University of Abomey-Calavi

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Faculty of Agricultural Sciences

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BID-AF2015-0065-NAC PROJECT

"Capacity building and biodiversity data mobilization to address health and food security priorities in Benin (West Africa)"

Report on data use

August 2017

Content

FOREWORDS

We seize this opportunity to thank very much, European Union (EU) who funded this project. We tell our gratitude to the Secretariat of the Global Biodiversity Information Facility (GBIF) and to the team of the program for Biodiversity Information for Development (BID) for their supports and solicitude all along the implementation of the project.

As planned in the project, we used data on agroforestry and medicinal plants to achieve their distribution maps at present and in the future under different scenarios of the Intergovernmental Platform for Climate Change (IPCC). We also try to find out the usefulness of the protected areas of Benin as of today and in the future with respect to the conservation of the target species. Our investigation is still going on and here, we report on the first steps of our findings. Our results will serve as baselines for a forum discussion that will take place during workshops planned in the coming months. The enriched results will be used to inform decision on biodiversity conservation in Benin.

The capacities that enabled GBIF Benin to use GBIF data to achieve the results presented here were developed in the framework of a project funded by JRS Biodiversity Foundation in support of the implementation of the National Biodiversity Information System of Benin. We here acknowledge also the support of JRS Biodiversity Foundation to GBIF Benin.

1-Agroforestry species

1.1-Ecological niche modeling and strategies for the conservation of *Dialium guineense* Willd. (Black velvet) in West Africa

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Extended abstract

Dialium guineense Willd. is a multipurpose species useful in many respects. It is used in agroforestry and is believed to restore soil fertility in fallows. Its leaves are used to cure many diseases such as diarrhea, cough, stomachaches, malaria fever, and the trade of its fruits, firewood, and charcoal is a substantial source of income for rural populations. Despite those high interests of *Dialium guineense* to populations, we don't know much about how its spatial distribution could be impacted by climate change and which strategies to implement for it is sustainable use and conservation. To overcome those challenges, we used MaxEnt to model the ecological niche of *Dialium guineense*, and derived its spatial distribution. We used different decision thresholds to interpret and classify the outputs of MaxEnt. From our main results, we noted that under Africlim rcp 4.5 horizon 2055, the predicted stable areas of the distribution of the species will be about 73% of West Africa (our Landscape of Interest (LOI)) when we considered the threshold of the minimum training presence and will decrease to 12% of our LOI when the threshold of the maximum training sensitivity plus specificity is considered (**figure 1**). Under Africlim 8.5 horizon 2055, the corresponding values we noted for the stable areas of the species are respectively 70% and 8% of the LOI. With respect to our LOI, globally in Benin, *D. guineense* will be less threatened by climate change but, the protected areas of the department of Alibori in the North-East of the country are predicted to be unsuitable for the distribution of *Dialium guineense* whereas the rest of the protected areas of the country are predicted to be partially or totally suitable for the species (**figure 1)**. Among the strategies of the conservation and sustainable use of the species we recommend to grow and introduce it in its favorable areas where it is actually absent or grows at low densities. In order to lighten pressure on the species, it is also important to build capacities for farmers and other users of the species and assist them in growing and planting the species as well as in tending operations to ensure its survival along the successional stages of the vegetation growth.

Key-words: *Dialium guineense*, ecological niche modeling, spatial distribution, biodiversity conservation, Benin, West Africa.

