## Themes of WHSC-2009

The issues related to the conference theme i.e. Water – Harvesting, Storage and Conservation will be dealt under following three categories:

### (i) Policy Issues:

- ***Regulatory requirements for rainwater harvesting:*** Rainwater harvesting is exploding and so are the cities, states and other entities involvement with it. Still there is much confusion about what harvested rainwater really is. Understanding the local regulatory requirements is an essential first step in implementing a rainwater harvesting system. Regulatory requirements for rainwater harvesting system in India are very fragmented. Hence, this sub-theme aims to review various probable issues in order to develop new regulatory requirements or to modify existing one, if any, before implementing rainwater harvesting system.

- ***Policy initiatives for rainwater harvesting in different states - Rural vs. Urban scenario:*** While recent State and societal interest in rainwater harvesting in India is to be welcomed, in the backdrop of prevailing natural resources statutes, the nature of policy and legal initiatives taken so far at best present a fragmented and unidirectional approach. The need for a policy framework for water harvesting systems arises mainly because the prevailing policy statements like the National Water Policy (2002) do not touch extensively upon the issues pertaining to rainwater harvesting. There is a clear need to evolve a decentralized legal regime with regard to water harvesting for both rural as well as urban conditions, which empowers people and makes them real managers of resources. Hence, this sub-theme aims to critically review and discuss the policy initiatives taken so far and requirements of amendments, if any, for wider implementation of rainwater harvesting in rural as well as urban regimes.

- ***Development of surface water bodies vis-à-vis groundwater recharge:*** It is a common belief that groundwater is far better than surface water for different usage of human beings. But contaminated groundwater is very difficult to treat to make it usable. Thus the use of surface water bodies as a potential source of water for human consumption is ever increasing in present scenario. This sub-theme intends to discuss comparatively and formulate policy guidelines in order to develop surface water bodies vis-à-vis groundwater recharge as potential source of water for human consumption.

- ***Water pollution – standards for disposal, reuse, recycle, recharge, harvesting and storage:*** Freshwater scarcity and saline intrusion of coastal aquifers are currently problems for many regions due to anthropogenic activities and are predicted to get worse as human populations increase in affected areas. For many years, effluent discharges have been accepted as an important source for maintaining minimum stream flows. In order to prevent water pollution, there are standards formulated by State Pollution Control Bodies in India for disposal of treated wastewater into the surface water bodies and onto the land. Further, as sources of water supplies have become limited, there has been greater use and acceptance of reclaimed wastewater effluents for recycle and reuse, artificial groundwater recharge, rainwater harvesting and storage as an alternative source of water for a wide variety of applications. These practices, if not properly managed and regulated, can result in significant risks to public health. Thus there is a need to review existing wastewater disposal standards and develop and formulate water quality standards for reclaimed wastewater effluents for recycle and reuse, artificial groundwater recharge, rainwater harvesting and storage in order to safeguard human health.

- ***Water consumption for various uses – quality and quantity aspects:*** The objective of this sub-theme is to critically review current knowledge about the response of water consumers to different water conservation instruments. It encompasses the issues related to quality and quantity aspects of water use practices, responses to water policy instruments, and emerging paradigms which provide new opportunities for designing conservation strategies.

- ***Water Conflicts:*** The water conflicts are exasperated by the relative paucity of frameworks, policies and mechanisms to govern the use of water resources. Conflicts caused by severe water shortages could plague India in the coming decades as rivers dry up, groundwater is depleted and canals are polluted. It is widely acknowledged that prevention is better than cure. To prevent water conflicts we must be able to anticipate conflicts, engage in policy advocacy, and demonstrate through our own efforts as well as those of others, what physical, grassroots measures are required for reducing and/or adequately and fairly managing demand for water. Thus, the sub-theme intends to discuss, recommend and develop policy measures aimed at increased water productivity, at increased social and economic mobility of water, at increased water use efficiency, to measures involving water pricing and other incentives to save water, rights based allocation mechanisms, including right to water required for livelihoods, etc. in order to prevent and resolve water conflicts.

