MEASURING THE IMPACTS OF HUMANITARIAN SUPPLY CHAINS ON THE ENVIRONMENT (GREENHOUSE GAS EMISSIONS AND WASTE)

A QUANTITATIVE RESEARCH STUDY

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Agenda

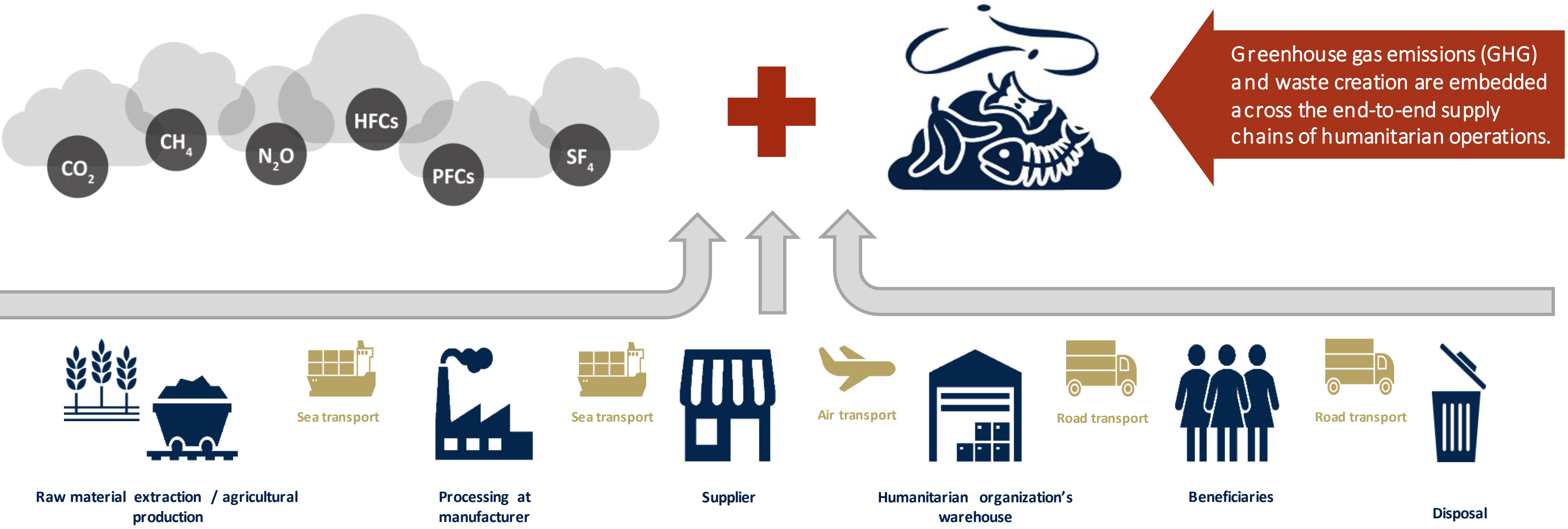
1. MOTIVATION
2. RESEARCH
3. CONCLUSIONS
4. Questions

MOTIVATION:

Environmental sustainability in humanitarian logistics

Humanitarian operations suffer from the consequences of climate change

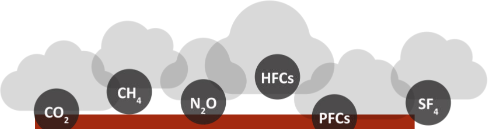
Life-saving humanitarian action can have unintended environmental impacts.



To address these challenges, this quantitative study pursues the following goals:

1. **Measure the environmental impacts of humanitarian operations along the entire supply chain during disaster response**

2. **Evaluate the effectiveness of existing and potential solutions to reduce the environmental impact of humanitarian aid**



GHG emissions

Waste creation

In collaboration with:

LOGISTICS CLUSTER

DRC DANISH REFUGEE COUNCIL

IFRC

Save the Children

WFP

Case Studies:

Harvest loss in Chad following flooding (2022)
© WFP / Evelyne Fey

SUPER CEREAL PLUS (CSB++) DELIVERED TO CHAD FOLLOWING FLOODS (2022)

Aftermath of Flooding in Islamabad, Pakistan (2022)
© Pakistan Red Crescent Society

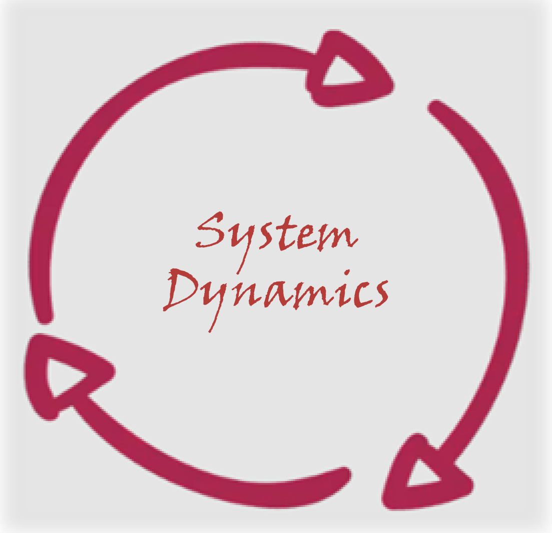
TARPAULINS DELIVERED TO PAKISTAN FOLLOWING MONSOON RAIN AND FLOODS (2022)

