ISSN: 2349-3763

IJENAS

International Journal of Environment and Natural Sciences

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An Assessment of Solid waste generation during the Religious occasions at Haridwar city

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(Received: August 9, 2014; Accepted: September 11, 2014)

Abstract

The urban centers of India produce 120,000 ton of solid waste per day. The unscientific disposal of solid waste creates many environmental and pollution problems. This communication reveals the problems of solid waste generation in Haridwar city due to religio-touristic activities during the selected festive occasions. In this study eight festivals were selected for the study and solid waste categorized in to two category viz. Bio-degradable and non-biodegradable. The maximum amount of total solid waste (3307.250kg) found at Har Ki Pauri during the Kanwar festival and lowest amount of total solid waste (537.550kg) on the occasion of Makar Sakranti at Sapta Rishi Ashram Ghat.

Keywords: *Religio-touristic activities, Festive days, Solid waste generation*

Introduction

The municipal refuge is referred as any waste that is generated by the domestic and industrial sectors in municipality. The municipal solid waste (MSW) is heterogeneous in nature and contains paper, plastic, rag, metal, glass piece, ash and compostable matter. In addition, other substances like scrap materials, waste papers, dead animals, discarded chemicals, paints, hazardous hospital waste and agricultural residue are also categorized under MSW. In Indian cities solid waste generation rate is on the increase. Urban solid waste management is considered as one of the most immediate and serious environmental problem confronting municipal authorities in developing countries like India. It is now a major global concern that is increasing every day. The rapid growth of population and urbanization is making the nonrenewable resources to be in shortage and dispose of effluent and toxic waste indiscriminately. They are some of the major environmental issues posing threats to the existence of human being. The most common problems associated with improper management of solid waste include diseases transmission, fire hazards, odor nuisance, atmospheric and water pollution, aesthetic nuisance and economic losses.

Haridwar, which literally means "Gateway (Dwar) to God (Hari)" and is also known by the names of Mayapuri, Kapila and Gangadwar. It is believed that taking bath here purifies the soul and opens the way for the ultimate freedom, Moksha. The Ganga is a major river of the Indian subcontinent rising in the Himalaya Mountains and flowing about 2,550 km generally eastward, through a vast plain, to the Bay of Bengal. The Ganga river alone drains an area of over a million square km with a population of over451 million people living in its basin are directly and indirectly dependent upon the Ganga River. Millions of devotees and visitors take a dip in the holiest river Ganga during a number of festive occasions round the year like Makar Sakranti, Maha Shivratri, Basant Panchami, Ganga Dussehra, Guru Purnima, Kartik Purnima, Kanwar Mela besides Ardh-Kumbh and Maha Kumbh and other festive occasions.

The pilgrims bring a lot of offering in the form of flowers, cloths, old icons of Gods and Goddess, last remains (ashes) of their loved ones, to dispose in and around the river Ganga, at Haridwar. Most of the times such offerings are brought in polythene bags. These polythene bags and other biodegradable and non-biodegradable materials remain either floating on the water surface or bathing sites. In this way, pilgrimage exerts a heavy burden not only on the total sanitary and health-hygiene, infra-structure and life supporting systems of the city but on the riverine ecosystem of holy river Ganga. Therefore, it is necessary to monitor the impact of pilgrimage through scientific study, especially on festive occasions round the year on the environmental condition of city and river. Municipal sewage constitutes 80 per cent by volume of the total waste dumped into the Ganga, and industries contribute about 15 percent. Naturally, as a consequence of rise in massive number of these pilgrims and tourists, the consumption of all commodities also rises. This leads various types of pollution i.e. water, noise, solid waste, air of varying physico-chemical nature. It was being experienced for many years that the Haridwar city is experiencing a growing pressure of pilgrims and tourists to meet out their various types of routine as well as special needs. In the present study an attempt has made to find the generation of solid waste during auspicious occasions.

Materials and methods

Study Area: Haridwar is situated on the bank of river Ganga at the foot hills of Shivalik range of mountain that constitute the outer Himalaya. Haridwar city lies at an elevation of 965ft from the sea level and between the latitude 200, 58' N and Longitude at 780, 13' E. According to Hindu mythology, Hardwar is one of the four sites where drops of elixir of immortality (AMRITA) accidentally spilled over from the pitcher in which it was being carried (KUMBHA) away by the celestial bird Garuda, after the Samudra Manthan (Churning of sea). These four places are Haridwar, Allahabad, Ujjain and Nasik where famous "Kumbh Mela" is held. It is believed that taking bath here purifies the soul and opens the way for the ultimate freedom, Moksha.

Solid waste: During the study period solid waste was also assessed in the pre festive, festive and post festive occasions at each sampling sites. The solid wastes were also categorized into two categories, based on its gross composition biodegradable and non-biodegradable.

Results and discussion

India is known for its spiritual revels and this has far more occurrences of solid waste generation than in any other country, during different religious festivals celebrated round the year. The results obtained for the studies made during eight festive occasions, occurring round the year as mentioned in Table-2 and described below:

Biodegradable Waste: In the festive occasions highest mean value of biodegradable waste was recorded 2560.850 Kg on the festive occasion of Kanwar Mela at site-II Har-ki-Pauri and lowest mean value of biodegradable was found 307.650Kg on the festive occasion of Makar Sakranti at Sapta Rishi Ashram Ghat.

Non- Biodegradable Waste: In the festive occasions highest mean value of non-biodegradable waste was recorded 768.700 Kg on the festive occasion of Kanwar Mela at Pathri Station and lowest value of non-biodegradable waste was recorded as 229.000 kg on the occasion of Makar Sakranti at Sapta Rishi Ghat.

During the study period it was also found that, most of the offerings are carried in polythene bags, envelops and in paper or cloth bags, beside the bamboo baskets of various sizes to the Deities. All these offering are left at the bathing site, which are normally collected from the extra staff members of the city municipality as litter around the bathing ghats. This waste is rarely collected systematically and brought to the solid waste dumping ground of the city about 5-6 Km. away to minimize the service cost related to its transportation, collection and disposal, by the management of the municipality. These types of solid waste have various negative impacts to the concern area. In this series, Gangwar and Joshi (2008) studied the quantity of solid waste during the Ardh Kumbh period of 2004. They reported that 62.20% biodegradable, 17.14% Non

Biodegradable and 13.61% miscellaneous during the different festivals of Ardh Kumbh. Sharma et. al. (2010) surveyed different type of colonies in Haridwar city and observed that the financially better people generate roughly twice as much garbage as people from slum areas.

The Haridwar municipality takes lot of preventive measure to keep the city and the bathing ghats/ platforms sanitarily and hygienically clean and high-quality condition, but for the flow of massive congregation during the festive days and the pressure of work on the sanitary staff, the garbage still finds pockets of accumulation all around. The solid waste disposal site of Haridwar city is situated about 2.5km away from generation site (Har Ki Pauri) on the bank of river Ganga. The open vahicles normally used for transporting garbage from its generation site to dumping site spill the garbage in way, which again originates foul smell and traffic congestion due to slow speed as also reported by Mazumdar (1996) from the cities of his study.

To manage the congregation the Haridwar municipality almost routinely reschedules its civic services related to waste collection and transportation, during the festive occasions. In addition to its regular scavenging staff of 567 workers, the municipality employs additional staff of around 175-200 persons, on contract basis to carry out extra cleaning of these places, during the festive days. Routinely there are about 15 tractor trolley, 5 container, 7 tipper truck, 2 sewer jetting machine, 5 sewer cleaning machine, and about 270 container for the daily collection and transportation to open dumping site for single trips but during the festive days , number of solid waste disposal transportation trip of vehicle is increased more than three to four times. In the present study, out of eight selected festivals and at seven selected sites, viz. Sapta Rishi Ashram Ghat, Har Ki Pauri, Kusha Ghat, Chandi Ghat, Prem Nagar Ghat, Pul Jatwada and Pathri Station. In the Sapta Rishi Ashram Ghat selected as reference site the lowest total gross amount of solid waste was observed during the 507 kg during the festive occasion of Makar Sakranti during the year of 2011 and the highest value of total gross amount of solid waste was 3429.4kg at Har Ki Pauri during the festive occasion of Kanwar Mela. This solid waste may lead to communicable disease in the concern areas.

The chances of the spread of communicable diseases in the bathing sites area due to the lack of efficient municipal services, as has been reported earlier by Saini et. al. 2009 in Hardwar city during Kanwar Mela and described the number of patients significantly rise during the festive occasions and these patients mainly suffering from water borne disease.

In the present study the huge amount of solid waste was found during the Kanwar Mela and the gross total amount of solid waste was 16777.9Kg during said festival at all the sampling site. It may due to number of tourists/pilgrims visited the spot. According to data of tourism department approximately 1932326 numbers of people visited the Haridwar city during the month of July in which the Kanwar Mela was held.

