AI-Driven Green Growth Simulation (AI-GGSim) for Gender and Social-Inclusive Policy in Africa

AI for Good
Impact Initiative

AI Readiness

Towards a standardized readiness framework

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Global Green Growth Institute (GGGI)

Room Q, Workshop
10 July 2025, 14:00 - 17:15 CEST
Palexpo, Route François-Peyrot 30, 1218 Le Grand-Saconnex
Geneva, Switzerland

Outline

1. Introduction to the AI-GGSim
2. AI approaches in the AI-GGSim
3. AI-GGSim analysis
   - ❑ Business-as-usual (BAU) projections
   - ❑ Nature for Futures Framework (NFF) scenarios
   - ❑ NFF scenarios for gender equality and social inclusion (GESI) indicators
4. Next steps 2025-2026

Introduction to the AI-GGSim - History

PHASE 1 (2020)
Pilot applications
(Covering more SDGs)

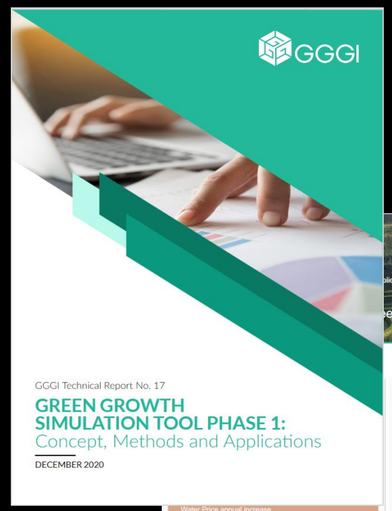
- 2020: Phase 1 report on literature reviews of sectoral models was published
- 2021: GGSim online tool was developed
- 2022: Literature review and piloting AI approaches for GESI models
- 2024: Literature review and piloting AI approaches for data and model automation

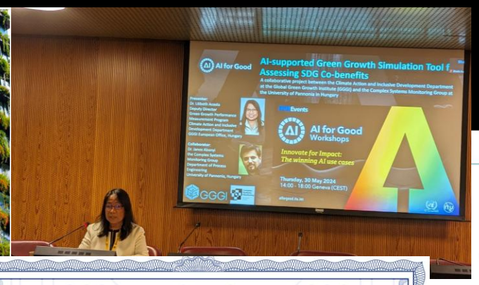
PHASE 2 (2022)
National applications
(LT-LEDs, NAPs, and NDCs)

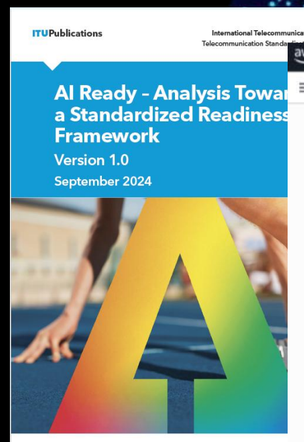
- 2022: National validation and applications of sectoral models in GGGI Member Countries
- 2024: Phase 2 report on national applications, introducing AI approaches for the GGSim
- 2024: AI-GGSim received ITU Innovative Impact and WAIC Super AI Leader (SAIL) awards
- 2025: AI-GGSim for GESI assessments in NDC

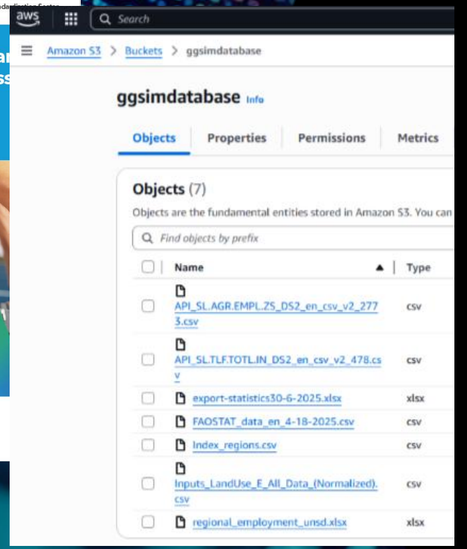
PHASE 3 (2024)
Global and regional applications
(Online tool)

- 2024: Formed the AI-GGSim International Expert Group
- 2025: Cloud credit award from the ITU for the AI-GGSim AWS platform
- 2025: Presentation of regional AI-GGSim for GESI during the 2025 AI4Good Summit
- 2025: Phase 3 report on regional applications



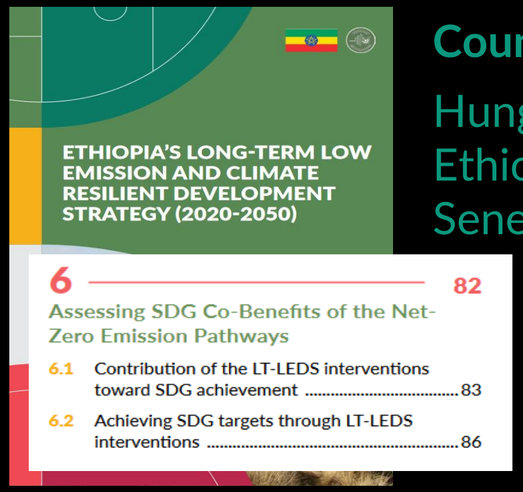






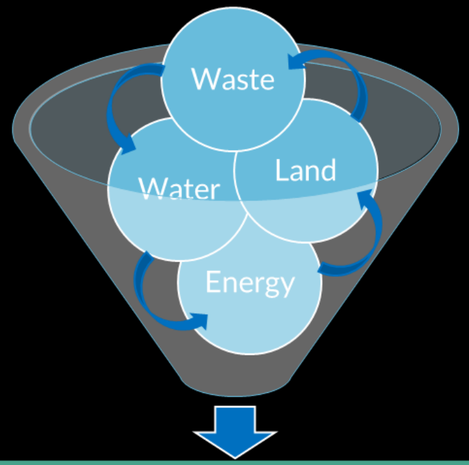
Introduction to the AI-GGSim - Applications

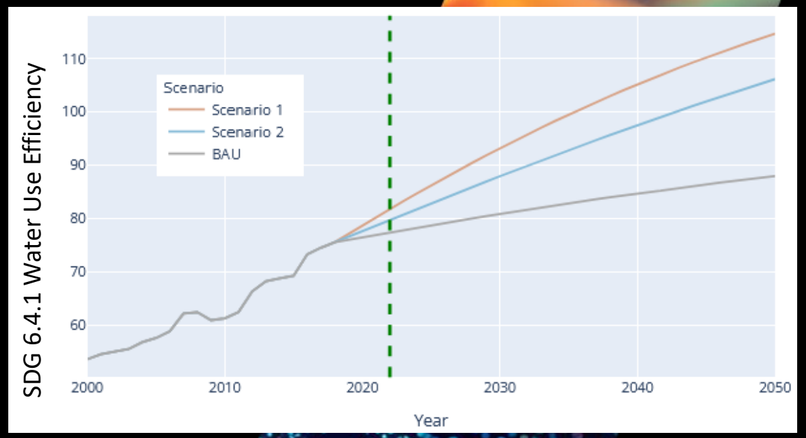
- With links to the Green Growth Index indicators, the Green Growth Simulation (GGSim) Tool offers scenario analysis for evaluating SDG co-benefits in national strategic plans like LT-LEDs, NAPs, and NDCs.
- It includes systems dynamics models for energy and transport (ET), agriculture, forestry, other land use (AFOLU), water, materials, and waste circularity (CE).



