SYMPOSIUM CLIMATE CHANGE, NUTRITION AND HEALTH: GLOBAL CHALLENGES AND POTENTIAL SOLUTIONS
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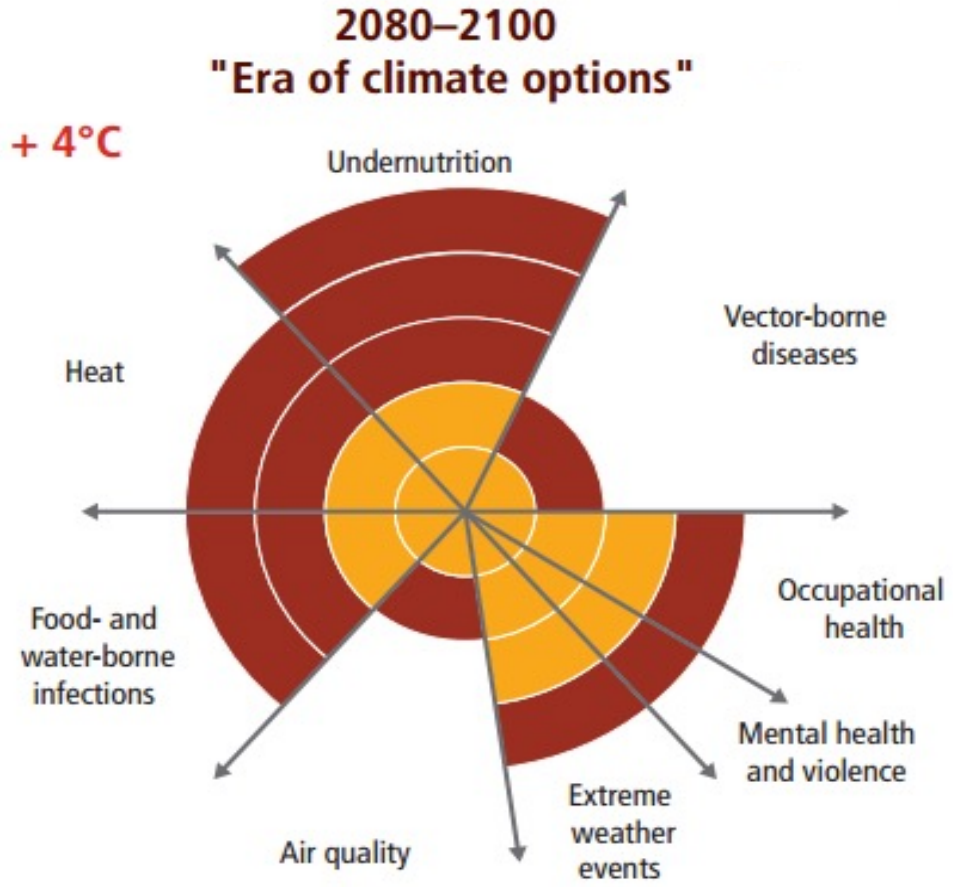
Projecting deaths from undernutrition from empirical time series in Nouna, Burkina Faso

Dr Kristine Belesova, Dr Christoph Gornott, Dr Issouf Traore, Prof Paul Wilkinson, Prof Rainer Sauerborn

