# Sustainable Rainwater Management – A Paradoxical Situation in Coastal Dakshina Kannada District

*** Jagadisha Bala**
**** Dr. Y. Muniraju**

***Abstract***

*Water is the sustainer of all forms of life and plays a critical role on ecosystem. In order to meet the rise in demands, groundwater reserves are tapped, often to unsustainable levels, resulting in the rapid depletion of water tables. In coastal cities, over extraction of groundwater has led to intrusion of salinity in its aquifers.*

*Contrary to heavy monsoon, Dakshina Kannada district of coastal Karnataka experiences drinking water shortfall in summer, especially in rural parts. In the light of above background, a study was conducted (2012) in the Grama Panchayath level of Mangalore taluk in coastal Dakshina Kannada district.*

*Extracting more water to meet increasing demand results in groundwater overdraft and is found in the entire rural Mangalore taluk. Groundwater depletion has also resulted in salinity and undue mineral contents in deep borewells making water non-potable. Mere increased spending on water projects has not improved the water scenario. Key suggestions include protection of local water bodies, joint projects to share the river water, strengthening the local traditional water harvesting techniques, recognizing individual efforts, proper execution of government schemes and participatory approach for a sustainable water management at the coastal region.*

***Keywords:*** *Rainwater harvesting, Groundwater, Water management, Sustainability, Water shortage, Grama panchayat, Coastal Dakshina Kannada, Drinking water.*

** Research scholar & Associate Professor, Government First Grade College, Haleyangadi- 574146, Mangalore Taluk.*
*E-mail: bala.jagdish@gmail.com*

*** Professor, Dept. of PG Studies & Research in Commerce, Mangalore University.*

## Introduction

Water is a limited and renewable resource. It is the sustainer of all forms of life and plays a critical role on ecosystem. The quantum of water on this planet has remained over centuries the same. Gradually due to over exploitation and pollution, potable water is becoming a scarce commodity. Recently there has been an enormous increase in demand for water used for agricultural, household and industrial needs. Freshwater sources are being heavily exploited to meet these demands. As surface water sources fail to meet the rise in demands, groundwater reserves are tapped, often to unsustainable levels. Almost all cities and villages depending on groundwater face the rapid depletion of their water tables. Especially in coastal cities, over extraction of groundwater has led to intrusion of salinity in its aquifers.

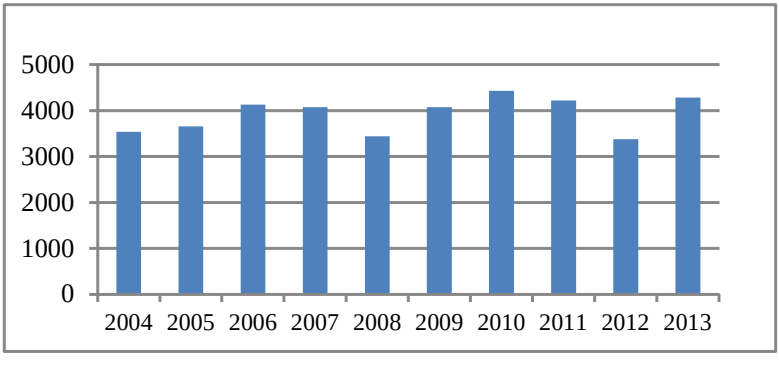
Dakshina Kannada district of coastal Karnataka receives the highest rainfall. Average rainfall of 10 years is around 3900 mm Table No. 1.

**Table No. 1. Annual Rainfall (mm) in Dakshina Kannada District of Coastal Karnataka**

| Year | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Rainfall | 3539.6 | 3652.8 | 4128.6 | 4076 | 3440.9 | 4076.2 | 4427.8 | 4224 | 3374.8 | 4284.6 | 3922.53 |

***Source:*** *India Meteorological Department, (compiled for various years).*

**Figure No. 1-Ten Years Annual Rainfall (mm) in Dakshina Kannada District**




Contrary to heavy monsoon, district experiences drinking water shortfall in summer. This is because the entire rainwater is collected in masonry drains from houses, roads, etc. which is then taken to the

Arabian Sea instead of recharging the groundwater. The groundwater available is extracted during summer which makes the aquifer empty. Rainwater should be recharged into the aquifers during rainy season by locally suitable water harvesting measures.

