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Museum and Water Education: Issues, Perspectives and Way Forward

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Abstract:

The knowledge about issues and challenges of water resources sustainability is of prime importance as it contributes to our survival and welfare. There are limitations and challenges to monitor access and manage water resources across the globe. Surface water is susceptible to bacteriological contaminations, whereas groundwater is a hidden and finite resource that poses multiple problems for sustainable development. This article justifies these arguments of the present practice of water extractions, limitations, and scope of conservation through mass sensitizations and community participation approach towards the goal of water sustainability. The involvement of museums would be a new paradigm to spread mass awareness about water education to large numbers of audiences. The large numbers of people visiting museums belong to the different sections, age groups, and education levels of our society. The establishment of a museum exclusively displaying water-related issues would help to make aware to the public aware of the gravity of water challenges and sustainability issues that our earth is likely to confront shortly. Water is an integral part of the environment, which is undergoing innumerable changes in different spaces and times. Water resources are depleting to an alarming extent, which need to be restored and managed to maintain their pristine states in the facade of rising exploitation pressures for various needs of humans. Mass water education, awareness, and public interaction programmes in combination with water policies, laws, and community participation would be the key to safeguarding our future generations from water scarcity disasters. To make everyone part of the water conservation and decision-making process on the local scale, water education is mandatory and museums would play a vital role in the water campaign.

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1.0 Introduction

The role of the museum as an informal center of education has quite markedly changed during the last 20 years. The museum laid more focus on its societal role and responsibility towards making awareness of conserving nature, the environment, and precious natural resources. Water is a precious natural resource for the sustenance of life forms and the environment. Judicious management of water resources is very important for ensuring the sustainability of flora and fauna including human beings and planet earth. Water is essential for all living beings including human life, livestock, etc. Given its key role in all spheres of life, sustainable planning, and management of water resources is inevitable. Considering its increasing scarcity at a rapid rate, water resources demand the utmost attention to maintain the ecological balance in addition to the economic and other developmental activities. Therefore, in the current context, the best possible, cost-effective, and reasonable use of this precious resource is of paramount importance to maintain its sustainability. For the livelihood of more than one billion population in India, location-specific micro-level water management is of pre-requisite. The sustainability of water resources is a complex issue having linkage to different sectors of the Indian economy including agricultural, industrial, domestic, power, environment, fisheries, transportation, and tourism sectors. The water resources management practices should be on par with the accelerated demand for more water supplies. The practices should address the demand and supply management aspects, especially under water-stressed water conditions. For maintaining the quality of freshwater, water quality assessment and problem-specific management strategies are required to be developed and implemented. For the planning and management of the water resources projects, robust decision support systems (DSS) and infrastructure are required to be developed. There is the interplay of various factors that govern access and utilization of water resources and in light of the increasing water demand, it becomes important to look for holistic and people-centered approaches for water management. It is evident that drinking water is precious and long-term availability is a prime concern of the population, so this gigantic responsibility can not be left to a single institution only. The combined initiative and efforts of everyone are needed if, in the real sense, the socio-economic development is to be achieved. Uninterrupted secured drinking water availability would be ensured if we can develop a typical bent of mind to attend to the issue seriously. The present article deals with the review of the importance of mass awareness to educate the people of all spheres in different tiers, especially through the means of museums aiming that common people come forward to preserve the valuable water resources in the country.

The leading museums are considered vital and reliable knowledge bearers within human society. Hence, consciousness is a must about the consequences that ascend from signifying Indigenous peoples, and the facts being communicated through the museum as actuality. This accountability has motivated the New

Museological era (Dubin 2001:83-99; Cobb 2005:488). The term 'Museum Education' encircles the complete museum operation, by the 1930s the educational role of museums was mostly restricted to working with the school children at the primary level. Since then, educational perspectives have evolved and broadened until, at the present-day time, various museums can be observed to be taking up their public ardently, and opportunities for information, encouragement, amusement, and facts are being unwrapped (Hooper-Greenhill, E., 1991). Time has arrived to explore the idea of a more accountable museum and the necessity of an amplified wisdom of socio-economic aspects and environmental caring as the substance for future sustainability to make the museum acceptable in the forthcoming social and environmental transformation of society. Difficulties with organizational efficiency are the methods for augmenting better organizational consciousness of societal concerns. The concept of progressive museum practice addresses the probable consequences of indecision, which proposes the necessity of museums on the same wavelength as the challenges and goals of the communities (Janes, R.R., 2010). The web-based education texts make a noteworthy input to sense-making by motivating thoughts, inspiring reflection, portrayal prevailing experience and knowledge, and refining the curiosity of visitors, which is largely accomplished through the descriptions power of narrative and exploration, and their capability to challenge the standing approaches and embrace the museum visitors in historical and modern events and state of affairs (Glover Frykman, S., 2009).

2.0 Methodology

Interrelation of the museum sector and possible mechanism of mass sensitization have been visualized to develop awareness about the precarious situation of water scarcity across the world to museum visitors. Systematic water education has been thought over in multiple steps including an audio-visual running display about water issues and challenges at the entrance of the museum followed by fundamental water perspectives on the ground floor of the water museum coupled with further detailed displays of models on water disciplines like Geology, Hydrogeology, Geophysics, Hydrology, Hydrogeochemistry, and Hydrometeorology in the first and second floors of the water museum. This systematic chronological orientation of the water galleries would guide the museum visitors to have water education in totality at one go. This basic water education through the museum would help to build alertness on water scarcity and its future threat among the visitors.