According to Mishra and Joshi (2002), 20,435 Kg solid waste was generated in Hardwar city during the important six festive occasions in 1997. These data give us a bright status of solid waste generation for this holy city, during different festive occasions. Dhere et. al. (2008) studied the adverse impact of municipal solid waste on air and ground water due to the improper disposal of waste in Pune city. In this series Omofonmwan and Esiegbe (2009) reported the ground water contamination due to the lechate contribution of the solid waste in metropolitan city of Nigeria. Zade and Noori (2008) also described the adverse impact of solid waste in concerned areas. At Sapta Rishi Ghat the maximum gross total amount 927.2 Kg of solid waste was found during Kanwar Mela which is relatively 82.88% higher than the total gross amount of solid waste during the Makar Sakranti during the year of 2011. It is significantly correlated with the number of tourist/pilgrims visted to the city. According to available data from tourism Department during the month of July, 2011 about 1932326 numbers of pilgrims visited the city which is 252% higher in number during the month of January, 2011. In a similar kind of results for festive days, Mishra and Joshi (2004) reported 4000.90kg of total solid waste, during the Pitra visarjini amawasya, at Har Ki Pauri, Haridwar. The highest amount reported for the present study at Har Ki Pauri, during festive day of Kanwar Mela. As a result there is extra work on the local municipality. Rampal and Sharma (2003) reported total solid waste generation in the Bhubaneswar city was 162,000 mt. and 180,000mt.k, during the study year of 2001 and 2002 respectively. After the popular Har ki Pauri the Prem Nagar Ashram Ghat is busiest ghat of the city and mostly used by the local people for the bathing but during the festive occasions huge amount of pressure is also observed on this bathing site. Population growth and religio-touristic activities have brought increasing amounts of solid waste to urban areas. Similar kinds of results were made by Rather et. al. (2010) in which they described that the urban waste certainly degraded the water quality of river Jhelum in Srinagar. In most developing countries, the ever-increasing quantities have overwhelmed local governments' capabilities to cope efficiently. Every city needs to implement record keeping on the health of its solid waste workers, including the informal waste pickers and recyclers. Rather than having open access of waste pickers to solid waste disposal sites, all solid waste workers should be registered and participate in a regular vaccination and health examination program.

Acknowledgement

The authors extend their thanks to Indian Academy of Environmental Sciences, Hardwar and UGC-BSR research fellowship for financial support during present study. The thanks are also acknowledged to city municipality and district tourism office for their co-operation.

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Table 1. Schedule for the study

Sl. No.	Festive Occasions	Date and Month (2010)	Date and Month (2011)
1	Makar Sakranti	14 January	14 January
2	Maha Shivaratri	14 February	3 March
3	Baishakhi	14 April	14 April
4	Ganga Dussehra	21 June	11 June
5	Kanwar Mela	16 July to 30 July	16 July to 29 July
6	Somvati Amavasya	9 August	29 August
7	Kartik Poornima	6 November	26 October
8	Pitra Visarjini Amavasya	7 October	27 September

Table 2. Quantitative and Quantitative amount of solid waste at seven selected sites during eight selected festivals

Sites		Sapta Rishi Ghat		Har-Ki-Pauri		Kusha Ghat		Chandi Ghat		Prem Ashram Nagar Ghat		Pul Jatwada		Pathri Station	
Fes.		Bio-deg.	Non-Biodeg.	Bio-deg.	Non-Biodeg.	Bio-deg.	Non-Biodeg.	Bio-deg.	Non-Biodeg.	Bio-deg.	Non-Biodeg.	Bio-deg.	Non-Biodeg.	Bio-deg.	Non-Biodeg.
M.S	T.S.W	307.650	229.900	1350.100	361.850	978.450	310.450	471.350	254.450	1288.150	346.700	1343.000	379.950	1693.350	501.900
M.Sh.	T.S.W	344.050	247.200	1435.450	451.250	1080.950	359.950	536.100	280.350	1433.350	485.50	1484.450	416.350	1830.650	582.600
B.K.	T.S.W	450.200	286.050	1813.400	518.600	1144.300	389.650	588.500	318.100	1497.400	548.100	1590.500	443.500	1998.000	620.100
G.D.	T.S.W	373.250	306.950	1749.950	451.850	1125.700	364.400	542.400	294.400	1291.100	370.850	1464.300	416.250	1664.300	580.450
K.M.	T.S.W	553.100	347.150	2560.850	746.400	1918.000	541.500	733.550	418.150	2295.650	647.950	1750.600	614.750	2332.500	768.700
S.A.	T.S.W	335.800	274.950	1563.450	406.900	870.000	341.450	405.700	271.200	896.800	318.650	1192.400	370.850	1535.250	490.750
P.V.A.	T.S.W	373.500	298.450	1893.150	478.150	1260.200	432.800	588.700	328.850	1390.700	413.700	1715.600	441.000	1781.500	624.250
K.A.	T.S.W	431.700	326.100	2024.400	559.850	1486.500	490.100	677.200	411.050	1564.000	455.200	1858.900	490.550	1901.400	722.700

*(All values are mean of 2010 and 2011 in Kg)

[Non-Biodeg. = Non biodegradable, Bio-deg. = Biodegradable, T.S.W= Total solid waste, M.S= Makar Sankranti, M.Sh=Maha Shivaratri, B.K= Baishakhi, G.D= Ganga Dussehra, K.M. = Kanwar Mela, S.A.= Somvati Amavashya, P.V.A= Pitra Visarjini Amavashya]

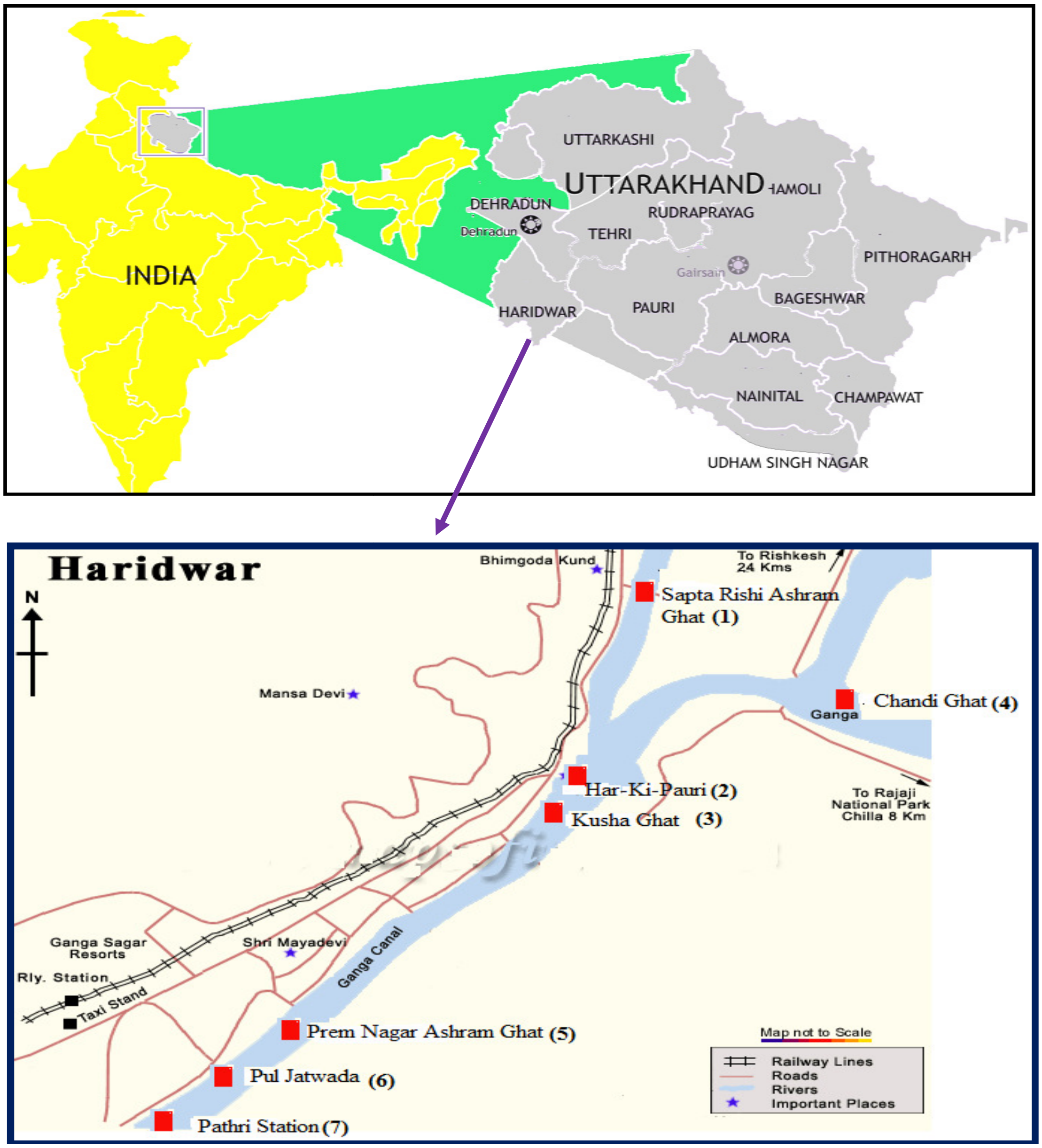

Figure 1. Map of Haridwar city showing location the of study sites

ISSN: 2349-3763

IJENAS
International Journal of Environment and Natural Sciences
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Assessing the impact of open cast mining on floristic diversity: A case study from Gandhamardan hill of Keonjhar, Odisha

