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Sudan and the Water Sciences Programmes of UNESCO

Abdin Salih, Mohammed Ombadi

Department of Civil Engineering, Faculty of Engineering, University of Khartoum
Khartoum, Sudan (E-mail: abdeensalih@gmail.com)

Abstract:UNESCO's contribution to enhance the knowledge base, research and capacity to sustainably manage water resources of the world is continually growing for a period close to seventy years (1948 to date). This paper summarizes the initiation of this programme in 1948, leading to the major project in Arid Zone which was followed by the IHD and then the famous current IHP which was enforced by the UNESCO water family that included as well as the UNESCO-IHE and WWAP. The paper gives a brief introduction of these initiatives and examples of the benefits gained by Sudan in the various stages of these initiatives. It also encourages further enhancement in Sudan's interaction with the UNESCO water family.

Keywords:*UNESCO; Water Initiatives; Arid Zones; IHD; IHP; Sudan.*

1. INTRODUCTION

UNESCO's contribution to enhance the knowledge base, research and capacity to sustainably manage water resources of the world is continually growing for a period close to seventy years (1948 to date). This paper summarizes this journey starting with ideas of 1948, the Major Project of Arid Zones, to the International Hydrological Decade (IHD-1965 to 1974), and the International Hydrological Programme (IHP-1975 to date). IHD made a great contribution to the knowledge base and capacity in hydrology, but IHP went further in that direction by enhancing its scope significantly to the wider field of Water Resources Management. This great contribution has been strengthened within the last few years to produce the UNESCO "Water Family" constituted from IHP, the UNESCO-IHE Institute for Water Education, and the World Water Assessment Programme (WWAP). Many countries of the world made significant use of these great contributions from UNESCO, including the Sudan. In this review paper an introduction of these programmes and a sample summary of that contribution and its interaction with the Sudan will be highlighted in order to enhance the country's benefits from this important programme in future.

2. HISTORY OF WATER IN UNESCO

Water is an essence for the human lives not only because of the essential domestic needs, but also because of its cardinal role in the development of countries and the perpetuation of global sustainability. Given the ubiquity of water-related conundrums in today's world: the inadequate access to safe drinking water, the lack of sanitation, the increased pollution of freshwater resources, altered weather patterns of floods and droughts caused by climate change, increasing demand for irrigated agriculture, and the numerous disputes over water resources, it is not surprising that water has drawn the attention of UNESCO from an early time. This is better elucidated by the following lines of protest by Michel Batisse, who witnessed the growing emergence of water issue in UNESCO at an early time of its establishment, "Water and its management are a priority issue in UNESCO's scientific programmes. And yet water and natural resources in general are not mentioned in Unesco's constitution and were not even referred to during the working sessions leading to UNESCO's creation in 1946" [1]. Batisse went further and explained why this omission of water is not surprising "Water is first of all a practical problem dealt with by specific institutions such as the World Health Organization (WHO) for potable water and the United Nations Food and Agricultural Organization (FAO) for irrigation water" [1]. However, though these two organizations have tackled very well these two aspects, the wide perspective of water that include scientific and managerial aspects was later on successfully dealt with by UNESCO.

UNESCO's involvement in the realm of water started when "its member states voiced loudly the importance of creating an international institute for studying issues related to natural resources including water resources through a decision of its General Conference in 1948 ordering its establishment "[2]. These views were strengthened further by a decision from its General Conference in 1950 to establish a global programme on Arid and Semi-Arid Zones. It must be recorded with pride in this regard, that Sudan ,with its growing arid zone belt, was there in these dialogues represented by the late Mr. AbdelrahimBayoumi, the then Director of Development of

Rural Hydraulic Resources in Sudan, who served in the advisory committee on Arid Zone Research. In 1956 the Major Project on Scientific Research on Arid Lands had been initiated through a decision of the General Conference held in New Delhi. This project had contributed significantly to the knowledge-base and capacity development in the arid and semi-arid zones of the world including the Sudan .It also put the foundation for the launching of the International Hydrological Decade (IHD) in 1965 [3].