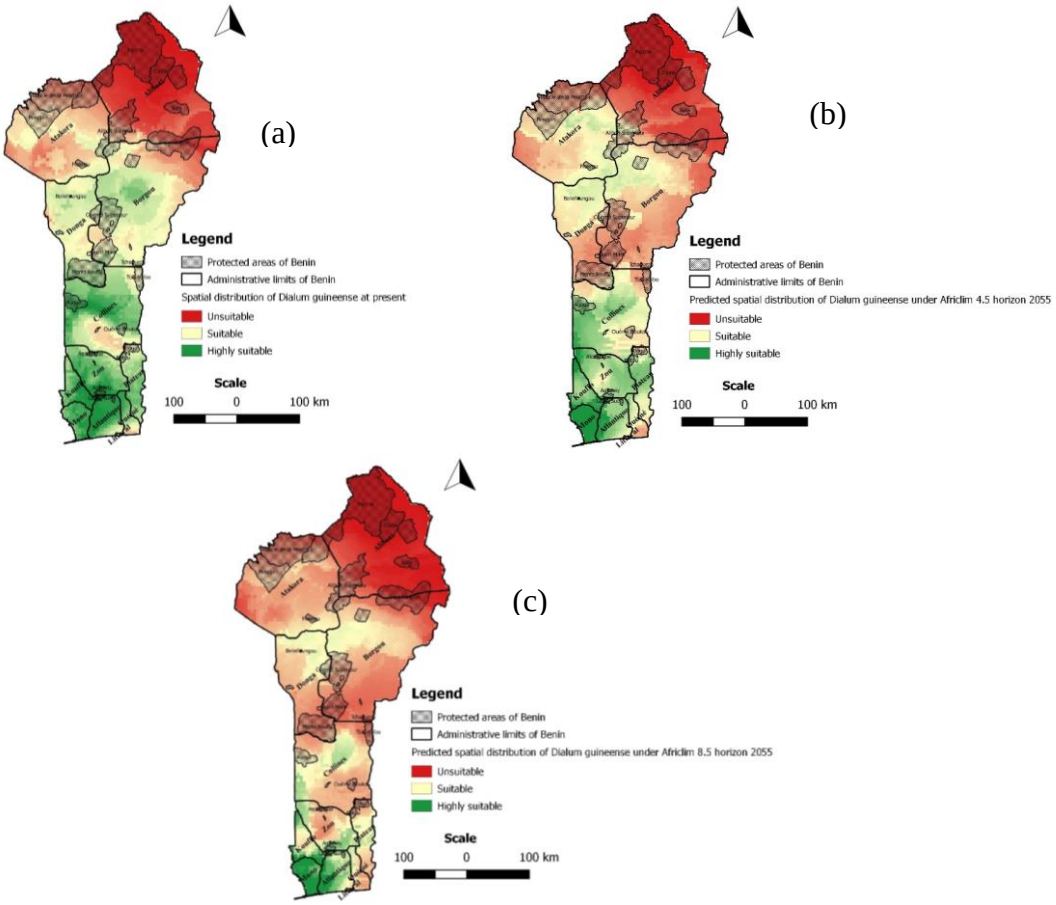

Figure 1: Spatial distribution of *Dialium guineense* in Benin*:* a) at present; b) under Africlim RCP4.5, horizon 2055; c) under Africlim RCP8.5, horizon 2055

1.2-Spatial distribution and strategies for the conservation of *Chrysophyllum albidum* G. Don (white star apple) in Benin

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Extended abstract

Despite its importance to the survival of humanity, biodiversity is threatened by habitat fragmentations, overexploitations, invasive alien species, pollutions, and climate change. On vulnerable continents like Africa, threats of climate change to biodiversity must be tackled very seriously to preserve the important ecosystems services to poor populations. Among the components of forest ecosystems to be preserved, *Chrysophyllum albidum* deserves particular attention because of its multipurpose uses by rural and poor populations. It is an agroforestry species and its fruits contain many vitamins and nutrients indispensable in the equilibrium of the diet of rural populations. It is also source of income for rural populations. The objective of our study is to examine the possible impacts of climate change on the distribution of the species and therefore suggest strategies for its conservation. To achieve that purpose, using GBIF plugin in QGIS, we downloaded from GBIF site (www.gbif.org) 231 occurrence points of the species in West Africa. The software MaxEnt was used to model the ecological niche of the species both at present and in the future under the scenarios RCP4.5 and RCP8.5 at horizon 2055. From our main results, at present the favorable area for the distribution of the species is a coastal band extending from Côte-d'Ivoire to Cameroun. In Benin, apart from the far most department of Alibori in the North of the country and its protected areas, the rest of the country including the remaining protected areas are favorable to the species distribution (**figure 2**). In the future under the two scenarios taken into account, the favorable areas for the distribution of the species will decrease both in the north and in the south of West African countries including Benin. Among the strategies to conserve the species, we suggest its population assessment in its favorable areas and then an introduction of the species where it is absent or at insufficient densities. Tending operations should be carried out to assist the species throughout its developmental stages to sustain its establishment.

