Federal Ministry
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POTSDAM INSTITUTE FOR
CLIMATE IMPACT RESEARCH

Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

Climate Risk Analysis for Identifying and Weighing Adaptation Strategies for the Agricultural Sector in Northern Ghana

- A Study at District Level in the Upper West Region -

Supplementary Material

Supplement to a study prepared by the Potsdam Institute for Climate Impact Research (PIK) for the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), in collaboration with the Department of Planning and Land Management at the University for Development Studies (UDS) and the Resilience Against Climate Change (REACH) project.

Chapter 1 – Changing Climate Conditions

Climate Models

A climate model is a computer model, describing the state and change rate of different Earth components, for example atmosphere, land surface, vegetation, ocean, sea ice, aerosols and carbon cycle (van Storch, 2005). The components of such a model are sketched in the figure below.

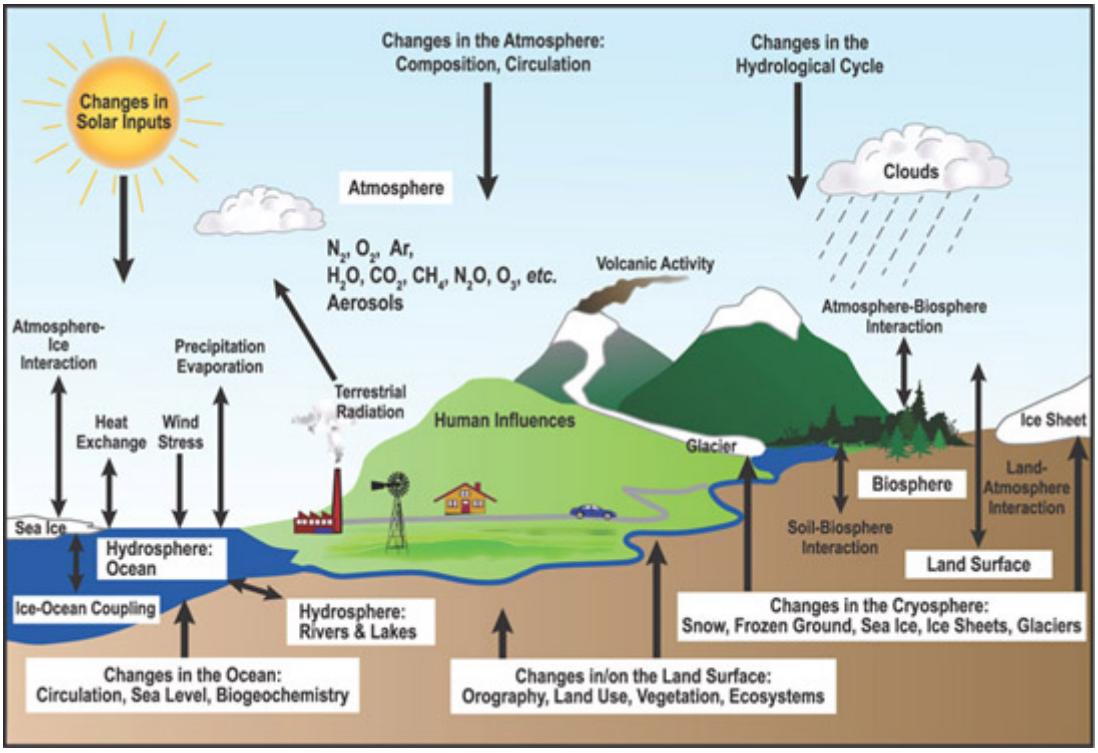

Figure 1: Components of the global climate system (IPCC, 2007).

Climate models have proven to reproduce current climate and past climate changes reasonably well. There is considerable confidence that the models are capable of estimating future climate changes, especially on continental and larger scales. Climate model's predictions come with fewer uncertainties for some climate variables (e.g. temperature) than others (e.g. precipitation). They can represent annual mean values better than extreme events and annual variations (IPCC, 2014). More detailed information on climate models can also be found in van Storch (2005).