Aftermath of Cyclone Idai in Beira, Mozambique (2019)
© IFRC Climate Centre / Denis Onyod

TARPAULINS DELIVERED TO MOZAMBIQUE FOLLOWING FLOODS AND TROPICAL CYCLONE (2019)

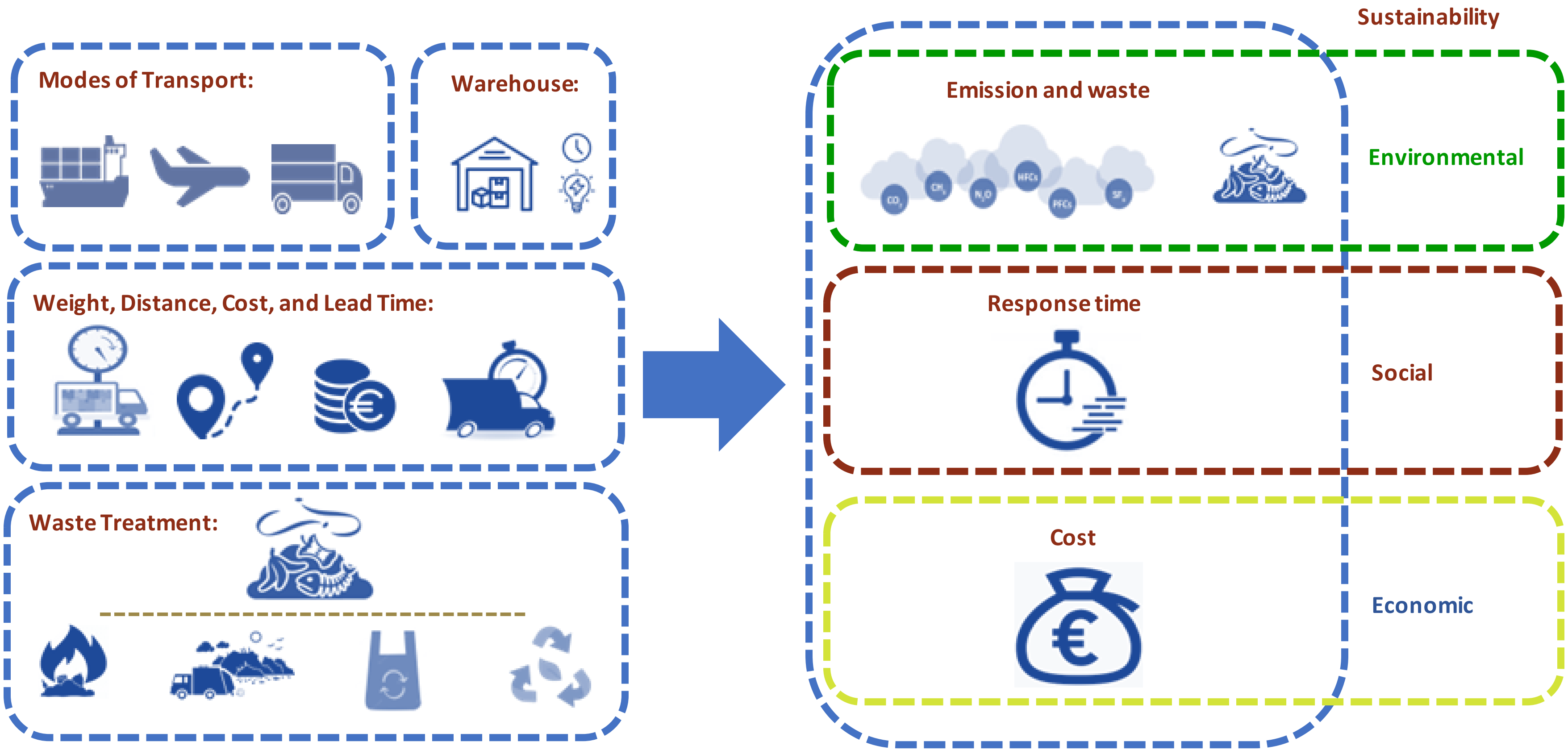
Research Methodologies

The life cycle assessment (LCA) + System Dynamics

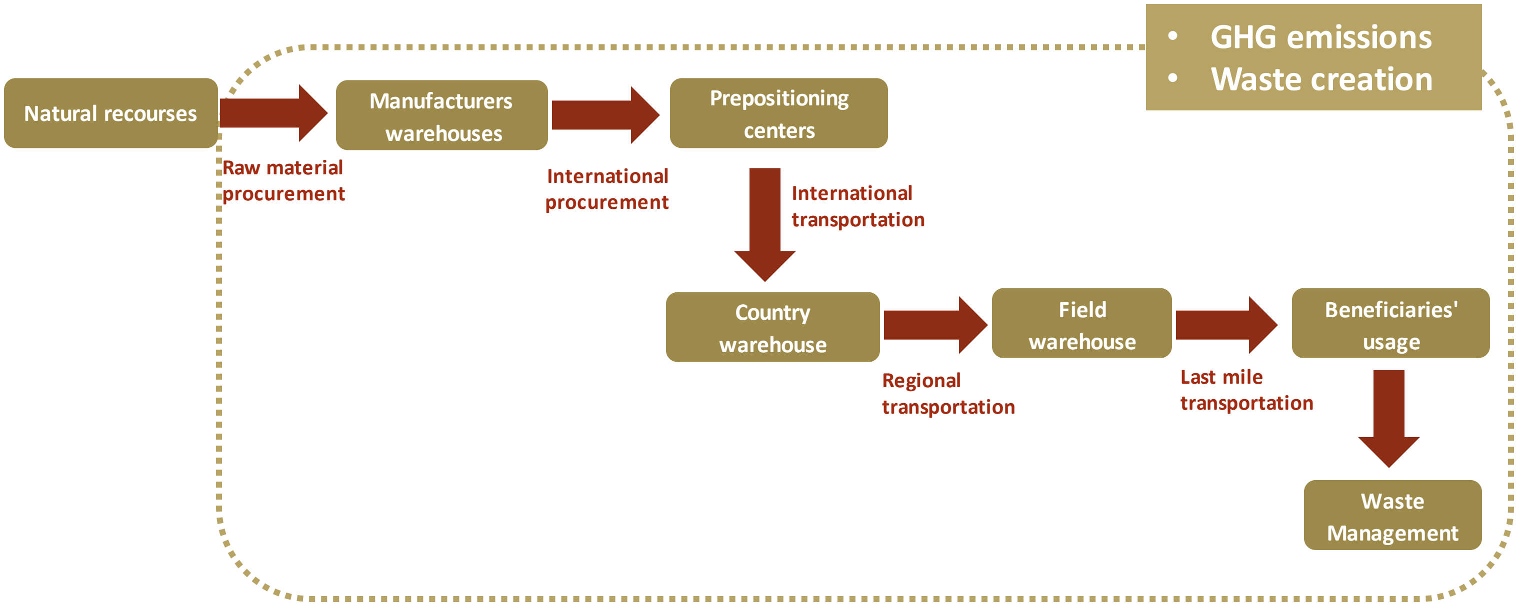


(Besiou and Van Wassenhove, 2015; Besiou et al., 2011; Tomasini and Van Wassenhove, 2009; Van Wassenhove, 2006)

