

Opportunities for valorisation of pelagic *Sargassum* in the Dutch Caribbean

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TKI 1 year project (jan-dec 2020)

Goals of the study

- Review the state-of-the-art on *Sargassum* biology and value chains for valorisation
- Identify knowledge gaps and define a research agenda to support implementation of valorisation chains in Dutch Caribbean

1. Biology, ecology, origin, socio-ecological impact and management (Matthijs van der Geest, WMR)

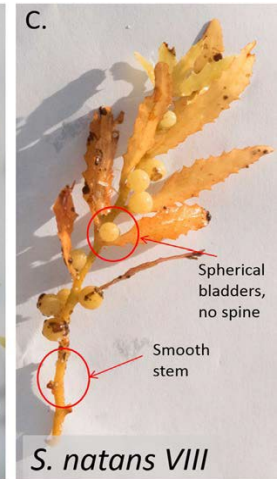
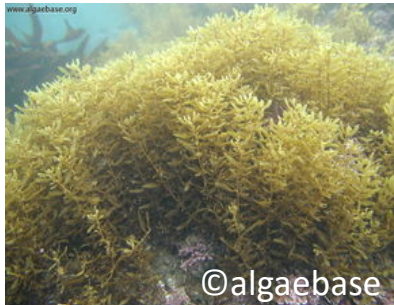
2. Valorisation options (Ana Lopez Contreras, WFBR)

3. Economic, societal and environmental impact of value chains (Sander van den Burg, WEcR)

4. Research agenda (KG), 5. Implementation plan, 6. General conclusions

1.1 Biology and ecology of pelagic *Sargassum*

- ***Sargassum***: a genus of brown macroalgae with >350 species in both temperate and tropical oceans, mostly **benthic** (bottom-attached)
- A few species, restricted to the Atlantic Ocean, are “**holopelagic**” spending their full life cycle afloat, transported by ocean currents with influence from surface winds



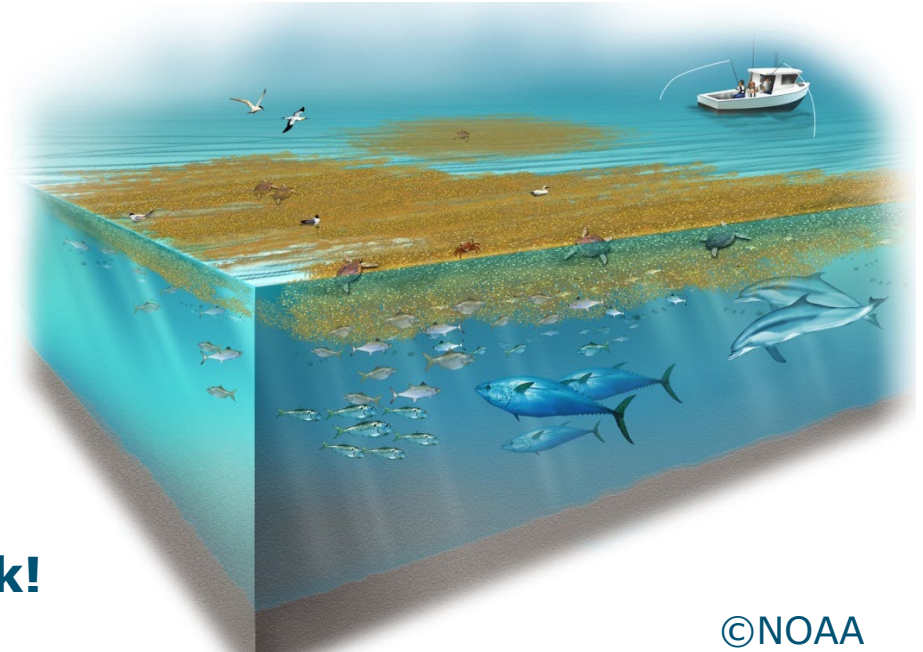
1.1 Biology and ecology of pelagic *Sargassum*

- Vegetative reproduction through growth and fragmentation
- Rapid growth when conditions are favorable (doubling time: 9-14 days)
- Formation of extensive floating rafts in otherwise empty ocean

