




Remote sensing information for land use planning and pasture management in Tusheti, Georgia

Integrated Biodiversity Management, South Caucasus

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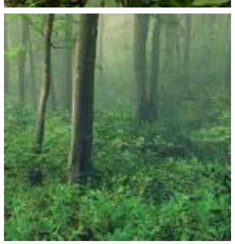

The Caucasus - One of 35 global biodiversity hotspots

Criteria:
1) > 1500 endemic plant species (found nowhere else)
2) > 70 % of its original habitat has been lost

www.conservation.org
www.wwf.org

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Approach

Regional level: Exchange of experiences and promotion of regional dialogue.

National level: Promote management of biodiversity and ecosystem services across sectors through support of institutional and legal reforms & capacity development.

Local level: Piloting of integrated approaches for the sustainable management of biodiversity and ecosystem services together with the local stakeholders.

General public: Promote a more positive perception on the value of biodiversity among the general public through events & campaigns, dialog platforms and strengthening of education institutions.

Close cooperation is sought with other donors and local NGOs.

The overall frame is the **Convention on Biological Diversity**.

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Challenges and Threats to Biodiversity

- **Rising pressure** on natural resources, due to
  - rapid economic growth agenda
  - high demand for energy and raw materials
  - widespread rural poverty
- **Political transformation**
- **Lack of strategies** for **integrated** and **inter-sectoral** sustainable management of biodiversity and ecosystem services
- **No sufficient reliable data** on biodiversity and ecosystem services for decision-making processes

http://content.time.com






Where we work

Pilot areas

1 Four Forest Enterprises in the North of Armenia
2 Syunik Marz, Armenia
3 Aragatsotn Marz, Armenia
4 Shirak Marz, Armenia
5 Ismayilli District, Azerbaijan
6 Dedoplistskaro Municipality, Georgia
7 Akhmeta Municipality, Georgia

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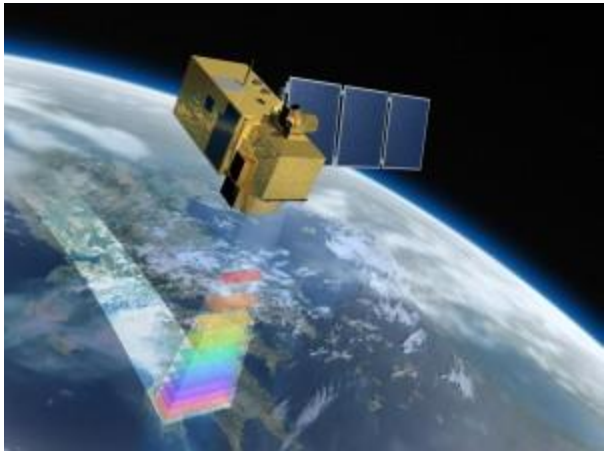
Technical cooperation in the field of spatial data development between IBiS and the Georgian government

- Georgia has setup a National Spatial Data Infrastructure project in alignment with the EU-INSPIRE framework.
- IBiS supports the Ministry of Economy and Sustainable Development of Georgia in spatial planning on the national level.
- On the local level, IBiS supports pilot projects for spatial data development based on remote sensing information.



