

# ZUR no. 12

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Science brief from the ZEF-UNESCO project on Sustainable Management of Land and Water Resources in Khorezm, Uzbekistan

## Trees from a bird's eye view: Photogrammetry for forest and tree plantation inventories in Uzbekistan

Measures to inventory and monitor forests and tree plantings are necessary for the sustainable management of this important natural resource. This also applies to Uzbekistan, where implementation is presently constrained by limited funding and a lack of staff on the part of the Main Forestry Department (MFD), the institution responsible for forest monitoring. Therefore, a cost-effective method is required that allows a comprehensive and reliable inventory of national forests.

Aerial photographs, analyzed using photogrammetry in combination with GIS-based tools have been used for forest inventories with high accuracy all over the world. This method also seems promising for Uzbekistan, where aerial photographs are regularly taken for actualizing topographic maps. However, the photographs had not been used for forestry needs for decades due to the lack of efficient methodology and equipment. Recent research results now show the potential scope for the innovative use of aerial photographs by the MFD.

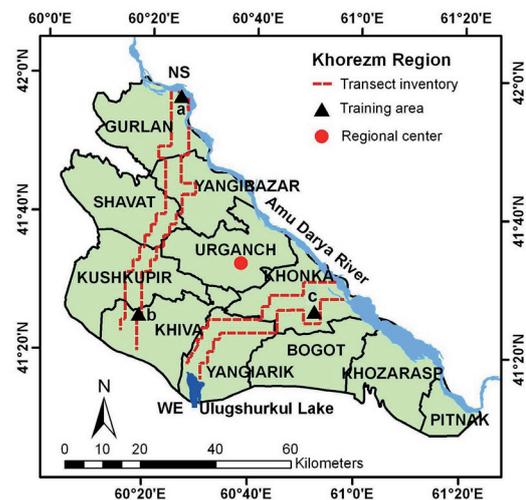


Figure 1: Selected study area

This research was performed within the framework of the German-Uzbek ZEF/UNESCO research project in Khorezm (<http://www.khorezm.uni-bonn.de>). Black and white aerial photographs with a scale of 1:20,000, taken by the Land and Geodesy Cadastre Center of Uzbekistan in November 2001, were tested to extract data on tree stands and forests in the region of Khorezm. The aim was to develop a standard methodology which could be applied by the MFD. The selected study area within two transects (oriented in NS and WE directions) covered virtually all typical land uses and types of vegetation on a total area of about 10% of Khorezm (Figure



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1). Three methods of assessment were developed for (i) the extent of tree hedgerows along irrigation networks, roads and borders of agricultural fields as well as the windbreak function of these hedgerows, (ii) the extent of orchards and plantations of mulberry and hybrid poplar, and (iii) the extent and species composition of the floodplain (tugai) forest (Figure 2).

Photogrammetric equipment in the form of a VISOPRET 10-DIG analytical stereoplotter (an optical-mechanical stereo viewer attached to a computer) with AutoCAD software as well as ESRI GIS software package with extension tools were used for the post-processing of the data. Although the stereoplotter is an expensive device, it can be replaced today with more advanced, cheap and effective digital photogrammetric workstations. The only photogrammetric hardware needed is the high resolution scanner, the stereo glasses, floating mark controller, 3D mouse or pointer and appropriate hard-copy plotters.

The analysis of the aerial photographs showed that detailed and accurate information could be extracted on the extent of tree plantings and forests (Figure 2). Thus, thematic information was extracted to distinguish, for example, pollarded mulberry and willow hedgerows/windbreaks from those consisting of hybrid poplar, willow and Russian olive. The verification of results in the field confirmed that the photographic indicators, including the appearance of horizontal crown projection, crown shadow profile and site condition, could be further used to assess tree plantations and forests with similar species and growing conditions in Uzbekistan. Furthermore, windbreak design criteria, such as orientation to the prevailing winds, mean stand height, crown closure and the length along the adjacent agricultural fields could be determined with an acceptable accuracy.



