SENSES
Case Study in Kenya

The first stakeholders workshop report

The project SENSES is part of the European Research Area for Climate Services (ERA4CS), an ERA-NET initiated by JPI Climate. It is funded by BMBF (DE), BMWFW (AT), NWO (NL), FORMAS (SE) with co-funding by the European Union (Grant 690462). (ERA4CS).

Contents

Introduction

That climate change is likely to negatively impact Kenya's future development and achievement of the goals of *Kenya Vision 2030*[1] is evident with the recent publication of Kenya's National Climate Change Action Plan 2018-2022 (NCCAP).[2] The report states that climate change has increased the frequency and magnitude of extreme weather events in Kenya. This has led to loss of lives, diminished livelihoods, reduced crop and livestock production, and damaged infrastructure, among other adverse impacts. Kenya's economy is very dependent on climate-sensitive sectors such as agriculture, water, energy, tourism, wildlife, and health, and there is a worry that increased intensity and magnitude of weather-related disasters might aggravate conflicts, mostly over natural resources, and contribute to security threats.

However, the NCCAP report only describes impacts of climate change *within* Kenya's borders. In addition to these risks, Kenya will also be exposed to impacts of climate change in other countries. In an increasingly globalized world, no country is fully insulated from the impacts of climate change outside its borders. Hitherto this aspect of climate change has only played a minor role in most countries, and Kenya is no exception. A recent study[3] suggest that these 'transnational climate impacts' (TCI) are transmitted across borders along four risk pathways:

- The biophysical pathway encompasses transboundary ecosystems, such as river basins, oceans and the atmosphere;
- The finance pathway represents capital flows and climate impacts on assets held overseas;
- The people pathway involves the movement of people between countries, e.g. tourism and migration;
- The trade pathway transmits climate risks across international supply chains.

In addition to those four risk pathways, the framework of Hedlund et al. also incorporate the global context by assessing how globalised each country is.

SENSES project and the Kenya case study

The case study, "Exploring Kenya's vulnerability to future transnational climate impacts using scenarios", is part of the research project SENSES[4] (Climate Change Scenario Services: Mapping the future) which investigates potential socio-economic futures in the face of climate change and how this knowledge can be made accessible to a broader public. The overarching goal of the SENSES project is to develop a tailor-made, user-determined Climate Change Scenario Toolkit (the "SENSES" Toolkit) connecting the wide array of scenarios developed by the climate change research community to selected user and stakeholder groups. The SENSES project is being led by world-class research

[1] http://vision2030.go.ke

[2] Government of Kenya (2018). *National Climate Change Action Plan (Kenya): 2018-2022*. Nairobi: Ministry of Environment and Forestry.

[3] Hedlund, J., Fick, S, Carlsen, H., Benzie M. (2018), "Quantifying Transnational Climate Impact Exposure: new perspectives on the global distribution of climate risk", *Global Environmental Change* 52, 75-85.

[4] www.senses-project.org. SENSES is funded by JPI Climate which is an initiative of EU member states and associated members to align national programs.

institutions like Potsdam Institute for Climate Impacts Research (PIK), the International Institute for Applied Systems Analysis (IIASA), Wageningen University, the Potsdam University of Applied Sciences and the Stockholm Environment Institute (SEI). The case study on Kenya is led by SEI with its office in Nairobi and strong connections and collaborations with local and national stakeholders and policy makers.

The case studies in the SENSES project are vehicles for developing tools and techniques for better connecting climate community scenarios to local user needs. However, in addition to this overall goal of conducting case studies in the SENSES project, each case study aims at delivering real value to the national and local stakeholders involved. The SENSES case study in Kenya builds upon the national futures projections and adaptation plans and adds value by 1) linking national impacts and scenarios to the global shared socio-economic pathways and 2) by introducing transnational climate impacts to the Kenya climate risk profile.

This study focuses on identifying future transnational climate risks along the four risk pathways (as defined above) for Kenya. We will do this by developing a set of futures scenarios including both climate projections and socioeconomic developments. A scenario is a story with plausible cause and effect links that connects a future condition with the present, while illustrating key drivers, events, and consequences throughout the narrative. The scenarios for Kenya will be linked to the shared socio-economic pathways (SSPs), the global set of scenarios currently used by the climate change research community.[5] The set of future scenarios for Kenya will be used as a backbone for assessing future transnational climate risks along the four risk pathways above and the development and assessment of adaptation options.

The Kenya case study consists of three main objectives, including 1) develop future scenarios for Kenya and linking those to the shared socio-economic pathways (SSPs), 2) identifying future transnational climate impacts (TCI) risk and opportunities considering those scenarios, 3) and co-producing integrated adaptation pathways in respond to both national and transnational climate impacts.

The overall process of the Kenya case study consists of six steps:

- *Scoping*; with a set of semi-structure interviews with experts and stakeholders, users' needs and knowledge gaps will be identified.
- *Drafting future scenarios for Kenya*; in the first stakeholder workshop, the skeleton of a set of scenarios for Kenya will be co-produced through a participatory process with selected stakeholders.
- *Scenario building*; the co-produced scenarios will be enriched by adding climate change impacts for Kenya as wells as relevant impacts from outside of Kenya.
- *Combining scenarios with TCIs*; in the second stakeholder workshop, the Kenya scenarios and the TCI pathways will be used as the framework to identify future TCI risks as well as options for adaptation. This workshop will also initiate the development of adaptation pathways in response to both national and transnational climate impacts.
- *Communication and outreach*; the results, including the set of scenarios and future TCI risks and opportunities will be communicated with Kenyans stakeholders, policy makers and

[5] The so-called Shared Socioeconomic Pathways. For more information about scenarios in climate change research, see the 'Scenario Primer' developed by the SENSES project https://climatescenario.org/primer/.

practitioners. We are currently investigating plans to organize an event around the publication of the case study report.

First workshop in the Kenya case study

To conduct a co-production process, we organize two workshops to bring together a diverse group of stakeholders to explore Kenya's vulnerability to transnational climate impacts through interactive and creative participation. The workshops in the Kenya case study bring together stakeholders and representatives from the National and County Governments, NGOs, private sector, universities and international organizations working on air quality in Kenya.

The first workshop was held on Thursday 10 January 2019 from 8:30 AM at the SEI Africa Centre,. The main objective of the first workshop was to create a skeleton for future scenarios as tools to explore the future TCIs in Kenya.

In the following sections, we explain the first workshop's process[6] and present the initial results co-produced during the workshop with stakeholders and the SENSES team.

Workshop opening

Philip Osano, SEI Africa's centre deputy director, launched the workshop with some welcome notes to all participants. The total number of participants was 11 with a gender distribution of 6 males and 5 females. Participants were distributed among several organisation types such as the national government (2), county government (2), universities (2), the private sector (3) and NGO's (2). A participation list can be found in annex 2.

Presentation 1; SENSES, Kenya case study and Transnational Climate Impacts

Henrik Carlsen, senior research fellow at SEI's headquarters and the workshop's lead facilitator, did a presentation in which he introduced Transnational Climate Impacts (TCI), the SENSES project and the overall objective of the Kenyan case study. The full presentation can be found in annex 3.

Brainstorming session; Identifying drivers of vulnerability to future TCIs

The brainstorm session was an exploratory session, in which the participants were asked to define ideas on drivers of TCI for Kenya. Before starting the session, the lead facilitator emphasised that all ideas were equally valid and that there would be room for discussion on the ideas in a later stage of the workshop. Furthermore, the lead facilitator introduced the "Chatham house rules" and indicated that participants only represented themselves and not their organisations. On the wall of the workshop room, local drivers of challenges to adaptation from earlier research[7] were posted to

[6] For the full program, see annex 1.

[7] Schweizer & O'Neill (2014), "Systematic construction of global socioeconomic pathways using internally consistent element combinations", *Climatic Change* 122, 431-445.

accentuate the difference between local drivers and external drivers (TCI). Additionally, the Big Four Agenda from the Kenya Vision 2030 were posted on the wall to indicate the issues which are currently addressed by the national government.

The focus question of the brainstorm session was: "*What are the most important drivers for understanding Kenya's vulnerability to future transnational climate risks?*". For the first round of brainstorming, each participant presented two ideas of drivers, which were written down in capital letters on yellow oval post-its. In the second round of brainstorming the participants could choose to present one or two more ideas on drivers of TCI. All ideas were collected on the wall and ideas which had similarities were put close together.

After the brainstorming session was ended, the SENSES team reviewed the drivers placed close to each other and tried to recognize the thematic similarities between these drivers. Accordingly, the SENSES team assigned each group of drivers (cluster) a broad name representative of all the drivers included in the group. The team reviewed the clusters' names several times and made sure that there was a consensus between the team members about the clusters' names. At the beginning of the next session, the workshop's lead facilitator also made sure that the participants agree and have consensus about the clusters' names and their representativeness of the initial drivers as well.

The results of the brainstorming session are shown in table 1.

