WEBINAR SERIES

BUILDING NEXUS RESILIENCE

Webinar 2: Integrating Migration Models and WEF Nexus Assessments

Tuesday September 10, 2024

3:00-4:30 PM CET
8:00-9:30 AM CST

Texas A&M University Texas A&M Energy Institute | TEES Texas A&M Engineering Experiment Station | UNU FLORES | Columbia Climate School Center for International Earth Science Information Network | UNU EHS | ULB École de Santé Publique | NexusNet | IWRA International Water Resources Association

INTRODUCTION

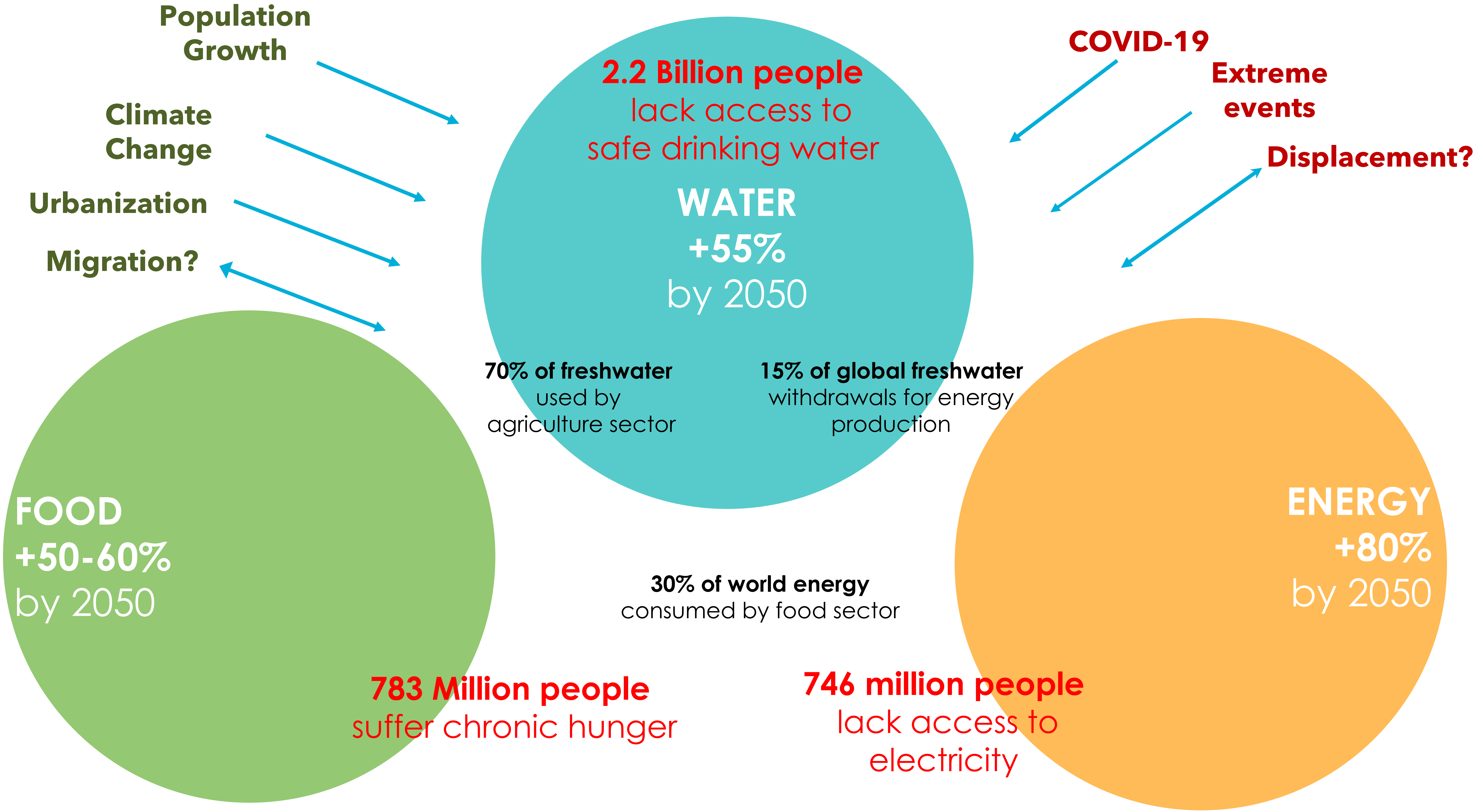
DR. BASSEL DAHER

Texas A&M Energy Institute
SustainFood Network
International Water Resources Association

INTRODUCTION

REWA ASSI

International Water Resources Associations (IWRA)



(Daher and Mohtar, 2022; IRENA 2015)

International migrants[a]

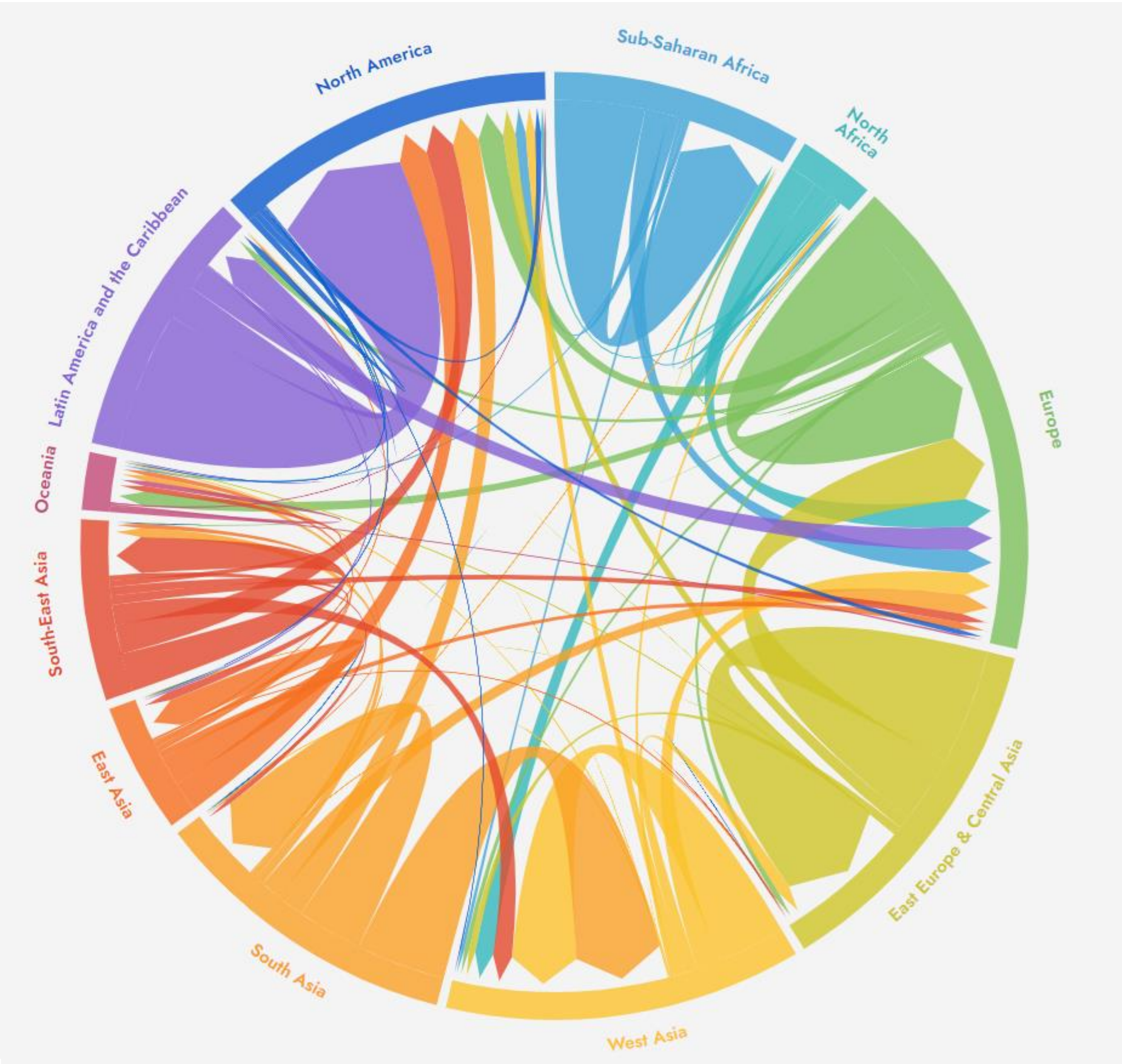
281 million

international migrants globally in 2020, or 3.6 per cent of the world's population

Displaced persons[e,f]

117 million

people were living in displacement globally at the end of 2022 (includes refugees, asylum-seekers, IDPs and others)



Abel, G.J., Cohen, J.E. (2019). Bilateral international migration flow estimates for 200 countries. *Sci Data* **6** 82

WEBINAR SERIES OBJECTIVE

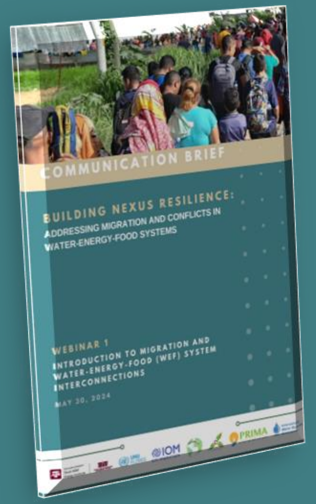
Catalyze cross-disciplinary, cross-institutional, and international **dialogues** toward understanding the *knowledge gaps* and *opportunities* in taking a **holistic, systems approach** to addressing interconnected challenges at the intersection of **migration** and **water-energy-food systems.**

TEXAS A&M UNIVERSITY Texas A&M Energy Institute | TEES TEXAS A&M ENGINEERING EXPERIMENT STATION | UNU FLORES | COLUMBIA CLIMATE SCHOOL CENTER FOR INTERNATIONAL EARTH SCIENCE INFORMATION NETWORK | UNU EHS | ULB ÉCOLE DE SANTÉ PUBLIQUE | NexusNet | IWRA International Water Resources Association

WEBINAR SERIES

Webinar #1
May 30, 2024

Introduction to Migration and Water-Energy-Food (WEF) System Interconnections



Webinar #2
September 10, 2024

Integrating Migration Models and WEF Assessments

Webinar #3
December 3, 2024

Governance Considerations and Evidence-based Policy Making

BUILDING NEXUS RESILIENCE: Integrating Migration Models and WEF Nexus Assessments

Texas A&M University Texas A&M Energy Institute
TEES Texas A&M Engineering Experiment Station
UNU FLORES
Columbia Climate School Center for International Earth Science Information Network
UNU EHS
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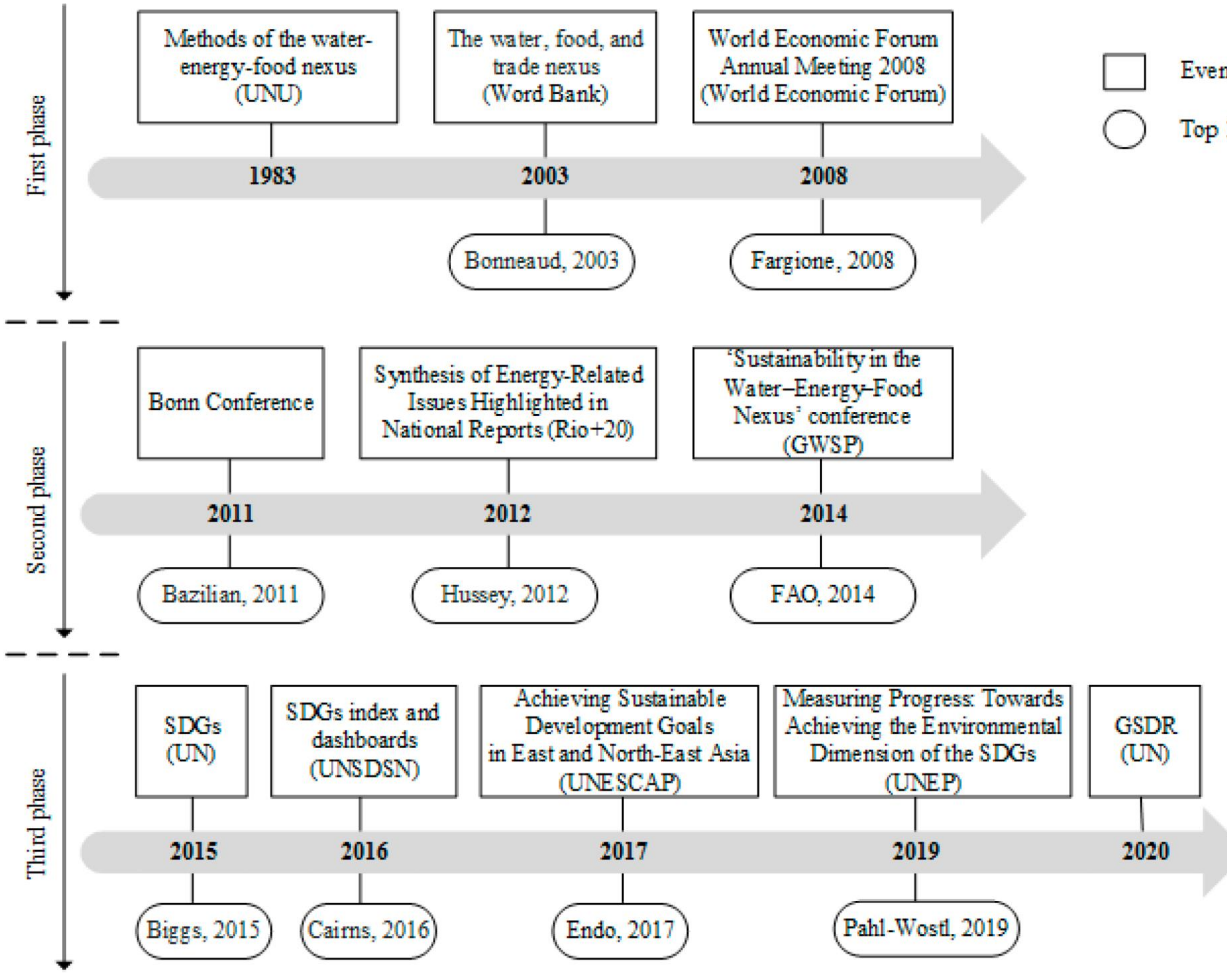
WEBINAR SERIES OUTCOMES

1- **Facilitate** the development of a **common framework** and **road map** for integrating migration in nexus assessment tools.

2- **Contribute** to exploring and developing **anticipatory tools** and **strategies** incorporating **migration dynamics** into **nexus assessments**, aiming to guide policymakers, researchers, and practitioners toward evidence-based, sustainable, and resilient solutions.