Country Applications:

Hungary, Burkina Faso, Ethiopia, St. Lucia, Senegal, Lao PDR





MODEL INPUTS

Mitigation and Adaptation

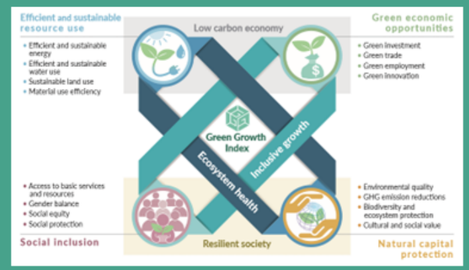
- Policy measures
- Green investments

SYSTEM DYNAMICS MODELS

- Equation(s)
- Variables
- Parameters

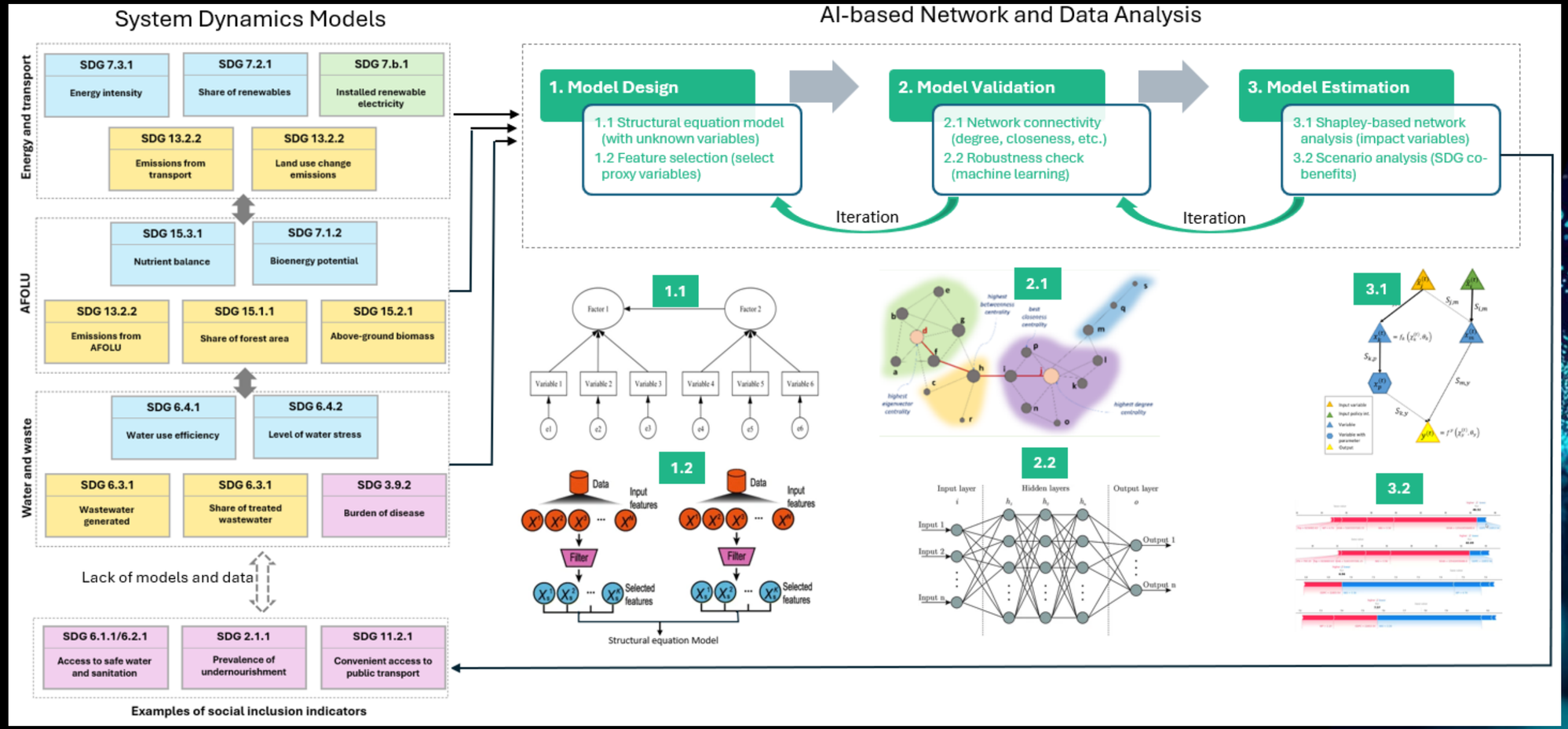
MODEL OUTPUTS

Co-benefits on SDGs

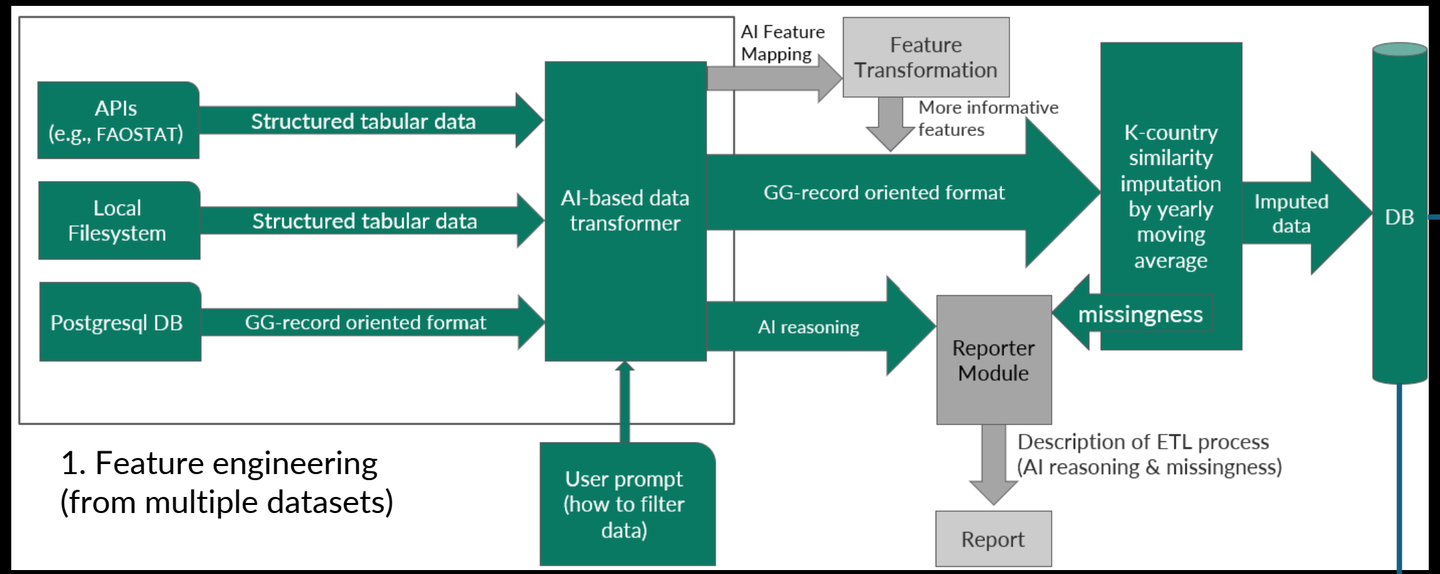


AI approaches in the AI-GGSim – Model flow

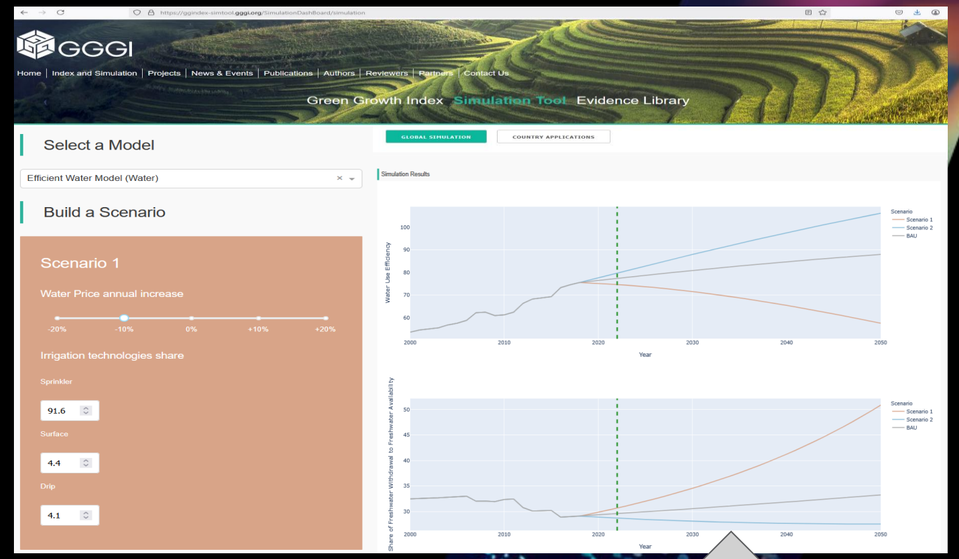
