



Risks to biodiversity from cocoa suitability shifts under a changing climate

Arnell, A.P., Sassen, M., Hill, S.J., van-Soesbergen, A.J.

UN Environment Programme World Conservation Monitoring Centre

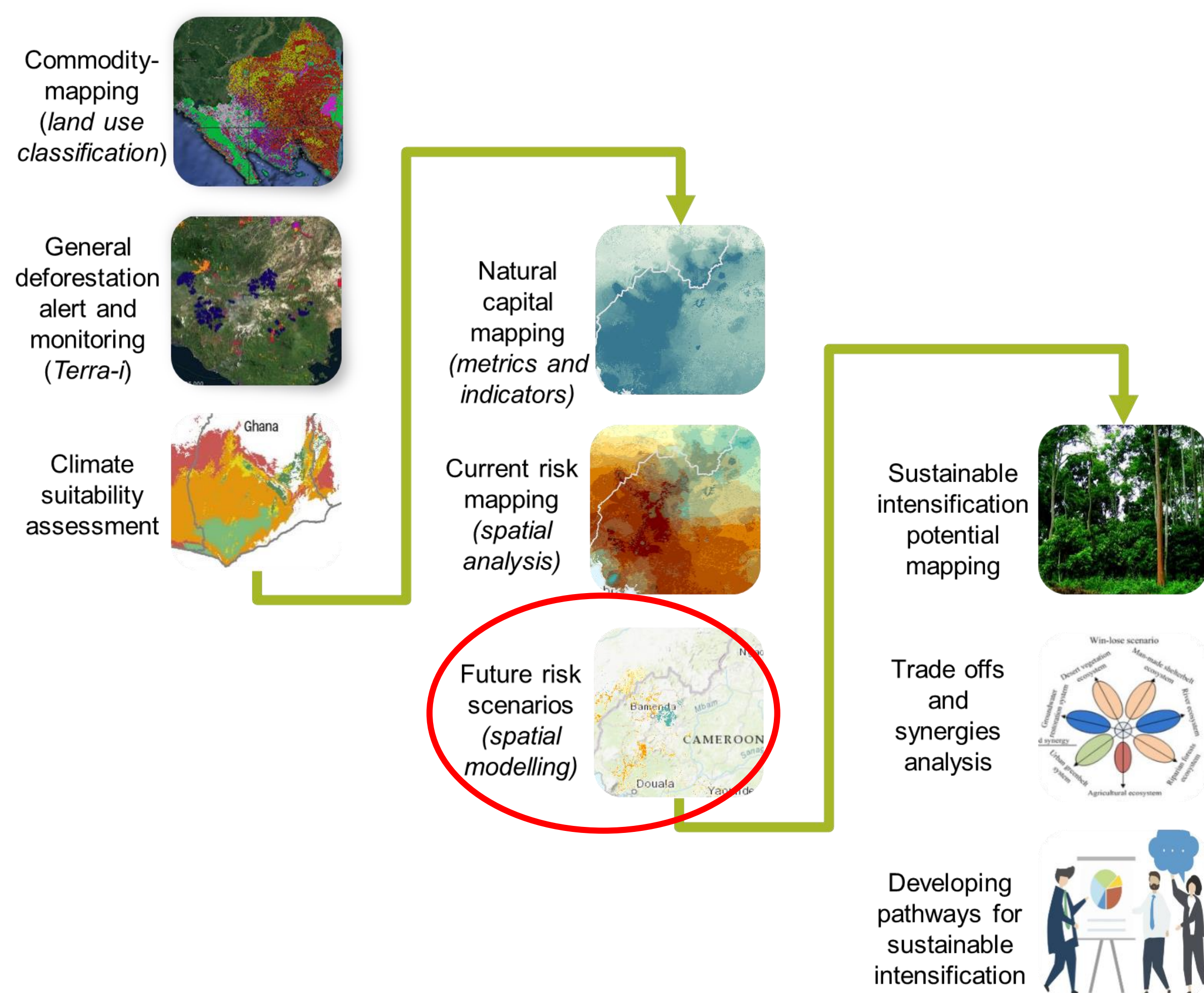
Introduction

Climate change threatens future cocoa production and may lead to shifts in cocoa growing areas. Cocoa production itself contributes to climate change by being a major driver of deforestation.