WEF Nexus: Timeline and growth of published papers



T. Ding, et al.

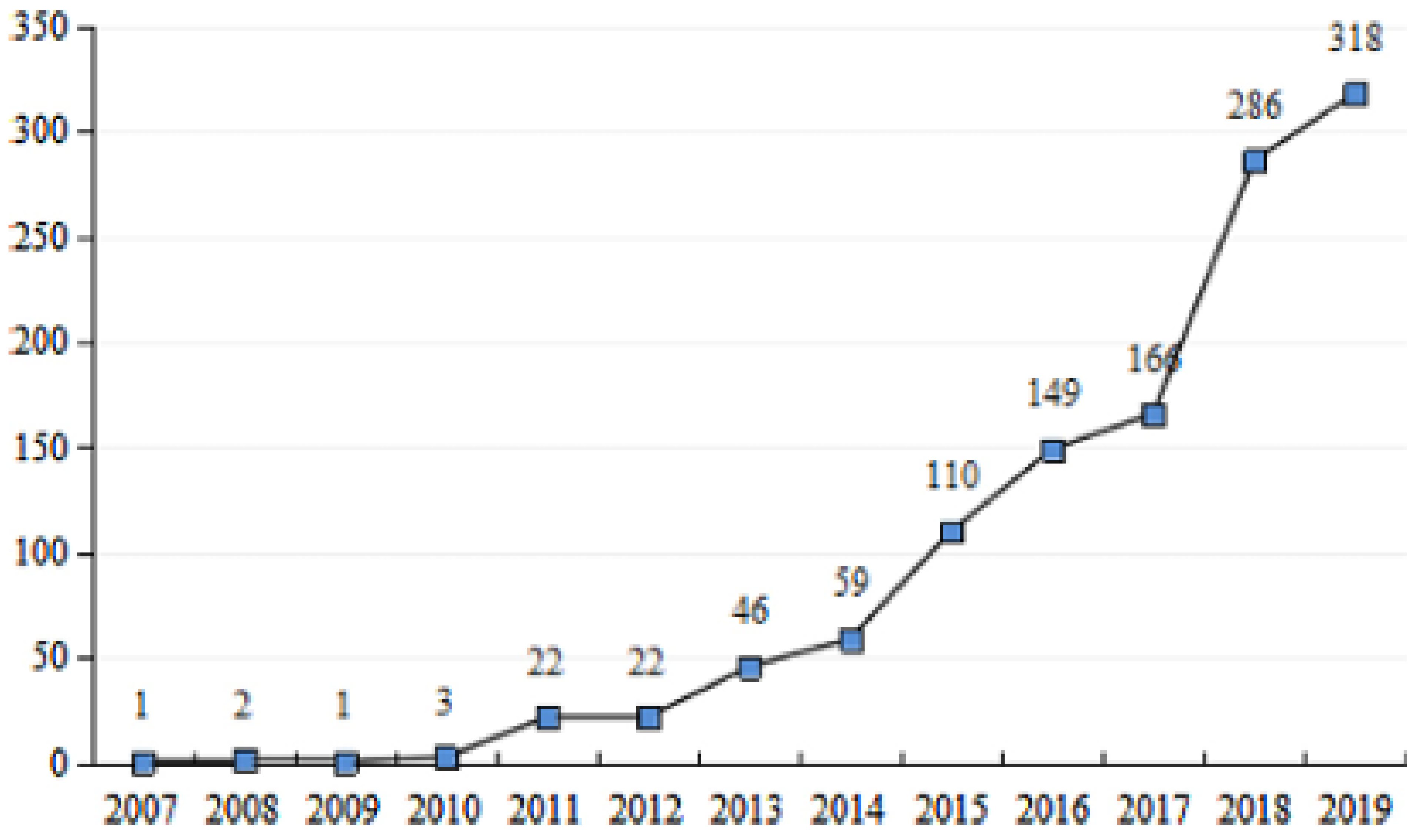
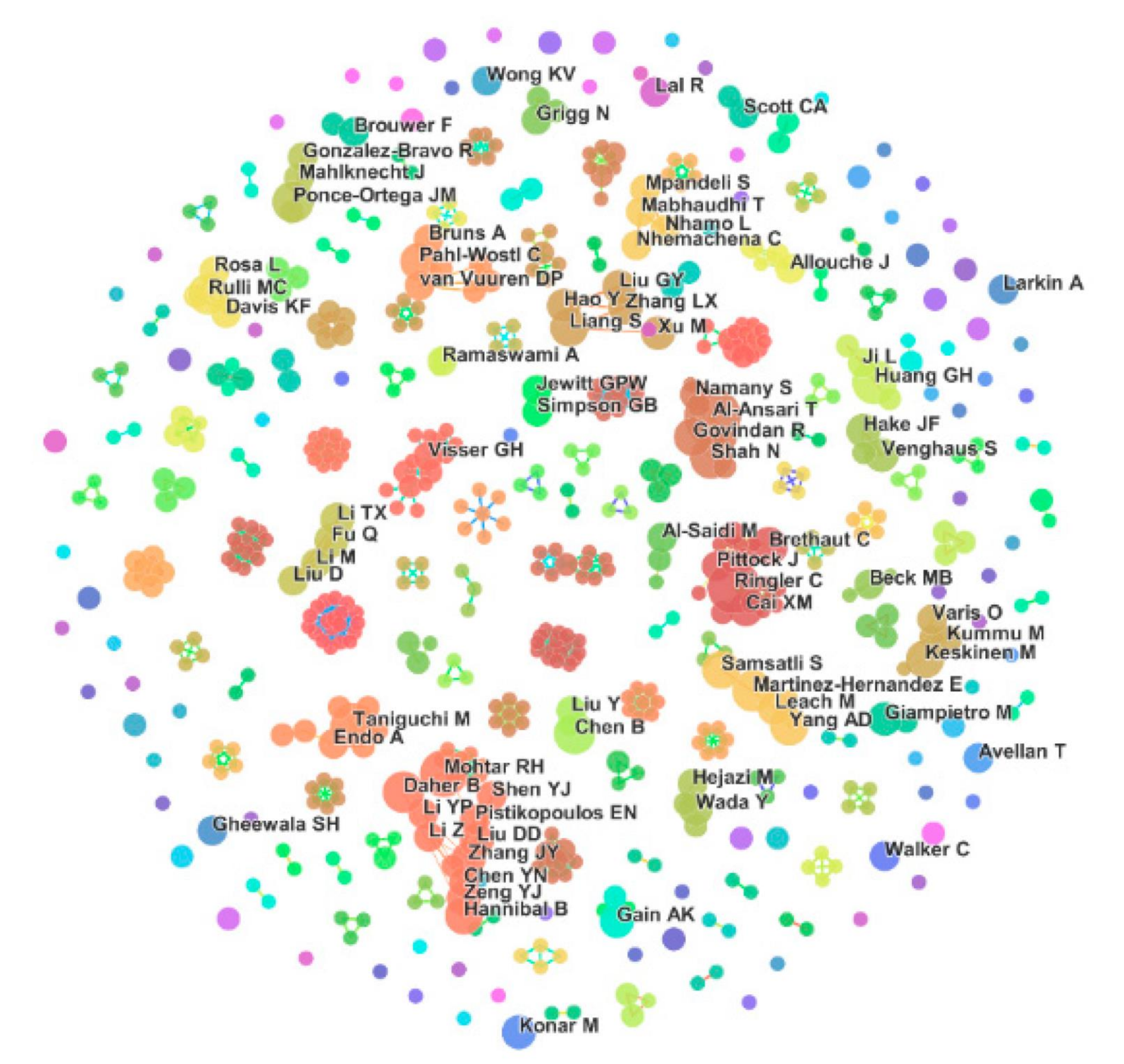
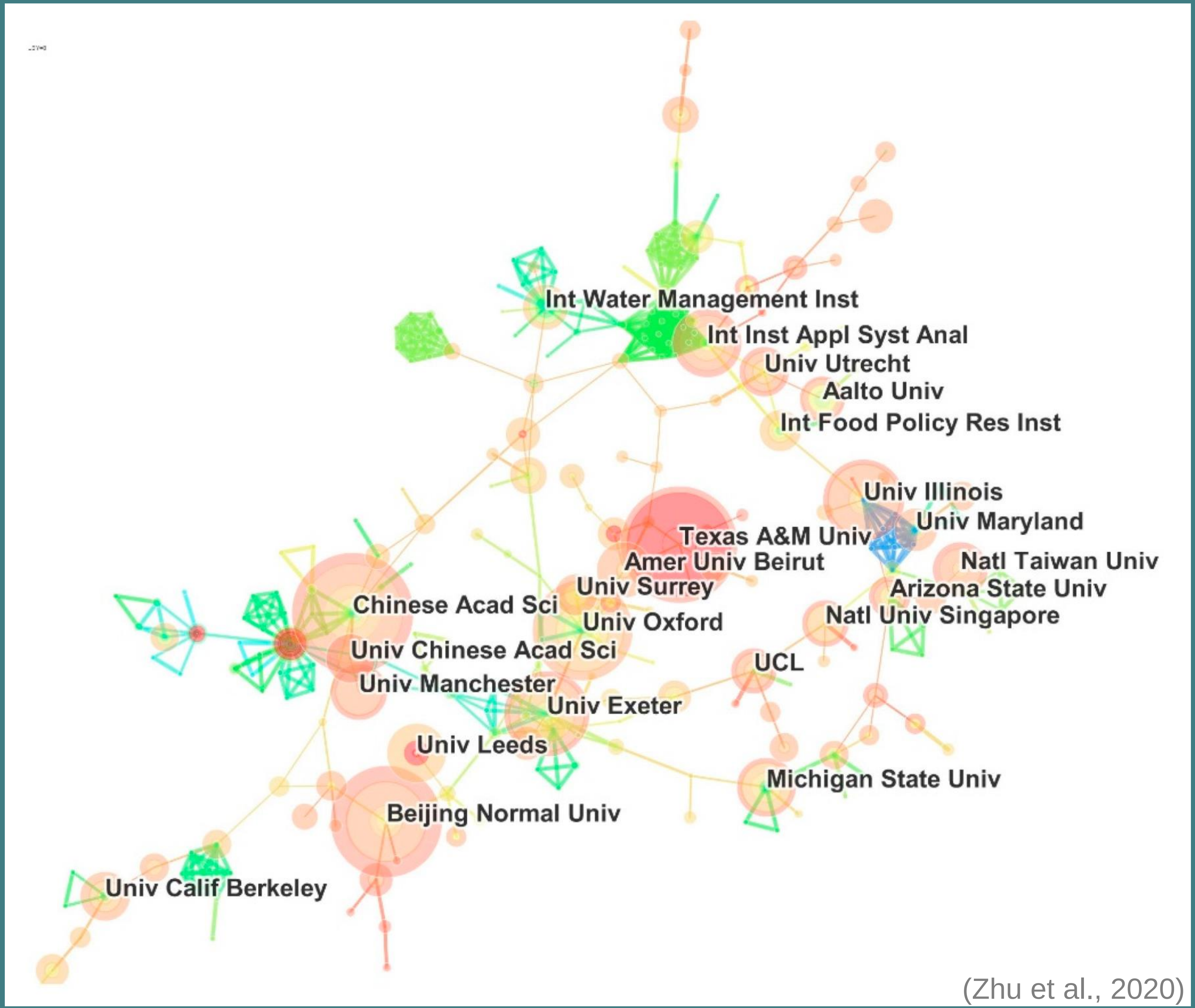


Fig. 1. Distribution of papers each year.

BUILDING NEXUS RESILIENCE: Integrating Migration Models and WEF Nexus Assessments

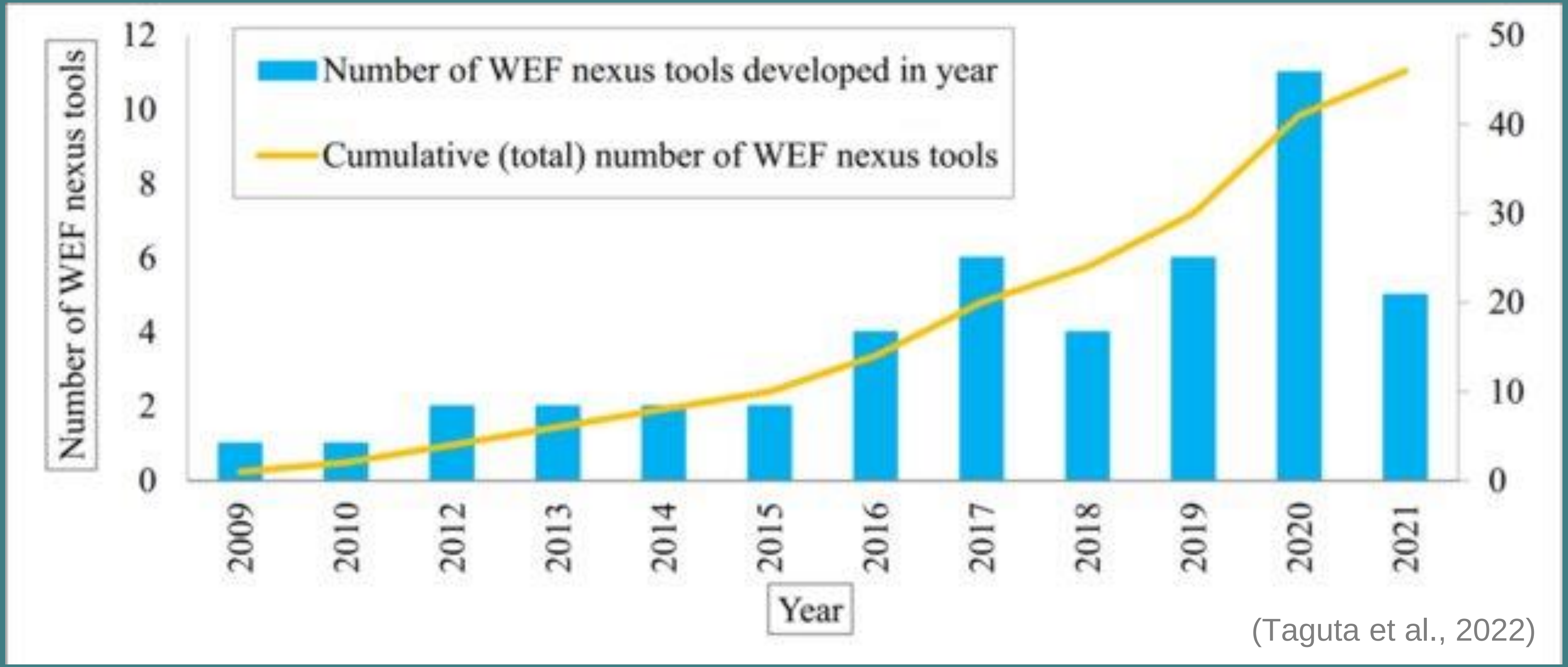
Co-authorship network of authors and institutions – WEF Nexus





(Zhu et al., 2020)

WEF Nexus Tools



46
WEF Nexus Tools

WEF Nexus Tools

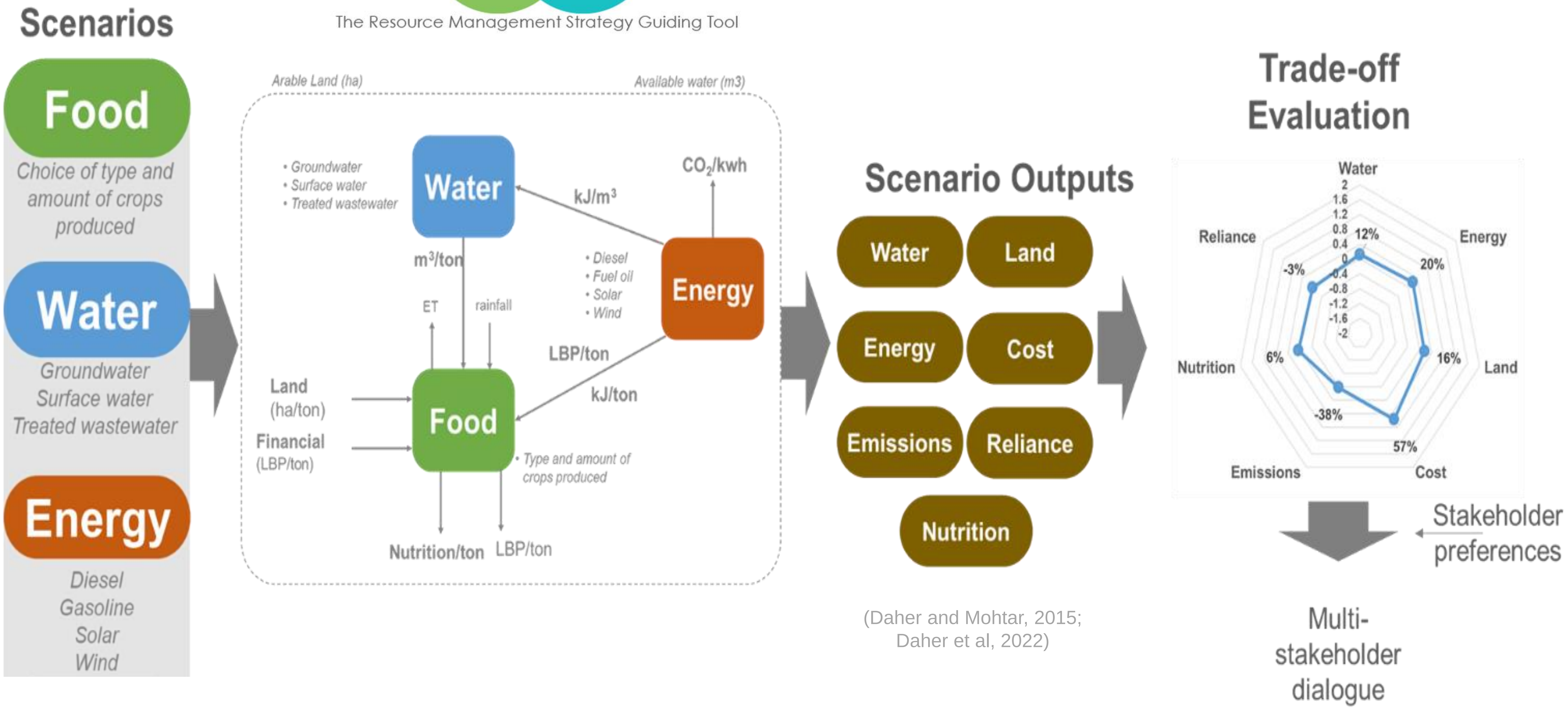
Table 4. The main quantitative models used in food–energy–water nexus.

