World Bulletin of Social Sciences (WBSS)
Available Online at: https://www.scholarexpress.net
Vol. 6, January,2022
ISSN: 2749-361X

MONITORING OF WATER QUALITY

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Article history:

Received: November 7 th 2021
Accepted: December 7th 2021
Published: January 12th 2021

Abstract:

Fresh water supply is a major challenge to agriculture in semi-arid zones and deep groundwater pumping for irrigation is applied widely in such regions to span droughts. However, climate change and overexploitation of groundwater reservoirs foster instability and qualitative degradation of aquifers, thus adaptation measures to increasing water scarcity such as the construction of fresh water reservoirs from surface runoff were applied during the last decades. Small-scale retention basins seem to be ecologically more appropriate in comparison to large dam systems, as construction of large dams causes deforestation and harmful impacts on wildlife. In this context, the ways of controlling and monitoring of water will be discussed

Keywords: Resource, Water Quality, ISO, Water Pollution, Human Activities, Monitoring, Management Actions

Water is a critical natural resource and its availability affects social, economic and ecological sustainability. For humans and ecosystems water, quality is as important as water quantity (UNESCO 2012[1]). Many ecosystem services are derived directly from water and agricultural activities especially in semi-arid and arid climate zones depend on the availability of fresh water.

Today, we consider water as one of the scarcest natural resources on our planet. It is important to humankind, animals, and plants]. Depending on the quality of water, it may be either a source of life and good health or a source of diseases and deaths. The growing environmental degradation in recent years brought about by development, population increase and climate change increases the need for researchers to look into its negative impact in the environment, especially in water sources and its implication. Increasing water pollution in oceans, lake, and river triggers worldwide demand more advanced methods in environmental monitoring systems particularly in the field of water quality monitoring. Moreover, developing countries like the Philippines rely on the conventional methods of collecting water samples and water analysis. Due to lack of technical know-how and a huge amount in the initial investment, water analyses are usually done through conventional procedures or by using portable testers which are not only expensive and laborious but also lack the capabilities for real-time data acquisition, analyses and fast dissemination of gathered information which are crucial and essentials for effective water quality monitoring endeavor.

Water Pollution – any physical, chemical, or biological change in water quality that has a harmful effect on living organisms or makes water unsuitable for desired uses. Pollutants may be biodegradable, non-biodegradable, or slowly degradable. Sewage, industrial chemicals, heavy metals from industrial processes, and household cleaners are examples of materials commonly discharged into streams and rivers. Additional water pollutants include chemicals, pesticides, fertilizers, motor oil, litter, and other components of polluted runoff. Pollutants that come from the air – a process called atmospheric deposition, can also pollute water.

Gross organic pollution leads to disturbance of the oxygen balance and is often accompanied by severe pathogenic contamination. Accelerated eutrophication results from enrichment with nutrients from various origins, particularly domestic sewage, agricultural run-

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off and agro-industrial effluents. Lakes and impounded rivers are especially affected.

Agricultural land use without environmental safeguards to prevent over-application of agrochemicals is causing widespread deterioration of the soil/water ecosystem as well as the underlying aquifers. The main problems associated with agriculture are salinization, nitrate and pesticide contamination, and erosion leading to elevated concentrations of suspended solids in rivers and streams and the siltation of impoundments. Irrigation has enlarged the land area available for crop production but the resulting salinization, which has occurred in some areas, has caused the deterioration of previously fertile soils. Direct contamination of surface waters with metals in discharges from mining, smelting and industrial manufacturing is a long-standing phenomenon.

However, the emission of airborne metallic pollutants has now reached such proportions that long-range atmospheric transport causes contamination, not only in the vicinity of industrialized regions, but also in more remote areas. Similarly, moisture in the atmosphere combines with some of the gases produced when fossil fuels are burned and, falling as acid rain, causes acidification of surface waters, especially lakes. Contamination of water by synthetic organic micropollutants results either from direct discharge into surface waters or after transport through the atmosphere. Today, there is trace contamination not only of surface waters but also of groundwater bodies, which are susceptible to leaching from waste dumps, mine tailings and industrial production sites.

