TERRAMAR workshop 20-10-2023 output

Climate Impacts for Bonaire

02 April 2024

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Content

1. Introduction

A workshop on 20 October 2023 was jointly organized with Islanders at the Helm, TERRAMAR, stichting Climate Adaptation Services (CAS), KNMI, and WUR to discuss and prioritize climate impacts. This workshop was part of the Trans-Atlantic Platform (TAP) developed within Islanders at the Helm to promote knowledge and awareness of climate challenges through courses, lectures and workshops. For the workshop, 63 contacts were invited from government, nature organizations, social-cultural, and economic sectors. Presentations were given about climate scenarios, the climate impact atlas, and adaptation approaches. The recording can be found here.

For the interactive workshop session, climate impact diagrams were discussed. These show the consequences of climate change for various climate themes, such as heat and drought. The impact is categorised in economic, environmental, and socio-cultural impacts. A first version of the climate impact diagrams for Bonaire was made by stichting CAS based on a literature study. During the workshop, we validated and prioritized the climate impact diagrams with the attendees. This document describes the results of the workshop. Section 2 describes the feedback on the climate impact diagrams per theme (e.g., drought, heat, sea-level rise); section 3 lists the priorities identified during the workshop; and we conclude in section 4 on how this input is used in continuation of the research and knowledge infrastructure. Annex A lists the impacts, sources consulted, and any changes made during the workshop. Annex B includes pictures of the posters edited during the workshop.

2. Climate Impact Diagrams per theme

Climate impact diagrams present a simplified, visual summary of current scientific knowledge of climate impacts. The diagrams help to gain more insight into opportunities and risks, and may kickstart the search for additional knowledge or collaborations. As these diagrams are simplified representations, they are consequently incomplete. Nevertheless, they offer a powerful starting point for a joint approach in taking climate action.
The diagrams show the climate hazard theme in the center (e.g., "It is getting drier" below), with the relevant hazards connected to it, that are themselves connected to sector-based impacts. The impacts are sector-specific, but were divided in three main categories: socio-cultural (purple), environmental (green) and economic (blue). Note that it is not always easy to define an impact to specifically one sector.

2.1. It is getting drier

The workshop resulted in the above diagram of impacts of climate change on the theme "It is getting drier". These impacts encompass a variety of social, economic, and natural consequences. Prolonged drought, seawater intrusion, and increased evaporation lead to limited freshwater resources, crop failures, and loss of terrestrial biodiversity. Heavy rain after drought events exacerbate flooding and runoff issues.
The diagram shows which elements were added during the workshop:

- Addition of wildfire impact
    - Air pollution, No place to go, social stress, pressure on health care. Droughts can cause wildfires which have many social impacts. It can cause air pollution (specifically: dioxins cause cancer). Houses can burn down. People have no place to go if there are no shelters.
    - Loss of biodiversity.
- Addition of heavy rain impacts after drought. Heavy rain events can cause flooding and mud slides. This is especially the case after periods of droughts. This can cause damage to infrastructure like houses or roads. Schools, shops and businesses might need to close. It can also cause run-off of sediment into the ocean which impacts the coral reef.
- Addition of more dust leading to less solar radiation, impact on plants
- Elaboration on loss of terrestrial biodiversity: Less ponds and salinas due to dry conditions impact fish and flamingo. Due to drought, nature restoration becomes harder.
- Elaboration on Crop failure: Less food for animals & humans. Seed termination is a big problem. Reason to grow food forests. Higher food prices and food scarcity have health impacts.
- Elaboration on Limited freshwater resources: No drinking water for animals, Pumps in Rincom houses dry out, Wells get drier and saltier (impact for farmers), No stable rainy season to plant, Regulation of water use and resources is needed, Reforestation can be a solution.

2.2. Storms, rains, and cyclones are intensifying

With intensifying storms, rains & cyclones, erosion, flash floods, and coastal inundation are increasing issues posing risks to infrastructure, health systems, and natural habitats (diagram above).

Additions that were made during the workshop:

- Addition of declining water quality from erosion.
- Addition of erosion impacts leading to uneven flooring for houses and dirt roads washing away.
- Addition of regional effects because of dependencies (food/goods supply, cross-family bonds between islands, etc.)
- Addition of social disruption, cars damages from flash floods.
- Addition of intensive rains leading to damage to houses.
- Addition of on island migration
- Addition of the loss of natural coastal protection
- Water management was mentioned and its impact on erosion and water quality. Goat management and wildlife grids on kaminda di lac, removing goats will help the natural resilience of nature. As this is a solution rather than an impact of climate change, it is not included on the below final impact diagram.

Questions that were posed:

- Will the hurricane season get larger?
- How will local ocean currents change?
    - Impact on coral reproduction

2.3. Changing wind

Changing wind patterns amplify the impacts from waves and surges, affecting the west coast. It further damages vegetation and coral reefs, while also posing challenges for building codes and perceived temperatures.

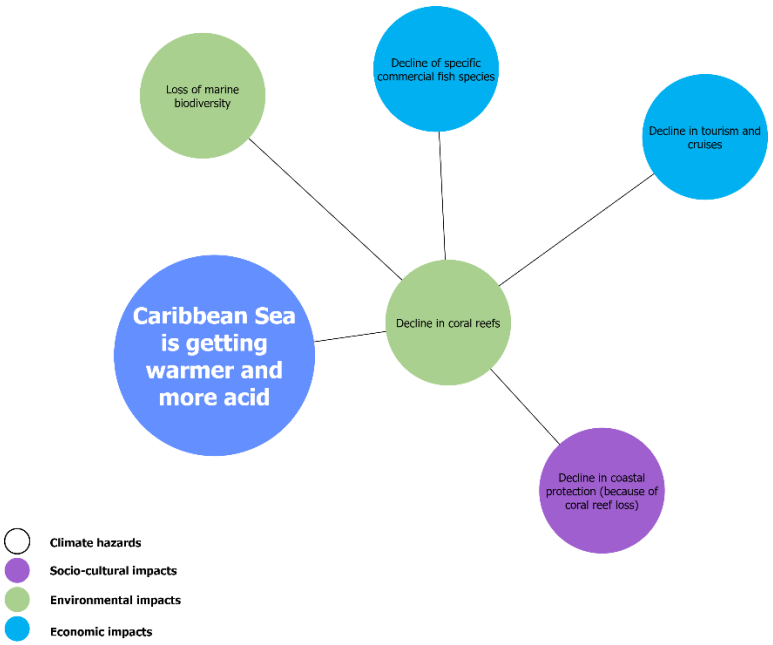
Adjustments that were identified during the workshop:

- Addition increase in evaporation. An increase in average wind enhances evaporation by promoting the diffusion of water vapor away from the evaporating surface. The saturated air layer will be dispersed, allowing drier air to replace it. The increased evaporation can contribute to soil drying with impact on vegetation.
- Addition of Impact on temperature experience. With more wind, the heat is more tolerable for humans.
- Addition of Sahara dust. Wind could bring Sahara dust to Bonaire which can have

health impacts: astma.