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(Received: July 12, 2014; Accepted: September 10, 2014)

Abstract
Mining operations, which involve minerals extraction from the earth's crust tends to make a notable impact on the environment, landscape and biological communities of the earth. Forests are the greatest victims of developmental activities like mining, which can be gauged from the depletion of the forests in various mine belts. Large scale ~~of~~ ongoing unplanned & unscientific open cast mining in various mineral belt of state of Odisha has emerged as a major cause of concern & threat to the biodiversity of the region. This has got some serious implications on the vegetation pattern of this area. The present study was undertaken to assess the impact of open cast mining on the surrounding plant diversity & population structure. The study concluded that the diversity of plants located at non affected zone is comparatively high with respect to mining impact zone. Similarly the study found out that the mining impact zones bear more number of shrub & herb species with comparison to non-impact zone. Simpson diversity index for tree and shrub species were found low in mine impact areas as compared to that of the non-mined area. The study is an attempt to probe the nature of change of vegetation composition occurred due to anthropogenic activity such as mining.

Keywords: *Iron mining, Species diversity, Dominance, Simpson diversity Index, Environment, Forest.*

Introduction
Minerals are critical resources in economic growth of any country. Production and utilization of minerals have often been taken as an index of development (Roy,2007) .Minerals and metals have played a crucial role in the development and continuation of human civilization. After agriculture, it is the second largest industry at all scales &regions. It has played a vital role in the development of civilization from ancient times (Lodha,2009) . However Mining, like any other industrial activity tends to leave a strong negative impact on the environment unless it is meticulously planned and carefully executed. It is a well-established fact that mining is an environmentally destructive activity. The state of Odisha is bestowed with abundant mineral resources which are found to be deposited under the large tract of forest mostly located in Keonjhar, Sundergada, Mayurbhanja, Koraput & Kalahandi district. After 2000, the state

government tried to turn around its development fortune by using its mineral deposits (World Bank 2007). For this, the state government has leased out a large part of its mineral resources, whose exploration is found to directly affect the forest. Data of Directorate of mines, government of Odisha shows that till date more than 600 mines (both functional &nonfunctional) covering diversified minerals have been leased out in different part of state. The environmental impact of open cast mining is many and diverse. Mining operations, which involve minerals extraction from the earth's crust tend to, make a notable impact on the environment, landscape and biological communities of the earth. Mining operation cause big void on earth, thus causing degradation of the land, loss of forest and topsoil (UNESCO,1985). Mining and quarrying has destroyed large tracts of forest land in all the states of India. According to,Ministry of Mines (2008),Governmentof India, the total forest land diverted for mining in India has been estimated to be at 1, 14,304.45 ha between 1980 and 2008 (Bhusan,2008) . Increase mining & allied activities have put tremendous negative impact on the forest (Vaghlolikar,2003) . The problems of waste rock dumps during mining become devastating to the landscape, as a result, natural plant communities get disturbed thus making the environment unsuitable for growth of plants.

Understanding the impact of mining on the environment particularly on the composition of vegetation is quite important in order to mitigate the adverse impact. In order to achieve this objective, it is imperative to compare the natural vegetation in the ambient forest ecosystem with the mine affected forest. Substantial knowledge in this direction will pave the way for rehabilitating mining devastated forest ecosystem [1]. The present study was conducted surrounding a mining affected forest in-order to find out the impact of mining on the surrounding vegetation. This study will provide valuable insight in to the modalities for post mining phase reclamation as well as planning for new mining area.

Study area:

The study area is located at 21°37'09"-21°40'02"N and longitudes 85°29'20" - 85°31'30"E, near to Suakati town in Keonjhar district of Odisha (Figure 1). It is coming under Banspal block. A major iron ore deposit of state namely Gandhmardan hill is located at the center of study area, having a reserve of 350 million tonne of iron ore. The existing iron ore mines located at this hill is one of the oldest mines of Odisha. The iron ore mining started in Gandhamardan hill range by Odisha Mining Corporation (OMC), a State governmenmt owned agency in 1965 & presently it has two open cast iron mines namely Gandhamardan A & B covering around 2200 hectare. Similarly two Private owned mines are also operating at Putulpani (Talajagar) and at Urumunda village respectively covering a total area of 182.1932 hectares. The forest cover of the study area can be classified in to pure sal forest, mixed forest, degraded forest, extensive plantation & open forest. Reserve forest like Nayagarh , Gandhamardhan, Raiguda , Kumundi , Khejurmundi , Suakati , Sanaghagara & Siddhamatha are found to be located within 10 Km of the mines area which proves the ecological richness of the area. However mining and associated activities have resulted in reduction of a large patch of dense forest to open forest category during last 10 years gap.

Materials and methods

To analyze the impact of iron mining on vegetation, distance gradient analysis was carried out. The structure and composition of vegetation was studied in mining affected (core) and adjacent undisturbed forest area (buffer). The unaffected area is located far away from mining area, relatively unaffected by mining & allied activity. The mine affected area are open forest where the canopy covers ranges between 10-40% & lies relatively closer to the centers of mining activities . In total, 14 sampling locations were identified, 7 at as core zone (lease area) and 7 at buffer zone (up to 10 km from leasehold) of mine. The IVI value and Diversity richness of these areas were calculated based on Phyto-sociological study. The species encountered in the quadrats were identified as per Saxena, 1994 . Quantitative community characteristics such as frequency, density, basal area and importance value index (IVI) of each species were determined (as per Curtis and McIntosh (1950). Shannon-Wiener diversity index and Simpson's dominance index were also computed following Magurran ,1988.

Results and discussion

Majority of the landscape in the lease area (core site) is characteristic of degraded natural landscape as it is a mined area. On the edges of the lease area, towards the Western-side there are some forest patches which are dominated by young *Shorea robusta* and

Diospyros melanoxylon (Tendu) vegetation. Most of the herb and shrub species prevalent in the open spaces were weeds such as *Lantana*, *Ageratum* and *Eupatorium*.The forest patches towards the perennial spring are relatively diverse while other areas are extensively dominated by Sal (*Shorea robusta*).

Summary of Phyto-sociological study of Core Site:

The Core site has sparse vegetation cover . The species of plants observed in the nearby areas are characteristic of disturbed and degraded natural systems. The tree diversity indicated dominance of *Shorea robusta* but the herbs and shrubs diversity was dominated by weeds and exotic species. In total 89 species of plants were observed in the core site. The floral diversity in the core site included 32 species of trees, 20 species of Shrubs, 25 species of Herbs and Grasses, 11 species of Climbers and 1 species of Parasite. No species classified as rare, endangered or threatened were observed during the study in the lease area. But, in the adjoining forest ranges there can be presence of ecologically important and protected species. During the quadrate study, it was observed that *Shorea robusta* - Sal(IVI 144),followed by*Lannea coromandelica*– Shemat (IVI 33),*Holarrhena antidysenterica* (IVI 20), and *Acacia aurculiformis* (IVI 16), were the most common species in the core site. *Acacia aurculiformis*is planted across at various locations over dump plantation.

Summary of Phyto-sociological study of Buffer Region:

Various areas (Forest, River, Open landscapes) in the Buffer region were examined and data was collected to understand species dominance and composition in the buffer region. Within the 10 km area comprising the Buffer region, there are some major reserve forests such as Nayagarh R.F, Gandhamardhan R.F, Raiguda R.F, Kumundi R.F, Khejurmundi R.F, Suakati R.F, Sanaghagara R.F & Siddhamatha R.F. These forests represent the natural ecology of the region and are mostly characterized by plant species such as *Shorea robusta, Diospyros melanoxylon, Diospyros montanna, Terminalia arjuna, Terminalia tomentosa, Anogeissus latifolia, Buchanania lanzan, Haldina cordifolia, Madhuca indica* etc. The overall landscape is undulating and the elevation ranges from 1900-2300 ft.

