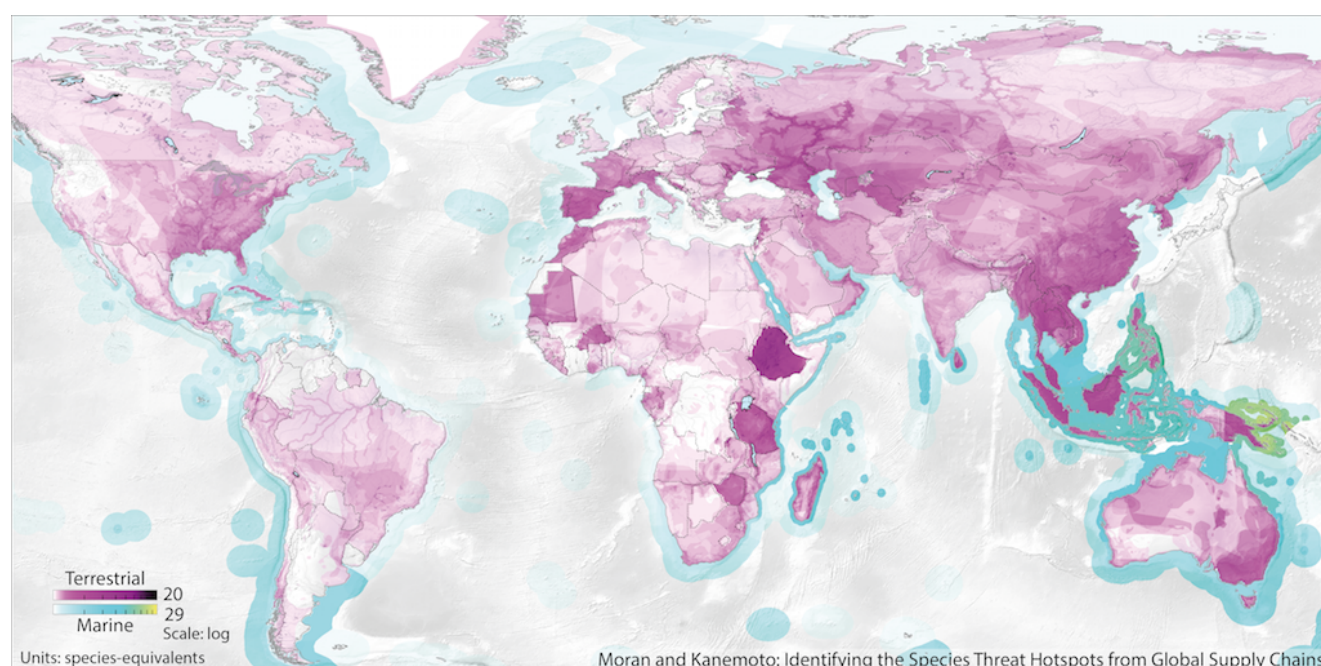


## Mapping the carbon, air pollution, and biodiversity footprints of nations: A GIS + global supply chains

\*Keiichiro Kanemoto<sup>1</sup>, Daniel Moran<sup>2</sup>

1. Shinshu University, 2. Norwegian University of Science and Technology

"Spatial footprinting" is an approach for locating the actual hotspots where impacts driven by consumption occur. Spatial footprinting offers the potential to link any remote sensing or earth observatory GIS data that is tagged to an economic sector to any MRIO-based economic model. We present new method for locating at a subnational level the environmental emissions induced by global supply chains. As the world economy becomes more complex it is increasingly difficult to connect consumers and other downstream users to the origins of their GHG emissions and other impacts. Given the important role of subnational actors in GHG abatement and other environmental protection efforts, it is advantageous to connect consumers to the locations where their purchases are driving environmental pressure. We present spatial footprint results for 187 countries showing the footprint of GHG emissions, air pollution hotspots, and biodiversity threats, and discuss our spatial footprinting methodology.