**(ii) Technology Issues:**

- ***Rainwater harvesting techniques for different geo-hydro-thermo regions:*** India is a vast country having diversified geo-hydro-thermo regimes, agro-climatic zones and complex geological and geo-morphological setups spread across Northern Himalayas to Southern part and from eastern border of India to Pakistan border in the west. This disparity in nature has resulted in drastic quantitative and qualitative variations in several characteristics of natural resources. This is most ubiquitously noticed in the availability of water in any region depending on the prevailing favorable and unfavorable hydro-geological conditions in that region. However, besides unfavorable hydro-geological conditions, human population is also facing water scarcity due to an increase in the water demands, increase in population and per capita consumption, and a generalized decrease in water quality. Therefore, rainwater harvesting in arid and semi-arid regions is of crucial importance as an alternative source of water. Hence, this sub-theme aims to explore different rainwater harvesting techniques with design, cost and water quality parameters for diversified geo-hydro-thermo regimes.

- ***Risk management in rainwater harvesting:*** Rainwater harvesting system is becoming more and more important in India, especially arid and semi-arid regions as it is very effective in providing water supply, disaster prevention, alternative water source, and does not create water right conflicts. Understanding and evaluating the involved risks is one of the major steps in implementing a rainwater harvesting system. A risk assessment should be carried out following a recognized/standard process at the design stage of the rainwater harvesting system. The assessment should take into account the design, installation, testing, commissioning, operation and maintenance of the system and cover water quality, structural integrity and access. Additionally, the risk assessment should consider potential sources of contamination of water entering, or already in the system. Hence, this sub-theme intends to review, explore and standardize different risk assessment techniques for implementing rainwater harvesting system.

- ***Capacity assessment for rainwater harvesting:*** The Capacity Assessment Tool is used in an organization and a facilitator work to determine an organization's competencies to carry out social and behavioral changes in following three areas: (i) Planning and design, (ii) Program implementation, and (iii) Monitoring and evaluation (M&E) and research. This flexible tool can be adapted for use across a wide variety of areas/projects including rainwater harvesting. The tool provides the scoring along with feedback, which serves as a baseline and identifies the gaps in the rainwater harvesting implementation project. The same tool can be administered at a later point to provide data that shows improvements in specific competencies and where additional work still remains. Hence, this sub-theme aims at exploring different technical options in order to perform capacity assessment for wider implementation of rainwater harvesting system.

- ***Innovative water storage techniques:*** Nearly all water systems include some form of storage in order to cover peaks in demand, smooth out variations in supply, provide water security in case of supply interruptions or disaster, water supply in case of emergency like fire, meet legal requirements, improve water quality, provide thermal storage and freeze protection and to store harvested rainwater. Storage of water is also required in areas having scanty rainfall. Traditional water storage techniques suffer from several drawbacks. The retention period of water in storage is critical as preservation of water in storage for longer period is also hazardous. Creative, innovative and cheapest solutions are needed to store more water in combination with spatial functions such as housing, economic development and nature. Hence, this sub-theme intends to explore different innovative water storage techniques and its related aspects like retention period, water quality, etc.

- ***Groundwater recharge:*** The easy accessibility of groundwater by even small-scale users, its local availability and the difficulty of coordinating and governing many users of the same aquifers across wide geographic spaces has frequently led to indiscriminate extraction of this precious natural resource for domestic, industrial and agricultural uses around the world. Groundwater exploitation, particularly in India, has increased by leaps and bounds over the last 50 years along with the expansion of shallow, mostly private, wells. The reasons for the increase in groundwater use in India are varied and include technological, hydrologic and policy factors. As demand for groundwater has gone up, rapid urbanization and land use changes have decreased drastically the already low infiltration rates of rainfall into the soil and have diminished the natural recharging of aquifers. To respond to the growing groundwater crisis and take advantage of the high levels of runoff not captured by natural recharge, augmentation of groundwater resources through natural as well artificial recharge of aquifers has become widespread in India over the last few decades. In some senses, the artificial recharge movement in India can be considered as a successful example of community-based efforts to manage common property resources. However, because of the distributed nature of aquifers and their interconnectivity across space and with surface water supplies, recharge by one group or community may impact water availability for other neighboring or downstream groups. Thus, the artificial recharge in India highlights both the benefits and problems. Thus, the sub-theme aims to review and discuss the different groundwater recharge techniques, associated pros and cons and recommendation of improvised techniques for sustainable water resource management.