Key-words: *Chrysophyllum albidum*, ecological niche modeling, spatial distribution, biodiversity conservation, Benin, West Africa.

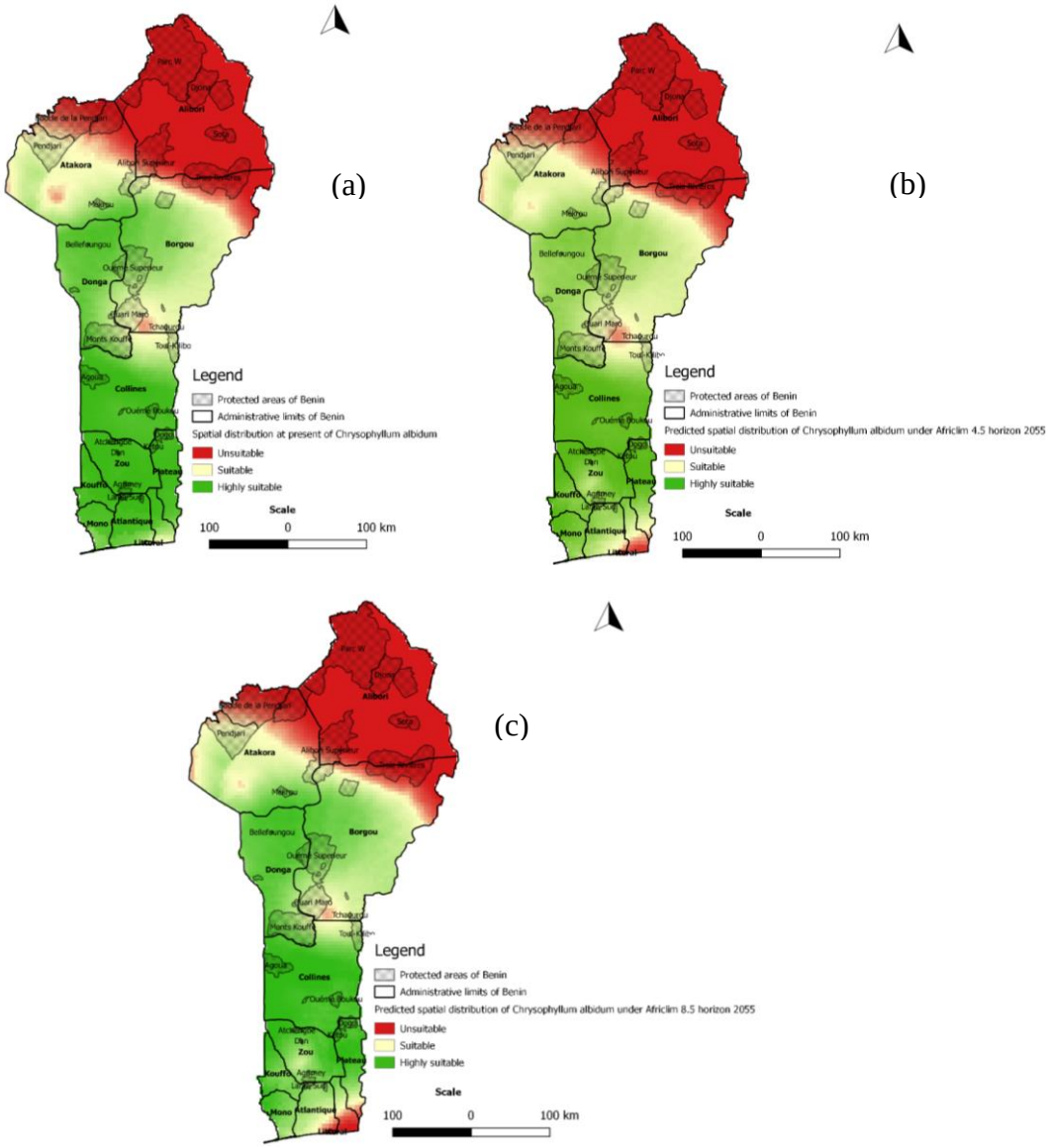

Figure 2: Spatial distribution of *Chrysophyllum albidum* in Benin*:* a) at present; b) under Africlim RCP4.5, horizon 2055; c) under Africlim RCP8.5, horizon 2055

1.3-Modeling the Spatial Distribution of multipurpose forest trees for sustainable conservation and use in the context of Climate Change: Case of *Afzelia Africana* Sm. And *Pterocarpus Erinaceus* Poir. In Benin (West Africa)

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Extended abstract

Despite the important roles played by biodiversity for human survival and ecosystem stability, forest resources are still disappearing at a high rate. Benin, located in the Dahomey gap, is a West African country with low forest resources. With its high percentage of rural populations, its natural resources are under pressure with the risks of extinction of some important tree species. Indeed, the diverse activities led by local population to feed their families and earn their livelihood put some of the tropical trees in vulnerable state. These activities are deforestation, selective logging, intensive agriculture, charcoal production… Destruction of natural habitats has drastically affected many species' distributions, often reducing their historical ranges to a set of small, fragmented populations. Many useful tropical forests are overexploited for multiple purposes due to the high quality of their timbers through selective logging, foliage harvesting, and the use of roots, bark, leaves, and fruits in traditional medicine. Our study on Species Distributions models was implemented by using the method of the Maximum Entrorpy with the program Maxent (version 3.3.3k). We applied this tool to two multiple purposes tropical forests trees that are overexploited: *Afzelia africana* Sm. and *Pterocapus erinaceus* Poir. To evaluate the impact of climate change on species distribution, we used the models of