- Addition of Building house for cooling. In case of sustained (anthropogenically driven) changes to wind direction this could result in houses that are build in a certain direction to provide cooling being less able to keep temperatures low.
- Addition of Surges. In case of wind reversals, the lay side of the island may face flooding (Kralendijk for example).
- Addition of Fisherman vessels and cruise boats. Changes in wind direction might cause problems with docking for cruise ships and for fisherman vessels to perform work (e.g. rough and unpredictable sea conditions).
- Addition of Damage to vegetation and coral reef impacts from wind gusts. Wild sea, rough conditions and turbulence might impact the health of coral reef systems.
- Addition of surfing conditions. Some wind directions are preferable for good surfing conditions (depends on location on Island).

2.4. Caribbean sea is getting warmer and more acid



The "Caribbean Sea is getting warmer and more acidic" theme underscores the decline of coral reefs, loss of marine biodiversity, and economic impacts on tourism and coastal protection efforts. Rising sea temperatures threaten the livelihoods of fishermen, coastal communities, and tourism industries, leading to economic losses and social disruptions. Discussions during the workshop:

- It was mentioned that a pro-active approach is needed for the decline in coral reefs. During the workshop, the causes of both coral bleaching as well as sewage overflow was mentioned, which should both be researched.
- It was mentioned that there are only 5 instead of 20 tuna fish further in the sea.
- Adjustment from 'collapse' to 'Decline of specific commercial fish species'.

- it was said that loss of marine biodiversity also leads to longer working hours for fisherman, more fuel, loss of culture, decrease in supply of local fish, and higher prices.
- It was mentioned that tourism decline could be positive, given the negative impacts from mass tourism (too many divers in certain areas was mentioned).
- It was mentioned that there is a relation with more nutrients leading to more sargassum.
- The question was asked: More jellyfish?

2.5. The sea level is rising

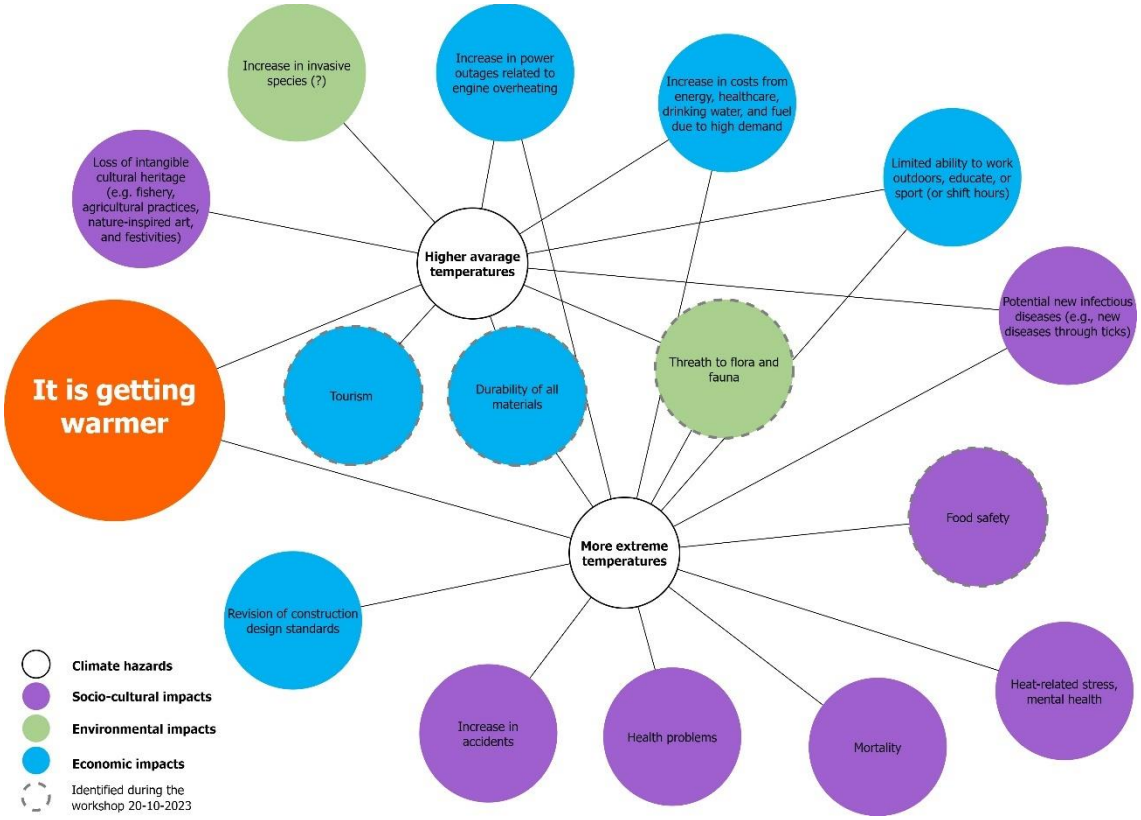
The theme "The sea level is rising" encompasses coastal inundation, salinization, and beach erosion resulting in permanently flooded buildings and infrastructure, including cultural heritage, leading to social and economic disruptions. Additionally, the loss of beach habitats due to erosion exacerbates the vulnerability of nesting sea turtles and other coastal species, impacting biodiversity and ecosystem resilience.
Adjustments that were identified during the workshop:

- Decline of beach recreation was added.
- Salinization as a result of seawater intrusion was added (amplifying impacts from

drought, see also section 2.1).

- The hospital and airport were identified as critical infrastructure at sea level. Belnem was identified as an area with social housing at risk.
- It was stressed that mangroves prevent beach erosion. Furthermore, it was mentioned that beach erosion also damages infrastructure and cars, and affects the accessibility between places.
- It was mentioned that dykes will not work because of porous soils (or with concrete but in vain). Also, the name kralen*dijk* was highlighted.
- Loss of jobs if Cargill can no longer function.
-

2.6. It is getting warmer



The theme of "It is getting warmer" brings about socio-economic challenges, including health problems due to heat-related stress and potentially increased mortality rates. Higher average temperatures also lead to rising costs for energy, healthcare, and fuel, disrupting economic stability and affecting public health systems. Additionally, the durability of materials decreases, impacting construction and infrastructure projects, while tourism faces declines due to uncomfortable conditions. Finally, heat is a threat to flora and fauna.
Adjustments made that were identified during the workshop:

- It was uncertain whether an increase in invasive species is likely with climate change.