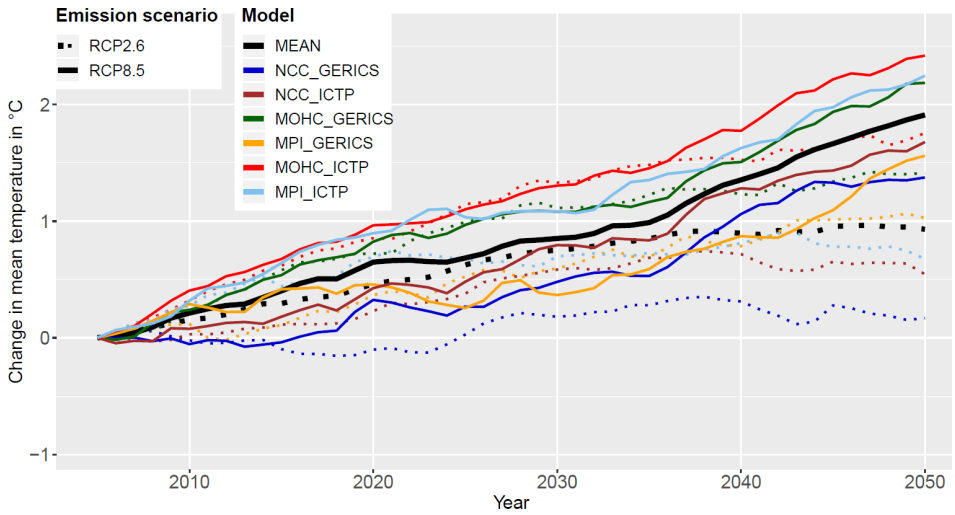

Figure 2: The 11-year moving average of the change in maximum daily temperature in °C compared to 2005 based on CORDEX-CORE data. Values are averages over UWR. Each variegated line indicates a projection of an individual model. The black line displays the multi-model mean.

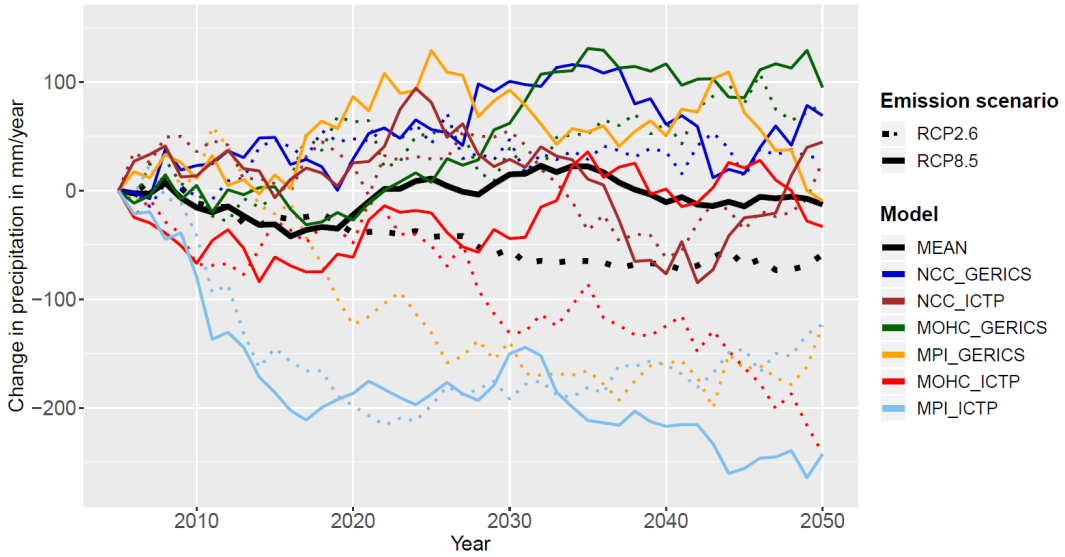

Figure 3: The 11-year moving average of projected change in mean annual precipitation in mm per year compared to 2006 based on CORDEX-CORE data. Values are averages over the UWR. Each variegated line indicates a projection of an individual model. The black line displays the multi-model mean.

