THE ESTIMATION OF GROUNDWATER EXCHANGE IN AYDARKUL–ARNASAY LAKE SYSTEM BY A LAKE WATER BALANCE MODEL

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In this paper, a unique lake water balance (LWB) has been proposed as a key component for the sustainable groundwater (GW) management in arid/semi arid region, particularly in Aydarkul-Arnasay Lake System (AALS), Uzbekistan. The uniqueness of LWB here is by incorporating GW distribution and its interaction. Meanwhile, the evaporation is also locally trimmed for arid/semi arid area. It is a monthly-based calculation by introducing the lake surface area as function of observed lake water level. The result shows that from March to July, GW recharge is higher than GW discharge as indicated by positive GW-exchange ranging from 0.13 to 0.83 km^3/month. From August to February, GW discharge is higher than GW recharge (a negative GW-exchange). It's about -0.05 to -0.51 km^3/month. Verified with the observed data, this approach seems to serve as a reliable method for the reconstruction of GW-exchange into/out from the lake as well as useful information towards the sustainable GW management.

Key Words*: groundwater exchange, Aydarkul-Arnasay Lake System, lake water balance, arid/semi arid area.*

1. INTRODUCTION

Groundwater resources are considered as one of the important sources of freshwater in arid and semi-arid areas. A basic problem in arid areas, which often cannot be solved easily with conventional hydrological techniques, is to determine whether a given body of groundwater is actively recharged, i.e. whether it is a renewable resource.

There are several approximations to predict groundwater recharge/discharges into water bodies. Most of them include water balance that captures into account the meteorological data and land surface variables such as soil moisture and land cover types (Finch)[1)]. However, to gain better results then the local site-characteristics, that may differ from commonly used scientific approaches, should be carefully adopted in the determination of Lake Water Balance (LWB) components (Shaw)[2)].

Another one is by utilizing the hydraulic-head surface map coupled with boreholes, the water level assessment through GIS techniques application (Salama *et al.*)[3)]. This approach sounds very costly and relies on the existence of borehole data. It is difficult to be carried out under precise hydrologic environment, particularly where the depth of the aquifer is large. Groundwater tracers such as ^{222}Rn and ^{226}Ra have also been greatly used to determine groundwater flows even though they cannot give precise quantification (Hussain *et al.*)[4)].

In assessing groundwater movements, the most common way is by counting the quantities of the net-groundwater flow (the distinction between groundwater inflow and leakage) as a unique unknown variable in the water budget equation (Lee and Swancar)[5)]. Numerous lake hydrologic investigations regarding the net-groundwater flow has been reported (e.g. Krabbenhoft *et al.*[6)], Al-Weshah[7)], Motz *et al.*[8)] and Chikita *et al.*[9)]). Nevertheless, these kinds of works are extremely expensive and labor detailed seeing that lots of hydrogeologic, as well as water quality information or groundwater inspection boreholes are needed.

In arid/semi-arid areas, the water level and surface area of lake are highly sensitive to the climatic variables. In this situation the lake water level fluctuations becomes excellent indicators of drought/wet conditions changes. Moreover, it is an important measurable element of LWB.

The objective of this study is to estimate the groundwater exchange by a LWB approach. The uniqueness of the proposed LWB here are; (1) has