climate projections datasets established by the project CMIP – 5 (Couple Model Inter comparison Project Phase – 5), MIROC5, following the scenarios RPC4.5 and RCP8.5 recently used for some studies on African species in the same study area. We then downloaded all the records from different database sites and essentially on the Global Biodiversity Information Facility (GBIF) site (www.gbif.org; DOI of *P. erinaceus*: http://doi.org/10.15468/dl.6ucyrp ; DOI of *A. africana*: http://doi.org/10.15468/dl.yl7epd). Benin has been considered as study area.

From the main results, we found out that, under the current conditions, the potential suitable area for both species are at least 85% of the area of Benin. With the future predictions, the national parks that some parts were unsuitable presently shows more suitable area under the future predictions. The suitable areas of both species are located mostly in the Sudanian – Guinean zone and the Sudanian zone characterized by environmental conditions corresponding to the ecological preference of *A. africana* and *P. erinaceus* (**figure 3)**. Considering all the models, the only protected areas often affected by the unsuitable areas are the national parks (parks of Pendjari and Park of W). The results of the different projections allowed us to say that

the protected areas network will still stay favorable for the conservations of the species. The high rate of suitable habitat observed ensure that there will be sufficient land for potential future reintroductions or for naturally colonizing populations of the species and some activities of afforestation for these species. With this new threat of climate change on species, protected areas managers must implement some new strategies of conservation and consider the following actions: (1) implementation of long-term species monitoring, (2) improvement of the management and recovery of deforested areas in protected areas and buffer areas to increase resilience; and (3) incorporation of climate change into planning conservation activities.