http://www.cesbio.ups-tlse.fr/multitemp/?tag=sentinel-2

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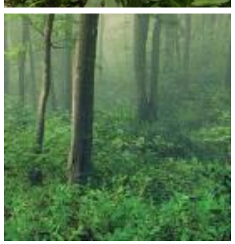
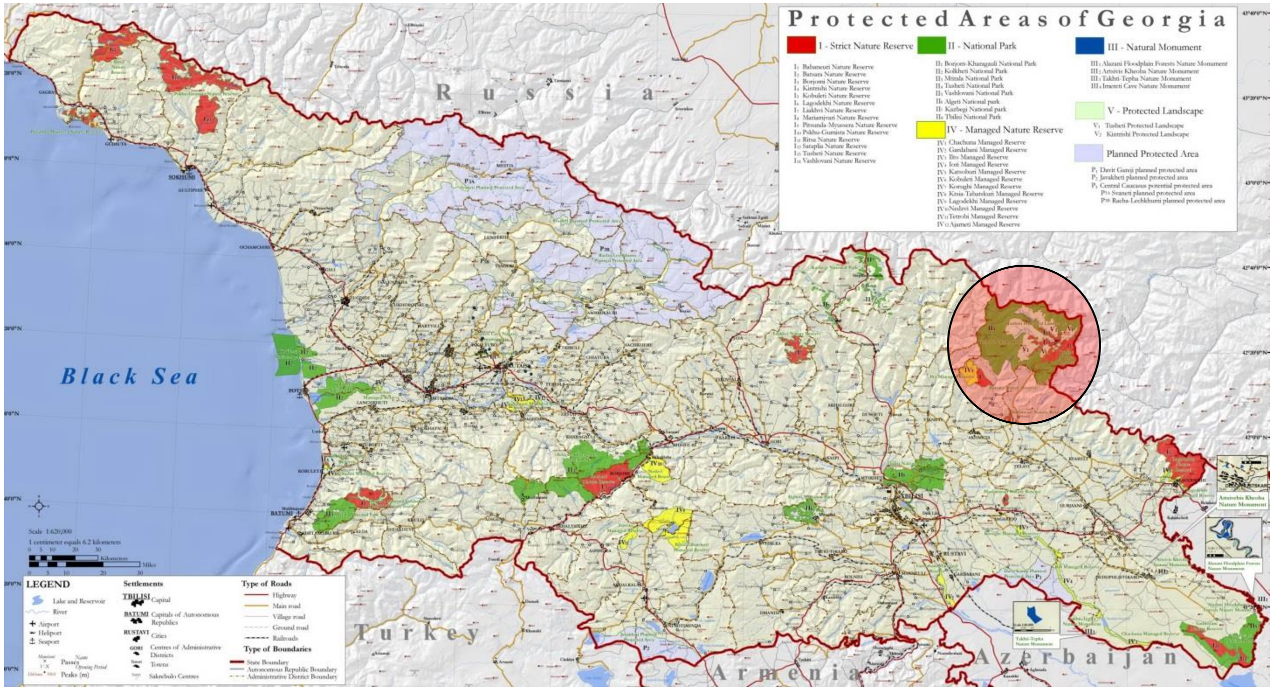


Support of land use planning and creation of reliable data for Tusheti

Tusheti is situated in the north-east of Georgia. Its landscape is protected under a national park, a protected landscape and a strict nature reserve.



http://www.georgia-tours.eu/wp-content/uploads/2011/12/Georgia-Protected-Areas_eng_Page_2.jpg

High erosion risk in Tusheti

- Mountainous landscape with alpine meadows
- High grazing pressure
- Lack of appropriate pasture management practices
- Lack of precise land use and land owner information

https://thedregsgoglobal.wordpress.com/2014/02/17/georgia-on-my-mind-part-iv-tusheti/

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Acquisition of remote sensing based information about erosion and biomass availability

- For improved spatial planning and landscape/pasture management, remote sensing data in combination with environmental models were used to assess erosion, land use and biomass distribution on pastures in the pilot region.
  - Erosion was assessed based on the Revised Universal Soil Loss Equation (RUSLE).
  - Land cover information was derived from Sentinel 2a data.
  - Biomass of pastures was assessed by a regression model derived from field data and spectral remote sensing information.






Erosion mapping

- RUSLE is an empirical model developed in the United States using the following formula:

A=R*K*LS*C*P

with:

