

# KULUNDA – How to prevent the next „Global Dust Bowl“? Characteristics and Extent of Soil Degradation in the Kulunda-Steppe



P. Illiger, G. Schmidt & M. Frühauf

## The Investigation area

of the KULUNDA-Project is the Kulunda-Steppe (Fig. 1), located in Southwestern Siberia. It represents a typical example of a conversion region (Meinel 2002). From 1954 to 1963 approx. 420.000 km<sup>2</sup> of steppe area have been converted into intensely used farmland, primarily for Soviet grain supply (Mc Cauly 1976).

The intense cultivation, in great measures inappropriate to natural heterogeneities and with out dated methods, caused widespread soil degradation and decline of soil organic carbon of the Chernozems and Kastanozems, typical for this region. Where water and wind erosion show the most obvious effects (see. Table 1, 2; Fig. 2, 3, 4), additionally physical and chemical processes influence the soil productivity and the yields (see. Fig. 5). Because of a natural southwest-northeast gradient of e.g. precipitation, steppe types or degradation level, the Kulunda-Steppe offers multiple possibilities for investigations on the interacting natural processes (see. Fig 1, 5).

With respect to the climate change, esp. the changes in extreme climate (Bulygina 2007) and changes in the land use practices, the KULUNDA projects aims to reduce the emission of green house gases and to lead to a sustainable regional development.



Fig. 3: Effects of Deflation (Photo: Meinel 2007)  
face farmers with the loss of topsoil which goes hand in hand with the loss of humus and nutrients necessary for plant production.



Fig. 4: Huge Gullies (Photo: Illiger 2012)  
, that could be found especially in the northern parts of the study area, caused the termination of agricultural activities by now.