- GGSim's AI-based network analysis aims to improve databases and implement structural equation modeling (SEM) for social inclusion and gender-related SDGs that lack data and models.
- GGSim uses machine-learning approaches to build BAU projections and validate the robustness of SDG co-benefits from integrated system dynamics and network models.

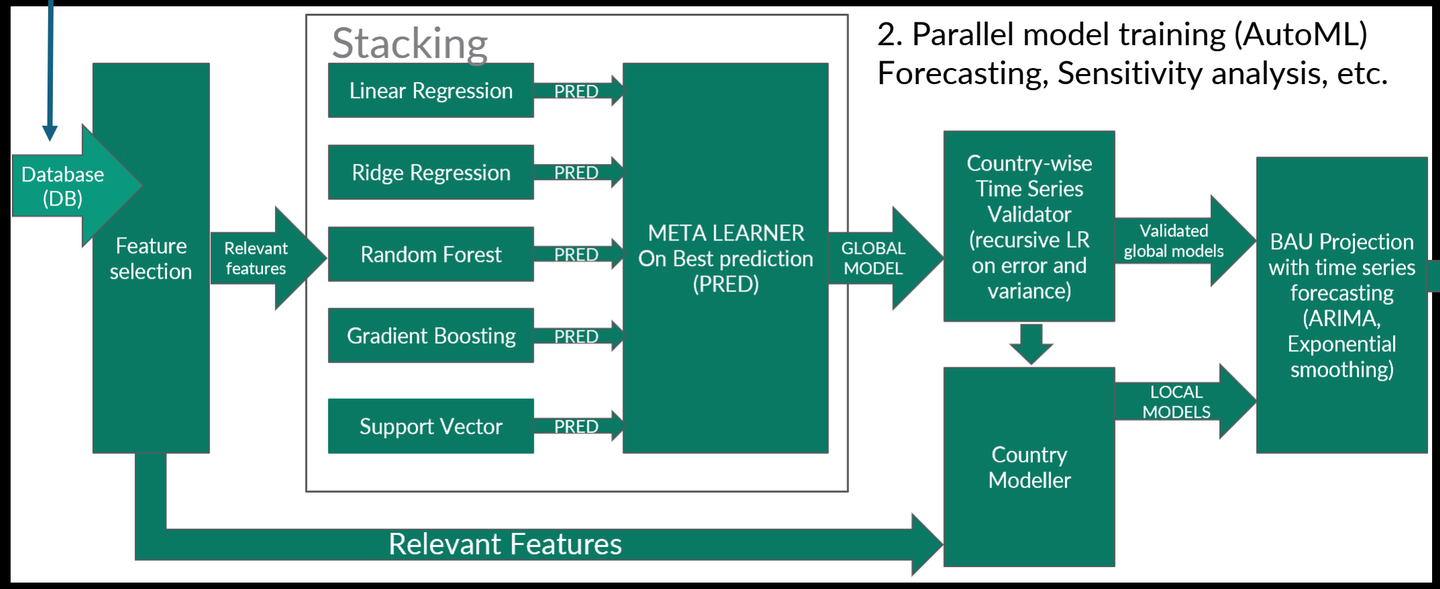


AI approaches in the AI-GGSim - AI architecture



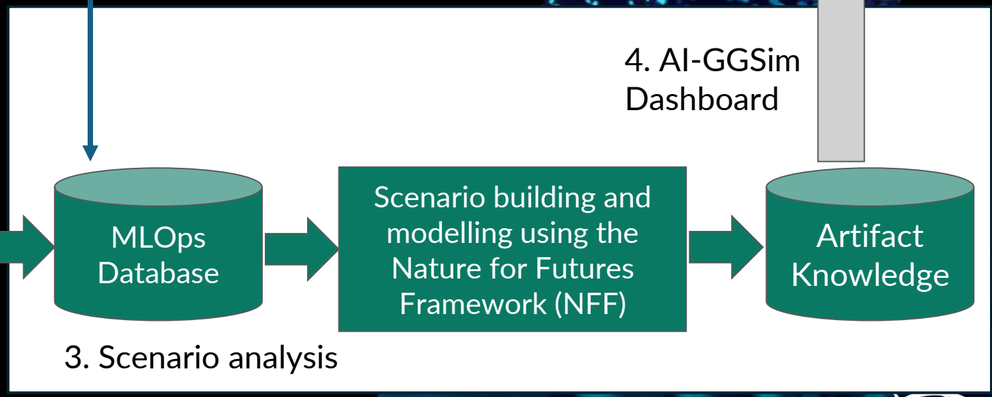
1. Feature engineering
(from multiple datasets)