3.0 Discussion

3.1 Global water availability

Total global water resources amount as 1400 million cubic kilometers (m km^3) and cover around 70% of the earth's surface area. Of total global water wealth, seawater accounts for 97.5% and is saline in nature. Freshwater resources availability

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accounts for 35 m km^3 only. Total freshwater resources include 68.7% frozen in ice caps, 30% stored in underground aquifer systems, and on the surface of the earth only 0.3% water is available. The surface water resources include 87% in the lakes, 11% in the swamp, and 2% in the rivers. Despite utmost endeavour, entire potable water is not possible to extract wholly and only 1% of the total potable water can be utilized by human beings (Anon. 2006).

As the water was available in abundance, initially it was considered as a free resource for generation after generation. But, with increasing demand for water for various uses and subsequent depletion of the available water table, consequently assured supply of fresh water has become a mounting concern. On account of the uneven distribution of water resources throughout the different continents, the problem is arising out of the availability of surplus water in some countries and many other countries are suffering from severe water scarcity. Similarly, the skewed growth of population in various continents is developing a widespread inequality between the existing population and the availability of water resources. Out of the total continents, Asia alone holds 36% of the available freshwater reserves, whereas with over 60% of the world's population water is a scarce commodity.

Indeed, in comparison to Asia, the situation in Africa is better, where 13% of the population has access to freshwater reserves at the rate of 11%. Australia and Oceania have an abundance of water resources with 1% population owning 5% of the freshwater, followed by North and Central America, with 8% population and 15% water, and South America with 6% global population and 26% freshwater resources. Culture, lifestyle, and industrial development are the controlling factors of the water use pattern of the different countries for generations, as the availability of water was not a grave worry. It may be observed that the per capita water use is only 245 m^3 per year in Africa followed by 478 m^3 in South America, 519 m^3 in Asia, 713 m^3 in the former USSR, 1280 m^3 in Europe, and 1861 m^3 in North and Central America.

The available water is generally used for agriculture, industrial production, and domestic purposes. Water is also needed for fishery, hydro-power generation, transportation, and maintaining biodiversity and ecological balance. The proportion of water used for agriculture and industries varies from country to country depending on the lifestyle, extent of industrial development, and water use efficiency.

The developing countries use comparatively less water for agriculture and more for industrial and domestic purposes. Contrary to this, developing countries like India and Africa use 80-90% of the water for agriculture and only 5-12% of the water for industrial use. This is reflected in the inefficient use of water in agriculture and poor investments in industrial development. With urbanization and industrial development, the usage of water is likely to increase in the coming years. It may also be noted that the per capita water use in India will increase from the current level of 99 liters per day to 167 liters per day in 2050. On the other hand, currently, the per

capita consumption in the USA will reduce from 587 liters to 484 liters per day (lpd) in 2050.

Water is life because plants and animals cannot live without water. Water is needed to ensure food security, feed livestock, take up industrial production, and conserve the biodiversity and environment. Although India is not a water-poor country, due to the growing human population, severe neglect, and over-exploitation of this resource, water is becoming a scarce commodity. While this is a growing concern worldwide, India is most vulnerable because of the growing demand and in-disciplined lifestyle. This calls for immediate attention by the stakeholders to make sustainable use of the available water resources to ensure a better quality of life.

3.2 Water Resources of India

Rainfall influences people in several ways, such as livelihood, economy, etc., although agriculture is the career most dependent on rainfall. More than 70% of the rural population in India relies on agriculture for their livelihood (FAO of UN). India is blessed with good rainfall well distributed for 5 to 6 months in a year. The average annual rainfall in the country is 1170 mm with a wide range between 100 mm in desert areas of Rajasthan to 10000 mm in Cherapunji. The total available sweet water in the country is 4000 billion m3 per annum. Out of this, over 1047 billion m^3 of water is lost due to evaporation, transpiration, and runoff, reducing the available water to 1953 billion m^3 and the usable water to 1123 billion m^3. It is disturbing to note that only 18% of the rainwater is used effectively while 48% enters the river most of which reaches the ocean. Out of the total usable water resources, 728 billion m^3 is contributed by surface water, and 395 billion m^3 is contributed by replenishable groundwater. The replenishment of the sub-surface aquifer system is happening through the recharge received from rainfall as part of the hydrological cycle. Against the above supply, the water consumed during the year 2006 in India was 829 billion m^3 which is likely to increase to 1093 billion m^3 in 2025 and 1047 billion m^3 in 2050, as estimated by the Government of India (2009). As the potential for increasing the volume of utilization of water is only just 5-10%, India is bound to confront the severe scarcity of water in the forthcoming years.

India is the largest user of groundwater. With growing domestic, industrial, and agricultural demand, the stress on groundwater resources is ever-increasing its sustainability has become an issue of concern. Groundwater availability and reliability are closely linked with food security. Dynamic groundwater resources assessment of India in 2022 indicates that the total annual groundwater recharge is 437.60 billion cubic meters (BCM), out of which annual extractable groundwater resources are estimated as 398.08 BCM. The average stage of groundwater extraction in India is 60.08% (Central Ground Water Board, 2022).

While water for consumption is most vital, it is equally important to provide water for irrigation to augment food production and livestock husbandry, to ensure

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food security for the ever-increasing population. Accelerated population growth, as everyone is aware, is a grave concern as it will create a further burden on the per capita water availability in the future. The per capita water availability in 1951 was 5177 m^3 per year when the total population was only 361 million. In 2001, as the population increased to 1027 million, the per capita water availability reduced drastically to 1820 m^3 per year. By 2025, the per capita water availability will further drop down to 1341 m^3, and 1140 m^3 in 2050. Based on the average requirement of water for a variety of uses, the circumstances are considered as a water stress situation and water scarcity condition when the per capita water availability ranges from 1000 to 1700 m^3 per year, and when the availability reduces to 1000 m^3 per year respectively. As the water available within the country varies widely as a result of rainfall, groundwater reserve, and proximity to river basins, most of the Indian States will have reached the water stress condition by 2020 and water scarcity condition by 2025. This would further hinder food security, as the scarcity of water resources will in a way restrain the agricultural growth.