Table 1. Clusters of drivers

No	Cluster	Drivers
1	**Import of food**	1. Food security - Storage - Process – value addition - Value chain
		2. Food security - Innovations and technologies
		3. Irrigation technologies available related to import of food
		4. Adaptation of sustainable consumption and production practices - Best agriculture
		5. Trade cross-border vulnerability assessment
2	**Regional collaboration on TCI**	1. Improve regional coordination - East Africa
		2. Regulatory frameworks - inter-regions
		3. Sugar from Brazil domestic production versus import -> creates dependency
3	**Policy implementation**	1. Governance - Due care - Inclusion - Stewardship
		2. Improve policy implementation
		3. Devolution - Affects governance agreements and implementation

		4. Implementation of relevant regional policies and strategies
4	**Land use change in Kenya**	1. Land use changes due to emerging land tenure systems - Restriction on access
		2. Size of arable land
		3. Settlements along strategic areas - e.g. next to water borders
5	**Knowledge management systems**	1. Access, use and effects of climate information and advisories - (services)
		2. Creation of knowledge management platforms - Fragmented knowledge
		3. Develop data bases and baseline surveys
		4. Awareness creation of climate risks
		5. Information sharing - (Local and Global)
6	**Rapid population growth**	1. Rapid population growth - Competing for same resources, pollution and waste disposal
7	**Access to TCI relevant data**	1. Data of TCI
8	**Importing energy**	1. Energy creation mix and distribution - Nuclear - Import from Ethiopia
9	**Climate finance**	1. Access to climate finance
10	**Urbanization and cultural change**	1. Urbanization and behavioural change
		2. Loss of livelihood and rural – urban migration - Slum settlements - Pressure on social amenities - Industrialization - Water quality
		3. Cultural distortion due to modernization
11	**National infrastructure**	1. Infrastructure - Effect in climate change
12	**New economic perspectives**	1. Circular economy
		2. Productive economic sectors - (relative terms)
13	**Tourism in Kenya**	1. Wild life migration / extinction - Effects on tourism
14	**Supply chain risk management**	1. Value chain integration and sustainability
15	**Insecurity and terrorism**	1. (In) security and terrorism - Could reduce adaptation capacity
16	**Healthcare**	1. Healthcare and emerging terminal illnesses

17	**Technology transfer**	1. Technologies to reduce vulnerability to TCIs
		2. Innovation for enhanced and sustainable production of food
		3. Research and technological transfer - Mechanization OMO
18	**Extreme poverty**	1. Extreme poverty Capacity building
19	**Shared natural resources**	1. Transnational water availability and management
		2. Water and waste water management practices - Improving
		3. Investment in water sector - And interdependencies to other countries
		4. Sharing natural resources - Desertification of livelihoods - +Uganda +Ethiopia
		5. Resource – use conflicts

Prioritization process; Importance and Uncertainty assessment

These clusters in Table 1 were then prioritized by the participants. Prioritization of the clusters was done in two dimensions: importance and uncertainty. Each participant received 5 red voting stickers to indicate uncertainty and 5 green voting stickers to indicate importance. They were invited to come to the wall to determine which of the clusters were important or uncertain or both according to their perspective.

The results of the importance and uncertainty assessment process are shown in table 2 and figure 1.

Table 2. Importance and uncertainty assessment

	Number of Clusters																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Imp	4	4	6	0	7	3	2	0	2	2	0	0	2	0	0	2	7	0	4
Unc	0	1	1	9	0	3	0	5	0	1	3	1	4	3	6	0	0	4	0

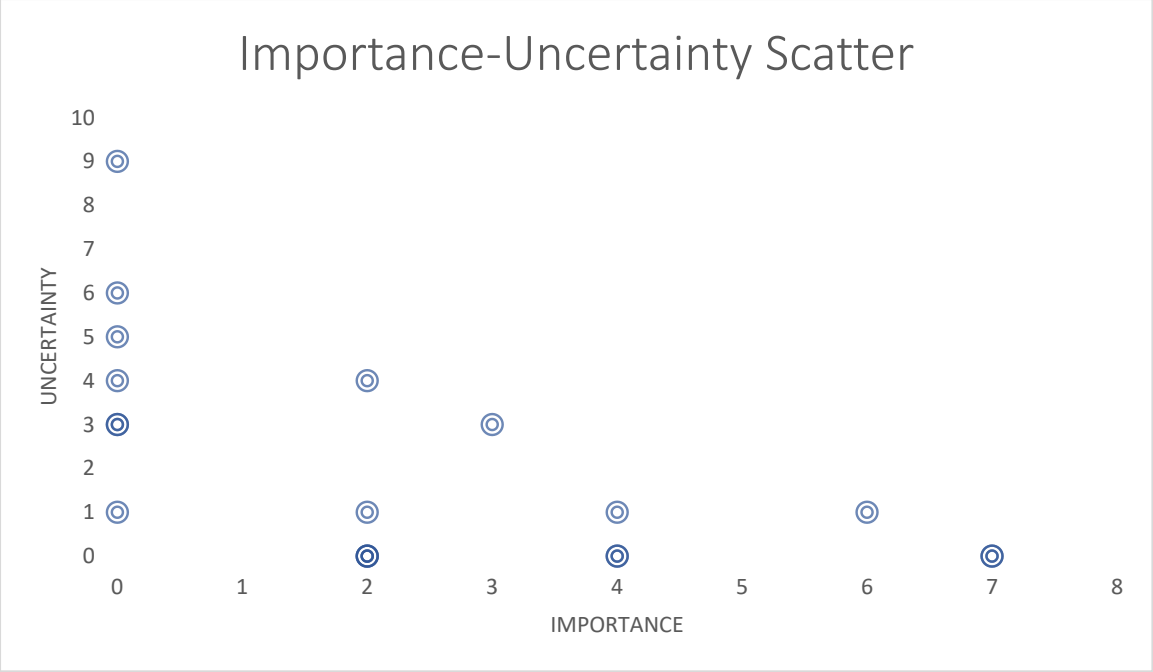


Figure 1. Importance and uncertainty scatter

The clusters with the most voting stickers on both importance and uncertainty were supposed to be selected as the input materials for the groupwork sessions in the next phase of the workshop. However, the participants distributed their votes on importance and uncertainty in a way that none of the clusters of drivers was assessed as a cluster with high importance and high uncertainty. As can be seen in figure 1 above, the high importance and high uncertainty region of the matrix is empty. Therefore, the research team adjusted the selection and made a collective selection on drivers of which the participants found to be highly important or somewhat uncertain. Ultimately, 8 clusters were prioritized and selected for the next phase of the workshop. The selected clusters include cluster 1. Import of food (importance = 4), cluster 2. Regional collaboration (importance = 4), cluster 3. Policy implementation (importance = 6), cluster 5. Knowledge management systems (importance = 7), cluster 6. Rapid population growth (importance = 3), cluster 17. Technology transfer (importance = 7), and cluster 19. Shared natural resources (importance = 4).

It is worth mentioning that the process of numbering the clusters was random, and the numbers were assigned to each cluster only for easiness of working with clusters, particularly when placing them on the importance and uncertainty axes.

Presentation 2; Introducing the Shared Socioeconomic Pathways (SSPs)

The second presentation was also done by Henrik Carlson. In this, he introduced Climate Change scenarios, the context scenarios of the Shared Socioeconomic Pathways (SSPs) and he explained the process for the next group work sessions. The full presentation can be found in annex 4.

Groupwork sessions; Identifying alternative states for each cluster of drivers

The participants, which were a total of 9 at this point, were divided into two groups and each group got a number of clusters to work with. The main question for this groupwork was: "*How might this cluster (of drivers) play out in the 2050s perspective given each context scenario?*". The context scenarios in the core question refer to SSP1, SSP3, SSP4 and SSP5[8] (SSP2 was not included because it represents the continuation of current practices and a business as usual situation which is not of interest and/or importance for this case study).

Each group worked with 3 -5 clusters of drivers, across all four scenarios. The task was to interpret the regional developments for each of the prioritized clusters in relation to the global scenarios. The global scenarios entered the work as a "boundary condition" for the local development in Kenya. In each group, the participants first got the time to read the summaries of the 4 SSPs. The group facilitator then went through the summary of the scenarios and initiated a short discussion about the scenarios and different interpretations of the scenarios. After this opening discussion, the participants started to discuss the alternative states of each cluster in different SSPs.

Group 1, which was facilitated by Philip Osano, started with the cluster 'Shared Natural Resources' and discussed how the cluster might play out in the SSP1 as the context scenario, then moved on with the same question for SSP3, SSP4 and SSP5. For instance, in the sustainability context of SSP1, collaboration on Shared Natural Resources will be better managed. The facilitator wrote down the states and brief notes on the group discussions on oval post-its. The group systematically repeated the same process and discussed the same questions for the rest of the drivers in the context of alternative SSPs. Group 1 worked with cluster 19. Shared natural resources, cluster 17. Technology Transfer, cluster 5. Knowledge Management Systems and cluster 3. Policy Implementation.

The results from group 1 are shown in table 3 below.

Table 3. Alternative states for clusters 19, 17, 5 and 3

	SSP1	SSP3	SSP4	SSP5
Cluster 19: Shared natural resources	- Collaborative management of shared natural resources - Improved resource efficiency - Shared equitable economic benefits from the shared resources	- Isolated planning for the use of shared natural resources (leading to degradation of resources) - Increased investments in national / local governmental institutions	- Some countries use the shared natural resources more than other shareholders - High disparities in level of development btw Kenya and western countries	- Increased use and harvest of natural resources - Collaboration and shared approaches in managing shared natural resources
Cluster 17: Technology transfer	- Increased use of green tech and renewables	- Greater investments in research and	- Increased capacity gap btw	- Advanced exploration and exploitation of

[8] A summary of the four storylines can be found in annex 5.

	- Full food security - Improved human settlement - Increased life expectancy	knowledge creation in local and national institutions - Protection to access of locally developed technologies and innovations - High costs of access to knowledge	high- and low-income people - Only wealthy people and countries have access to technology - Poor people and communities are not able/ cannot afford to have access technologies	fossil fuel resources - Low adoption of clean green technologies
Cluster 5: Knowledge management systems	- Increased research on sustainability and resource management - Enhanced governance - Robust information systems - Better decision making based on knowledge	- Poor knowledge sharing practices internationally and externally - Increased knowledge gaps due to poor and low sharing of knowledge	Poor do not have access to and cannot contribute in knowledge	- Increased research on fossil fuel-based development and infrastructures (roads, ports, etc.) - Better national planning + projections of fossil fuel resources for economic growth
Cluster 3: Policy implementation	- Effective implementation of sustainability policies - Vision 2030 will be attained	Poor attention to regional and global policies and increased attention to national and local policies	- Disparities in policy implementation between countries - Vision 2030 won't be attained	Strong policies on economic development but weak in sustainability

Group 2, which was facilitated by Kasper Kok, assistant professor at Wageningen university (WUR), started with a discussion on the current state of the clusters[9] because there was no general agreement between the stakeholders on that. Group 2 also discussed different interpretations of the context scenarios (SSPs) themselves to reach a relative consensus about the meaning and characteristics of the SSPs[10]. After the opening discussions, the clusters were put in the future SSP perspectives, and the

[9] Group 2 started with an extensive discussion of the *current* (in contrast to the possible states in each of the context scenarios) state of the cluster 1, import of food. According to these discussions, at the present time, the level of food import in Kenya is high due to lower costs. Mexico is an important food exporter for Kenya. The stakeholders in group 2 identified the main factors of food import system as follow: population growth, globalization, productions costs and technology.