2. Parallel model training (AutoML)
Forecasting, Sensitivity analysis, etc.

4. AI-GGSim Dashboard



3. Scenario analysis

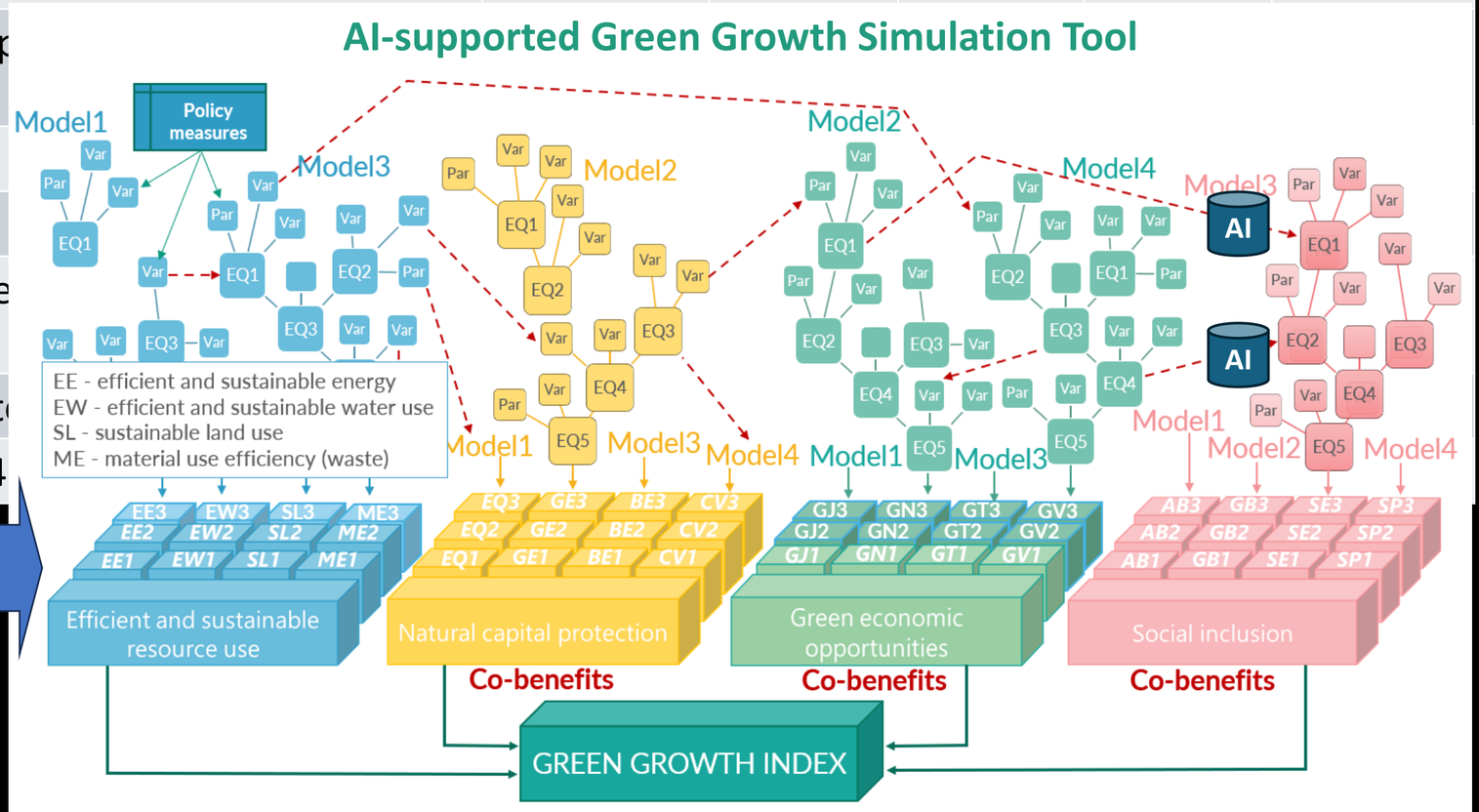
Legend:

BAU Analysis: Modelling sectoral SDG co-benefits

Sectoral modules	SDG Indicators	Unit	Baseline	Business-as-usual Projections		
			2020	2030	2040	2050
Agriculture, forest, and other land use (AFOLU)	Share of forest to total land area (SDG 15.1.1)	Percent	27.89	26.53	25.17	23.82
	Nutrient balance (SDG 2.4.1)	Kg/ha	20.50	17.39	17.02	16.66
	GHG Emissions from agriculture (SDG 13.2.2)	Mt	16,592	17,227	19,341	21,455
Energy & transport	Mean annual concentration of fine p (SDG 11.6.2)					
Water use	Level of water stress (SDG 6.4.2)					
	Water use efficiency (SDG 6.4.1)					
	Share of bodies of water with ambie 6.3.2)					
Materials and waste	Share of municipal solid waste treat					
	Hazardous waste treated (SDG 12.4					

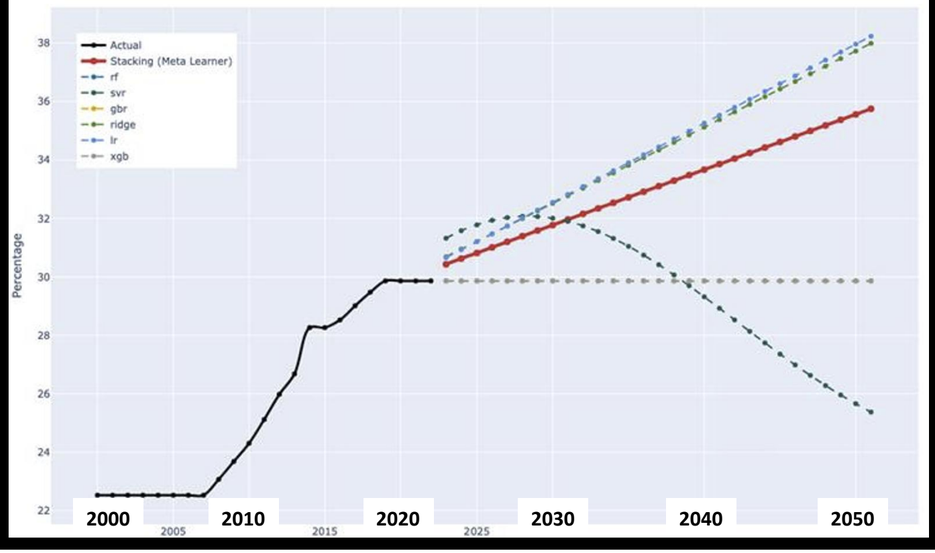
*Illustrating values for Europe due to the data gaps in Africa