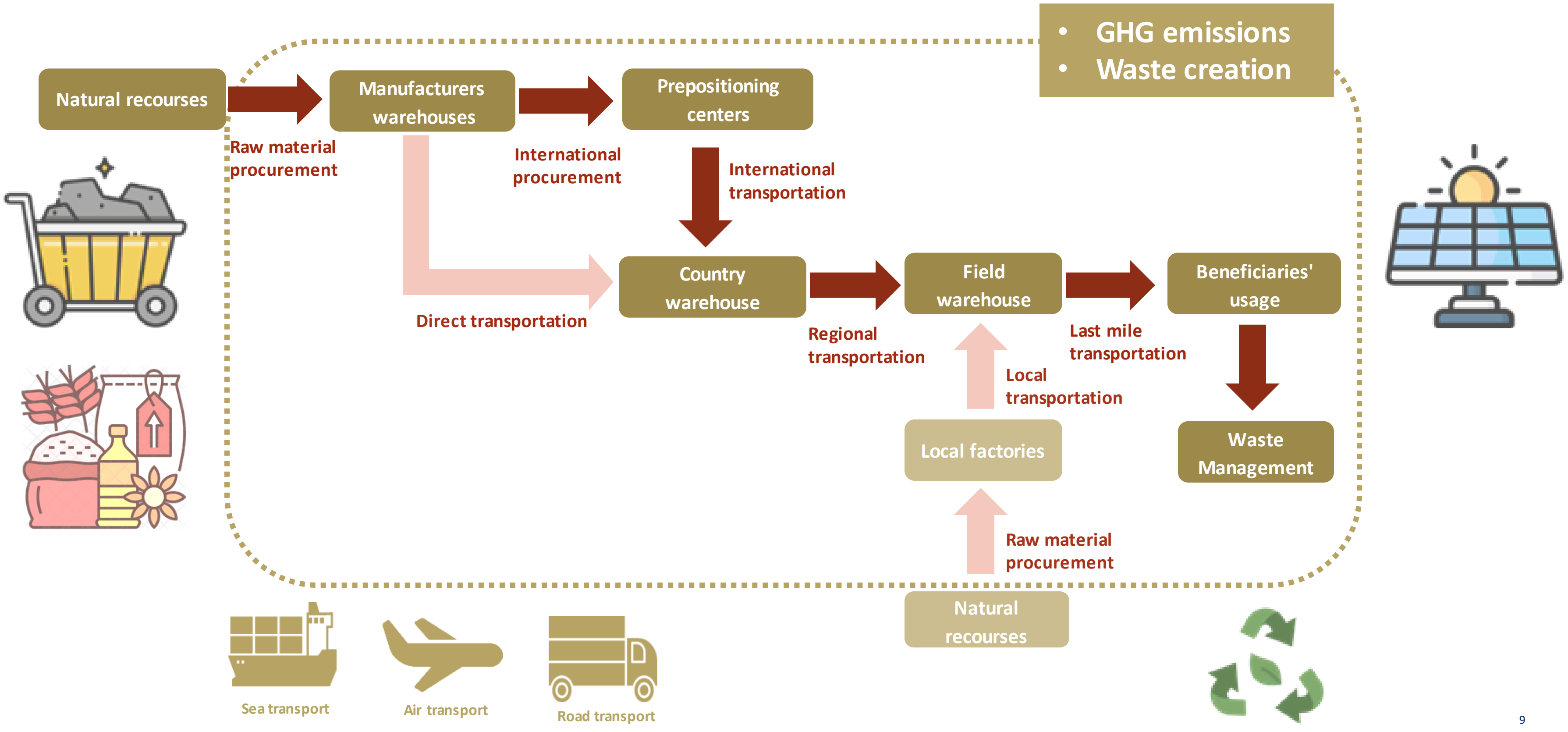
Input and output data



The scope of the supply chain:



Different scenarios in the supply chain:



Case study:

TARPAULINS DELIVERED TO