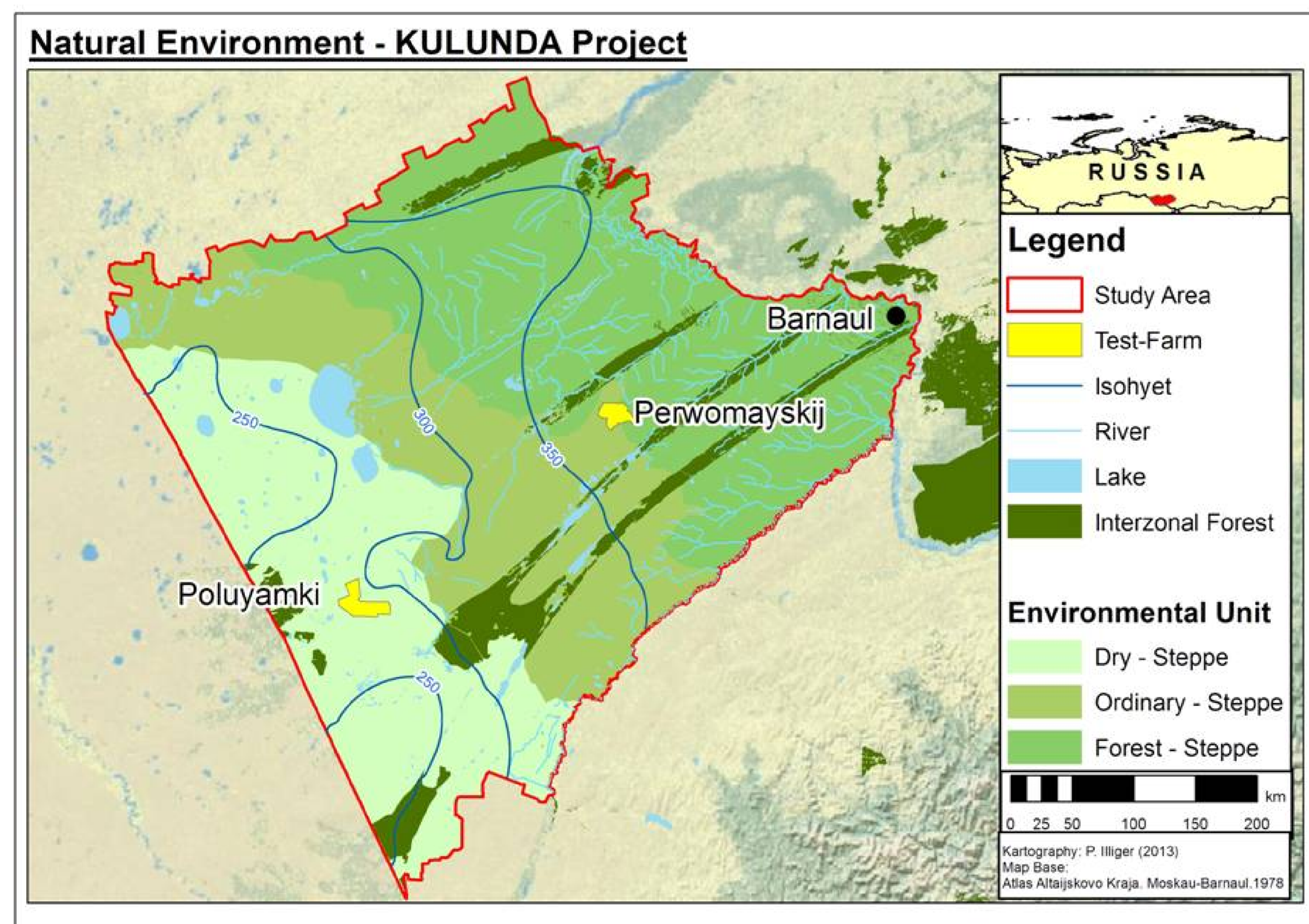


Fig. 1: Natural Environment and Test Sites of the Kulunda-Project (Illiger 2013)

Table 1: Humus Content in Farmland Soils (Belayev 2012)

| Very Low Humus Content (< 4%) | Low Humus Content (4-6%) | Medium Humus Content (6-9%) | High Humus Content (> 9%) |
|-------------------------------|--------------------------|-----------------------------|---------------------------|
| 1537,4 M ha (22,5%)           | 4366,2 M ha (63,9%)      | 751,6 M ha (11,0%)          | 177,6 M ha (2,6%)         |