The idea of establishing the International Hydrological Decade (IHD) was formally adopted in UNESCO's General Conference in 1964 in Paris and the Decade was officially launched in January, 1965. " IHD consolidated understanding of the hydrological cycle, compiled the first comprehensive water atlases and reference works, fostered programmes to train new water researchers, established protocols for collecting and exchanging information, and perhaps most significantly, drew public attention to the importance of water" [4]. IHD beyond all dispute contributed highly in enhancing the knowledge base in water sciences and hydrology. Quoting from AndrasSzollosi-Nagy "It may sound an overstatement but IHD indeed pushed hydrology into becoming a science" [5]. The mid-1970s had witnessed the end of the IHD and the commencement of the International Hydrological Programme (IHP) which has evolved from the IHD. The authors could not find any record on direct involvements of the Sudan in IHD. Noting that this period coincided with the post October 1964 popular revolution where significant setback occurred on the recording of hydrological information and links with UNESCO's water programmes.Thus one could expect some sort of unrecorded benefits, noting that Sudan was one of the founders of the arid zone programme.

3. THE INTERNATIONAL HYDROLOGICAL PROGRAMME (IHP)

3.1 The foundation and Development of IHP

Founded in 1975 as a follow-up to the International Hydrological Decade, IHP is operated through phases of about six years; each phase adopts a handful of themes that are pertinent to the needs of member states of UNESCO. This approach enables the programme to adapt to the kaleidoscopic nature of our world. It only requires one look at the particular themes of each phase to realize the dramatic change in the orientation of IHP, which has evolved from a pure scientific programme, one that followed the same trend of IHD, to a programme that besides its scientific aims it also encompasses cultural, social and economic considerations. In fact, IHD itself had witnessed a significant change in its approach, quoting from Michel Batisse "Naturally the programme could not be limited to the somewhat academic approach of its beginnings, when it was focused solely on inventorying knowledge and exchanging scientific information. As time went on and more funds were set aside for the programme, more direct and localized actions came to be associated with it" [1].

The core themes of the first three phases of the IHP (1971 – 1989) had followed the same directions of IHD (1965 – 1974) focusing on developing methods and techniques in order to acquire better understanding of the hydrological phenomena. However, it was on the 4th phase (1990 – 1995) that the programme had crossed these boundaries to sustainability, water resources development and management adopting as a core theme "Hydrology and Water Resources for Sustainable Development". In the 5th phase of IHP the same trend had been followed but with more emphasis on managing water resources in vulnerable ecosystems choosing "Hydrology and Water Resources Development in a Vulnerable Environment" as a core theme. As the world came to understand that there is no way to advance social justice without sagacious management of water resources, the core theme for IHP-VI had been defined as "Water Interactions: Systems at Risk and Social Challenges".

During 2006 and 2007, an overall UNESCO Science Programme Review was conducted which noted that the world faces new challenges related to unequal economic development, environmental degradation, and globalization. This was the baseline for making the transition from IHP-VI to IHP-VII [6].

Response to arising priorities and needs of member states has, as well, influenced the formulation of the current 8th phase of IHP (2014 – 2021) adopting "Water Security: Responses to Local, Regional, and Global Challenges" as the overarching theme, following UNESCO's extension of its short term strategies to eight years.
Fig.1 provides a summary of the different phases of IHP with their overarching and sub themes as well as illustrating the transitions in the orientation of the different phases of IHP.

3.2 IHP Response to Landmarks

Global efforts in water in the form of mega conferences have been taking place since the beginning of the 1970's when the UN Conference on the Human Environment was held in Stockholm, Sweden in 1972. However, the first major and substantial water meeting at a high political level is the United Nations Water Conference in 1977 which was held in Mar del Plata, Argentina. Sudan was there represented by the secretary general of the conference Mr. Yahia Abdel Mageed, who wrote about the conference saying "It is hoped that the Water Conference would mark the beginning of a new era in the history of water development in the world" [7]. The outcome of the conference was eight recommendations and twelve resolutions covering many aspects of water: assessment of water resources, agricultural water use, pollution control, and regional and international cooperation among others [8]. UNESCO's IHP and WMO's OHP were entrusted with providing UN member states with scientific methods and training programmes for their water resources assessment; a responsibility that IHP and OHP took very seriously and made significant contributions.