The extent of the human activities that influence the environment has increased dramatically during the past few decades; terrestrial ecosystems, freshwater and marine environments and the atmosphere are all affected. Large-scale mining and fossil fuel burning have started to interfere measurably with natural hydro geochemical cycles, resulting in a new generation of environmental problems. The scale of socio-economic activities, urbanization, industrial operations and agricultural production, has reached the point where, in addition to interfering with natural processes within the same watershed, they also have a worldwide impact on water resources. As a result, very complex inter-relationships between socio-economic factors and natural hydrological and ecological conditions have developed. A pressing need has emerged for comprehensive and accurate assessments of trends in water quality, in order to raise awareness of the urgent need to address the consequences of present and future threats of contamination and to provide a basis for action at all levels. Reliable monitoring data are the indispensable basis for such assessments.

The International Organization defines monitoring for Standardization (ISO) as: "the programmed process of sampling, measurement and subsequent recording or signaling, or both, of various water characteristics, often with the aim of assessing conformity to specified objectives". This general definition can be differentiated into three types of monitoring activities that distinguish between long-term, short-term and continuous monitoring programs as follows:

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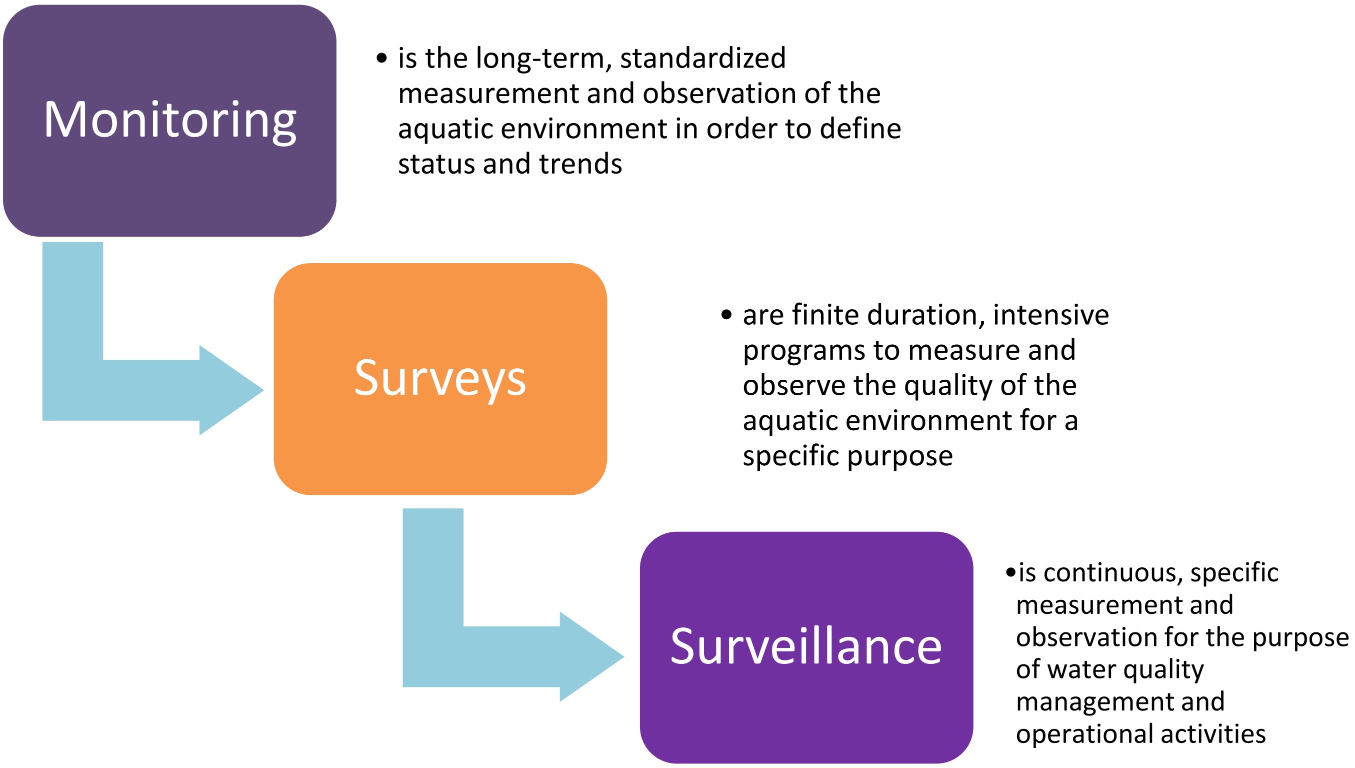