Method	Model	Publication
Econometrics	Based on existing research or expert judgments	Fu et al. [45] Nerini et al. [86]
Target decision-making	Multicriteria comprehensive evaluation; econometric model	Weitz et al. [87] Huang et al. [71]
Input–output analysis	Input–output model; data envelopment analysis (DEA)	Munoz Castillo et al. [62] Sueyoshi et al. [64]
Life cycle assessment	Life cycle assessment (LCA)	Laurent et al. [66]
Econometric model	Global macro-econometric model	Brouwer et al. [88]
Simulation modeling prediction	Threshold 21; system dynamics model; Integrated model for sustainable development goals (iSDG); Bayesian networks; agent-based model	Collste et al. [76] Li et al. [72] Bakhshianlamouki et al. [73] Chai et al. [74] Abdel-Aal et al. [75]
Multi-system model	Computable general equilibrium (CGE); long-range energy alternatives planning (LEAP); water evaluation and planning model (WEAP); climate, land-use, energy and water systems (CLEWS); WEF Nexus Tool	Weitz et al. [80] Payet-Burin et al. [81] Zhang et al. [82] Philippidis et al. [83] Olawuyi [84] Welsch et al. [85] Daher and Mohtar [79]

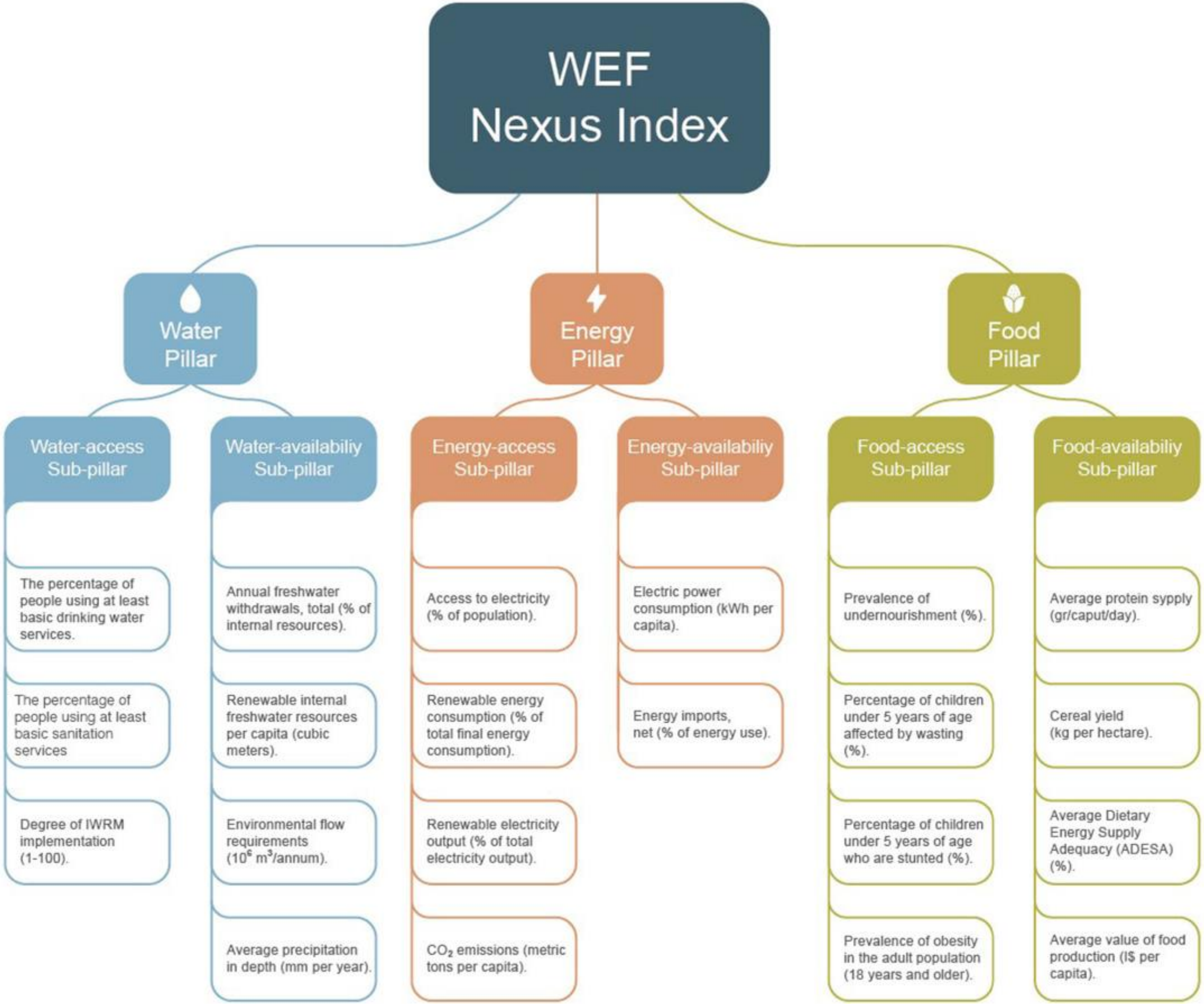
(Zhu et al., 2020)

WEF Nexus Tool 2.0

The Resource Management Strategy Guiding Tool



(Daher and Mohtar, 2015;
Daher et al, 2022)



(Simpson and Jewitt, 2019; Simpson et al; 2022)

WEF
Nexus Index

USA in 2023

The Water-Energy-Food (WEF) Nexus Index is a composite indicator that aggregates 21 globally available indicators. The WEF Nexus Index value for USA is **74.5**, placing the nation in the **4th** position for the countries assessed. USA has a value of **80.4** for the Water pillar, **67.8** for the Energy pillar and **75.1** for the Food pillar.

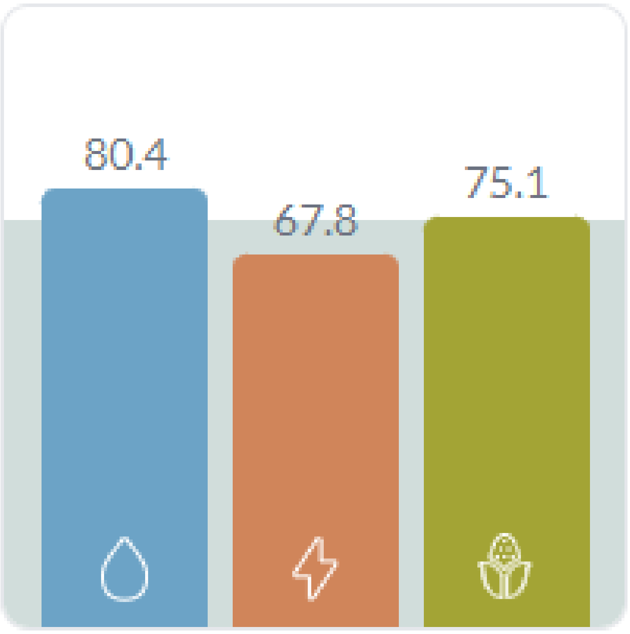
Print page

WEF Nexus Index

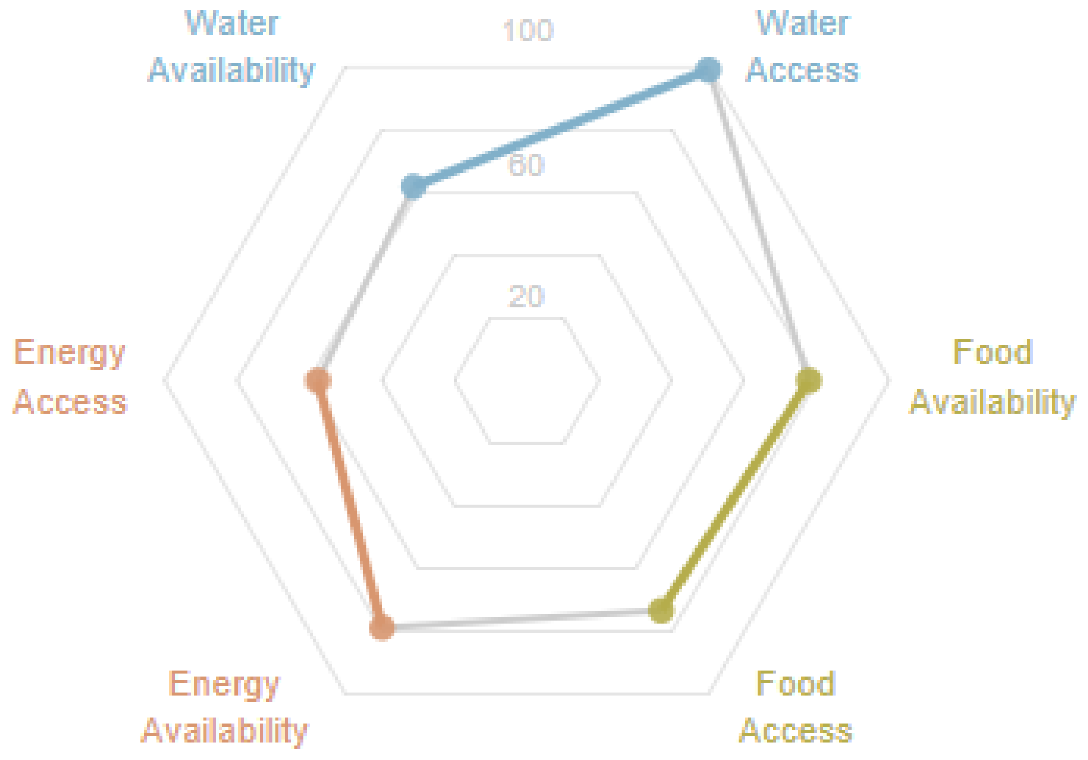
74.5

4th world rank in 2023
vs 4th in 2022

The Index includes three pillars



Each pillar includes two sub-pillars



Migration models

Table 1. Types of migration models.

Model	Migration	Author	Scale	Tool	Context	Remarks
Gravity Model	Voluntary	Mayda, 2010	International	Statistical Analysis	Economic and non-economic determinants of migration to OCED countries	Utilizes open source data
	Voluntary	Poot et al., 2016	Internal and International	Statistical Analysis	Migration pattern based on mobility between sources and destinations.	Data intensive Focused on general pattern of migration
	Voluntary	Dharmadasa and Herath, 2018	International	Statistical Analysis	Economic migration based on economic determinants from Srilanka to Middle East countries	Identifies push and pull factors of economic migration
	Forced	Saldarriga and Hua, 2019	Internal	Statistical Analysis	Influence of social network on the choice of victims of forced migration due to violence in Colombia	Requires access to city specific data and national database
Radiation Model	Voluntary	Simini et al., 2012	Internal	Statistical Analysis	Focused on human mobility based on modes of communication	Emphasis on general migration pattern; Requires data which might be hard to access.
	Forced	Davis et al., 2018	Internal	Statistical Analysis	Projection of climate driven migration in Bangladesh due to sea level rise	Utilizes open source data Connected migration flow with excess demand of food, jobs and housing
Agent Based Model	Voluntary	Chen et al., 2018	International	Statistical Analysis	Key behavioral motives of migrants from Mexico to USA	Data collected from interviews of individual
	Forced	Suleimenova et al., 2017	International	FLEE Simulation Framework	Predicting flow of refugees in refugee camps due to conflicts in African countries	Suitable to predict refugee volume across camps during conflicts
	Forced	Herbert et al., 2018	International	Simulation	Refugee mobility and flow prediction from Syria to neighboring countries based on incident of violence	Only considers death toll as a variable directly related to violence
	Forced	De Kock, 2019	International	CoFMMA Framework	Predicting flow and direction of refugees during conflicts from Syria to Jordan	Data intensive High complexity
	Forced	Hussani-Mahmooei and Parris, 2012	Internal	Simulation	Predicting flow of IDPs from different part of Bangladesh due to climate change	Utilizes open source data Long term projections

(Daher et al., 2020)

WEBINAR GUIDING QUESTIONS

1. Considering the interconnectedness between WEF and migration, ***how can migration models be integrated into WEF assessments***?

2. What ***challenges and opportunities*** exist for integrating migration models into WEF assessments?

3. What are the ***current gaps in research*** regarding the intersection of WEF and migration?

POLL TIME!

1. Region
2. Organization type
3. Career stage

PANEL INTRODUCTION

Dr. FLOOR BROUWER

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PANELISTS

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Institute for Environment and Human Security

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PANELIST #1

The Importance of Water in Internal Climate Migration Modeling

Dr. ALEX DE SHERBININ
Columbia Climate School
Columbia University

TEXAS A&M UNIVERSITY Texas A&M Energy Institute
TEES TEXAS A&M ENGINEERING EXPERIMENT STATION
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The Importance of Water and Food in Internal Climate Migration Modeling

Alex de Sherbinin[1], Bryan Jones[2], and Jacob Schewe[3]

[1]CIESIN, Columbia University, [2]CUNY Institute for Demographic Research,
[3]Potsdam Institute for Climate Impact Research

WEF - Migration Webinar
6 September 2024

Columbia Climate School
Center for International Earth Science Information Network
CUNY Institute for Demographic Research
PIK

Material drawn from:

Africa Climate Mobility Initiative

http://africa.climatemobility.org

The Groundswell report series

http://hdl.handle.net/10986/29461 and https://hdl.handle.net/10986/36248

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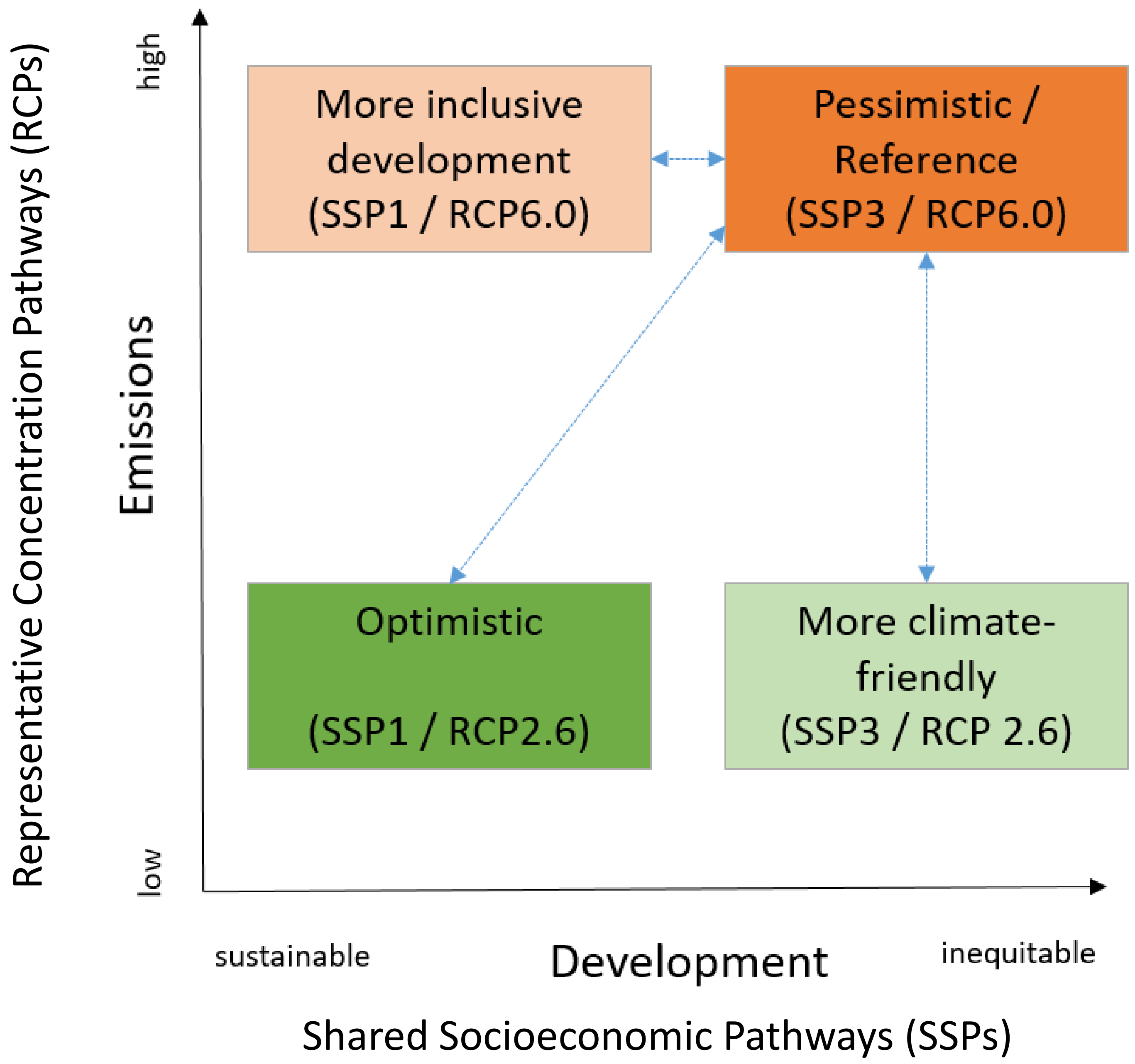
The scenario-based approach



Composite of demographic & climate impact models run for each scenario at a **4 km** grid resolution (but aggregated to **15 km** resolution)