Key-words: *Afzelia Africana*, *Pterocarpus Erinaceus*, ecological niche modeling, spatial distribution, biodiversity conservation, Benin, West Africa

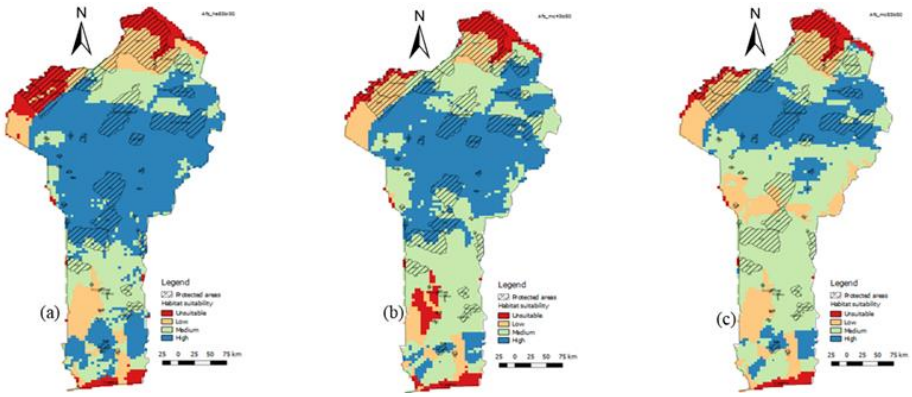

Figure 1: Map showing the suitability area of *A. africana* in Benin: (a) current, (b) MIROC5 RCP4.5, (c) MIROC5 RCP8.5

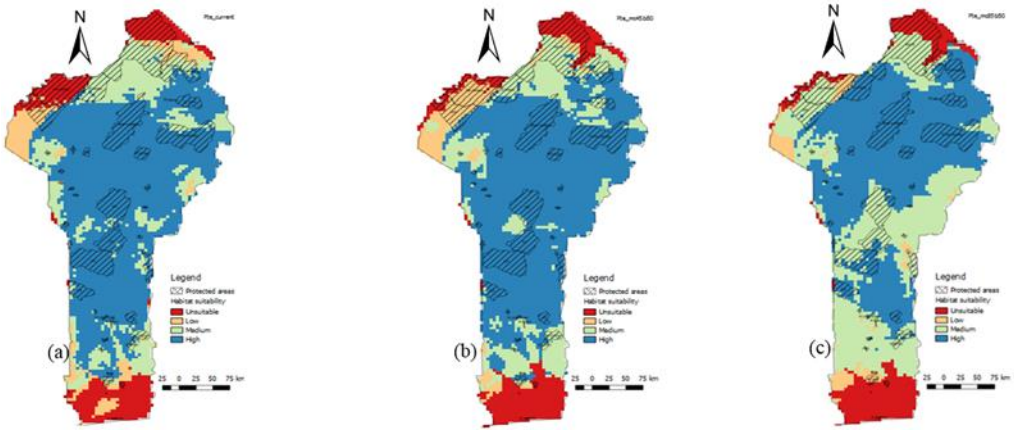

Figure 2: Map showing the suitability area of *P. erinaceus* in Benin: (a) current, (b) MIROC5 RCP4.5, (c) MIROC5 RCP8.5

2-Medicinal plants

2.1-Potential geographical distribution of *Cissus populnea* Guill. & Perr. in Benin (West Africa)

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Extended abstract

This study was carried out in Benin Republic, located between 6°10' and 12°50' N and 1° to 3°40' E in West Africa. In total, 229 occurrence records were downloaded from the Global Biodiversity Information Facility portal. Current (1950–2000) climate data were obtained from WorldClim version 1.4. And future climate data were downloaded from AFRICLIM version 3.0. The projections were modeled under representative concentration pathway (RCP) 4.5 and RCP 8.5 for 2055 time horizons. The Maximum Entropy algorithm was used for the habitat suitability modeling. From our main results, at present, *Cissus populnea* is distributed throughout the whole country (**figure 4**). The future projections showed a strong decrease for suitable areas of the species both for RCP4.5 and RCP8.5 in Sudanian-Guinean climatic zone.