Equally importantly to note the emphasis given to collection of data for a purpose in the definitions of water quality monitoring above. This aim is most commonly related to water quality management, which aims to control the physical, chemical and biological characteristics of water. Elements of management may include control of pollution, use and abstraction of water, and land use. Specific management activities are determined by natural water quantity and quality, the uses of water in natural and socio-economic systems and prospects for the future.

Before the planning of water sampling and analysis can be started, it is necessary to define clearly, what information is needed and what is already available and to identify, as a major objective of the monitoring program, the gaps that need to be filled. It is useful to prepare a "monitoring program document" or "study plan", which describes in detail the objectives and possible limitations of the monitoring program. Figure 1.1 outlines the contents of this book in relation to the process of developing such a plan, its implementation and the interpretation of the findings. If the program's objectives and limitations are too vague, and the information needs inadequately analyzed, the information gaps will be poorly identified and there will be a danger of the program failing to produce useful data.

Water quality monitoring is the foundation on which water quality management is based. Monitoring provides the information that permits rational decisions to be made on the following:

• Describing water resources and identifying actual and emerging problems of water pollution.

• Formulating plans and setting priorities for water quality management.

• Developing and implementing water quality management programs.

• Evaluating the effectiveness of management actions.

Moreover, climate change and in particular increasing temperatures and changes in hydrological patterns such as droughts and floods will affect water quality and exacerbate water pollution from sediments, nutrients, dissolved organic carbon, pathogens, pesticides and salt, as well as thermal pollution. Further, sea-level rise is projected to extend areas of salinization of groundwater and estuaries and thereby influencing the availability of freshwater for humans and ecosystems in coastal areas.

Water quality is usually affected by organic loading from the aforementioned activities. Such include

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sewage containing pathogens in waste streams from humans and domesticated animals, agricultural runoff and human wastes loaded with nutrients (e.g. nitrates and phosphates) that give rise to eutrophication and oxygen stress in waterways. Others include salinization from irrigation and water diversions, heavy metals, oil pollution, synthetic and persistent engineered chemicals (e.g. Plastics and pesticides), medical drug residues and hormone mimetic and their by-products, radioactive pollution, and even thermal pollution from industrial cooling and reservoir operations.

When a water quality monitoring programme is being planned, water-use managers or similar authorities can reasonably expect that the programme will yield data and information that will be of value for management decision-making. The following are examples of the type of information that may be generated by a monitoring programme:

• How the quality and quantity of water in a water body relate to the requirements of users.

• How the quality and quantity of water in a water body relate to established water quality standards.

• How the quality of water in a water body is affected by natural processes in the catchment.

• The capacity of the water body to assimilate an increase in waste discharges without causing unacceptable levels of pollution.

• Whether or not existing waste discharges conform to existing standards and regulations.

• The appropriateness and effectiveness of control strategies and management actions for pollution control.

• The trends of changes in water quality with respect to time as a result of changing human activities in the catchment area. Quality could be declining as a result of waste discharges or improving as a result of pollution control measures.

• Control measures that should be implemented to improve or prevent further deterioration of water quality. •

The information required from a monitoring programme does, however, provide an indication of the type of programme that should be implemented. Some monitoring programmes will be long-term and intended to provide a cumulative body of information; others will have a single objective and will usually be of short duration.

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