At present, despite the appreciable distribution of rainfall, India is unable to make optimum use of rainwater, because of a lack of awareness and insufficient infrastructure to erect water storage structures like dams and reservoirs. Consequently, only about 35-40% of the cropping area receives irrigation to grow single or occasionally double crops in a year. Out of the total cultivable area of 182 m ha, only 140 m ha are under net cultivation and of this, 62 m ha are under irrigation. There is further potential to enhance the area under irrigation to 140 m ha, which would include 76 m ha from surface water, and 64 m ha by using groundwater resources. So far, the irrigation potentials have already been created to cover 107 m ha, although they are not utilized effectively. It is estimated that the effective area under irrigation by 2025 will be 76 million ha, although the Government of India is estimated to cover 104 million ha. Groundwater is the major source of irrigation and this trend will continue. Around 60 million ha will be irrigated by using groundwater by the year 2025, whereas by 2050, the area under groundwater irrigation may increase up to 70 million ha. In 2000, the area under canal irrigation was 17 million ha, which will increase to 27 million ha by 2050. There is further scope to increase the potential by 35 million ha, by interlinking the rivers and harnessing 36 billion m^3 through artificial recharging of groundwater (Government of India, 2009).

In addition to irrigation, innumerable rivers in the country are used for generating hydropower. Out of the estimated hydropower potential of 1,50,000 MW, only 21% has been developed so far and an additional 10% of power generation projects are under implementation. Presently, the country is facing many difficulties in further tapping the potential, due to difficult sites, forest conservation concerns, inter-state issues, poor implementation, and lack of commitment. It is also possible to develop multipurpose projects for power generation and irrigation which can improve the project viability while increasing water supply.

The water supply as well as human health conditions is severely affected by water pollution. Access to drinking water is available for 4 to 6% urban population in India, whereas 5% of the total water is used for domestic use and 27% of the village people. Apart from the inadequate supply of water, there is a serious concern about the quality of water, which is severely affecting health. The study reveals that more than 70% of the water consumed by the rural population in India does not satisfy the World Health Organization (WHO) standards. The detailed survey indicates that about 80% of rural illnesses, 21% of transmissible diseases, and 20% of deaths among children within the age group of 5 years have a direct link to consumption of contaminated water.

Water pollution is caused by the cumulative effects of the discharge of untreated sewage and industrial effluent into rivers, excessive use of fertilizers in agriculture, and contamination of groundwater with salts and minerals available in the underground soil zones. Lack of proper scientific treatment of sewages also causes a major contribution towards groundwater pollution. The estimation reveals that about 36 million tons of sewage is generated every day in New Delhi only; out of which only 50% gets treated and the remaining portion is allowed to let into the Yamuna River directly without any treatment. A similar grave situation is also prevailing in other cities as well. In 23 major cities, out of total sewage water generated only 31% is treated and the rest untreated part is polluting the 18 major rivers in the country. The fluorides, nitrites, and several toxic metals are also contaminating most of the rivers in our country. At present, more than 66 million people are prey to fluorosis after consuming water containing >1.5 ppm fluoride. In addition to this, poor sanitation in both rural and urban areas is one the reasons reason for the major pollution of drinking water sources. Toilet facilities are accessible to only 30% and 65% of rural and urban populations respectively. The water tanks and open wells are contaminated by the nitrates and other harmful germs coming from human excreta flowing down through percolation.

No precise estimate details are available regarding the areal extension of groundwater pollution on account of the extreme application of chemical fertilizers and pesticides. The reason for the problem is not only due to the excessive use of fertilizers but in addition, indiscriminate extraction of water for irrigation is also the key factor to be taken into consideration for groundwater pollution. Consequently, it is observed in irrigated areas that the majority of the well water used for drinking purposes is polluted. Unplanned and too much irrigation has also been responsible for further damage to soil health since the percolated water reaching the sub-surface layers of soil facilitates the release of salts to dissolve into the water in this region. Subsequently, these salts come to the topsoil through capillary action. Such soils with high concentrations turn into sodic wastelands unfit for agricultural production. At present around 9 million ha of fertile irrigated lands have been converted into sodic wastelands and the high concentration of salt in water is unfit for human consumption as well as for agricultural production. The incidences of illnesses are

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high as the people living in these villages are being forced to drink such hard water having no alternative sources.

3.3 Water Conservation for Secured Future

Water conservation is now a vital element in fulfilling the accelerated demand for fresh water and its long-term sustainability. This calls for cautious attention to water utilization to minimize waste and decrease environmental impacts. Careful treatment of the water at every step of processing would be important for meeting the freshwater requirement today. The natural resources scenario of the country is changing fast both in terms of availability as well as quality. The situation is further aggravated by the looming climate change which is going to alter the paradigm of management of natural resources. Water is a critical natural resource and is being affected by increasing population, industrialization, urbanization, pollution, deforestation, and above all climate change. We have to fight Water Scarcity by striking a balance between Water Usage and Water Replenishment by sensitizing all the stakeholders. "Water conservation refers to every policy, managerial measure, or user practice that aims at conserving or preserving the water resources and combating its degradation, namely focusing on its quality, while water-saving aims at limiting or controlling the water demand and use, thus avoiding wastes and the misuse of water"(Pereira et al., 2012).