A = estimated average soil loss in tons per acre per year

R = rainfall-runoff erosivity factor

K = soil erodibility factor

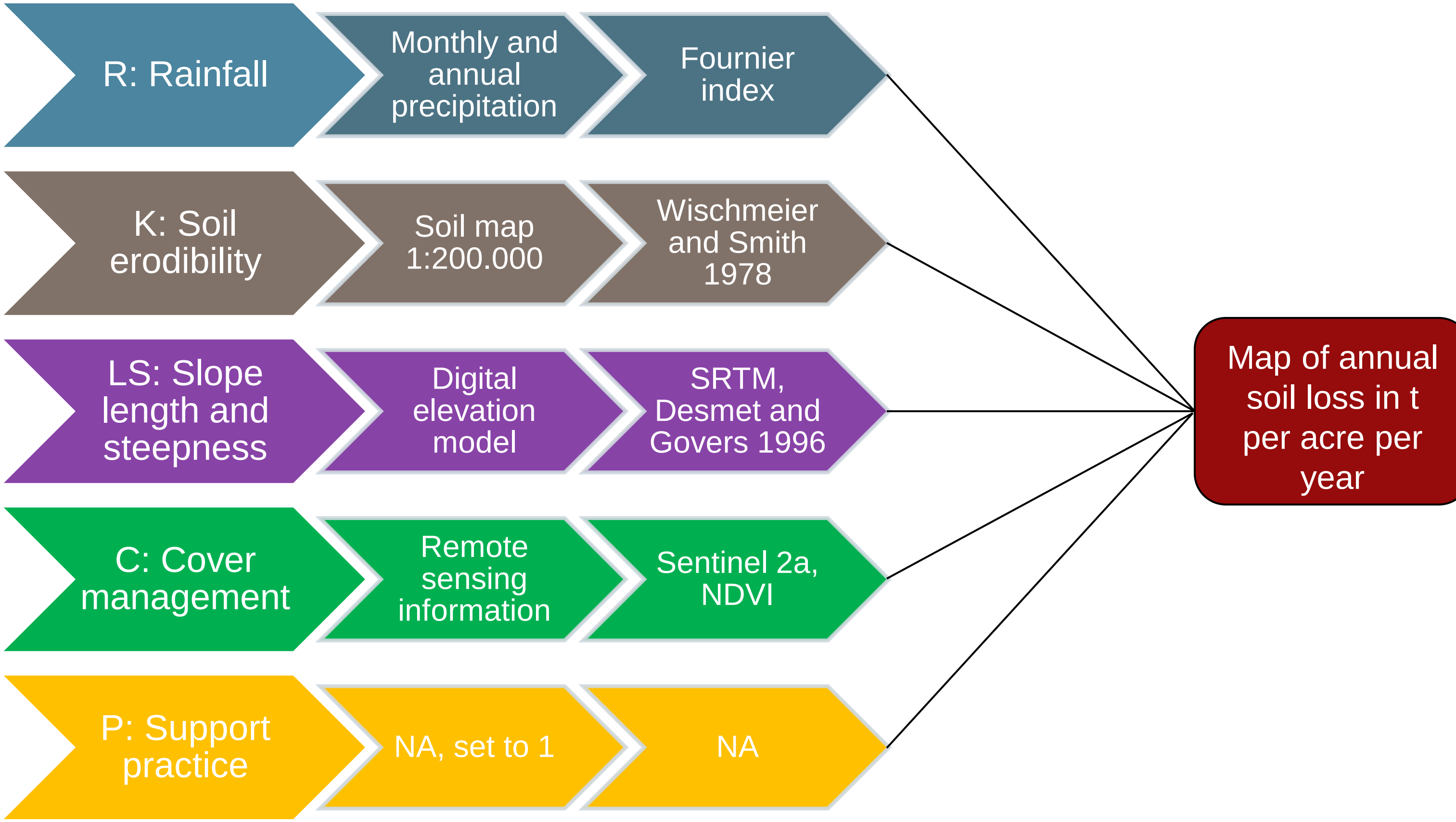
L = Slope length factor

S = Slope steepness factor

C = Cover-management factor

P = Support practice factor

Input data for RUSLE

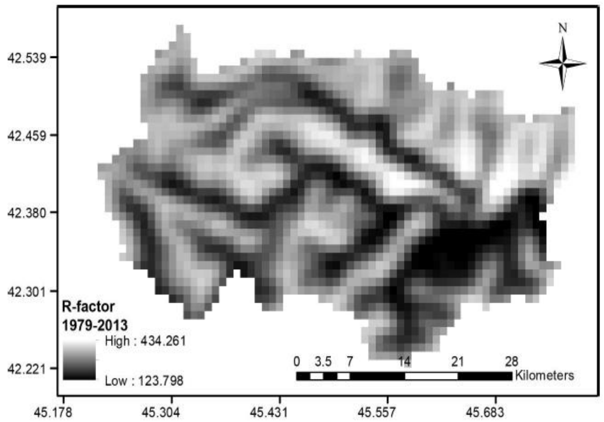







Maps of R, K, LS, C

Figure 2. R-factor based on Fournier Index (1979-2013) for the Tusheti area.