Study on rainwater harvest management is of recent origin. No study has been conducted so far in this part of coastal Karnataka on rainwater harvest management, especially in rural parts, where clean drinking water scarcity exists in summer.

**Review of Literature**

The literature review encompass within this section includes prominent studies on Water and Sustainable Development and Water Resource Management.

The research of Mehta Lyla (2000) in drought-prone Kutch district in western Gujarat disclosed– Water harvesting is unlikely to have the same deleterious consequences as those associated with large dams and schemes tapping finite groundwater resources. Yet, it has not gained acceptability amongst key decision-makers in water resources management. There is a widespread notion that water harvesting structures and watershed developments are merely 'add-ons' to surface water schemes. ... But strategies such as rainwater harvesting, livestock development and techniques to enhance dry land agriculture can help overcome many of these constraints.

Gujja Biksham, Shaik Hajara (2005) remarks– One of the problems is that India has got into a vicious cycle of drinking water allocations. The supply of drinking water has become an annual ritual – money allocated, money spent, villages covered. The following year brings on the same drinking water crisis and money is allocated again. ... Unfortunately India continues to look at the issue of drinking water in terms of money spent. However, allocating greater sums of money each year will not solve the problem unless the country learns to deal with its available water resources.

Dr. Madhyastha N. A. (2007) in his study conducted in erstwhile undivided Dakshina Kannada district of Coastal Karnataka, analyses that- It is a paradox that a region, which experiences very heavy

rainfall goes dry during summer months. It is mainly because of unscientific management of water resource and traditional methods being ignored. ... Future scenario seems to be worse as the region is all set for industrialisation. Ecosystem people of the district would likely become ecological refuges to cater the needs of omnivorous people.

The Editorial of Kurukshetra- (2007) opines- Rainwater harvesting is one technique of water management which is gaining favour but has yet to become an essential part of day-to-living. Rainwater can be safe for drinking, and in fact is free from several metals and contaminants like heavy metals like arsenic.

Bhadti Radhakrishna S. (2010), analyses– In recent 30 years, Bangalore had five severe droughts and three mild droughts. Water problems in layouts are common in the city. Again people are scared of even small rain as it leads to flood due to improper drainage. For both of these problems, Rainwater harvesting and recharging is the only solution.

Shivashankar S. C., Chandrashekar T. C. and Reddy Ravindra (2011) analysing the Water Resource Mismanagement concludes- Although many analysts believe that water demand will outstrip water supply by 2020, there is still hope for India. Water scarcity in India is predominantly a manmade problem; therefore if India makes significant changes in the way it thinks about water and manages its resources soon, it could ward off, or at least mollify, the impending crisis.

Even regarding local specific planning, Iyer Ramaswamy R (2011) opines– There must be area-specific studies of water needs and local water availability, and possibilities of local water augmentation through rainwater harvesting, micro watershed development, groundwater use, and such other means as are available.

In the Draft Approach Paper to the 12th Five Year Plan, Planning Commission (2011), analyses- Economic development will be sustainable only if it is pursued in a manner which protects the environment. With acceleration of economic growth, these pressures are expected to intensify, and we therefore need to pay greater

attention to the management of water, forests and land. It further analyses – Management of water resources poses increasingly difficult challenges that will require attention in the Twelfth Plan.

Analysing the present scenario of water management in India, the National Water Policy (2012), issued by the Ministry of Water Resources, reports - Issues related to water governance have not been addressed adequately and mismanagement of water resources has led to a critical situation in many parts of the country. ... Water resources projects, though multi-disciplinary with multiple stakeholders, are being planned and implemented in a fragmented manner without giving due consideration to optimum utilisation, environment sustainability and holistic benefit to the people. ... Climate change may also increase the sea levels. This may lead to salinity intrusion in ground water aquifers / surface waters and increased coastal inundation in coastal regions, adversely impacting habitations, agriculture and industry in such regions. ... The Centre, the States and the local bodies must ensure access to a minimum quantity of potable water for essential health and hygiene to all its citizens, available within easy reach of the household. ... Community should be sensitised and encouraged to adapt first to utilisation of water as per local availability of waters, before providing water through long distance transfer. Community based water management should be institutionalised and strengthened.