SDG Indicators

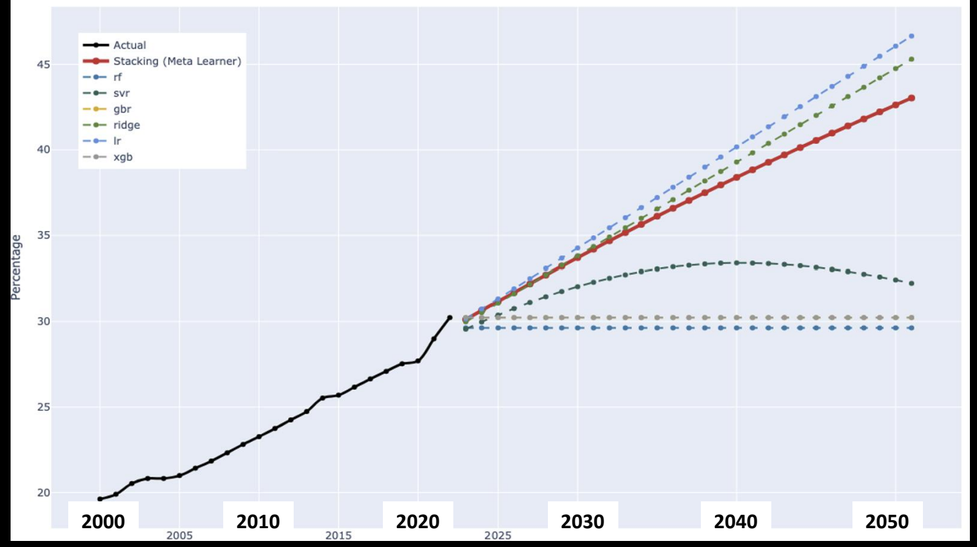


BAU Analysis: SDG Projections for Africa using meta learner

Historical trend and BAU projections for SDG 6.1.1 safely managed water

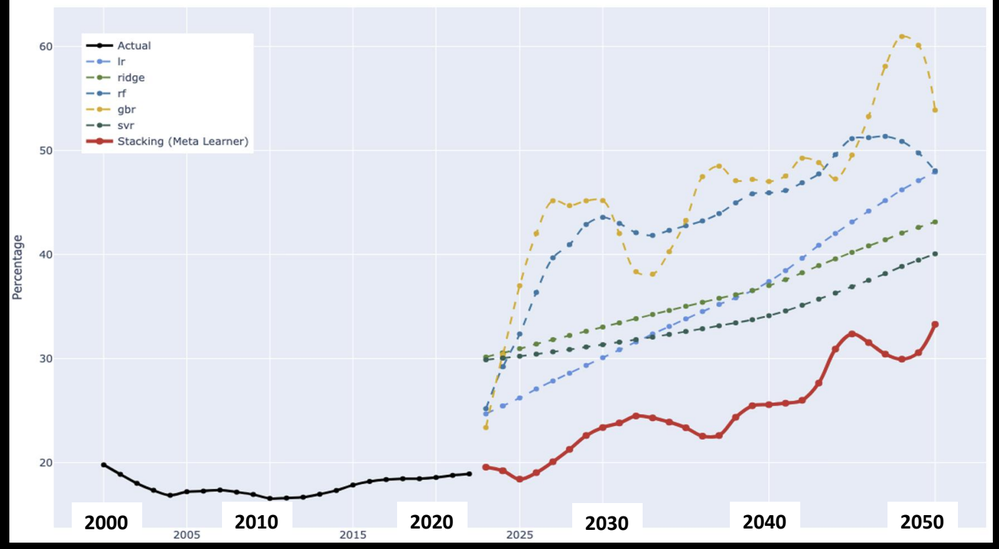


Historical trend and BAU projections for SDG 6.2.1 safely managed sanitation

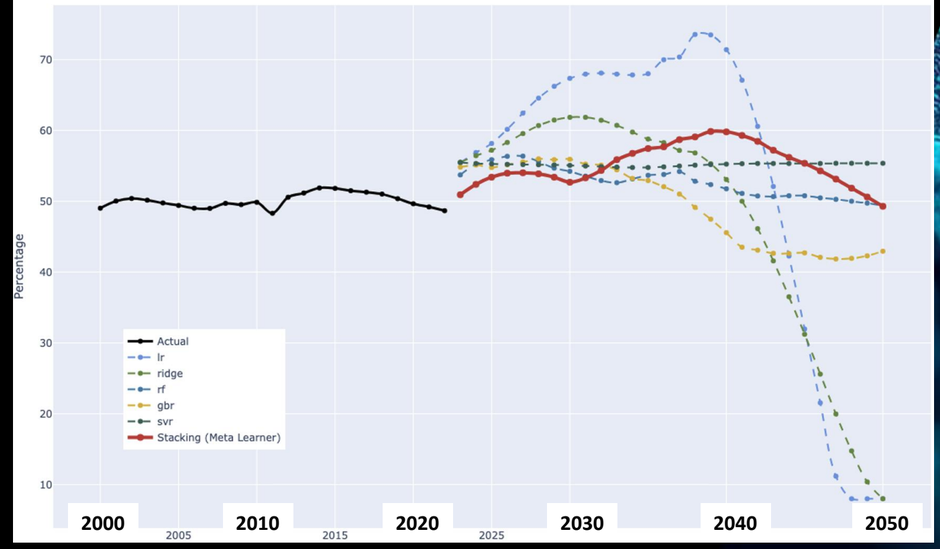


lr: Linear Regression
ridge: Ridge Regression
rf: Random Forest Regressor
gbr: Gradient Boosting Regressor
svr: Support Vector Regressor
stacking: Stacking Regressor

Historical trend and BAU projections for SDG 7.1.2 access to clean cooking fuel



Historical trend and BAU projections for SDG 11.1.1 people living in slums



Scenario Analysis: Building NFF scenarios

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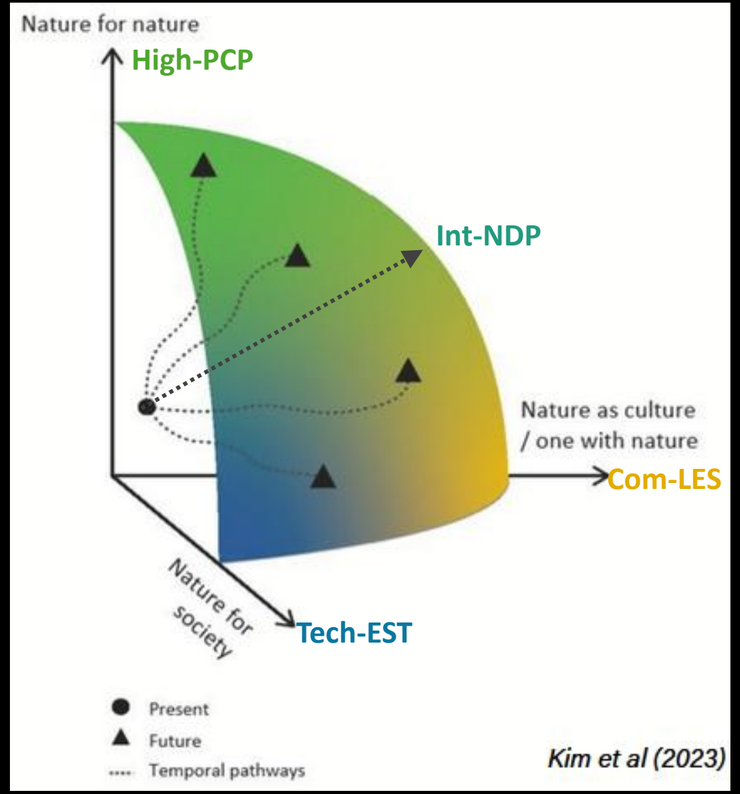
Towards a better future for biodiversity and people: Modelling Nature Futures