	Maize			Sorghum			Groundnut			Cowpea		
Parameters	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Planting density	4	4.5	6	1.5	2.0	2.5	8	10	12	10	12	15
Starting fertiliser	10	20	50	5	5	20	10	20	50	20	30	50
Top dressing	30	50	80	5	2	10	5	5	10	-	-	-
Manure	500	1000	-	500	1000	-	500	1000	-	500	1000	-
Tillage type	Chisel	Blade	Disc	Chisel	Blade	Disc	Chisel	Blade	Disc	Chisel	Blade	Disc

Table 1: Parameters for different farming systems used in APSIM

Chapter 3 – Selection of adaptation measures

	Position	Date	District
1	Gender Desk Officer	09.02.2020	Wa West
2	Manager of Wechiau Hippo Sancturary, and former Assembly Man of Wechiau	09.02.2020	Wa West
3	Coordinator of Lawra Climate Change Platform, and retired agricultural officer	11.02.2020	Lawra
4	Field officer, CIKOD (Center for Indigenous Knowledge and Organisational Development)	11.02.2020	Lawra
5	Regional Manager of Irrigation Authority	12.02.2020	Wa
6	Regional Deputy Director of Agriculture	12.02.2020	Wa
7	District Director of MoFa Wa West	12.02.2020	Wa
8	Deputy Director of MoFa Wa West	12.02.2020	Wa
9	Agricultural Extension Officer, MoFa	16.06.2020	Sissala East
10	Production Officer, MoFa	16.06.2020	Sissala East
11	Desk Officer of "Women in Agriculture"	12.06.2020	Sissala East

Table 2: List of interviewees[1]

	Position	Date	Location
1	Cashew-groundnut farmer	07.05.2020	Soma, STK
2	Cashew-groundnut farmer	11.05.2020	Sawla, STK
3	Cashew-groundnut farmer	07.05.2020	Dunbey, STK
4	Maize farmer	20.04.2020	Tumu, Sissala East
5	Maize farmer	23.04.2020	Kog, Sissala East
6	Maize farmer	24.04.2020	Tumu, Sissala East
7	Sorghum farmer	19.04.2020	Konyukuo, Lawra
8	Sorghum farmer	22.04.2020	Konyukuo, Lawra
9	Sorghum farmer	20.04.2020	Zambo, Lawra
10	Tomato farmer	18.04.2020	Daboziri, Wa West
11	Tomato farmer	16.04.2020	Tengdomo, Wa West
12	Tomato farmer	30.04.2020	Daboziri, Wa West

Table 3: List of experts interviewed for cost-benefit analysis

[1] All interviewees gave consent to record the interview and state their position and district

Strategies	votes	sub-strategies	votes	benefits		barriers
Irrigation	60	furrow system	2	cheap	source of income, food security, all year round farming, source of employment	wastes water
		boreholes (solar, manual)	9	reliable water source		capital intensive, maintenance costs
		water pumps	4	reduces labour cost, longer distances possible		costs, maintenance, fuel
		drip, mist irrigation	11	efficient water use		cost, maintenance difficult
		water cannels	10	minimum water loss		capital intensive, maintenance costs
		shallow wells (hand dug)	3	use available moisture for production		dry out easily
		use of residiual moisture/wetland				
		rivers				high cost of equipment, destruction by
		wells				
		dams	21			
		ponds				
Moisture conservation	6	zai pits		conserves moisture, improved soil fertility, improved soil structure, improved crop yield		tedious, can't be done on a large scale
		crop residuals				access to materials; bush fires, termites
		living mulch	1			seed availability, agronomic knowledge
		mulching with grass				bushfires, seed grass
		green manuring				
		composting				
		afforestation	5			
Weather forecasting	10	traditional methods	5	easily accessible	no losses, improved yields, timely operation	limited knowledge
		rainfall data	1			high cost of weather station equipment, farmers ability to read weather information, poor record keeping
		G-met				
		Esoko forecast	4	easily accessible, early information		need a phone, network, not reliable, costs
		Iska weather forecast		easily accessible		need a phone, network
Soil fertility management	18	crop rotation or intercropping (cereals-legumes)	4	improved soil structure and moisture retention of soil, improved soil nutrient levels, weed control		
		Manure	5			
		composting	7			inadequate access to water at farm for composting; competitive use for biomass;
		erosion control	2			
		organic fertilizer				organic fertilizer is costly
Improved seeds	43	improved seeds (Hybrid/OPV)	26	high yielding, high nutrient value, early maturing, maximises land use, fixes nitrogen in soils, improved local seeds are adaptive to environment		inadequate capacity to produce improved seed, expensive to acquire seed, requires high fertilization, takes more time and attention, agronomic skills needed
		Establish community seed production system	17	traceable seed growers		
Agroforestry	33	Cashew/Mango with legumes	21	Cash crops, short + long-term incomes, nutritious	increase in population of pollinators, by product for livestock feeding	destruction by herders/cattle, availability of seedlings, bush fires, water shortage in dry season, access to land, labour
		Natural regeneration of trees (shea, Faidherbia, Dawa Dawa)	12	increase income to women, medicinal, fruits/shea butter, allows intercropping		bushfires, cutting of trees for charcoal production, destruction by herders/cattle
Improved Post-harvest management (IPM)	11	early harvesting	1	value additions (through quality control), reduced losses,		inadequate knowledge in IPM
		PICs bags	7			
		mechanised threshers	3			
		use of tarpaulin				
		moisture meter				
Integrated pest and desease management	6	hand picking	2	requires no technical knowledge		
		farm hygiene		less expensive		
		appropriate use of chemicals	4	readily available chemicals		high cost of chemicals
		use of natural enemies		eco-friendly		
		pest resistant varieties				non availability of pest resistant varieties