It was furthermore questioned whether climate change impacts infectious diseases with more mosquitos. The potential change of new infectious diseases was mentioned, e.g., through ticks.

- The impact of more extreme temperatures to all animals and reduced resilience of vegetation and less opportunity for restoration were added.
- The energy transition in relation to increases in power outages with engine overheating was mentioned.
- Including the increasing costs of healthcare in 'Increase in costs from energy, healthcare, drinking water, and fuel due to high demand'. Relatedly, energy poverty was mentioned. In addition, suggestions were made for using numbers from WEB, statline, CBS, ACM for studying the statistics.
- In addition to impacts on the limited ability to work outdoors (or shift working hours), also the impacts on education and sport was added. Not just the economic impact, but also socio-cultural impacts, as everything is more tiring in the heat. The remark was made that a shift in working hours is often restrained by the school hours. "Cannot shift with kids going to school". Selibon has already started rubbish collection earlier due to heat in September 2023.
- Isolation of elderly people was mentioned as an important problem related to heat-related stress and mental health issues.
- For heat-related mortality it was mentioned that determining the link with climate change is hard there is no proper registration. However, from experience, more hospital admissions of elderly people and more noncommunicable diseases (NCDs), such as heart disease, cancer, chronic respiratory disease, and diabetes, are seen during hot periods.
- It was mentioned that heat-health problems are also sport related.
- Increase in car accidents was widened into a general increase in accidents given that for example people stop wearing helmets at work.
- The revision of construction design standards given more extreme temperatures was changed into the investment in construction design including wind and vegetation. It was mentioned that European design is flawed, and that local trees should be favoured over palm trees.
- Addition of The economic impact of higher average temperatures on tourism.
- Addition of the impact of durability of all materials.
- Food safety. Conservation of perishable goods is already difficult and expensive and will only increase. In addition, growing crops is more difficult with more extreme heat.

3. Priorities

Prioritisation was done based on stickers, with each attendee receiving 3 stickers. They were asked the question: *"What are the most important impacts?"*.
The results showed that drought was considered to have the most significant impacts, including prolonged drought and seawater intrusion, limited freshwater resources, exacerbating health impacts and damage, and the loss of terrestrial biodiversity. Secondly,

the themes 'Storms, rains, and cyclones are intensifying' and 'Caribbean sea is getting warmer and more acid' were prioritised. The impacts that were highlighted mainly relate to impacts from extreme rainfall, and impacts on marine ecosystem. Heat-related impacts were ranked fourth in importance, while sea-level rise was fifth. Changing winds did not receive any stickers, indicating lower perceived importance in the discussions.
The list of prioritised impacts (numbers represent number of stickers):

1. **Drought (15)**: Prolonged drought and seawater intrusion (3) + loss of terrestrial biodiversity (4) + limited freshwater resources (2) + health impacts and damage (1) + 5 on theme
2. **Storms, rains, and cyclones are intensifying (11)**: Erosion and washing away of soil (5) + Waterbeheer (5) + 1 op thema
3. **Caribbean sea is getting warmer and more acid (11)**: decline in coral reefs (4) + decline in coastal protection (1) + decline in specific commercial fish species (2) + loss of marine biodiversity (2) + 2 on theme
4. **It is getting warmer (8)**: More temperature extremes (1) + health problems (1) + increase in costs (2) + increase in invasive species (1) + loss of intangible cultural heritage (1) + threat to bird species and turtles (1) + 1 on theme
5. **The sea level is rising (4)**: decrease in beach habitats (2) + permanently flooded cultural heritage (1) + threat to salt pans and loss of jobs Cargill (1)
6. **Wind (0)**

4. Continuation

This section briefly describes how outcomes will be followed up.

The first version of the KNMI Climate scenarios and the Climate Impact Atlas for the BES islands were launched end 2023. The KNMI climate scenarios consist of four pathways that describe a possible future climate around 2050 and 2100, based on low to high emissions and dry to wet climate model ranges. The atlas provides a first picture of the climate impacts on the islands and can be used by anyone concerned with climate change. See also the interview about the Climate Impact Atlas with Maurice Adriaens and Timo Kelder.

The input from this workshop suggests the need to place more emphasis on drought and rainfall-runoff impacts on Bonaire. Relatedly, the WUR is currently active in a policy support research programme focusing on resilience. One of the subprojects is focusing on sustainable rainwater management including sediment flows on the BES islands in which the effect of climate change is taken into account.

In the coming years, the scenarios and Climate Impact Atlas will be further developed. In 2024, for instance, maps and stories will be developed for St Eustatius and Saba, and maps and stories for Bonaire will be further developed. For the maps, accurate elevation data (soon to be mapped at the time of writing) and satellite information (available since beginning 2024) are important. The climate stories could move further towards action perspectives or include more local stories and knowledge. If you have ideas or suggestions for further information to include in the scenarios, maps, or stories, please let us know!

Annex A. Full list of impacts and consulted sources

Climate theme	Hazard or impact	Impact	Impact description	Source	Impact categories
The overarching climate theme	***The relevant hazards, categorized per relevant climate theme***	***The relevant impacts***	***A description of the impact***	***Source of the impact description***	***The relevant impact category for this impact***
Combination of all	For the diagrams related to heat	**Loss of intangible cultural heritage**	Climate change is predicted to impact Bonaire's culturally relevant fishery, agricultural practices, nature-inspired art, and festivities	IVM, 2022	Social impacts
It is getting drier	Prolonged drought, seawater intrusion, increased evaporation (or temperature)	**Limited freshwater resources**	Resources become limited due to decreased rainfall, seawater intrusion, increased temperature, increased reach of tides, waves and storm surges	DCNA, 2020	Social impacts
It is getting drier	Prolonged drought, seawater intrusion, increased evaporation (or temperature)	**Crop failure**	Sea level rise, heat waves, droughts storms have indirect impacts on health through vector-borne diseases, NCDs (like Respiratory, cardiovascular, circulatory, and kidney problems), heat-related stress, malnutrition and food insecurity, water-borne diseases, skin diseases, and mental health.	IVM, 2022	Economic impacts
It is getting drier	Wildfire	**Health impacts and**	Droughts and heat can lead to increasing number of wildfires impacting chronic diseases	IVM, 2022	Social impacts