All these literatures emphasis the effective management of water resources, local planning, community participation and importance of rain water harvesting for sustainable development of the nation.

**Objectives of the Study**

Among other things, the specific objectives of this study are;

1. To identify and analyse the potable water sources at Grama Panchayath (GP) level
2. To analyse the potable water situation at GP level during summer
3. To identify the perception of GPs on rain water management in resolving the water crisis and to highlight the success factors.

4. To analyse the budgetary outlay of GPs towards water activities
5. To analyse the implementation of different schemes of State and Central Government towards rain water harvest management at GPs

**Methodology**

In the light of above background, a study was conducted (2012) at the Grama Panchayath (GP) level coming within the geographical limits of Mangalore taluk in coastal Dakshina Kannada district of Karnataka. In Mangalore taluk there are 49 Grama Panchayaths (GPs) comprising 100 villages in total. In the present study 35 GPs (71.4 percent) comprising 80 villages are surveyed.

In order to generate primary data and information, a survey was conducted with the help of a comprehensive and pre-tested questionnaire. The GP Development Officers / Secretaries were contacted personally for the purpose of eliciting relevant data and information. The concerned officials of Mangalore Taluk Panchayath, Dakshina Kannada Zilla Panchayath, Watershed Development Department and Minor Irrigation Department were also contacted to elicit relevant data and information. The data and information collected from the survey are co-ordinated and analysed in an integrated manner throughout this research work.

**Excessive Dependency on Groundwater**

The twentieth century witnessed a phenomenal expansion of groundwater extraction. The some trend can be observed in the case of rural Mangalore Taluk also.

**Table No. 2: Primary Source of Water of Grama Panchayaths**

| Primary Source | No. of GPs | Per cent |
|---|---|---|
| Bore wells | 29 | 82.8 |
| Open wells | 5 | 14.3 |
| Corporation Water | 1 | 2.9 |
| Total | 35 | 100.0 |

**Table No. 3: Secondary Sources of Water of Grama Panchayaths**

| Secondary Sources | No. of GPs | | Per cent of Cases |
|---|---|---|---|
| | Users | Per cent | |
| Open Well | 27 | 44.3% | 77.1% |
| River | 7 | 11.5% | 20.0% |
| Bore Well | 6 | 9.8% | 17.1% |
| Ponds/Lakes | 5 | 8.2% | 14.3% |
| Corporation water | 2 | 3.2% | 5.7% |
| Tanker Water | 14 | 23.0% | 40.0% |
| Total | 61 | 100% | 174.2% |

82.8 percent of the GPs use bore-wells and 14.3 percent GPs use open wells as their primary source of drinking water in the rural taluk.

Open wells are used as secondary sources by majority (77.1 percent) of the GPs. On analysis of both primary source and secondary sources of water, it is clear that overwhelming majority (97.1 percent) of the GPs depend on groundwater (bore-wells and open wells) as their primary source (Table 2) and again as secondary sources also 94.2 percent of the GPs depend on groundwater (Table 3). Surface water (rivers, ponds/lakes) is not used as primary source by any GP and 34.3 percent of the GPs in rural Mangalore taluk use surface water only as secondary sources of water. Hence, it may be concluded that the GPs rely upon almost entirely on groundwater rather than on surface water.

It is disheartening to note that the GPs are not using the available surface water sources properly. Out of the total 35 respondent GPs, 14 GPs are having rivers which could be used are source of water but out of these only 42.9 percent of the GPs are using them as their secondary source of water. It can be perceived that inadequate projects at GP level to tap these sources may be one of the reasons for the marginal usage.

**Table No. 4: Existing Rivers and its Usage**

| No. of Rivers | No. of GPs | | |
|---|---|---|---|
| | Existing | Using | Per cent used |
| One | 12 | 5 | 41.7 |
| Two | 2 | 1 | 50.0 |
| Total | 14* | 6 | 42.9 |

**Table No. 5: Usage of Ponds/Lakes Owned by Grama Panchayaths**

| Usage | No. of GPs | Per cent |
|---|---|---|
| No Usage | 15 | 75.0 |
| 50% | 1 | 5.0 |
| 75% | 2 | 10.0 |
| 100% | 2 | 10.0 |
| Total | 20* | 100.0 |

At present, public ponds and lakes owned by GPs are found in very few villages of Mangalore taluk. Even such existing ponds and lakes are not conserved properly by local authorities. Hence, in 75 percent of the GPs, the existing public ponds/lakes are not used for any water needs of their villages. Only 25 percent of the GPs use the ponds too varied extent that to as a secondary source of water.

