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Water, Energy and Food Nexus: A new perspective for managing High Aswan Dam Lake

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أنزَلَ مِنَ السَّمَاءِ مَاءً فَسَالَتْ أَوْدِيَةٌ بِقَدَرِهَا فَاحْتَمَلَ السَّيْلُ زَبَدًا رَّابِيًا ۚ وَمِمَّا يُوقِدُونَ عَلَيْهِ فِي النَّارِ ابْتِغَاءَ حِلْيَةٍ أَوْ مَتَاعٍ زَبَدٌ مِّثْلُهُ ۚ كَذَٰلِكَ يَضْرِبُ اللَّهُ الْحَقَّ وَالْبَاطِلَ ۚ فَأَمَّا الزَّبَدُ فَيَذْهَبُ جُفَاءً ۖ وَأَمَّا مَا يَنفَعُ النَّاسَ فَيَمْكُثُ فِي الْأَرْضِ ۚ كَذَٰلِكَ يَضْرِبُ اللَّهُ الْأَمْثَالَ

(١٧ الـرعد)

STATEMENT

This dissertation is submitted to Ain Shams University for partial fulfillment of the requirements for the Degree of Doctor of philosophy in Civil Engineering

The work included in this thesis was carried out by the author in the department of Irrigation and Hydraulics, Ain Shams University.

No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

Date: / /2019

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CURRICULUM VITAE

Mr. Amr Fawzy has been active in the water resources engineering in many aspects since his graduation. In 2009, he got his master of Integrated Water Resource Management, Cologne-FH; through his master study in Institute for Technology and Resources Management in the Tropics and Subtropics, he studied the mathematical base of the numerical models that used to solve both hydrological and water planning / management problems. Furthermore, he got deep excursuses in water management and planning. Then, he was a water resources engineer in Nile Water Sector. Currently, he is involved in transboundary water management issues with Nile Basin Countries studies through his work as an senior engineer in the Ministry of Water Resources and Irrigation.

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ABSTRACT

Significant impact on Nasser Lake (NL) inflow is highly expected due to unilateral on-going development plans in some of Nile Basin countries and climate change negative impacts. For decades, NL is considered Egypt's fresh water bank, where Nile water is stored during flood to be used during the recession for agriculture, industrial, municipal and other uses. The expected development activities will have adverse effects on Egyptian water resources overcome, therefore new operation strategies and changes in infrastructure function are needed to adapt with such effects and meet future challenges. New creative ideas are suggested based on applying large scale Water-Food-Energy (WEF) nexus approach, to propose a development plan in the three main Khors which are the major water bodies within the lake. GIS and modelling tools such (ArcGIS 10.3, RIBASIM 7 and MATLAB 2016) were used to select the best scenario to implement the proposed plans. Results were affected mainly by the energy losses between pumping and hydropower and the limited capacity of Old Aswan Dam (OAD) reservoir. In addition, the economic feasibility of constructing renewable energy plants, the proposed infrastructure and WEF nexus approach offer a significant opportunity to meet future challenges. New operation strategies are proposed for NL to enhance the using of dead storage zone below 147 m AMSL, taking into consideration environmental issues.

Keywords: Nile Basin, WEF Nexus, Nasser Lake (NL), Khor Klabsha, High Aswan Dam (HAD), Old Aswan Dam (OAD), Arc-GIS, RIBASIM 7, Pump Station, Run-of-River hydropower, Supplementary Irrigation

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AMSL	:Above Mean Sea Level
BCR	: Benefit Cost Ratio
DEM	:Digital Elevation Model
GDP	: Gross Domestic Production
GIS	:Geographic Information System
HADL	:High Aswan Dam Lake
IDW	:Inverse Distance Weighted
MAF	: Mean Annual Flow
NWRC	:National Water Research Center
MWRI	:Ministry of Water Resources and Irrigation
MSL	:Mean Sea Level
NB	: Nile Basin
NL	:Nasser Lake
NREA	:National Renewable Energy Authority
PV Power Plant	:Photovoltaic Power Plant
RIBASIM	:Deltares Delft Hydraulics package
TIN	:Triangulated Irregular Networks
WEF Nexus	:Water, Energy, and Food Nexus