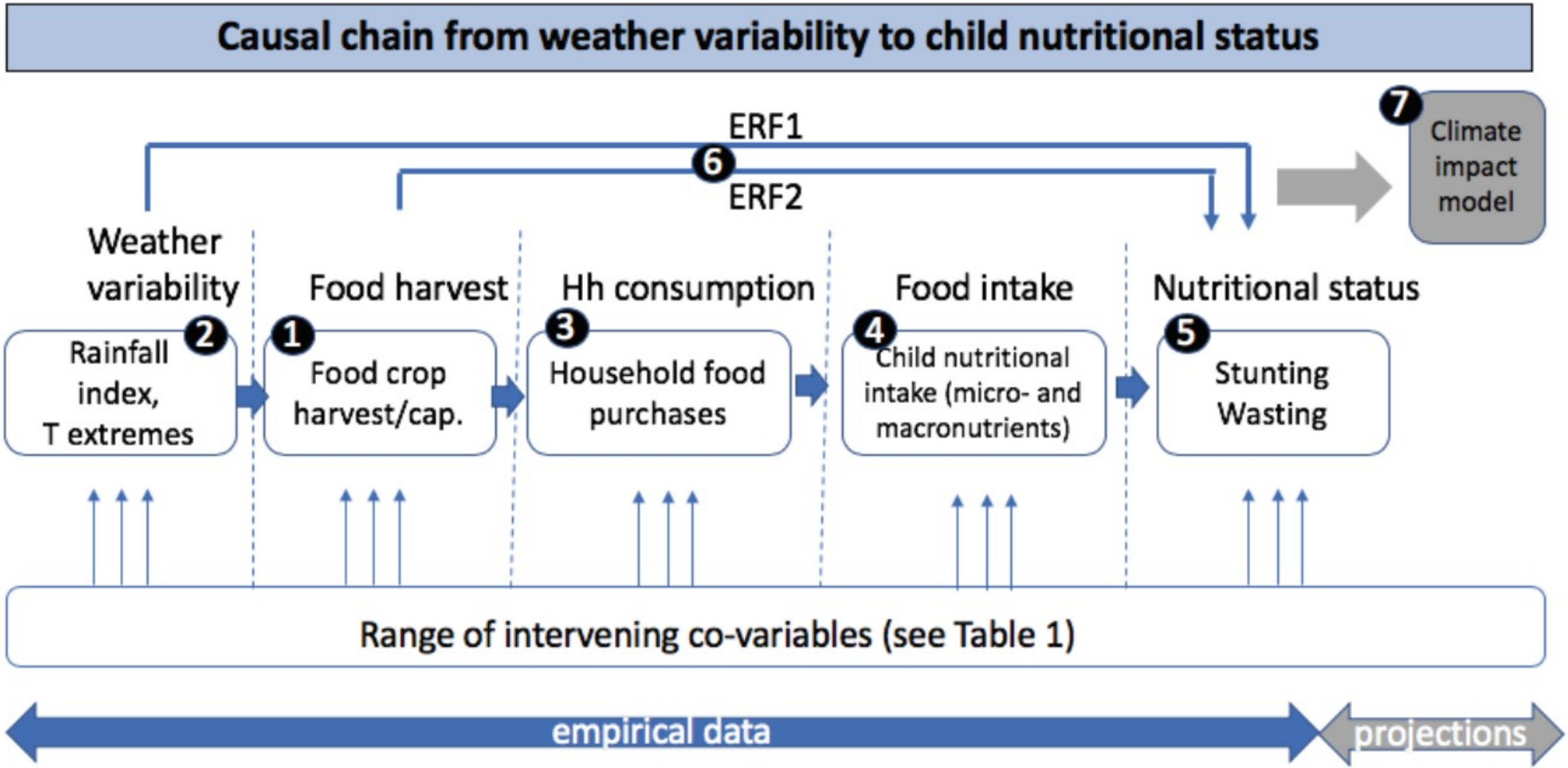
Background

- ✓ Poor crop yield – a risk factor for child undernutrition & mortality among subsistence farmers
- ✓ 1/3 of crop yield variation related to climate variability globally
- ✓ Climate change may result in 45% increase in the number of stunted children in West Africa by 2050