The dominant vegetation in the forests seen in the Buffer region can be broadly categorized as a Moist and Dry Sal Forest (Government ofOrissa, 1994). In total 219 species were encountered during the study which included 71 species of Trees, 51 species of herbs, 40 species of Shrubs, 36 species of climbers, 15 species of Grass and 5 species of Epiphytes and Parasites. Almost all of the forest patches showed a heavy dominance of *Shorea robusta* (IVI 180) followed by other species such as *Holarrhena antidysenterica* (IVI 15), *Terminalia tomentosa* (IVI 10), *Anogeissus latifolia* (IVI 7.5), Buchnania lanzan (IVI 7), *Madhuca indica* (IVI 6.8), *Diospyros melanozylon* (IVI 6.5) and so on. It can be clearly seen here that the overall forest composition is dominated by Shorea robusta (Sal) and other Tree species are secondary associates. The under stories of almost all of the forested areas visited are very low in diversity and density. In the open spaces the area is occupied by *Shorea robusta* and *Holarrhena antidysenterica* regeneration. *Chromolaena odorata* along with *Ageratum conyzoides* are the most common species of shrubs prevalent in most of the locations. Plant species like*RouvolfiaSerpentine*(Endangered),*Dalbergia latifolia*(Endagered)*and Oroxylum indicum*(Endangered),*Pterocarpus marsupium (*Endangered), *Symplocos racemosa*(Critcially Endanegred)*and Embellia ribes*(Vulnerable) are species that were found in the buffer region during the survey.

Diversity Index Calculation:

Diversity Index was calculated based on the observation made. The diversity Index was used to compare the core site and the buffer region. The overall diversity index of the area can be summarized as follows:

Core Site:

i. Simpsons Index (D) : 0.24
ii. Simpson's Index of Diversity 1 – D : 0.76
iii. Simpson's Reciprocal Index 1 / D: 4

Buffer Region:

i. Simpsons Index (D) : 0.200
ii. Simpson's Index of Diversity 1 – D : 0.799
iii. Simpson's Reciprocal Index 1 / D:4.9

As observed from the above value of simpsons index of diversity, the buffer region is more diverse and rich than the core site. The core site is richer than many of the areas in the Buffer zone because the core site has a forest patch very close to the mine boundary that was considered in the sampling.

Conclusion

A study by Sills et al, , 2006in the iron ore mining district of Keonjhar , Orissa has concluded that both quantity & quality of forest increase with the distance to iron ore mines. The number of species /species diversity decreases as a stable ecosystem is disturbed due to anthropogenic pressure like mining. Mass felling of trees due to anthropogenic activity like mining and associated activity, results in growth of scrub & bushy forest. A study by using GIS & Remote sensing (Patra and Sethy, 2012) in the mining area of Gandhmardan forest of Keonjhar, Odisha found out that the open forest category has significantly increased at the cost of dense forest during last 30 years. The prevailing habitat conditions in these areas have reduced the chances of regeneration of many species, thereby reducing the number of species in the mined areas. The higher number of herbaceous species in the mined areas than in un-mined areas could be due to colonizing ability of herbs in the degraded area. Since the mined and unmined areas were located at similar climatic, edaphic and physiographic features, the differences in species composition could be attributed mainly due to the mining activities. Dominance-diversity index have been used to interpret the dominance of species in the community in relation to resource apportionment and niche space (Whittaker,1973). The Sampson index & IVI value as observed in the un-mined area suggests that there was more or less an even apportionment of resources among the members of the important species. However, the broken-stick model curves in the mined areas were attributed due to presence of less number of species and stress environments where conditions were not favorable for plant growth. Species diversity was low on mined stands, but the species that grow here appear to have developed tolerance. It is evident from the results of the study that the mining activities are detrimental to the plant diversity. Thus it is advisable that such activities are strictly regulated to avoid further damage to the species.Scientific mining has to be taken up in a proper manner to minimize further damage to the vegetation. Appropriate plantation measures using local tolerant plant species such as Neem, Sal, Mango, Sisoo, Jackfruit , Arjuna, Mahua need to be practised by the mine authority in order to restore bio-diversity .

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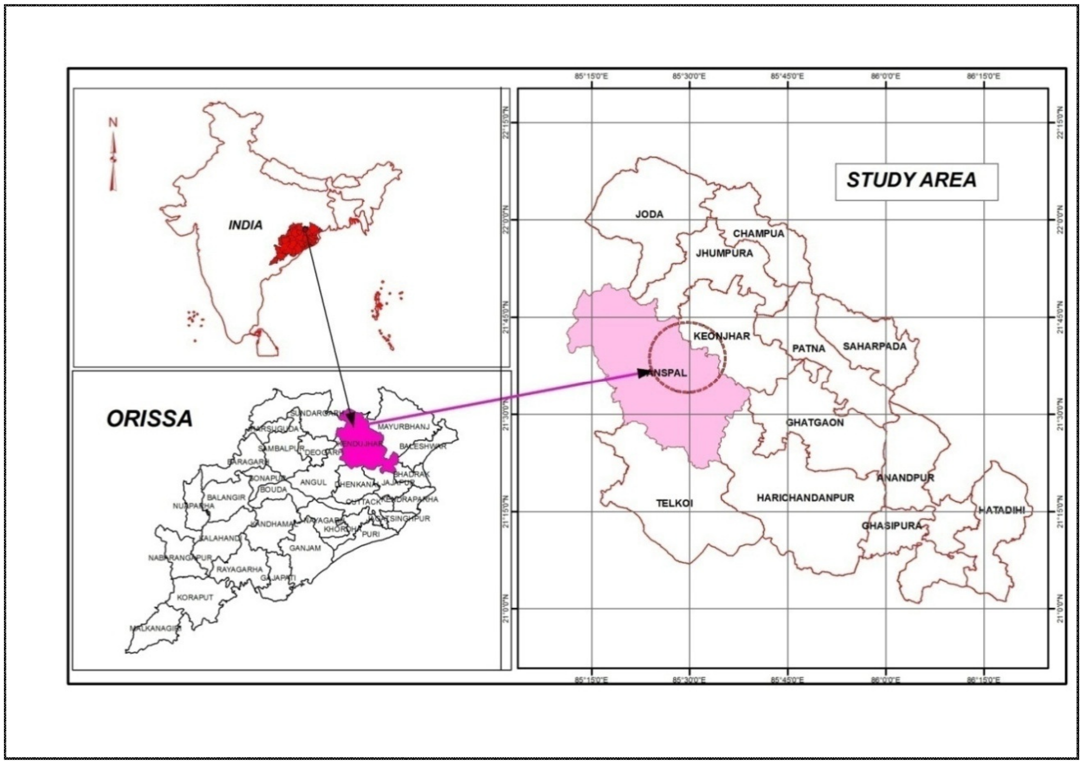