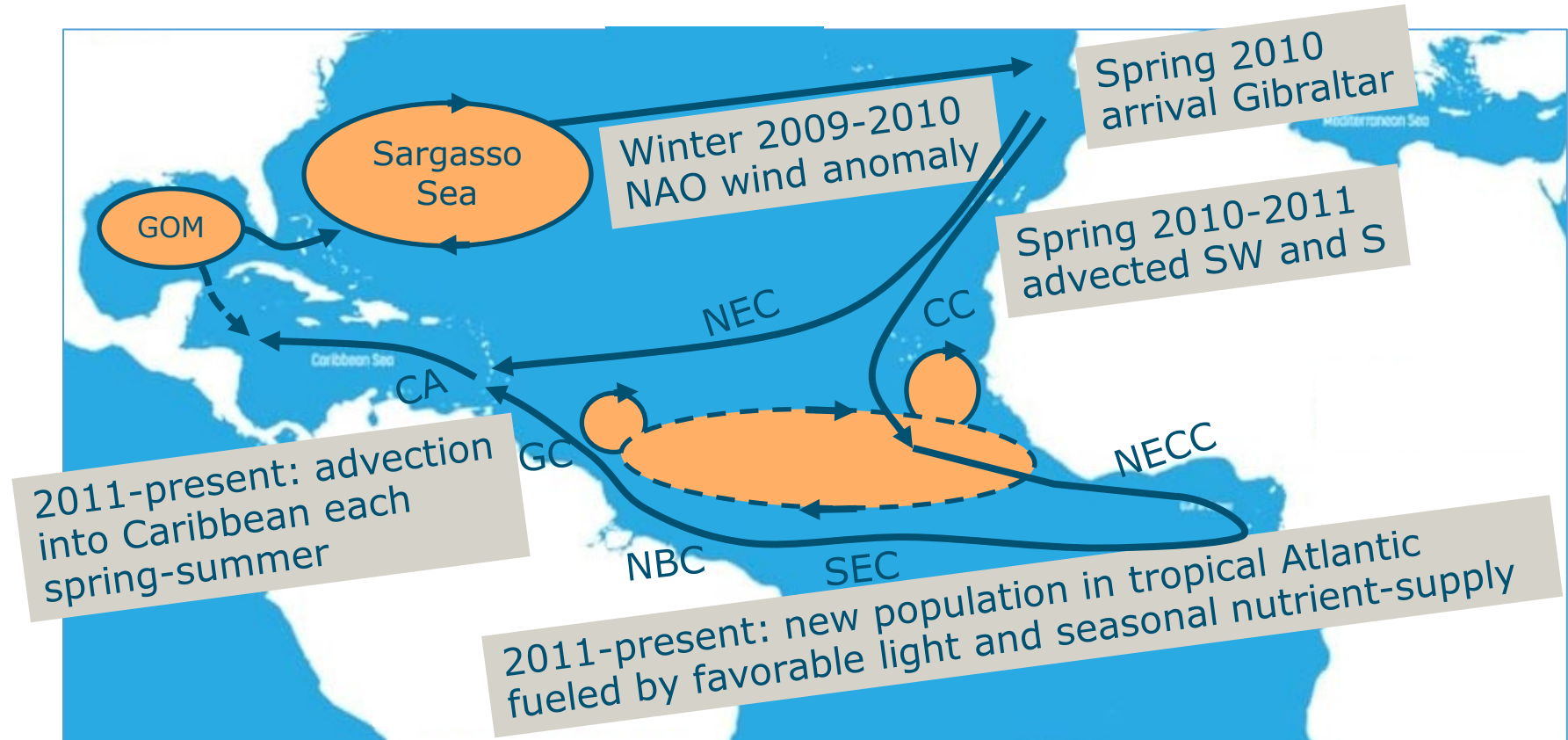


1.1 Biology and ecology of pelagic *Sargassum*

- *Sargassum* rafts provide a critical spawning, nursery and foraging habitat for many (endangered) species, some of which are endemic
 - 145 invertebrate species
 - 111 fish species
 - 26 seabird species
 - 4 sea turtle species
 - Dolphins
-
- **Also an important carbon sink!**



1.2 Origin pelagic *Sargassum* influxes Caribbean



1.3 Impacts pelagic *Sargassum* influxes Caribbean

When beaching socio-ecological impact on:

- Coastal habitats and fauna
- Tourist industry
- Human health
- Fisheries (indirect and direct)