Water is everybody's business and indeed everybody is professing ways, means, and solutions for addressing the issues. There is a plethora of ideas, paradigms, and philosophies put forth by experts, activities, civil society, media, etc. from their perspectives on the management of water. This has resulted in incoherent and divergent opinions regarding the current state of the sector as well as the required future action to tackle the challenges. To have a focused and uniform approach to tackle the challenges in the coming decades, it is very much important that all stakeholders are sensitized about the current scenario, future needs, and the need for a proper scientific and rational approach to mitigate the issues and challenges collectively.

3.3.1 Water Security Scenario

Freshwater is the maximum critical aid for mankind, cross-slicing all social, financial, and environmental activities. It is a circumstance for all existence on our planet, a permitting or proscribing issue for any social and technological development, a probable supply of welfare or misery, cooperation or conflict. To acquire water security, we should shield inclined water systems, mitigate the effects of water-associated risks consisting as floods and droughts, protect get right of entry to water features and offerings, and manipulate water sources in an incorporated and equitable manner. United Nations Educational, Scientific and Cultural Organization (UNESCO) works to construct the clinical know-how base to assist international locations in manipulating their water sources sustainably through the

Intergovernmental Hydrological Programme (IHP), through main the UN-huge World Water Development Report, and several Centers and Chairs on water across the world.

3.3.2 Water Foot Print (WFP)

Increasing water scarcity across the globe is a burning phenomenon at the present age. The introduction of the WFA idea was conceived by Hoekstra in 2003. This is an indicator of freshwater use that takes care of both direct uses of water by consumers or producers along with indirect water use. The water footprint has been conceptualized to have a trademark among water use and intake of humans. A well-described water footprint of rustic consists of the extent of water is applied to the products and offerings, that are fed on with the aid of the humans of the specific United States. The virtual water idea is exactly related to the idea of water footprint (Chapagain et al, 2004). Virtual water is described because of the extent of water required to provide a commodity or service. International alternatives of commodities imply flows of digital water over huge distances. The water footprint of a country may be assessed with the aid of taking home water assets, subtracting the digital water waft that leaves the United States, and uploading the digital water waft that enters the country. The inner water footprint of a country is the extent of water used from home water assets to provide the products and offerings fed with the aid of the population of the country. The outside water footprint of a rustic is the extent of water utilized in different nations to provide items and offerings imported and fed on with the aid of the population of the country.

3.4 Water Education: Future Trend and Sustainable Approach

3.4.1 Tertiary and Professional Education (TPE)

Human capacities and know-how of the water region and associated regions ought to be ensured to ensure frequent get entry to freshwater and deal with complicated demanding situations related to social, economic, climatic, and different elements at local, nearby, and worldwide tiers. The goal of TPE consists of the following (UNESCO, 2021):

• Support the enhancement of tertiary water schooling capacities, mainly in growing countries. Promote and help the improvement of interdisciplinary and multidisciplinary curricula and studies tasks related to water-associated packages in better schooling and studies institutions.

• Strengthen collaboration among UNESCO-IHE Institute for Water Education, the UNESCO Category II Water Centers, UNESCO water-associated Chairs, different UN machine organizations and programmes, and present worldwide water-associated schooling programmes. • Promote and assist techniques and movements for the non-stop expert improvement of water scientists, engineers, managers, and coverage makers inside the water region.

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• Develop interdisciplinary substances, inclusive of recommendations, briefing papers, prototype expert improvement programmes, and case research linked with water schooling for water security, related to the implementation of different IHP subject matters and programmes.

3.4.2 Vocational Education

IHP will goal to keep and increase the schooling of technicians in water-associated fields, inclusive of hydrometeorological monitoring, irrigation structures, sanitation, and water delivery structures. A crucial thing of this focal location could be to survey and put together case research with examples of main practices in sustainability including water control for the schooling of water technicians. The approach targets the following:

• Support particular tasks in growing Member States to preserve and enhance water-associated vocational schooling.

• Survey, put together, and examine case research of examples of main practices in sustainable water control inside the schooling of water technicians and assist the instruction of recommendations and briefing papers primarily based totally on them.

• Develop efforts inside UNESCO and in partnership with different UN machine organizations and programmes to keep and increase the schooling of technicians in water-associated fields.

3.4.3 Children and youth

Water schooling must be a widespread thing of the K-12 curriculum. Although formal schooling structures are the primary cognizance here, different tasks could be considered, inclusive of the improvement of water-associated sports in children's eco-clubs, sports activities clubs, and explorer groups. Intergovernmental Hydrological Programme (IHP) will pursue intently with UNESCO's Education Sector, in addition to different companion agencies with the task of improving water schooling in schools. IHP provides scientific knowledge and research skills cooperating with existing initiatives and world-class organizations, particularly about the issue of transboundary waters. The application can even goal to enhance the potential of instructors and casual educators to apprehend water problems on the local, nearby, and worldwide scales, and to decide on a water ethic. The targets are as below:

i) Develop the potential of instructors and casual educators on water problems on the local, nearby, and worldwide scales.

ii) Support and manual improvement of stepped-forward equipment for the coaching of water problems within the K-12 curriculum.

iii) Guide and offer technical assistance to national/nearby demonstration initiatives and the improvement of prototype substances at national/nearby tiers in chosen Member States/regions.

iv) Provide technical help for the improvement of interdisciplinary assist substances, inclusive of recommendations, briefing papers, and case research on main practices in K-12 water schooling, and curriculum improvement on water resources, in coordination with different UNESCO Sectors.