Key-words: *Cissus populnea*, ecological niche modeling, spatial distribution, biodiversity conservation, Benin, West Africa

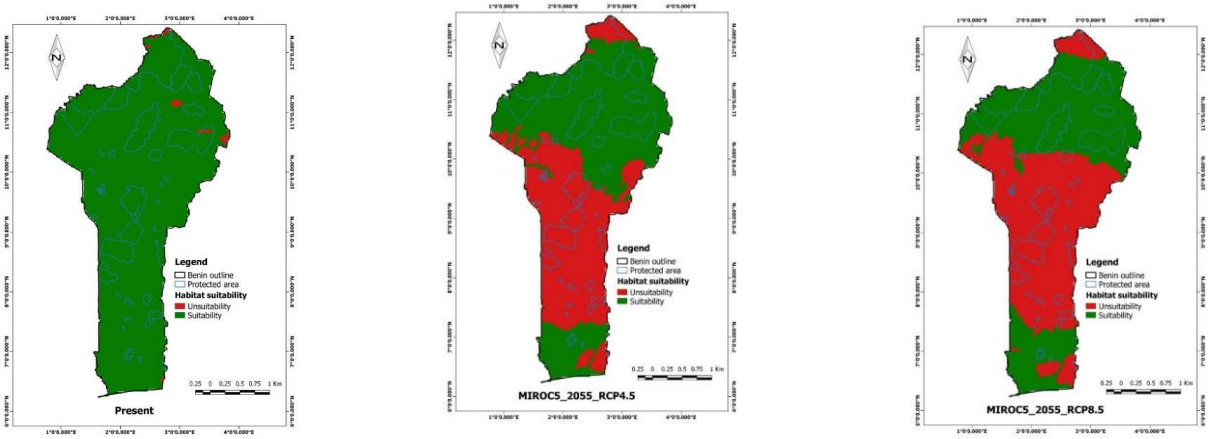

Figure 4: Spatial distribution of *Cissus populnea* in Benin under different scenarios

2.2-How broads are the suitable areas of *Nauclea latifolia* Sm. to support the conservation of the species despites the use of all of its parts.

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Extended abstract

This study aimed to assess the impacts of climate changes on the spatial distribution of *Nauclea latifolia* Sm., one of the most requested medicinal plants of Benin. To this end, we used the ecological niche modelling tools and the Maximum Entropy approach of MaxEnt using occurrence data for the species to identify currently suitable areas, and then make a projection in the future using two scenarios, the RCP 4.5 and the RCP 8.5 at the horizon 2055. Computations helped map the climate changes impacts on the species in the time and in the space. The model of present confirmed the species likelihood to occur in the Benin's entire areas from the south to the north. The most surprising results are that climate changes are in favor of *Nauclea latifolia* Sm. at the point that all suitable areas in current situation will remain so at horizon 2055. The expected climate changes impacts on the species sound good and would decrease significantly the threats on it (**figure 5**). Hence, environmental variables promote the species potential distribution but we do need to control the human pressure on the species. Otherwise, we can have only young individuals in natural environment because of the harvesting of its roots for medical purpose. Its occurrence despite human pressures is due to its facility to proliferate. As the species can be grown anywhere in Benin, we propose that home garden be promoted for roots taking. This will allow the species to develop in natural ecosystems and attend the maturity age, which would be useful in many other ways.