- ***Conventional water-borne sanitation system:*** Conventional water-borne sanitation, widely used in most parts of the world, is based on the collection and transport of wastewater via a sewer system, using (drinking) water as transport medium. The system mixes comparatively small quantities of potentially harmful substances with large

amounts of water and the magnitude of the problem is multiplied. The design of the system is furthermore based on the premise that excreta are waste and that waste is only suitable for disposal. This system has even more fundamental shortcomings than their high costs such as over-exploitation of limited renewable water sources, pollution of soil and groundwater, waste of valuable components in wastewater and the difficulty for an effective removal of pollutants. There is ever growing demand to minimize the use of fresh water in conventional water-borne sanitation system. In this context, the sub-theme aims to critically review and discuss the issues related to conventional water-borne sanitation system and to explore any creative and novel techniques for minimizing water use in sanitation.

- ***Water Storages and Wetlands:*** As water storage space is scarce, there is requirement for policymakers to look for multiple use of the same areas, namely by combining water storage and nature. One of such solutions for current and future periods with shortage of water is the storage of water in wetlands. Wetlands help to regulate the water cycle, filter the water supply, prevent soil erosion, and absorb floodwaters. Storage in a wetland consists of surface water, soil moisture, and ground water. Storage capacity refers to the space available for water storage, the higher the water table, the less the storage capacity of a wetland. Some wetlands have continuously high water tables, but generally, the water table fluctuates seasonally in response to rainfall and evapotranspiration. Storage capacity of wetlands is lowest when the water table is near or at the surface i.e. during the dormant season when plants are not transpiring and/or during the monsoon season. Storage capacity increases during the growing season as water tables decline and evapotranspiration increases. When storage capacity is high, infiltration may occur and the wetland may be effective in retarding runoff. When water tables are high and storage capacity is low, any additional water that enters the wetland runs off the wetland rapidly. Knowledge is vastly limited about the factors affecting water storage capacity of wetlands and its extent apart from water quality suitability. Thus, the sub-theme aims to review and discuss various technological issues pertaining to water storages in wetlands, associated pros and cons and recommendation for improvised means for sustainable water storages in wetlands.

### (iii) Planning & Implementation Issues:

- ***Rainwater harvesting for climate change adaptation and energy saving:*** Climate change affects rainfall and increases evaporation, which puts increasing pressures on our ecosystems services. Complex and extreme climate events such as aridity, drought, heat wave, flood, cyclone and scanty rainfall are expected to leave a much greater impact on human society than gradual changes in climate. As culture and climate are interlinked, there is a general human response to adapt and mitigate the sufferings associated with such climate extremes. People may also resort to modify the dwelling environments by adapting strategies to optimize the utility of available water by harvesting rain and conserving energy. But still there is lack of complete and clear understanding for the climate-rainwater harvesting link and energy savings. A comprehensive knowledge of climate fluctuations and corresponding adaptation by human society is crucial for our progress towards sustainability. Hence, the sub-theme deals with the issues related to rainwater harvesting as adaptation and mitigation technique in response to climate change.

- ***Centralized vs. decentralized rainwater harvesting:*** Most urban water infrastructures are becoming vulnerable to extreme rainfall events due to climate change (CC). Maintaining such system becomes costly because of aging infrastructure and increasing energy cost.