3.4.4 Informal Water Education

The groups are required to have enough expertise and perception knowledge approximately the troubles touching the watershed, ii) the herbal, social, and cultural situations together with guidelines and protocols, monetary traits and increased potentialities to be concerned in water control and conservation measures. They additionally want to be extra enthusiastically related and prepared to yield the favored goal. The water training sports for groups might be advanced via way of means of the IHP in partnership with the IHP National Committees. Mass media experts can play a crucial function in growing consciousness of water-associated issues and troubles. Yet restricted efforts had been made to teach them about water troubles, and so reviews are specifically on intense water-associated situations, while preventive measures or movements relative to disasters, conflicts, contamination, lack of existence, and herbal assets are not applicable. If journalists, bloggers, radio, television, film, and different media experts recognize the significance of local, local, and international water troubles, this may be a powerful mechanism for growing standard public consciousness. The goals of the techniques are as below:

- Develop and sell network training techniques associated with water troubles (nation of the resource, conservation, co-control, amongst others).
- Provide technical help for the improvement of interdisciplinary aid materials, which include guidelines, briefing papers, and case research on the main practices of in-water training for groups.
- Provide technical help for the improvement of interdisciplinary aid materials, which include guidelines, briefing papers, and case research on main practices of in-water training for mass and network media experts.
- Engage main mass media experts in consciousness-elevating campaigns and programmes.

3.4.5 Education for the Co-operation

Many of the massive basins and aquifer structures for the duration of the globe are in transboundary nature having enlargement in among or extra countries. Hence, the conservation of water sources and sustainable control aim is to want to be initiated through negotiations and mutual know-how among the involved states. But the handiest few establishments the world over have committed guides or initiatives

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highlighting the water negotiation for cooperation. The IHP allows the development of tutorial organizations that facilitate transboundary water cooperation and mutual know-how. The smart practices and steerage equipment on shared water sources control and negotiation are compiled and evolved via way of means of a long-term IHP project, i.e., Potential Conflict of Co-operation Potential (PCCP). The ongoing transboundary control and negotiations may be evolved in this section to help the Member States through their endeavors like new potential constructing equipment, guidelines, curricula, and case research. Objectives:

- Provide technical help for the boom of interdisciplinary help sources, together with strategies, briefing papers, and case research on main practices in training and potential construction for transboundary water cooperation.
- Increase Member States' assistance and mutual know-how, improve talents, and develop agreements for the long-term control of transboundary water through potential constructing sports in any respect levels.
- Support the formula of curricula and studies on transboundary water cooperation in better academic establishments.

Apart from the above water education methods, the issues include also form an integral part of water education are as below.

i) Sustainability development goal;

ii) Capacity building for ecological sanitation;

iii) Flood mitigation;

iv) Water, sanitation, and sustainability;

v) Water for socio-economic development.

The thematic areas accompanying the water sector fascinate the necessity for water education as follows:

a) Climate change, environment,

b) Recharge to the water table-depleted aquifers,

c) effects of extreme weather events,

d) agriculture,

e) energy,

f) health,

g) industry,

h) urbanization,

i) reusing wastewater for the circular economy,

j) customer-led revolution, smart water network solutions,

k) Water conflicts, peace, and society.

The below-tabulated flow chart (Table: 1) for water education steps would be beneficial for a country to preserve precious water resources and achieve sustainable development goals for future generations.

Table 1: Water education flow model

Level of Participation (Through Sensitization/ Training/ Educational Course Curriculum/ Government Initiative/ PPP) ⇩													
Individual			Community			Academic			Industry	NGO	Office Sector	International Co-operation	Others
Common People	Farmers	Household	Village	Block	District/State	School	College	University					

NGO – Non-Government Organization; PPP-Public-private Partnership

3.5 Changing Role of the Museums in the 21st Century

Museums play a vital function in shaping and growing identities and bringing distinctive network organizations together, they're a catalyst for regeneration via the introduction of the latest venues and civic spaces and aid in growing the abilities and self-assurance of contributors of these communities. Conventionally, museums permit humans to discover collections for inspiration, studying, and enjoyment. They are establishments that collect, protect, and make on-hand artifacts and specimens, which they maintain in accept as true within society. Museums permit humans to discover collections for inspiration, studying, and enjoyment. They are establishments that collect, protect, and make on-hand artifacts and specimens, which they maintain in accept as true within society. Gift burning troubles like water, flood, strength, sanitation, etc. having a sturdy effect on society also are being taken into consideration as the concern timetable via way of means of the museums to train the public.

3.5.1 Water Museum Initiatives Throughout the World

The Times of India (timesofindia.indiatimes.com, September 20, 2019) suggested that there has been a concept towards the installation of a National Water Museum in New Delhi and numerous satellite museums in the different states of India, by the Union Jal Shakti (Water Resources) Ministry of Government of India,

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to create recognition regularly diminishing natural resources of water and the need of its conservation among the people. Apart from generating awareness, the museum additionally showcases the traditional practices of water conservation, contemporary traits, and practices of the groups who are efficaciously holding water assets.

3.5.1.1 A brief review of a few existing Water Museums of the World

a) Museum of Water, United Kingdom.
b) Water Museum of Venice, Water Museums, Global Network.
c) Santorini Water Museum, Greece, Water Museum, Global Network.
d) Museu da Agua, Lisbon, Portugal. Water Museum, Global Network
e) Water Museum of Bavaria "Haus am Strom", Germany.
f) National Water Museum of China, Hangzhou, China.
g) Kahramaa Water Awareness Park, Doha, Qatar.

