НОВЫЕ МЕТОДЫ И РЕЗУЛЬТАТЫ ИССЛЕДОВАНИЙ ЛАНДШАФТОВ В ЕВРОПЕ, ЦЕНТРАЛЬНОЙ АЗИИ И СИБИРИ

Монография в 5 томах

Том I Ландшафты в XXI веке: анализ состояния, основные процессы и концепции исследований

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Монография содержит информацию о самых современных методологиях и результатах в ландшафтных исследованиях. Она может быть использована в качестве руководства для исследователей, преподавателей, студентов и всех, кого интересует тема ландшафтной науки и смежных дисциплин. Монография является особо ценной информационной базой для лиц, принимающих решения на различных уровнях, от местных до международных органов по принятию решений. Приведенная в монографии информация представляет собой современный уровень ландшафтной науки в очень краткой форме.

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This monograph shall inform you about up to date methodologies and recent results in landscape research. It is intended as a guide for researchers, teachers, students, decision makers, stakeholders interested in the topic of landscape science and related disciplines. It provides information basis for decision makers at various levels, from local up to international decision bodies, representing the top level of landscape science in a very short form.

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Chapter I/68: METHODS OF IN SITU GROUNDWATER QUALITY MONITORING IN AGRICULTURAL LANDSCAPES

Глава I/68: Методы полевого мониторинга качества подземных вод в сельскохозяйственных ландшафтах

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ABSTRACT. Against the background of the paramount importance of fresh water resources for human well-being, the protection of groundwater bodies is one of the top themes of the environmental ambitions in Europe’s industrialised societies. This holds true especially for areas under predominantly agricultural use against nitrates from plant production. To support utilization of a catalogue of agricultural measures of groundwater conservation available in general, a methodology for in-situ monitoring of the groundwater quality is needed as the basis for assessing the efficiency of those measures. Characteristics of selected recent monitoring and sampling methods are exemplarily presented. These are groundwater sampling beneath the groundwater table, monitoring using observation wells and monitoring by means of multi-level observation wells.
GROUNDWATER SAMPLING BENEATH THE GROUNDWATER TABLE

In regions with depths to the groundwater of less than 6 m, taking samples from the near-surface groundwater is feasible to obtain relatively short-dated information about the impact of agricultural measures on groundwater quality by a suction lance [Fig. 2 a]. The seepage zone is penetrated by means of a drill hammer with push rod, and a lance completed by a suction cup is inserted down to max. 20 cm below the water table. Application of low pressure causes extraction of water from the groundwater surface to a suction unit. As soon as a filter cake has built up around the suction cup, a sample of...
relatively clear water can be abstracted to be analysed in a water laboratory. In the case of peaty soils and sites with higher content of fine silt, no effectual filter structure may develop outside the cup. Those samples are to be pressure-filtered prior to laboratory analysis. With regard to the probable temporal variability of solute concentrations over the seepage period and the effect of the lateral groundwater movement, sampling beneath the water table should be repeated several times during the period of seepage flow. At least, water abstraction should be executed once a year by the end of the seepage period. Results obtained at that time at selected sampling points are best comparable with current solute inputs from the land surface because of the short transit time. Under general conditions, the local displacement of solutes (nitrates) by groundwater flow must be taken into account while interpreting the results.

GROUNDWATER MONITORING OF OBSERVATION WELLS

In the catchments of groundwater abstraction wells for the public water supply, as a rule, observation wells [Fig. 2 b] are placed in the vicinity of the production wells. Such observation wells also have been occasionally installed for the large-scale assignment of the subterranean catchment of a river or a canal. In addition, suppliers of potable water or water management authorities erect special observation networks to monitor the groundwater quality development, e. g. upstream of a well field or downstream of any polluters [Fig. 1]. These categories of observation wells, though installed for different purposes, all are suitable for groundwater quality monitoring provided they meet some requirements with regard to the site conditions and the level of their performance. These requirements are:

- Filter lining (screen) be placed in the upper groundwater zone
- Short filter lines
- Unique attribution of the related catchment area be given

Groundwater samples should be taken with moderate pumping power to minimise any water table drawdown and, thus, mixing with water from the adjacent (higher and lower) aquifer zones. By systematic sampling, analyzing and inspection of the results from observation wells, the effects of groundwater-protecting measures can be detected on the medium to long term. For this, the actually
contributing subsurface catchment is to be attributed to the observation well according to the depth of the filter screen paying attention to the groundwater flow velocity or residence time. This may be complicated in special cases, and sometimes the catchment boundary may vary with time. To increase the trustworthiness of the intended success control several observation wells should be monitored.

GROUNDWATER MONITORING OF MULTI-LEVEL OBSERVATION WELLS
Multi-level observation wells [Fig. 2 c] allow for the vertical differentiation of the hydrochemical conditions within one or between several groundwater-bearing units. In recent times, multi-level observation wells have been often supplemented by probes at various depths for analysing the dynamics of the vertical matter exchange also in the unsaturated zone or the near-surface groundwater. While taking groundwater samples, the pumped discharge has to be adjusted to the water yield of the investigated aquifer zone. To avoid the hydraulic equilibrium over the whole depth of the aquifer be disturbed too much during pumping, a certain water volume drawn up before the actual sampling should not be exceeded. As stated above, especially in the case of multi-level observation wells, it is indispensable to recognise the hydrogeological background within the groundwater catchment previous to drilling. An important task is to determine the groundwater flow direction. Therefore, besides the extensive and costly multi-level equipment, also a sufficient number of regular observation wells must be installed within the catchment area. The results of monitoring the groundwater quality at single dates are assembled in a concentration–depth profile. Provided the hydrogeological conditions within the subterranean catchment are reasonably homogeneous, the depth-specific groundwater samples can be allocated to their respective areas of origin, under consideration of the rate of groundwater recharge, the effective flow velocity, and the specific yield (actual porosity). As well, deeper aquifer zones can be evaluated with respect to their denitrification potential.

CONCLUSIONS
1. We presented a selection of rules and methods for monitoring impacts of agriculture on groundwater quality.
2. Monitoring rules and data analysis have to be based on the geological and hydrological situation of the subterranean catchment and at the sampling point.
3. Methods exemplary for the unconsolidated rock region are groundwater sampling beneath the groundwater table, monitoring using observation wells and monitoring by means of multi-level observation wells.

4. Our methods have potential of being applied to other regions of Eurasia.

REFERENCES