Cleaning of 1m² coastline: ~1000 USD



1.4 Management of pelagic *Sargassum* influxes

Current situation Dutch Caribbean

- Insufficient material for prevention
- Damage to coastal habitats
- Beach clean-ups labor-intensive with risk to human health and environmental damage
- Often no management plan/policies for disposal and storage of *Sargassum*



1.4 Management of pelagic *Sargassum* influxes

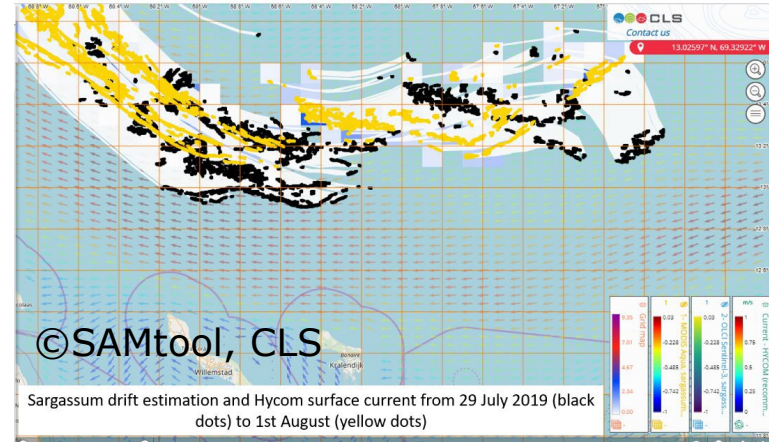
An environmental trade-off: harvesting at sea or let it beach?

Harvesting:	On-shore	Near-shore	Off-shore
Environmental impact	high	low	high
Suitable for processing	-	+	+
Technical & economic feasibility	+/-	+	-

Prevent *Sargassum* from beaching: **harvest near-shore!**

1.4 Management of pelagic *Sargassum* influxes

- Early warning systems based on RS:
4-day stranding forecasts
- Easily deployed, cleanable, robust
booms to prevent beaching and direct
Sargassum to suitable sites for harvest
- Multicat that can harvest and process
Sargassum near-shore
- **Sustainable valorisation chain for
harvested *Sargassum***



2. Valorisation Options

- *Sargassum* is mainly composed of sugars (polymers, mannitol), uronic ac. (alginic ac.), salts, protein, lipids
- Relative composition varies with growth conditions
- Contains bioactive compounds: fucoidans, other
- Wide range of uses: from fertilizer to building material
- Content in heavy metals, iodine and arsenic can limit applications in food chain



Composition of pelagic *Sargassum* samples

Samples Bonaire	% of dry weight				mg/kg		
	Sugars*	Uronic ac	Ash**	Protein	I	tAs	iAs
Lagun	14.1	13.5	42.5	6.2	221	89	56
Lac Bay	12.1	12.9	47.5	5.8	403	74	44

*Glucose, xylose, fucose. Mannitol detected in Lac Bay sample, 0.7%

** K, Ca, Na, S most abundant

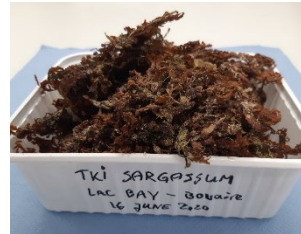
For use as organic fertilizer: iAs max. content is 40 mg/kg