3.5.1.2 Existing Water Museums in India

i) Water Heritage Museum and Bio-park at Kozhikode, Kerala.
ii) Living Waters Museum – Center for Heritage Management, Ahmedabad University, India.
iii) Water Resource Museum, Ludhiana, Punjab

3.5.2 Concept of a National Water Museum for Water Education in Mass Population

The demand for water among various sectors is increasing due to population growth and economic development, creating competition within sectors. The severity of this issue will have a direct impact on the water and food security of the country in the future. Due to the overexploitation of water resources, it has become scarce in many parts of the country. In this regard, the government has undertaken various programs in water conservation and management successfully from the inception of FYP in the country. In the course of all these programmes, the country became the largest producer of several millets and the second-largest producer of rice and wheat in the world. Among the number of programmes, CADWM, NWDA, and WDP were the major programmes for land development and water (resources) conservation and management in the country. Further, among externally assisted water sector projects, the World Bank is the primary source followed by ADC, JBIC, and Kfw, Germany. Many projects under the external assistance of these sources were completed and a few are ongoing in many States. All these programmes of underwater conservation created huge irrigation potential for agriculture and are trying to improve the water and food security situations in the country. In addition, they not only protect and conserve the environment but also contribute to the livelihood security of the rural poor. Therefore, the country still requires continued efforts of the government along with external aid, especially in the issues of global climate change and consumer awareness on water conservation. The government should come up with a new water

policy prescribing the role and involvement of individuals, community, and government in the conservation of water.

Water is life because plants and animals cannot live without water. Water is needed to ensure food security, feed livestock, take up industrial production, and conserve the biodiversity and environment. Although India is not a water-poor country, due to the growing human population, severe neglect, and over-exploitation of this resource, water is becoming a scarce commodity. While this is a growing concern all over the world, India is most vulnerable because of the growing demand and in-disciplined lifestyle. This calls for immediate attention by the stakeholders to make sustainable use of the available water resources to ensure a better quality of life.

3.6 Museum and Water Conservation

Water is one of the maximum vital sources on earth and as a part of the Henry Hauser Museum's persevering with water-themed events, a brand-new showcase will discover water conservation. The "Be Water Wise" showcase opens Saturday, from 1 to 3:30 p.m., at the museum and could be characteristic of a ribbon-reducing ceremony. The showcase is a collaboration with Water Wise software with a project of growing nearby consciousness and proper stewardship of water sources within the network. Water Wise has an extended record of over twenty years of running closer to that purpose through teen programmes, workshops, tours, lessons, and running with network leaders. Museum curator Nancy Krieski stated this felt like an excellent partnership with the museum that endured to inform the essential water tale of the network that becomes the focal point of the latest Smithsonian showcase hosted here. "I discovered a lot approximately the whole thing they've executed and for us to be part of that and hold our water tale from the Smithsonian Water Ways showcase, it becomes ideal timing," she stated. "Water Wise has had a dramatic effect on water conservation in this area." The showcase will have characteristic records accumulated in an oral record of the museum and Water Wise body of workers Rebecca Dailous and Mary Ann Capehart accumulated from founders Doug Dunn and Cado Daily.

Through lots of presentations and a group of items Water Wise has used over time for instructional purposes, site visitors will research no longer the records of the programme, however, methods they can comprise water conservation into their very own lives. "We have already had a few site visitors who got here in who these days moved right here who've been choosing up the statistics approximately the way to use gray water, the way to train themselves on the way to xeriscape and water harvest," Krieski said. "In the closing weeks the show-off has been open, human beings had been enthusiastic about studying that and having an aid to head to "I sense that through partnering with Water Wise and assisting to get the phrase out, their prolonged records, we're assisting the network and we've got already helped more than one human being be aware of our scenario and trying to discover ways to

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preserve water on their very own." The show-off additionally functions over a hundred and fifty posters created through nearby college students from 0.33 grades to 8th grade as a part of Water Wise's annual Water Conservation Poster Contest. From 1 to 1:30 p.m. on Saturday, Sierra Vista City Councilwoman Gwen Calhoun will gift the awards to the younger winners. The museum will even host a sequence of workshops, occasions, and lessons for each adult and youngsters with Water Wise beginning in June (figure: 1), all centered on water conservation (Source: http://www.sierravistaaz.gov/event/be-water-wise-exhibit-grand-opening)

