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Representation of multiple cropping systems in land use data sets

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In a nutshell

For the first time information on the extent and type of multiple cropping systems in sub-Saharan Africa, India and China is combined in a global map which will improve the quantification of crop yields, soil carbon and water fluxes in global agricultural and land use modelling and in food security and climate impact studies.

Motivation

Multiple cropping is a common and widespread management strategy in tropical and subtropical agriculture which allows for crop intensification and lowers the risk of crop failure. The occurrence of multiple cropping systems influences ground coverage, soil erosion, albedo, soil chemical properties, pest infestation, and the carbon sequestration potential.

However, their spatial distribution is unknown in many parts of the world, thus multiple cropping areas are largely neglected or underestimated in global land use data sets and in global agricultural models. As data on the type and extent of different agricultural systems is of crucial importance for e.g. modeling land use and land use change it is important to improve the representation of multiple cropping areas in global land use data sets.

Regional Data Sets

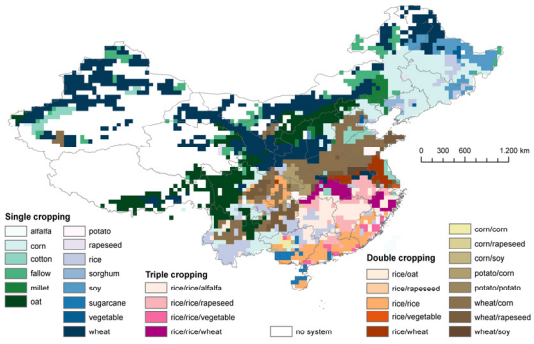


Fig. 3 Major multiple cropping systems in, from top to bottom, China (1990-1996), India (1999-2000), and sub-Saharan Africa countries (2002-2004). All rice rotations in India are irrigated unless specified as rainfed at the end of their name. Multiple cropping systems in Eastern and Southern Africa is available too, but not shown here.

Global Data Sets

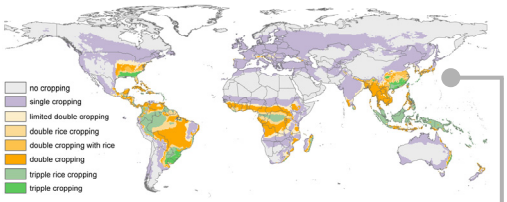


Fig. 1 Potential multiple cropping zones in rainfed agriculture (GAEZ 2000).

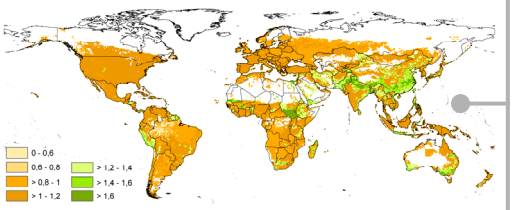


Fig. 2 Maximum cropping intensity in 1998-2002 defined as total harvested area (km² / yr) divided by maximum of the sum of monthly growing areas of all irrigated and rainfed crops (km²) (CI_{max} in Portmann et al. 2010, CI_{NF} in Siebert et al. 2010)

Methods

We combine information of

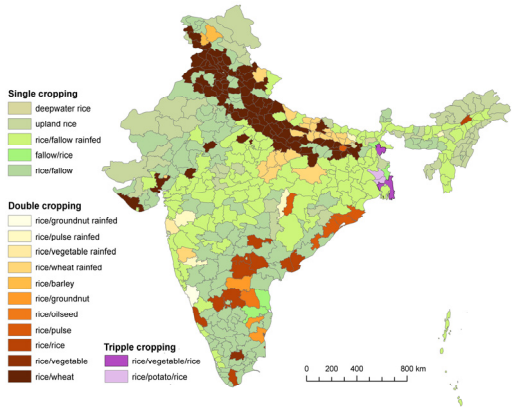
(i) Global data set on potential cropping zones from the Global Agro-Ecological Zones (GAEZ 2000) (**Fig. 1**),

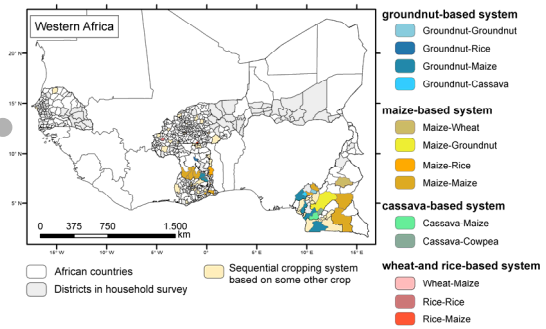
(ii) Cropping intensity from the global land use data set MIRCA2000 (Portmann *et al.*, 2010; Siebert *et al.*, 2010) (**Fig. 2**), and

(iii) Regional data sets on multiple cropping zones which exist for India (Frolking *et al.*, 2006), China (Frolking *et al.*, 2002) and ten countries in Sub-Saharan Africa (Waha *et al.*, 2013) (**Fig. 3**).

We aggregate MIRCA2000 to 30 arc-min resolution and combine the district- and province level data for India and sub-Saharan Africa with raster data by calculating the multiple cropping system's area from an administrative unit in a grid cell as described in Frolking *et al.* (2002).

We then identify grid cells which are potentially suitable for multiple cropping according to GAEZ and which have a cropping intensity of more than 1.05 according to MIRCA2000. From regional data sets we identify the type of multiple cropping systems.

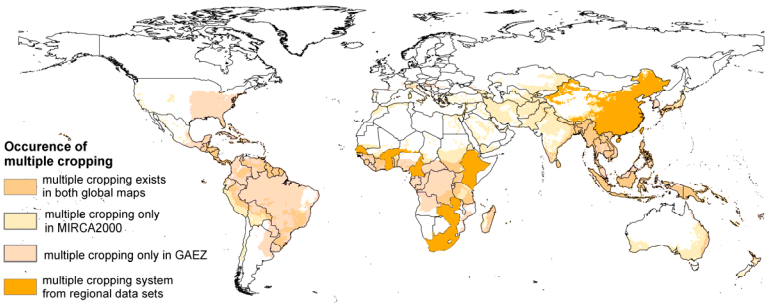




- 21657 grid cells with multiple cropping exist in one of the two global data sets (55% of total cropland).
- Global maps disagree in 15600 grid cells where:

(i) Soil and climatic conditions are suitable for rainfed multiple cropping according to GAEZ mainly in South America and eastern parts of the United States, but cropping intensity is low in MIRCA2000, and

(ii) Cropping intensity is high in MIRCA2000 but no rainfed potential cropping zone exists in e.g. Australia and Middle East.



- Regional data sets provide information on the multiple cropping systems for one third of the grid cells.
- Mainly for South America, sub-Saharan Africa, the United States of America and Australia, we do not have any information on the cropping systems
- Uncertainty from different time periods, handling of fallow land
- Cropping systems like intercropping, non-rice systems in India might not be represented very well

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