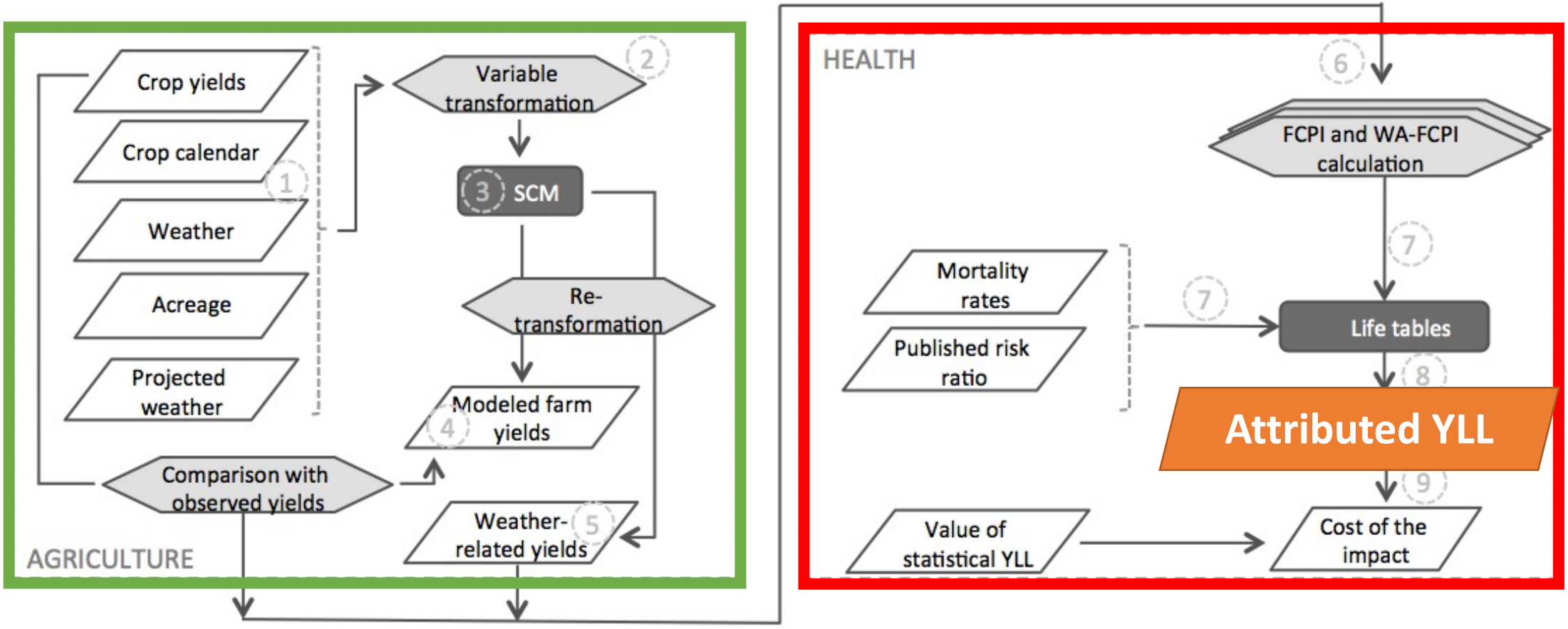


Belesova et al, 2017
Ray et al, 2015
Grace et al, 2016
Lloyd et al, 2012
Johnson & Brown, 2014
Hales et al, 2014
IPCC health group: Smith et al, 2014