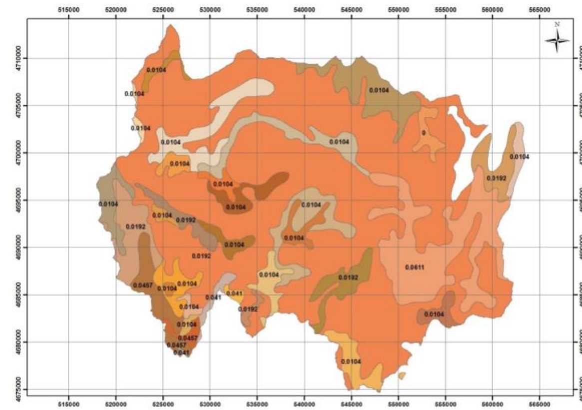


Fig 3. Vector Soil map of Tusheti area

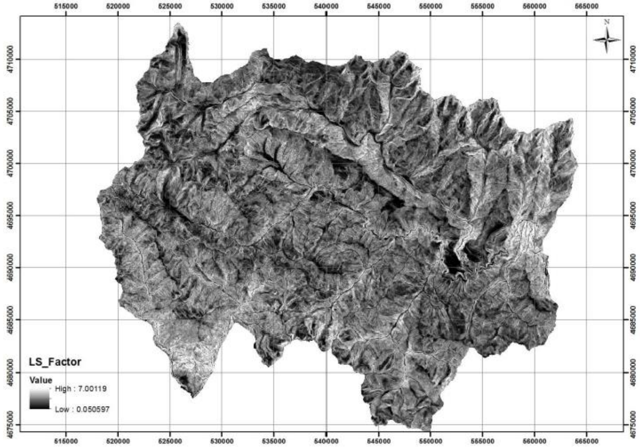


Fig 4. Raster map of LS factor

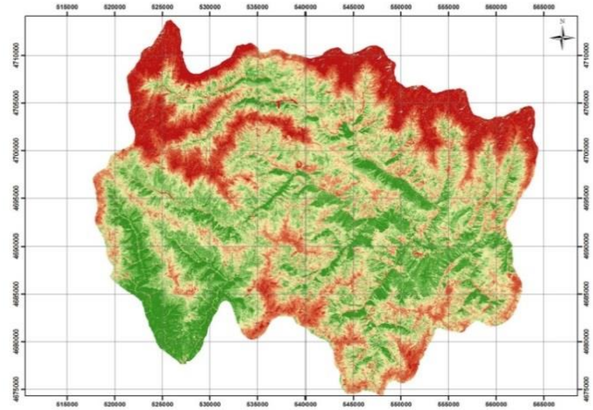


Fig 5. Raster map of C factor

