An opponent evaluation of Alpo Mpande Kapuka´s PhD thesis

Social-ecological aspects of climate change impacts and adaptation in southern Africa

Faculty of Forestry and Wood Sciences, Department of Forestry Technologies and Construction of the Czech University of Life Sciences, Prague

The PhD candidate submitted a very topical dissertation work – despite the ongoing climate change seems to be the most carefully examined issue of our time, understanding the human causes and, in particular, impacts on human wellbeing has still been an important research area. This topic is particularly relevant in southern Africa, a region with the vast majority of the local rural communities depending on forest resources (services, products, incomes). And despite southern Africa is vulnerable to climate change's effects, the impacts of climate change on the socio-economic benefits of the forests have not been fully addressed from a research perspective to date. This dissertation offers insight into climate change's effects on ecosystems and humans.

The thesis uses a modern and preferable format – a collection of published articles. The thesis' objectives were addressed through four original studies published in scientific journals with impact factors (IF). The studies aligned with the topic of the thesis, focusing on various aspects of climate change impacts and adaptation in southern Africa.

Identification of knowledge gaps in current understanding of climate change impact and adaptation options in Sub-Saharan Africa were addressed in two research papers:

- Kapuka, A., Hlásny, T., Helmschrot, J., 2022. Climate change research in southern Africa in recent two decades: progress, needs, and policy implications. Reg Environ Change 22, 1–16. (an analysis of trends and patterns in climate change research in Sub-Saharan Africa)
- Kapuka, A., Hlásny, T., 2021. Climate change impacts on ecosystems and adaptation options in nine countries in southern Africa: What do we know? Ecosphere 12, e03860. (research into knowledge gaps in climate change impacts on ecosystems, species, and populations and adaptation options in nine countries in southern Africa).

Climate change impact on trees species distribution and ecosystem services provision in Sub-Saharan Africa were addressed in the following study:

- Kapuka, A., Dobor, L., Hlásny, T., 2022. Climate change threatens the distribution of major woody species and ecosystem services provision in southern Africa. Sci Total Environ 850, 158006.

Patterns of socio-ecological vulnerability in Namibia were addressed in the following study:

- Kapuka, A., Hlásny, T., 2020. Social Vulnerability to Natural Hazards in Namibia: A District-Based Analysis. Sustainability 12, 4910.

The PhD candidate is always the first author, and his contribution to the work is thus significant. Also, the journals represent a relevant choice of scientific channels to reach adequate impact. The above four publications are complemented by two other research papers published during the candidate´s study:

- Nikodemus, A., Abdollahnejad, A., Kapuka A., Panagiotidis, D., Hájek, M., 2023. Socio-economic benefits of Colophospermum mopane in a changing climate in northern Namibia. Forests 14(2), 290

- Phiri, J., Malec, K., Kapuka, A, Maitah, M., Appiah-Kubi, SNK., Gebeltová, Z., Bowa, M., Maitah, K., 2021. Impact of Agriculture and Energy on CO2 Emissions in Zambia. Energies 14(24):8339.

Also, these two papers deal with the dissertation topic and analyze climate change issues from the impact (first paper) and the pressure perspectives.

Since all the papers underwent a rigorous review process, it is not necessary to review them again. Instead, it is more relevant to check up how the thesis´s conclusions (i) answer the main research question "How different social-ecological systems are influenced by climate change in southern Africa and how the societies respond to these challenges?" and (ii) correspond with the main objectives, which are the following:

1. understand the current state of knowledge on various aspects of climate change in southern Africa
2. assess projected climatic vulnerability of major woody species in southern Africa and risk for the provisions of main ecosystem services
3. evaluate the patterns of vulnerability of the human societies to natural hazards in Namibia as a case study.

The candidate confirmed an ability to use a great variety of analytical skills – he applied modeling, statistical analyses, policy analyses, indicator-based assessment etc. The papers verified some already known facts (lack of regional climate change research and education transformation in southern Africa etc.) as well as brought important new information (distinct spatial patterns of vulnerabilities to both ecosystems and human populations etc.) – thus, the results of this thesis have important implications for practice and they will hopefully be used by national and regional managers, policymakers, funding organizations etc.

A couple of specific questions:

1. In the paper dealing with risk to distribution of major woody species and ecosystem services, you selected 8 species for the analysis. All the selection criteria were relevant but the territorial criterion was missing – what percentage of the total woody area is covered by these 8 tree species? (e.g. in the CR, only about 6 species account for 90 % of the forested area).

2. The vulnerability of the Namibian population was evaluated based on the interaction of 2 indices - Social Vulnerability Index (SVI) and the hazard index. An important issue for composite indicator is always the variables/sub-indicators selection and their weighting.

    - In terms of the SVI, you pre-selected 29 indicators (variables) characterizing social, economic, and demographic conditions. Then, you narrowed the long list to the final set of 12 indicators. Similarly, you selected 9 indicators for the natural hazards – what was the selection procedure? Ideally, you would create the two concepts (socioeconomic system and natural system), and then you would operationalize them into indicators. Here, it sounds more as a data-driven approach (looking into available data first), which is legitimate in some cases.

    - A composite indicator of natural hazards – it comprises 9 variables/indicators combined into 3 components (hazard types – floods, drought, fire). What was the procedure for

setting weights to the variables (e.g. why is human mortality less important than livestock deaths?).

Final evaluation: Mr. **Alpo Mpande Kapuka** has proven independent and innovative thinking, fully meeting the criteria for the doctoral thesis. His work "Social-ecological aspects of climate change impacts and adaptation in southern Africa" is an appropriate piece of scientific work in the field of forestry, therefore I fully recommend it for defense.

Assoc. Prof. Tomas Hak, PhD.
Charles University
Praha

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