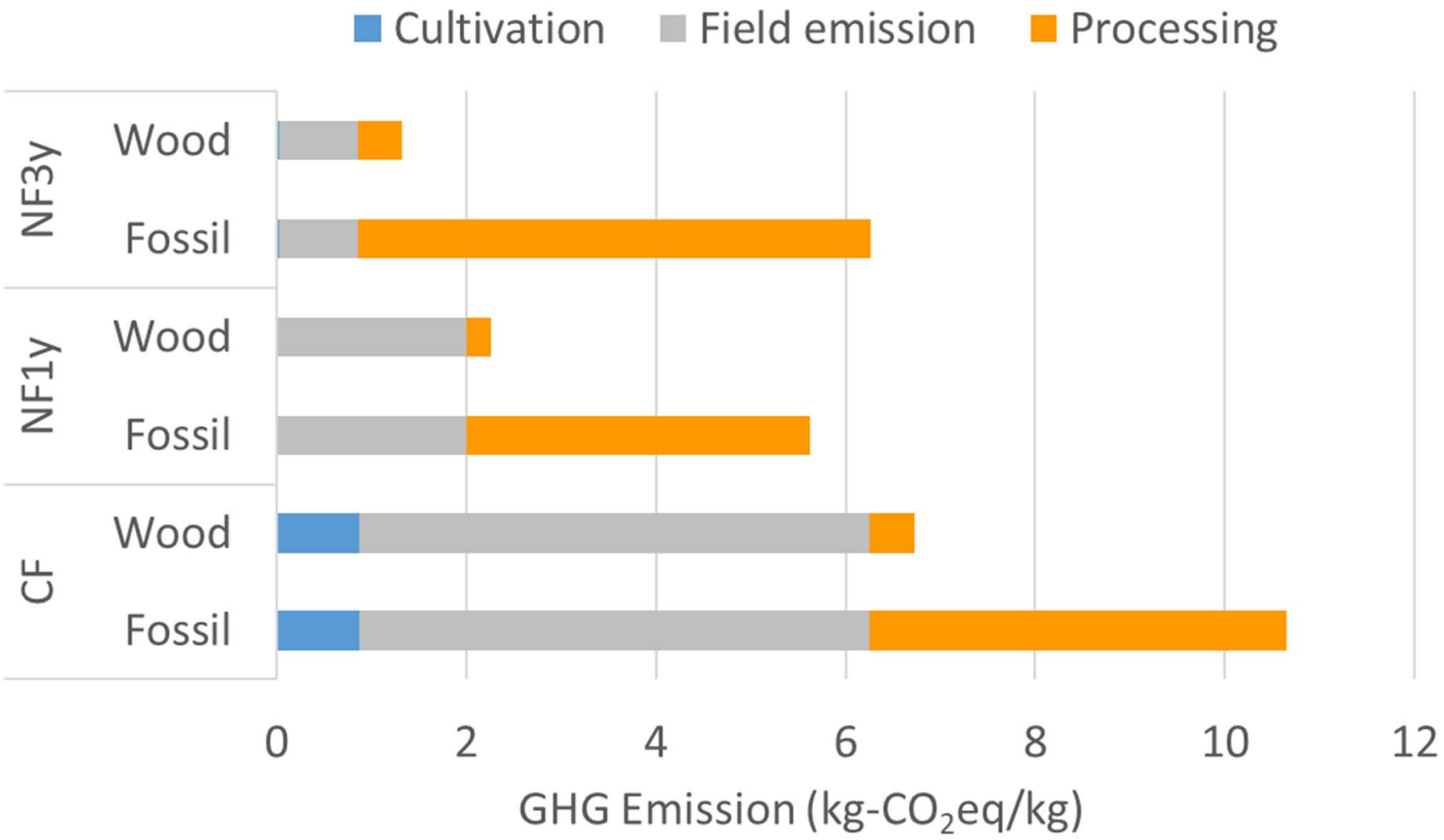
Collecting actual data of natural farming