In 1992, the UN Conference on Environment and Development (Earth Summit) was held in Rio de Janeiro, Brazil. It resulted in Agenda 21 which is an action plan with regard to sustainable development; the 18th chapter of the agenda "the Protection of the Quality and Supply of Freshwater Resources" gave a high priority to the

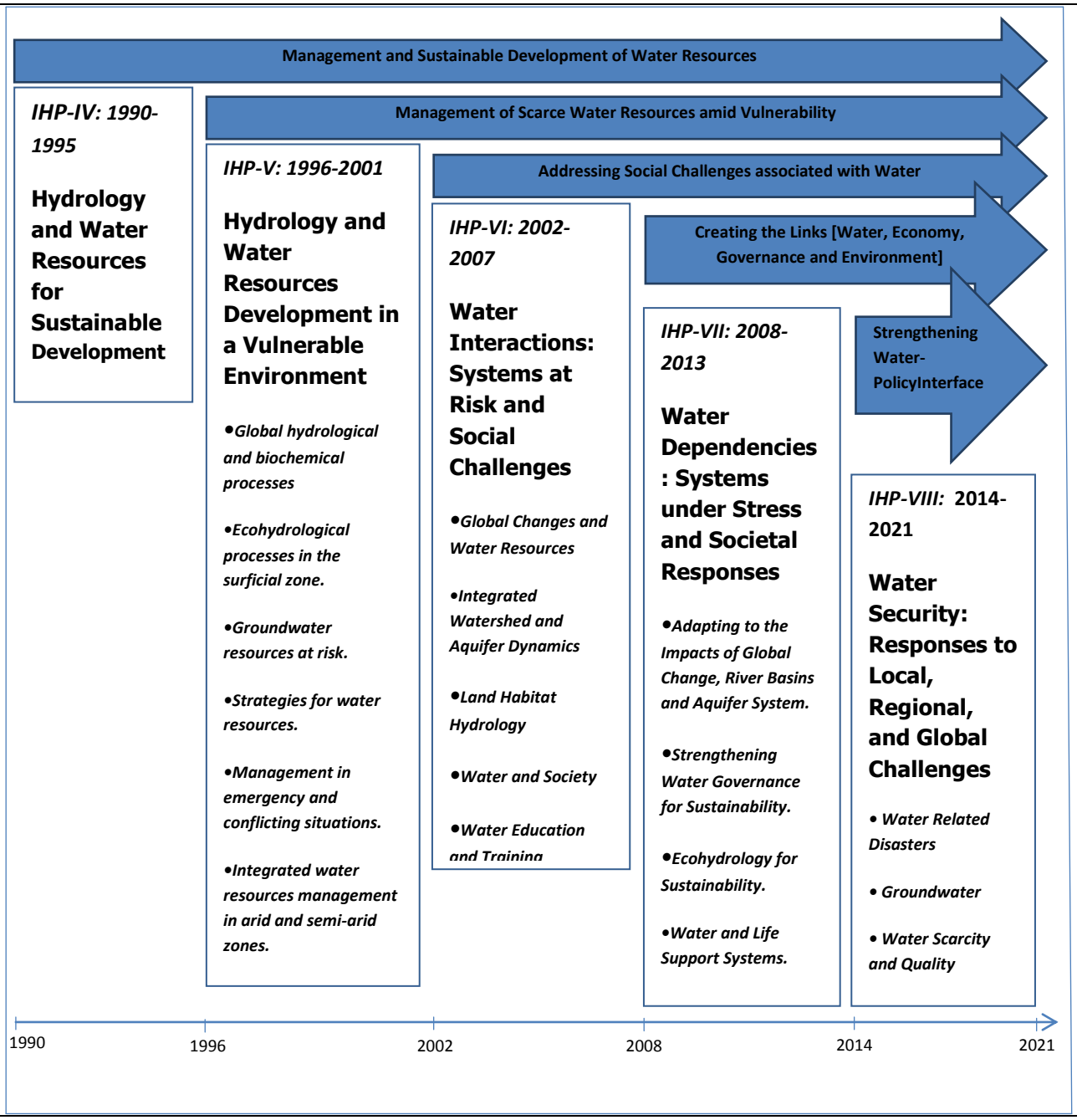

Fig. 1. Main Transition in IHP themes

conservation of water resources through their sustainable management. This has been well embraced by the IHP-VI with its overarching theme "The management and sustainable development of water resources".

Eight years later, the Millennium Development Goals (MDGs) were established following the Millennium Summit of the United Nations in 2000. It refers to water in "Target 10" under "Goal 7" which states "Halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation". The contribution to the achievement of the MDGs has been incorporated as part of the planning principles and implementation plans inall recent phases of IHP.

In September 2015 the Sustainable Development Goals (SDGs), which is also known as the 2030 Agenda for Sustainable Development has succeeded the MDGs. While the sixth goal of the SDGs "Clean Water and Sanitation" is entirely about water, there are many other goals thatare related to water including the 13th goal on climate change. Certainly the challenges of water security, which are addressed by the current 8thphase of IHP, will benefit from the current movement towards the Sustainable Development Goals.

3.3 IHP's Associated Activities, Chairs, and Centers.

Since the commencement of IHP in the mid-1970s, many supporting initiatives have been established in the form of Crosscutting programmes and associated programmes. Table.1 lists some of theseprogrammes. The implementation of the these programmes and IHP approved themes is greatly strengthened by thirty six chairs and twenty five category-II regional centres, distributed within the different regions of UNESCO. The Sudan has its share from these chairs and centres represented by the UNESCO Chair in Water Resources at Omdurman Islamic University and the Regional Centre on Capacity Development and Research in Water Harvesting.

