German Remote Sensing Data Center (DFD)
Land Surface Dynamics

Remote Sensing Solutions to Assess Land Degradation and to Enhance Smallholder Farming in West Africa

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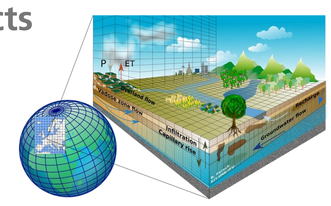
BACKGROUND

Challenges in Sub-Saharan Africa

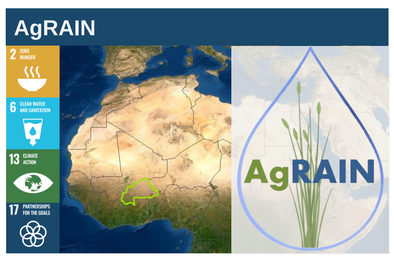
- … Sub-Saharan Africa faces **multiple risks (climatic, social, economic, ecological)** with partly uncertain future developments
- … Projected **population development** from **400** million to **1.2** billion in **2100**
- … Different risks and **different impact of land use** in different agro-ecological zones and under farmers' socio-economic conditions
- … **Limiting yields** and thus the acceptance of certain measures by farmers
- … This generally leads to **agricultural expansion** to satisfy increased demands and compensate degradation
- … **Rising population** as driver for **increase in cropland** and in **livestock**
- … Consequences are **loss in carbon** and **loss in biodiversity**

Research on Mitigation and Adaption in different projects

CONCERT



Mitigation:
- *Greenhouse gas emissions and mitigation options are evaluated*



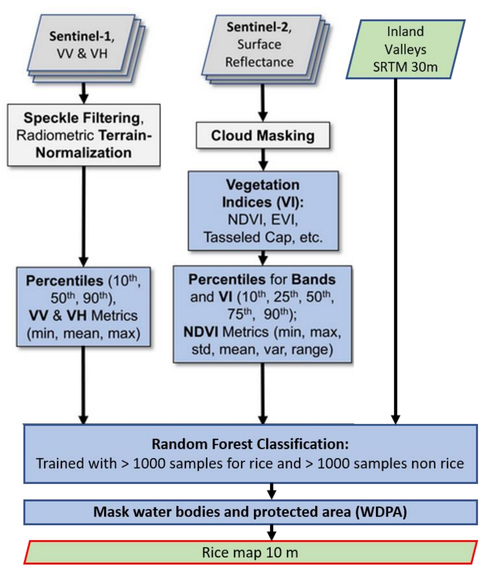
Adaptation:
- *Suitability analysis for rice cultivation using climate and soil data*
- *Assessment of the actual used rice area using Sentinel-1 and Sentinel-2 data*

Adaptation:
- *Co-Design with local farmers*
- *Identify socio-economic insentives for using SI practices*
- *Evaluation using EO data*

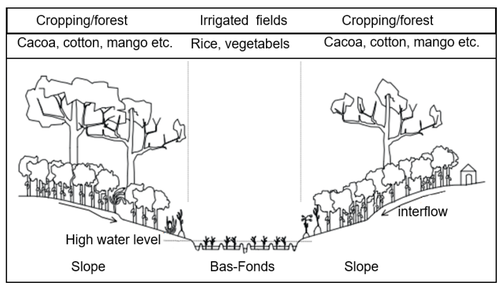
COINS
co-developing innovations for sustainable land management in West African smallholder farming systems

METHODS

Mapping actual rice cropping area in inland valleys



Inland valleys are:
- High potential for agriculture
- Not part of the traditional agriculture system
- Mapped using SRTM (30m)
- Different topographic and wetness indices