		damage			
It is getting drier	Prolonged drought, seawater intrusion, increased evaporation (or temperature)	**Loss of terrestrial biodiversity**	Increased temperatures will drive forests of Saba and St. Eustatius further uphill, which increases their exposure to extreme weather such as droughts and hurricanes. Furthermore, the drier lower regions will then become more susceptible to fires, further threatening these areas.	DCNA, 2022	Natural impacts
It is getting drier	Wildfire	**Air pollution, No place to go, social stress, pressure on health care**	Droughts can cause wildfires which have many social impacts. It can cause air pollution (specifically: dioxins cause cancer). Houses can burn down. People have no place to go if there are no shelters.	Workshop	Social impacts
It is getting drier	Wildfire	**Loss of biodiversity**	Wildfire can destroy flora and fauna	Workshop	Natural impacts
It is getting drier	Heavy rain events	**Runoff**	Heavy rain events can cause run-off of sediment into the ocean which impacts the coral reef.	Workshop	Natural impacts
It is getting drier	Heavy rain events	**Flooding and mud slides**	Heavy rain events can cause flooding and mud slides. This is especially the case after periods of droughts. This can cause damage to infrastructure like houses or roads. Schools, shops and businesses might need to close (or the Terramar museum).	Workshop	Social impacts
It is getting drier	More dust	**Less solar radiation, impact on plants**		Workshop	Natural impacts
It is getting drier	Prolonged drought,	**Loss of**	Less ponds and salinas due to dry conditions impact fish	Workshop	Natural impacts

	seawater intrusion, increased evaporation (or temperature)	**terrestrial biodiversity**	and flamingo. Due to drought, nature restoration becomes harder.		
It is getting drier	Prolonged drought, seawater intrusion, increased evaporation (or temperature)	**Crop failure**	Less food for animals & humans. Seed termination is a big problem. Reason to grow food forrests. Higher food prices and food scarcity have health impacts	Workshop	Social impacts
It is getting drier	Prolonged drought, seawater intrusion, increased evaporation (or temperature)	**Limited freshwater resources**	No drinking water for animals, Pumps in Rincom houses dry out, Wells get drier and saltier (impact for farmers), No stable rainy season to plant, Regulation of water use and resources is needed, Reforestation can be a solution,	Workshop	Natural impacts
It is getting warmer	More extreme temperatures	**Increase in car accidents**	Asphalt is not of the best quality, which means that oil may surface during extreme temperatures leading to slippery conditions. During the workshop, increase in car accidents was widened into a general increase in accidents given that for example people stop wearing helmets at work.	CPA report 2022	Social impacts
It is getting warmer	More extreme temperatures	**investment in construction design including wind and vegetation**	During the workshop, the revision of construction design standards given more extreme temperatures was changed into the investment in construction design including wind and vegetation. It was mentioned that European design is flawed, and that local trees should be favoured over palm trees.		Economic impacts
It is getting	Higher average	**Limited**	Both direct impacts due to e.g. unbearable working	Izaguirre,	Economic

warmer	temperatures, more extreme temperatures	**ability to work outdoors, educate, or sport (or shift hours)**	conditions or health impacts, as well as indirect impacts through e.g., impact on family or deprived sleep from hot nights. During the workshop, it was mentioned that in addition to impacts on the limited ability to work outdoors (or shift working hours), also the impacts on education and sport was mentioned. Not just the economic impact, but also socio-cultural impacts, as everything is more tiring in the heat. The remark was made that a shift in working hours is often restrained by the school hours. “Cannot shift with kids going to school”. Selibon has already started rubbish collection earlier due to heat in September 2023.	2020	impacts
It is getting warmer	Higher average temperatures, more extreme temperatures	**Increase in costs from energy, healthcare, drinking water, and fuel due to high demand**	With hotter temperatures there is more demand for air conditioning, fuel, and drinking water. This increases the costs. Whether the price would increase was still debated. People from Aqualectra Curacao mentioned that the solar energy efficiency goes down at high temperatures. An example of the increase in electricity costs is that in September, the warmest month of the year, the cost is highest due to higher usage. During the workshop, the increasing cost of healthcare was mentiond. Curative is more expensive than preventive healthcare. In addition, suggetions were made for using numbers from WEB, statline, CBS, ACM for studying the statistics.	Monioudi, 2018 and CPA report 2022	Economic impacts
It is getting warmer	Higher average temperatures, more extreme	**Increase in power outages**	During the workshop the energy transition in relation to increases in power outages with engine overheating was mentioned.	CPA report 2022	Economic impacts

	temperatures	**related to engine overheating**			
It is getting warmer	more extreme temperatures	**Health problems**	Heat increases cardiovascular and respiratory diseases, especially within the elderly. These increased temperatures can raise the level of ozone and other pollutants, as well as pollen and other aeroallergens, further threatening individuals with weakened cardiovascular or respiratory systems. Experts predict that there will be an increase in water- and foodborne infectious diseases caused by global warming. During the workshop the remark was made that health problems on the island are also sport related, and should not be looked at just from a climate (heat) perspective.	DCNA, 2023	Social impacts
It is getting warmer	more extreme temperatures	**Mortality**	During the workshop, it was mentioned that determining mortality is heat-related is hard given limited registration of cases. However, from experience, more hospital admissions of elderly people and more noncommunicable diseases (NCDs), such as heart disease, cancer, chronic respiratory disease, and diabetes, are seen during hot periods.	IVM, 2022	Social impacts
It is getting warmer	Higher average temperatures, more extreme temperatures	**Potential new infectious diseases (e.g., new diseases**	During the workshop, it was questioned whether climate change impacts infectious diseases with more mosquitos. The potential change of new infectious diseases was mentioned, e.g., through ticks.	IVM, 2022 then workshop revision	Social impacts

		through ticks)			
It is getting warmer	Higher average temperatures, more extreme temperatures	**Heat-related stress, mental health**	During the workshop, isolation of elderly people was mentioned as an important problem related to heat-related stress and mental health issues.	IVM, 2022	Social impacts
It is getting warmer		**Increase in invasive species (?)**	Increase in mosquitos pose a threat to human health. Other invasive species inlcude the lion fish or snails (unsure about the link with climate change)	DCNA, 2023	Natural impacts
It is getting warmer	higher average temperatures	**Threath to flora and fauna**	Higher average temperatures are a potential threat to birds species and turtles. This impact was removed and the impact of more extreme temperatures to flora and fauna was added during the workshop. Reduced resilience of vegetation and less opportunity for restoration was mentioned.	workhop	Natural impacts
It is getting warmer	more extreme temperatures	**Tourism**	The economic impact of higher average temperatures on tourism was added.	workhop	Economic impacts
It is getting warmer	more extreme temperatures	**Durability of all materials**	With higher temperatures, the durability of all materials decreases	workhop	Economic impacts
It is getting warmer	more extreme temperatures	**Food safety**	Conservation of perishable goods is already difficult and expensive and will only increase. In addition, growing crops is more difficult with more extreme heat.	workhop	Natural impacts
Caribbean Sea is getting warmer and more acidic	Rising sea temperatures	**Decline in coral reefs**	Due to Coral Bleaching as well as Ocean Acidification. During the workshop, it was mentioned that a pro-active appraoch is needed. During the workshop, the causes of both coral bleeching as well as sewage overflow was mentioned, which should both be researched.	IPCC, WGII, factsheet	Natural impacts