Key-words: *Nauclea latifolia*, ecological niche modeling, spatial distribution, biodiversity conservation, Benin, West Africa

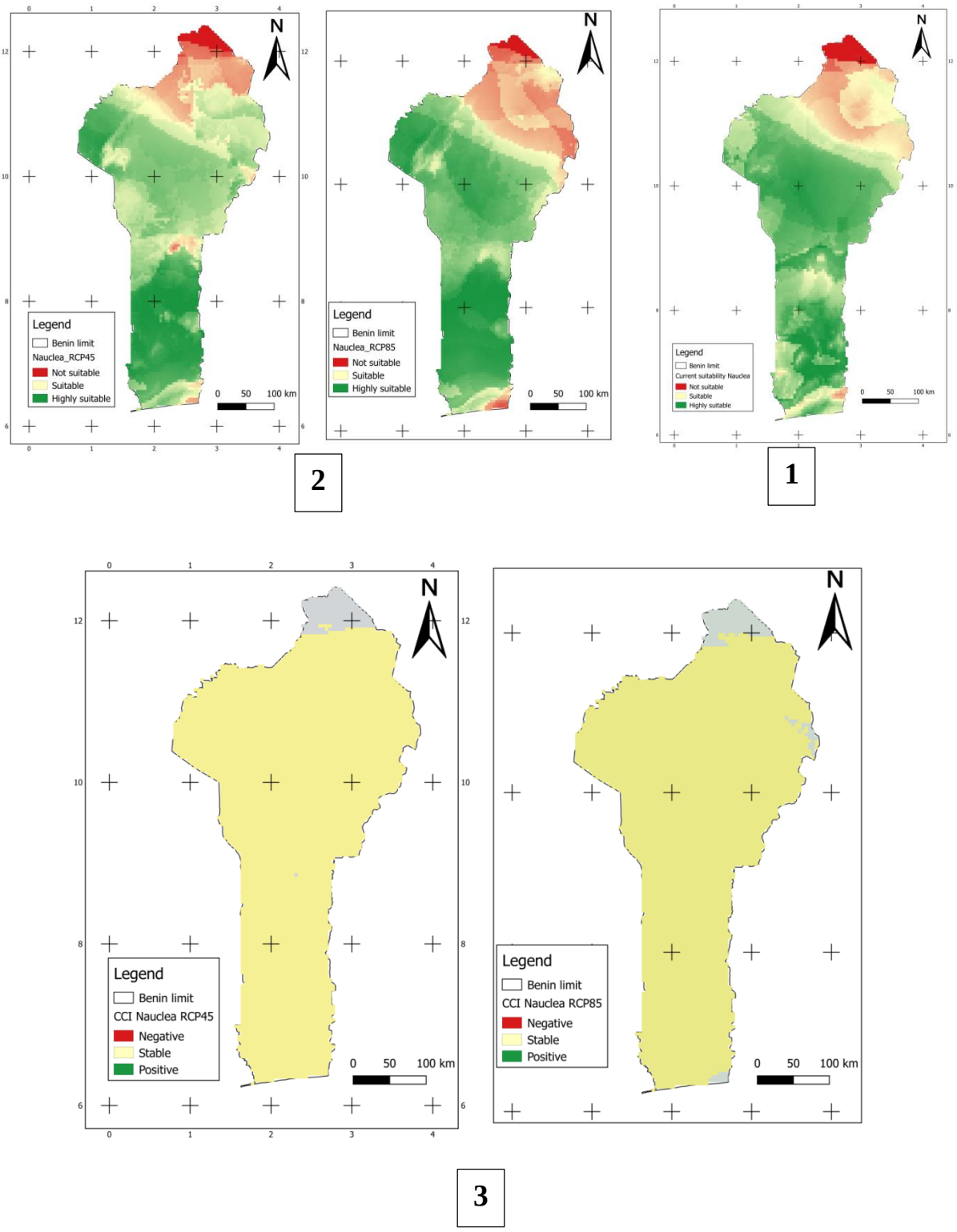

Figure 5: *Nauclea latifolia* suitability areas in the present (1); Suitability areas for *Nauclea latifolia* under Africlim 4.5 and 8.5 at 2055 horizon (2); Climate changes impacts on *Nauclea latifolia* under Africlim 4.5 and 8.5 at 2055 horizon (3)