Abstract. The landscape-agrogeochemical balance of potassium in the watersheds of four small rivers of the Oka Valley, U.S.S.R., was investigated. It was shown that application of potassium fertilizers results in K accumulation in soils. A statistically significant correlation between fertilizer rates and K content in surface and ground waters was shown.

1. Introduction

Like the other biophil elements K is one of the natural compounds, but unlike nitrogen (N) and phosphorus (P) the transformation of potassium (K) in soil is not closely related to its microbiological and chemical fixation. Nevertheless K migration through the soil profile is limited due to its exchange and non-exchange absorption by the soil colloids. The content of total K and its mobile forms in soils is considerably higher than that of N and P. This results in more pronounced geochemical flows of K and in higher concentrations of K in natural waters (Bashkin et al., 1980). This is of environmental concern since excessive amounts of K in natural water may stimulate eutrophication (Reuss, 1970).

At present the input of K in the various areas takes place through industrial and municipal sewage, mineral fertilizers, cattle-breeding waste and precipitation. For a separate study of these factors of K input it is necessary to find out the geochemical regions with predominant effect of one of them. On the base of the landscape-geochemical approach, the small river basins or closed irrigational systems with identical soil and climatic conditions and similar man activity, from an ecological point of view, are ideal for studying the agrogeochemical cycle of K as well as other biophil elements and their landscape-agrogeochemical balance.

2. Materials and Methods

Four small agricultural river basins – the Oka river tributaries (Gorodnyanka, Moscow Region, grey forest soils; Skniga, Tula Region, grey forest soils; Itska, Orel Region, leached chernozem; Sokhna, Kaluga Region, soddy-podzolic sandy and sandy-loam soils) served as the areas of investigation. These regions have different agricultural land
use, soils, erosion processes and level of fertilization. The detailed landscape-agro-
geochemical characteristics of the given regions and their agricultural use were presented 
a earlier (Bashkin et al., 1980; Kudeyarov et al., 1981; Bashkin and Kudeyarova, 1981).

The addition of K in mineral fertilizers to the watersheds was statistically estimated. 
Potassium input with precipitation was evaluated on the basis of both literature data 
shown for the given areas (Bulatkin, 1980) and those of our observations. These values 
changed from 4 to 6 kg K ha\(^{-1}\) during all observation period. The amount of K in 
manure was not considered when estimating K input, for in this case circulation of this 
element within the given regions took place.

On the basis of statistical and reference data, K export from the regions with 
agricultural production (cattle and plants) was taken into account when estimating the 
landscape-agrogeochemical K balance.

In 1978–1979 the crops were tested for total K content. It should be noted that K 
is mainly found in straw which is not exported from the regions. Potassium losses from 
manure during storage were estimated by the difference between the amount of K 
accumulated and applied with manure. The accumulation of K in manure was considered 
on the basis of the reference data, average content of K in the organic fertilizer was 
estimated to be 0.5\%. The amount of K surface runoff was estimated on the basis of 
periodical observations on the content of K in water and water discharge in the rivers 
from 1977 to 1979 (Bashkin et al., 1980; Kudeyarov et al., 1981; Bashkin and Kudeya-

Potassium was determined by flamephotometer. In plant samples the determination 
was carried out after digestion with concentrated \(\text{H}_2\text{SO}_4\) and catalizer.

The statistical processing of data was carried out by EC-1010 computer with a set 
of dialog programs (Komarov and Mironenko, 1979).

3. Results

Table I shows the landscape-agrogeochemical balance of K in Gorodnyanka river basin. 
During 10-yr period (1969–1979) the amount of applied K mineral fertilizers was 
increased by 3.7 times and consisted of 95\% of the total input in 1979. The input of K 
with atmospheric precipitation almost did not change but its relative role was consider-
ably lower. During the 10-yr period the total amount of K input into Gorodnyanka 
watershed increased from 147.4 tons to 480.5 tons.

Potassium export from this region with agricultural products and surface runoff were 
the main outputs of landscape-agrogeochemical balance (see Table I). Export with 
agricultural products was within 21.3 to 39.2 tons or 6 to 15\% of total K input in the 
area. Potassium surface runoff was almost the same during the whole period of observa-
tion. Total K output in Gorodnyanka basin increased by 1.2 times from 1969 to 1979. 
Since the input of K was higher than its output (28 and 72\% of total K input was output 
in 1969 and 1979, respectively) this area was characterized by a positive balance sheet.

In Skniga watershed there was a 4.9-fold increase in application of K fertilizer over 
the 10-yr period. The precipitation was thought to be responsible for the considerable