Figure 1. The Location map of study area

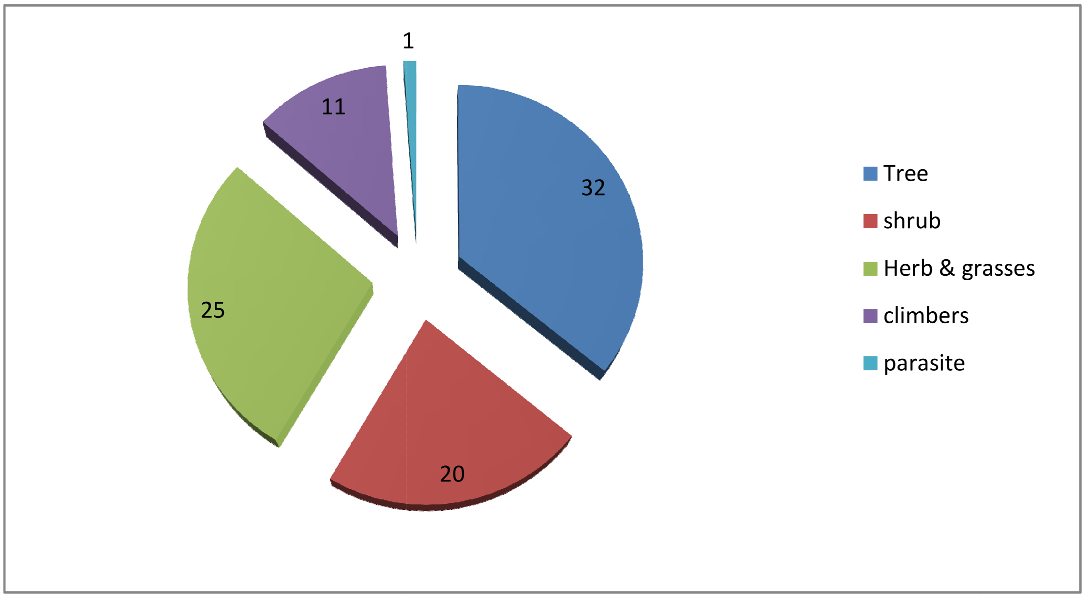

Figure 2. The species composition at core zone

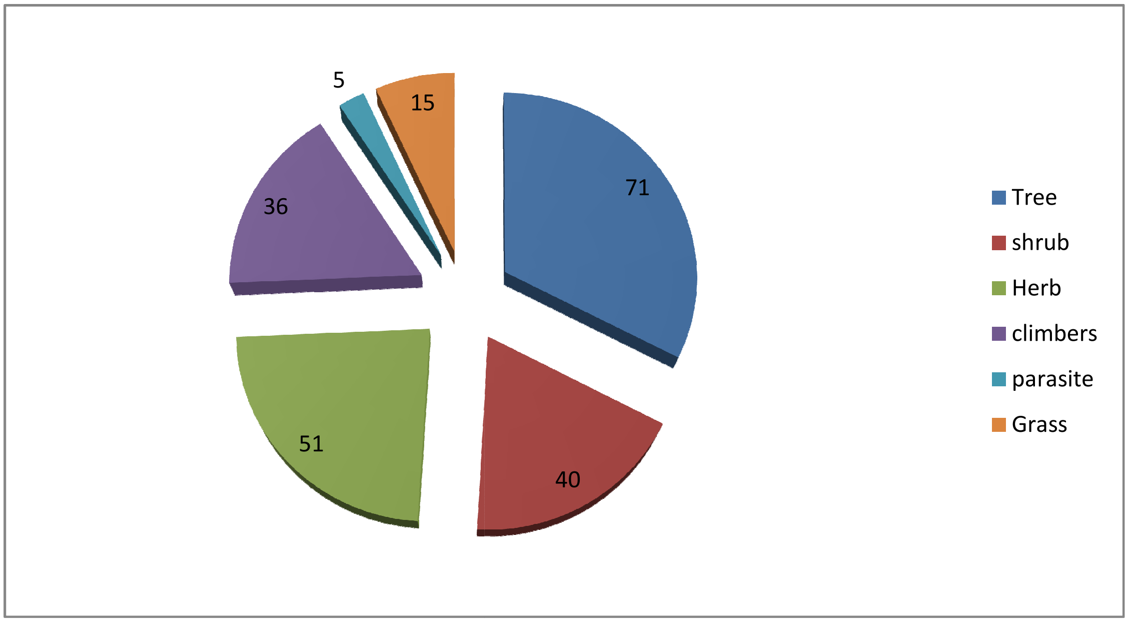

Figure 3. Species composition at Buffer zone

IJENAS

ISSN: 2349-3763

International Journal of Environment and Natural Sciences

Website: www.ijenas.com; Email: journalijenas@gmail.com; © Centre for research in ecology, environment and social sciences (CREESS)

India Managing Sustainable Rural Water Conservation for Rural Development in India

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(Received: September 15; Accepted: September 23, 2014)

Abstract

Water is the life of all living object of the universe and no one can survive without it. Including human, plant, animal etc. are directly or indirectly depends on it. Whole of the world is surrounded by sea water, where most of sea animals are living their life. India is well known for rivers and these rivers are considered by Indians as Goddess of prosperity. Since the beginning of human civilization,, Indians always consider rivers as source of life and they respect it. Presently the situation of rivers are poor than earlier. Population increase is one the most responsible factor for bad condition of the rivers. Encroachment of rivers banks, transfer of waste material, especially chemicals are other major factors of dirty rivers in India. Industrialization near the main river banks such as Kanpur, New Delhi, Lucknow and Varanasi are examples for dirty rivers. Surface water is decreasing due to environmental changes so underground water level is also decreasing as a result. Drinking water is supplied in urban areas through rivers after proper cleaning and treatment because day by day underground water level is decreasing. In rural areas water is available but due to miss management of water there is a huge problem of drinking water facilities. Natural resources of water conservation such as natural ponds, artificial ponds are increased over utilised by people for their personal usage. There is no proper guideline for water use and even any rule and law regarding the wastage of water by a common man. In this paper, an attempt has been made to manage, rural water sustainably.

***Keywords**: Sustainable Rural water conservation, Rivers, Rural Area, Underground water.*

Introduction

Water is essential for human civilization, living organisms, and natural habitat. It is used for drinking, cleaning, agriculture, transportation, industry, recreation, and animal husbandry, producing electricity for domestic, industrial and commercial use. However, much of the world's water has little potential for human use because 97.5% of all water on earth is saline water. Out of the remaining 2.5% freshwater, most of which lies deep and frozen in Antarctica and Greenland, only about 0.26% fresh water in rivers, lakes and in the soils and shallow aquifers which is readily usable for man. Water conservation is a practice in which people, companies, and governments attempt to reduce their water usage. The goal may be to address an ongoing water shortage or to make lifestyle modifications to be more environmentally friendly. Water usage emerged as a major issue, especially in the developing world, where many people do not have access to safe drinking water, and the question of conservation began to attract a great deal of attention. Water conservation refers to reducing the usage of water and recycling of waste water for different purposes such as cleaning, manufacturing and irrigation. Water conservation helps save energy, protect wild animals, and prevent people from using so much water that it cannot be replaced with rain. Water is the source of life for every living thing. Water conservation is using smaller amounts of water to meet our needs, and reusing cleaned, treated water when possible and appropriate. Water conservation effectively means avoiding wastage of potable water. It is necessary, because it is in shortage and the demand for it is increasing with the rapid increase in world population. Water conservation means using the resources in a wise manner so that besides meeting the present requirement it also takes care of the future generations. If each individual starts conserving natural resources in the best way possible we can soon build a beautiful world. Water conservation needs to be a way of life, not just something we think about once in a while.

Water Conservation and Management

India is a developing country with a vast territory, complex topography, varied climate and a large population. Frequent floods, drought and unstable agricultural production have always been a serious problem. According to Indian Meteorological Department (IMD), there are only 40 rainy days in India, and hence a long dry period. India, being an agricultural country, its economic development is linked with agriculture. The major limiting factor for agriculture is water. A growing population and consequent need for increase in food production causes increase in area of agricultural fields and overuse of water for irrigation. Due to overexploitation of water resource, it has become scarce in many parts of our country. Needless to say, water conservation is of great importance to the economic, social and cultural development of India.

Conservation techniques

Primary source of water in India is south-west and north-east monsoons. Monsoon, however, is erratic and as you have already studied the duration and the amount of rainfall is highly variable, in different parts of our country. Hence, surface runoff needs be conserved.

The techniques for conservation of surface water are:

(a) **Conservation by surface water storage**
Storage of water by construction of various water reservoirs have been one of the oldest measures of water conservation. The scope of storage varies from region to region, depending on water availability and topographic condition. The environmental impact of such storage also needs to be examined for developing environment friendly strategies.

(b) **Conservation of rain water**
Rain water is conserved and used for agriculture in several parts of our country since ancient times. The infrequent rain, if harvested over a large area can conserve considerable amount of water. Contour farming is an example of such harvesting technique involving water and moisture control at a very simple level. It often consists of rows of rocks placed along the contour of steps. Runoff captured by these barriers also allows for retention of soil, thereby serving as erosion control measure on gentle slopes. This technique is especially suitable for areas having rainfall of considerable intensity, spread over large part i.e. in Himalayan area,

north east states and Andaman and Nicobar Islands.

In areas where rainfall is scanty and for a short duration, it is worth attempting these techniques, which will reduce surface runoff, which can then be

(c) **Groundwater conservation**

Attributes of groundwater

i. There is more groundwater than surface water
ii. Groundwater is less expensive and economic resource and available almost everywhere.
iii. Groundwater is sustainable and reliable source of water supply.
iv. Groundwater is relatively less vulnerable to pollution.
v. Groundwater is a free of pathogenic organisms.
vi. Groundwater needs little treatment before use.
vii. There are no conveyance losses in underground based water supplies.
viii. Groundwater has low vulnerability to drought.
ix. Groundwater is the key to life in arid and semi-arid regions.

Techniques of ground water management and conservation

Artificial recharge

In water scarce areas, there is an increased dependence on ground water. The water table declines quickly due to low and erratic rainfall. The only alternative is to replenish the ground water by artificial means. As you have studied in the previous lesson, there are various techniques to develop and manage ground water artificially. In one of the methods, water is spread over ground to increase area and length of time for water to remain in contact with soil. So as to allow maximum possible opportunity for water enter into the ground.

Catchment area protection (CAP)

Catchment protection plans are usually called watershed protection or management plans. These form an important measure to conserve and protect the quality of water in a watershed. It helps in withholding runoff water albeit temporarily, by delaying the run off through construction of a check bund across the streams in hilly terrains to so that greater time is available for water to seep underground. Such methods are in use in north-east states, in hilly areas of tribal belts. This technique also helps in soil conservation. Afforestation in the catchment area is also adopted for water and soil conservation.

Inter-basin transfer of water

A broad analysis of water and land resources and population statistics of various river basins in our country reveal that areas in western and peninsular regions have comparatively low water resources/cultivable land ratio. Northern and eastern region which are drained by Ganga and Brahmaputra have substantial water resources. Hence, the scheme of diverting water from region with surplus water to water deficit region can be adopted, the Ganga- Cauvery link would enable transfer of vast quantities of Ganga basin flood water running out to sea, to west and south west India. The transfer of the surplus Ganga water would make up for the periodical shortage in Sone, Narmada, Godaveri, Krishna and Cauveri. The National Grid Commission envisages diversion of part of the surplus discharge in the Ganga near Patna during the high flood period.

Adoption of drip sprinkler irrigation

Surface irrigation methods, which are traditionally used in our country, are unsuitable for water scarce areas, as large amount of water is lost through evaporation and percolation. Drip irrigation is an efficient method of irrigation in which a limited area near the plant is irrigated by dripping water. It is suitable method for any area and especially for water scarce areas. This method is particularly useful in row crop. Similarly sprinkler method is also suitable for such water scarce areas. About 80% water consumption can be reduced by this method, whereas the drip irrigation can reduce water consumption by 50 to 70 %.