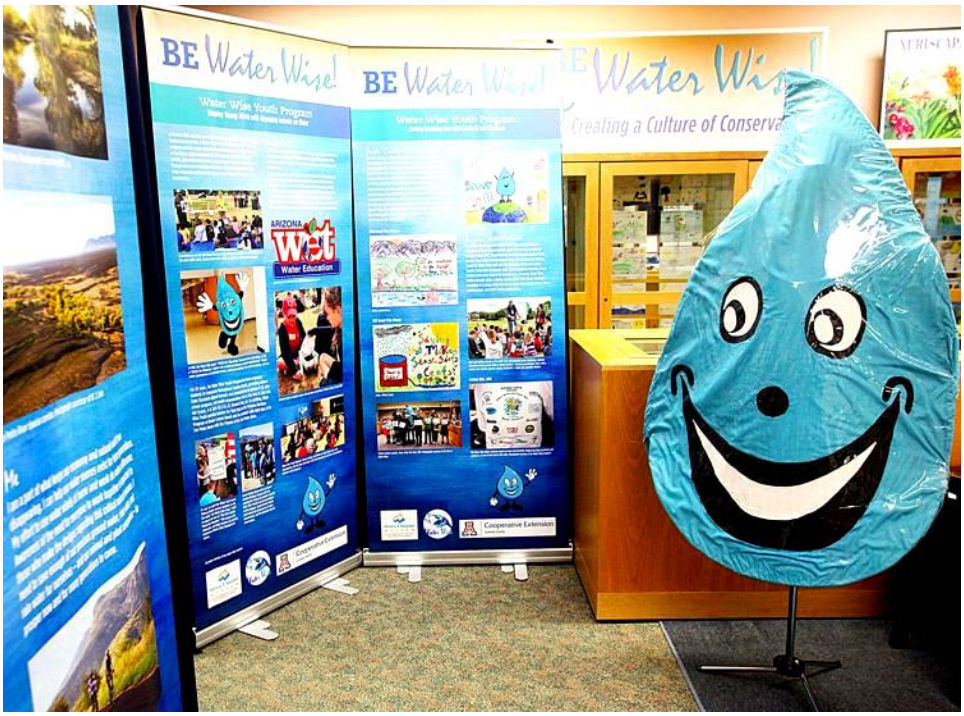

Figure 1: Creating a Culture of Conservation is the Be Water Wise title of the new exhibit in the Henry Hauser Museum. The exhibit opens on Saturday.

(Source: https://www.myheraldreview.com/users/profile/Jamie%20Verwys, 2019 (Accessed on 27/05/2021 at 2.24 pm)

3.6.1 Museum Education on Traditional Water Conservation Practices

The improvement significantly needs education. Education without cultures of humans in any society is hollow and inadequate. One of the main targets of the museum is to educate, and the museum has that functionality and the capacity to impart cultural training correctly because it homes the wished gear and sources for appearing the position via its collections. In cutting-edge society, the museums decorate academic improvement by exposing kids and the general public to their

antiquity in an optimistic way. They guide our successors to recognize and recognize their records and way of life and take pleasure in the successes of their forbearers.

Museums own substances and facts that may and must be utilized in enriching and enhancing the faculty curriculum in diverse disciplines. What is vital is for the instructional planners to paintings intently with museum professionals on how the instructional assets that might be to be had inside the museum may be included in the curriculum and the getting to know the procedure in any respect levels. On its part, the museum must broaden academic programmes for the diverse ranges of the faculty gadget, namely, number one schools, secondary schools, instructor schooling schools, technical schools, and universities, amongst others. A nicely articulated museum training programme becomes a vital factor inside the basic academic gadget of society.

Educational visits to the museums must be advanced and recommended to cater to all hobby groups, and as we method the flip of the century, it has emerged as vital for our museums to make certain that they emerge as children-friendly. As we input the brand-new millennium, we cannot disregard the function our kids can and must play in our society as they too are a part of our collective humanity. Workshop subject matters must accept a voice inside the museums. Special academic and cultural programmes must be advanced for them and that they must be allowed to be concerned in discussing programmes which might be made for them, as they do have thoughts of a good way to beautify such programmes if given a risk to make contributions and talk out. For too long we've neglected our kids, for too long we've taken them for granted, and far too long we've made them tag alongside the back of adults in maximum activities. I talk for our kids; I plead that our kids accept a risk to talk to us and I plead that we listen to the voices of our kids in our museums (Emmanuel N. Arinze, 1999).

3.6.2 Galleries in Water Heritage Museum

One sample design of a water museum addressing the audience for water education is enumerated below:

Design of a Water Museum for Water Education to the Audience	
Galleries of importance	
Hydrogeology Gallery	❖ **Audio-visual display** ➢ **G-1: Geology and Stratigraphy** ➢ **G2: Aquifer System -Transboundary Aquifers System** ➢ **G-3: Groundwater Provinces** ➢ **G-4: Groundwater Exploration – Methods & Equipments** ➢ **G-5: Aquifer Identification**

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	➢ **G-6: Well Construction and Well Assembly Design** ➢ **G-7; Well Development and Well Construction** ➢ **G-8: Well Development** ❖ **Audio-visual display: First Floor** ➢ **G-8: Groundwater Hydraulics- Hydrological Test and Aquifer Parameters Determination**
Hydrology Gallery	❖ **Audio-visual display** ❖ **Galleries:** ➢ **G-1: Hydrological Cycle** ➢ **G-2: Surface Water Resources** ➢ **G-3: Transboundary River System** ➢ **G-4: Sea Water Intrusion and Inland Salinity** ➢ **G-5: Climate Change and Water Sector** ➢ **G-6: Groundwater for Irrigation** ➢ **G-7: Global Warming**
Geophysics Gallery	❖ **Audio-visual display** ❖ **Galleries:** ➢ **G-1: Geophysical Methods and Applications in Water Sector** • **Electrical Logging of borehole** • **Composite log preparation for well assembly Design** ➢ **G-2: Electrical Resistivity Survey for identification of Sub-surface water-bearing zones** ➢ **G-3: Tomography** ➢ **G-4: Display on Herringbone survey** ➢ **G-5: Geophysical Apparatus & Equipments**