PAKISTAN FOLLOWING MONSOON FLOODS (2022)

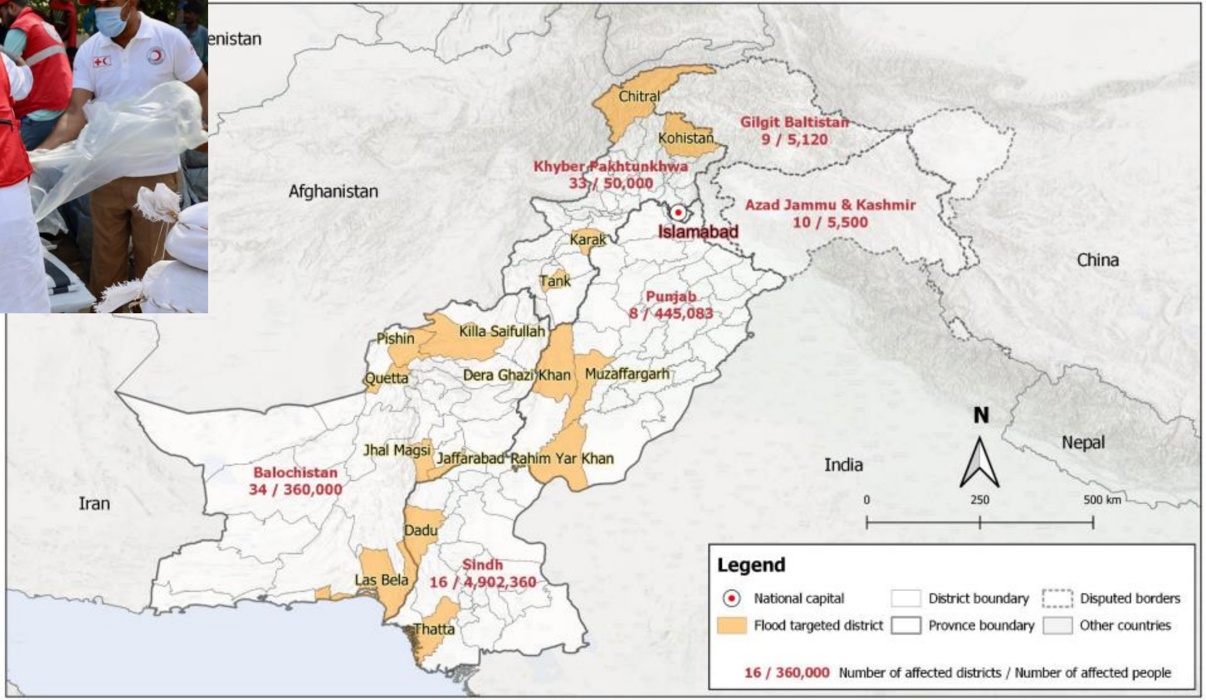
Example case study:

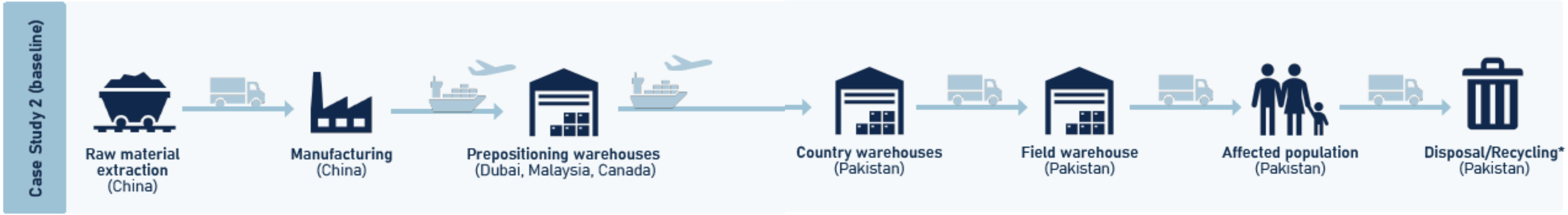
IFRC shelters in Pakistan (Monsoon floods)