Inventory data based on actual practice and material flows in 2017

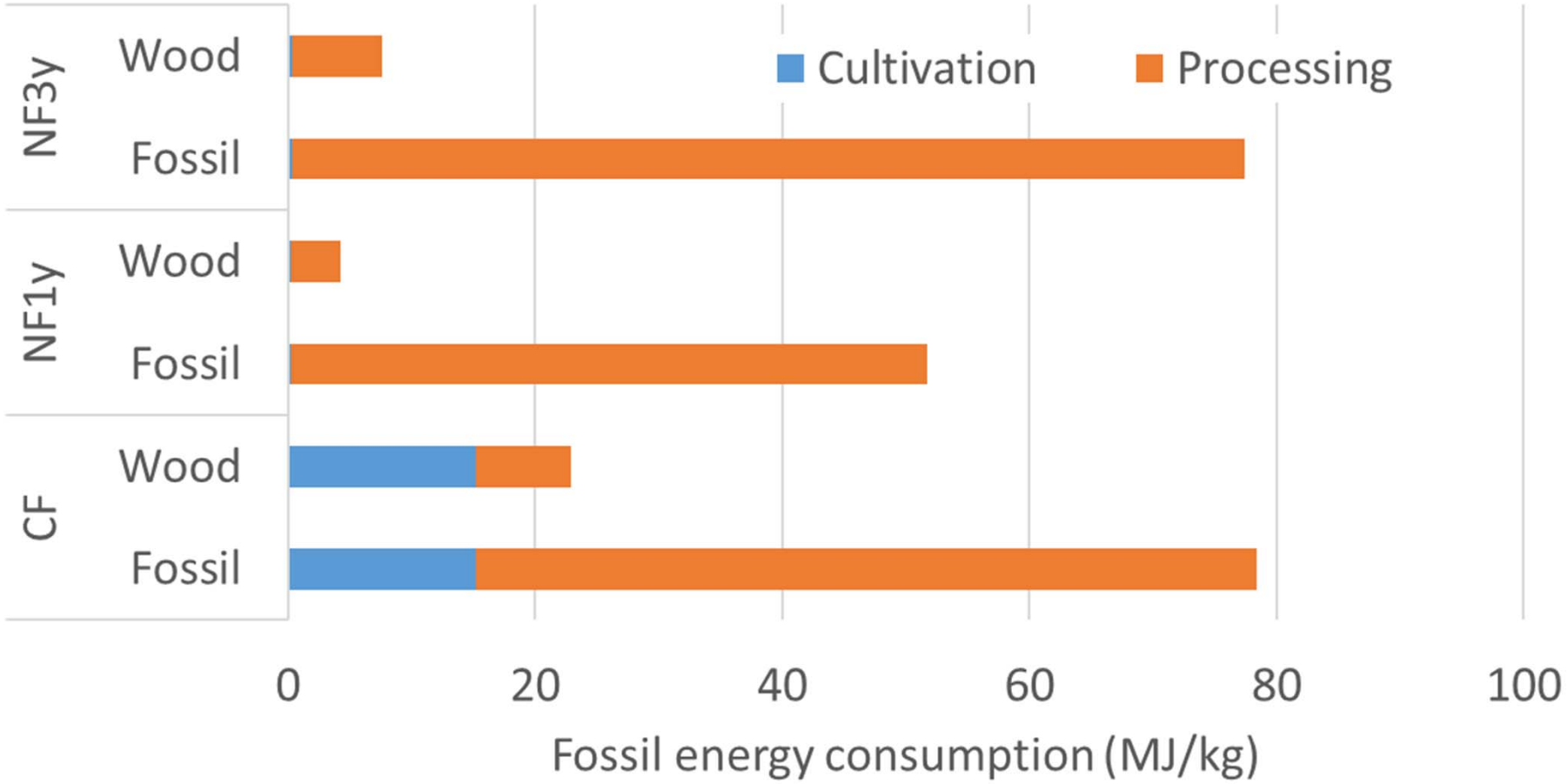
✓*GHG emission from field was also included*