Caribbean Sea is getting warmer and more acidic	Decline in coral reefs, Higher average temperatures, more extreme temperatures	**Decline in tourism and cruises**	With rising sea temperatures corals in the Caribbean are already being impacted, affecting diving tourism. Furthermore, hotter temperatures may make it less appealing for tourists to come to Curacao. This leads to income decline. During the workshop it was mentioned that this could be positive, given the negative impacts from mass tourism (too many divers in certain areas was mentioned).	Spencer, 2022	Economic impacts
Caribbean Sea is getting warmer and more acidic	decline in coral reefs	**Decline in coastal protection**	With the decline in coral cover on shallow reefs there is less structure to attenuate waves from storm surges	IPCC, WGII, factsheet	Social impacts
Caribbean Sea is getting warmer and more acidic		**Loss of marine biodiversity**	Ocean acidification threatens calcicfied organisms and coral reefs, climate change threatens seagrass beds and mangroves (also serving as coastal protection), increase algal blooms, and alter ocean currents impacting fish and mammal migritaion. During the workshop, it was said that this also leads to longer working hours for fisherman, more fuel, loss of culture, decrease in supply of local fish, and higher prices.	DCNA, 2023	Natural impacts
Caribbean Sea is getting warmer and more acidic	decline in coral reefs	**Decline of specific commercial fish species**	Deterioration of coral reefs, shifts in migration patterns and the worsening of water quality conditions can also negatively affect fisheries, and could lead to a total collapse of specific commercial fish species [3]. This is not only an issue for food availability, but will also have economic impact as there are a number of fishermen on these islands which depend on fisheries to make a living. During the workshop it was mentioned that there are	DCNA, 2023	Economic impacts

			only 5 instead of 20 tuna fish further in the sea.		
Storms, rains & cyclones are intensifying	Erosion and washing away of soil	**Damages to land (e.g. trees falling down, roads washing away)**	Damages to land (e.g. trees falling down, exposed pipelines & cables, roads washing away). Impact on dirt roads (vulnerable neigborhoods)		Economic impacts
Storms, rains & cyclones are intensifying	Erosion and washing away of soil	**Negative impacts on the shallow reef corals and other organisms**	Increase of sedimentation and nutrients on the reef can have negative impacts on the shallow reef corals and other benthic organisms	Waitt, 2017	Natural impacts
Storms, rains & cyclones are intensifying	Flash floods	**Flooded roads / disrupted road network**			Economic impacts
Storms, rains & cyclones are intensifying	Winds, waves and coastal floods	**Injury and loss of life**	Tropical storm Tomás developed late October 2010 and became a hurricane when it was located near St. Vincent on October 29. It weakened to a minor tropical storm on November 1 and the center passed about 115 kilometers north of the ABC Islands, later that day. A feeder band developed during the early evening of the same day and barely moved throughout that night. The result was a persistent heavy thunderstorm activity over mainly the south-eastern half of Curaçao and parts of Bonaire. In	Meteorological Department Curaçao, 2018	Social impacts

			Curaçao, this heavy rain led to a couple of deaths and an estimated flood damage of about US$200 million.		
Storms, rains & cyclones are intensifying	Winds, waves and coastal floods	**Damaged buildings and infrastructure**		Meteorological Department Curaçao, 2018 and IVM, 2022	Economic impacts
Storms, rains & cyclones are intensifying	Winds, waves and coastal floods	**Risks for critical health infrastructure**	Critical infrastructure is vulnerable to sealevel rise and extreme weather events in times of which much-needed "health service delivery and healthcare access" may be jeopardized due to damages to the infrastructure and to essential equipment. Extreme weather events can cause power shortages or situations where the medical services cannot function. Critical infrastructure can suffer from the effects of accompanying storm surges and stronger winds.	IVM, 2022	Social impacts
Storms, rains & cyclones are intensifying	Erosion and washing away of soil	**Declining water quality**		Workshop	
Storms, rains & cyclones are intensifying	Erosion and washing away of soil	**Uneven flooring for houses**		Workshop	
Storms, rains & cyclones are intensifying	Erosion and washing away of soil			Workshop	
Storms, rains & cyclones are intensifying	regional effects because of			Workshop	

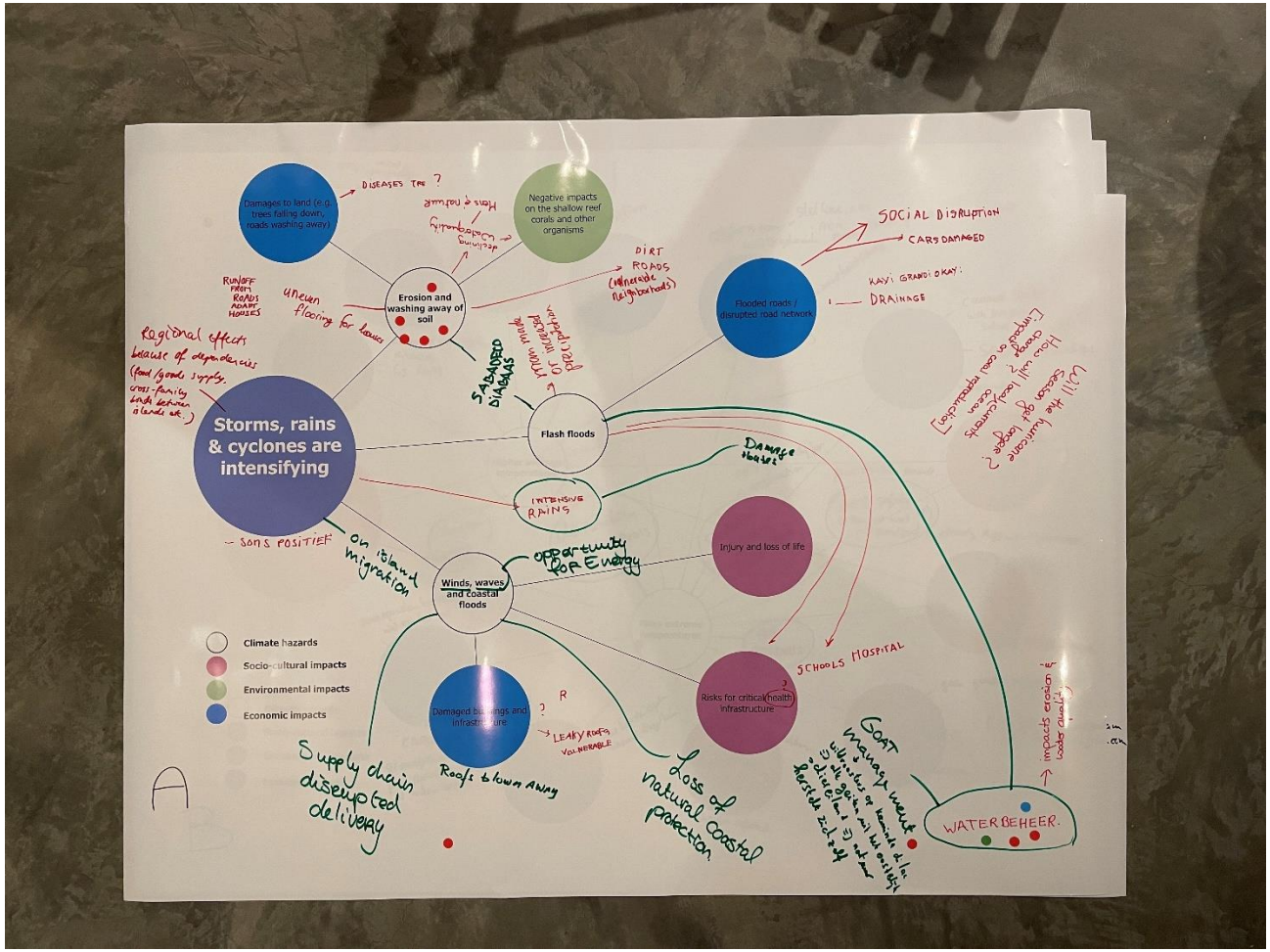
	dependencies (food/goods supply, cross-family bonds between islands, etc.)				
Storms, rains & cyclones are intensifying	Flash floods	**Social disruption, cars damages**		Workshop	
Storms, rains & cyclones are intensifying	Intensive rains	**Damage to houses**		Workshop	
Storms, rains & cyclones are intensifying	On island migration			Workshop	
Storms, rains & cyclones are intensifying	Winds, waves and coastal floods	**Loss of natural coastal protection**		Workshop	
Storms, rains & cyclones are intensifying	Winds, waves and coastal floods	**Supply chain disrupted delivery**		Workshop	
Changing wind	Increase in average wind speed	**Increase in wind power**		Workshop	Economic impacts
Changing wind	Increase in average wind speed	**Increase in evaporation**	An increase in average wind enhances evaporation by promoting the diffusion of water vapor away from the	Workshop	Natural impacts

