JOURNAL INDIAN ASSOCIATION OF SEDIMENTOLOGISTS ISSN NO 2582 – 2020
Vol. 39, Issue 2, 2022, pp. 1-2
DOI: **https://doi.org/10.51710/jias.v39iII.267**

Geology of Wetlands: key for their conservation and development

Wetlands are prevalent in all types of landscapes around the world and constitute landforms, soil units, water features and faunal and floral communities. Wetlands sustain flora and fauna in the surface layer and they are dynamic and changing as such are reffered to as living landforms. Wetlands provide natural solutions for achieving "the Paris Climate Goals, Global Biodiversity Framework, and Sustainable Development Goals". Unfortunately wetlands have not received due attention by geologists even though geology and geological processes are at the baseline for their evolution and development. The main reason is a poor understanding of wetland landforms. Wetlands can develop only in regions where water accumulates, and the underlying surface/bed rock is impervious. They constitute unusual landforms developed by biogenic materials (solid materials, biological or organic mostly peat, gas and water) predominantly formed by biological processes.

Wetlands can be broadly classified as 1) mineral wetlands which generally develop in high-energy environments and 2) peatland wetlands which dvelop in low-energy environments. They either go through terrestrialization or paludification during the course of their development. Wetlands as landscape and economic resource are important and will continue to remain so in the future. They are intimately connected to the surroundings within their individual basins and watersheds. The geology of wetlands focuses on understanding these relationships (Moore, 2001). Sustainable use and management of wetlands are of paramount importance to conserve and enhance these resources to serve the needs of the associated faunal and floral communities and, protect the environment and health of human society.

India has nearly 4.6% of its land as wetlands which cover an area of 15.26 million hectares which constitute largest network of wetlands and Ramsar sites in South Asia. The 49 Ramsar sites in the country cover an area of 10, 93,636 hectares as of February 2022. The Indian wetland ecosystems are distributed in different geographical regions; most of these are directly or indirectly linked with major river systems (the Ganges, Cauvery, Krishna, Godavari and Tapti). There are 27,403 wetlands in India including 23,444 inland wetlands and 3,959 coastal wetlands. These cover around 4.63 percent of India's land area, with paddy cultivation accounting for 70% of that. The natural wetlands in India include high-altitude wetlands in the Himalaya, flood plains of major river systems, saline and transient wetlands in dry and semi-arid regions, and coastal wetlands (lagoons, backwaters, estuaries, mangroves, swamps, and coral reefs, etc.).

With the increasing awreness about global warming, climate change and their adverse impact on human society, wetland science has gained importance, refinement and has been widely recognised as a distinct and unique discipline in the environmental sciences. What is now needed to conserve this resource and its sustainable management is to understand the intricacies of wetland landforms, its hydrodynamics, biogeochemistry, fauna and flora, ecology and its linkages with climate, natural and anthropogenic interferences. In order to learn the intricacies of these elements of wetlands, role of geology and geological processes form the baseline for advancement in wetland science.

During 1900s geologists initiated to work on wetland geology but today geologists need to be involved with wetlands and to play their leading role, especially in view of current environmental and economic issues, like climate change, landscape development and rehabilitation, sustainable use of wetland resource, surface water and groundwater conservation and management, and health of human society. Geologists' interest in wetland geology should go beyond their narrow historical role with regard to peat as an economic resource, and must engage with much broader issues in understanding the origin, character, development, and management of the overall wetland resource. The new outlook and inputs from geologists will go a long way for plans and designs to ensure that wetlands remain intact, and engineers are enable in restoring and sustaining wetlands. This new outlook will indeed provide solution to the challenges of working with wetlands in the landscape and inventing nature-sensitive technologies and codes of debvelopment of wetlands.