HyeJin Kim [a b c], Garry D. Peterson [d], William W.L. Cheung [e], Simon Ferrier [f], Rob Alkemade [g h], Almut Arneth [i], Jan J. Kuiper [d], Sana Okayasu [g], Laura Pereira [d j k], Lilibeth A. Acosta [l], Rebecca Chaplin-Kramer [m n o], Eefje den Belder [g p], Tyler D. Eddy [q], Justin A Johnson [r], Sylvia Karlsson-Vinkhuyzen [s], Marcel T.J. Kok [g], Paul Leadley [t], David Leclère [u], Carolyn J. Lundquist [v w], Carlo Rondinini [x y]...Henrique M. Pereira [a b au]



Scenarios	NFF Axes	Conceptual Relationship	Policy Relevance
A. High-Protection Conservation Priority (High-PCP)	Nature for Nature	Aligns NFF's intrinsic value of nature (ecosystems and biodiversity) with GGSim's emphasis on ecosystem health, resilience, and biodiversity as foundational to sustainability	Expanding protected areas, halting species loss, promoting reforestation, and ecological restoration **AI-GGSim dimension:** Natural Capital Protection
B. Tech-Enabled Sustainability Transition (Tech-EST)	Nature for Society	Connects NFF's instrumental values (supporting human well-being and development) with GGSim's focus on leveraging natural assets for inclusive green growth and sustainable livelihoods	Promoting green jobs, renewable energy, eco-industries, and nature-based infrastructure for economic growth **AI-GGSim dimension:** Green Economic Opportunities
C. Community-Led Ecological Stewardship (Com-LES)	Nature as Culture	Links NFF's relational values (identity, spirituality, and local knowledge tied to nature) to GGSim's equity lens by embedding cultural identity, traditional knowledge, and gender-responsive approaches	Supporting Indigenous rights, gender equity, local environmental governance, and community-based resource management **AI-GGSim dimension:** Social Inclusion
D. Integrated Nature-Development Pathway (Int-NDP)	Balanced Values	Reflects NFF and GGSim frameworks' integrative vision, i.e., integrating ecological integrity, social equity, and economic viability in systems-level transformation.	Advancing circular economy, sustainable agriculture, and cross-sectoral resource governance (e.g., water–energy–food) **AI-GGSim dimension:** Efficient and Sustainable Resource Use

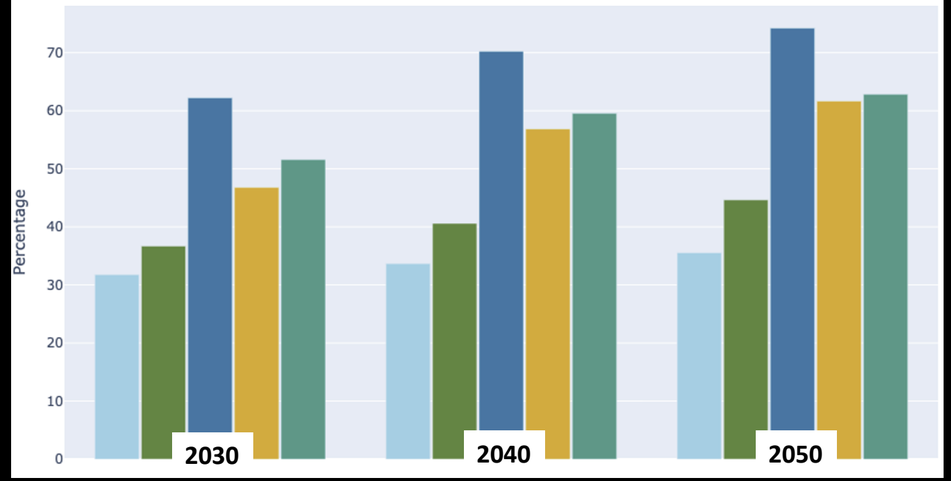
Scenario Analysis: Gender and social inclusion (GESI) co-benefits in Africa

AI for Good

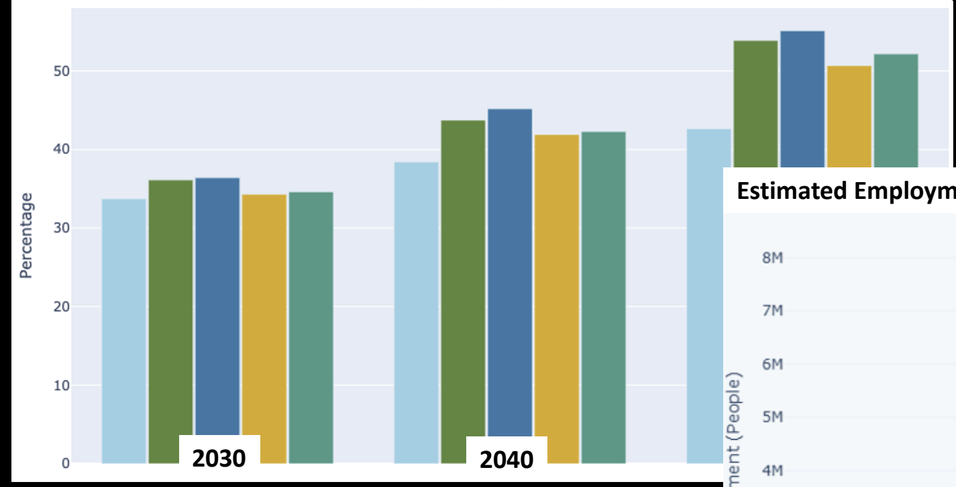
GGGI

Complex Systems Monitoring Research Group

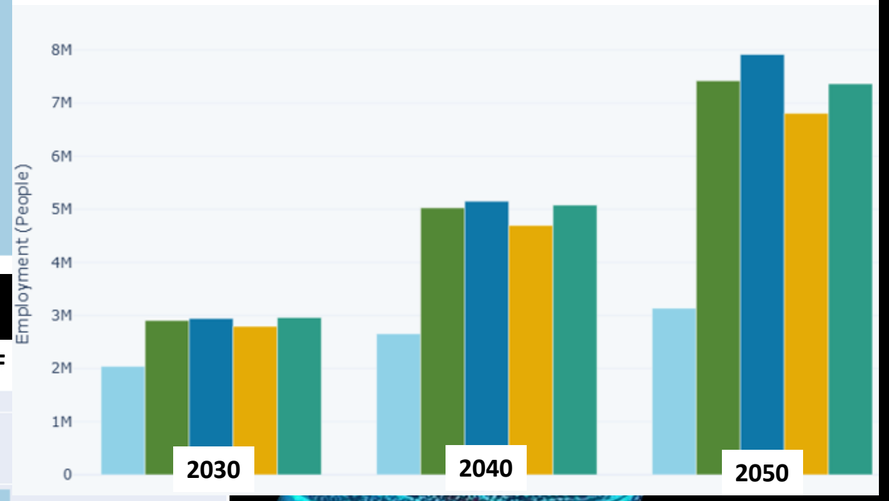
Estimated SDG 6.1.1 access to safely managed water under the NFF Scenarios