Nouna, Burkina Faso

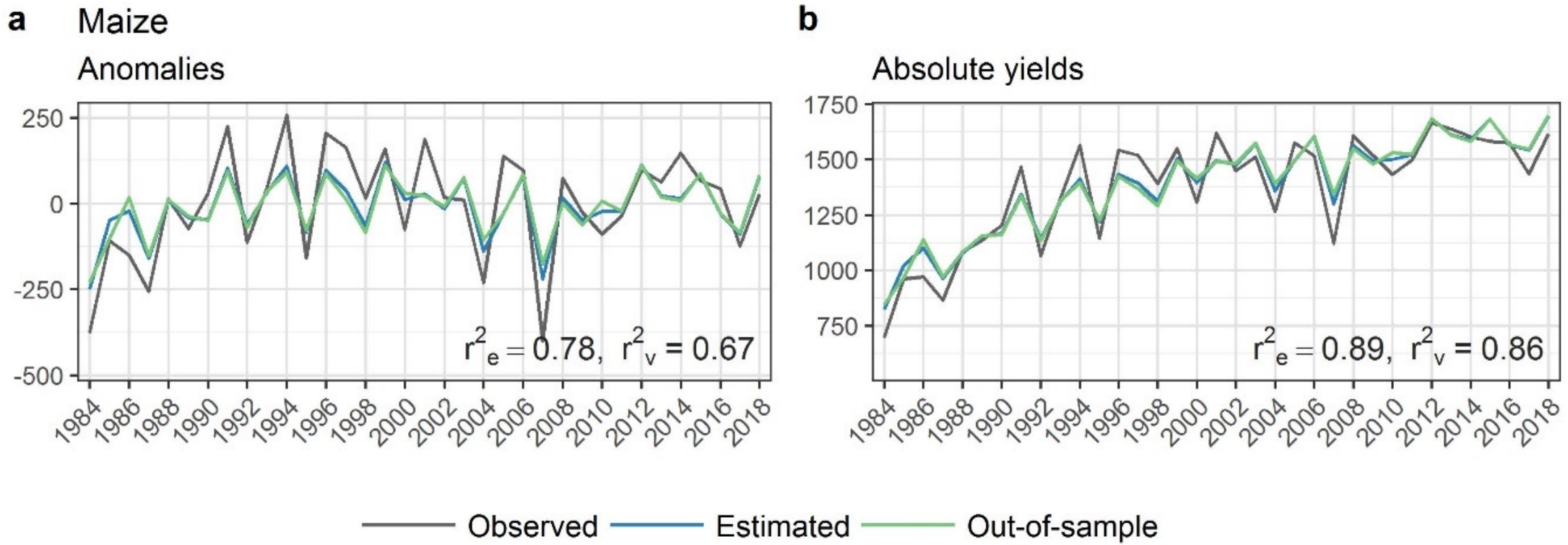

Causal chain from weather variability to child nutritional status
ERF1
6
ERF2
7
Climate impact model
Weather variability
Food harvest
Hh consumption
Food intake
Nutritional status
2
Rainfall index, T extremes
1
Food crop harvest/cap.
3
Household food purchases
4
Child nutritional intake (micro- and macronutrients)
5
Stunting Wasting
Range of intervening co-variables (see Table 1)
empirical data
projections

Modelling framework



Belesova, K., Gornott, C., Milner, J., Sié, A., Sauerborn, R., & Wilkinson, P. (2019). Mortality impact of low annual crop yields in a subsistence farming population of Burkina Faso under the current and a 1.5 ° C warmer climate in 2100. *Science of the Total Environment*, *691*, 538–548. https://doi.org/10.1016/j.scitotenv.2019.07.027