The cocoa sector, national governments and the international community are concerned about reduced cocoa productivity, loss of livelihoods and increased deforestation and biodiversity loss. Increasingly the private sector and governments are committing to zero-deforestation from agriculture.

Understanding areas that remain or become high risk for biodiversity under future climate change can help inform options for climate smart sustainable intensification and more effective land use planning.

The work presented here is part of a series of steps undertaken during the project, as set out below:



In this step (circled in red above), we create vulnerability and opportunity maps for biodiversity under future climate change projections affecting cocoa suitability areas, in the West African cocoa zone.

Materials and Methods

We follow the following two steps:

1. Identify “risk areas” which are currently important for biodiversity.
2. Separate these areas into regional cocoa adaptation planning zones, based on current and future suitability for cocoa production. The adaptation zones are described in Schroth *et al.*, (2017) and based on climate suitability modelling by Schroth *et al.*, (2016):

- 1) **Intensification and Expansion Zone** - cocoa suitability remains at medium/high levels in 2050.
- 2) **Diversification Zone** - cocoa suitability declines from medium/high to medium/low levels by 2050
- 3) **Conversion Zone** - cocoa suitability declines from medium/low to very low suitability by 2050

Biodiversity importance is based on rarity-weighted richness (weighted endemism) for all amphibians, mammals, birds, reptiles as well as a representative set of plants. Species range data from IUCN Red List (2019), were refined by a habitat map based primarily on Copernicus Land Cover (Buchhorn *et al.* 2019) and elevation (Jung *et al.*, *in prep.*). Refined ranges were then aggregated from 1km to 10km resolution.

Caveats:

- Forest areas with a high potential suitability for cocoa are assumed to have high risk of deforestation and a reduction in habitat for forest biodiversity.
- As described in Schroth *et al.*, (2017), in reality the adaptation zones have no set boundaries and gradually merge into each other. Thus we mapped them only provide an indicative example as to where different risks may be present for biodiversity due to changes in cocoa systems.

Results and Discussion

- Figure 1 shows areas of high biodiversity importance (in red) that are projected to have continued ongoing pressure from cocoa production to 2050. They may impact biodiversity from expansion into forest areas, or intensification of existing cocoa agroforestry. They occur primarily in Cameroon and patches of remaining forest in Ghana and Cote d’Ivoire.
- Figure 2 shows current high risk areas to biodiversity (in red) that in future should be at lower risk from ongoing cocoa production. However, any diversification to other crops (except perhaps if other agroforestry systems) could provide a novel risk to biodiversity. These risk areas occur in scattered patches in South West Cameroon.
- Figure 3 shows areas of high biodiversity (in red) that currently are at low risk from cocoa production. Although, as the risk of pressure from cocoa is projected to decline further, the climatic changes may lead to new pressures from conversion to other land uses that may now become suitable (as with the diversification zone). These risk areas occur predominately in Liberia and Cameroon.