For use as feed: iAs max. content 2 mg/mg

Iodine is at relatively high levels for direct applications on food/feed



Lagun sample



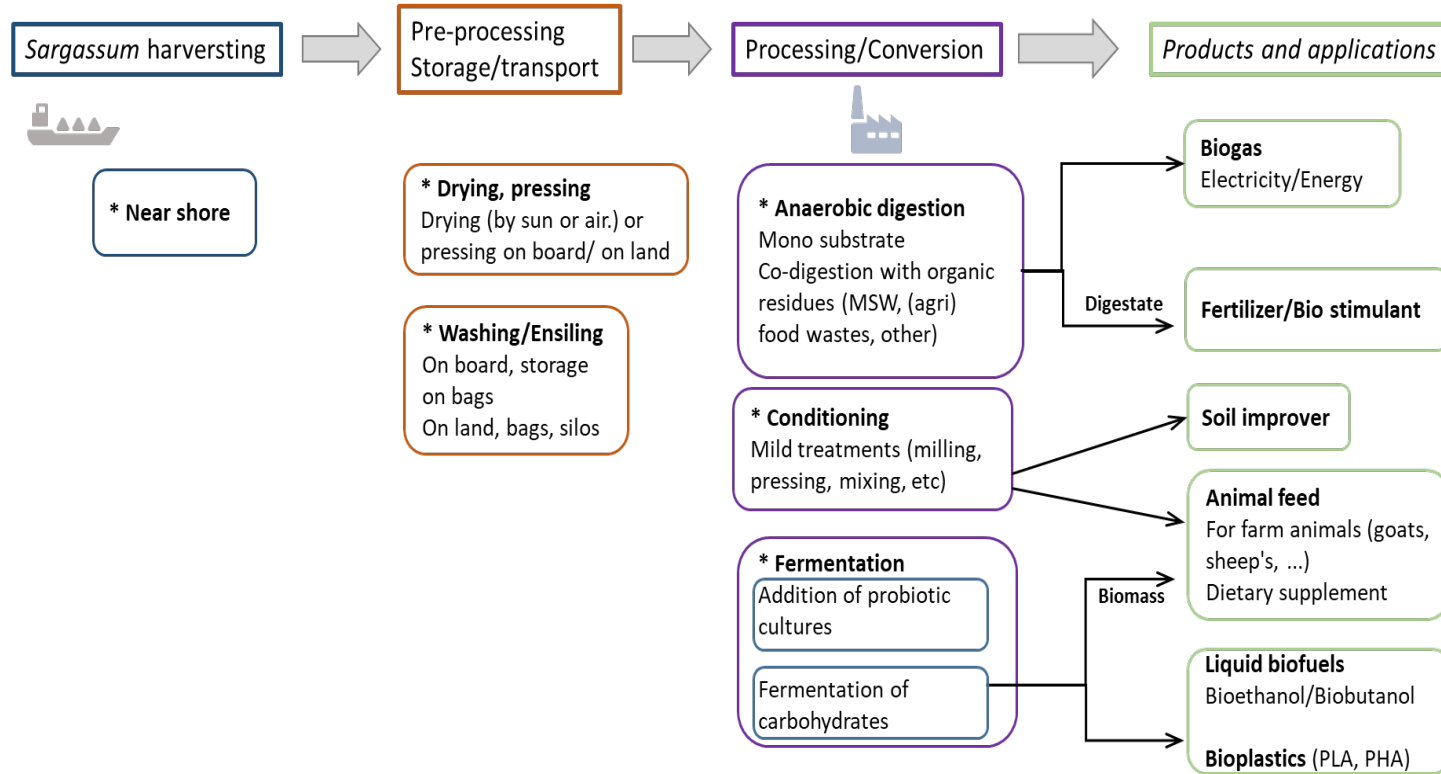
Lac Bay sample



Value chains for valorisation

- *Sargassum* blooms are seasonal and difficult to predict in the long term
- For a *Sargassum*-based valorisation chain, reliable and sustainable supply is necessary: Farms could be an option, not established yet
- For the current situation in Dutch Caribbean: Prevent disposal and combine the processing of *Sargassum* with other organic wastes (food waste, manure, garden waste,..) in the islands, contributing to a circular use of biomasses
- Need for scalable and continuous systems to process the biomass of blooms as needed

■ Valorisation chains



Combining processing of
Sargassum with organic wastes
for energy or agriculture

Contribute to circular use of
wastes and resilience of
communities

3. Economic, societal and environmental impact of valorisation chains

Based on literature: a general feeling that pelagic *Sargassum* is a costly problem but no detailed analysis.

Step one: Getting to grips with the problem:

- Stakeholder analysis, incl. who bears current costs
- Analysis of direct economic impact
- Analysis of indirect economic impact