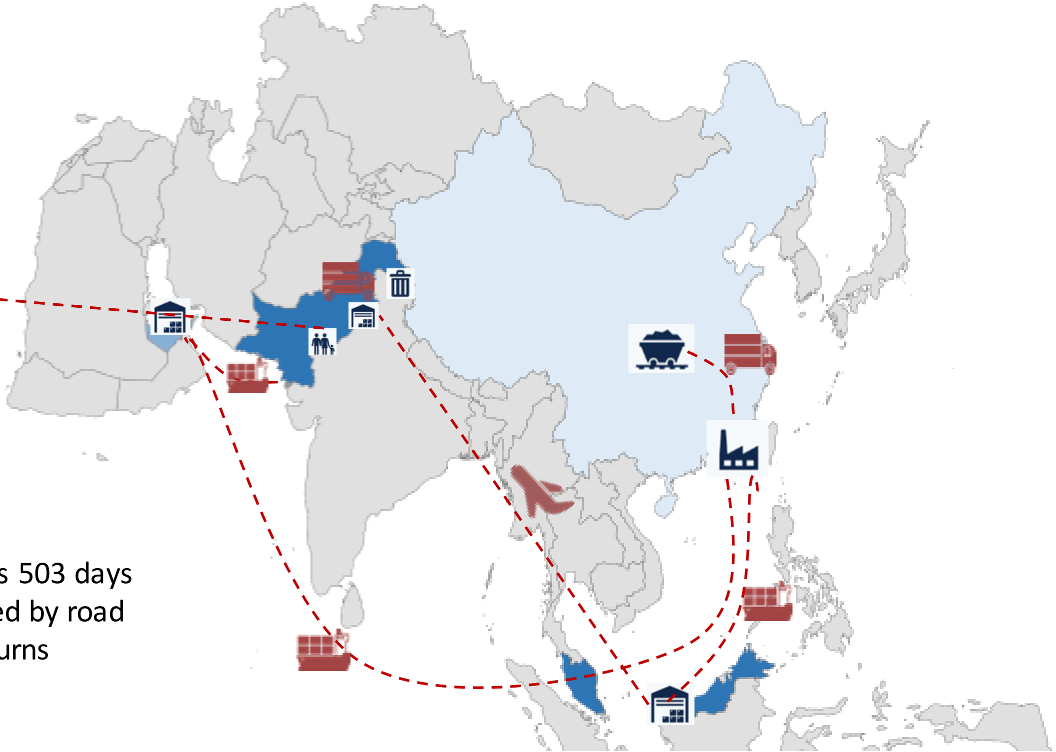
Shelter

IFRC

The International Federation of Red Cross and Red Crescent Societies







Baseline,

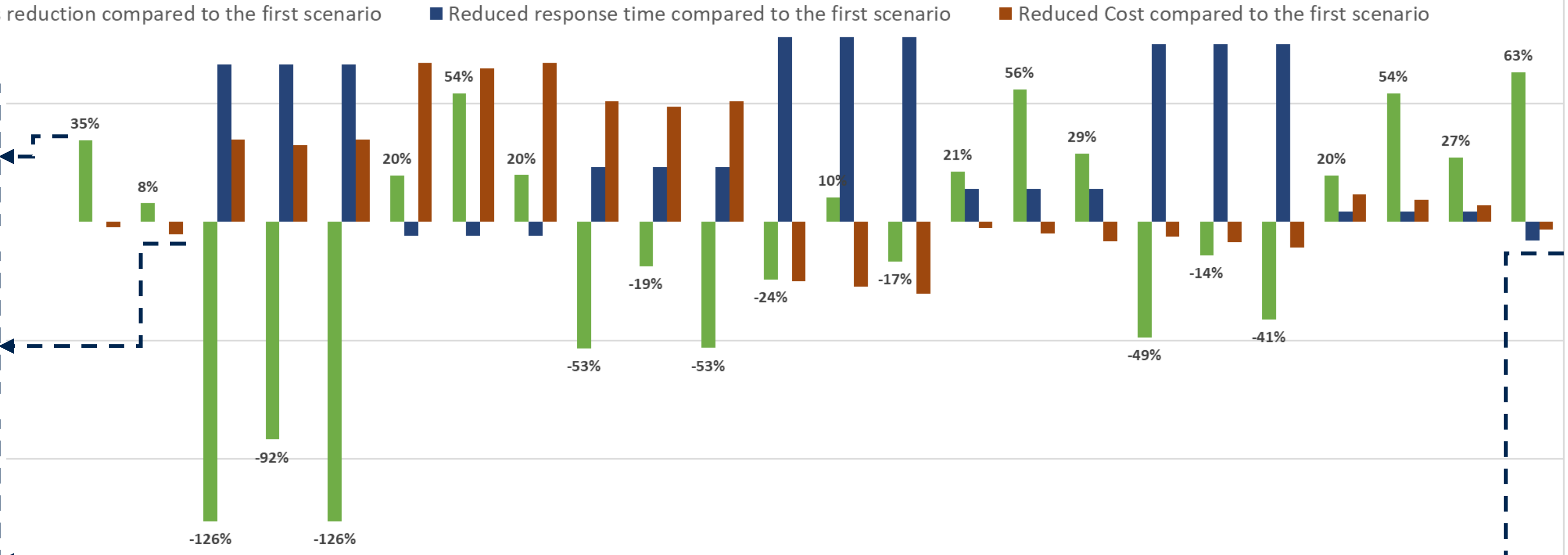
- China to prepositioning warehouses by sea
- Dubai (20%) by sea
- Malaysia (70%) by air
- Canada (10%) by air to Pakistan
- Dubai's prepositioning is 48 days, and Malaysia's is 503 days
- In Pakistan, sent to field warehouses and distributed by road
- Waste disposal: 95% to open dumps, 5% to open burns