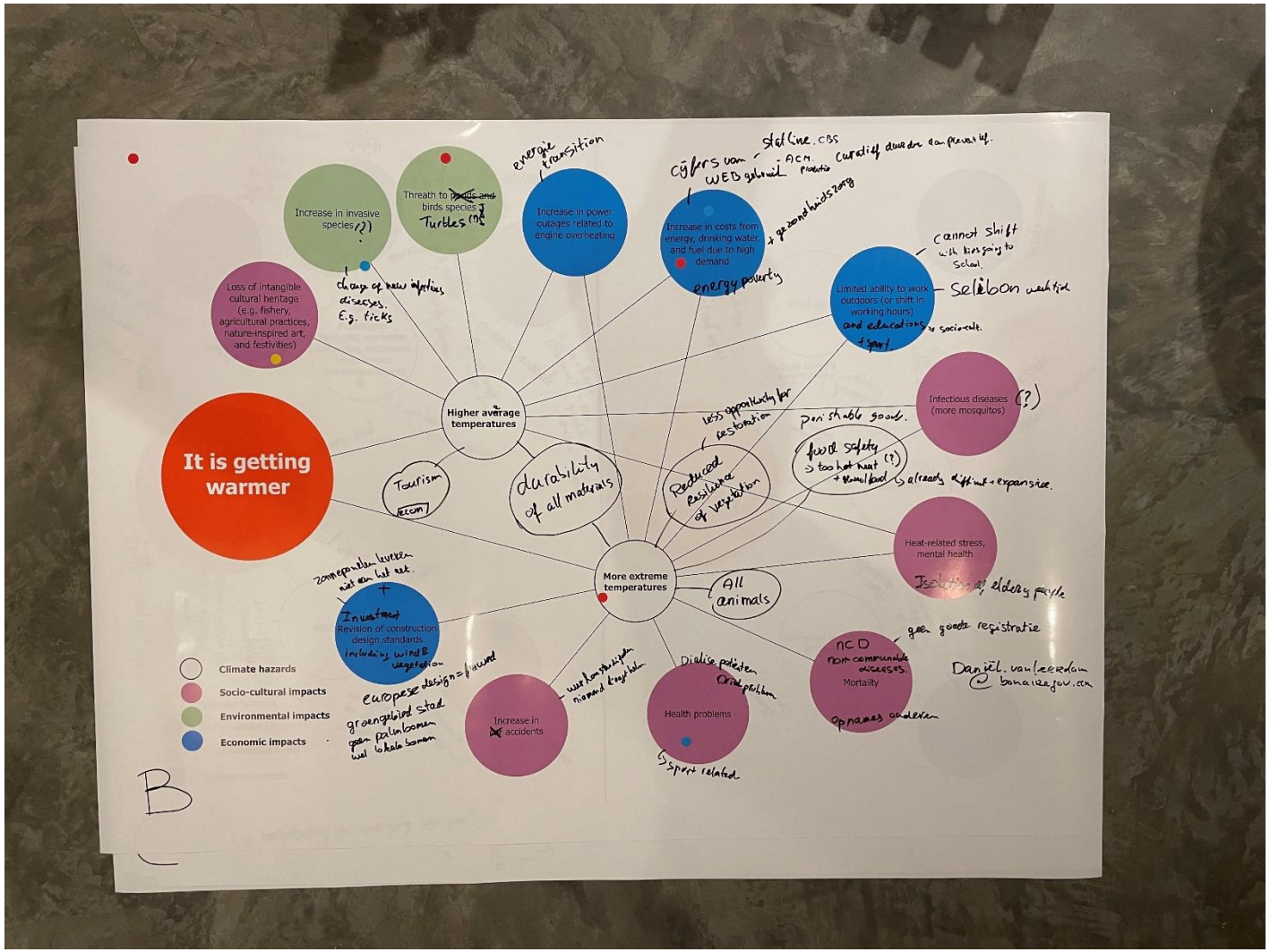
			evaporating surface. The saturated air layer will be dispersed, allowing drier air to replace it. The increased evaporation can contribute to soil drying with impact on vegetation.		
Changing wind	Increase in average wind speed	**Increased production of wind energy**	With more wind, the wind mills produce more energy.	Workshop	Economic impacts
Changing wind	Increase in average wind speed	**Impact on temperature experience**	With more wind, the heat is more tolerable for humans	Workshop	Social impacts
Changing wind	Changing wind direction	**Impact on temperature experience**	If there's no wind, heat becomes intolerable: could result in school closings	Workshop	Social impacts
Changing wind	Changing wind direction	**Sahara dust**	Wind could bring Sahara dust to Bonaire which can have health impacts: astma	Workshop	Social impacts
Changing wind	Changing wind direction	**Surfers**	Some wind directions are preverable for good surfing conditions (depends on location on Island)	Workshop	Social impacts
Changing wind	Changing wind direction	**Building house for cooling**	In case of sustained (anthropogenically driven) changes to wind direction this could result in houses that are build in a certain direction to provide cooling being less able to keep temperatures low	Workshop	Social impacts
Changing wind	Changing wind direction	**Surges**	In case of wind reversals, the lay side of the island may face flooding (Kralendijk for example)	Workshop	Social impacts
Changing wind	Changing wind direction	**Fisherman vessels and cruise boats**	Changes in wind direction might cause problems with docking for cruise ships and for fisherman vessels to perform work (e.g. rough and unpredictable sea conditions)	Workshop	Economic impacts