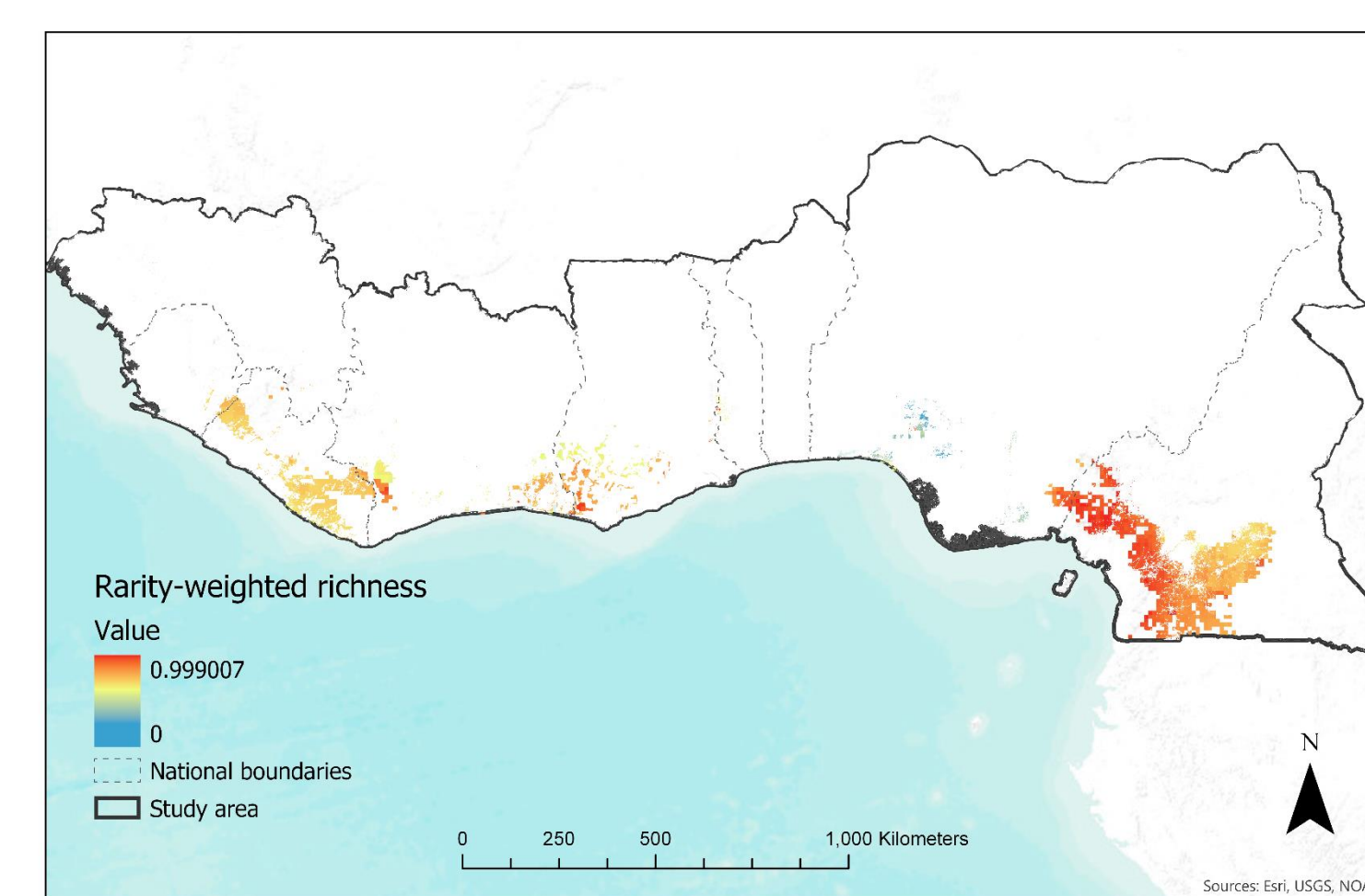


Figure 1: Biodiversity importance in forests in the Intensification and Expansion Zone