[10] According to the discussions in group 2, Eastern Africa becomes a strong block in the regional rivalry scenario (SSP3) facing challenges similar to the present time. In the fossil fuel development scenario (SSP5), first the use

group worked on exploring the states of each cluster in the context of different SSPs in a similar process as in group 1. The clusters with which group 2 worked included cluster 1. Import of Food, cluster 2. Regional Collaboration and cluster 3. Population Growth.

The results from group 2 are shown in table 4 below.

Table 4. Alternative states for clusters 1, 2 and 6.

	SSP1	SSP3	SSP4	SSP5
Cluster 1: Import of food	Slightly down	Down for trans-continental, And up for neighbouring states	Continues (Elite benefits from imports, masses do not)	First: (Strong) increase Later: stabilising
Cluster 2: Regional collaboration	Improves (and keep growing)	Start: positive, collaboration Long run: rivalry up, collaboration down	Elite collaborates Blocs try to unite	Increases
Cluster 6: Rapid population growth	Slowly comes down	Continues high	Continues high	Maintain high growth

Conclusion and final remarks

The 1st workshop for SENSES case study in Kenya was arranged as a one-day workshop. The program for the workshop was profound and included extensive new information about global scenarios, socioeconomic pathways and transnational climate impacts. We received feedback from stakeholders that the program was significantly intense, and, in some cases, the participants did not have the chance to apprehend new concepts and familiarize themselves with core questions.

Another issue needed to be reflected on in the results of the process of importance and uncertainty assessments. As can be seen in table 2 (and figure 1), none of the clusters of drivers were considered a contingency with both high impact and high uncertainty. According to the stakeholders' votes, almost all drivers with high uncertainty were rated low for importance, and almost all drivers with high importance were evaluated with very low or even zero uncertainty. We noticed two main possible reasons for this result. First, a few stakeholders participating in the morning sessions of the workshop left the event just before the voting session. Hence, we assume the unexpected distributions of importance and uncertainty votes might be a result of the decreased number of participants in this session. Second, we hypothesize that the facilitators were not successful in communicating how uncertainty was intended to be interpreted in the context of scenario planning.

of fossil fueled-based technologies and practices increases dramatically, but later, there will be a significant focus and investment on green solutions and technologies.

Theoretically, a cluster's uncertainty rating should be proportional to the discrepancy between different states of that cluster in different context scenarios. Hence, highly uncertain clusters are usually assigned with a diverse set of states, while clusters with low uncertainty most likely appear with the same or similar states across the context scenario set.

However, as obvious in the results of the groupwork sessions, stakeholders identified utterly different and diverse states for clusters which were previously evaluated low uncertainty. For example, cluster 19. Shared natural resources was rated zero on uncertainty, but, in the groupwork session, group 1 identified entirely different states for this cluster in the context of different SSPs. The same patter repeated for clusters 17, 5, 3 and 1 as well. On the other hand, while cluster 6. Rapid population growth, for example, was rated 3 on uncertainty in the voting session, group 2 in their groupwork session determined its states to be similar in three out of four context scenarios. Our conclusion is that in the subsequent work we will ignore the results of the voting on uncertainty above and focus the scenario building process on those states that were actually generated during the group work. These provide the skeleton for the Kenyan extended SSP to be developed after the workshop.

Appendix

Annex 1. Full workshop program

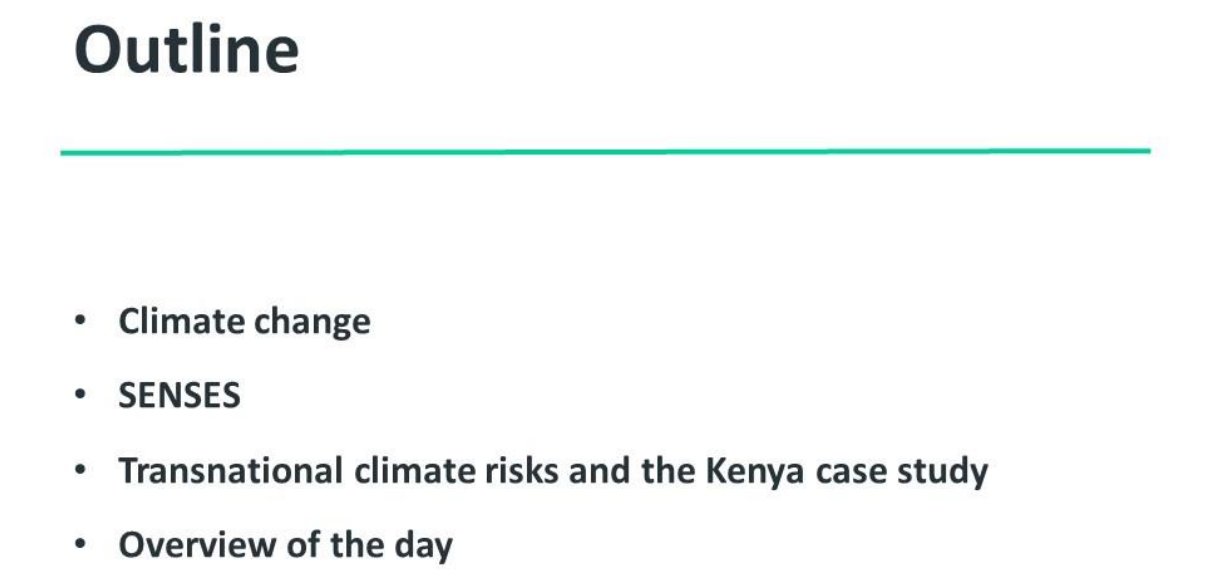
9.30	Coffee and sandwiches are served.
10.00	*Welcome and introduction* • Introducing the project, the case study on Kenya and participants including SENSES team • Review of climate change impacts in Kenya and adaptation activities • Transnational climate impacts, the world and Kenya • Introducing a futures perspective, including Kenya's Vision 2030 and global scenarios • Overview of the
11.00	COFFEE
11.30	*Brainstorming: Drivers of importance for understanding how the global development influences what climate risks Kenya might face in the future* This is an exploratory session in which we are going to try to come up with ideas for drivers in relation to the focus question. In this session all participants contribute equally to the work. We will work under "Chatham house rules" and participants only represent themselves. The session will be facilitated by the SENSES team.
12.30	LUNCH
13.30	*Prioritization of cluster of drivers*
14.15	*Group work 1: Introducing the global picture* The future development is dependent on a range of external factors and therefore we are now going to map the prioritized drivers to a set of global context scenarios form the climate change research community, the SSPs.
15.30	COFFEE
16.00	*Reporting back* Each group report in plenum
16.45	*Concluding the workshop and future steps*
17.00	*End of workshop*

Annex 2. List of participants

Nr	Name	Organization	Email
1	Cynthia Awuor	Adaptation specialist	cawuor@gmail.com
2	Elizabeth Auma	KALRO	obethokiri@yahoo.com
3	Maurice Ogoma	Ecofinder Kenya	luleogoma@gmail.com
4	Patrick Nyangweso	KNCCI	patrick.nyangweso@kenyachamber.or.ke
5	Victor Orindi	NDMA	vorindi@adaconsortium.org
6	Evline Boruru	ICCA-UoN	boruru@uonbi.ac.ke
7	Joyce Njogu	KAM	joyce.njogu@kam.co.ke
8	James Kaoga	ICCA-UoN	jkotieno@uonbi.ac.ke

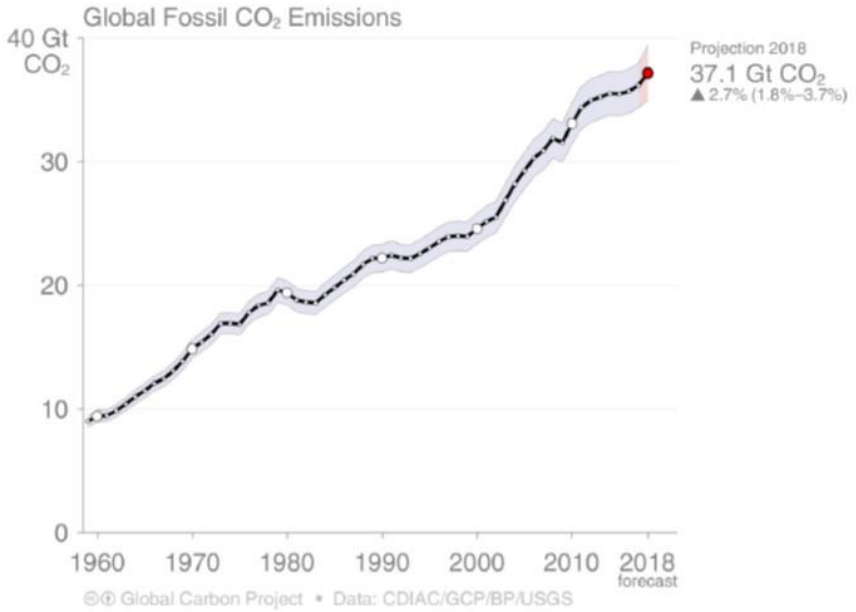
9	Margaret Kariuki	NCCG	margaretk91@gmail.com
10	Edwin Murimi	NCCG	siredwins@gmail.com
11	Philip Dinga	CHO Cities	pdinga@c40.org

Annex 3. SENSES and the case study on "Exploring Kenya's vulnerability to future transnational climate risks"



and we emit more and more…

Global fossil CO_2 emissions have risen steadily over the last decades.
The peak in global emissions is not yet in sight.