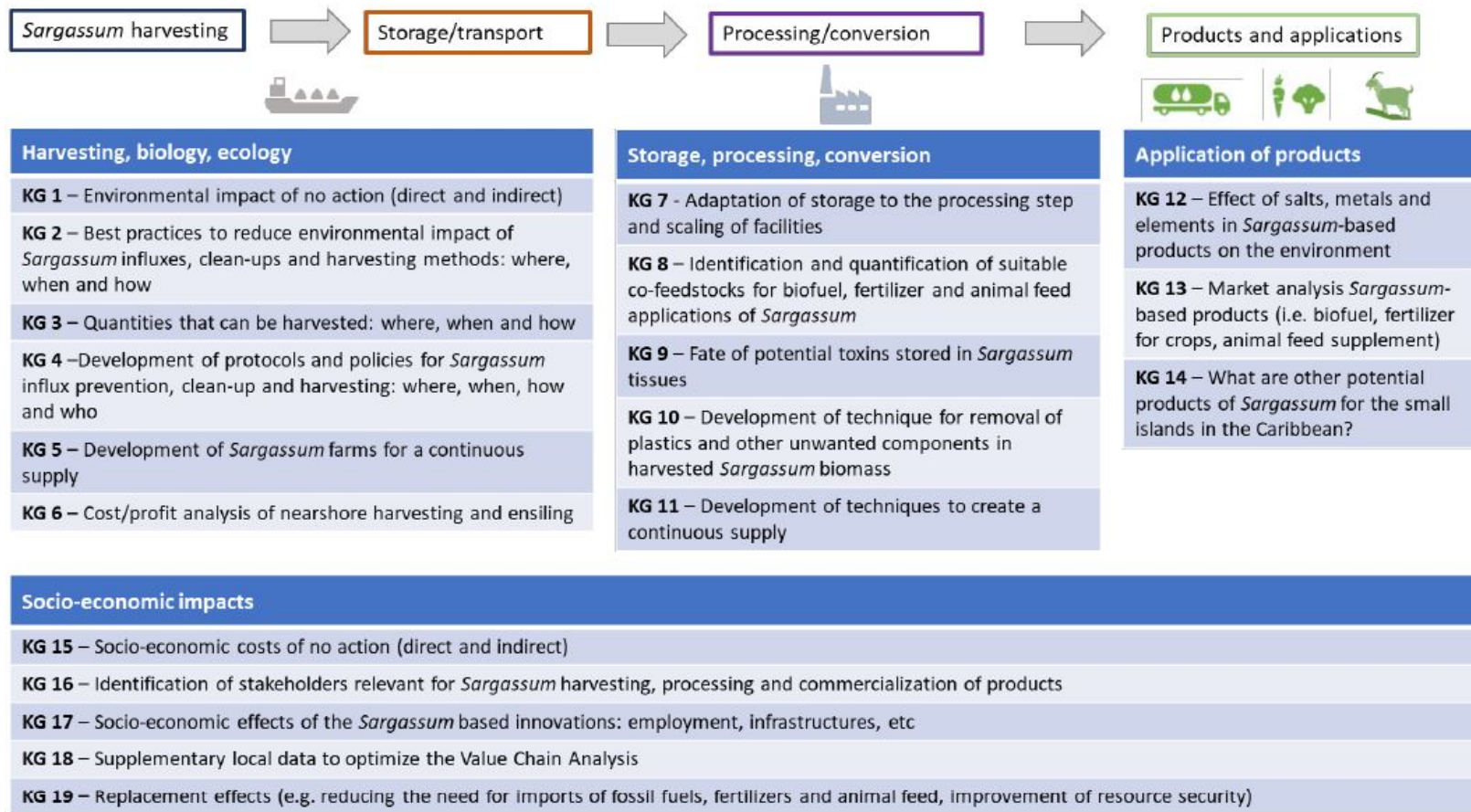
<https://caribischnetwerk.ntr.nl/2018/03/07/iedereen-doet-wat-hij-kan-tegen-sargassum-op-bonaire/>