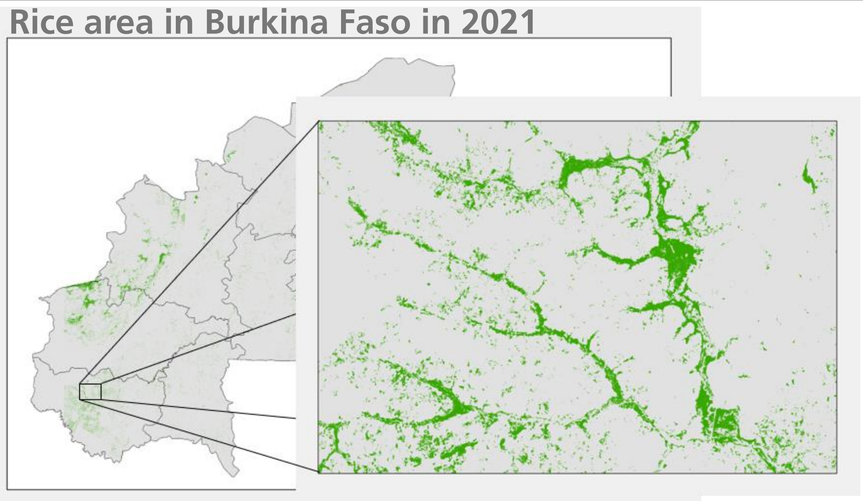


Delineation of field boundaries using a CNN in Senegal

- **Input:** Planet data (NICFI) 2016-07 - 2023-07 (5 bands: R, G, B, NIR, maxNDVI)
- Use of maxNDVI to map all active fields
- **Training data** creation:
  - 4 sample regions representing different agricultural systems
  - Polygons were drawn across all agricultural fields
  - Rasterized to Planet resolution
- **Preprocess data**:
  - Stretch the dataset using augmentation techniques like flipping, rotating and scaling and image generators
- **Train the U-Net model (Ronneber et al., 2015)**:
  - Tune hyperparameters and monitor learning curves to reach minimum loss
  - fully convolutional neural network (CNN)
  - Only convolutional layer

RESULTS

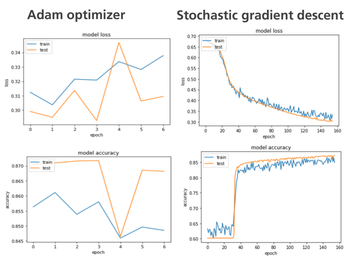
Rice area in Burkina Faso in 2021



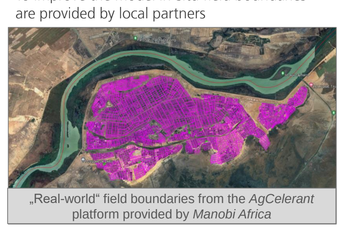
- EO-based analysis show that 2% of the country area is used for rice cropping
- Mapped areas follow inland valley
- North to south gradiant caused by the climate
- Rice cropping can increased from **~2-10%** land area

Comparison of field boundaries delineated from Planet (NICFI) data with:
- RGB high resolution image and ESA *WorldCover*
- Field data provided to local partner to plan with exact field sizes

Comparison of optimizer functions

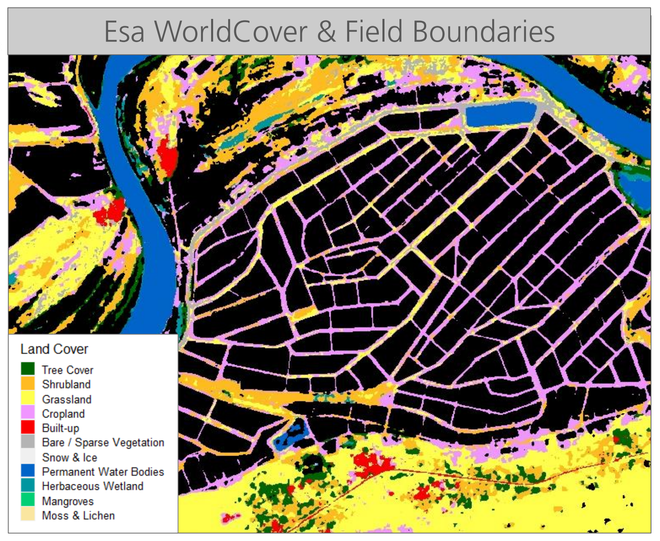


To improve the model in-situ field boundaries are provided by local partners



„Real-world" field boundaries from the *AgCelerant* platform provided by *Manobi Africa*

Esa WorldCover & Field Boundaries



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Ronneberer, O.; Fischer, P.; Brox, T. (2015): Medical Image Computing and Computer-Assisted Intervention (MICCAI), *Springer*, LNCS, Vol. 9351: 234-241.

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