Estimates of **climate mobility** derived by comparing grid-cell level population for “climate impact” scenario with that of the “no climate impact” scenario

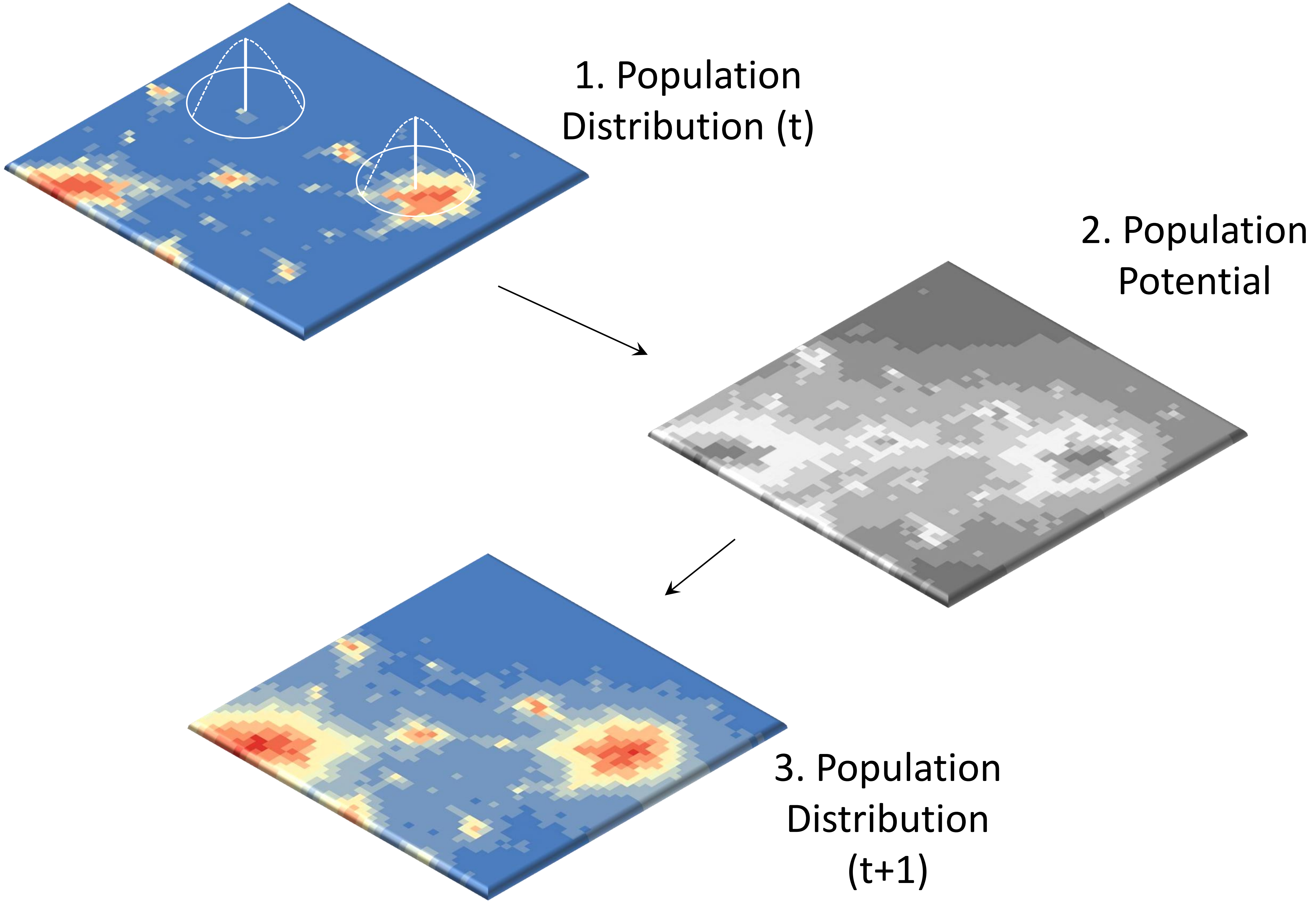
Results produced at national level, and aggregated at regional level

The modeling method employs combinations of development scenarios (SSPs) and climate impact scenarios (RCPs).

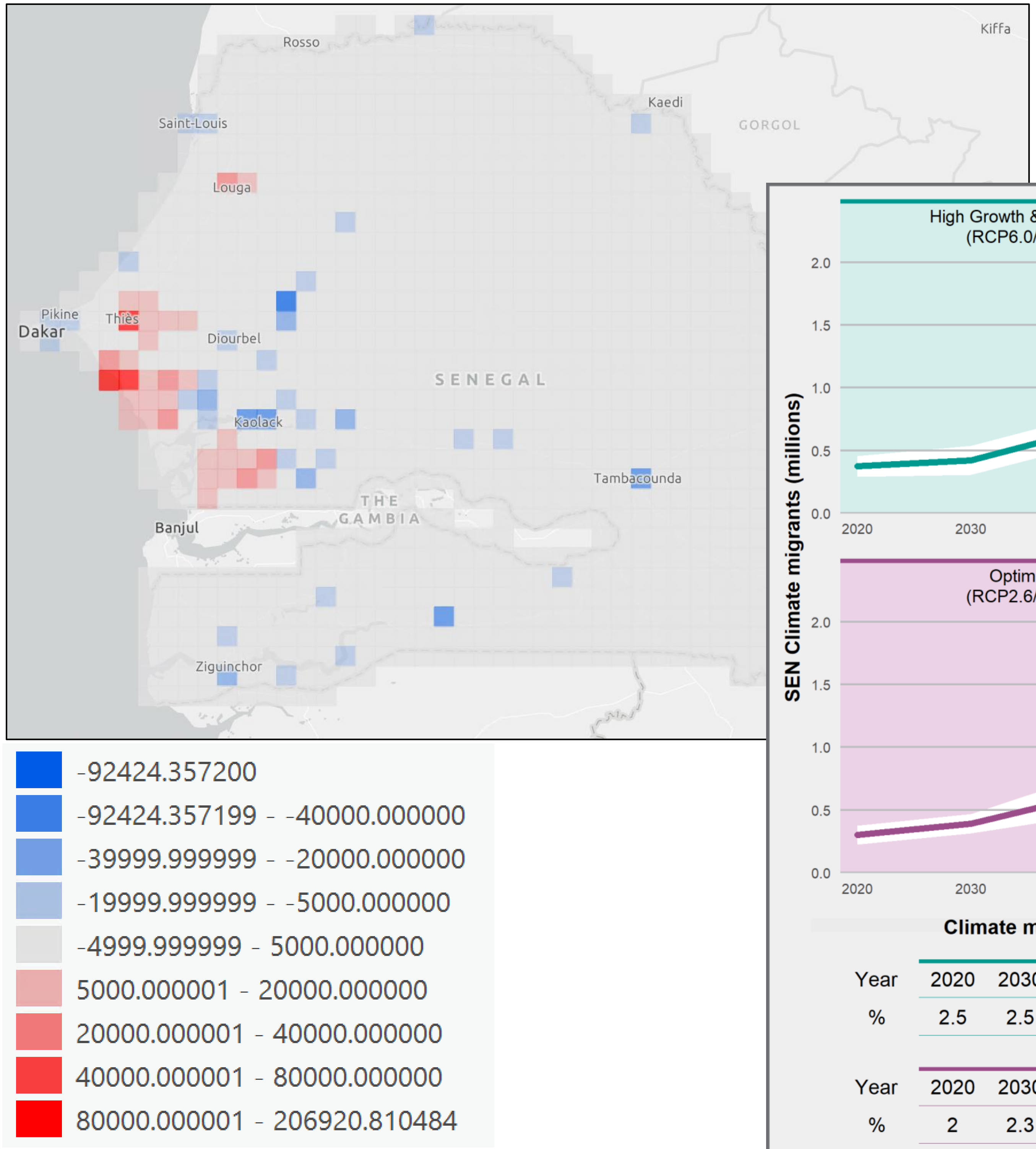
Methods: model approach

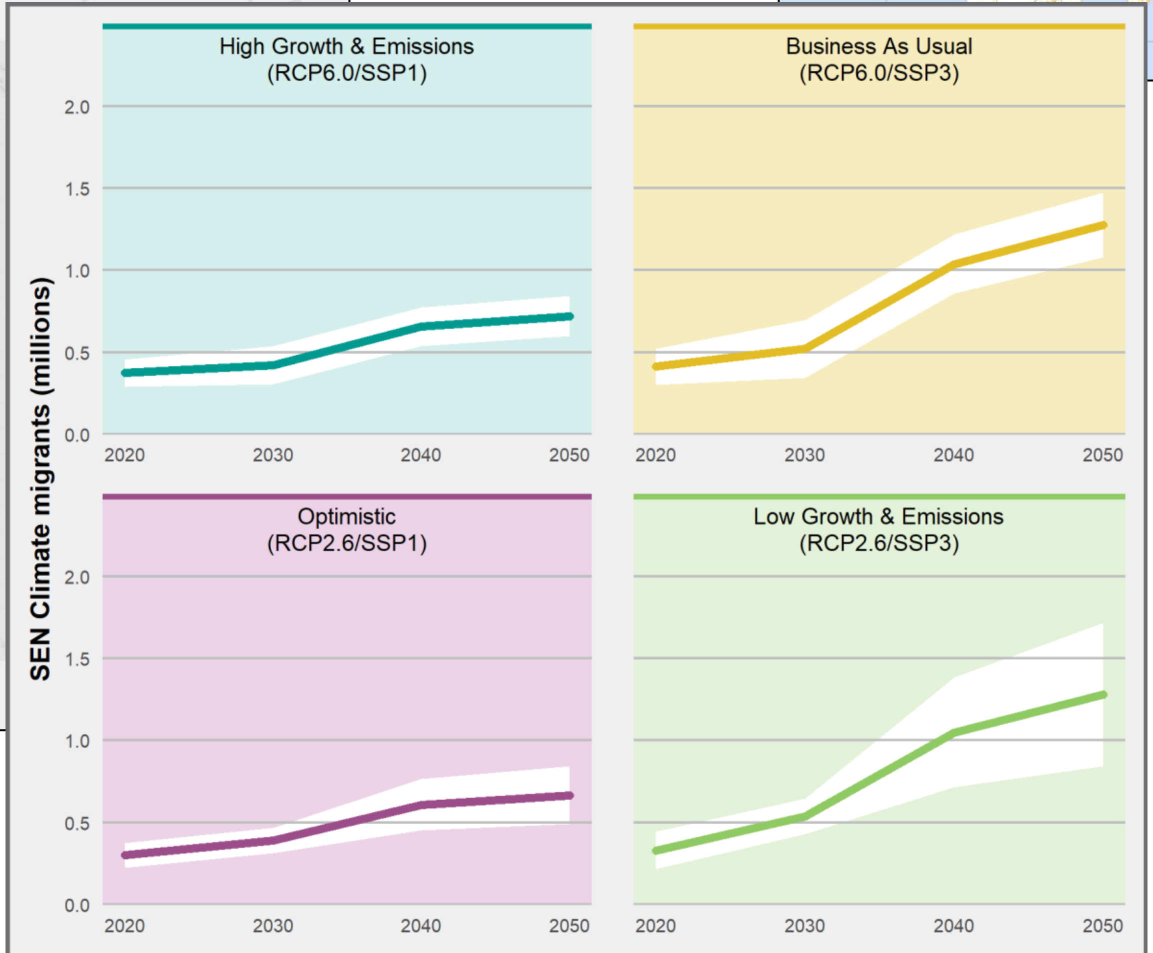
Assumptions:

- Spatial choice informed by accessibility
- Population agglomeration is a proxy for the socio-economic characteristics of “attractive” places
- Environmental/sectoral change will impact relative attractiveness



We compare climate impact *to* no climate impact scenarios



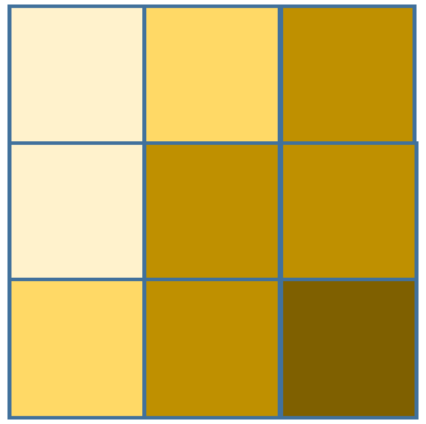


Climate migrants as a percentage of the total population

Year	2020	2030	2040	2050	2020	2030	2040	2050
%	2.5	2.5	3.5	3.7	2.5	2.5	3.9	4

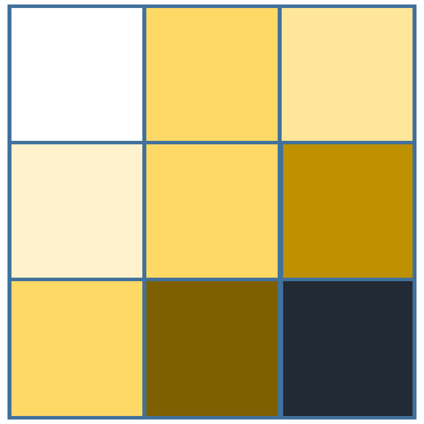
Year	2020	2030	2040	2050	2020	2030	2040	2050
%	2	2.3	3.3	3.4	2	2.5	4	4

No Climate Impacts (development only) Scenario



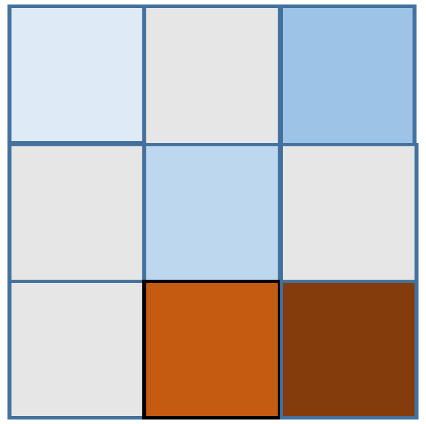
1. SSPs only

Climate Impacts Scenario



2. RCPs + SSPs

Climate Impacts *minus* No Climate Impacts Scenario = In-Migration (red) or Out-Migration (blue)



Migration = 2 - 1

Each Scenario had **four model runs** based on combinations of:

- Socioeconomic Scenarios (SSPs 1 and 3)
- Climate impacts on **crop production (maize, wheat, rice, soya),** and **water availability** under **two emissions scenarios** (RCP2.6 and RCP8.5)
  - Gap filling of crop production model outputs with ecosystem impact models (net primary productivity - NPP) for pasturelands and forests
- **Sea level rise** based on the **two emissions scenarios – 1m for low, 2m for high**

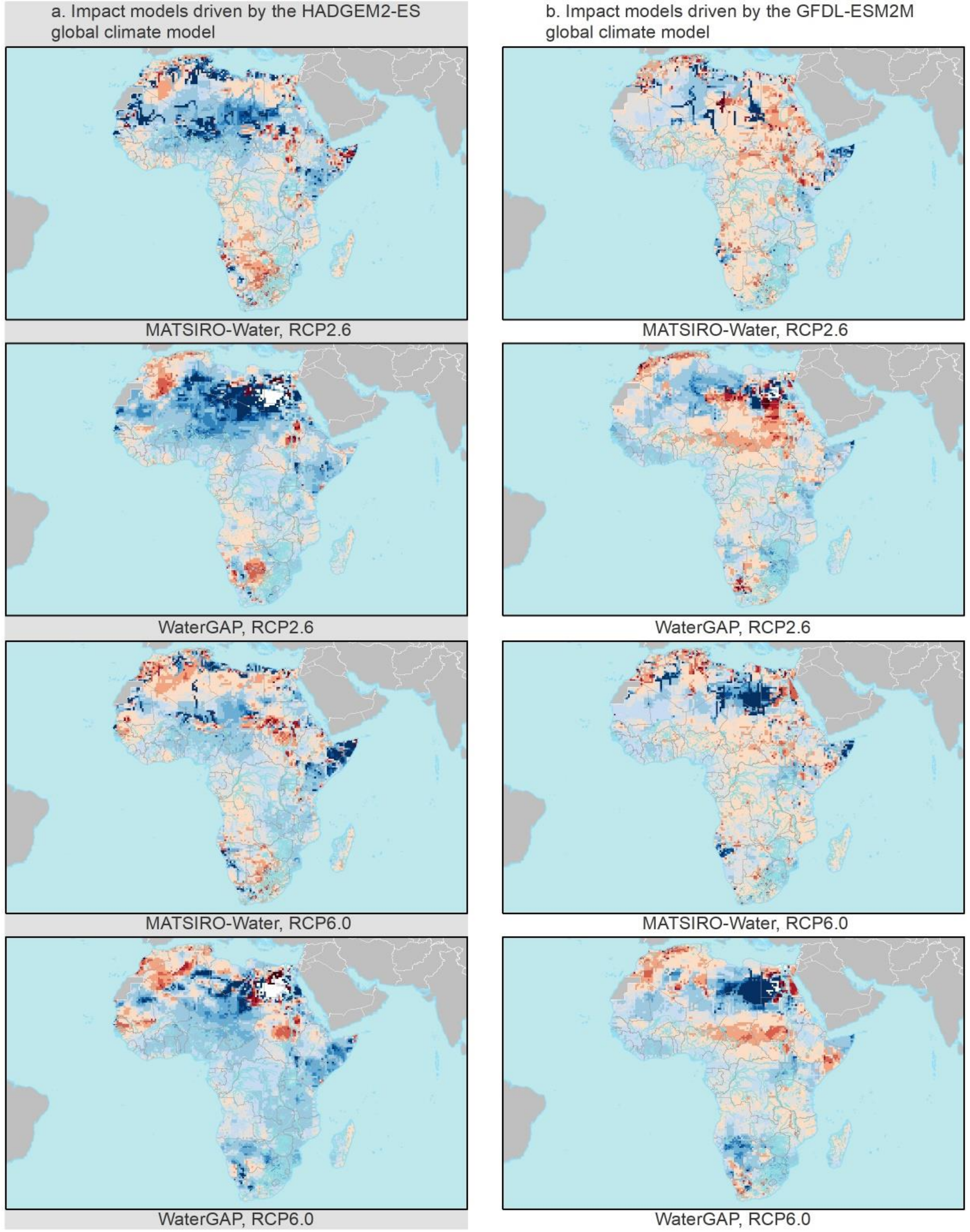
Crop, water, and NPP impacts were based on data from the Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP)