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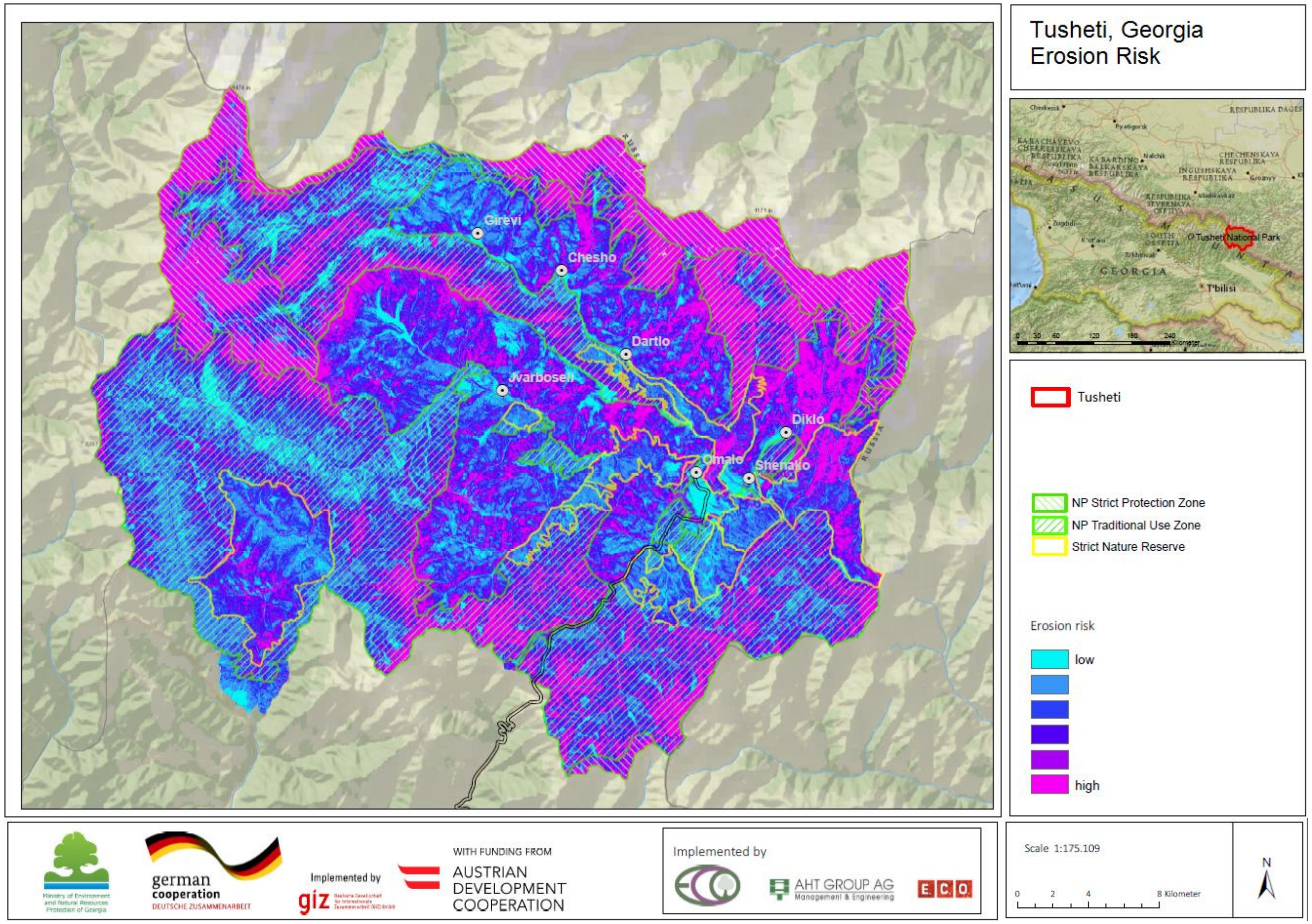
Erosion map of Tusheti



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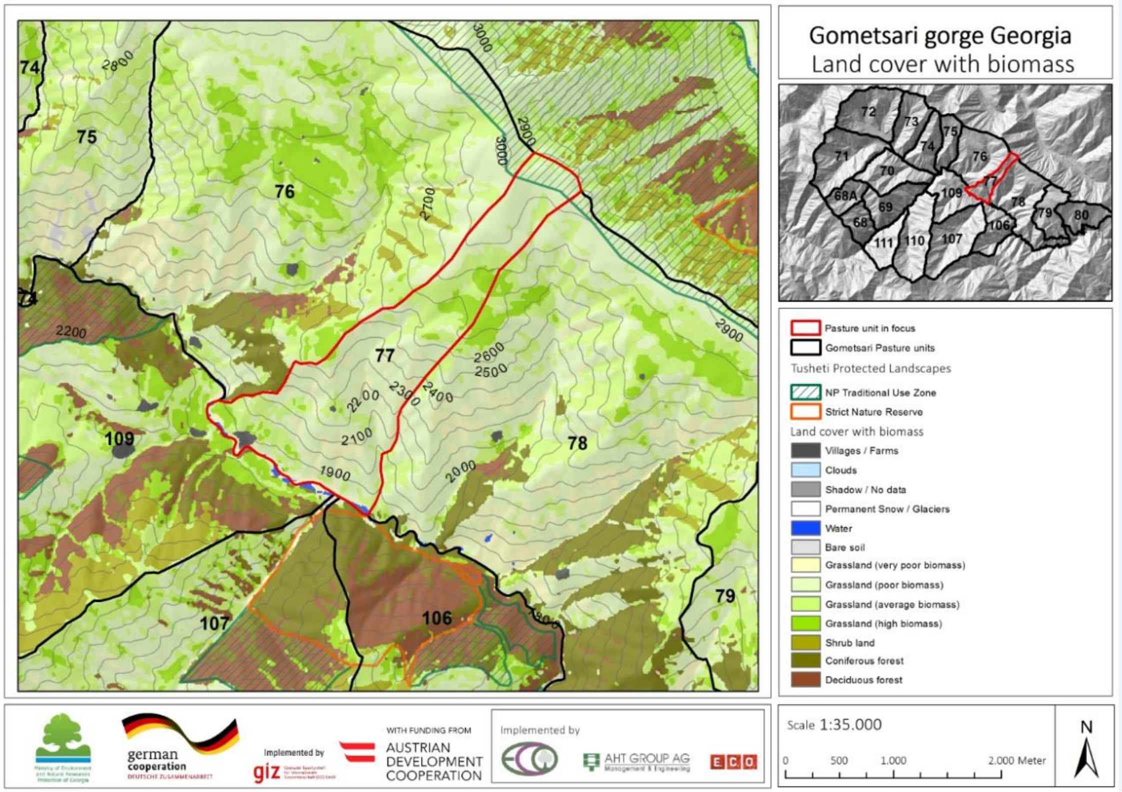
Land cover map