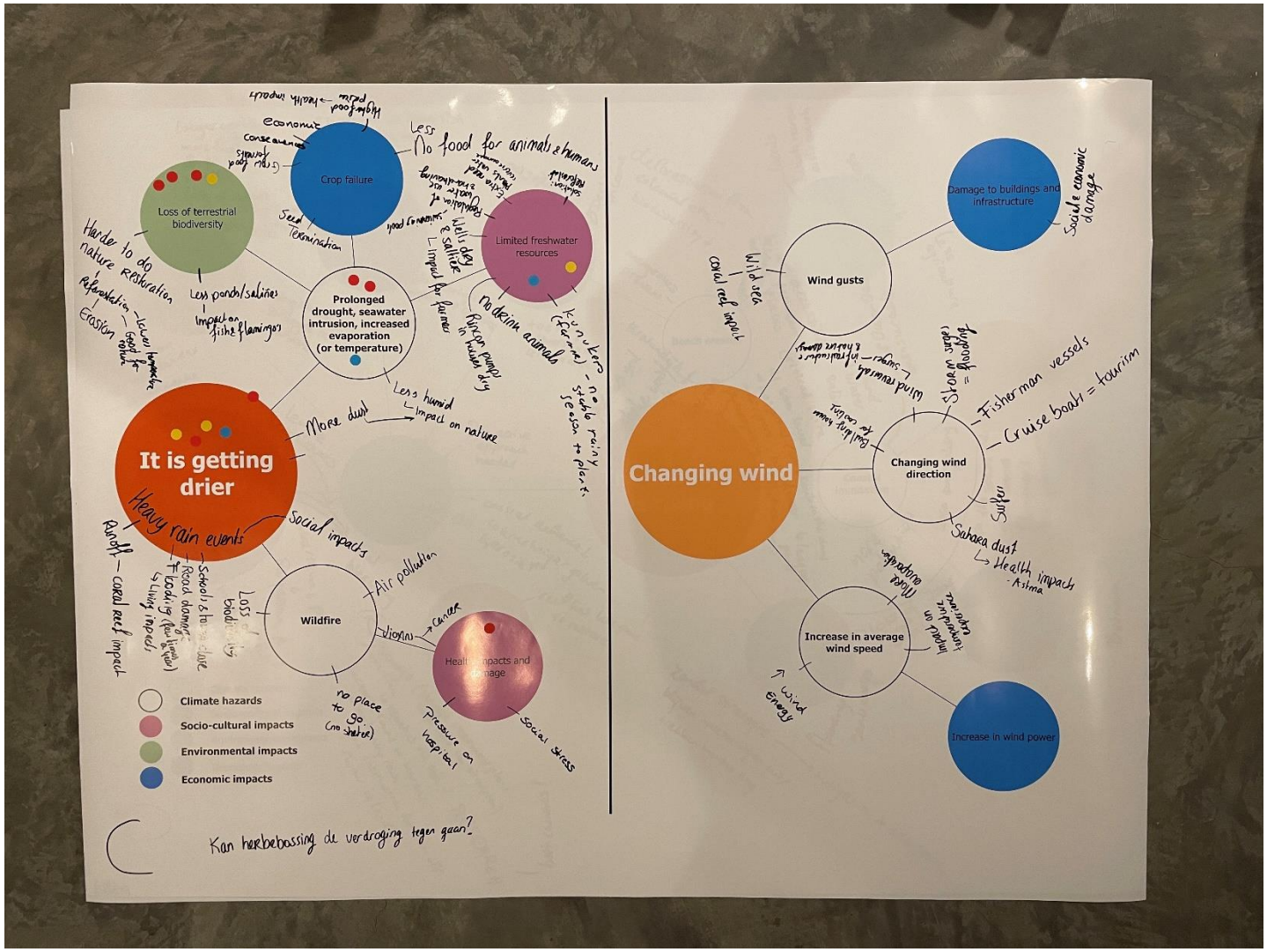
Changing wind	Wind gusts	**Coral reef impact**	Wild sea, rough conditions and turbulence might impact the health of coral reef systems	Workshop	Natural impacts
Changing wind	Wind gusts	**Damage to buildings and infrastructure**		Workshop	Social impacts
Changing wind	Wind gusts	**Damage to vegetation**		Workshop	Natural impacts
The sea-level is rising	Beach erosion, coastal inundation	**Tourism revenue decrease**	Sandy beaches are threatened by climate-change-induced sea level rise. Loss in sandy beaches, results in hotel room loss and thus tourism revenue decrease. Curacao: ~0.7% loss towards 2015 (RCP45/RCP85), ~29.2% - 32.2% loss towards 2100 (RCP45/RCP85). A sea level rise of one meter would cause more than 29% of major resort properties in the Caribbean to be partially or fully inundated by water, while 49% would be damaged or destroyed by a combination of sea level rise and storm surge.	Spencer, 2022 and DCNA (2020)	Economic impacts
The sea-level is rising	Coastal inundation	**Permanently flooded buildings and infrastructure**	salt pans, slave huts, and lighthouse, will be inundated due to SLR, storm tide, and wave setup. During the workshop, it was mentioned that dykes will not work because of porous soils (or with concrete but in vain). Also, the name kralen*dijk* was highlighted. Furthermore, loss of jobs if Cargill can no longer function. Belnem was identified as an area with social housing at risk.	IVM, 2022, CPA 2022	Economic impacts
The sea-level is rising	Coastal inundation	**Permanently flooded**	salt pans, slave huts, and lighthouse, will be inundated due to SLR, storm tide, and wave setup	IVM, 2022, CPA 2022	Social impacts

