An Integrated Pathway of Production Systems Modelling Analysis in Sub-Saharan Africa

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Introduction

Agriculture is certainly the most vulnerable sector in Sub-Saharan Africa (SSA) (Roudier et al., 2011). Crop yields are highly dependent in SSA on climate fluctuations, as agriculture is mostly rain fed (96% of all agricultural land, World Bank, 2008). A rise in food demands of about 70% is expected globally by 2050 with largest increase rates in Sub-Saharan Africa. On the other hand, Sub-Saharan Africa remains the region with the lowest crop productivity per hectare (highest yield gap) and lowest adaptation capacity to the expected climatic changes. A comprehensive and detailed analysis of the production systems in each country at the national level is resource and data limited. However, emerging issues like closing yield gaps or impacts of climate change could be addressed via model based, spatially explicit scenario analysis of national production system, estimating the impact of crop production systems intensification on the national food production. One major output would be the identification of potential hotspots of vulnerability to climate change or of most promising areas for investment into intensified crop production. Due to the fact, that a national assessment of the food production systems may require a high level of generalization, which would not be able to account for the specificity of local or regional production systems, a two-phase approach is proposed. The approach is based on a finer resolution analysis of local/regional production systems using cropping system/agroforestry system models combined with farm scale models to represent locally relevant bio-physical and bio-economic drivers. Then the results of the first phase analysis will be integrated into national food system models taking into account economic and physical equilibrium of demand and supply at the national scale. A possible pathway for such two-phase analysis is presented in **Figure 1**, showing a possible feedback to the supply and demand module of the nation-wide model integration chain.

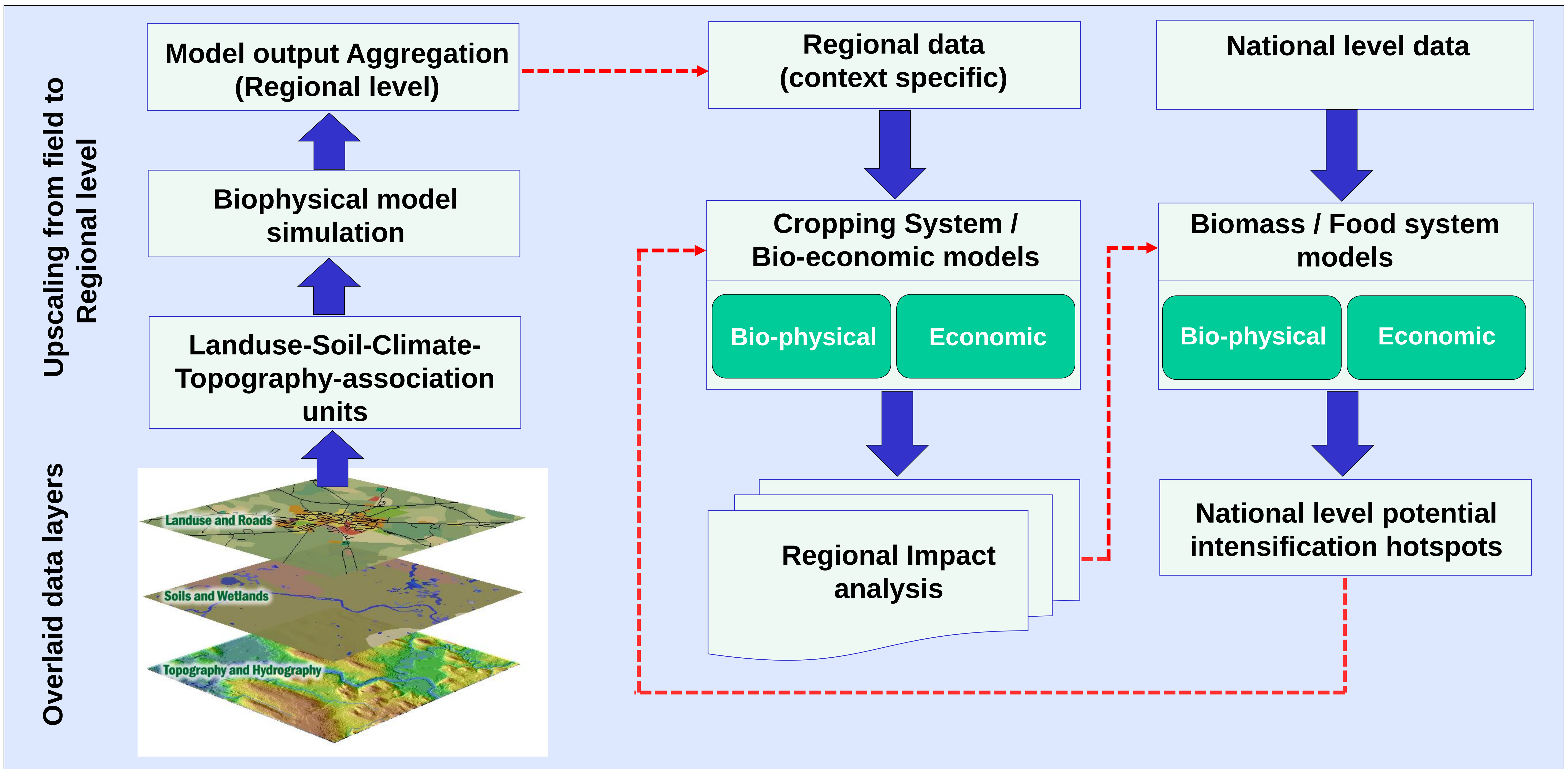

Figure 1: Schematic presentation of a two-way approach of production systems analysis

In a biophysical analysis at the level of landscape units, generalization from the production systems as analyzed above, and integration of the information about percentage of areas used by a crop, soil typologies, topography, climate and cropping intensity (population density could also be used as a proxy for cropping intensity but only after validation), would produce multiple subgrid - scale simulation results per unit area. At the regional scale, this would not be uselful only to the bio-economic analysis to explore different production systems, but would also create a key input to the development of a modelling layer to build a link between simulation and statistics. The production constraints due to prices can be successfully accounted for via the linking of bio-physical and economic models at the national level. In fact, prices are marginally context specific, hence not requiring a detailed, context specific, layer of information. Structural constraints instead are context specific, and must be considered in the regional analysis outlined above. However, it stands exclusive in the limited time horizon analysis. Intensification of production systems may require additional resources with respect to current systems and the resources may be subject to multiple demands from various sectors. The typical example could be labour, assets, and fuel which may be increasingly unavailable for agricultural production. Consequently, the development of intensification strategies for most promising hotspots requires implementing additional constraints on the input side of the economic models. The demand for (natural) resources from more intensive production system can be itself an input to the regional scale models of resource use. Another factor in designing the intensification strategies in the agricultural sector is related to changes in land use which can be very dynamic in the developing countries given the non-rigidity in allowing the switching from rural to urban land use or from forest to crop land. This dynamics should be considered at the regional scale analysis.

Conclusion and outlook

Given the multiplicity of the goals of analysis related to impact assessment of agricultural production systems and the fast dynamics, one aspect of primary importance is the development of a framework which enables updating the analysis under changes of inputs and also allowing addressing new research questions.

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References

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