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SUSTAINABLE DEVELOPMENT OF WATER RESOURCES: CONCEPT AND IMPLEMENTATION

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ABSTRACT

Nowadays we all are talking about water sustainability. Now actually water and its sustainability have become two sides of the same coin. Water plays a very important role in our day to day life. It is a finite resource and its sustainability can only be accomplished if it is managed smartly. Smart water management is also a pre-condition of sustainable development. The purpose of this paper is to explore the fundamental concepts of sustainability/ sustainable development of water resources and its implementation in water resources management.

***Key words**: Sustainability; sustainable development; water resources; water sustainability; water management*

INTRODUCTION

The name sustainability is derived from the Latin word sustinere (tenere, to hold; sub, up). The primal meaning of Sustain is "maintain", "support", or "endure". Since the 1980s sustainability has been used more in the sense of human sustainability on planet Earth and this has resulted in the most widely quoted definition of sustainability as a part of the concept sustainable development, that of the Brundtland Commission of the United Nations on March 20, 1987(WCED,1987): "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

According to Simonovic (1997), Sustainability has become a unifying concept emphasizing the need to consider the impacts resulting from decisions and actions taken today, both on those living today as well as on those following in the future.

Sustainable also means continuing without lessening, Flint et al., (2002, 2003). Development means improving or bringing to a more advanced state, such as in our economy. Thus, sustainable development can mean working to improve human's productive power without damaging or undermining society or the environment—that is, progressive socio-economic betterment without growing beyond ecological carrying capacity: achieving human well-being without exceeding the Earth's twin capacities for natural resource regeneration and waste absorption[4]. Sustainability requires a different way of thinking about the consequences and implications of development decisions. This is leading to a new commitment based on fundamental linkages between environmental protection and management, economic development, and the social well-being of people. Sustainability is explicitly as a three-dimensional concept: (i) economic, (ii) environmental and (iii) social. Fig. 1 shows interaction among the three components with a middle 'zone of sustainability' which recognizes the interdependence of biological economic and social systems (Spies, 2003). This notion of three integrated aspects is called 'Three pillars of Sustainability"; Environmental Sustainability, Economic Sustainability, and Social Sustainability .

A redefined concept is of the community as whole system made up of three concentric circles (Fig. 2): the economy is found within society, and both economy and society exist within the environment. Sustainability indicators are therefore said to attempt to measure the extent to which these boundaries are respected, Mensah and Castro (2004).

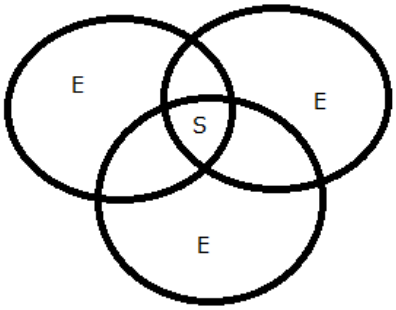

Fig1: The interaction of three E's (Economy, Environment, and Equity) with a middle zone of Sustainability (S)

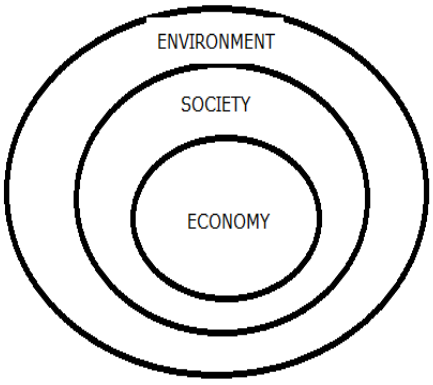

Fig 2: Sustainability measures as a whole concept (Source: Hart Environmental data, www.sustaianblemeasures.com)

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Flint (2004), said in his study that the word sustainability implies the ability to support life, to comfort, and to nourish. For all of human history, the Earth has sustained human beings by providing food, water, air, and shelter. Sustainable development is the centerpiece and key to water resource quantity and quality, as well as national security, economic health, and societal well-being.