Decentralized rainwater management (DRM) is emerging as an alterative to centralized rainwater management using dams, pumping facilities and sewers. Decentralized rainwater management includes rainwater facilities for storage and infiltration. DRM is likely to play an important role for CC adaptation making up for the existing centralized urban water infrastructures in terms of the safety improvement of urban water infrastructures and reduction of energy cost for construction and maintaining. DRM is a very promising short term solution for CC adaptation to mitigate urban flooding and, in the long run, reduces the energy for water treatment and transmission. Therefore, the sub-theme aims to critically review, compare and discuss the pros and cons of centralized versus decentralized rainwater harvesting systems for efficient and sustainable rainwater harvesting method.

- ***Water quality aspects in rainwater harvesting system:*** There has been a growing interest, especially in developing countries, in rooftop rainwater harvesting as an alternative source of drinking water. But there is also growing concern that the quality of harvested water from roof catchments often does not meet the drinking-water guideline values. It has been revealed that harvested water is heavily contaminated microbiologically by a variety of indicator and pathogenic organisms unless special care is taken during collection and storage of rainwater. Heavy metals and trace organics could also pose problems in some cases. It has been suggested that the purity of rainwater harvested from rooftops should not be taken for granted, and analysis of the harvested water especially for microbiological contamination should be undertaken. Appropriate treatment of collected rainwater would be necessary to make the harvested rainwater fit for drinking. Hence, this sub-theme intends to discuss various issues pertaining to water quality in rainwater harvesting system.

- ***Water quality management through rainwater harvesting:*** Although the 'global water crisis' tends to be viewed as a water quantity problem, water quality is increasingly being acknowledged as a central factor in the water crisis. Ironically, water-borne diseases are the major cause of death of some five million persons, mainly children and infants, annually. In relation to water, everyone thinks about and looks for the safe/fresh water for drinking as well as for hygiene. Since there is scarce amount of safe/fresh water available, there are large potentials to exploit rainwater harvesting in this context of human well-being. There are greater possibilities in managing water qualities at par with safe/fresh water through rainwater harvesting. Hence, this sub-theme intends to discuss the issues and challenges for water quality management through harvesting the rainwater.

- ***Community participation in rainwater harvesting:*** Community participation is a critical aspect of any programme/project to be implemented. A programme/project will not be successful unless until community participation is ensured. People living in a settlement, share common interests, common resource and feel that they belong to a singular community. Communities, as also groups within a community, differ greatly in the extent to which they influence decisions that affect the use of common resources available and, therefore, the extent to which they are sharing the common resources. The provision of water supply requires money, materials, labor and time. Most importantly, it requires people to build, operate, and maintain for continued use by the options available, the relative advantages and disadvantages of each option, are capable of making the choice, and finally own up the responsibility of maintaining the facility/project implemented. Therefore, this sub-theme encompasses the issues related to community participation in implementing rainwater harvesting system. Any case study on community participation in rainwater harvesting irrespective of its success can be included under this sub-theme.

- ***Natural water resources management:*** The condition of our natural environment influences our health, economic prosperity, and quality of life. Uses of water include agricultural, industrial, household, recreational and environmental activities. Virtually all of these human uses require fresh water. Fresh water is a renewable resource, yet the world's supply of clean, fresh water is steadily decreasing. Water demand already exceeds supply in many parts of the world and as the world population continues to rise, so too does the water demand. Awareness of the global importance of preserving water for ecosystem services has only recently emerged as more than half the world's wetlands have been lost along with their valuable environmental services. Biodiversity-rich freshwater ecosystems are currently declining faster than marine or land ecosystems. So there is an immediate need to fulfill the gaps and manage the natural water resources. In the context, the sub-theme aims to explore and discuss various issues and challenges in managing natural water resources.