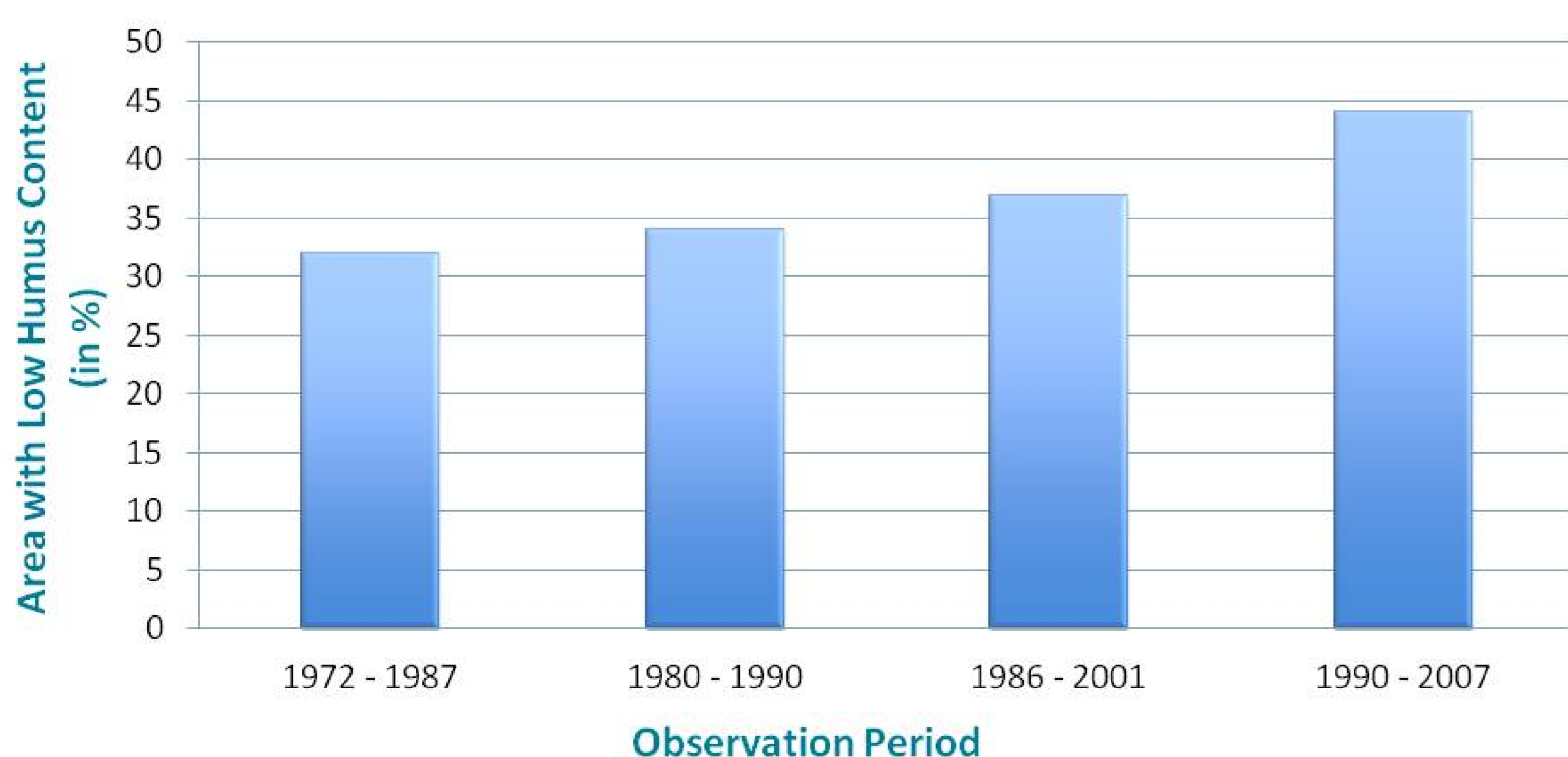


Fig. 2: Increase of Areas with Low Humus Content (Belayev 2012)

Table 2: Qualitative Characteristic of Arable Land in Altai Krai (Belayev 2012)

| Zone               | Exposed to Erosion, % |      |      |               |      |      |
|--------------------|-----------------------|------|------|---------------|------|------|
|                    | Wind Erosion          |      |      | Water Erosion |      |      |
|                    | mean                  | min. | max. | mean          | min. | max. |
| West-Kulundinskaja | 97,1                  | 92,1 | 99,2 | 0,7           | 0    | 2,6  |
| East-Kulundinskaja | 87,5                  | 81,2 | 93,2 | 3,6           | 0    | 10,9 |
| Alejskaja          | 22,2                  | 0    | 69,8 | 35,5          | 0    | 95,8 |
| Priobskaja         | 61,3                  | 4,3  | 89,2 | 15,4          | 0,4  | 39,0 |
| Centralnaja        | 11,7                  | 0    | 58,6 | 35,3          | 19,8 | 53,0 |
| Wostotschnaja      | 0                     | 0    | 0    | 57,0          | 17,9 | 84,6 |
| Predgornaja        | 0,5                   | 0    | 3,1  | 30,4          | 9,3  | 53,9 |

