Management of annual runoff renewal as the tool for inexhaustible water use

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INTRODUCTION

The water resource is a renewable resource and therefore opportunities for river runoff use have greater prospects. However, many regions already feel a water deficit. A constantly increasing deficit of freshwater is a wicked water problem. In 1990, the 85 countries with 70% of the world's population had a freshwater deficit; there was only 500 to 5000 m^3/year of freshwater available per person. There will be 96 such countries in 2025 (Golubev, 2006).

The river runoff forms the basic part of annually renewable freshwater resources. Now there is a tendency to reduction of water quantity in the rivers. There are different reasons for this tendency. It is necessary to reveal the distinctions between the notions of "exhaustion of river resource" and "loss of environment ability to renew river runoff". It is necessary to understand and to distinguish these phenomena in order to define new tools for water management (Fig. 1). If the reasons for these phenomena are different, then the tools for solving problems should be different too.

OBJECTS AND RESULTS

The notion "exhaustion of river resource" assumes a resource crisis. Ways out of this crisis may be:

(a) reduction of diversion from river due to creation of the new closed-circuit technologies;
(b) reduction of diversion from river due to replacement of water by alternative liquid in a technological cycle;
(c) increase of diversion from river due to complete diversion or partial diversion from the next river basin; and
(d) increase of diversion from river due to use of groundwater.

The consequence of the resource crisis is a shortage of water in the river for economic use. The exhaustion of local river resources reflects a strengthening pressure of economic activities on water bodies.

The notion "loss of environment ability to renew river runoff" assumes exhaustion of a natural mechanism which provides the stable water-regulation role of the natural environment. The climate and environment renew and support the natural water quantity in the river basin. The climate determines the precipitation quantity and the air temperature. The natural environment and its ecosystems redistribute the volume as overland runoff for all periods of high water and low water due to the processes of filtration and accumulation in the river basin. This overland runoff is generated by precipitation across the river basin.

The destruction of natural landscapes changes the water-regulating role of the natural environment. These changes cause the increase or the reduction of evaporation, transpiration, filtration and accumulation of the overland runoff in river basin. Without the river basin environment (woods, meadows, bogs, etc.), even small precipitation events cause overland flow on slopes and catastrophic discharges in streams. This runoff will pass very quickly, and then the riverbed remains almost dry, feeding only groundwater. The change of the water-regulation functions of natural environment changes the processes of the annual runoff renewal in river basin. Therefore, the crisis of runoff renewal is formed on a local scale.

The disappearance of small rivers, lakes and bogs is a reflection of the crisis of runoff renewal in the basin of basic river. A consequence of the crisis of runoff renewal is a transition from the

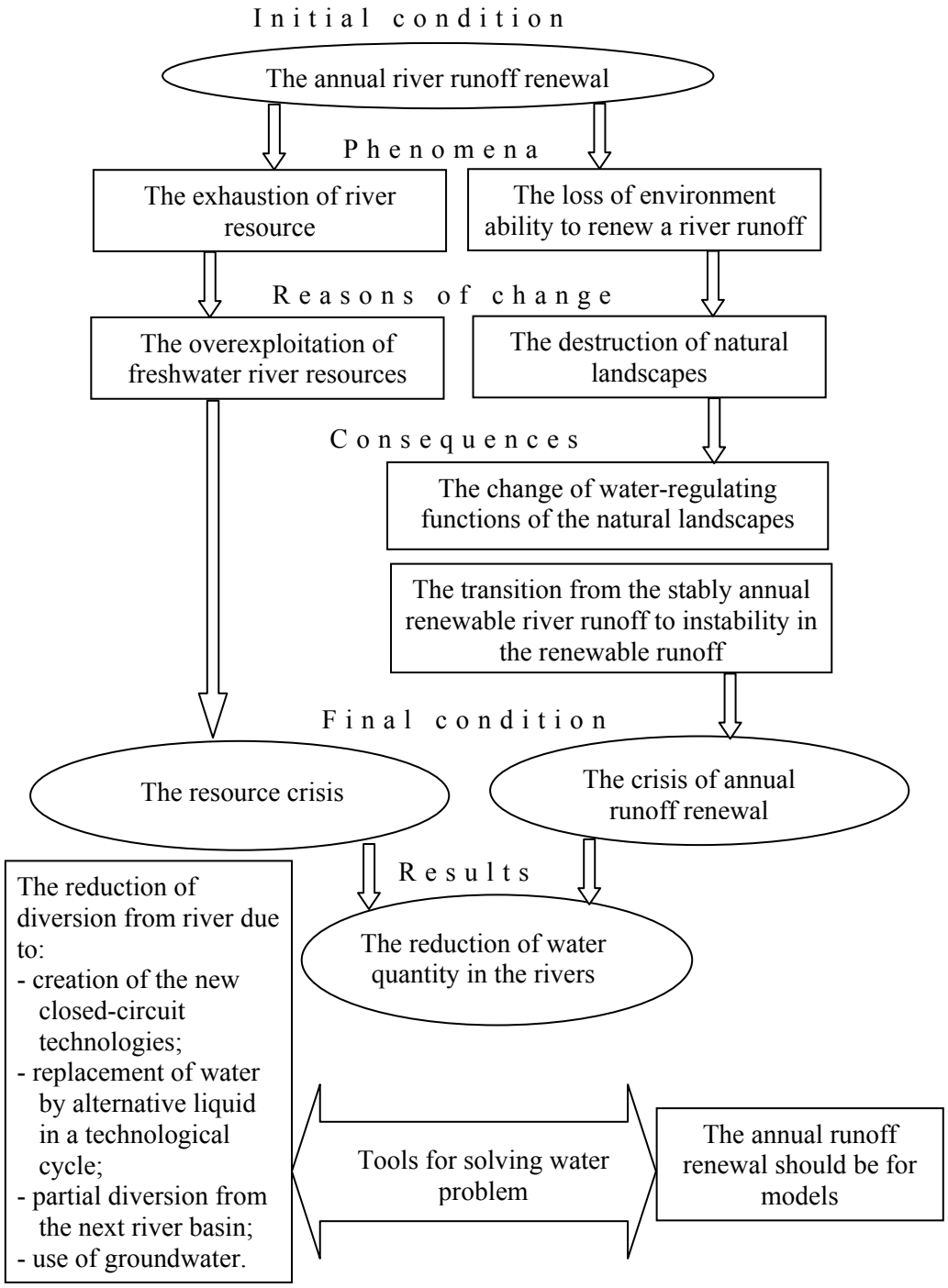

Fig. 1 The scheme of transition from the annual renewable river runoff to instability in the renewable runoff.

annual renewable river runoff to instability in the renewable runoff. This problem is more difficult than the resource crisis.

The loss of the environment's ability to renew and to support the river's runoff limits water use. An inexhaustible water use is a basis for sustainable economic development. Thus, the annual runoff renewal should be the tool for water management.

REFERENCES

Golubev, G. N. (2006) *Geoecology*. Aspect Press, Moscow, Russia (in Russian).