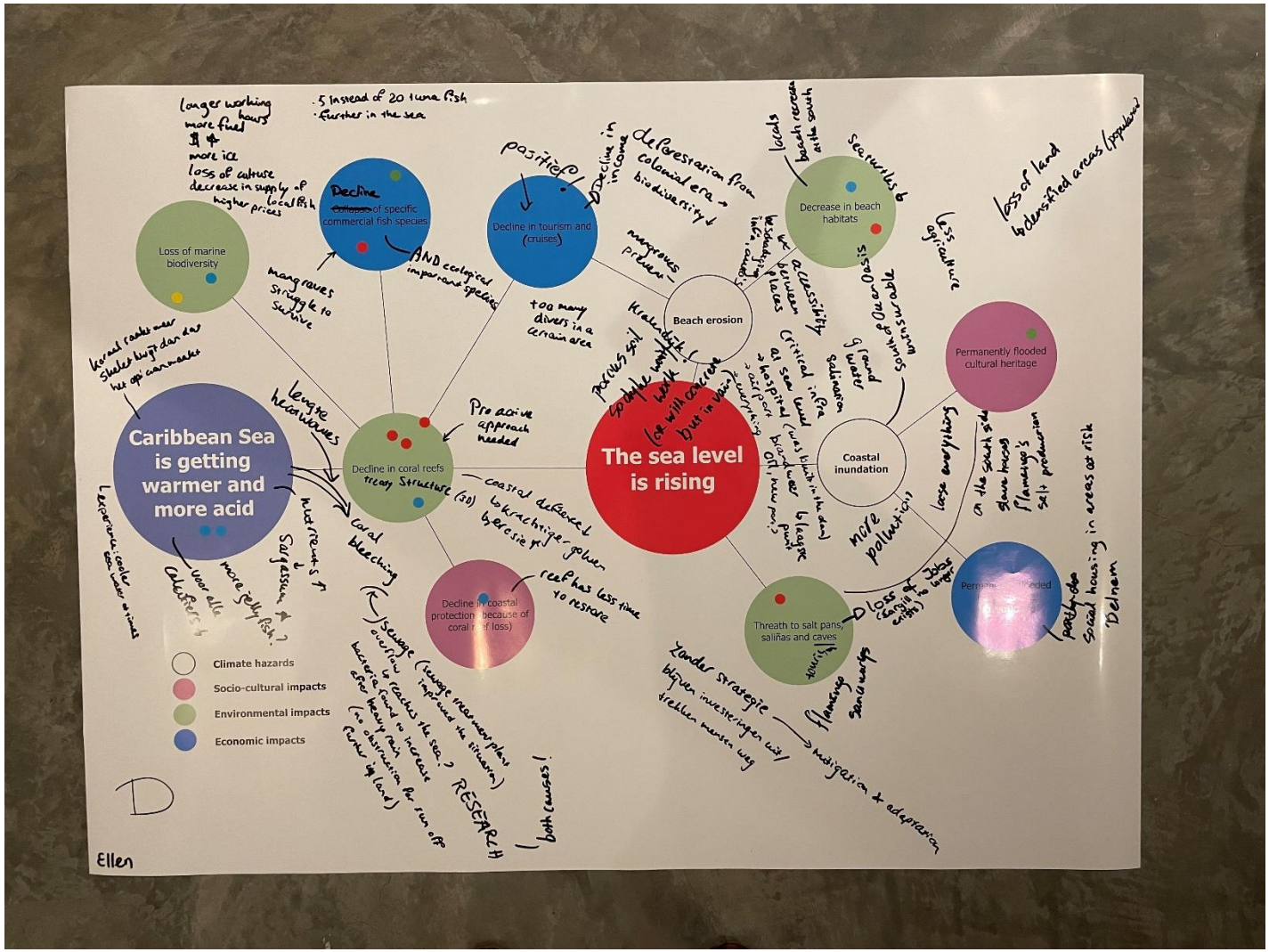
		cultural heritage			
The sea-level is rising	Rising sea level	**Threath to salt pans, saliñas and caves**	Changes in rainfall affect the salt pans and saliñas which also serve as freshwater collection points during rainy seasons. Saliñas are important areas for many different species. During the workshop, the hospital and airport were identified as critical infra at sea level .	DCNA, 2021, IVM 2022	Natural impacts
The sea-level is rising	Beach erosion	**Decrease in beach habitats**	Sea level rise, waves, storm surges, larger tidal differences exacerbate beach erosion. With sand being a limited resource, beach erosion often leaves behind hard fossilized substrate unsuitable for beach habitat which many species depend on, especially nesting sea turtles. During the workshop, it was stressed that mangroves prevent beach erosion. It was mentioned that beach erosion also damages infrastructure and cars, and affects the accessibility between places.	DCNA, 2021	Natural impacts
The sea-level is rising	Beach erosion	**Decline of beach recreation**	Especially in the south	Workhop	Social impacts
The sea-level is rising	salinization	**seawater intrusion**	Increasing salt levels as a result of seawater intrusion (or irrigation practices). See also the impacts in the theme drought.	workshop	

Annex B. Pictures of the posters edited during the workshop




It is getting warmer
Higher average temperatures
More extreme temperatures
Increase in invasive species
Threath to birds species
Turtles
Increase in power outages related to engine overheating
Increase in costs from energy, drinking water and fuel due to high demand
energy poverty
Loss of intangible cultural heritage (e.g. fishery, agricultural practices, nature-inspired art, and festivities)
Limited ability to work outdoors (or shift in working hours)
Infectious diseases (more mosquitos)
Tourism
durability of all materials
Reduced resilience of vegetation
Heat-related stress, mental health
All animals
Revision of construction design standards including wind & vegetation
Increase in accidents
Health problems
NCD non-communicable diseases
Mortality
Climate hazards
Socio-cultural impacts
Environmental impacts
Economic impacts


It is getting drier
Crop failure
Loss of terrestrial biodiversity
Limited freshwater resources
Prolonged drought, seawater intrusion, increased evaporation (or temperature)
Wildfire
Health impacts and damage
Social impacts
Changing wind
Changing wind direction
Wind gusts
Damage to buildings and infrastructure
Increase in average wind speed
Increase in wind power
Fisherman vessels
Cruise boats = tourism
Sahara dust
Health impacts
Asthma
Heavy rain events
Air pollution
Social stress
Climate hazards
Socio-cultural impacts
Environmental impacts
Economic impacts
Kan herbebossing de verdroging tegen gaan?


Caribbean Sea is getting warmer and more acid
The sea level is rising
Decline in coral reefs
Loss of marine biodiversity
Decline of specific commercial fish species
Decline in tourism and (cruises)
Beach erosion
Decrease in beach habitats
Coastal inundation
Permanently flooded cultural heritage
Threath to salt pans, saliñas and caves
Decline in coastal protection because of coral reef loss)
Climate hazards
Socio-cultural impacts
Environmental impacts
Economic impacts
Ellen