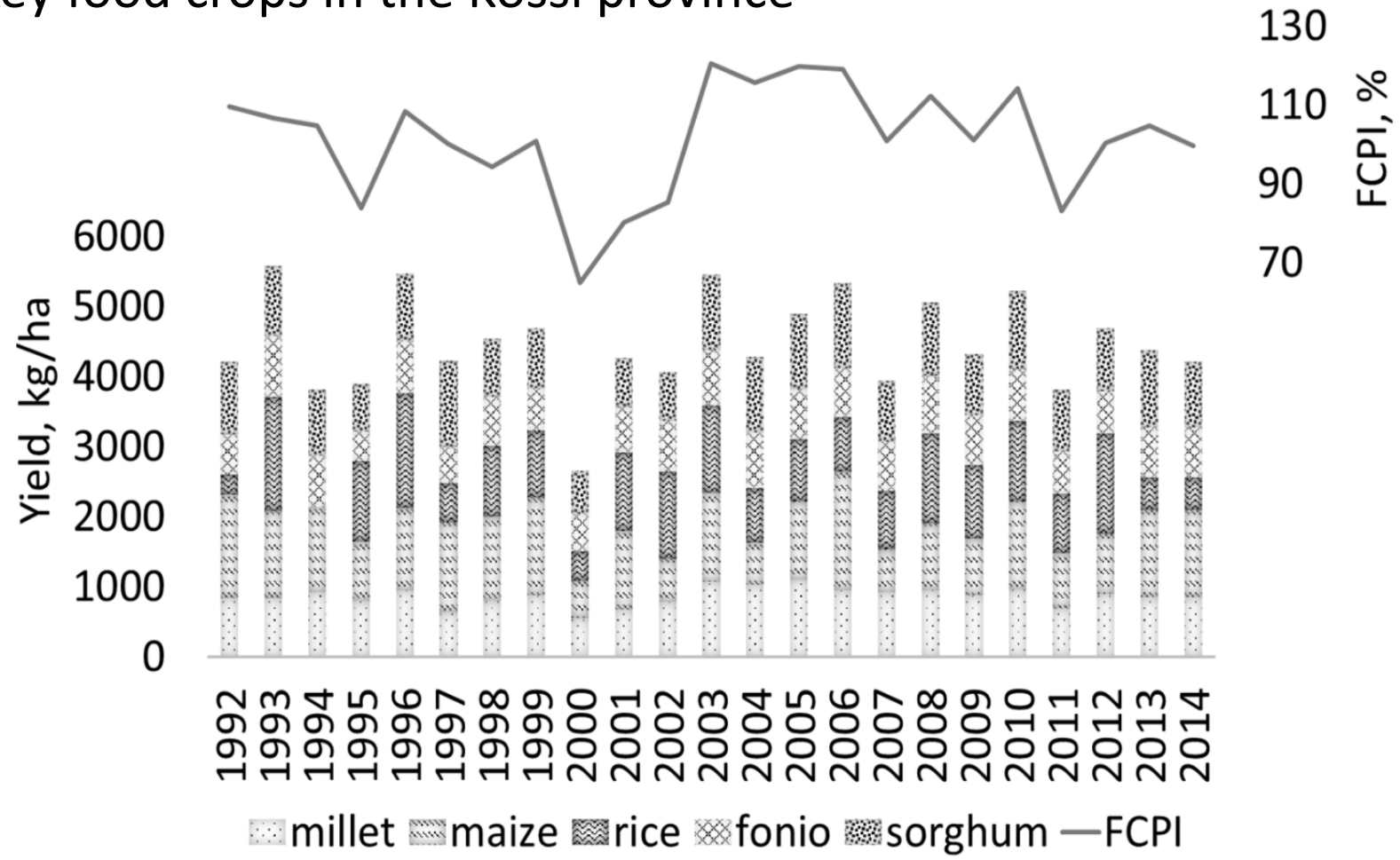
Modelled crop yield estimates



Laudien, …, Gornott, in prep.

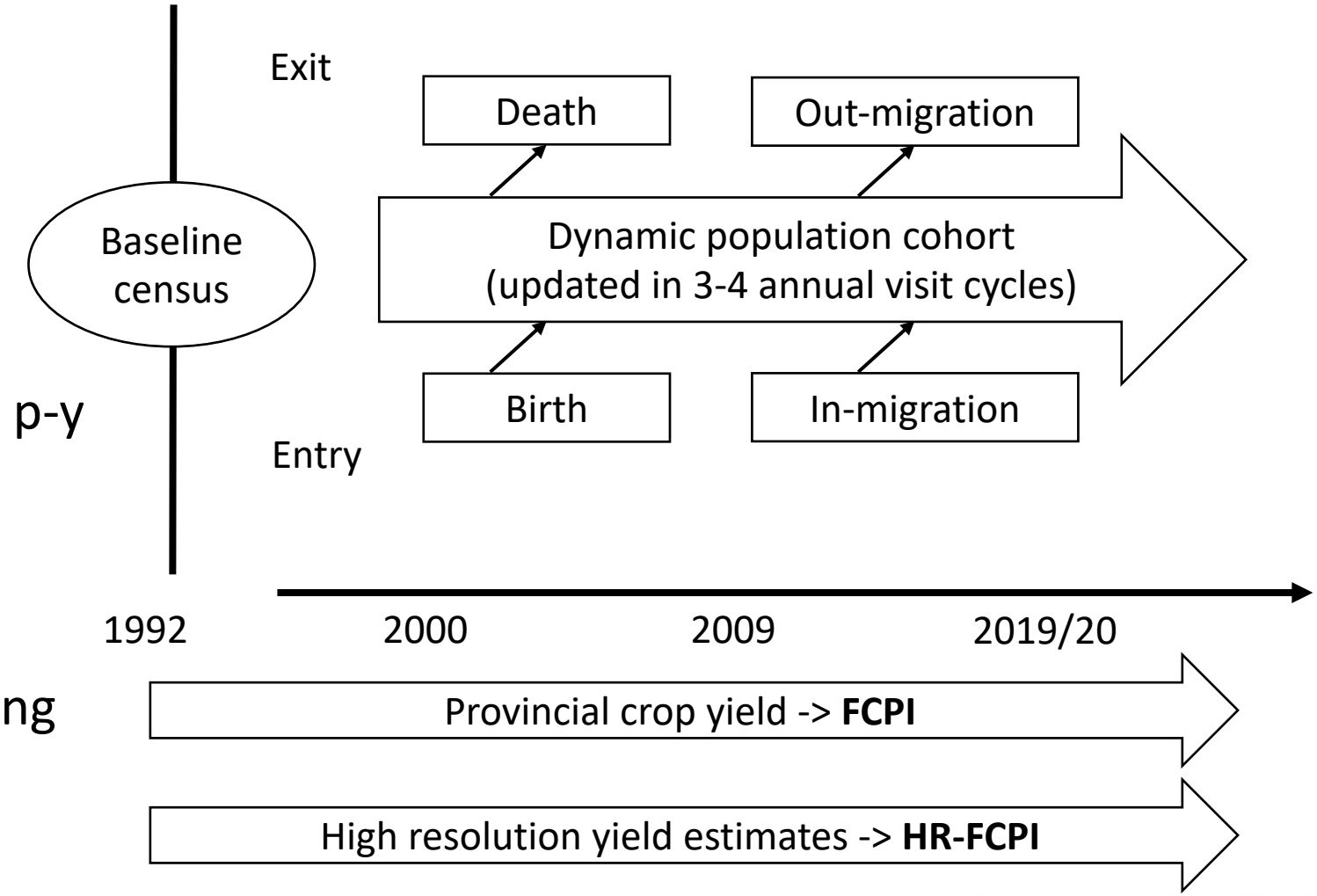
Food Crop Productivity Index (FCPI)