REFERENCES

[1] Das, B.M. (2002). Principles of Geotechnical Engineering, 5th Edition, Brooks/Cole, Pacific Grove, California, pp. 268 - 311.

[2] Holtz, W.G. (1960), "The Effect of Gravel Particles on Friction Angle," ASCE Research Conference on Shear Strength, pp. 1000-1001.

[3] Hawley, P.M. (2001). Site Selection, Characterization, and Assessment. In: W.A. Hustrulid, M.K. McCarter and D.J.A. Van Zyl (Editors), Slope Stability in Surface Mining. Society for Mining, Metallurgy, and Exploration, Inc (SME). Littleton, pp. 267-274.

[4] Holtz, R.D. and Kovacs, W.D. (2003). An Introduction to Geotechnical Engineering. Civil Engineering and Engineering Mechanics Series. Pearson Education Taiwan Ldt., 733 p.

[5] Kirkpatrick, W. M. (1965), "Effect of Grain Size and Grading on the Shearing Behavior of Granular Material, " Proceedings 6th International Conference on Soil Mechanics and Foundation Engineering, Vol. I, pp. 273-277.

[6] Cho, G.C., Dodds, J. and Santamarina, J.C. (2006), "Particle shape effects on packing density, stiffness, and strength: Natural and crushed sands," Journal of Geotechnical and Geoenvironmental Engineering, 132: pp. 591-602.

[7] Bishop A.W. (1996). The strength of soils as engineering materials Géot, 16, 2, 91-128

[8] El-Ghonaimy, A.Y. (1992). Prediction of shear strength for Port Said soft clay, M.Sc. Thesis, Faculty of Engineering, Cairo University, 144 p.

[9] Koumoto, T. (1989), "Dynamic analysis of t0068e fall cone test," J. Jpn Soc. Irrigation, Drainage and Reclamation Engng, Vol. 144, pp. 51-56.

[10] Koumoto, T. (1990), "Determination of the both liquid and plastic limits of clay by the fall cone test," J. Jpn Soc. Irrigation, Drainage and Reclamation Eng. Vol.146, pp. 95-100.