- ***Watershed management:*** Watershed management and development refers to the conservation, regeneration and the judicious use of the natural (land, water, plants, and animals) and human habitat within a shared ecosystem (geological hydrological-aquatic and ecological) located within a common drainage system. Over the years, watershed management has come to be seen as the initiation of rural development processes in arid and semi arid areas. Watershed management is a strategy which responds to the challenges like water scarcity, rapid depletion of the ground water table and fragile ecosystems, land degradation due to soil erosion by wind and water, low rainwater use efficiency, high population pressure, acute fodder shortage and poor livestock productivity, mismanagement of water sources, and lack of assured and remunerative livelihood opportunities. Therefore, the watershed management approach seeks to ensure human well-being and progress toward sustainable development through improved ecosystem services-including food, fresh water, fuel wood, and fiber. Changes in availability of all these ecosystem services can profoundly affect aspects of human well-being. The framework of watershed management acknowledges the dynamic interrelationship between people and ecosystems. The watershed approach enables planners to harmonize the use of soil, water and vegetation in a way that conserves these resources and maximize their productivity. Thus, the sub-theme aims to review and discuss the issues pertaining to watershed management.

- ***Water budgeting:*** Water budgeting reflects a balance between the inputs and outputs of water to the earth. The earth's total water volume is constant. Water goes through the hydrologic cycle of evaporation, transpiration, condensation, precipitation, infiltration, percolation and runoff. However, water is not always located where it is needed because of unequal distribution of precipitation at any given time or location. Also, the demand for water is always increasing. The budget is the power tool for analyzing these impacts on the environment. The effects brought by climatic change or anthropogenic activities over the time can be examined by performing water budgets for conditions before and after the change. This means tht assessing the consequences of anthropogenic impact of the environment has been applied where logging, severe grazing, prescribed use of fire, clearing a forest for cultivation, urbanization or other alterations of ecosystems have occurred. Hence, the discussion on the methods and issues of water budgeting is required for better management of water resources and is included under this sub-theme.

- ***GIS for neighborhood-level analysis of rainwater catchment:*** Drastic and tremendous development in information technology especially in Geographical Information System (GIS) has consequently become a useful intellectual resource to support decision making.

However, GIS is just an application tool to support spatial and non-spatial data handling with action-oriented database concept and need to be customized to become more specific towards the need of the customers. GIS can provide a greater impact to the decision making process which are becoming more challenging with the advent of modern technology. GIS system has the capability to perform spatial analysis in three main classifications namely locality, neighborhood and regional. In a locality classification, analysis will be focused to the entities of the object without any consideration to the relationship factors which is practiced in the neighborhood classification. In regional classification, object entity or the entity itself is being modified to suit with the regional phenomenon. The neighborhood-level analysis of rainwater catchment using GIS can measure the changing structure of landscape, total rainfall and can analyze the scientific and engineering implications of the change and thus can facilitate planning and implementing a rainwater harvesting system. Thus, issues and progress in neighborhood-level analysis of rainwater catchment using GIS for implementing rainwater harvesting system are included in this sub-theme.

- ***Wastewater management:*** India has become a massive and perhaps a frightening reality as far as waste management is concerned. This country can no longer afford to allow urban areas constituting cities and towns of varying magnitude to take care of them. They need the full and undivided attention of our planners and decision makers for protection of environment, aquatic resources and ultimately for better management of health aspects. Cities and towns located at upstream side dispose and dumps wastes into the surface water bodies whereas the downstream cities and towns take the same surface water for consumption. Partly-treated and mostly untreated wastewater are disposed and dumped into surface water bodies. Hence, proper management of wastewater is critical to the health and well-being of urban residents. Various pollution control authorities realized the gravity of water quality deterioration instituting studies on wastewater management in India with changing urban pattern during the last few decades and highlighted the need for urban wastewater management. Hence, various issues and challenges pertaining to wastewater management are included in this sub-theme with an aim of exploring the most efficient, economic and sustainable treatment option for wastewater management.