Estimates for 2015, 2016 and 2017 are preliminary ; 2018 is a projection based on partial data.
Source: CDIAC; Le Quéré et al 2018; Global Carbon Budget 2018

But (?) we have agreements

While the **Paris Agreement** sets out a target to limit the increase in global mean temperature to well below 2 °C above pre-industrial levels along with the pursuit of efforts to limit the increase to 1.5 °C, current emissions trajectories points to increased temperatures between 2 and 3 degrees.

At COP24 countries settled on ("**Katowice Agreement**") most of the tricky elements of the "rulebook" for putting the Paris agreement into practice. This includes how governments will

- measure,
- report, and
- verify

their emissions-cutting efforts.

But countries did not agree on levels for emissions reductions!

SENSES

The SENSES project investigates potential socio-economic futures in the face of climate change and how this knowledge can be made accessible to a broader public.

SENSES will develop tools and approaches to make the new generation of **climate change scenarios** more comprehensible.

The Senses Toolkit helps you understand and communicate climate change scenarios

PIK

IIASA International Institute for Applied Systems Analysis

WAGENINGEN UNIVERSITY & RESEARCH

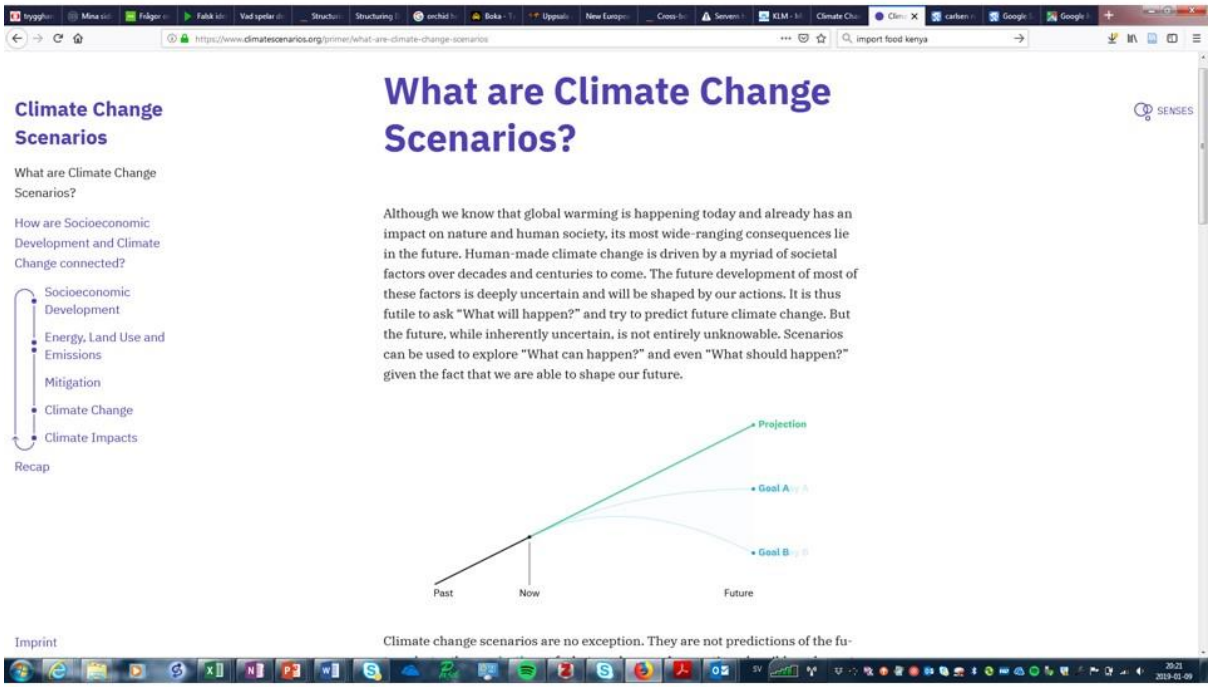
FH;P Fachhochschule Potsdam University of Applied Sciences

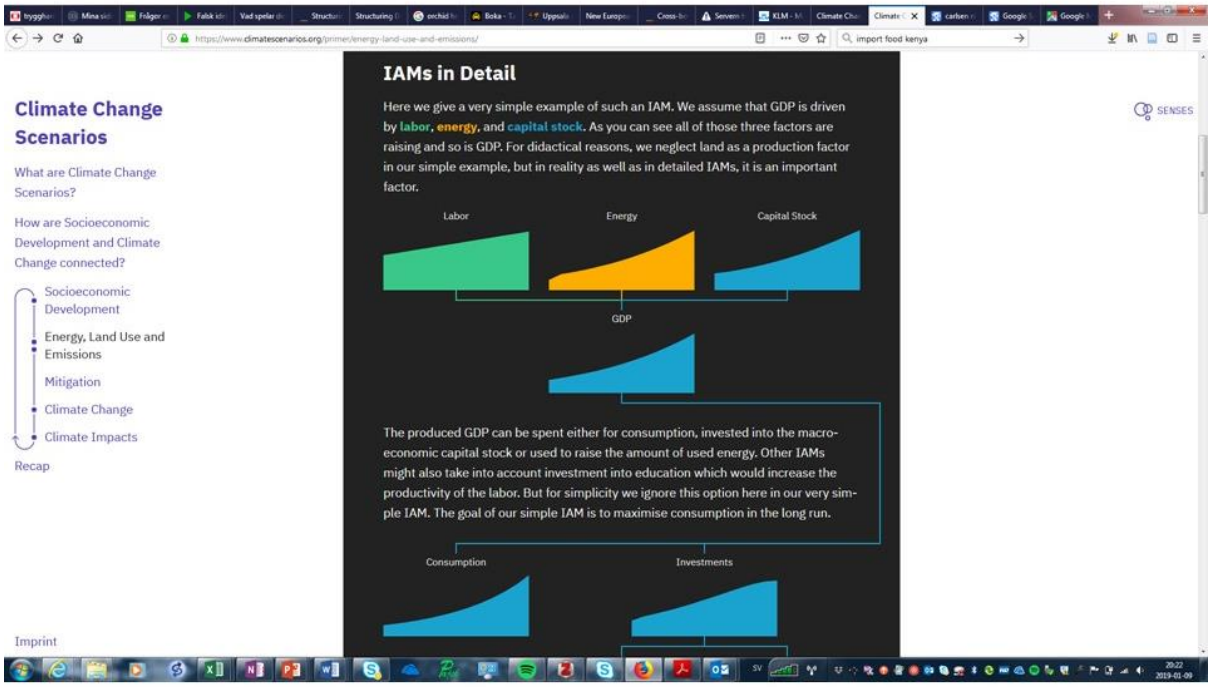
Climate Change Scenarios

We can't predict the future, but scenarios allow us to explore possible futures, the assumptions they depend upon, and the courses of action that could bring them about.

This interactive primer explains what climate change scenarios are and how they are connected to socioeconomics, energy & land use, emissions, climate change and climate impacts.

→ Get Started


Climate Change Scenarios
What are Climate Change Scenarios?
How are Socioeconomic Development and Climate Change connected?
Socioeconomic Development
Energy, Land Use and Emissions
Mitigation
Climate Change
Climate Impacts
Recap
Imprint
What are Climate Change Scenarios?
SENSES
Although we know that global warming is happening today and already has an impact on nature and human society, its most wide-ranging consequences lie in the future. Human-made climate change is driven by a myriad of societal factors over decades and centuries to come. The future development of most of these factors is deeply uncertain and will be shaped by our actions. It is thus futile to ask "What will happen?" and try to predict future climate change. But the future, while inherently uncertain, is not entirely unknowable. Scenarios can be used to explore "What can happen?" and even "What should happen?" given the fact that we are able to shape our future.
Projection
Goal A
Goal B
Past
Now
Future
Climate change scenarios are no exception. They are not predictions of the fu-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Climate Impacts
Recap
Imprint
IAMs in Detail
Here we give a very simple example of such an IAM. We assume that GDP is driven by labor, energy, and capital stock. As you can see all of those three factors are raising and so is GDP. For didactical reasons, we neglect land as a production factor in our simple example, but in reality as well as in detailed IAMs, it is an important factor.
Labor
Energy
Capital Stock
GDP
The produced GDP can be spent either for consumption, invested into the macro-economic capital stock or used to raise the amount of used energy. Other IAMs might also take into account investment into education which would increase the productivity of the labor. But for simplicity we ignore this option here in our very simple IAM. The goal of our simple IAM is to maximise consumption in the long run.
Consumption
Investments
SENSES

The Kenya case study

The overall objective for the Kenyan case study is to design and execute a process in order to *better understand how the global development influences what climate risks Kenya might face in the future.*

Climate change and Kenya's vision 2030.

Climate change is likely to negatively impact Kenya's future development and achievement of the goals of *Kenya Vision 2030 and the Big Four Agenda:*

1. food security,
2. affordable housing,
3. manufacturing,
4. affordable healthcare for all

Source: National Climate Change Action Plan 2018-2022 and Kenya Vision 2030

Key impacts from *within* Kenya

Kenya's economy is very dependent on climate-sensitive sectors such as agriculture, water, energy, tourism, wildlife, and health.