[11] Morrow, C.A, Shi, L.Q. and Byerlee, J.D. (1984), "Permeability of fault gouge under confining pressure and shear stress," Journal of Geophysical Research, 89(B5): pp. 3193-3200.

[12] E. S. Abu Seif and E. M. Abd Al-Aziz (2008), "Geotechnical Factors Governing Shear Strength Of Quseir Shale In Dakhla Oasis, Western Desert, Egypt," Journal of Engineering Sciences, Assiut University, Vol. 36, No. 1, pp. 131- 145, January 2008.

[13] Lagaly, G. (1989), "Principles of flow of kaolin and bentonite dispersions," Appl. Clay Sci., vol. 4, pp. 105 - 123.

[14] Muller-Vonmoos, M. and Loken, T. (1989), "The Shearing Behaviour of Clays," Applied Clay Science, vol. 4, pp. 125-141.

[15] Skempton, A. W. (1957), "The Planning and Design of New Hong Kong Airport," Proceedings of the Institute of Civil Engineers, London, Vol. 7, pp. 305–307.

[16] Tsiambaos, G. (1991), "Correlation of mineralogy and index properties with residual strength of Iraklion marls," Engineering Geology 30, pp. 357-369.

[17] Khera, R.P., and Krizek, R.J. (1968), "Effect of principle consolidation stress difference on undrained shear strength," J. Soil. And Foundation, vol., VIII, No., 1, pp. 1-17, the Japanese Society of Soil Mech. and Found. Eng.

[18] Lambe, T.W. and Whitman, R.V. (1969). Soil Mechanics, Wiley Eastern Limited, New Delhi.

[19] Koumoto, T. and Houlsby, G.T. (2001), "Theory and practice of the fall cone test," Geotechnique, LI, No. 8, pp. 701-712.

[20] Manish K.M, Sudheerkumar, Y. and Sreedeep S. (2014), "Undrained shear strength of cohesive soils at consistency limits," International Conference on Civil and Chemical Engineering – ICCCE 2014; Nov. 2014.

[21] Toll, D.G. (2000), "The Influence of Fabric on the Shear Behaviour of Unsaturated Compacted Soils," Advances in Unsaturated Soils, Geotechnical Special Publication No. 99 American Society of Civil Engineers, pp. 222-234.

[22] Brackley, I.J.A. (1973), "Swell pressure and free swell in compacted clay," In: COKCA, E., TILGEN, H.P., 2010: Shear strength-suction relationship of compacted Ankara clay. Applied clay science 49, pp. 400–404, ISSN 1872-9053.

[23] Brackley, I.J.A. (1975), "A model of unsaturated clay structure and its application to swell behavior," In: COKCA, E., TILGEN, H. P., 2010: Shear strength-suction relationship of compacted Ankara clay. Applied clay science 49, pp. 400–40, ISSN 1872-9053.

[24] Bowles, J. (1995). Foundation Analysis & Design, 5th edition, McGraw-Hill, New York, USA.

[25] Ladd, C.C. (1991), "Stability evaluation during staged construction," Journal of Geotechnical Engineering, 117, pp. 540–615.

[26] Boulanger and Idriss (2007), "Residual shear strength of liquefied soils, " 27th USSD Annual Meeting, March 2007.

[27] British Standard (1990). British Standard 1377, Methods of Test for Soils for Civil Engineering Purposes. British Standard Institution, London.

[28] Mohamed, A.E.M. (1986). Microstructure and swelling Characteristics of an Untreated and Lime-treated Compacted Black Cotton Soil, Ph.D. thesis, University of Strathclyde, Glasgow.

[29] Zumrawi, M.M.E. (2000). Performance and Design of Expansive Soils as Road Subgrade, Thesis Submitted for the Degree of Ph.D. in Highway Engineering,

Chang'an University, China.
[30] Elsharief A.M, Zumrawi M.M.E. and Salam A.M. (2014), "Experimental Study of Some Factors Affecting Swelling Pressure," University of Khartoum Engineering Journal (UOFKEJ), Vol.4 Issue 2, pp. 1-7.