Conservation of water in domestic use

There is a large scope for conserving water at house hold level. General awareness among people about the importance of water and its availability, and need for conservation can help in minimizing wastage to a large extent.

Losses during water supply can also be prevented by reducing the leakages.
Some of the ways for improving the efficiency of water use at household level are:

- Reduce wastage by checking leaking pipes, as this prevents lot of water from reaching people. In Delhi estimated losses are 35-40 %.
- Closing of taps while not in use.
- Better irrigation techniques – irrigation systems waste up to 70% water used. In drip irrigation water loss is significantly less.
- Use low flush toilets-reducing the amount of water used each time the lavatory is flushed.
- Build latrines and compact toilets which can turn human waste into clean, useful manure this is much cheaper than connecting toilet to a piped sewage line.
- Use bowls to wash vegetables, dishes instead of running tap.
- Greater use of recycled water 'grey water' in the home, Instead of using potable or treated water use bath and shower water for watering the plants.
- Use washing machine or dish washer when it is fully loaded.

Reduce the loss of water

There are numerous methods to reduce losses due to evaporation and to improve soil moisture. Some of them are listed below:

- Mulching i.e. the application of organic or inorganic materials such as plant debris, compost, etc., slows down the surface run-off, improves soil moisture, reduces evaporation losses and improves soil fertility.

- Soil covered by crops, slows down run-off and minimizes evaporation losses; hence, fields should not be left bare for long periods of time.

- Ploughing helps to move the soil around. As a consequence it retains more water thereby reducing evaporation.

- Shelter belt of trees and bushes along the edge of agricultural fields slow down the wind speed and reduce evaporation and erosion.

- Planting of trees, grass, and bushes breaks the force of rain and helps rainwater penetrate the soil.

- Fog and dew contain substantial amounts of water that can be used directly by adapted plant species. Artificial surfaces such as netting-surface traps or polythene sheets can be exposed to fog and dew; the resulting water can be used for crops.

- Contour farming is adopted in hilly areas and in lowland areas for paddy fields. Farmers recognize the efficiency of contour based systems for conserving soil and water.

- Salt-resistant varieties of crops have been also developed recently. Because these grow in saline areas, overall agricultural productivity is increased without making additional demands on fresh water sources. Thus, this is a good water conservation strategy.

Reuse of waste water

Wastewater contains lot of nutrients. Its use for irrigation saves these nutrients. It improves the productivity of crops and soil fertility. General utilization of wastewater through reuse and recycling improves water use efficiency. In fact, wastewater is a resource rather than a waste since it contains appreciable amount of nitrogen, phosphorus and potash. Stabilization ponds can be used for fish aquaculture. The effluent can also be used for cultivation of short-term and long term, ornamental, commercial and fodder crops.

Declaration of the Year 2013 as "Water Conservation Year-2013

The Union Cabinet today gave its approval for declaring the year 2013 as "Water Conservation Year" 2013. A number of mass awareness activities were undertaken during Water Conservation Year 2013 with emphasis on sensitizing the masses on water related issues, encouraged them to conserve and use it judiciously. The policies and programs of the Ministry of Water Resources will be propagated to create a sustainable society and economy. An effective and sustained mass awareness programme will be launched with the involvement of all stakeholders to achieve the objectives identified in the National Water Policy, 2012 and National Water Mission.

Water Resources in India: Present Status

India is blessed with good rainfall well distributed over 5-6 months in the 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 m^3 per annum. Out of this, over 1047billion m^3 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 and most of which reaches the ocean. Out of the total usable water, 728billion $m^3$is contributed from surface water and 395billion $m^3$is contributed by replenish able ground water. 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^3in 2050, as estimated by the Government of India (2009). As the potential for increasing the volume of utilization of water is hardly 5-10%, India is bound to face severe scarcity of water in the near future.

While water for consumption is most crucial, it is equally important to provide water for irrigation to increase the food production and livestock husbandry, to ensure food security for the increasing population. Growing population, as everyone is aware, is a serious concern as it will create further burden on the per capita water availability in the future. As can be seen in Table 4, 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 to 1140 m^3 in 2050. Based on the average requirement of water for various purposes, the situation is considered as water stress condition when the per capita water availability ranges from 1000 to 1700 m^3 per year and it is considered water scarcity when the availability reduces to 1000 m^3 per year. Water available within the country varies widely, as a result of rainfall, ground water reserve and proximity to river basins, most of the Indian States will reached the water stress condition by 2020 and water scarcity condition by 2025. This would further hamper the food security, as the scarcity of water will directly suppress agricultural production.

Presently, inspite of good rainfall distribution, the country is unable to make good use of rain water, because of lack of awareness and poor infrastructure to construct dams and reservoirs. As a result, only about 35-40% of the cropping area receives irrigation to take 1-2 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 increase the area under irrigation to 140 m ha, 76 m ha through surface water and 64 m ha by using ground water. So far, the irrigation potential has been created to cover 107 m ha, although they are not utilized effectively. It is estimated that effective area under irrigation by 2025 will be 76 million ha, although the Government of India is estimating to cover 104 million ha. Ground water is the major source of irrigation and this trend will continue. By 2025, 60 million ha will be irrigated by using ground water and by 2050; the area underground water will increase 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 inter-linking the rivers and harnessing 36 billion m^3 through artificial recharging of ground water (Government of India, 2009).

Apart from irrigation, many rivers in India are also used for generating hydro power. Out of the estimated hydro power potential of 1,50,000 mw, only 21% has been developed so far and additional 10% 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.

Pollution of water resources is another major concern which is affecting the water supply as well as human health conditions. Although, 5% of the total water is used for domestic use, 27% of the villages and 4 to 6% urban population in India do not have access to drinking water. Apart from inadequate supply of water, there is a serious concern about the quality of water, which is severely affecting the health. It is reported that over 70% of the water consumed by rural population in India does not meet the WHO standards. It has been reported that 80% of rural illnesses, 21% of transmissible diseases and 20% of deaths among children in the age group of 5 years, are directly linked to consumption of unsafe water.

The major causes of water pollution are discharge of untreated sewage and industrial effluent into rivers, excessive use of fertilizers in agriculture and contamination of ground water with salts and minerals present in the lower soil profiles. It is estimated that in New Delhi alone, 36 million tons of sewage is generated everyday of which only 50% is treated and the rest is let out into the Yamuna River directly. Same is the situation in other cities. Only 31% of the sewage water generated in 23 major cities is treated and the rest is polluting 18 major rivers in the country. Most of the rivers in the country are also contaminated by fluorides, nitrites and several toxic metals. Presently, over 66 million people are suffering from fluorosis after consuming water containing more than 1.5 ppm fluoride. Poor sanitation both in rural and urban areas is another reason for pollution of drinking water sources. Only 30% rural population has access to toilet facilities while 65% urban people use toilets. Nitrates and harmful germs from human excreta flow and percolate down to contaminate the water tanks and open wells.

Augmentation of Water Resources

While the consumption of water in India will increase by over 50%, the supply will increase only by 5-10% during the next 12-15 years. This will lead to water scarcity situation and most of the people, particularly those who are dependent on agriculture and living in poverty will suffer the most. Water scarcity will affect the food production, biodiversity and the environment. Environmental degradation will accelerate global warming, which in turn will accelerate water crisis. This is a vicious cycle. The only solution is to tap all the possible water resources and make them available for sustainable use, while improving the water use efficiency. This can be done by addressing various concerns and initiating suitable actions for development of new water resources, augmentation of available resources, prevention of water pollution and improving the efficiency of water use in all the sectors.

For creating additional water resources, the following activities should be initiated:

Increasing Water Storage Capacity:

Activities such as farm ponds, percolation tanks, water reservoirs and construction of small and medium size dams and rivers can retain more surface water, while increasing the ground water recharge. Series of contour bounds particularly in undulating areas will facilitate percolation of water in the soil and improve the ground water table, while reducing soil erosion. Gully plugging, construction of series of small dams on rivulets will help in storing water in reservoirs.

In the absence of harnessing rainwater in the forests and denuded hilly terrains, inadequate soil and water conservation measures are leading to severe soil erosion, silting of rivers beds and reservoirs and frequent flooding across the country. Presently, over 40 million ha are prone to floods in the country. Invariably, 8-10 million ha are affected by floods over year. During the year 2007-08, floods in India have caused 3689 deaths, loss of 1.14 lakh livestock and damaged 3.5 million houses, causing huge loss to the people, society and the Government. One of the major reasons for soil erosion and silting of rivers is severe deforestation. As a result of soil erosion, many of the rivers have been changing their courses almost every year damaging fertile agricultural lands. Brahmaputra is a good example where the width of the river during summer is 3-4 km which increases to 10-12 km during the rainy season. This highlights the extent of flooding of the river and harassment to the people living along the river. Due to poor management of this river, only 22 billion m^3 of water is utilizable while over 607 billion m^3water is wasted. Similar situation is prevailing with respect to other rivers such as Ganga, Godavari, Mahanadi, Narmada, etc.