Similarly according to Heintz (2004), sustainability is a concept that describes a dynamic condition of complex systems, particularly the biosphere of Earth and the human socioeconomic systems within it. It reflects both our fundamental values and our knowledge of the fundamental nature of life on Earth. Sustainable development is a program of action, a set of principles and ways of thinking about patterns of human activity that can be derived from the concept of sustainability and from our knowledge of how the world works. Sustainable development is also a social movement, a set of believs about how human activities should be conducted, that has been expanding in acceptance and applicability throughout the world for almost two decades. Sustainable development takes sustainability as an overarching long-term goal for humanity. It is clear that because water is essential to all life, water resources management, using the principles of sustainable development, will be essential for achieving sustainability.

AIM OF SUSTAINABLE DEVELOPMENT

The aim of Sustainable Development (SD) strategy outlined by Our Common Future is 'promote harmony among human beings and between humanity and nature'. In Our Common Future the definition of SD (development that meets the needs of the present without compromising the ability of future generations to meet their own needs) is based on two concepts – basic needs, and environmental limits.

Critical objectives for environment and development policies that follow from the concept of SD are: (i) reviving growth, (ii) enhancing the quality of growth, (iii) meeting essential needs for jobs, food, energy, water and sanitation, (iv) ensuring a sustainable level of population, (v) conservation and enhancing the resource base, (vi) reorienting technology and managing risk, and (viii) merging environment and economics in decision making.

WATER AND SUSTAINABLE DEVELOPMENT

Water is essential to life and the life processes of all living things. It is essential for meeting human needs and wants. Water is used directly for drinking, sanitation, and food production, and only slightly less directly for economic production across a very broad range of sectors. It is thus a primary basis for sustaining human well-being for generations to come.

The first global conference specifically dedicated to water was the United Nations Water Conference in 1977, in Mar del Plata, Argentina. The Mar del Plata Action Plan stimulated a number of activities, including the International Drinking Water Supply and Sanitation Decade (1981-1990). This decade, proclaimed by the full access to water supply and sanitation for all inhabitants of developing countries. Although this goal was far from achieved by the end of the decade, it was successful in creating awareness of the importance of clean water and sanitation in developing workable strategies for further improvements, Christmas and Rooy (1991).

The concept of sustainable development (SD) was first launched in World Conservation Strategy, a joint report by the IUCN, UNEP, and WWF(1980). Though there was little political commitment, strategy received wide attention. The concept really entered the political arena a few years later, when at the end of 1983 the General Assembly of the United Nations decided to form a World Commission on Environment and Development with the task of formulating 'a global agenda for change'. In 1987, the commission published its well known report - Our Common Future[1] also known Brundtland report, which set out the global challenge of sustainable development, 'to meet not only our current needs but also those of future generations'.

The most important political event since then has been the United Nations Conference on Environment and Development (UNCED) in June 1992 in Rio de Janeiro, Brazil, which produced Agenda 21, an action plan for the 21st century (Summit, 1992) . As a preparation for UNCED, the International Conference on Water and Environment (ICWE) was held in Dublin, Ireland, in January of the same year. ICWE was the most comprehensive water conference since the one in Mar del Plata, produced a Report of the Conference and a Dublin Statement (ICWE 1992a, 1992b), the latter containing four 'guiding principles' which should give direction to future water policies at local, national, and international level. Briefly, the first principle states that - as fresh water sustains life, development and the environment – a holistic approach to water management is needed, linking social and economic development with the protection of natural ecosystems. According to the second principle, water management should be based on a participatory approach, involving users, planners and policy makers at all levels. The third principle emphasizes the central role of women in the provision, management and safeguarding of water. The final principle states that water should be considered as an economic good, adding that it is vital to recognize first of all the basic right of all human beings to have access to clean water and sanitation at an affordable price.

In addition to these four principles, the seven sustainability criteria for water by Gleick (1995) are also mentioned, which give further insight into the key issues today. First, a minimum water requirement should be guaranteed to all humans to maintain health. Second, sufficient water should be guaranteed to restore and maintain the health of ecosystems. Third, data on water resources availability, use and quality should be collected and made accessible to all parties. Fourth, water quality should be maintained to certain minimum standards. Fifth, human actions should not damage the long-term renewability of fresh water stocks and flows. Sixth, institutional mechanisms should be set up to prevent and resolve conflicts over water. Finally water planning and

decision making should be democratic, ensuring representation of all affected parties and fostering direct participation of affected interests.