Comparing different scenarios with the baseline scenario:

Recycling can reduce CO_2e to 35%

Solar with more cost can reduce CO_2e only to 8%

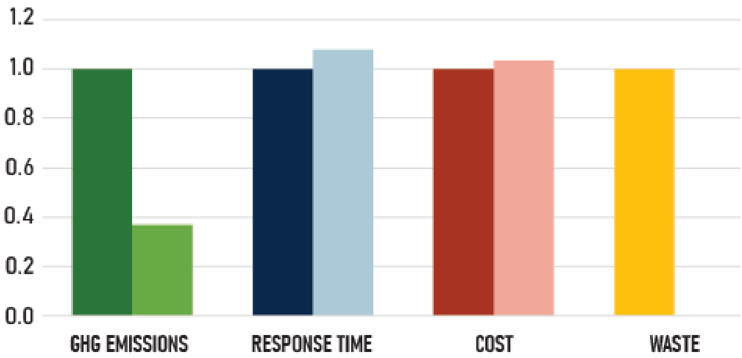
Recycling + Solar +Ship can reduce CO_2e to 63%



	Actual scenario in Pakistan (P1: 20%, P2: 70%, Inkind: 10%) 1	Actual scenario in Pakistan (P1: 20%, P2: 70%, Inkind: 10%) / Recycling 2	Actual scenario in Pakistan (P1: 20%, P2: 70%, Inkind: 10%) / Solar 3	Direct transportation from China to Pakistan/Air 4	Direct transportation from China to Pakistan/Air /Recycling 5	Direct transportation from China to Pakistan/Air /Solar 6	Direct transportation from China to Pakistan /Ship 7	Direct transportation from China to Pakistan /Ship/Recycling 8	Direct transportation from China to Pakistan /Ship/Solar 9	Direct transportation 50% ship and 50% air 10	Direct transportation 50% ship and 50% air/ Recycling 11	Direct transportation 50% ship and 50% air/ Solar 12	Scenario with prepositioning (P1: 50%, P2: 50%) /Air 13
GHG emissions reduction compared to the first scenario		35%	8%	-126%	-92%	-126%	20%	54%	20%	-53%	-19%	-53%	-24%
Reduced response time compared to the first scenario		0%	0%	66%	66%	66%	-6%	-6%	-6%	23%	23%	23%	78%
Reduced Cost compared to the first scenario		-2%	-5%	35%	32%	35%	67%	65%	67%	51%	49%	51%	-25%

	Scenario with prepositioning (P1: 50%, P2: 50%)/Air /Recycling 14	Scenario with prepositioning (P1: 50%, P2: 50%)/Air /Solar 15	Scenario with prepositioning (P1: 50%, P2: 50%) /Ship 16	Scenario with prepositioning (P1: 50%, P2: 50%) /ship/ Recycling 17	Scenario with prepositioning (P1: 50%, P2: 50%) /Ship/Solar 18	Scenario with Prepositions and In-kind donations (P1: 40%, P2: 40%, Inkind: 20%) /Air 19	Scenario with Prepositions and In-kind donations (P1: 40%, P2: 40%, Inkind: 20%) /Air/Recycling 20	Scenario with Prepositions and In-kind donations (P1: 40%, P2: 40%, Inkind: 20%) /Air/Solar 21	Scenario with Prepositions and In-kind donations (P1: 40%, P2: 40%, Inkind: 20%) /Ship 22	Scenario with Prepositions and In-kind donations (P1: 40%, P2: 40%, Inkind: 20%) /Ship/Recycling 23	Scenario with Prepositions and In-kind donations (P1: 40%, P2: 40%, Inkind: 20%) /Ship/Solar 24	Baseline scenario + ship + recycling + solar 25
GHG emissions reduction compared to the first scenario	10%	-17%	21%	56%	29%	-49%	-14%	-41%	20%	54%	27%	63%
Reduced response time compared to the first scenario	78%	78%	14%	14%	14%	75%	75%	75%	4%	4%	4%	-8%
Reduced Cost compared to the first scenario	-27%	-30%	-3%	-5%	-8%	-6%	-9%	-11%	12%	9%	7%	-3%

