

# Modelling a climate-related causal story on the emergence of the Darfur War in Sudan

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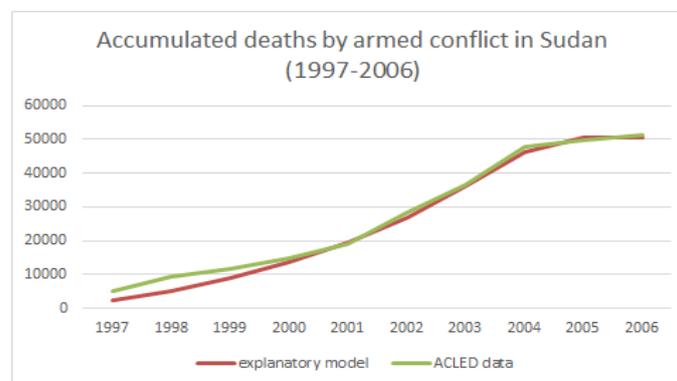
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## Reproduction of a UN causal story

The Darfur conflict, in Sudan, has been considered by the United Nations (Ban, 2007) as the first modern climate conflict in the world. A decline in precipitation, accompanied by changes in land use patterns, growing desertification and both human and livestock population growth were considered by the UN as causes of this conflict (UNEP, 2007). The UN has revealed, therefore, a bio-economic view of a problematic behaviour manifest in the emergence of the deadly Darfur war. One of the motivations for this study was to verify whether it is possible to reproduce, in dynamic terms, the rationale portrayed by the post-conflict report which was a landmark in the history of global climate change (UNEP, 2007). Does that logic sustain itself when modelled in dynamic terms? Could such a modelling exercise contribute to a broader understanding of the emergence of the deadly Darfur conflict, as well as other conflicts with similar dynamics in Sudan since the late 1990s? Would it have been possible to mitigate the emergence of conflict by intervening in this complex situation? Is there potential for replication of this modelling effort in other territories to generate the same type of insights before conflicts emerge?

Our effort to reproduce UNEP (2007) mental model in dynamic terms has resulted in a reproduction of the reference mode until the official end of the conflict, showing S-shaped growth on the death toll, as also shown in the reference mode (ACLED, 2017).



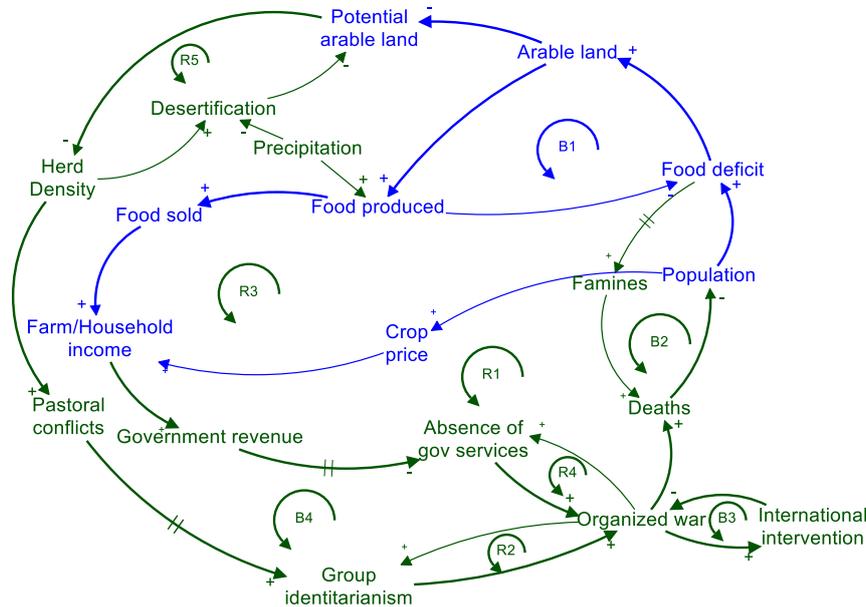
## Model

The model structure was built from Gerber's (2016) bio-economic model, which firstly described the variables in blue on the diagram below, allowing the elicitation of B1, B2 and R3. The main formulations were extracted from literature: UNEP (2017) and Welzer (2012) explain R2, R5, B3 and B4. Miguel (2017) inspired the formulations on R1 and R4.

Datasets for all variables were obtained from international organizations (ACLED, 2017; FAO, 2017; UNDP, 2006; UNEP, 2007; UNICEF, 2017; WHO, 2017; World Bank, 2017a, 2017b and 2017c).

Structure confirmation tests have been conducted with specialists from different departments within the United Nations and one community leader based in Sudan. The specialists recognized

the overall validity of the model structure as a description of the original rationale by UNEP (2007) but claimed for future modelling efforts in three different directions: political motivations for conflicts, international political interplay and historical roots of ethnic divides.



Loop dominance analysis indicated that the action of R2 triggered organized conflict in Sudan, which was allowed by poor outreach of government services. R5 has always been active, building up the conditions for conflict, as an invisible threat that could be occurring in other territories throughout the region. The conflict only fades away with international intervention (B3).

Parameter sensitivity analysis led us to identify key parameters for policy interventions (‘Time for international community to perceive war’ and ‘Annual growth in herd size’) and inspired the choice of policy alternatives to be simulated on the model: nationwide training for herd owners, nationwide land zoning, nationwide promotion of family planning, faster deployment of foreign peacekeeping forces.

According to simulation results, training for herd owners, so that they would not need to expand their herds when facing productivity challenges, would have been the most effective policy, as it could have avoided almost 90% of the war-related deaths. However, family planning could be considered more sustainable as the future challenges for the country when it comes to climate conflicts, malnutrition and famines would be relatively smaller. Lack of investment capacity, lack of human capital and political instability could undermine both policies. The two policies would also face important cultural resistance from the traditional populations, a theme for future studies.

## Conclusions

The first conclusion of this study is that the UN rationale is, indeed, reproduceable and dynamic terms and provides relevant contributions to a broader understanding of the emergence of modern climate war, its causes and mitigation alternatives. There is no single factor or cause that can explain it. Social, economic and environmental aspects need to be taken into consideration, and the role of integrative disciplines, such as system dynamics, is therefore fundamental. Trying to understand the values and assumptions behind the actions of global organizations might be a rewarding experience that may allow us to see beyond shallow power discourses.

As Welzer (2012) argues, the worst consequences of climate change, like climate conflict, are not equally distributed. System dynamics might be an important method to assess those risks, not only for its simulation attributes, but mainly due to its capacity to generate systemic awareness.

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