# The El Niño –La Niña cycle and recent trends in supply and demand of net primary productivity in African drylands

\*Abdulhakim Abdi<sup>1</sup>

1. Department of Physical Geography and Ecosystem Science, Lund University

The human-environment connection in the mostly rural drylands of sub-Saharan Africa forms a complex, interlinked system that provides ecosystem services. This system is susceptible to climatic variability that impacts the supply of its products, and high population growth, which impacts the demand for these products. When plants remove carbon dioxide from the atmosphere through the process of photosynthesis, they use some of this carbon to maintain plant cellular structure. The rest is stored as plant tissue and forms plant biomass. The annual accumulation of this plant biomass is called net primary production (NPP). On an annual basis, NPP supplies the provision of crops, animal feed and pasture. The societal implications of reduced NPP can be severe, possibly leading to crop failure and eventual food insecurity. The trends in NPP supply trends over sub-Saharan Africa 2000 –2013 are significant in 32% of the area (4.7 million km<sup>2</sup>). However, these trends are concentrated in three distinct areas: the western Sahel (2 g C m<sup>-2</sup> yr<sup>-1</sup>), central Africa (30 g C m<sup>-2</sup> yr<sup>-1</sup>) and parts of Zambia, Malawi and Mozambique (-25 g C m<sup>-2</sup> yr<sup>-1</sup>). In contrast, the mean overall trend in NPP demand is 3.5 g C m<sup>-2</sup> yr<sup>-1</sup>, though in urban areas it averages approximately 50 g C m<sup>-2</sup> yr<sup>-1</sup>. The tradeoffs between NPP supply and demand trends (i.e. change in one quantity relative to another) are locally constrained and linked to the prevailing climate, population growth and net migration. The demand-supply balance of NPP is influenced by climate, such as the variability caused by El Niño –Southern Oscillation. The greatest sensitivity to El Niño occurs in Southern Africa. Here, a +1°C shift in the Niño 3.4 index (as a measure of El Niño) causes a mean change in the NPP supply of -6.6 g C m<sup>-2</sup> yr<sup>-1</sup>. Despite the fact that there were more La Niña events than El Niño events during the period of this study, the negative impact of El Niño on Southern Africa is strong enough to tip the balance toward the negative.

Keywords: African Drylands, Net primary production, El Niño - Southern Oscillation

# Spatio-temporal characteristics of water budget due to the paddy field expansion in Naoli River Basin

\*Guoping Lei<sup>1</sup>, Hao Zhou<sup>1</sup>

1. Northeastern University

Since early 1990s, the agricultural structure of Naoli River Basin had been greatly changed with large amount of dry land transformed into paddy field. This resulted in serious water resources insufficiency. We were trying to reveal the water profit and loss situation under the cultivated land resources variation in this river basin, so as to predominate the overall spatial and periodical situation of water budget in Naoli River Basin and provide scientific basis for adjusting the layout of farmland. We analyzed the condition of Naoli River basin by using related model to compute the actual evapotranspiration (ET), and calculated the farmland water needs of the cultivated land in this basin by modeling the rice planting proportion coefficient which could show the cultivated land structure. Also through using the established water profit and loss degree evaluation model, which could reflect the potential shortage of water budget, it structured the order of evaluation standard to analyze the variation of area changes at different levels of moisture shortage. We discussed the water profit and loss situation of cultivated land resources in Naoli River Basin under the situation where the cultivated land was constantly changed in the basin between 1990 and 2014, and modeled future scenarios by using the CA-Markov model. All above analysis used the remote sensing image data, the long-term sequenced meteorological data and the DEM data as its fundamental data resources. Results showed that the changes between the paddy field and the dry land in Naoli River Basin were incredibly violent. The growth rate of cultivated land decreased gradually from 1990 to 2014, and different periods showed different changing characteristics. During the period between 1990 and 2002, the paddy field area increased dramatically, while the dry land increased slightly. From 2002 to 2014, the growth rate of paddy field area showed significantly decreased characteristics and the total dry land area decreased in a certain degree. The changes of the cultivated land's water profit and loss degree were obvious and the spatial distribution differences of the profit and loss index evaluation grades were great. The change magnitude was also not the same in different periods. From 1990 to 2002, the farmland types, which were evaluated by the cultivated land's water profit and loss grades, were dominated by moderate and serious moisture shortage in this river basin, and basically, there were no severe moisture shortage farmland types. In the period between 2002 and 2014, the biggest change happens to the mild moisture shortage types. On the other hand, the severe moisture shortage area decreased slightly. Among them, the proportion of farmland with normal water shortage was the biggest during these two periods. We also concluded that the water deficit of the farmland in this river basin would be further intensified, and the area with the higher grades of MPLD was more centralized, and partial high evaluated grades for the moisture shortage would expand in future. Except for the slight increase of the farmland with mild moisture shortage, the rest four evaluation grades farmland area all kept increasing, and the area of serious moisture shortage evaluation grades increased intensely. These research results can be used as references and consultancies for the farmland irrigation schemes in Naoli River Basin.

Keywords: farmland, moisture budget, simulation, Naoli River Basin

## Urban flood risk and land use change after circle levee in Dhaka downtown

\*Shigeko Haruyama<sup>1</sup>

1. Department of Environmental Science, Graduate School of Bioresources, Mie University

Dhaka Flood Control Project has several stages of land use changes with different social economic levels in this metropolitan area. The circle levee has constructed along the western perimeter of Dhaka and embankment along the eastern perimeter stretching to the Shitalakhya River after the memorial floods attacked by cyclone. The 1988 huge flood was the important epoch of regional planning and river management planning with mitigation, however, the second stage of land use change has been guiding the large floods in 1998, 2004 and 2007 again. Under the rapidly urban sprawls, the changing social structure has been pulling the other resilience of urban floods. The socio-economic data provided the information related to flood inundation risk on the basis of various land cover units. The temporal and spatial land use change has been revealed and was one of driven factors of flood risk with population growth and economic activity. Compared with satellite data and DEM, the inland enclosed circle levee has been transfiguration of surface with settlement and built-up zones in the low lying hazard zones. Also, built up area have been developed and have been showing high flood risk area. Towards to secure city, the land use planning should be desirous of flood mitigation understanding landform feature which is mostly related with flood history.

Keywords: urban flood, mitigation, land use change