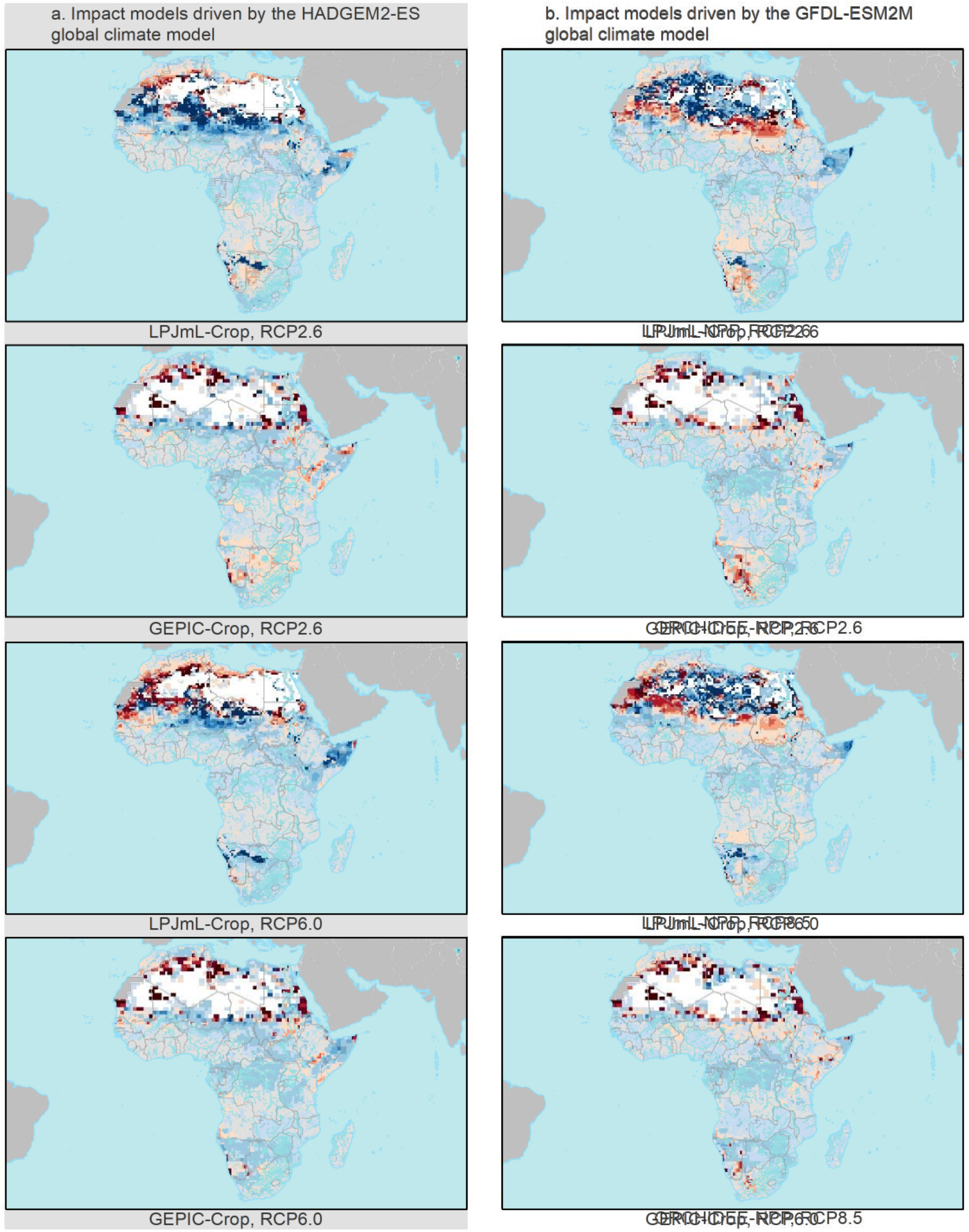
Matrix of climate sectoral models used for the modeling

			ISIMIP Crop Models			
	Global Climate Models (CMIP5)		**HadGEM2-ES**		**GFDL-ESM2M**	
		ISIMIP Models	GEPIC*	LPJmL**	GEPIC*	LPJmL**
ISIMIP Water Models	**HadGEM2-ES**	WaterGAP2	Model 1			
		MATSIRO		Model 2		
	GFDL-ESM2M	WaterGAP2			Model 3	
		MATSIRO				Model 4

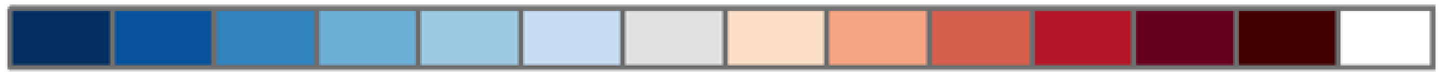
* GEPIC crop model coverage is gap-filled with the ORCHIDEE NPP model

** LPJmL crop model coverage is gap-filled with the LPJmL NPP model





Water

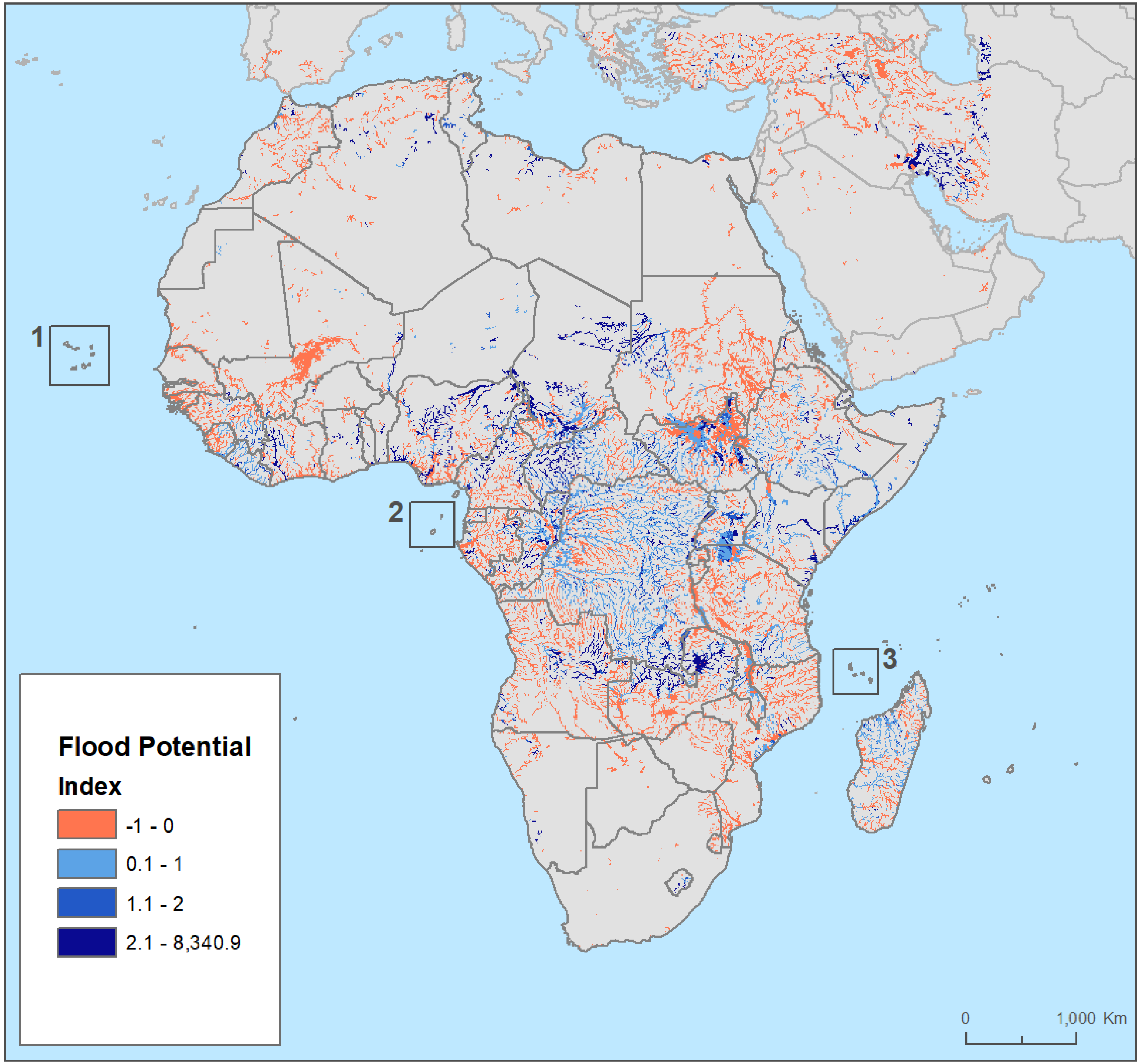


Crops + NPP

What's new? Flood Risk

- Under the *ACMI*, we incorporated flood risk as an additional element in the calibration.
- Here, we include future flood risk as part of the same **spatial mask** that incorporates the SLR risk as well.
- In practice, this removes land area, which effects the ability of new migrants to move into an area. We did this with a maximum removal of **20% of a 4km grid cell**.

ISIMIP Flood



Calibration

Africa Climate Mobility Initiative

Coefficient estimates derived from fitting the spatial autoregressive model to historic population distribution change data for the periods 1990-2000 and 2000-2010 for each of the potential drivers of spatial population change. Coefficients for Water and Crop/NPP can be interpreted similarly, but the coefficients are not normalized for Conflict.

	Urban													
	Cote d'Ivoire	Egypt	Ethiopia	Gabon	Ghana	Kenya	Malawi	Morocco	Senegal	S. Africa	Zambia	Zimbabwe	Mean	Std. Dev
Water	0.653	2.648	2.514	0.581	0.346	0.694	1.638	0.852	0.570	0.055	0.281	0.422	0.938	0.823
Conflict	-0.005	n/a	-0.002	n/a	0.000	-0.003	-0.061	-0.045	-0.002	n/a	-0.006	-0.012	-0.015	0.021

	Rural													
	Cote d'Ivoire	Egypt	Ethiopia	Gabon	Ghana	Kenya	Malawi	Morocco	Senegal	S. Africa	Zambia	Zimbabwe	Mean	Std. Dev
Crop/NPP	2.082	1.345	1.342	1.727	1.433	0.480	1.069	1.820	0.915	0.206	1.642	2.124	1.349	0.572
Water	0.973	2.353	1.876	1.429	0.404	1.552	0.419	2.225	2.948	2.178	1.070	1.833	1.605	0.751
Conflict	-0.005	n/a	-0.031	n/a	-0.002	-0.020	-0.035	-0.358	-0.011	-0.069	-0.169	-0.096	-0.080	0.105

The Groundswell report series

Table A.4: Model coefficients for North Africa (based on Morocco)

	Urban	Rural
Crop productivity	0.599	1.077
Water availability	0.712	1.111

Table A.6: Model coefficients for Central Asia (based on the Kyrgyz Republic)

	Urban	Rural
Crop productivity	0.030	0.197
Water availability	1.600	0.239

Lessons: Too much and too little water affects migration

- Flood impacts typically result in short-term displacement, but if repeated, may result in decisions to move out of flood-affected areas
  - Evidence: Jamuna River, Bangladesh (Freihardt 2023); Northern Bangladesh and Mekong Delta, Vietnam (Warner et al. 2012); Central Gonja District, Ghana (Afriye et al. 2017)
- Drought or secular trends in rainfall (decrease) and temperatures (increases) can result in declining agricultural yields, which impacts livelihoods in ways that may result in decision to migrate
  - Evidence: Senegal (Diallo 2023), Mexico (Nawrotzki et al. 2015), LAC countries (Baez et al. 2017)

Received: 24 October 2022 | Revised: 2 March 2023 | Accepted: 23 March 2023
DOI: 10.1002/wat2.1647

OVERVIEW

WIREs WATER WILEY

Global patterns of water-driven human migration

Li Xu[1] | James S. Famiglietti[1,2]

Review articles in 2022-2023

Climatic Change (2023) 176:100
https://doi.org/10.1007/s10584-023-03573-6

REVIEW ARTICLE

Check for updates

Migration as adaptation to freshwater and inland hydroclimatic changes? A meta-review of existing evidence

Martina Angela Caretta[1] · Valeria Fanghella[2] · Pam Rittelmeyer[3] · Jaishri Srinivasan[4] · Prajjwal K. Panday[5] · Jagadish Parajuli[6] · Ritu Priya[7] · E. B. Uday Bhaskar Reddy[8] · Cydney Kate Seigerman[9] · Aditi Mukherji[10]

Climatic Change (2023) 176:42
https://doi.org/10.1007/s10584-023-03524-1

Check for updates

Topic modelling the mobility response to heat and drought

Kerstin K. Zander[1] · Hunter S. Baggen[1] · Stephen T. Garnett[2]

The "agricultural pathway"

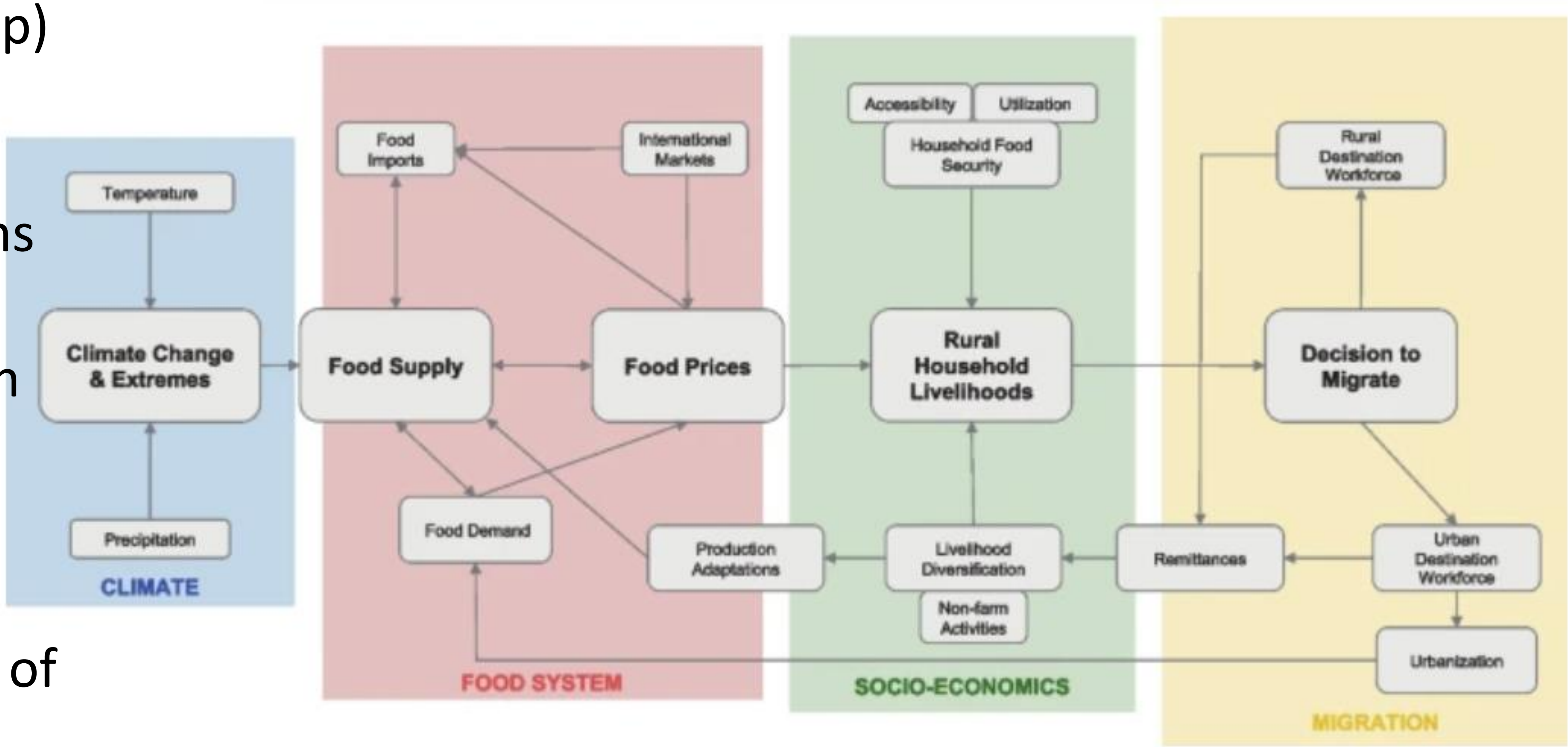
- There are many studies that find statistically significant associations between agriculturally relevant climate anomalies (temp, precip) and migration
- There are few studies that identify the precise mechanisms
- The agricultural sector is going to be a key factor in rural-urban migration in the future
- Youth are evaluating the long term viability of ag livelihoods
- Food insecurity will be a driver of immobility/mobility