Food Crop Productivity Index (FCPI) - measure of overall year-to-year variation of the five key food crops in the Kossi province



Outcome data: Nouna HDSS data

Nouna HDSS data
- Years: 24
- Children<5y: 61,335
- Deaths: 5,587
- P-y at risk: 217,143
- Av. death rate: 26 per 1,000 p-y



These children
- were born in Nouna HDSS
- lived there until exit/censoring
- re-entries excluded

Adapted from Sankoh & Byass, 2012

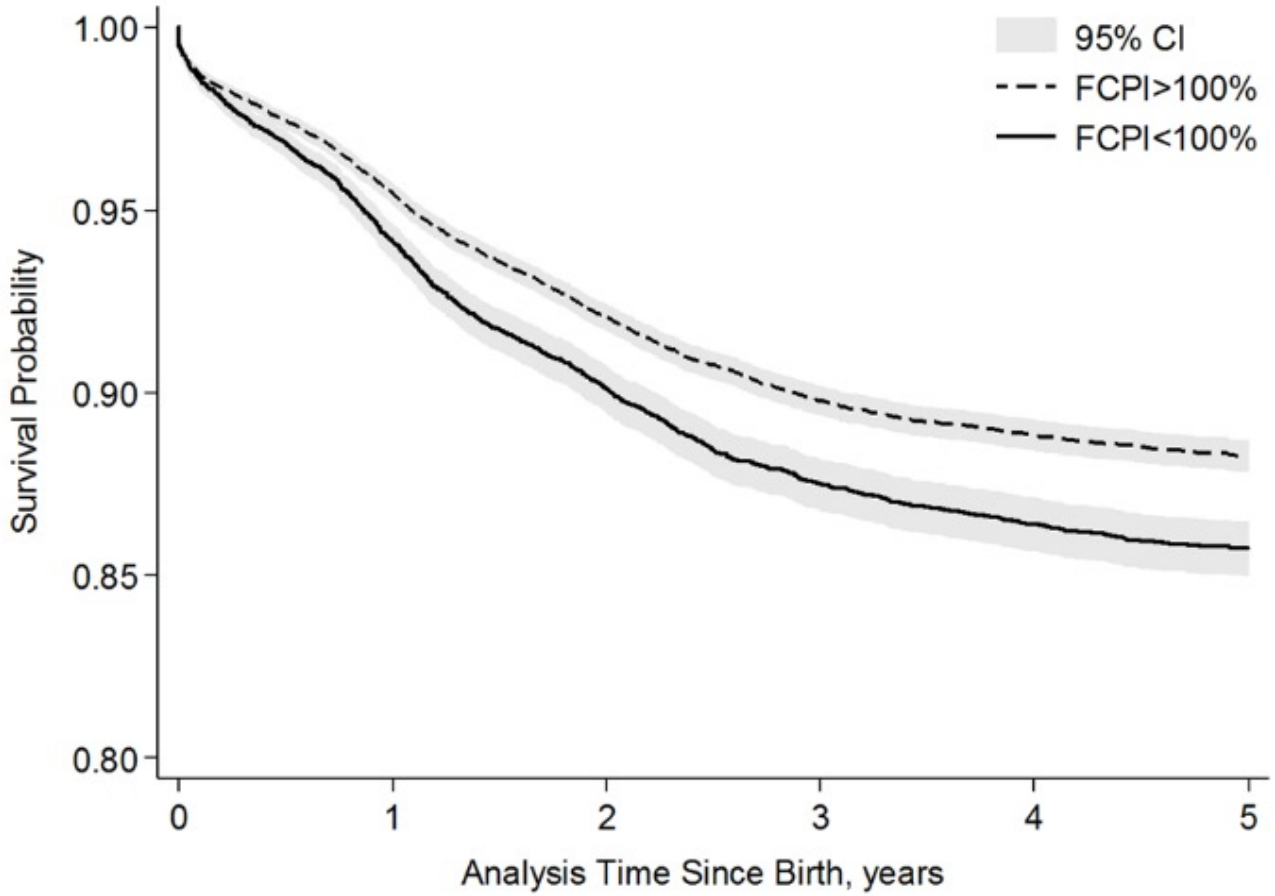
INDEPTH Network
Better Health Information for Better Health Policy