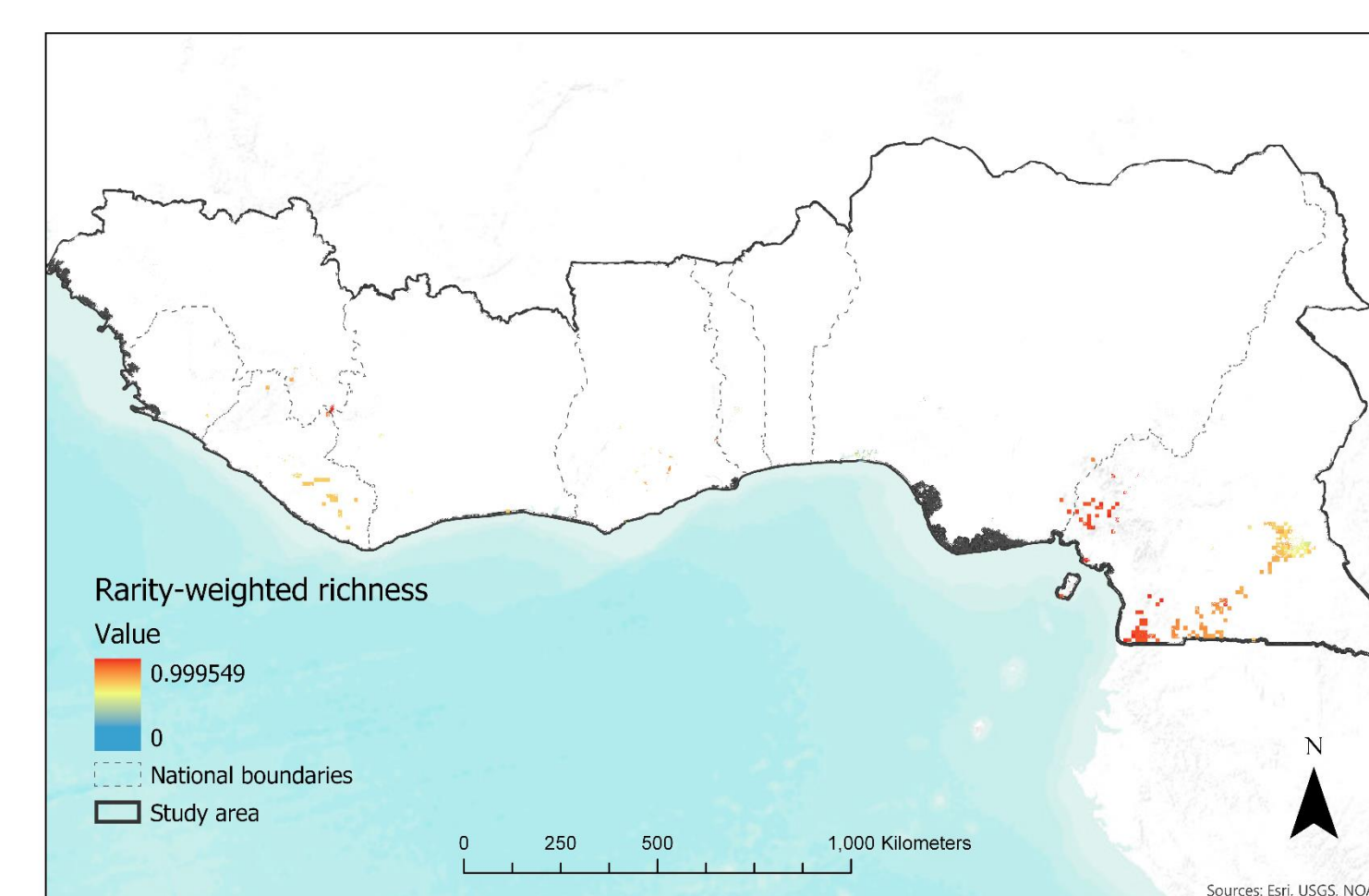


Figure 2: Biodiversity importance in forests in the Diversification Zone.