Population and Environment (2024) 46:8
https://doi.org/10.1007/s11111-024-00446-7

ORIGINAL PAPER

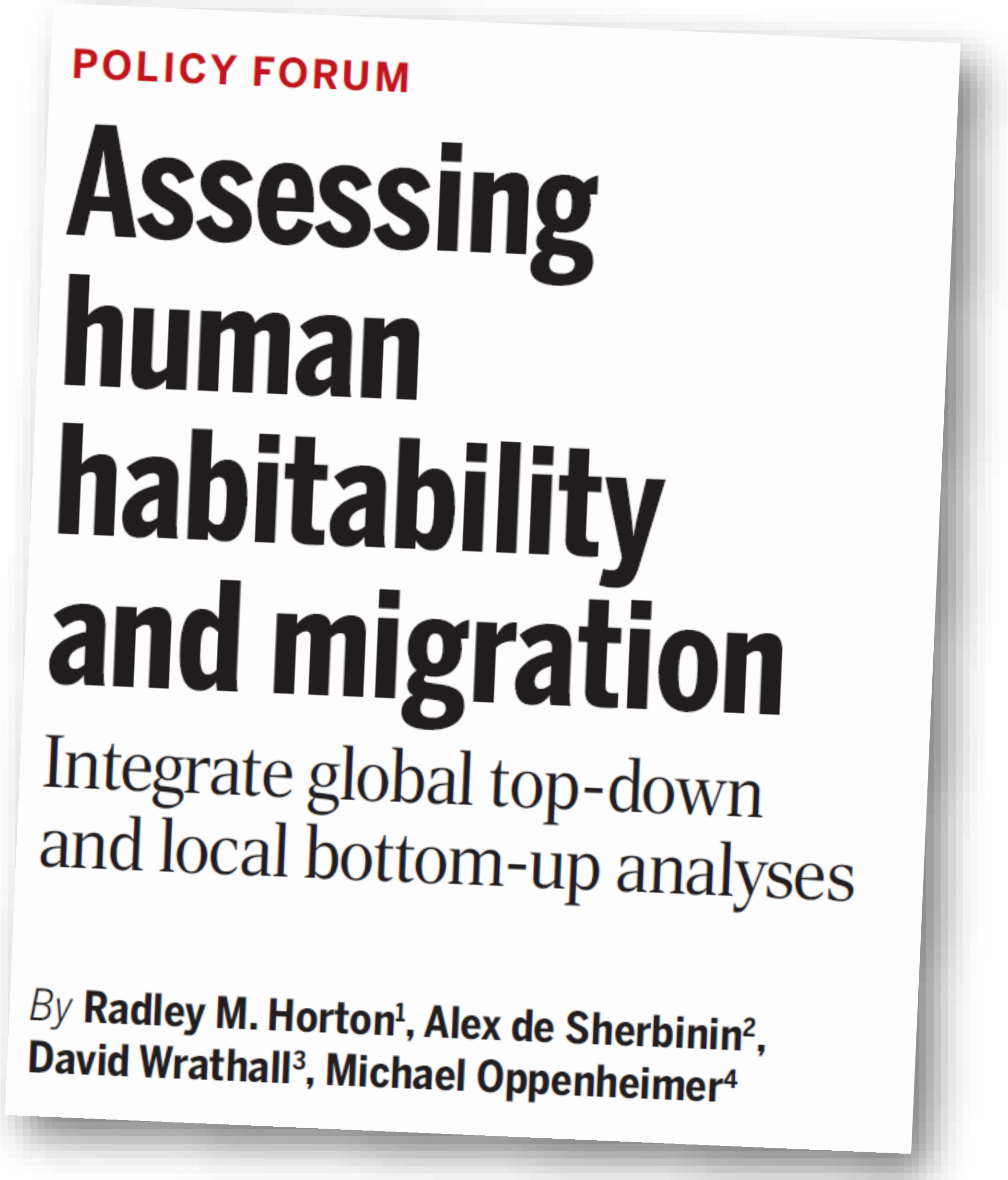
A framework to link climate change, food security, and migration: unpacking the agricultural pathway

Cascade Tuholske[1,2] · Maria Agustina Di Landro[2] · Weston Anderson[3] · Robbin Jan van Duijne[2] · Alex de Sherbinin[2]



Some last caveats

- Water availability or hydrological hazards, along with other climate-related factors, are rarely the most significant factors that affect migration decision making
- They can and do influence other more direct drivers – economic, social, etc. – but the precise weight of their influence is hard to determine
- Projections are necessarily contingent owing to so many social & political variables and socio-ecological uncertainties, but if recent climate extremes are any indication, habitability concerns will rise on the agenda


POLICY FORUM

Assessing human habitability and migration

Integrate global top-down and local bottom-up analyses

By Radley M. Horton[1], Alex de Sherbinin[2], David Wrathall[3], Michael Oppenheimer[4]

https://doi.org/10.1126/science.abi8603

References

Afriyie, K., J.K. Ganle & E. Santos (2017). 'The floods came and we lost everything': weather extremes and households' asset vulnerability and adaptation in rural Ghana. *Climate & Development*. doi:10.1080/17565529.2017.1291403

Baez, J., Caruso, G., et al. (2017). Droughts augment youth migration in Northern Latin America and the Caribbean. *Climatic Change*, 140(3-4), 423-435. doi:10.1007/s10584-016-1863-2

Diallo, A. (2023). Does climate variability influence internal migration flows in Senegal? Pre-print. doi:/10.21203/rs.3.rs-3137039/v1

Freihardt, J. (2023). When the river breaks the land: Environmental (im)mobility among rural households in Bangladesh. PhD Dissertation, ETH-Zurich

Horton, R., A. de Sherbinin, D. Wrathall, and M. Oppenheimer. 2021. Assessing human habitability and migration. *Science*, 372(6548), 1279-1283. https://doi.org/10.1126/science.abi8603

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Warner, K., T. Afifi, et al. (2012). *Where the Rainfalls*. CARE-France and UNU-EHS.

Thank you!

Columbia Climate School
Center for International Earth Science Information Network

CUNY Institute for Demographic Research

PIK

PANELIST #2

Understanding the nexus and vulnerability to improve migration models

Dr. ROBERT OAKES

United Nations University Institute for Environment and Human Security

Building Nexus Resilience:
Addressing Migration and Conflicts in Water-Energy-Food (WEF) Systems

Understanding the nexus and vulnerability to improve migration models

Robert Oakes
Environment and Migration: Interactions and Choices Division (EMIC)
United Nations University for Environment and Human Security (UNU-EHS)

10th September 2024

UNU EHS

Outline

Until now modelling of environmental migration has been dominated by physical sciences with emphasis on risk as defined as hazards and exposure to the detriment of understandings of vulnerability.

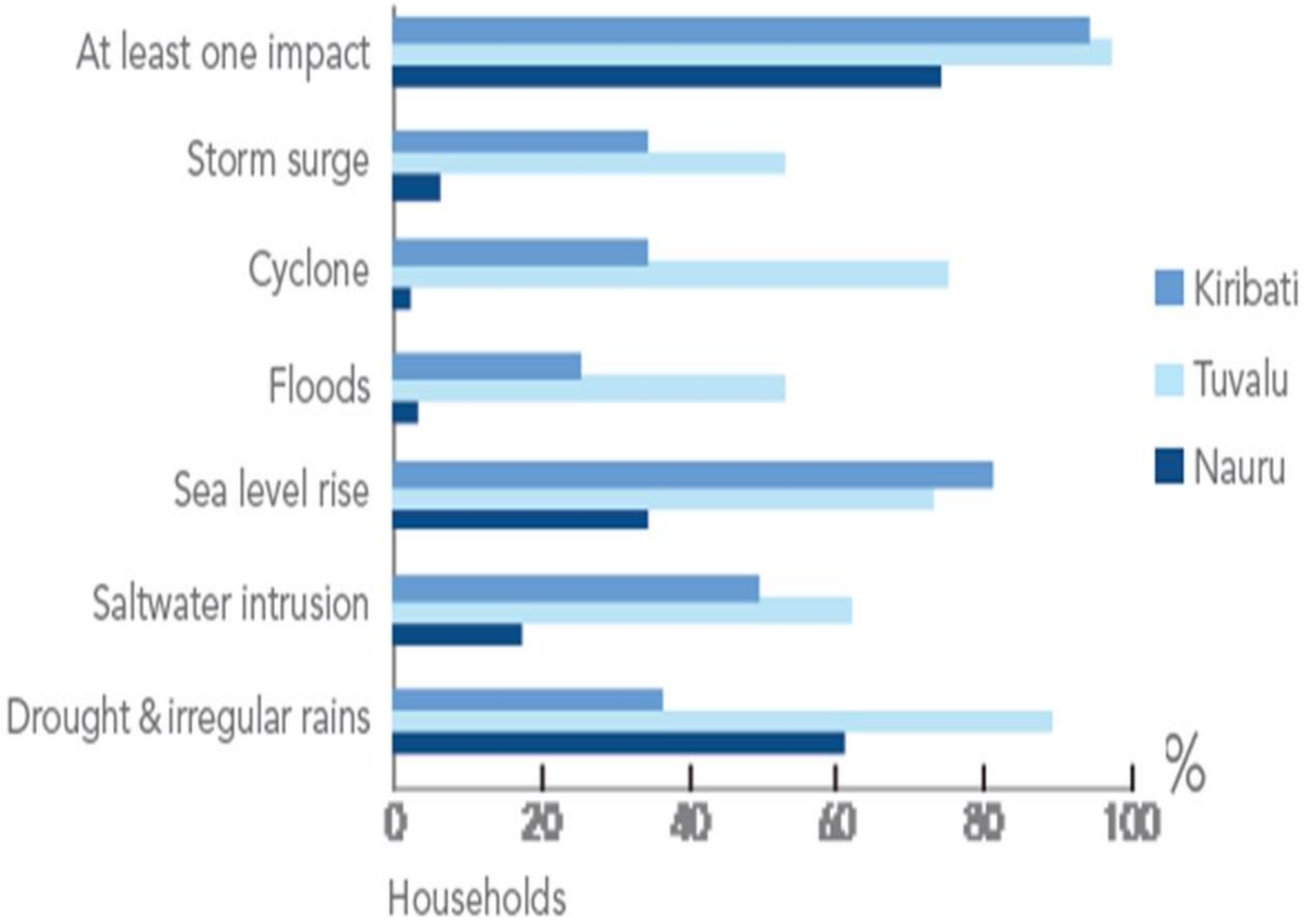
This presentation uses two case studies to show how two distinct modelling tools (agent-based models and probabilistic modelling) can combine physical and social sciences, utilising quantitative and qualitative data sources to better understand the complexity of the relationship between the nexus, vulnerability and migration.

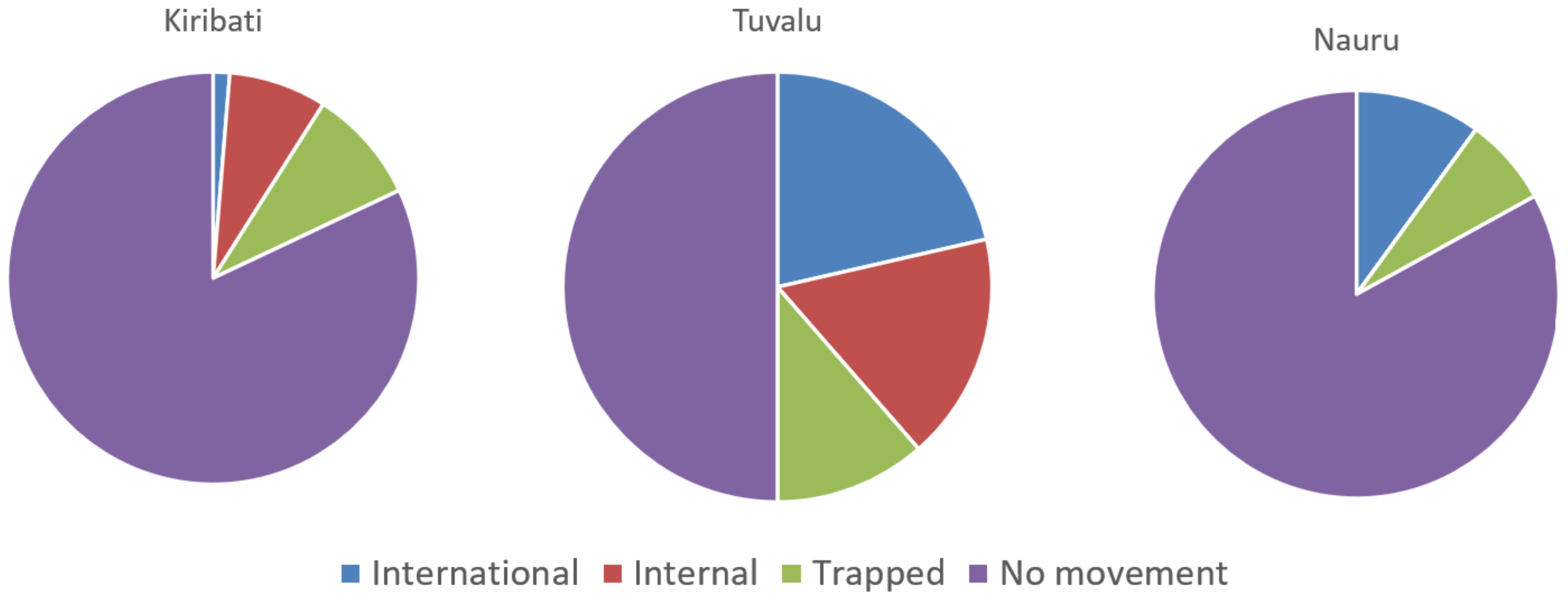
i. ABM for Pacific SIDS

ii. Model of displacement

I. ABM for Pacific SIDS

Pacific Climate Change Migration (PCCM) project funded by UN ESCAP. Large n household survey in Pacific developing island states Kiribati, Tuvalu and Nauru. Agent based models for Kiribati and Tuvalu – island setting ideal for models?