- ***Wastewater reclamation, recycle and reuse:*** Reclamation, recycle and reuse of wastewater for domestic, industrial and agricultural purposes has been occurring since historical times. However, planned reuse has gained importance only two or three decades ago, as the demands for water dramatically increased due to technological advancement, population growth, and urbanization, which put great stress on the natural water cycle. Reuse of wastewater for water-demanding activities, which, so far consumed limited freshwater resources is, in effect, imitating the natural water cycle through engineered processes. Several pioneering studies have provided the technological confidence for the safe reuse of reclaimed water for beneficial uses. While initial emphasis was mainly on reuse for agricultural and non-potable reuses, the recent trends prove that there are direct reuse opportunities to applications closer to the point of generation. There are several issues pertaining to wastewater reclamation, recycle and reuse, namely: (i) the lack of full knowledge on the hazards associated to the practice; (ii) the lack of application of the precautionary principle by the water management bodies; (iii) difficulties in the assessment of reclaimed real quality in real time; (iv) difficulties in the implementation of scientific methodologies for the needed epidemiological studies; (v) bad management of the social aspects related to the practice; e.g. acceptability, marketing; (vi) a never-ending discussion among scientists on the acceptable level of the standards to be applied; and (vii) a real lack of accepted planning procedures for

establishing reclamation and reuse in specific sites. Although the wastewater reclamation, recycle and reuse have proved beyond doubt as a viable alternative source of water with all these issues, there has been fragmented approach to implement it. The practical implementation of reclamation, recycling and reuse needs a proactive policy from the interested stakeholders, devoted mainly to gain knowledge on the benefits of the practice, without forgetting its derived hazards and risks. Thus, the sub-theme intends to review and discuss various wastewater reclamation, recycle and reuse options under implementation and their pros and cons. Any case study in this context irrespective of its success can be included under this sub-theme.

- ***Issues and challenges in dry sanitation:*** Dry sanitation is a modern adaptation of the ancient practice of managing excreta without the use of water, and therefore without sewage. It implies: (a) waterless toilets; (b) the on-site treatment of excreta; and (c) the production of a safe and effective soil amendment. Its benefits include saving large quantities of water, reducing water pollution, reducing the volume of excreta, and killing off pathogens, and retaining nutrients that can later be applied to agricultural crops. The issues and challenges in implementing dry sanitation are: (i) design aspects like proper designing of dry toilet model, (ii) environmental aspects like dry sanitation toilets don't work in less temperate areas as it involves composting which don't work at low temperature, (iii) public health aspects like sufficient time requirements for pathogen killing, handling of urine and partially infectious materials, (iv) cultural and social acceptability and (v) odor and fly nuisances. Although dry sanitation has these disadvantages, it has a lot of potential in delivering the clear environmental, social and public health advantages. Hence, this sub-theme aims to explore and discuss the various issues and challenges in implementing dry sanitation. Any case study in this context irrespective of its success can be included under this sub-theme.

- ***Challenges in implementing ecological sanitation in developing countries:*** Ecological Sanitation (EcoSan) works on the principle that urine and faeces are not simply waste products of the human digestion process, but rather are an asset that if properly managed can contribute to better health and food production and reduce pollution. EcoSan is an emerging wastewater treatment approach that is likely to be more economical and ecologically sustainable as compared to the conventional sewer approach. EcoSan insists on maximum possible re-use of nutrients from human excreta. Urine uncontaminated by faeces requires minimal processing and can easily be re-used in farming and gardening. In many developing countries, poor soil fertility and the increasing cost of artificial fertilizer is making it difficult for subsistence farmers to grow enough food to feed their families. For such kind of conditions, humanure/organic fertilizers are the best and economic option to raise the fertility of soil and yield. The challenge of advocating such a system is often associated with how the system is incorporated into governmental policy and how this policy is translated into sustainable implementation. Thus, plausible issues and challenges likely to face while implementing EcoSan in developing countries are included in this sub-theme. Any case study in this context irrespective of its success can be included under this sub-theme.