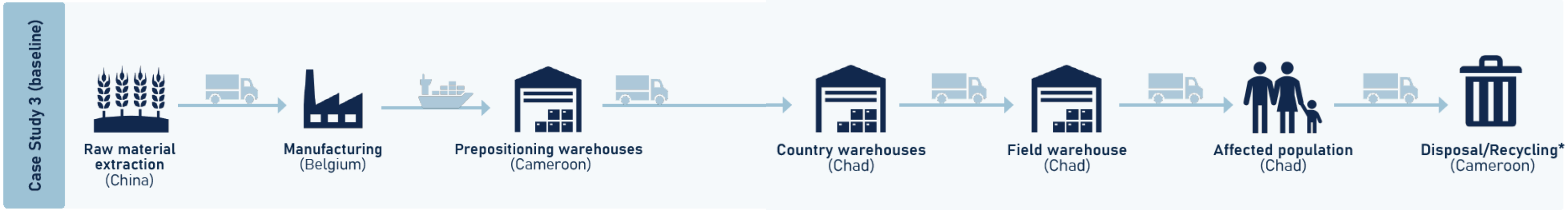
Comparing the most sustainable scenario with the baseline scenario:



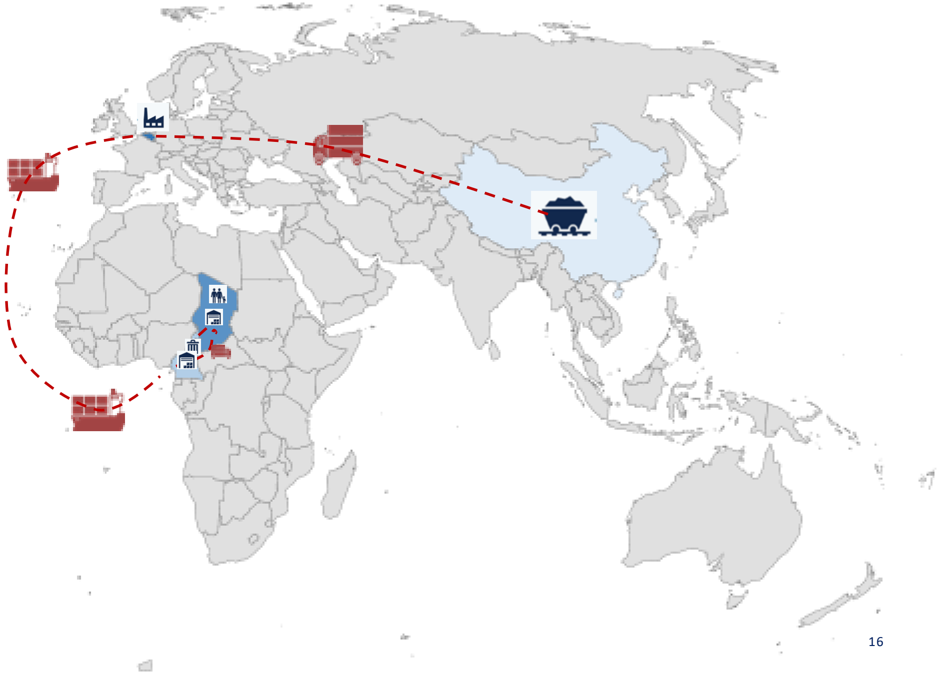
Comparison of baseline scenario to the most sustainable scenario in terms of GHG emissions (Baseline scenario + ship + recycling + solar) **in Pakistan**

Case study:

SUPER CEREAL PLUS (CSB++) DELIVERED TO CHAD FOLLOWING FLOODS (2022)



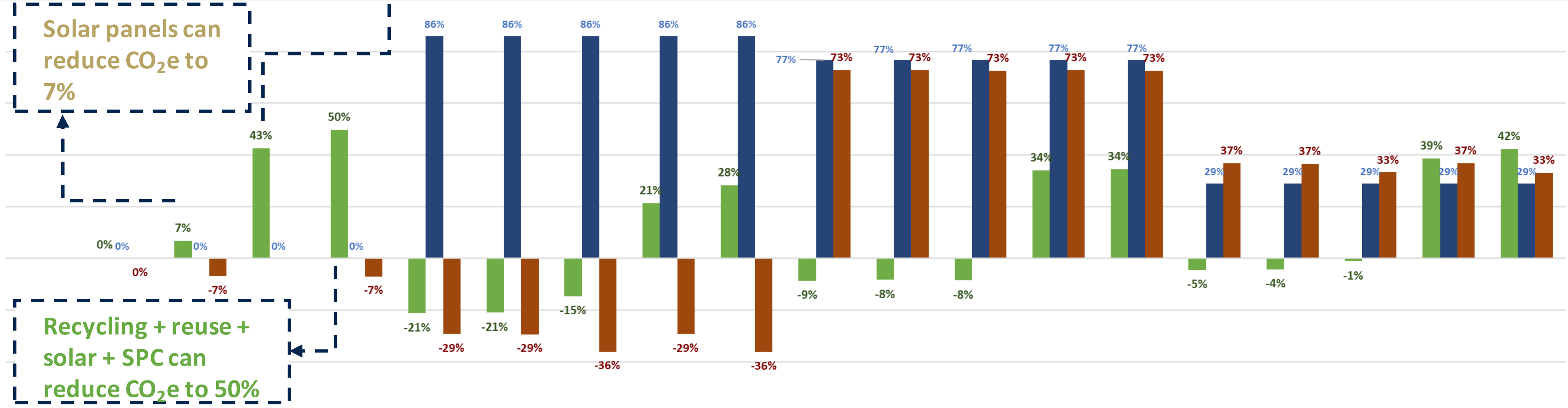
- **Raw material:** China
- **Supplier:** Belgium
- **Transport:** Ship to Cameroon.
- **Cameroon Storage:** 60 days.
- **Delivery to Chad:** Road transport.
- **Chad Storage:** 15 days.
- **Field Warehouses:** Road transport, 30 days storage.
- **Distribution:** Road to the affected population.
- **Cooking:** Open wood fire.
- **Packaging Disposal:**
    - 95% to open dump.
    - 5% to open burn.