Impact

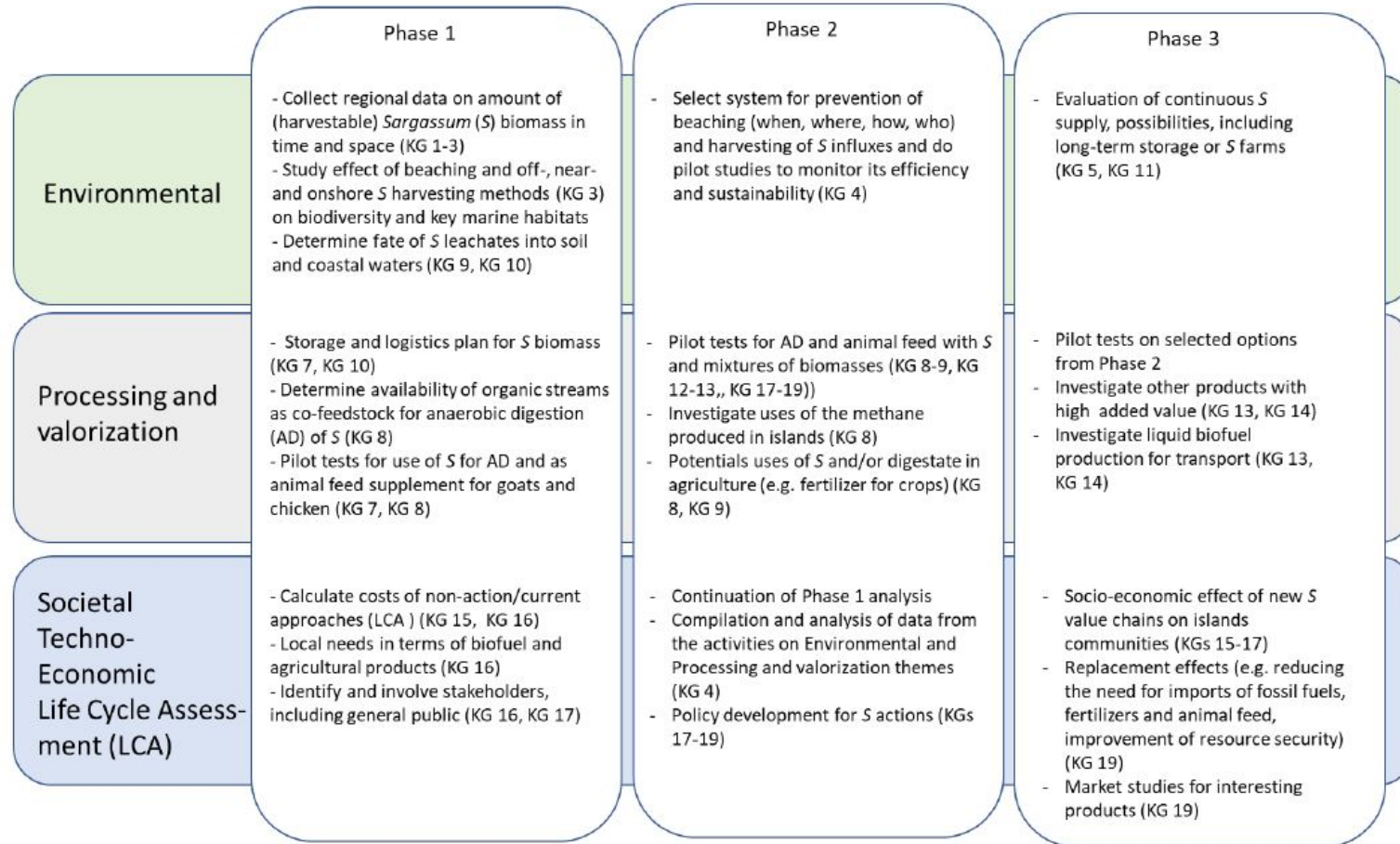
- Second step: analysis of costs and benefits of valorisation options
 - Which activities/valorisation options are the most promising?
 - Evaluation of environmental and climate impact using LCA and Carbon Footprint methods
- Who wants to invest in decreasing the impact of the pelagic *Sargassum* blooms?

-> multiple methodological suggestions are in our report

4. Knowledge gaps



5. Implementation plan



6. General conclusions

- Pelagic *Sargassum* provides vital ecosystem services at open ocean
- Pelagic *Sargassum* influxes and blooms in Caribbean likely to persist
- Influxes are a global problem that requires international cooperation
- To reduce socio-ecological impact of influxes best to prevent beaching
- Near shore harvesting most environmentally friendly
- Development of *Sargassum* management & valorisation policies needed
- Need for quantification of harvestable biomass in Dutch Caribbean to make appropriate business plan for valorisation

- Mapping and quantification of biomasses that can be co-processed with pelagic *Sargassum* for anaerobic digestion-based value chains
- Develop island specific *Sargassum*-based value chains
- Evaluate potential risks of where and how toxic compounds in pelagic *Sargassum* may accumulate in the value chain, including leaching in soil
- Evaluate social (job-creation) aspects of pelagic *Sargassum* management and valorisation and how it affects the communities involved

Thanks to collaborators

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Caren Eckrich (Stinapa)

Report available at: <https://library.wur.nl/WebQuery/wurpubs/fulltext/543797>