- Land cover mapping was conducted based on Sentinel 2a data.
- A support vector machine (SVM) supervised classification approach was used to derive 14 land use classes:







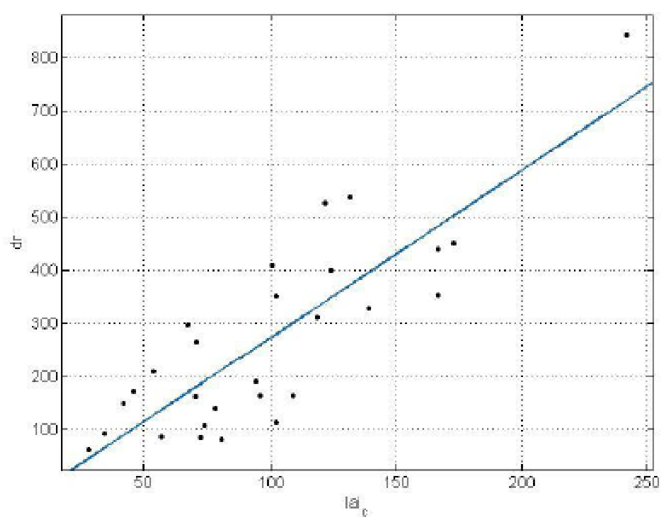

Modelling biomass

- Estimation of biomass was based on a regression model.
- For 28 sample points grassland biomass was assessed.
- From remote sensing data Leaf Area Index was calculated.
- The best model resulted in a linear regression.