Hydrochemistry Gallery	➢ **Audio-visual display** ➢ **G-1: Geogenic and Anthropogenic Contamination** ➢ **G-2: Drinking & Domestic Water Quality** ➢ **G-3: Irrigation Water Quality** ➢ **G-4: Industrial water Quality** ➢ **Wastewater generation from infrastructure**
Water Management Gallery	➢ **Audio-visual show & Flip Chart Display** ➢ **G-1: Demand and Supply Management** ➢ **G-3: Conjunctive Use of SW & GW** ➢ **G-4: Integrated Water Resources Management** ➢ **G-5: Springshed Management in Hilly Regions** ➢ **G-6: Conjunctive use of surface water and groundwater** ➢ **G-7: Inter-state and international water Issues**
Traditional Water Wisdom Gallery	➢ **Audio-visual display** ➢ **G-1: Traditional Water conservation practices** ➢ **G-2: State-wise traditional water conservation practices** ➢ **G-3: Community participation in water resources identification and sustainable management.** ➢ **G-4: Groundwater Discharge and Recharge** ➢ **G-5: Community-wise traditional water conservation practices**
Climate Change Gallery	❖ **Audio-visual display** ➢ **G-1: Green House Gases effect on climate and Hydrological cycle** ➢ **G-2: Global warming perspectives.** ➢ **G-3: Initiative and Research on climate change**
Recent research on Water Science across the globe	❖ **Audio-visual display** ➢ **G-1: Current Research throughout the world** ➢ **G-2: Recent research initiatives in India**

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3.6.3 Orientations of Galleries

Orientations of Galleries in water museums are of paramount importance to help the audience to have systematic learning about water science. The displays may be in audio-visual mode and model display to explain the water subject. The following topics include both surface water and groundwater issues, challenges, and future sustainable management strategies that would be on display for the audience, who is the visiting water museum:

i) Embody Water
ii) Natural Sources of Water
iii) Rock cycle and Hydrological cycle
iv) Surface Water and Transboundary River system
v) Ground Water and Transboundary Aquifer system
vi) Hydrochemical evolution of water.
vii) Rain Gauge, Weather Monitoring and Forecasting; Climate Change and Environment.
viii) Conservation of water through Vessels or Containers and other means in the Ancient Era.
ix) Evolution of Water Pumping or Collecting Systems.
x) Surface water Irrigation –Issues and Challenges.
xi) Groundwater Irrigation –Ancient Methods and Latest Irrigation Technologies.
xii) Groundwater development and management through a Geophysical approach.
xiii) Application of Remote Sensing in the Water Sector.
xiv) Groundwater Exploration–Methods and Age-old practices.
xv) Over-exploitation of Groundwater Resources in the present day.
xvi) Environmental Degradation –El-Nino and La-Nino Land Subsidence, Coastal submergence, seawater Intrusion, and Water Disasters.
xvii) Surface Water Pollution –Pollution in the Rivers, Lakes, Canals, Seas, etc. by anthropogenic means.
xviii) Groundwater pollution –Arsenic, Fluoride, Salinity, Chromium, Uranium, Nitrate, Iron, etc., and social implications.
xix) Industrial pollution towards surface water and Groundwater.
xx) Preservation of the Water Resources – Community Participation and Farmer's Participation.
xxi) Preservation of Spring water resources, Geothermal Springs, and Awareness programmes.
xxii) Aquifer disposition, Geometry, Aquifer Mapping Information, and Management System.
xxiii) Tube well design.

xxiv) Rain Water Harvesting System (RWH), Managed Aquifer Recharge (MAR); Integrated Water Resource Management (IWRM) and Socio-economic development; Groundwater Regulation.
xxv) Rainwater storage structures – Dam, Reservoir Pond, and Canal system.
xxvi) Groundwater irrigation and Government Initiatives.
xxvii) Ganga River cleaning endeavor.
xxviii) Green Revolution and Water Stress.
xxix) Traditional Water Wisdom and signatures in historical perspectives.
xxx) Interrelation of water, livelihood, rituals, religion, and culture.
xxxi) Growth of Indian Civilization and influence of water.
xxxii) Water Transport and Tourism.
xxxiii) Water, Health, and sanitation.
xxxiv) Water Pyramids.
xxxv) Current Technologies to address forthcoming water management challenges.
xxxvi) Current global research to protect the liquid treasure and way forward.

3.7 Educational Programmes on Water

3.7.1 Target Audiences

The target audience for water education through museums may include the following:

a) Primary school children
b) Secondary and Higher Secondary School children
c) Young Adults (College and University Students)
d) Families
e) Tourists and Groups
f) Researchers, Scholars, Academicians
g) Artists and craftsmen associated with the making of Water Containers
h) Professionals associated with Water Conservation

i) General Visitors

3.7.2 Exhibitions: Temporary and Permanent Galleries

The museum visitors may learn about water perspectives through exhibitions as displayed in the temporary as well as permanent galleries in the following manner:

a) Museum Shop

- Publications
- Souvenirs/ Mementos

b) Museum Workshop

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4.0 Conclusions

India is a water-abundant country, but on account of utter negligence, lack of systematic monitoring of water resources development projects coupled with improper management leads to experiencing severe water stress in many regions of India. The country may face severe water scarcity in the near forthcoming decades unless due care is undertaken right now. Hence, it's high time to adopt the necessary initiatives to avoid the grim situation shortly through the best use of the available technologies and resources. The aim is to conserve the existing water resources, translate them into utilizable form, and make proficient use of them for various uses like agriculture, industrial production, Infrastructure generation, and human consumption. Enforcing water laws, imposing regulatory measures to restrict the wastage of water in combination with increasing the numbers of Para-Hydrogeologists, participation of the local community people, and introducing rewards and punishment for water miscreants would help to encourage careful use of water and spread water conservation initiatives among people. Further, awareness generation and related orientation of all the water users to modify their lifestyle patterns to motivate water conservation would help the country to overcome the water crisis in the future. The water challenge can be managed if we start practicing water conservation through reducing, reusing, and recycling (RRR) along with changing our lifestyles and adopting the national water policy guidelines as envisaged by the government. The displays in the museum galleries may include traditional water conservation practices, local knowledge, and current research advances coupled with innovative perspectives in water science, which would help to educate the visitors about water issues, challenges, and the significance of the preservation of precious wealth.

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