Key sectors:

- **Flooods**: roads and infrastructure damages; crops
- **Droughts:** typically large-scale disatters in Kenya
- **Sea level rise:** impacting coastal towns and communities
- **Rising sea temperatures**: coral bleaching; impacts on fishing
- **Declining glaciers**: Mount Kenya is a key water resource

Cause and effect of climate change

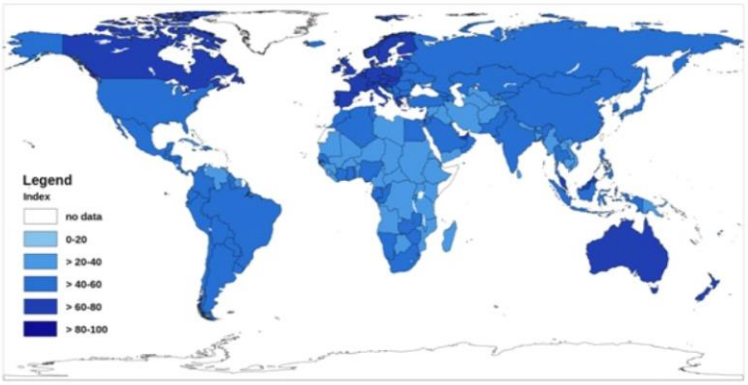
The causes of climate change: A **global** problem

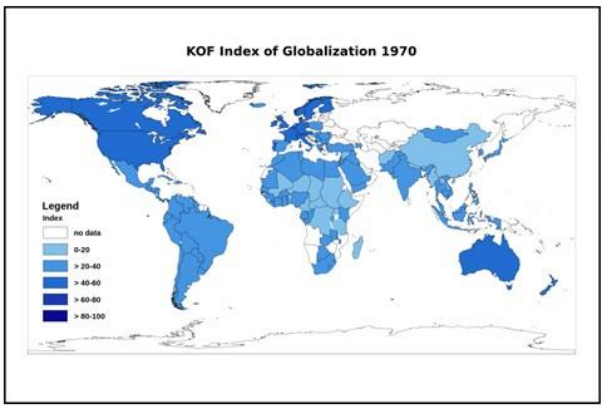
The effects of climate change: A **local** problem

Or?

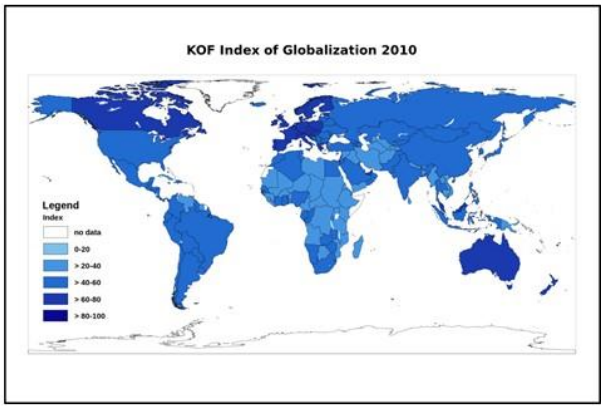
Globalization!

KOF Index of Globalization 2010

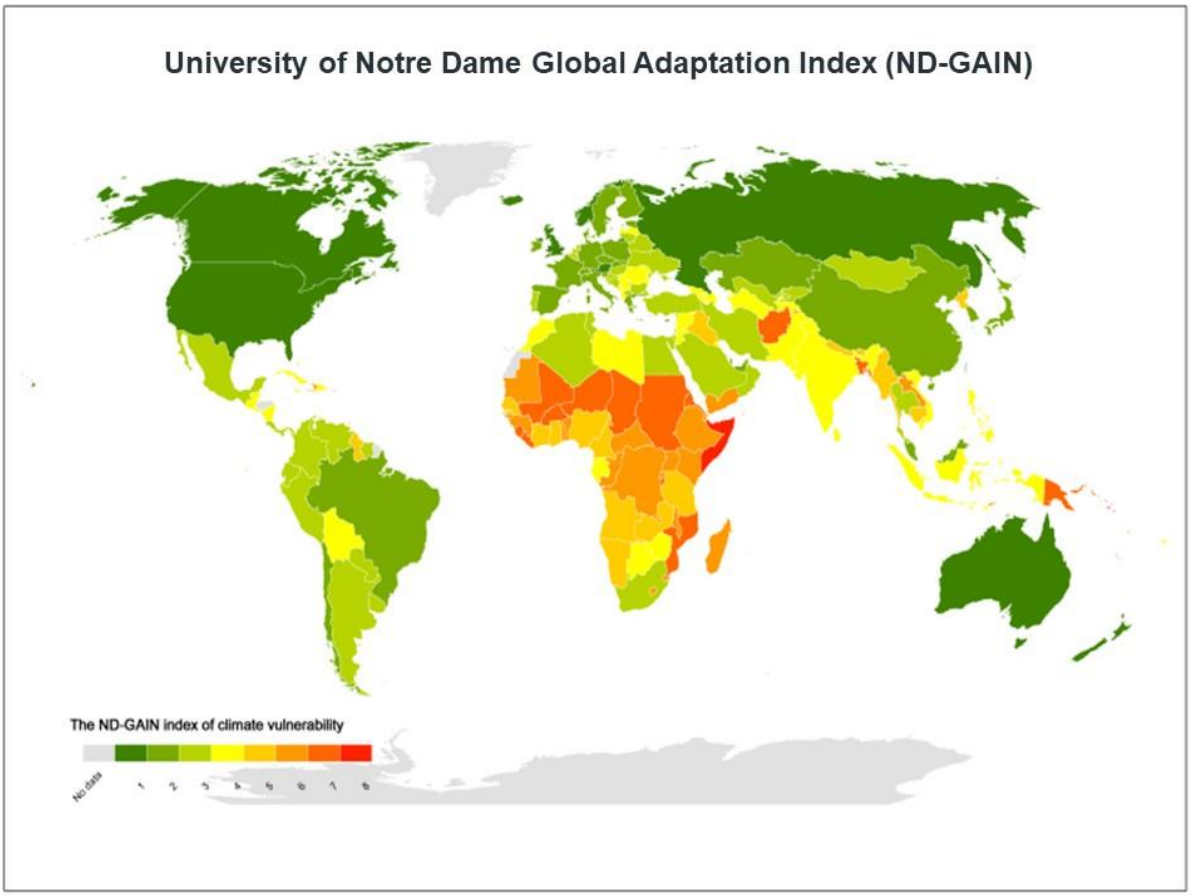




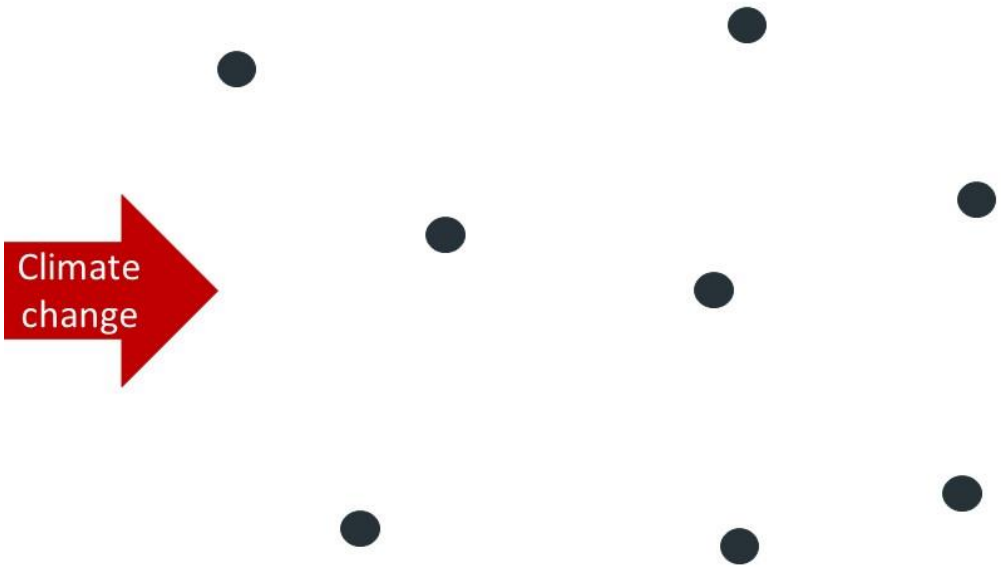
This world is affected in one way



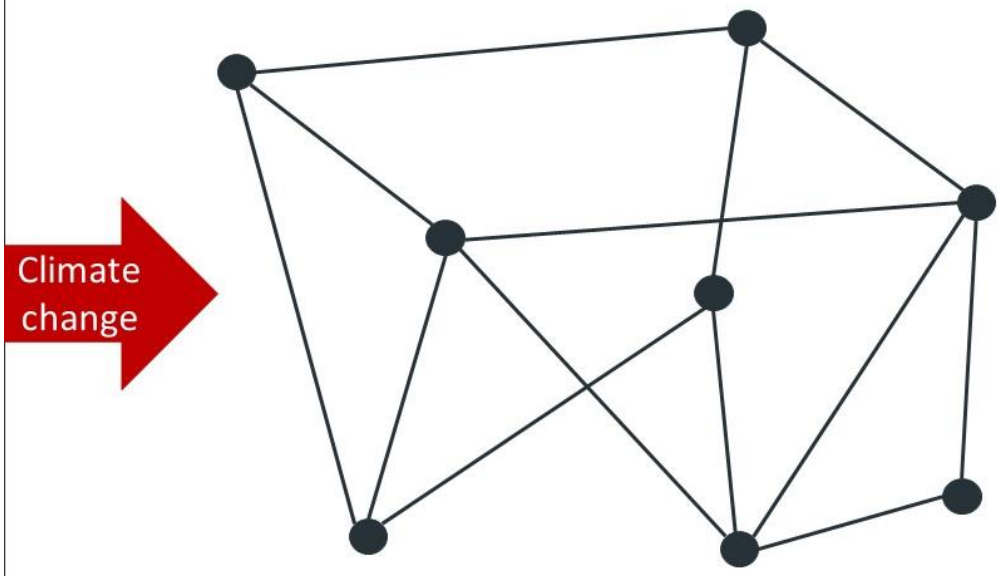
This world is affected in another way!