Exposure – response function

Years: 21
Children: 44,614
Deaths: 4,535

Hazard ratio associated with FCPI in the year of birth:

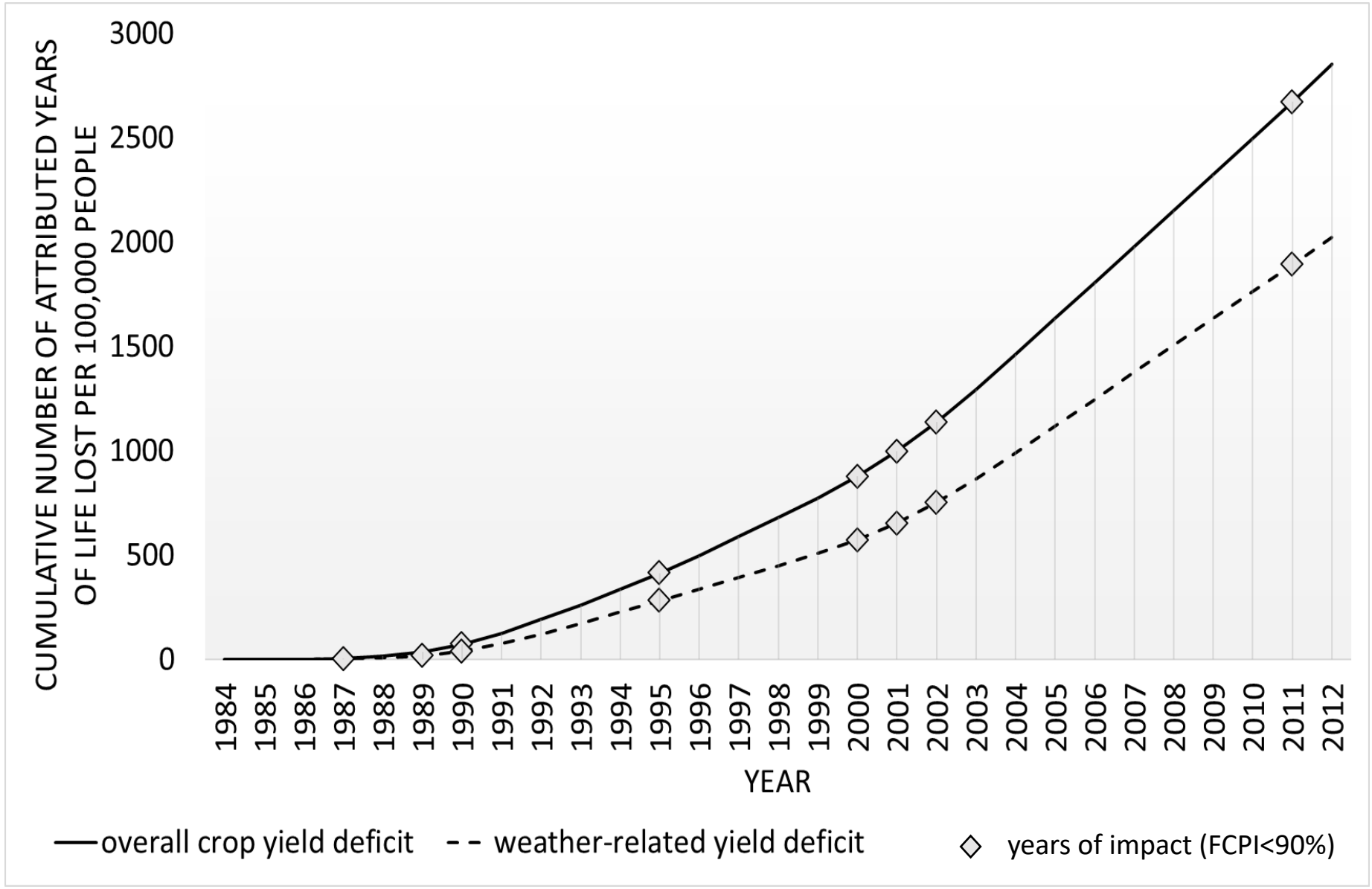
- Δ90-10p: 1.11 (95% CI: 1.02, 1.20)