Climate determines the sustainability of wetlands because it can both supply and remove water from them. If either of the two factors, geological setting or climate, impacts storage of water on the land surface, a wetland will not form. In case any one of these factors changes, the existing wetlands will perish. Low land wetlands termed as "Mineral wetlands" occur in high-energy settings and often exchange water with lakes, rivers or oceans in their vicinity. On the other hand, highland wetlands termed as peatlands occur in low-energy settings and are more independent of adjacent extraneous landscape units. Geology of the surrounding landscapes impact the evolution and development differently in these two cases. Peatlands are important repositories of paleoenvironmental information (Warner and Bunting, 1996). As such, they can be long-term time capsules of climatic changes, geomorphic changes, natural catastrophes and human activities. The signatures preserved in peat and organic sediment or geochemical markers in the peat and deep interstitial waters are the primary tools for reconstructing the past events.

Human activities may be responsible for setting up conditions conducive to wetland formation or promoting its developmental processes (e.g. Warner et al., 1989). Geologists have an important role to play in assessing human impacts on wetlands, because not all intact wetlands are as natural as we think. In particular they have a major role to play in assessing peatland carbon stocks, characterizing the dynamics of carbon cycling, and developing predictive models of carbon and climate change (Frolking et al., 2001; Blodau, 2002). Some wetlands may overlie important groundwater aquifers, which support numerous wetlands and important aquifers used by the dense population around them (e. g., Sharpe et al., 2002). Wetlands are important for protecting surface and ground waters and drinking water supplies from complex biogeochemical trasformations which occur in them and attinuate contaminants in runnoff water coming from variety of human activities (i.e. Devito et al., 2000).

Geologists have also a role to play in our national carbon inventory because the net carbon stored in our wetlands greatly exceeds the carbon stored in our forests and agricultural soils.

Wetland sediments are a sealed archive of the historical information to be unravelled. The sequence of sediment types and their contained fossils provides a detailed record of how a particular wetland developed and enables the scientist to reconstruct the course of succession at that site. The microscopic fossils (diatoms, pollen grains) in the sediments can provide additional information about the changing conditions (past landscapes, modern polution problem, increasing acidity of rainfall, provide information about the evolution and development of living organisms and ecosystems) as the succession proceeds.

Wetland geology is far more relevant and important than is generally assumed. geology cource needs to be included in school curriculam which delas with wetlands. More emphasis should be laid on wetland science by including courses on Quaternary and environmental geology and on related subjects at the university level. State and Central governments need share a greater responsibility for care of valuable wetland resource for conservation and protection. Much more efforts need to be taken by the professionals to raise awareness among average citizens and governments of the relevance of conservation and protection of wetlands as biological landforms.

References

Blodau, C., 2002, Carbon cycling in peatlands – A review of processes and controls: Environmental Reviews, v. 10, p. 111-134.

Devito, K.J., Fitzgerald, D., Hill, A.R., and Aravena, R., 2000, Nitrate dynamics in relation to lithology and hydrologic flow path in a river riparian zone: Journal of Environmental Quality, v. 29, p. 1075-1084.

Frolking, S., Roulet, N.T., Moore, T.R., Richard, P.J.H., Lavoie, M. and Muller,S.D., 2001, Modelling northern peatland decomposition and peat accumulation: Ecosystems, v. 4, p. 479-498.

Moore, P.D., 2001, Wetlands: Facts on File Inc., N.Y., 200 p.

Sharpe, D.R., Hinton, M.J., Russell, H.A.J., and Desbarnts, A.J., 2002, The need for basin analysis in regional hydrogeological studies: Oak Ridges Moraine, southern Ontario: Geoscience Canada, v. 29, p. 3-20.

Warner, B.G. and Bunting, M.J. 1996, Indicators of rapid environmental change in northern peatlands in Berger, A.R. and Iams, W.J., Geoindicators: Assessing rapid environmental changes in earth systems:A.A. Balkema, Rotterdam, p. 235-246.

Warner, B.G., Kubiw, H.J. and Hanf, K.I., 1989, An anthropogenic cause for quaking mire formation in southwestern Ontario: Nature, v. 340, p. 380-384.

G. M. Bhat
Department of Geology
University of Jammu, Jammu
bhatgm@jugaa.com; bhatgm1@rediffmail.com