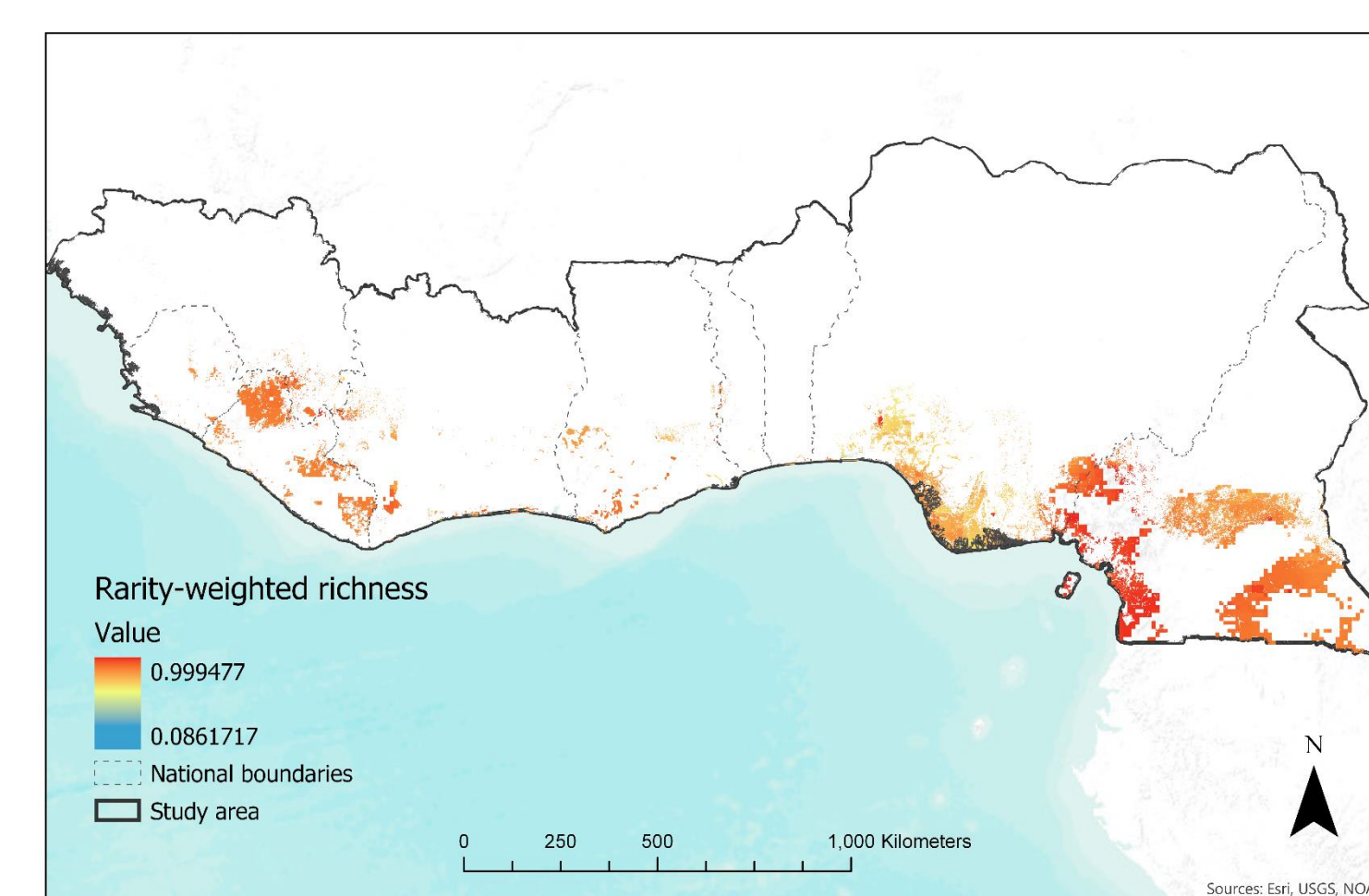


Figure 3: Biodiversity importance in forests in the Conversion Zone

Conclusion

Areas in red in the Expansion and Intensification zone (Figure 1) are at highest overall risk. Future climate change adaptation strategies need to consider biodiversity hotspots such as these, along with impacts from diversification to other crop types.

Acknowledgements

IIASA and IUCN for helping create biodiversity datasets, and CIAT for the cocoa suitability datasets.

References

Buchhorn, M. *et al.* Copernicus Global Land Service: Land Cover 100m: epoch 2015: Globe. *Dataset of the global component of the Copernicus Land Monitoring Service 2019.* DOI [10.5281/zenodo.3243509](https://doi.org/10.5281/zenodo.3243509)

IUCN Red List of Threatened Species (2019) Version 2019.2. <http://www.iucnredlist.org>.

Schroth, G. *et al.* (2017) From site-level to regional adaptation planning for tropical commodities: cocoa in West Africa. *Mitig Adapt Strateg Glob Change* (2017) 22: 903.

Schroth G. *et al.* (2016) Vulnerability to climate change of cocoa in West Africa: Patterns, opportunities and limits to adaptation. *Science of the Total Environment* 556:231-241.