DR_W(LAI_cab) = p1*LAI_cab + p2 [1],

where p1 = 3.153, p2 =-43.23

Goodness of fit: R^2: 0.7002, Adjusted R^2: 0.6886, RMSE: 101.7

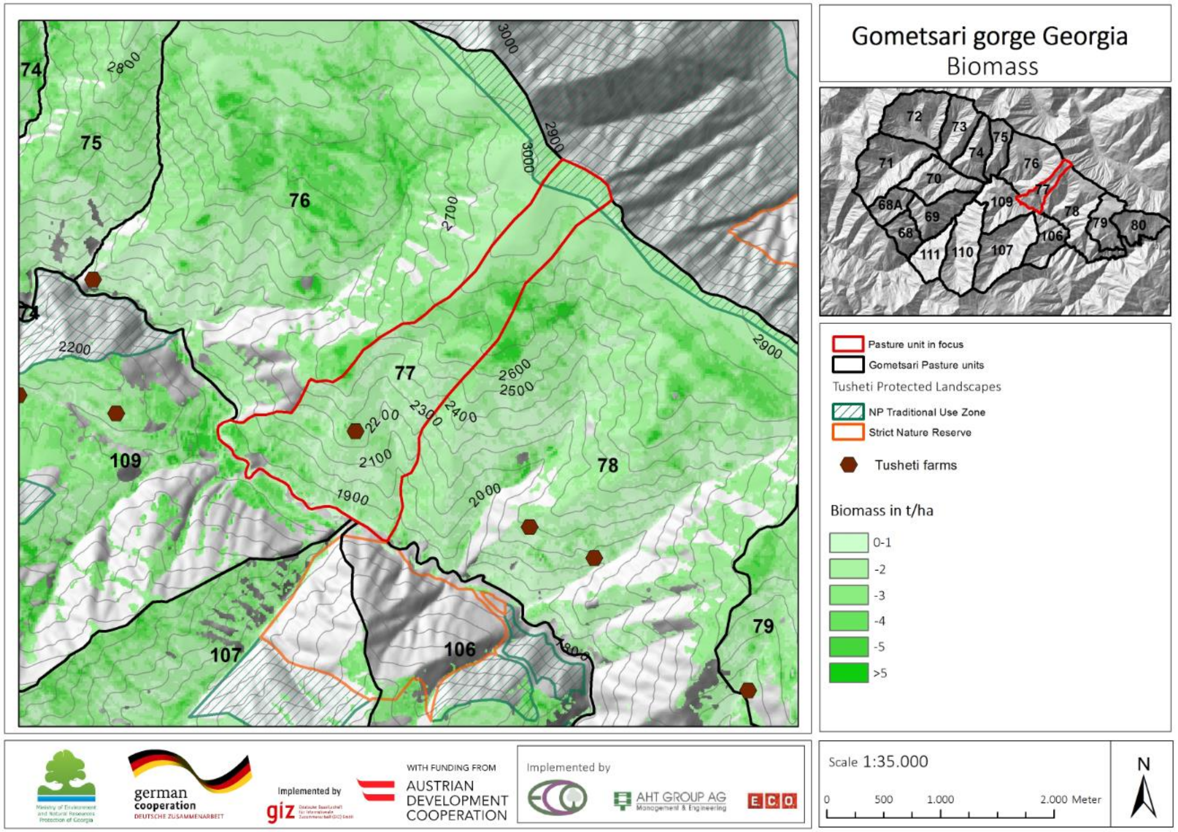







Estimation of biomass distribution

- The regression model served as a basis to predict the spatial distribution of grassland biomass.








Pasture management

- The presented information serves as basis for a sustainable pasture management approach.
- Example of a pasture "passport" for a certain pasture unit:

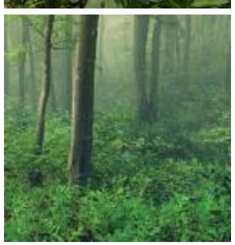
Pastur unit: 77

Landcover type:	ha
Villages/Farms	2,4
Water	1,4
Bare Soil	0,3
Grassland (very poor biomass)	28,7
Grassland (poor biomass)	172,4
Grassland (average biomass)	74,0
Grassland (high biomass)	19,4
Deciduous forest	0,0
Coniferous forest	0,9
Total size of pasture 77	**299,6**

Elevation:	ha	total biomass (t):	available for cattle and sheep	available only for sheep
2900	36,6	59,1	33,7	20,2
2800	24,9	50,0	25,2	24,7
2700	19,2	60,4	29,7	27,2
2600	21,0	55,4	25,0	20,8
2500	13,6	23,2	1,0	3,4
2400	21,0	35,3	4,9	5,9
2300	24,0	34,2	0,2	7,7
2200	25,0	39,5	1,5	10,8
2100	29,2	47,7	3,2	20,9
2000	27,1	42,4	0,9	10,0
1900	30,1	61,8	4,1	31,5
1800	27,9	47,1	17,0	16,6
sum of pasture 77		**555,9**	**146,4**	**199,6**





Conclusion

- Challenges in developing countries:
    - Lack of framework regulations for the development of geo-spatial systems
    - Limited experience of partner organizations with geo-spatial information
    - Lack of resources (maintenance of systems, monitoring)
    - Lack of qualified staff
- The open data policy of Copernicus supports to address some of the above mentioned challenges
- The development of services from Copernicus data could be a chance for developing countries to access information without major resources and highly qualified staff

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