**Water Stress on the Way**

Monsoon rich coastal area is not at ease for potable water needs. An attempt is made to identify the perception of GPs on water availability during summer. It is disturbing to note that majority (71.4 percent) of GPs are already in 'Shortfall' zone.

**Table No. 6: Perceptions of Grama Panchayaths on Water Availability during Summer**

| Water Availability | No. of GPs | Per cent |
|---|---|---|
| Good | 2 | 5.7 |
| Satisfactory | 8 | 22.9 |
| Shortfall | 25 | 71.4 |
| Total | 35 | 100.0 |

It is observed that in an overwhelming majority (85.7 percent) of the GPs, water shortage had begun for the last 5 years.

**Table No. 7: Beginning of Water Shortage at Grama Panchayaths**

In the entire rural Mangalore taluk water shortage is found after rainy season. Alarmingly in 22.8 percent of the GPs shortage begins in early winter (November - January) itself and in the remaining majority (77.2 percent) of the GPs shortage starts from summer (February – May).

**Table No. 8: Season of Beginning of Water Shortage at Grama Panchayaths**

In the study an attempt is made to observe the perception of respondents on the various water sources availability situation and it reveals that almost (94.3 percent) entire rural Mangalore taluk experiences decreasing water sources.

**Table No. 9: Water Sources Availability Situation at Grama Panchayaths**

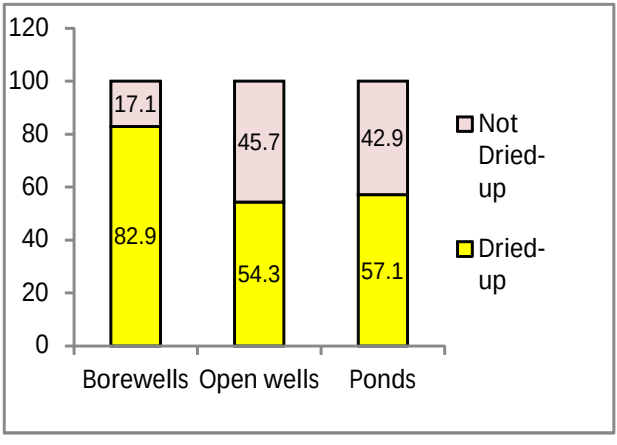
It is distressing that almost entire rural Mangalore taluk (97.1 percent) is facing the problem of depletion of groundwater level, even though it gets heavy rainfall during monsoon. It may be perceived that major reasons behind this crisis are excessive dependency on groundwater, and lack of water conservation and absence of rain water harvesting projects to recharge groundwater in villages by GPs.

**Table No. 10: Groundwater Depletion situation at Grama Panchayaths**

Groundwater depletion has also resulted in salinity and undue mineral contents in deep bore-wells making water non-potable. Such incidences of poor water quality are reported from many (45.7 percent) of the GPs. The depletion of the groundwater level is obvious as the minimum depth of bore-wells is reported at 120 feet and the maximum depth at 650 feet in rural coastal area.

As a result of excessive dependency on groundwater resulting in depletion of groundwater level, majority (82.9 percent) of the GPs revealed that during summer, bore-wells in their locality are dried up. With regard to bringing up of sources, 54.3 percent of the GPs reported dried up open wells and about 57.1 percent of the GPs reported that even ponds/lakes in their area are dried up.

**Figure No. 2: Dried-Up Water Sources among Grama Panchayaths**




***Source:*** *Field survey data*

**Inadequate Rainwater Management:**

It is a paradoxical situation that the region experiences heavy rainfall during monsoon, but faces drinking water shortage soon after. Obviously, this is the result of improper planning and management of rainwater. It is observed that majority (51.4 percent) of the rural Mangalore taluk experiences a general trend of flood situation during monsoon due to heavy rainfall from south-west monsoon.