Pacific SIDS affected by climate change impacts 2005-2015

WEF a big challenge

In 2005-2015 there were large numbers of internal movements, some international movements and many "trapped" persons

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I. Operationalising Aspirations and Capabilities in an ABM

Used Anylogic

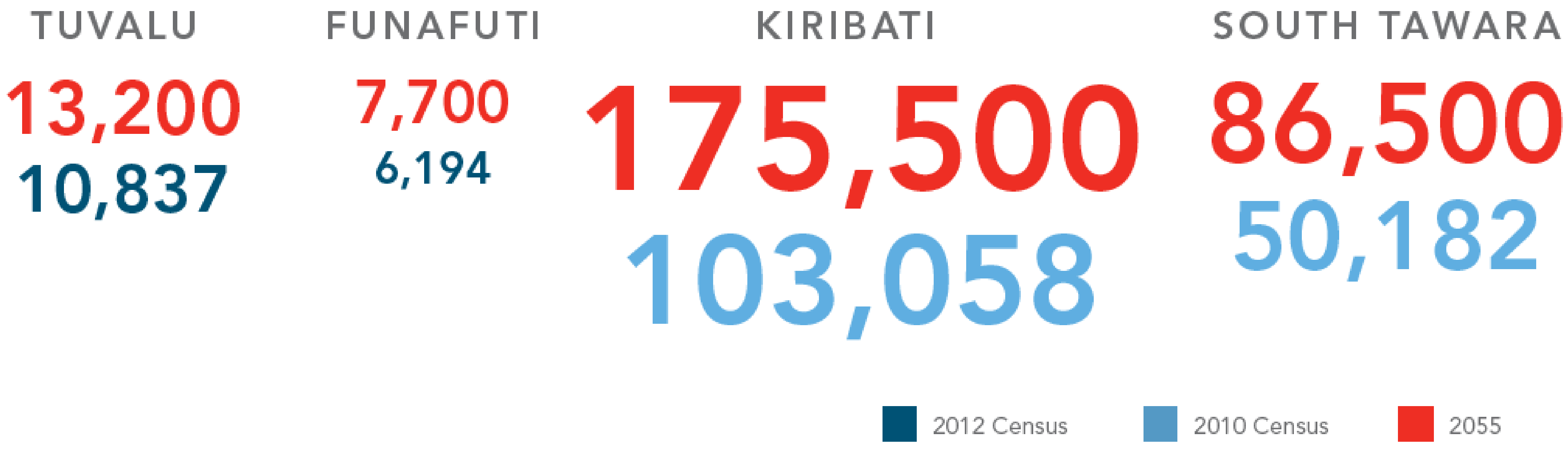
Aspiration defined by:

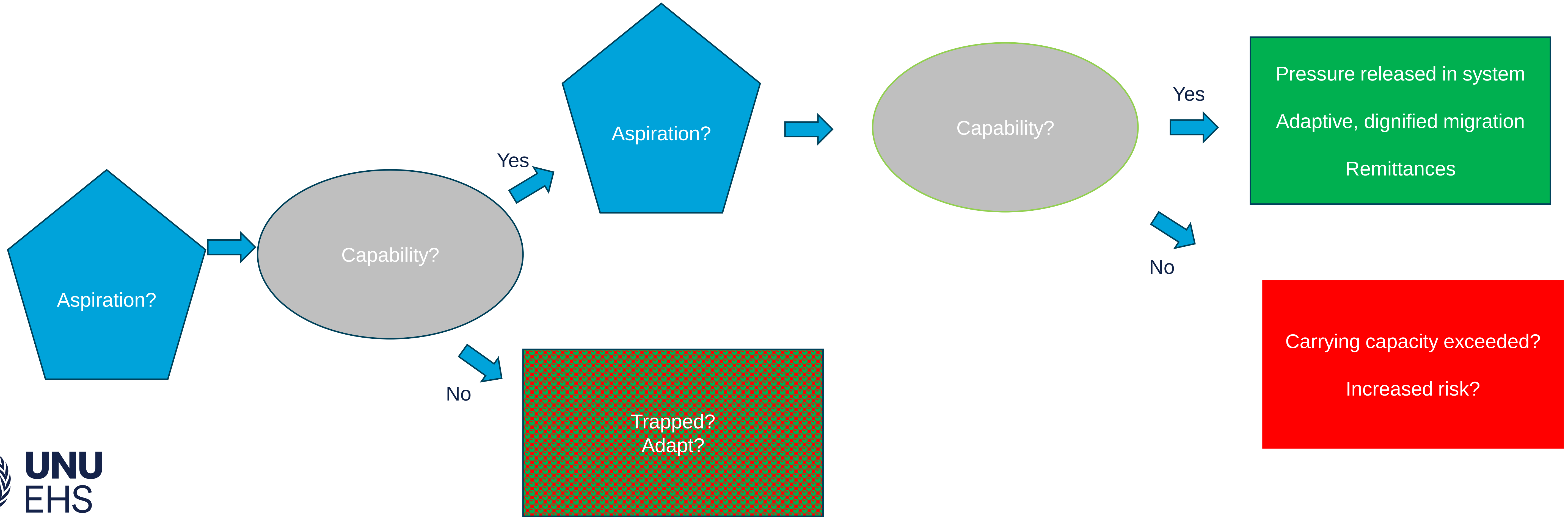
- Observed migration (data from HH survey) and conditioned by gender and age
- RCP (translated into multiplier of annual sea level rise to proxy CC impacts)
- Social network

Capability defined by:

- Constrained by Vulnerability index
- After migration those within migrants' social network have their vulnerability decreased = simulate remittances

I. ABM results and implications for WEF





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II. Our approach to displacement

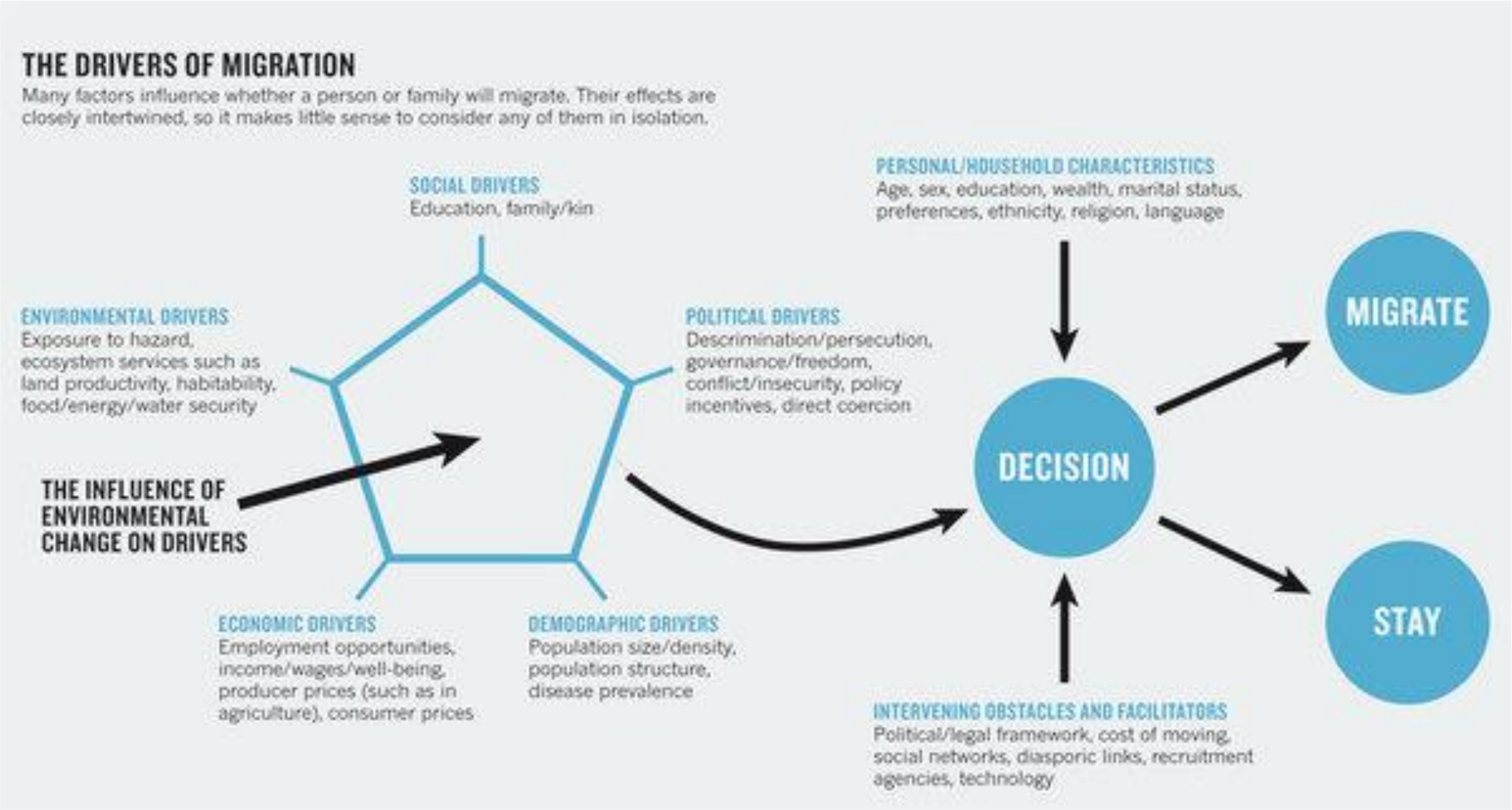
Ongoing work with the Internal Monitoring Displacment Centre (IDMC), ETH Zurich and UNU Colleagues

Climada = climate adapt – well established probabalistic model which considers hazard, exposure and vulnerability.

But until now vulnerability a little simplistic:

Important to bring in agency and decision making!

II. Back to basics – the migration pentagon of drivers (Black et al. 2011)



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Environmental

Our workings!

- **Recent shocks**
- **Uprooted people**
- Livelihoods depending on natural resources

Global Human Modification index

Social (Society)

- **Adult literacy rate**
- **Gender Inequality Index**

Vulnerable ethnic groups (ethnic power relation ETH zurich)

Economic

- **Development and Deprivation** (HDI, Multidimensional Poverty Index)
- **Gini Index**
- **Economic Dependency Index** (Public Aid per Capita, Net ODA received, Volume of remittances)

Wealth index?

Night light luminosity

Factors affecting need to move

Political/ Governance

- **HFA Scores**
- **Governance** (Corruption Perception Index, Government Effectiveness)

Battle affected peopl

Infrastructure and Services

- Others? (Hospitals, Schools, Building classes for TC from CAPRA…)
- **INFORM Risk Indicators:**
  - Road density
  - Sanitation
  - Drinking water
  - Access to electricity
  - Internet users
  - Mobile cellular subscriptions

Demographic

- **Food Security** (Food Availability Score, Food Utilization Score)
- **Health conditions** (HIV, Tuberculosis, Malaria, interventions against neglected tropical diseases)
- **Children under five** (Child Mortality, Malnutrition in Children under 5)
- **Access to health care** Index (Physicians Density, Immunization Coverage, Expenditure on health care, maternal mortality ratio)
- Other (Life Expectancy, dependency ratio, Population growth rate, median age (1)…)

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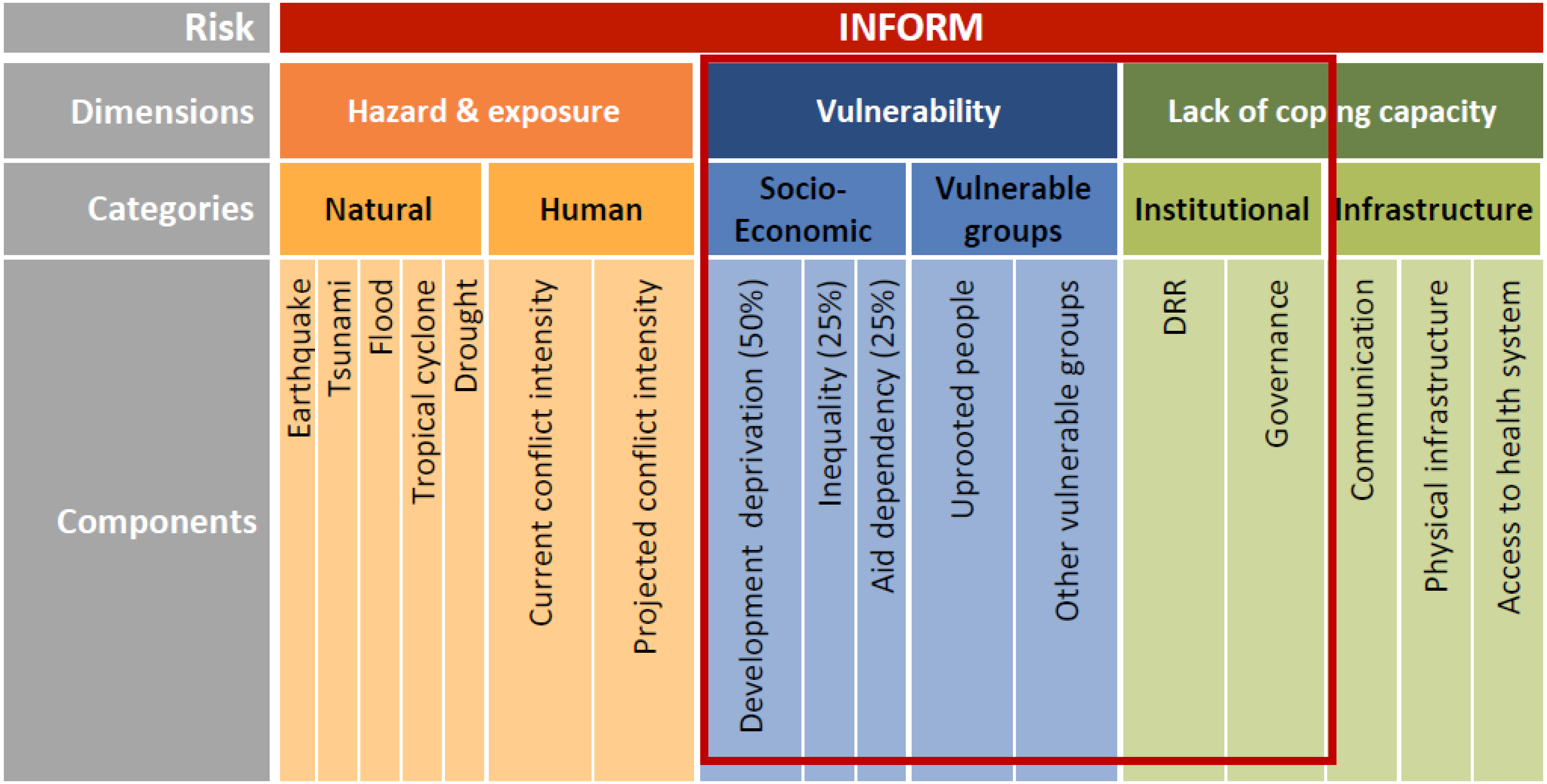
II. Adapting the Risk inform approach



II. Simplified but complex? Vulnerability and WEF

Factor	concept	explanation	Triangle	Drought weights	Cyclone weight
economic	hdi	general development (combining indicators of life exp	Socio-economic	30	70
economic	children and elderly	young and old dependents			
economic	aid dependency	extent to which economy depends on external mone			
social	gender	level of gender equality			
social	health	prevalence of disease and access to Drs			
social	food security	food availability and utiliztion			
environmental	nature-dependent people	proportion of population dependent on natural resou	Environmental	40	15
environmental	water	access to safe drinking water			
environmental	irrigated land	proportion of irrigated land			
political	ethnic participation	proportion of excluded populations	Governance	30	15
political	conflict deaths	local deaths from conflict			
political	DRR governance	measures (or political capacities?) to manage disaste			
political	displaced persons	those living in a state of displacement			

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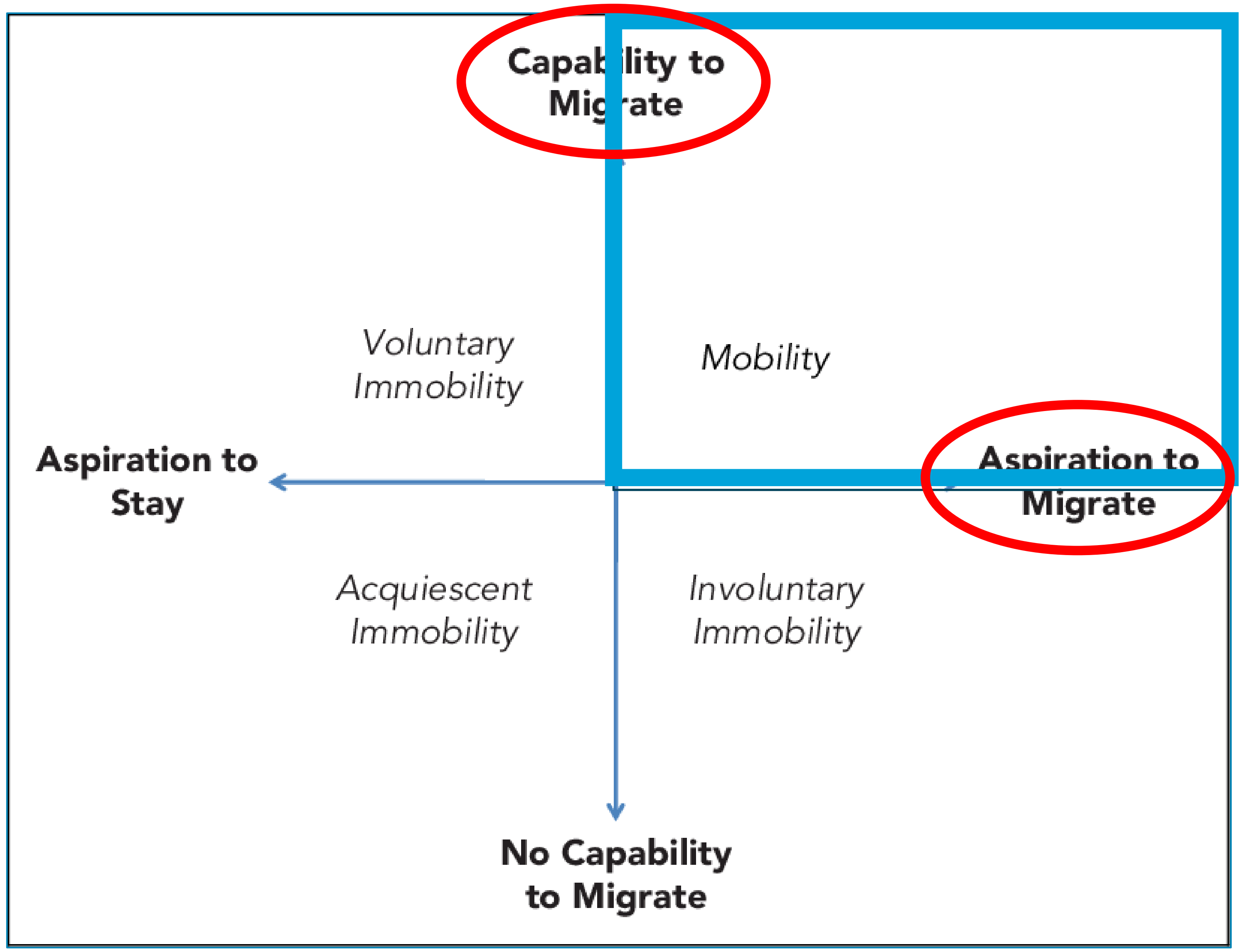
Conclusion – how to combine Aspirations and Capabilities framework and WEF?