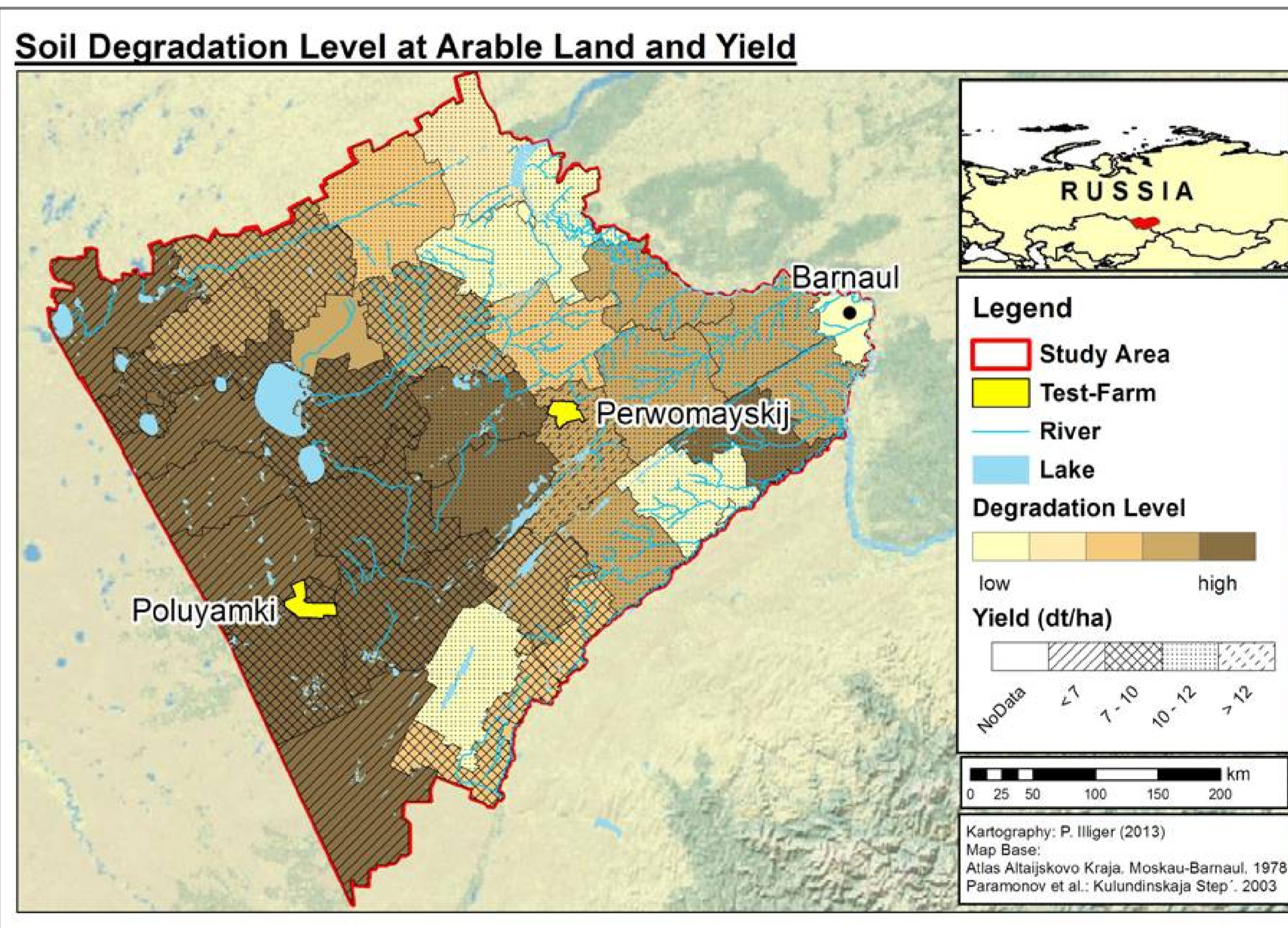


Fig. 5: Summarised Soil degradation on Farm Land and Yield (Illiger 2013)

## The Investigations on Soil Degradation

within the KULUNDA-Project follow a scale specific approach. Concrete “Test Site Analyses” allow the identification of soil degradation indicators and the assessment of the status quo of the soil inventory with respect to their natural characteristics. With due regard to existing and recent soil and land use data, spatial propagation patterns will be designated.

With the help of regionalization and transfer methods, the gained knowledge can be transferred to larger spatial and administrative areas. Thus essential principles for a sustainable land management on different levels will be provided.

## Further Information:

[www.kulunda.eu](http://www.kulunda.eu)

[www.sustainable-landmanagement.net](http://www.sustainable-landmanagement.net)

## Contact:

Martin-Luther-University Halle-Wittenberg  
Institute for Geosciences and Geography  
Von Seckendorff Platz 4  
06120 Halle (Saale)

patrick.illiger@geo.uni-halle.de  
gerd.schmidt@geo.uni-halle.de  
manfred.fruehauf@geo.uni-halle.de