The scene of the floodplain tugai forest patch (forest compartment 3) along the Amu Darya River in Khorezm

However, certain limitations such as the scale of available aerial photographs, precluded extracting information on species composition, health and age of tree plantings and forests, as well as the number of rows of hedgerows/windbreaks. Should such information be important, the photogrammetrical analyses need to be either complemented with field surveys or conducted using large-scale (<1:15,000) aerial photographs.

Following the training of MFD personnel, this method, developed and adapted for the situation in Uzbekistan, can replace the traditional labor- and time-intensive field surveys to closely monitor the implementation of the tree growing programs in Uzbekistan. These programs include windbreak and shelterbelt plantings, extension of fruit and grape plantations, as well as mulberry plantations for sericultural needs, and planting of hybrid poplar and other fast-

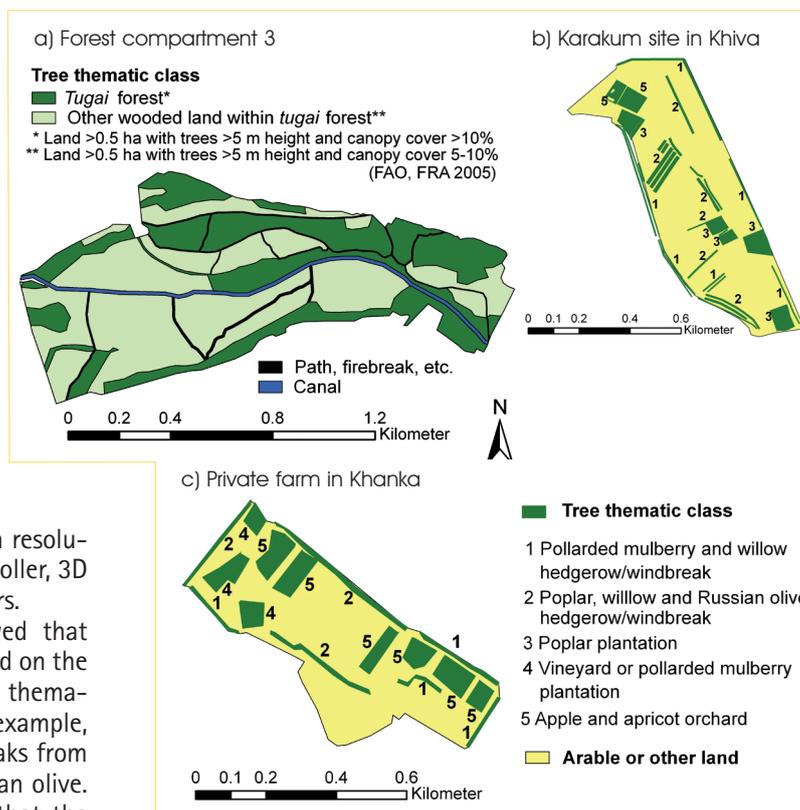


Figure 2: Thematic classes within the training areas (see Figure 1)

growing species to satisfy the high demand for construction wood and pulp. The photo-interpretation technique can also help the MFD to define site-specific recommendations for the protection and rehabilitation of the tugai forest ecosystem.

### Recommended for further reading:

FAO, Global forest resources assessment (FRA) 2005. Uzbekistan country report, Forestry Department FAO, Rome; Main Forestry Department of the Republic of Uzbekistan, 2009, available at [http://forestry.uz/index.php?option=com\\_content&task=view&id=22&Itemid=32](http://forestry.uz/index.php?option=com_content&task=view&id=22&Itemid=32)

Tupitsa A. 2010. Photogrammetric techniques for the functional assessment of tree and forest resources in Khorezm, Uzbekistan. ZEF Ecology and Development Series No. 71, 135 pp.

### IMPRINT

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