IMPLEMENTATION OF SUSTAINABLE DEVELOPMENT

Water, the basic element of the life support system of the planet, is indispensible to sustain any form of life and virtually every human activity. The global water cycle and the factors that affect the flow of water on and within the Earth's crust provide a natural capacity to supply water. The availability of water varies in time and space. In many places, human populations have tapped the available water to such an extent that there are times when there is not enough water for all the competing human uses, much less for supporting the functioning of aquatic and terrestrial ecosystems. There are also times when there is far too much water in some places, and its interaction with humans and their artifacts is costly to humans.

Awareness that water resource development has to be undertaken comprehensively and in terms of integrated development of component environment vectors, has been growing recently. The sustainable development of water resources is a multi-dimensional way of thinking about the interdependencies among natural, social, and economic systems in the use of water. Some conceptual and related studies to account for environmental aspects and sustainable management of water resources has been suggested of late. According to Golubev (1993) sustainable water development could be described as a set of actions securing the present functions of water without jeopardizing the interests of future generations in this area.

In Indian context a National Commission for Integrated Water Resource Development Plan (NCIWRDP,1999) has been set up by the Government to look into the integrated water resources development plan. According to Garg (Garg and Hassan, 2007) water scarcity is alarming and calls for urgent action before it becomes unmanageable. Sustainable water management in India poses numerous challenges, Jain (2012) : bridging the increasing gap between demand and supply, providing enough water for production of food, balancing the uses between competing demands, meeting the growing demands of big cities, treatment of wastewater, sharing of water with the neighboring countries and among the co-basin states, etc.

MEASURES FOR SUSTAINABLE DEVELOPMENT OF WATER RESOURCES

Globally less than 3% of the world's water is fresh – the rest is seawater and undrinkable. Of this 3% over 2.5% is frozen locked up in Antarctica, the Arctic and glaciers, and not available to human. Thus humanity must rely on this 0.5% for all of man's and ecosystem's fresh water needs. The distribution of this 0.5 % of fresh water is as follows:

- 10,000,000 km^3 stored in underground aquifers. Since 1950 there has been a rapid expansion of groundwater exploitations providing: 50% of all drinking water, 40% of industrial water,20% of irrigation water.
- 119,000 km^3 net of rainfall falling on land after accounting for evaporation.
- 91,000 km^3 in natural lakes.
- Over 5,000 km^3 in man-made storage facilities reservoirs. There has been a 7 fold increase in global storage capacity since 1950.
- 2,120 km^3 in rivers – constantly replaced from rainfall and melting snow and ice.

Above indicators shows water is indispensable natural resource on this earth. There should be priority to sustain water resources. Moving from a sectoral approach towards a holistic one, which captures interconnections between food, energy, health, trade, the environment and water is necessary. Water pricing, water efficiency, water reuse and recycling of water, technological advancement, and increased water tariffs will also be helpful to fulfill water demands in different sectors. Conventional and non-conventional programmes are to be equipped for reducing water requirement (Chawre, 2015). Apart from this the following measures are required for sustainability of water resources in India:

- Proper implementation of water Act.
- To control water pollution should be reduction in the use of chemicals fertilizers and feticides.
- Plantation of trees is useful to store water resources.
- Watershed management program me should be organized systematically.
- It is the duty of government to bring awareness among farmers regarding consumption of water.
- Water resources are to be purified and reused for consumption.
- Construction of dams without creating environmental problems.
- Appropriate water policy should be implemented and flexible changes according to climatic changes.
- Interlinking of rivers is required to protect water resources.
- Priority should be given to NGO's and Voluntary organizations in the implementation of water resource programme.
- The disputes of water resources among states and countries to be solved for equal and proper utilization of water resources.
- Mass awareness through advertisement is needed to understand the importance of water for future generations.

CONCLUSION

There is a lot of fresh water in the world but it is not always where man needs it. Awareness of water issues is increasing but translating awareness into action is very slow. Water resources management, using the principles of sustainable

development, will be essential for achieving sustainability. Actually sustainable development is a dynamic concept rather than a static state. It requires decision makers to be flexible to modify their approaches according to changes in the environment, human needs and desires, or technological advancement. Sustainability criteria must be added to the set of principles guiding water resources planning and management.

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