<u>Adjustments for confounding</u>
Individual: sex, season of birth, ethnicity, religion, mother's and father's ability to read
Household: non-agricultural occupation, wealth index
Village: semi-rural *vs* rural residence, village infrastructural characteristics
Other: a linear term for time trend (year), existence of an undernutrition treatment programme, *heat stress index, weather suitability for malaria*

Belesova, K., Gasparrini, A., Sie, A., Sauerborn, R., Wilkinson, P. 2017. Annual Crop Yield Variation, Child Survival and Nutrition among Subsistence Farmers in Burkina Faso. *American Journal of Epidemiology* kwx241: 15-17.

Cumulative years of life lost attributed to FCPI<90%



* YLL during 1984-2012

Need for intervention

Over the 8 years with FCPI<90% in the period of 1984–2012:

	Period average		**Worst affected year** (2000, FCPI=65%)	
	Overall crop deficit	Weather-related crop deficit	Overall crop deficit	Weather-related crop deficit
Mean deficit in food crop harvest				
kcal/adult equivalent/d	178	132	1,073	1,038
Health impact per 100,000 people				
Attributable deaths<5y	7	5	41	39
Attributable YLL*	383	277	2,374	2,279
Costs per person/year**, USD				
Monetized equivalent cost of YLL	5·8	4·4	25·7	24·7
Cost of grain to cover deficit	1·9	1·4	8·0	7·8

* YLL from the expected lifetime

** Estimates provided in 2011 USD at PPP rates

1.5 °C global warming

Projected impact for an average year under weather patterns of 2100:

	IPSL-CM5A-LR		MIROC5	
Impact per 100,000 people	**2015**	**2100**	**2015**	**2100**
Child <5 y deaths	7	10	3	6
Attributable YLL	438	667	183	374

*Based on deficits in years with FCPI<90% averaged across all years of the period 1984–2012

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Conclusions

- ✓ Appreciable current impact of low yield on child mortality
- ✓ Value in considering response strategies, based on cost estimates
- ✓ Impact largely related to weather effects on crop yields
- ✓ Weather conditions <1.5°C --> doubling of health impact
- ✓ In the short term, adaptation
- ✓ In the long term, mitigation

Further developments

- ✓ Downscaled regional-local backcasting/forecasting of yield changes
- ✓ Cumulative exposure-response functions
- ✓ Projections for multiple RCP and SSP combinations and larger ensembles of climate models
- ✓ Expanding similar analyses across other HDSS sites
- ✓ Developing solutions, e.g., early warning systems

Thank you!

kristine.belesova@lshtm.ac.uk
@kbelesova

Confounders

- **Individual**:
  - **Time invariant:** sex, season of birth, ethnicity, religion, mother's and father's ability to read
- **Household**:
  - **Time invariant:** non-agricultural occupation, wealth index
- **Village**:
  - **Time invariant:** semi-rural (Nouna town) *vs* rural residence (villages), indicators of village infrastructural characteristics (presence of a market, health care facility, drilled water wells, and quality of road connection)
- **Scale to be defined:**
  - **Time variant:** direct weather effects
    - Heat stress index (Bunker et al, 2017): annual sum of degree days with Tmax>35 C
    - Infectious disease risk indices (weather suitability for malaria: Yé et al, 2007):
      - annual sum of monthly rainfall in excess of 100 mm
      - annual sum of days when running average Tmean (over 30 days) falls between 24 and 30 C
- **Other**:
  - **Time variant:** a linear term for time trend (year), a binary indicator of the existence of an undernutrition treatment programme