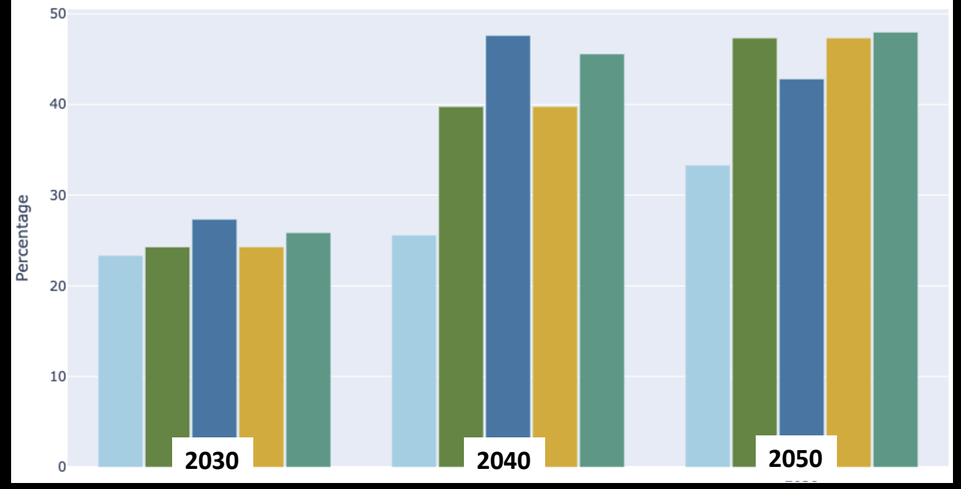
Estimated SDG 6.2.1 access to safely managed sanitation under the NFF Scenarios



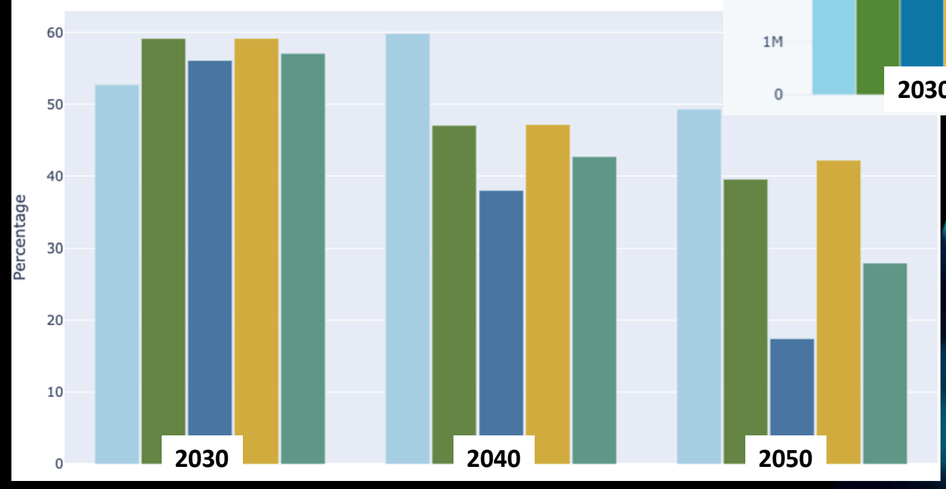
Estimated Employment in Organic Agriculture under the NFF Scenarios

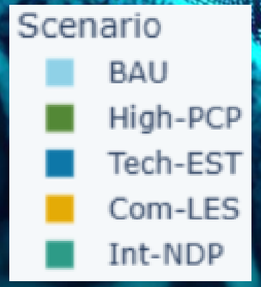


Estimated SDG 7.1.2 access to cooking fuels under the NFF Scenarios



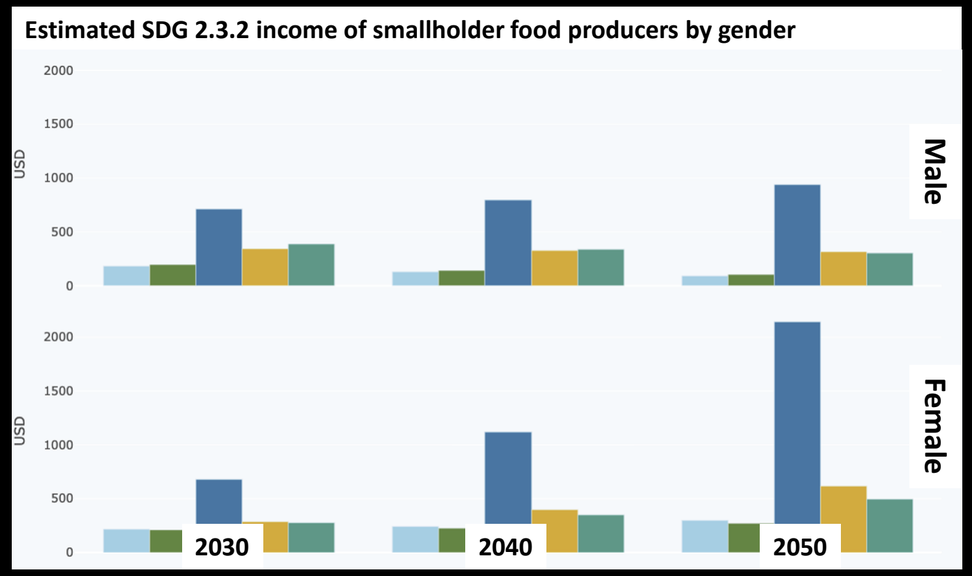
Estimated SDG 11.1.1 population living in slums under the NFF