Countries as non-interacting entities



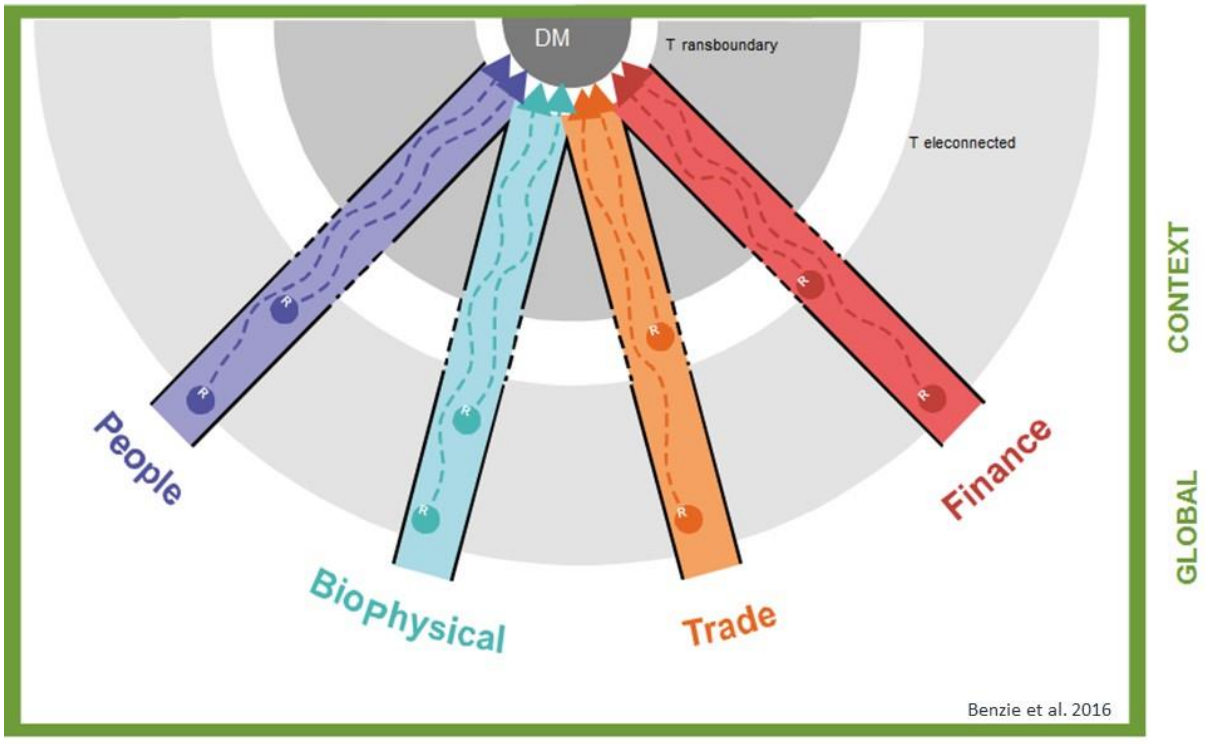
A Network Perspective on Impacts and Adaptation: Countries as Nodes and Flows as Links



Our definition

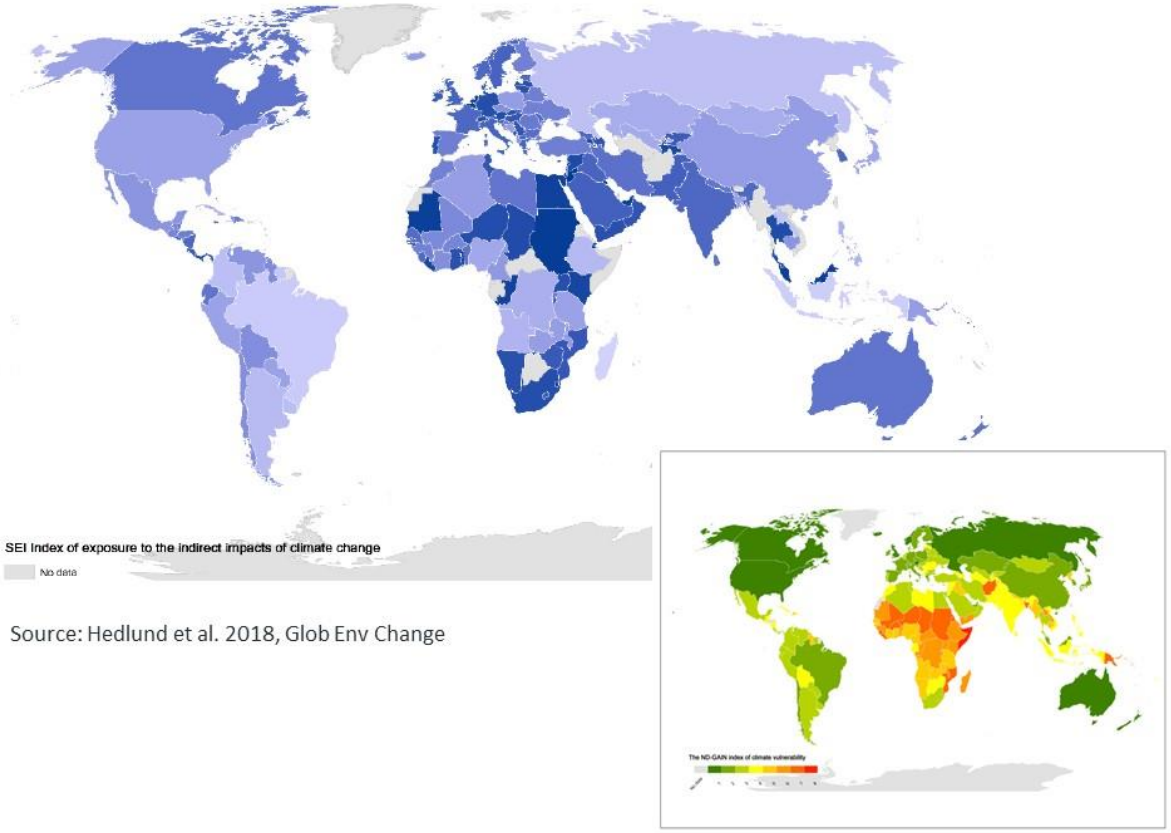
Transnational climate impacts (TCI) reach across borders, affecting one country – and requiring adaptation there – as a result of climate change or climate-induced extreme events in another country.

Conceptual framework of TCI



Identify *indicators* for the pathways

The Transnational Climate Impacts Index



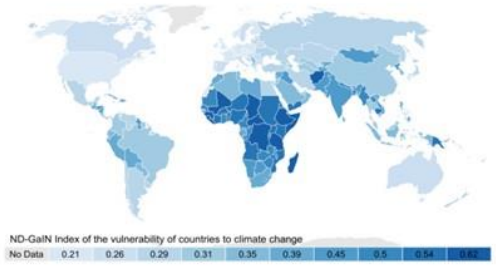
Source: Hedlund et al. 2018, Glob Env Change

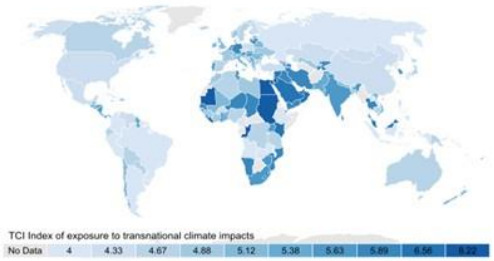
Increased interest in recent years

- UK: "…. such impacts can be at least as significant or even "an order of magnitude greater than impacts within the countries' borders (PwC, 2013)
- Liverman (2016) discusses research priorities in light of the third U.S. National Climate Assessment: "The NCA and many other regional climate impact studies generally do not take account of the global context for local climate impacts"
- The Paris Agreement recognizes an 'international dimension' to adaptation

The case study

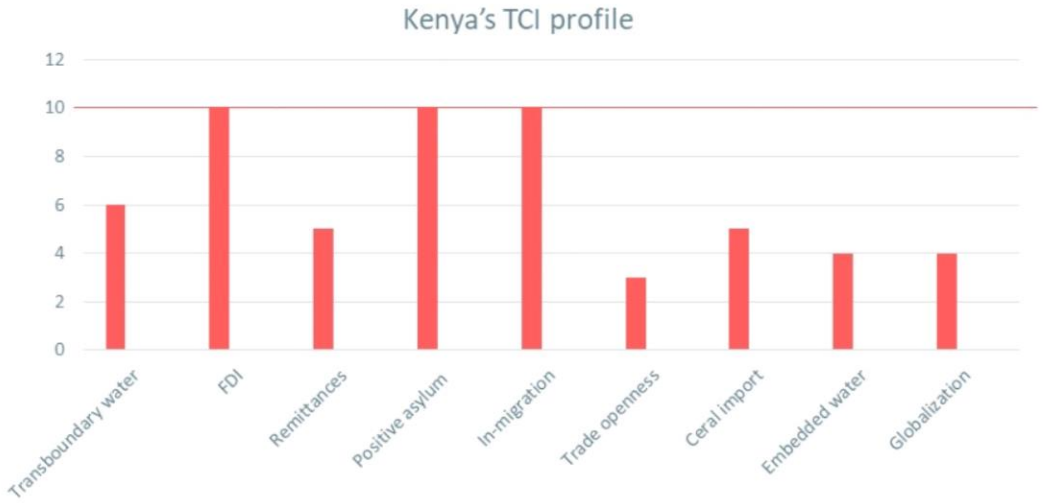
Explore Kenya's vulnerability to future transnational climate risks