Table 4: Group work during kick-off workshop: specification of adaptation measures; collection of opportunities & barriers

Chapter 7 – Irrigation

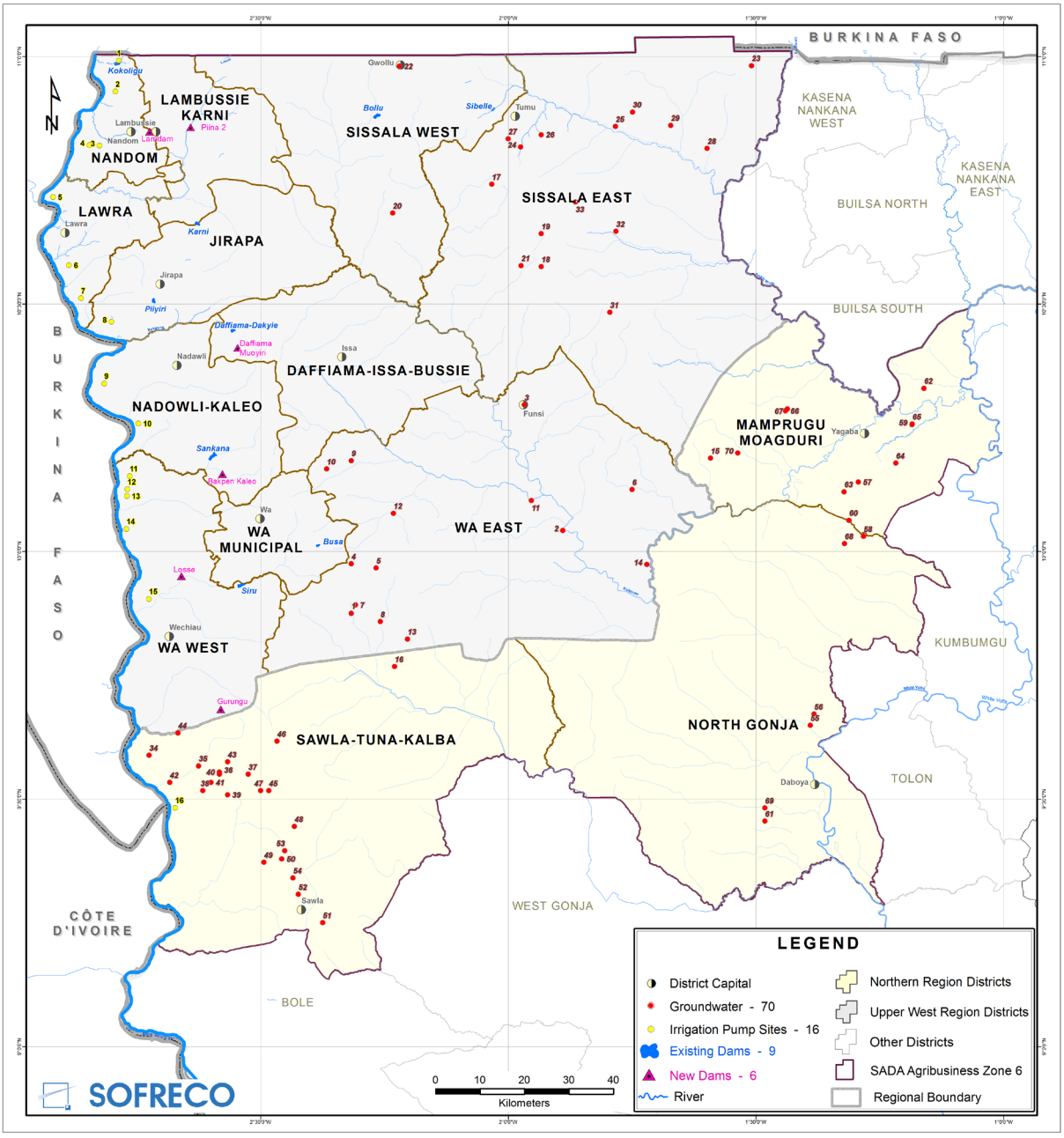

Figure 4: Irrigation map developed within the EUGAP project by SOFRECO[2] in 2017 with input provided by local authorities of the Upper West Region. An updated version of the map is on the way since some changes are planned. This includes a reduction in new pumping stations and boreholes. The dams are still planned to be implemented as shown in the map.

[2] Address of SOFRECO: 92-98, boulevard Victor Hugo 92115 Clichy-Cedex France

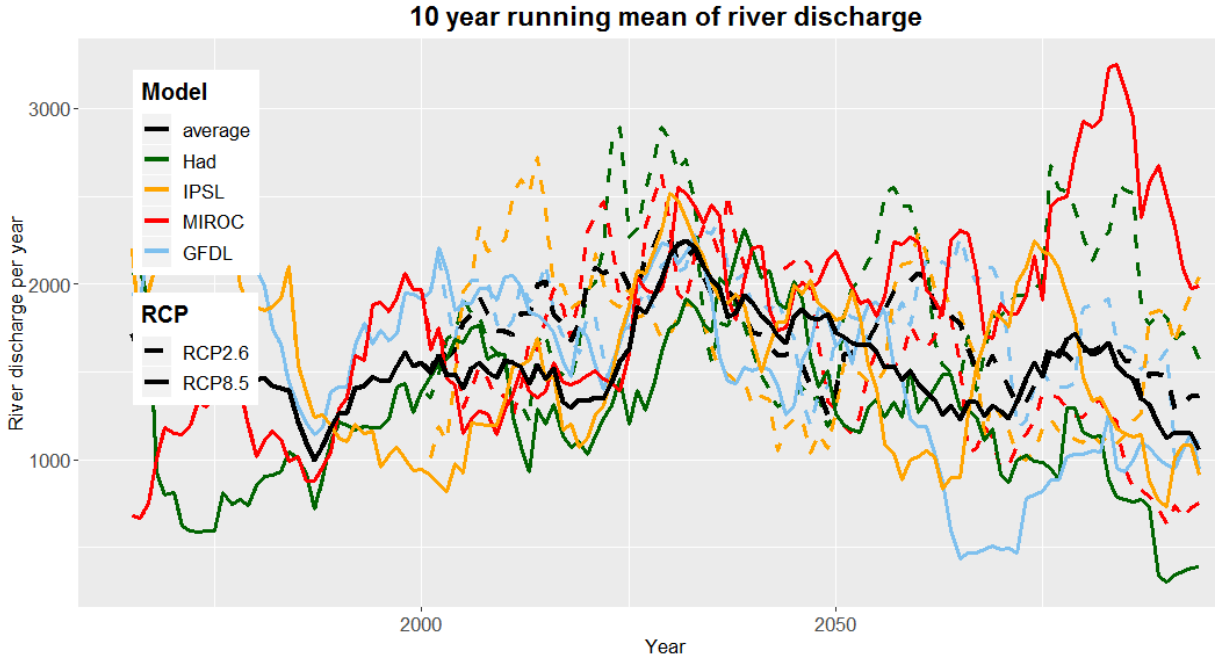

Figure 7: Simulations of past and future river discharge in the Black Volta River in Wa West based on results by (Murken, L. et al., 2019)

Bibliography

IPCC, (2007). Climate Change 2007 Synthesis Report. Fourth Assessment Report. https://doi.org/10.1256/004316502320517344

IPCC, (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

Murken, L., Aschenbrenner, P., Chemura, A., Hattermann, F., Koch, H., Lehmann, J., Liersch, S., Roehrig, F., Schauberger, B., Yalew, A., Gornott, C. (2019) *Climate risk analysis for identifying and weighing adaptation strategies in Ghana's agricultural sector*.

von Storch, H., (2005). Models of Global and Regional Climate. In *Encyclopedia of Hydrological Sciences*. https://doi.org/10.1002/0470848944.hsa035