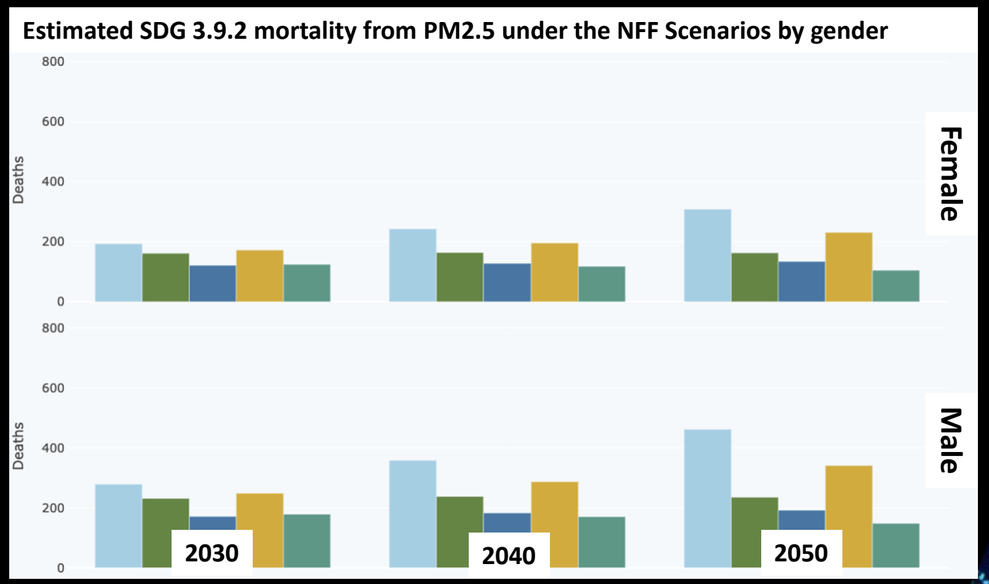


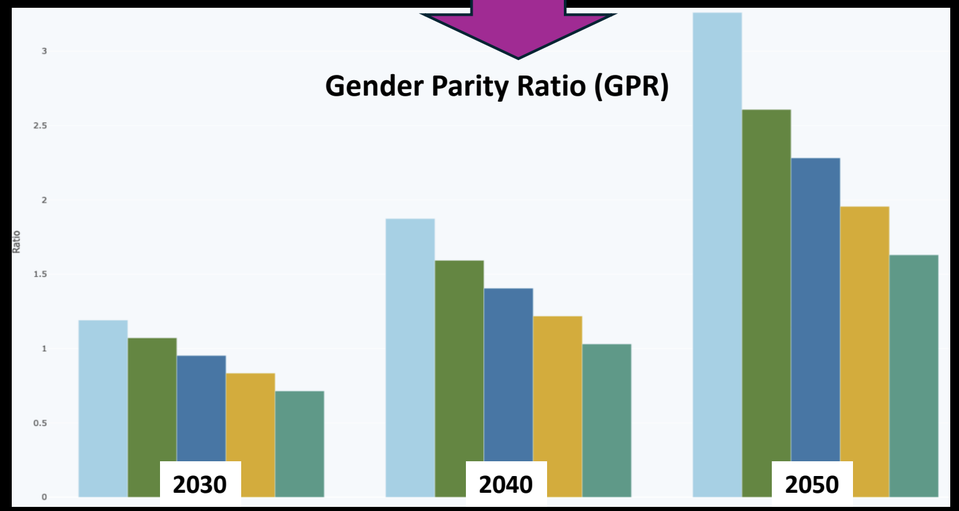


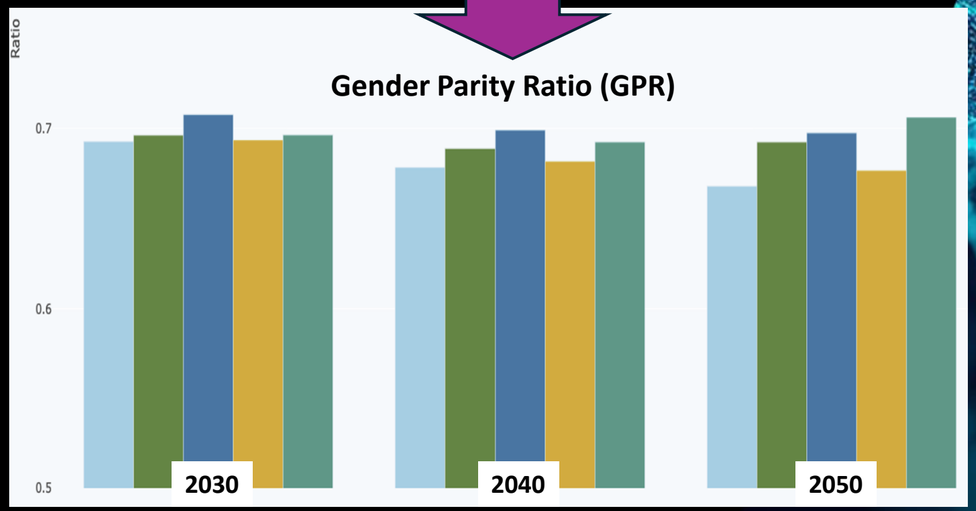
ITU

Scenario Analysis: Gender and social inclusion (GESI) co-benefits in Africa







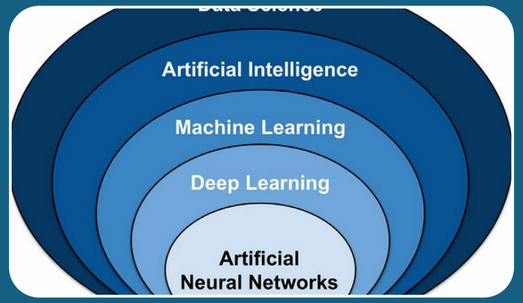


Scenario
- BAU
- High-PCS
- Tech-EST
- Com-LES
- Int-NDP

$$\text{GPR} = \frac{\text{Value for females}}{\text{Value for males}}$$

Where:
GPR = 1.0: Perfect parity
GPR < 1.0: Favors males
GPR > 1.0: Favors females

Next Steps 2025-2026

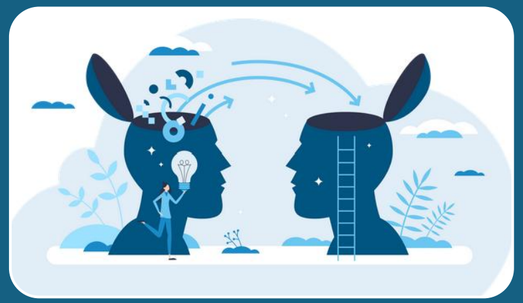


Developing Models

- Further enhance AI approaches and model integration
- Add more SDG indicators and models for gender to the AI-GGSim Tool
- Build the AI-GGSim interactive online tool for global NFF scenario analysis

Building Partnerships

- Elevate AI-GGSim Tool to the IPBES Task Force and NFF Community of Practice
- Continue collaboration with the ITU for the 2026 AI for Good Global Summit
- Partner with GGGI Member Countries in applying AI-GGSim for gender policy analysis



Disseminating Knowledge

- Publish Global Green Growth Progress and Pathways report
- AI-GGSim session during the 2025 Global Green Growth Week
- Conduct capacity building of GGGI government partners in using AI-GGSim online tool

Project Team

AI-Driven Green Growth Simulation (AI-GGSim) for Gender and Social-Inclusive Policy in Africa

AI for Good
Impact Initiative

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