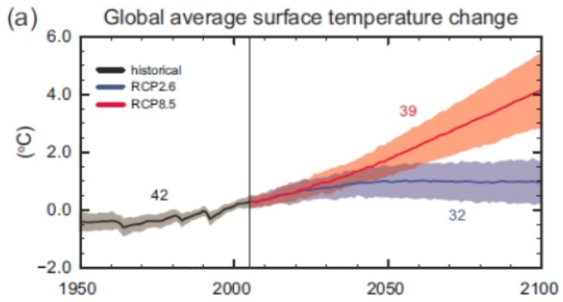
	TCI Index				ND-GAIN Index		
Rank	Country	ND-GAIN	Region	Rank	Country	TCI Index	Region
1	Jordan	0,82	MENA	1	Somalia	0,62	SSA
2	Bahrain	0,80	MENA	2	Burundi	0,59	SSA
3	Mauritania	0,79	SSA	3	Sierra Leone	0,59	SSA
4	Lebanon	0,77	MENA	4	Afghanistan	0,58	MENA
5	Kuwait	0,76	MENA	5	Central African Republic	0,58	SSA
6	Congo	0,73	SSA	6	Togo	0,58	SSA
6	United Arab Emirates	0,73	MENA	7	Liberia	0,57	SSA
8	Gambia	0,70	SSA	8	Dem. Rep. of the Congo	0,57	SSA
9	Liberia	0,69	SSA	9	Ethiopia	0,55	SSA
9	Netherlands	0,69	EUR	10	Guinea	0,55	SSA
11	Luxembourg	0,68	EUR	11	Mali	0,54	SSA
12	Montenegro	0,67	EUR	12	Chad	0,54	SSA
12	Djibouti	0,67	SSA	13	Solomon Islands	0,54	SIDS
12	Egypt	0,67	MENA	14	Madagascar	0,54	SIDS
15	Israel	0,66	MENA	15	Haiti	0,54	SIDS
15	Sudan	0,66	SSA	16	United Republic of Tanzania	0,54	SSA
15	Belgium	0,66	EUR	17	Guinea-Bissau	0,54	SSA
15	Malaysia	0,66	SE ASIA	18	Timor-Leste	0,53	SIDS
19	Swaziland	0,64	SSA	19	Burkina Faso	0,53	SSA
19	Togo	0,64	SSA	20	Kenya	0,53	SSA
21	Kenya	0,63	SSA	21	Niger	0,53	SSA
21	Tajikistan	0,63	CE & C	22	Yemen	0,53	MENA
23	Armenia	0,62	CE & C	23	Sudan	0,53	SSA
24	Maldives	0,61	SIDS	24	Uganda	0,52	SSA
24	Syrian Arab Republic	0,61	MENA	25	Rwanda	0,52	SSA
24	Mauritius	0,61	SIDS	26	Benin	0,52	SSA
27	Fiji	0,60	SIDS	27	Angola	0,52	SSA
27	Guinea-Bissau	0,60	SSA	28	Mozambique	0,51	SSA
27	Lesotho	0,60	SSA	29	Cote d'Ivoire	0,50	SSA
27	Malta	0,60	EUR	30	Nigeria	0,50	SSA

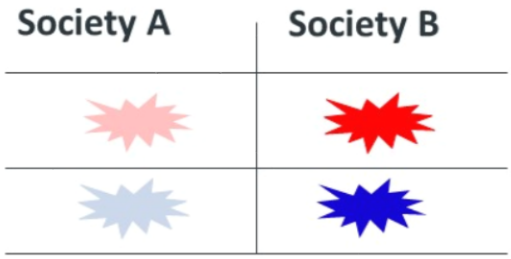
Exploring the details



This is today's risk profile. How could this profile change in the future?

Differerent future societies will react differently to one and the same climate





This is why we build socioeconomic scenarios!

What is a socioeconomic scenario?

It provides a description of a plausible future of a certain region or sector of society.

It combines different socioeconomic drivers.

Emphasis the interaction of socioeconomic factors.

It could consist of

i) qualitative data

ii) qualitative and quantitative data

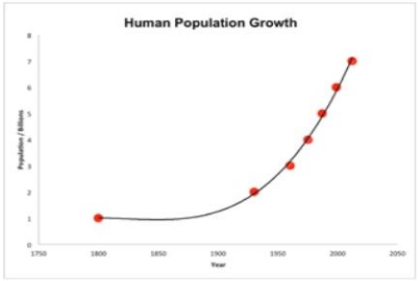
Socioeconomics do matter

A given level of climate change impact different societies differently

Different societies have different capacity to adapt to climate change

Adaptation strategies must be developed for different future possibilities

....it is the combined picture – a future climate and a future society – which influence threats and opportunites



$$CO_2 = P \times \frac{GDP}{P} \times \frac{E}{GDP} \times \frac{CO_2}{E}$$

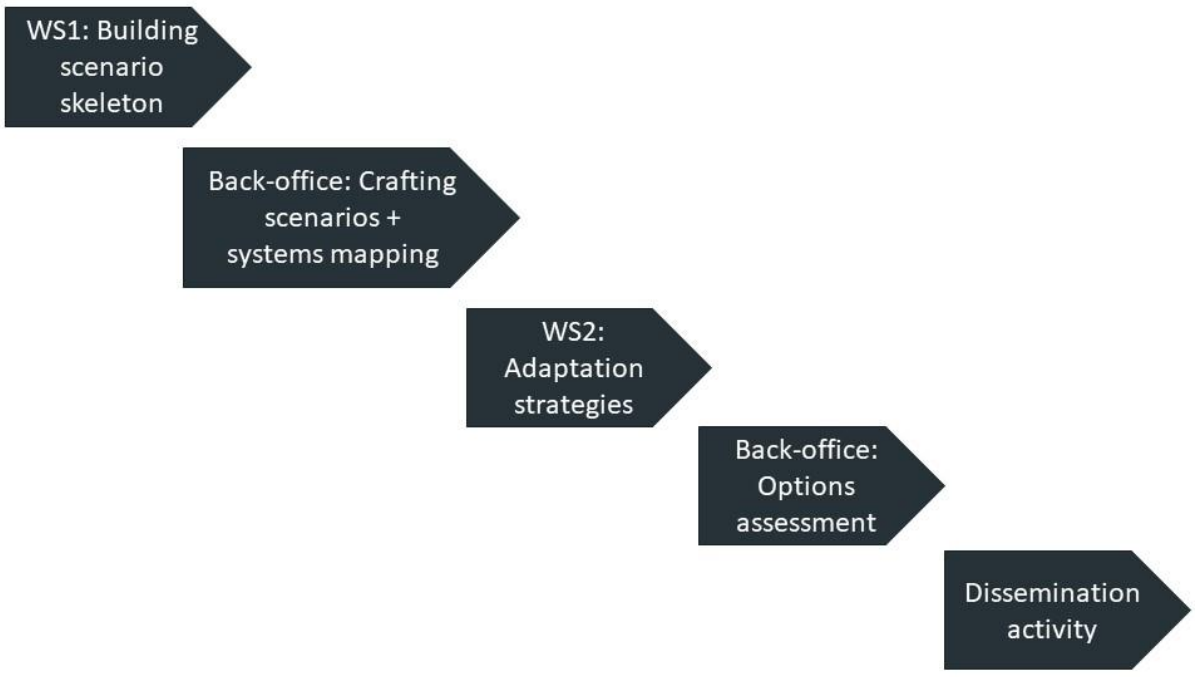
In the case study…

- We are going to build Kenyan socioeconomic scenarios describing plausible futures focusing on transnational climate risks.
- Scenarios are constructed from socioeconomic drivers and those are generated from a focus question:

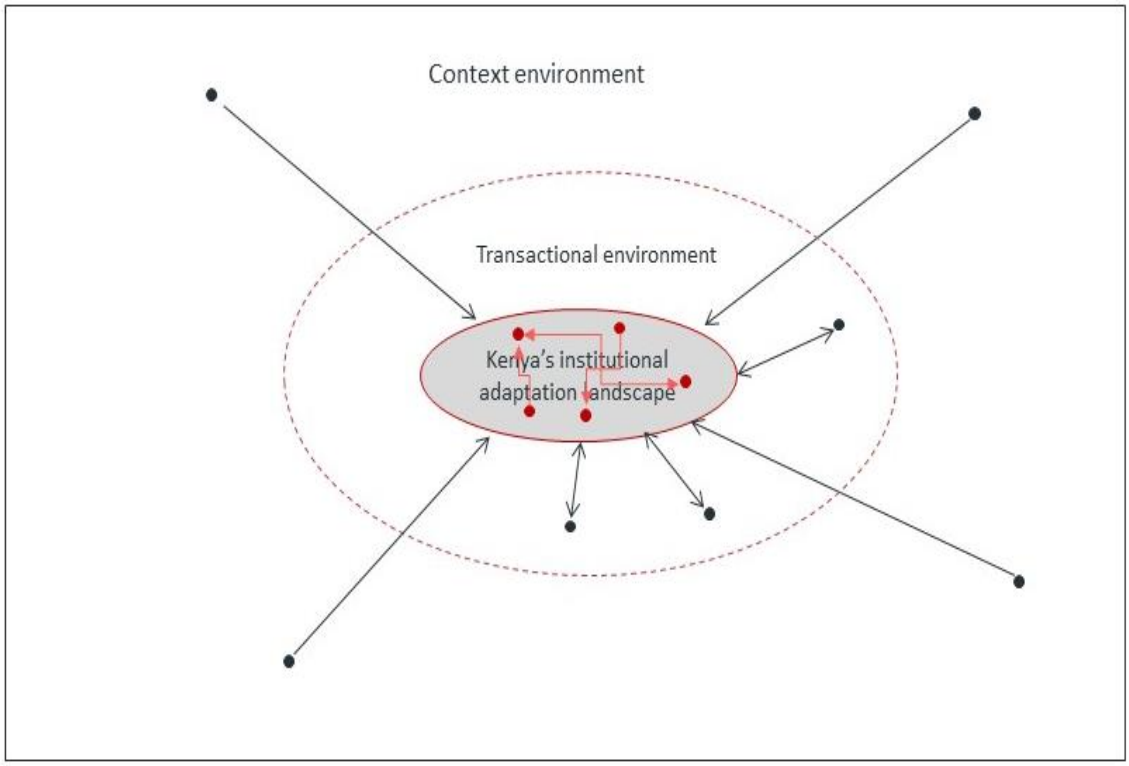
  What are the most important drivers for understanding Kenya's vulnerability to future transnational climate risks?

- The key objective of the first workshop is to co-produce a skeleton of Kenyan socioeconomic scenarios of relevance for assessing transnational climate impacts.