LC-GHG

✓ Two options of energy source of tea processing are considered

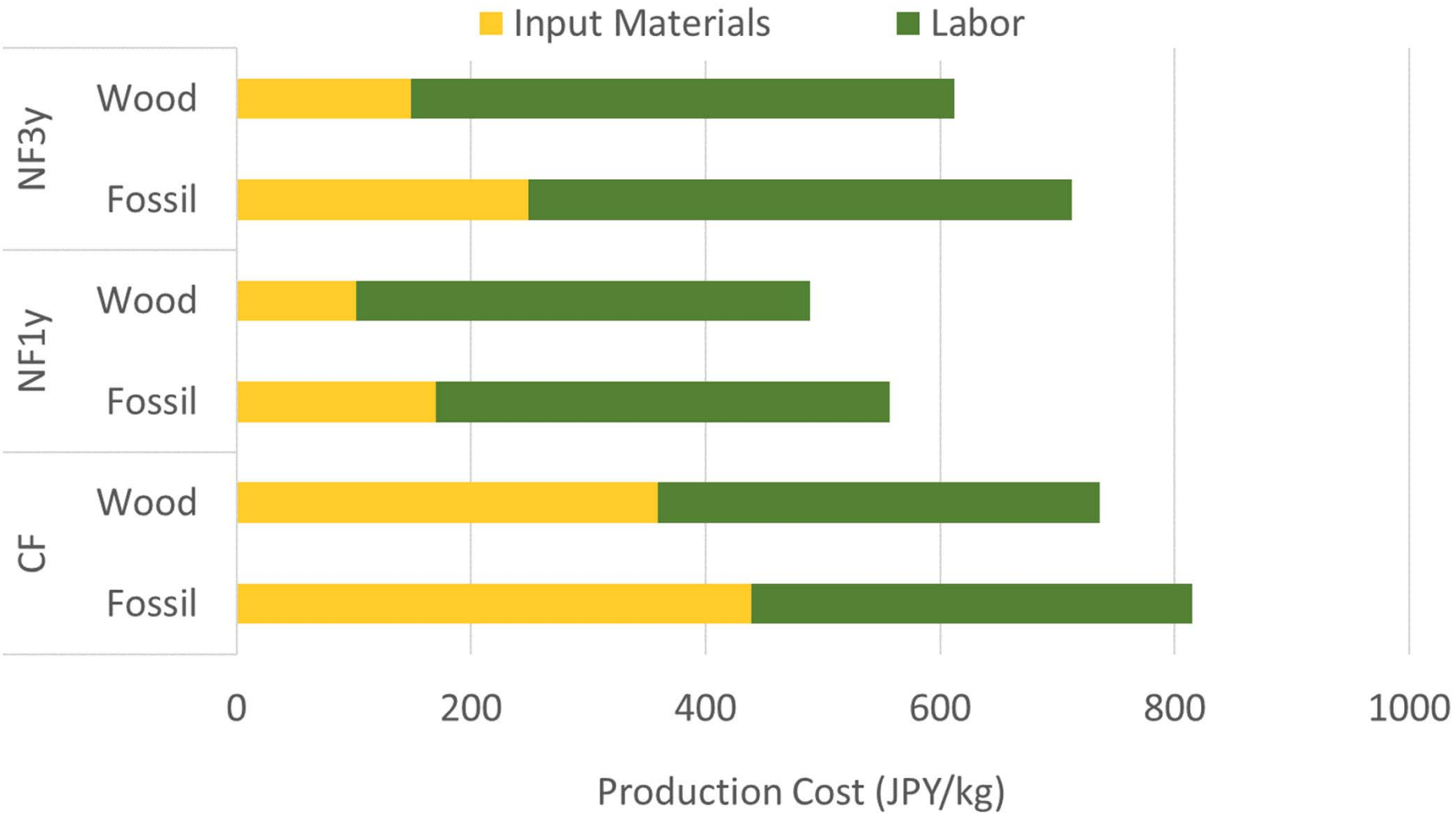


Energy requirement



Cost analysis

- ✓ Total production cost of NF will decrease compare to CF, while labor cost will be raise



Environmental efficiency

- Natural farming has advantage in production cost, GHGs, energy, but not in land productivity
- Wood biomass may reduce both environmental load and production cost
- Wood biomass: Applicable to small farms in current technology

		Production cost (JPY/kg)	Fossil Energy consumption (MJ/kg)	GHG (kg-CO_2eq/kg)	Land productivity (kg/ha)
CF	Fossil	100	100	100	100
	Wood	90	29	63	
NF1y	Fossil	68	66	53	67
	Wood	60	5	21	
NF3y	Fossil	87	99	59	71
	Wood	75	10	12	

Discussion

- Well-developed natural farming has potential to reduce environmental load and production cost
- Wood biomass can reduce GHG, energy, and production cost

Small scale natural faming-wood biomass model would be preferable under conditions not in land shortage

-->For this model it needs to develop ….

✓Technology of biomass thermal supply applicable to more complicated tea processing method

✓Capacity development of natural farming techniques

-->Next step of LCA: Considering nexus with other environmental load; water resource, water quality….