Interlinking of rivers will help in preventing floods while improving water distribution in the country. Control of water flow and floods will prevent soil erosion. Presently, billions of tons of fertile soil along with precious nutrients are washed out of our fertile agricultural lands and forests. In fact the amount of nutrients lost due to soil erosion is almost equivalent to the chemical fertilizers produced in the country. This highlights the impact of soil erosion control on the food production. Reforestation of degraded forests and development of wastelands through afforestation, will help in soil and water conservation (IDSA, 2010).

Judicious distribution of water for different uses can help in preventing water scarcity. Many sectors receive more water than what is needed at the cost of others. Even within the same sector, like irrigation for agriculture, the locations for infrastructure development are often influenced by those who are politically powerful, with vested interests, while depriving others in needy regions. To overcome such inefficiency and wastage of resources, a suitable investment mechanism should be developed based on the needs and return on investments. A transparent program implementation mechanism and regular monitoring for quality can improve the speed and quality of the projects.

Efficient Irrigation Practices:

Efficiency in irrigation is most essential, if the country wants to face the challenge of water crisis. As most of the crops are watered through flood irrigation, over 70% of the water used for irrigation is wasted. Furthermore, as the water supplied is not measured, farmers have a tendency to flood the field with excessive water without any additional cost. Such a practice has been creating a negative impact by way of increased cost of leached nutrients, pollution of ground water, increase in soil salinity and increase of pests and diseases. It is high time that India compels the farmers to adopt micro-irrigation systems, which will not only reduce the water requirement but also bring down the cost of production, while increasing the area under irrigation. The Government of India should consider enforcing a ban on flood irrigation in the country. Simultaneously, metered supply of irrigation water, recovery of water cost, promotion of micro-irrigation systems and involvement of water users' group for water distribution would significantly help in improving the water use efficiency and reducing the cost of agricultural production.

Conclusion

Water conservation and management in India needs to be quite different than that of the West. Integration of water quality, sanitation and hygiene, with positive outcome of intervention process are vital for bridging the existing gap. Community participation in operation and maintenance of the water treatment structure is vital in addressing the gaps in the sector. Research and review of national drinking standards taking into consideration the local condition, especially with regard to critical parameters like fluoride and arsenic is vital for preserving public health. Citizen action groups and civil societies should be increasingly engaged in making the government accountable in enforcing regulation with regard to industrial effluent and sewage treatment plant for preventing surface and groundwater contamination. Water conservation in India is taking different methods and technique regarding wastewater management and reuse of waste water. Outsourcing water quality data management and sample collection and monitoring could be an alternative mechanism that can be explored, which would ease the burden on the state and bring better efficiency and sustainability. More scientific debate on privatization of water conservation management in India needs to be considered.

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Table 1. per capita water availability in India

Year	Population(Million)	Per capita water availability (m3/year)
1951	361	5177
1955	395	4732
1991	846	2209
2001	1027	1820
2025	1394	1341
2050	1640	1140

Source: Government of India, 2009

Table 2. Current Water Uses status in India

Usage (%)	World	Europe	Africa	India
Agriculture	69	33	88	83
Industry	23	54	5	12
Domestic	8	13	7	5

Source: Government of India, 2011

ISSN: 2349-3763

IJENAS
International Journal of Environment and Natural Sciences
Website: www.ijenas.com; Email: journalijenas@gmail.com; © Centre for research in ecology, environment and social sciences (CREESS)

Ethics and Water Governance in India

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(Received: September 15 2014; Accepted: September 23, 2014)

Abstract

Water governance is most important need of today. It shows how an "ethical approach" contributes to an understanding of global water governance, and how it complements other perspectives on governance, namely management, institutional capacity, and social-ecological systems. Every essentiality needs proper governance for smooth functioning and controlling. Water is one the essential requirement of living species on this earth. When drought comes than we think the importance of water, otherwise water is easily available in our country so we don't its important. As a natural resource water is the most important resource which helps in all type of natural growth. The proper management of our limited water resources will be essential to ensure food security for our growing population and to eliminate poverty. It will be essential in order to evade the growing conflicts and the possibility of social unrest in the country in future due to water scarcity. Major issues in water governance is problem to access, deficiency in infrastructure, poor water supply, inefficiency in distribution system, wastages of water, insincerity of people in water uses. Some of metropolitan cities such as Mumbai, Delhi, and Chennai have a huge crisis of drinking water and government not focused in water governance. India which is developing on a faster pace is also nearing to a situation where water stress is being largely felt. This is also leading to water-becoming a marketable commodity. This is threatening the poor, especially those in rural areas. In this way 'Ethics' and 'water governance' is gaining importance.

Keywords: G*overnance, natural resource, management, ethics*

Introduction

Water is one of the most vital elements in our national developmental planning for the 21st century. Its availability, quality and cost-effective distribution have been a very serious concern to people. The term "water governance" needs to be carefully defined, as it may not be readily understood. It is also important to identify the attributes that make water governance "effective". The Global Water Partnership defines water governance as follows: *Water governance refers to the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society.* The notion of governance for water includes the ability to design public policies and institutional frameworks that are socially accepted and that mobilize social resources in support of them. Water policy and the process for its formulation must have as its goal the sustainable development of water resources, and to make its implementation effective, the key actors/stakeholders must be involved in the process. Governance aspects overlap with technical and economic aspects of water, but governance points us to the political and administrative elements of solving a problem or exploiting an opportunity. Governance of water is a subset of the more general issue of the creation of a nation's physical and institutional infrastructure and of the still more general issue of social cooperation. Water governance is concerned with those political, social and economic organizations and institutions (and their relationships), which are important for water development and management. Given the complexities of water use within society, developing, allocating and managing it equitably and efficiently and ensuring environmental sustainability requires that the disparate voices are heard and respected in decisions over common matter and use of scarce financial and human resources. Water governance is concerned with the functions, balances and structures internal to the water sector (internal governance). It includes the framing of social agreements on property rights and the structure to administer and enforce them known as the law. Influences also come from civil society and from the "current" government and these are considered parts of the *external governance* of water, which will be discussed later. Effective governance of water resources and water service delivery will require the combined commitment of government and various groups in civil society, particularly at local/community levels, as well as the private sector.

Water governance is the range of political, social, economic, and administrative systems that are in place to develop and manage water resource and the delivery of water services at different level of society. From the local to the global level, ethics are the central point for the purposes of governance. Ethics are personal or cultural standards that give intrinsic or extrinsic worth to subjects, objects, or behavior, and which delimit the sphere of moral consideration. Without ethical values, governance has no referent for adjudicating competing demands or for assessing different institutional paths. While governance systems typically deal with the behavioral expression of values or with defining governance aims (e.g., achieving efficiency), the values that legitimate behaviors and institutional cultures often go unattended. The decentralized water governance, success depends on initial social and ecological conditions, the biophysical scale at which problems are framed, and the types of governance changes sought. Achieving gender equity, for instance, requires deliberation at multiple scales and in view of the different religious, cultural, and legal spheres affecting the water rights of men and women. Operative values linking social and ecological systems to governance norms are not particular to any one scale.

Water Governance Principles and Legal Bases

The Dublin Water Principles bring water resources firmly under the State's function of clarifying and maintaining a system of property rights, and, through the principle of participatory management, asserts the relevance of meaningful decentralization at the lowest appropriate level. There is increasing pressure to recognize and formalize water rights and this is happening in many countries. Formalizing rights raises complex questions about the plurality of claims and the balancing of the distribution of benefits among the social groups. It also imposes responsibilities including in particular that of pollution prevention and financial sustainability. The process of formalization is often biased in favor of the rich and powerful who may abuse the system and capture rights. Informal 'rights', as defined locally with their historical rules and principles, are equally important and improper formalization may lead to conflict between the formal and traditional. The formalization of rights may be unnecessary or insufficient to secure access to water resources. The capacity to defend rights against competing claimants is essential for the rights to be meaningful, whether they are formal or informal. An important matter to clarify is to what extent the processes of devolving water rights serve segments of a population, or its entirety.

Water has several characteristics that present additional complications for governance structures:

- Water has an emotional and often spiritual dimension for many users.
- There is significant uncertainty about the amount and quality of

water available from year to year, in terms of both stocks and flows.

- Investment and water infrastructure provide a mix of public and private benefits. A dam, for example, provides public benefit such flood protection, but also stores water for individual households or businesses to use.
- Water management often requires large investment of public fund that is different for the general fund.
- Water resources usually must be managed across different time frame at different scales (local, regional, national, international).

Approaches of Water Governance

The “values approach” to water governance, it is helpful to review other perspectives that contextualize efforts toward global water governance. We consider three: (1) a management perspective, designed to unite both physical and social concerns; (2) an institutional perspective, of applied economics, political science, and law; and (3) a sustainability perspective, focused on social-ecological dimensions of water systems.

