A preliminary analysis of the supply and demand of net primary production in the semi-arid Sahel

Abdi, Abdulhakim; Ardö, Jonas; Seaquist, Jonathan; Eklundh, Lars; Tenenbaum, David

2013

Link to publication

Citation for published version (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.
Supply and Demand of Net Primary Production in the Semiarid Sahel

H. Abdi*, J. Ardö, J. Seaquist, L. Eklundh, D. Tenenbaum
Department of Physical Geography and Ecosystem Science, Lund University
Sölvegatan 12, S-223 62 Lund, Sweden

* Corresponding author: hakim.abdi@nateko.lu.se

Introduction

- NPP represents the rate of formation of new plant biomass and is an important component in the global carbon cycle.
- Fluctuations in the supply and demand of NPP drives ecosystem processes and directly impacts human livelihood in terms of providing food, feed, fuel and fiber.
- Semiarid regions in Africa are particularly vulnerable to fluctuations in the supply of, and demand for, NPP due to recurring food crises.

Research Questions

1. What is the present condition of per capita NPP availability in the Sahel?
2. What drives the trend of per capita NPP in the Sahel?
3. Are trends in annual food production visible in annual cropland NPP?

Methodology

Cropland NPP was extracted from MODIS\(^1\) and GLO-PEM\(^4\) using the recent MARS-JRC\(^2\) cropland mask. Then, per capita NPP was derived using decadal population data (1980-2010) from UNEP/GRID\(^5\) and divided by GLO-PEM (1981-2000) and MODIS NPP (2000-2010) data. Primary crop production data was downloaded from FAOSTAT\(^3\).

References

4. UNEP 1987; through UNEP/GRID-GIScience.

Early Results

- There is moderate correlation between MODIS cropland NPP and primary crop production for the eight Sahelian countries (Figures 1 and 3).
- Per capita trends in MODIS cropland NPP and primary crop production seem to be coupled to the extent that both datasets were able to detect the 2002 Sahelian food crisis (Figures 2, 4, and 5).
- Change in per capita NPP between 1980 and 2000 has not been constant across the region (Figure 4) and is speculated to be a function of land use and climate.

Figure 1: A) Mean annual precipitation in continental Africa from 1950-2000. Countries in the region include (1) Burkina Faso (2) Eritrea (3) Mali (4) Mauritania (5) Niger (6) Sudan (7) Senegal, and (8) Chad. B) Contrast between the dry and rain season in West Africa. Photos: NASA

Figure 2: (A) Sahelian precipitation anomalies showing an increase in rainfall in the 1990s, which led to (B) increase in the total NPP anomaly highlighting the dependence on rainfall (C) The Sahelian population increased at an average annual rate of 4.9% a year between 1981 and 2010 and is reflected in (D) the general decreasing trend of the per capita NPP that could indicate the inability of NPP to keep up with the population increase.

Figure 3: Relationship between primary crop production and MODIS NPP between 2000 and 2010 for the eight Sahelian countries that are the focus of this study. Data: FAOSTAT

Figure 4: An overview of the change in per capita NPP to the Sahel between 1980 and 2000 from GLOPEM data. Some areas have increased per capita NPP, for example Burkina Faso, could be attributed to a combination of land rehabilitation efforts and increased rainfall. Other areas, such as Darfur and South Kordofan in Sudan and south-central Mauritania, exhibit decreases in per capita NPP that could be caused by overgrazing and deforestation for fuelwood.

Figure 5: Trends in per capita NPP from MODIS and primary crop production from FAO between 2000-2010 for the eight Sahelian countries. The arrows show shortage in per capita NPP and primary crop production in connection to food crises that are visible in precipitation anomalies (see Figure 2A).

Figure 6: Time series of crop GPP over the Sahel using MODIS data and the MARS-JRC cropland mask. The black and green arrows correspond with the ones in Figure 5 and signify drops in food production.