Human mobility occurs when there is a combination of aspiration (need to move) to move and the capability (can move).

Until now models concentrate on need to move, often defined by physical data and assumptions.

Decision making or “agency” neglected – how can we address this?

Little done on immobility and trapped populations.

Both mobile and immobile populations have implications for WEF nexus in terms of triggers and outcomes.

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Thank you!

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PANELIST #3

Water-Migration-Gender Nexus: Towards Integrated Governance Strategies for (Non) Migrants

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Texas A&M University Texas A&M Energy Institute | TEES Texas A&M Engineering Experiment Station | UNU FLORES | Columbia Climate School Center for International Earth Science Information Network | UNU EHS | ULB École de Santé Publique | NexusNet | IWRA International Water Resources Association

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Water-Migration-Gender Nexus: Towards Integrated Governance Strategies for (Non) Migrants

Webinar Series: “Building Nexus Resilience: Addressing Migration and Conflicts in Water-Energy-Food Systems”

10th of September 2024

Dilare Ecenur IRBIK, PhD Candidate

École de Santé Publique, Université Libre de Bruxelles

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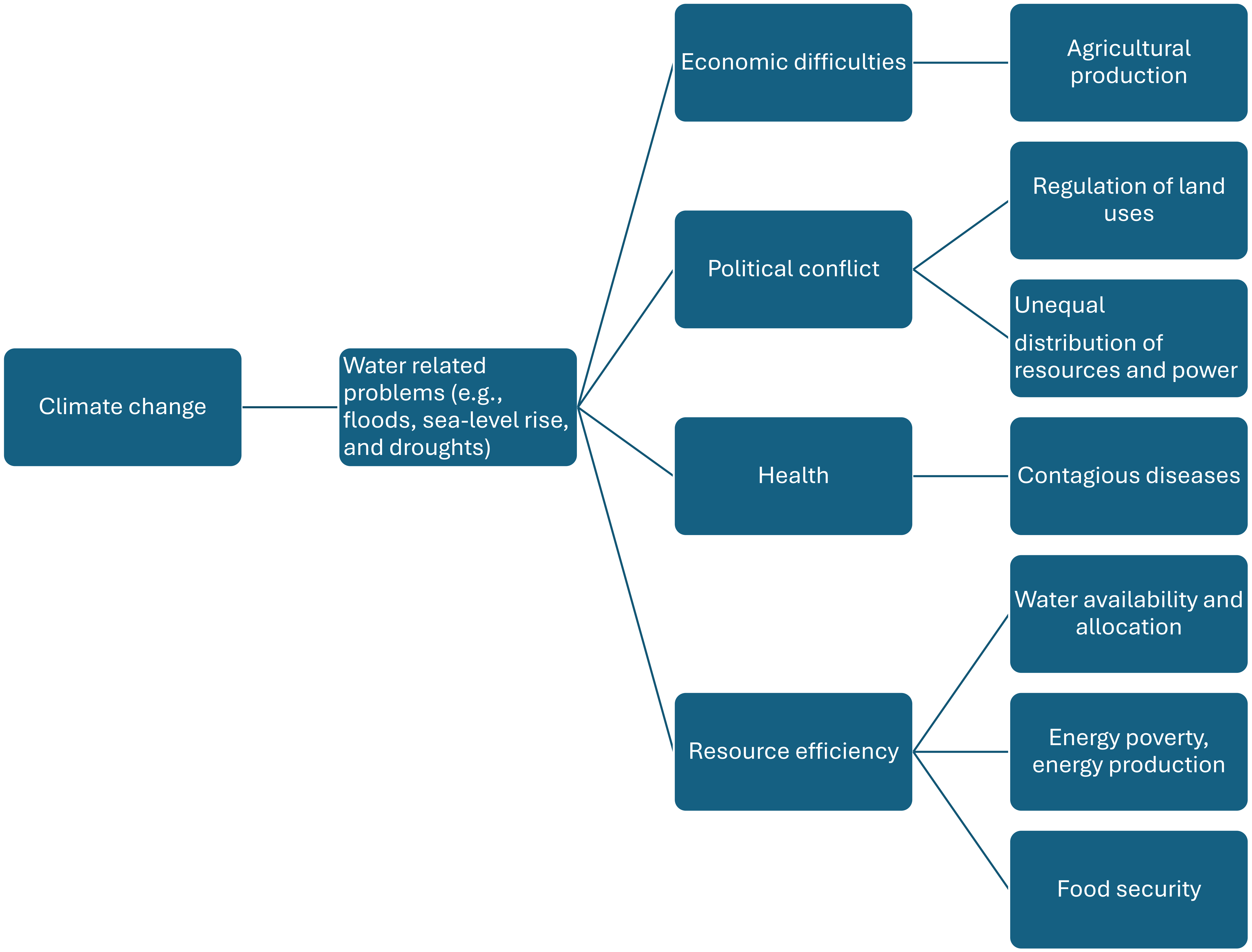
Climate change and its impacts



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Environmental (Non) Migration

Source: Kohut, 2020

- Water problems due to climate change might be direct or indirect push factors for voluntary or forced migration.
- Migration as a strategy:
  - In case of water stress, safe and orderly migration can contribute to economic growth in host communities (Wrathall et al., 2018).
- Migration as a challenge:
  - Despite the environmental challenges, the most vulnerable and poor people have the least opportunities to migrate away from the risky environment and should stay in their territories and adapt to the changes (Nagabhatla et al., 2020).
  - Even though people migrate for a better life, they may face several problems in urban areas since they are more likely to live in squatter's houses with a lack of water infrastructure (Stoler et al., 2021).

Women's challenges due to climate change and water stressors

- Climate change exacerbates water availability, access, scarcity, and security globally, with significant gender inequality consequences within and outside home (Enarson and Fordham, 2001; Cannon, 2002).
- Resource efficiency is one of the vital challenges resulting from water-related migration. It strongly connects to the sustainability of limited assets such as water availability and allocation, regulation of land use, food security, and energy production (Papadopoulou et al., 2020). For example:
  - A decrease in water volume due to climate change, compounded with the geographical proximity of water sources, determines the workload of women regarding distance covered, time spent, and frequency of water collection (Sugden et al., 2014).
  - More equitable access to farmland and freshwater, in terms of gender equity, contributes to improving agricultural performance and household food security (Niasse, 2017).
  - Water insecurity is particularly burdensome to women during the vulnerable periods of pregnancy and postpartum since their psychosocial or physical health is affected by, for example, lack of nutrition (Collins et al., 2019).
  - Given the women's limited or absent participation in water management, although they do not own land, male outmigration jeopardizes the sustainability and functionality of local water management institutions (Djoudi and Brockhaus, 2011), which increases the limits on land use for the women who are left behind.

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Research gap: Water – Migration – Gender Nexus

- The perception and response of women and men towards climate change are different.
  - Understanding these challenges requires analysing social relations and power structures to determine case-specific and functional adaptation strategies from a gender perspective (Ylipaa et al., 2019).
- There is a need for a critical and holistic approach that highlights women's roles, needs, and constraints within water-related problems and power structures in (non) migration settings.

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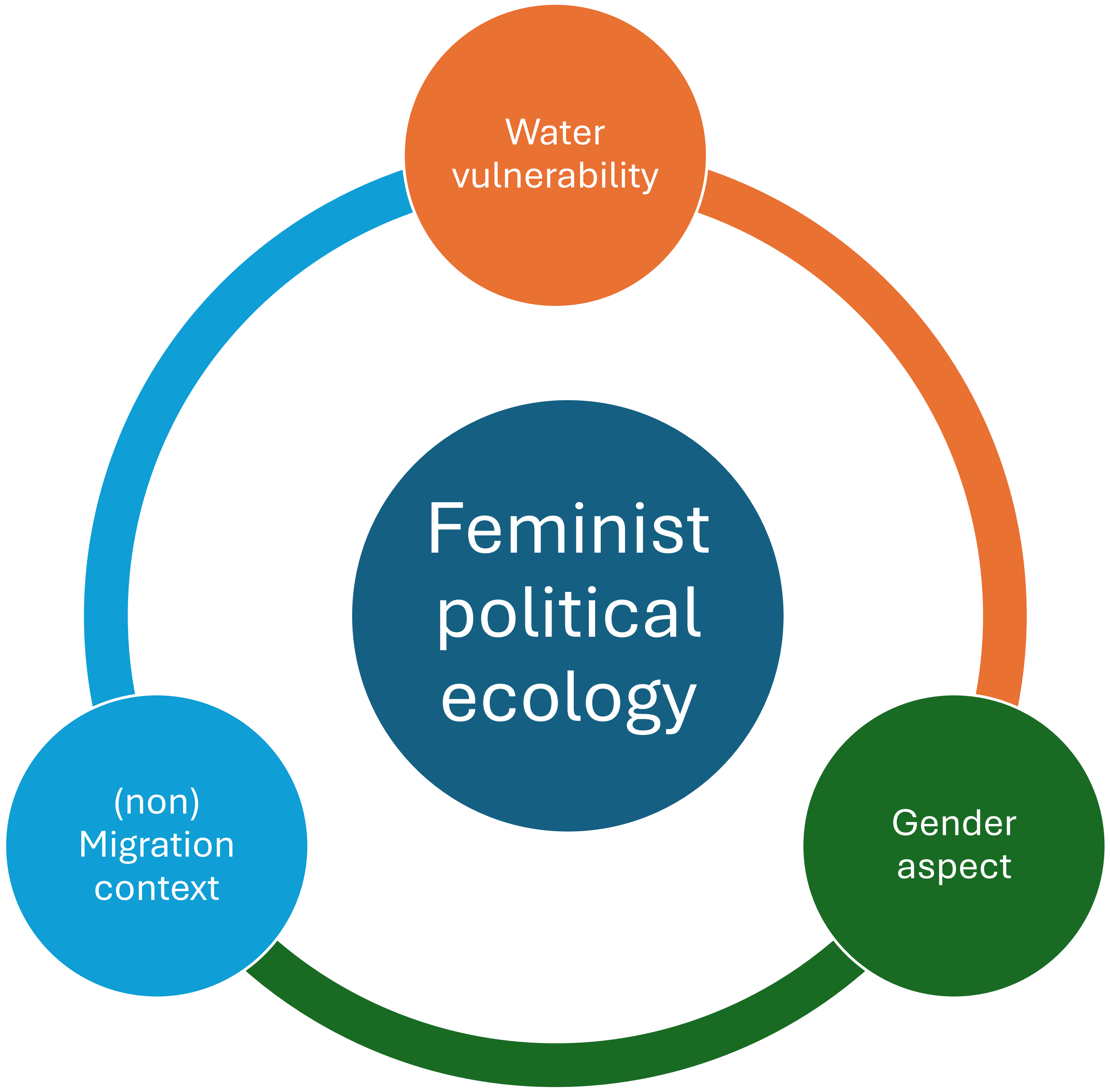
Solution: Combining the FPE and Water-Migration Nexus



Source: Author's illustration based on Ylipaa et al. (2019).

What is the feminist political ecology?

- **The central idea of the FPE** is that men and women have different experiences, responsibilities, and interests concerning nature due to gender differences in human-nature interactions. These gender differences are constructed socially, not biologically, resulting in divergence in culture, class, race, and place, and variation with the changing conditions of individuals and societies (Rocheleau et al., 1996; Sanyal, 2006).
- **Three concepts of the FPE** which overlap and influence each other (Ylipaa et al., 2019):
  - Policy and implementation
  - Knowledge (creation and value)
  - Rights and responsibilities (control, access, use of resources)

How it works?

- Feminist political ecology gives prominence to environmental justice and seeks to locate and explain the origins and causes of oppression and injustices, vulnerabilities, and the social relations causing them.

How it helps?

- Through its holistic perspective, it reveals the connections and interactions between the environment, the economy, and politics on a local to global scale and how they are gendered, intending to decrease such inequalities, poverty, and other vulnerabilities (Rocheleau et al., 1996).

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Results of the systematic literature review

- 67 peer-reviewed publications and collected the recommendations for the impact of climate change/water resources crisis on human (im)mobility and its intersection with gender.
- Most selected studies were conducted in Bangladesh (n = 13), India (n = 5), Kenya (n = 5), and Pacific Small Island States (n = 5). There were 79 study settings overall from 67 selected studies.
- The predominant water resource outcomes studied were livelihood, food and water security, water infrastructure, and infectious disease.
- Existing case studies mainly focus on four thematic areas:

Technological	Social-economic	Political	Health
• tools to increase resilience against climate and water-related problems	• social-economical recommendations that sought to enable vulnerable people to adapt to social-ecological change	• the importance of the political implications of climate change adaptation	• non-economic losses and damages of (im)mobile populations (e.g., sense of belonging, physical and mental health, or emotional wellbeing)

Gaps Learned From the Systematic Literature Review: **Integrated governance strategies**

To conclude:

- The existing case studies mainly suggest individual policies and solutions to water or migration problems in four main domains (technological, social-economic, political, and health). However, there is a need to study social, economic, and political inequalities arising from climate change and environmental (non) migration through the water-migration-gender nexus to solve the complex and multifaceted problems, inequalities, and injustices faced by vulnerable people.
- A conceptual framework combining feminist political ecology with integrated governance strategies may alleviate their problems through evidence-based, sustainable, and resilient solutions.

How can we achieve that?

Strategies to enhance the feminist political ecology in addressing the water-related (non) migration context:

- *Strategy 1: Holistic Policy and Implementation*
- *Strategy 2: Equal Knowledge Creation and Dissemination Among Men and Women*
- *Strategy 3: Increasing Women's Rights and Responsibilities*

Further research questions

1. Experiences, needs, and challenges of environmental (non) migrants based on their age or ethnicities?
2. How do challenges differ at the regional and international level, and what can be done?
3. What other themes can be examined?
4. In which countries is more research on the water-migration-gender nexus required?

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DIALOGUE

ALEX DE SHERBININ

ROBERT OAKES

DILARE ECENUR IRBIK

FLOOR BROUWER

Q&A

Feel free to ask your question in the Q&A box

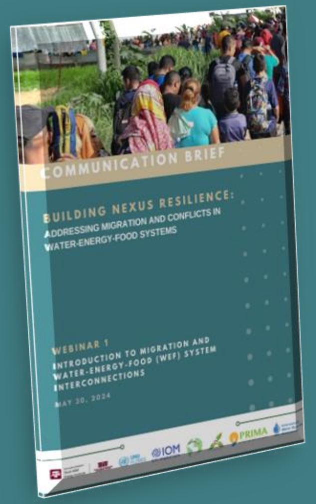
WRAP UP

Dr. BASSEL DAHER

Texas A&M Energy Institute
SustainFood Network
International Water Resources Association

WEBINAR SERIES

Webinar #1	Webinar #2	Webinar #3
May 30, 2024	**September 10, 2024**	**December 3, 2024**
Introduction to Migration and Water-Energy-Food (WEF) System Interconnections	Integrating Migration Models and WEF Assessments	Governance Considerations and Evidence-based Policy Making



BUILDING NEXUS RESILIENCE: Integrating Migration Models and WEF Nexus Assessments

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WRAP UP AND NEXT WEBINAR

Webinar #3

Governance Considerations and Evidence-based Policy Making

TUESDAY
December 3, 2024

3:00-4:30 PM CET
8:00-9:30 AM CST

Share your feedback!

BUILDING NEXUS RESILIENCE: Integrating Migration Models and WEF Nexus Assessments

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