Management

Water governance was essentially about control, with engineering works gradually expanding from single purposes and single means to multiple purposes through multiple means. The focus was on supply-side development, with management following to improve efficiency amongst competing social and environmental demands. It is scientific, technological, and socioeconomic systems in a manner that organizes water management concerns objectively. In irrigation, for instance, water productivity is a standard utilitarian objective but equity is also important. Similarly, governance objectives often include the empowerment of rural women, enhancing the livelihoods of indigenous people, and participatory development of rural communities. Selecting particular criteria has the effect of standardizing indicators to assess performance.

Institutions

Political, economic, and legal institutions already impinging on water, such as cooperative irrigation, are a key contextual factor for understanding operational norms. Ensuring the effectiveness of governance transitions therefore requires an understanding of how actors navigate socio-cultural norms and how ecosystems are comprehended vis-à-vis different culturally grounded rights regimes. The focus on institutional dimensions in governance necessitated recognition that command-and-control attitudes are out of step with the larger social-ecological systems in which institutions are embedded and the polycentric dynamics of multilevel governance. To re-orient institutions, new approaches require, understanding of social-ecological systems. The implications for governance are many. Law, for instance, has little or no precedent for conceptualizing problems or formulating legal tests in nonlinear terms. And when rivers are used as legal boundaries, the complex processes that lead to nonlinear channel shifts, This can confuse the basic spatial categories that were designed to simplify institutional problems.

Social-Ecological Systems

The unique contribution of the social-ecological perspective is that, it allows for an assessment of how water management decisions affect environmental outcomes, such as biodiversity loss, and socio-cultural outcomes, such as forced resettlement of livelihood. When social and environmental implications are considered we are reminded that there are numerous political and value factors embedded in naturalized concepts such as watersheds. Negotiating social and ecological water uses requires revisiting the fit of empirical standards with changing systems and acknowledging that we have little or no data for scientifically establishing environmental flows on many watercourses. The development of environmental flow standards requires new norms for governing complex systems and for stewarding both off stream uses of water, such as those benefiting society.

Challenging Issues in Water Governance

Water pricing

The fact that water is scarce economic input should be a major decisive factor determining the price of water. The objective of fair water pricing are (a) to seek revenue to pay for the operation and maintenance of water availability, (b) to improve water use efficiency,

(c) to recover the full costs of water pumping and treatment. In India, irrigation water is heavily subsidized, first of lack of linkage between volumetric water use and use charges and lack of agency capability to recover water charges and panelize free riders create and incentive for over use or waste full practices.

Enhancing Water Productivity

Not only, does the issue of scarcity of water need to be addressed, but also the conservation of water is essential for the survival of ecosystem. Since agriculture is the largest user of water in India, increasing agricultural water productivity offers one of the greatest opportunities to reduce demand for additional irrigation. India’s path to water resource security has much to gain from improving agriculture’s water productivity.

Water Harvesting

Natural replenishment of underground water is very slow and therefore continued over exploitation, brings ever increasing area under the dark zone that demand artificial replenishment. Collection of rain water recharges aquifers, easier accessibility of water resource an increases availability for irrigation through the year. There is theoretically speaking no village in India which cannot meet its drinking and cooking water need through rain water harvesting.

Community Participation

Any effort to improve water governance must be accompanied by increasing community participation. Participation produces a sense of community between the administration and users, lowers central administration costs and ensures that the interests of users are taken into consideration.

Increasing demand

Rapid economic development and societal change are putting increasing pressure on water ecosystems and other natural resources. In a number of countries or regions, demand is outstripping supply to the extent. Under such conditions, which are often referred to as river basin “closure”, available water resources are fully allocated and the political importance of effective water governance increases.

Access to water

Scarcity of water, whether absolute or induced, is not, however, the only fundamental reason for improving the effectiveness water governance, Pollution also contributes to scarcity and there is the challenge of meeting demand for good quality water. Less publicized, however, are problems of access to water that are as much a product of the social, economic and institutional, as they are of the technical factors governing water resource availability. For people who are able to pay or who belong to elite social groups, water is not scarce, even in situations where the available supply is extremely limited. Since water is a cornerstone for most economic activities, equitable distribution under changing patterns of supply and demand is often more of a challenging. Stakeholder involvement, political priorities and even issues such as political interference and corrupt practices all have a major bearing on design of infrastructure and the strategic and day to day allocation of water for both domestic and productive purposes. Hence, systems of effective water governance are needed that ensure that all sectors of society have equitable, reliable and sustainable access to water.

Lack of accountability and transparency

Corruption remains one of the least addressed challenges in relation to water governance and water service delivery. Until recently, governments, bilateral and multilateral organizations, have tacitly accepted corruption in the way water is governed. Corruption has been seen as something that could 'greasing the wheels' of development efforts. However, thinking is shifted and anti-corruption measures are now perceived as central to equitable and sustainable development water service delivery. Corruption is a symptom of governance deficiencies in both the private and public spheres. In many countries, enforcement of legislation is weak and judicial systems are inadequate. When these are combined than low wages, huge income disparities (both within and between countries) and accountability and transparency shortcomings, personal economic gain is more attractive than concern for the well-being of citizens. New research and case studies increasingly show how corrupt practices are detrimental to sustainable water use and service provision. Corruption ultimately limits the scope for improving poor people's livelihood opportunities.

Improvement of Water Governance

An assumption behind this scoping study is that it is somehow possible to improve water governance in the nexus that lies between water ecosystem management, poverty reduction and climate change. In order to do ‘better’, we have to first define what we mean by ‘better’ and consequently to establish criteria against which, we test the degree of success achieved. Doing ‘better’ necessarily involves change, so it is about learning both from the past and in the continuing present. We have to; therefore, institutionalize a method of promoting continued innovation, the discovery of new and better technical means, not only in order to adapt to a future that involves greater uncertainty and risk. Achieving good water governance cannot be undertaken hastily using blueprints from outside, any given county or region. Good governance needs to be developed to suit local conditions. Incremental improvement and flexibility is the key. New reforms do not have to be implemented in a comprehensive or fully integrated way. However, they do have to be workable and doing a few things well to demonstrate that new approaches work is both pragmatic and likely to generate public and political support. The effective water governance; indeed to be effective governance systems must fit the social, economic and cultural particularities of each country. Nevertheless, there are some basic principles or attributes that are considered essential for effective water governance.

Water Governance Challenges

(a) Economic, political and environment change

Water governance challenges are invariably complex. Even though desirable, they are not solely linked to, for example, the selection of water management strategies that involve greater involvement of the private sector, decentralization, integration and increasing emphasis on managing demand. The fundamental challenge is to establish systems of water governance that take account of and adapt to societal, economic and environmental conditions that are characterized by uncertainty, variability and change. It is just not possible to develop water management strategies and plans that will solve all water management problems now and well into the future. Instead, water governance capacity must be developed (i.e. information systems, stakeholder platforms, legal and regulatory mechanisms, executive capabilities and conflict resolution systems) to enable society to respond to and adapt to uncertainty, variability and change, that could be local or regional, short or long term, political, economic or environmental.

(b) Stakeholder participation

In water management, the boundaries of consent are shifting, through increased stakeholder participation in decision-making at both the water use and water resource (river basin) levels. It is clear, however, that the size of the population in most river basins, large villages or municipalities is such that it precludes the direct participation of all stakeholders in basin level decision-making. The question of who will represent large groups of stakeholders is a highly political one. The relationship of the people participating in any multi-stakeholder process to their constituents is problematic, especially when third parties are involved. It is a nostrum of development work that third-party facilitators (researchers, consultants, NGOs) are needed to identify, mobilize, organize and inform stakeholder groups.

Conclusion

In this paper we discussed three approaches to water governance—management, institutions, and social-ecological to understanding the water governance. These approaches overlap, and thus offer complementary insights. But the ethical approach is of special importance because it possesses explanatory power and has been largely overlooked in discussions of water governance. Focusing on the underlying values of water policies enables a clearer understanding of how different normative considerations regarding place and scale combine, as part of a water ethic. The ethical values are more than a residual category to cover anything that water management, institutions, or social-ecological science do not explain. An ethical values approach identifies the reasoning used to support laws, policies, and practices; it seeks to describe and explain those values; and it considers how alternate categories for defining the human–water relationship affect the ethic of governance. In so doing, a values approach connects place and scale to the justifications offered for pursuing certain policy paths over others. As such, it enables an explicit dialogue regarding both the reasons and values affecting water, ethics, and governance. An ethical approach to water governance does not resolve ethical dilemmas, but it improves our understanding of how and why ethical issues are central to the task of adapting technical and political issues to changing patterns of water governance.. The global governance of giving a fair hearing to the multiple and often conflicting values that affect water in social-ecological systems, particularly in the face of climate change. At the global level, where coordinating norms affect multiple types of human and nonhuman communities, clear articulation of water ethics is essential for recognizing when and where values affect the aims and ends of water governance.

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