The case study process



Annex 4. Presentation 2; Introducing the Shared Socioeconomic Pathways (SSPs)



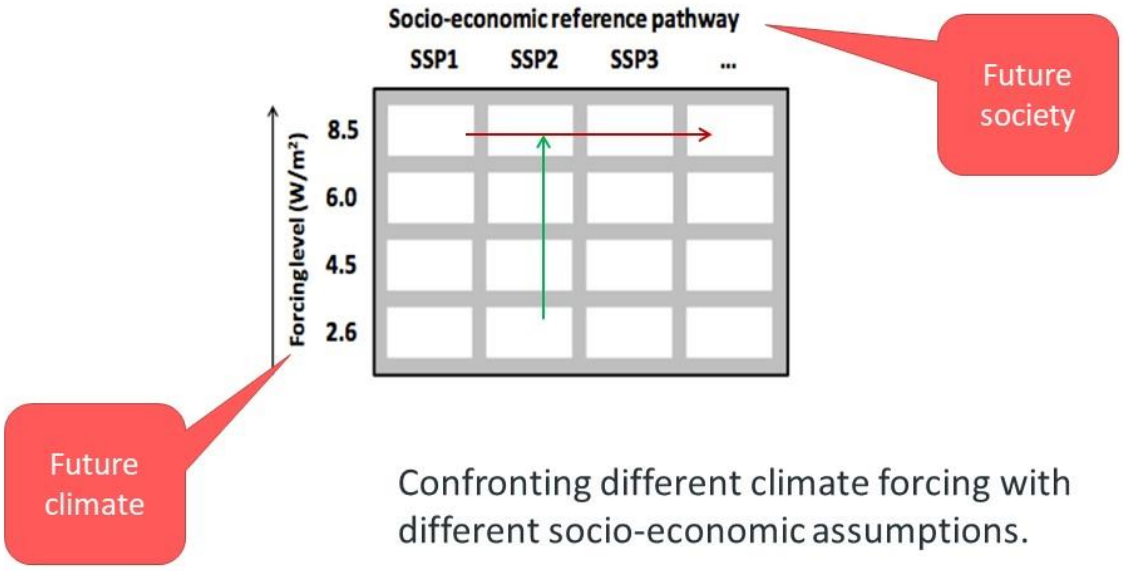
Linking the local to the global

We have now worked with drivers from the bottom-up perspective, i.e. from our joint perspective without any "boundary conditions".

However, any future development is dependent on a range of external factors

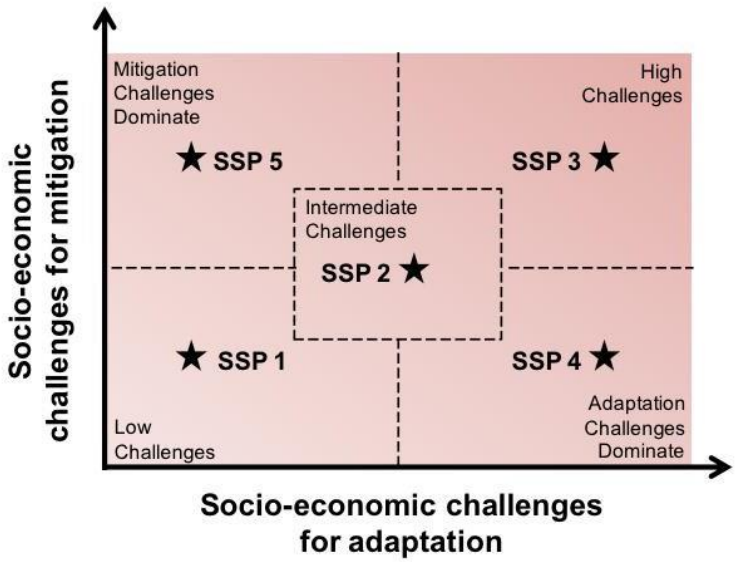
Therefore we are now going to map our (clusters of) drivers to a set of global context scenarios.

Global Climate Change Research Community's Scenario Architecture



Confronting different climate forcing with different socio-economic assumptions.

Spanning adaptation/mitigation space



SSP1: Sustainability

Low challenges to mitigation: Development of environmental & renewable energy technologies, international cooperation, and low energy demand.

Low challenges to adaptation: Improvements in human well-being, strong institutions

The world shifts gradually, but pervasively, toward a more sustainable path, emphasizing more inclusive development that respects perceived environmental boundaries.

SSP5: Fossil-fueled development

High challenges to mitigation:
Strong reliance on fossil fuels and lack of global environmental concern

Low challenges to adaptation:
Attainment of human development goals, robust economic growth, and highly engineered infrastructure

This world places increasing faith in competitive markets, innovation and participatory societies to produce rapid technological progress and development

SSP3: Regional Rivalry

High challenges to mitigation: Growing resource intensity and fossil fuel dependency. Difficulty in achieving international cooperation. Slow technological change.

High challenges to adaptation: Limited progress on human development, slow income growth, lack of effective institutions.

A resurgent nationalism, concerns about competitiveness and security, and regional conflicts push countries to increasingly focus on national and regional security issues, including energy and food security.

SSP4: Inequality

Low challenges to mitigation: Some research and investment in low carbon options. Well-integrated international political and business class capable of acting quickly and decisively

High challenges to adaptation: Large population groups have low levels of development and limited access to institutions for coping with economic or environmental stresses.

Increasing disparities in education, economic opportunity and political power lead to growing inequalities across and within countries. A gap widens between a well educated international society supporting a high-tech global economy, and fragmented lower-income, poorly educated societies that work in regional low-tech economies.

Introduction to group work

- The global scenarios here enter as a "boundary condition" for the local development.
- The task for group work is to interpret the regional developments for each of the prioritized drivers in relation to the scenario set.
- The question is "How could driver X play out at the regional scale in a world as the one described by scenario Y?"

	Sustainability	Regional rivalry	Inequality	Fossil fueled dev.
Cluster of drivers 1	Interpretation of driver 1 given the context of "Sustainability"	Interpretation of driver 1 given the context of "Regional riv."	Interpretation of driver 1 given the context of "Inequality"	…
Cluster of drivers 2	Interpretation of driver 2… "Sustainability"	Interpretation of driver 2… "Regional riv."	…	
…	…			

Comparing across scenarios

	Regional Rivalry	Sustainability	Fossil-Fueled Dev.	Inequality
Driver X	Interpretation of driver X given the context described in the scenario Regional Rivalry	Interpretation of driver X given the context described in scenario Sustainability	…	…
Driver Y:	Interpretation of driver Y given the context described in the scenario Regional Rivalry	…		
Driver Z:	…			
….	…			

Annex 5. Summary of Shared Socioeconomic Pathways (SSPs)

Sustainability (SSP1)

The world shifts gradually, but pervasively, toward a more sustainable path, emphasizing more inclusive development that respects perceived environmental boundaries. Increasing evidence of and accounting for the social, cultural, and economic costs of environmental degradation and inequality drive this shift. Management of the global commons slowly improves, facilitated by increasingly effective and persistent cooperation and collaboration of local, national, and international organizations and institutions, the private sector, and civil society. Educational and health investments accelerate the demographic transition, leading to a relatively low population. Beginning with current high-income countries, the emphasis on economic growth shifts toward a broader emphasis on human well-being, even at the expense of somewhat slower economic growth over the longer term. Driven by an increasing commitment to achieving development goals, inequality is reduced both across and within countries. Investment in environmental technology and changes in tax structures lead to improved resource efficiency, reducing overall energy and resource use and improving environmental conditions over the longer term. Increased investment, financial incentives and changing perceptions make renewable energy more attractive. Consumption is oriented toward low material growth and lower resource and energy intensity.

Regional rivalry (SSP3)

A resurgent nationalism, concerns about competitiveness and security, and regional conflicts push countries to increasingly focus on domestic or, at most, regional issues. This trend is reinforced by the limited number of comparatively weak global institutions, with uneven coordination and cooperation for addressing environmental and other global concerns. Policies shift over time to become increasingly oriented toward national and regional security issues, including barriers to trade particularly in the energy resource and agricultural markets. Countries focus on achieving energy and food security goals within their own regions at the expense of broader-based development, and in several regions move toward more authoritarian forms of government with highly regulated economies. Investments in education and technological development decline. Economic development is slow, consumption is material-intensive, and inequalities persist or worsen over time, especially in developing countries. There are pockets of extreme poverty alongside pockets of moderate wealth, with many countries struggling to maintain living standards and provide access to safe water, improved sanitation, and health care for disadvantaged populations. A low international priority for addressing environmental concerns leads to strong environmental degradation in some regions. The combination of impeded development and limited environmental concern results in poor progress toward sustainability. Population growth is low in industrialized and high in developing countries.

Inequality (SSP4)

Highly unequal investments in human capital, combined with increasing disparities in economic opportunity and political power, lead to increasing inequalities and stratification both across and within countries. Over time, a gap widens between an internationally-connected society that is well educated and contributes to knowledge- and capital-intensive sectors of the global economy, and a fragmented collection of lower-income, poorly educated societies that work in a labor intensive, low-tech economy. Power becomes more concentrated in a relatively small political and business elite,

even in democratic societies, while vulnerable groups have little representation in national and global institutions. Economic growth is moderate in industrialized and middle-income countries, while low income countries lag behind, in many cases struggling to provide adequate access to water, sanitation and health care for the poor. Social cohesion degrades and conflict and unrest become increasingly common. Technology development is high in the high-tech economy and sectors. Uncertainty in the fossil fuel markets lead to underinvestment in new resources in many regions of the world. Energy companies hedge against price fluctuations partly through diversifying their energy sources, with investments in both carbon-intensive fuels like coal and unconventional oil, but also low-carbon energy sources. Environmental policies focus on local issues around middle- and high-income areas.

Fossil fuelled development (SSP5)

Driven by the economic success of industrialized and emerging economies, this world places increasing faith in competitive markets, innovation and participatory societies to produce rapid technological progress and development of human capital as the path to sustainable development. Global markets are increasingly integrated, with interventions focused on maintaining competition and removing institutional barriers to the participation of disadvantaged population groups. There are also strong investments in health, education, and institutions to enhance human and social capital. At the same time, the push for economic and social development is coupled with the exploitation of abundant fossil fuel resources and the adoption of resource and energy intensive lifestyles around the world. All these factors lead to rapid growth of the global economy. There is faith in the ability to effectively manage social and ecological systems, including by geo-engineering if necessary. While local environmental impacts are addressed effectively by technological solutions, there is relatively little effort to avoid potential global environmental impacts due to a perceived trade-off with progress on economic development. Global population peaks and declines in the 21st century. Though fertility declines rapidly in developing countries, fertility levels in high income countries are relatively high (at or above replacement level) due to optimistic economic outlooks. International mobility is increased by gradually opening up labor markets as income disparities decrease.