Comparing different scenarios with the baseline scenario:

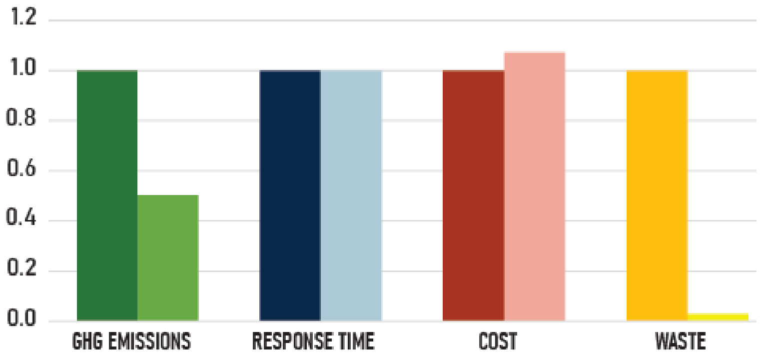
Recycling and reusing can reduce CO_2e by only 0.3%

Substituting animal-derived raw materials with plant-based alternatives can reduce CO_2e by 43%.



Baseline scenario	Baseline scenario + recycling + reuse	Baseline scenario + solar energy	Baseline scenario + soy protein concentrate (SPC)	Baseline scenario + recycling + reuse + solar + SPC	Baseline scenario + air from Cameroon to Chad	Scenario 6 + recycling + reuse	Scenario 6 + solar energy	Scenario 6 + SPC	Scenario 6 + recycling + reuse + solar + SPC	All items sent directly from supplier by air	Scenario 11 + recycling + reuse	Scenario 11 + solar	Scenario 11 + SCP	Scenario 11 + recycling + reuse + solar + SPC	50% to preposition ing by sea, 50% direct by air	Scenario 16 + recycling + reuse	Scenario 16 + solar	Scenario 18 + recycling	Scenario 18 + solar energy
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	0%	7%	43%	50%	-21%	-21%	-15%	21%	28%	-9%	-8%	-8%	34%	34%	-5%	-4%	-1%	39%	42%
	0%	0%	0%	0%	86%	86%	86%	86%	86%	77%	77%	77%	77%	77%	29%	29%	29%	29%	29%
	0%	-7%	0%	-7%	-29%	-29%	-36%	-29%	-36%	73%	73%	73%	73%	73%	37%	37%	33%	37%	33%

Comparing the most sustainable scenario with the baseline scenario:



Comparison of baseline scenario to the most sustainable scenario in terms of GHG emissions (Baseline scenario + recycling + reuse + solar + soy protein concentrate) **in Chad**

CONCLUSIONS

Summary of main findings and recommendations

Summary of main findings

GHG Emissions

Procurement choices, transportation modes, energy sources, and end-of-life phases are critical factors.

For example, plant-based ingredients, sea transport, renewable energy (solar panels), and recycling initiatives are effective in reducing emissions.

Waste

Recycling and reuse strategies effectively reduce both total waste and its environmental impact

Response Time

Air transport offers quicker responses but at the expense of higher GHG emissions and costs.

Careful planning, prepositioning, and localization help balance response time with environmental and financial considerations.

Costs

Environmentally sustainable alternatives may have higher upfront costs but exhibit potential for long-term cost-effectiveness (e.g., renewable energy, recycling, and reuse initiatives).

Recommendations for practitioners

Procurement Strategy:

Consider the entire life cycle of products, emphasizing end-of-life disposal.

Prioritize easily recyclable or reusable materials, especially in areas with limited waste management infrastructure.

Develop a procurement strategy systematically incorporating environmental sustainability.

Distribution Optimization:

Minimize air transport, opting for sea or road travel to significantly reduce GHG emissions.

Evaluate the sustainability of direct delivery from manufacturers, considering disaster response inventory sufficiency.

Explore localization to reduce environmental impacts, with a focus on local context evaluation.

Prepositioning Considerations:

Assess energy sources for storage.

Invest in renewable energy sources such as solar to reduce GHG emissions and costs in prepositioning.

Waste Management at End-of-Life:

Implement recycling and reuse strategies to play a pivotal role in waste reduction.

Consider waste management as a critical factor for an environmentally sustainable humanitarian response.

Thank you for your attention!

QUESTIONS?

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