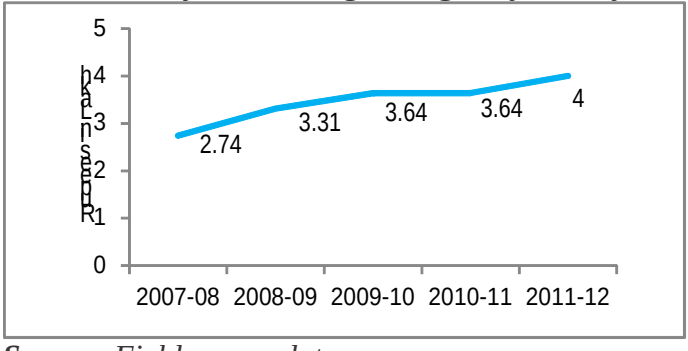
**Table No. 11: Flood Situations during Monsoon at Grama Panchayaths**

| Flood Situation | No. of GPs | Per cent |
|---|---|---|
| Had Flood | 18 | 51.4 |
| No Flood | 17 | 48.6 |
| Total | 35 | 100.0 |

Comparison of flood situation and groundwater depletion position reveals the alarming fact that even after heavy rainfall during monsoon, almost all (97.1 percent) GPs have the problem of groundwater depletion in summer (Table 10). It is obvious that absence of thoughtful efforts, on the part of GPs to recharge groundwater through various rainwater harvest and conservation techniques in villages, is the primary reason for both of these contradictions flood in monsoon and water shortage in summer.

The average budgetary spending on water projects (Figure 2) by the GPs in the year 2007-08 was Rs 2,73,804.55 and in the five years, average budgetary spending on water projects has increased to Rs 4,00,765.63 (2011-12), resulting in an overall average increase of 146 percent.

**Figure No. 3. Five years Average Budgetary Outlay on Water**




***Source:*** *Field survey data*

**Table No. 12: Increase in Budgetary Outlay on Water in 2011–12 as compared to 2007-08**

| Increase in 5 Years | No. of GPs | Per cent |
|---|---|---|
| No Increase | 6 | 20.6 |
| 1 to 2 times | 12 | 41.4 |
| 3 to 4 times | 7 | 24.0 |
| 5 to 10 times | 2 | 7.0 |
| Above 10 times | 2 | 7.0 |
| Total | 29* | 100.0 |

Irrespective of increase in the budgetary outlay towards various water projects by local bodies, villages continue to experience water shortage in summer. Increased spending on water projects has not saved the GPs from 'Water Shortfall'. Hence, it may be concluded that mere spending on water projects, without comprehensive long-term planning and locally appropriate, eco-friendly, decentralised rainwater harvest and conservation techniques, water crisis will never be resolved.

**Table No. 13: Perceptions on better Water Management through Rainwater Harvesting**

| Perception | No. of GPs | Per cent |
|---|---|---|
| Possible | 29 | 82.9 |
| Possible to a little extent | 5 | 14.3 |
| Impossible | 1 | 2.8 |
| Total | 35 | 100.0 |

An attempt is made in the study to identify the perception of the GPs on the possibility of managing water resources in a better way through rainwater harvesting techniques. It is observed that 82.9 percent of the GPs have felt that the situation could be averted, if their had been an effective rain water harvesting..

**Table No. 14: Water Harvesting Projects Undertaken by Grama Panchayaths**

| Harvesting Projects | No. of GPs | Per cent |
|---|---|---|
| Undertaken | 14 | 40.0 |
| Not Undertaken | 21 | 60.0 |
| Total | 35 | 100.0 |

But it is disappointing to note that in practice 60 percent of GPs do not have any water harvesting projects of their own in the panchayath area. On the other hand, it is observed that, majority of GPs which

claimed to have water harvesting projects are merely schemes executed earlier in local schools sponsored by these panchayaths. Many of these school models are now in non-usable condition due to poor maintenance.

In the present study, an attempt is made to identify the various schemes of Central and State government implemented in villages by GPs towards water harvesting, water conservation, watershed development, conservation of water bodies etc. the five years period (2007 to 2012). Out of the 35 respondent GPs, only 19 (54.3 percent) GPs reported the implementation of Central and State government schemes like Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), Integrated Watershed Management Programme (IWMP), Suvarnajala, Swajaladhara, Rainwater Harvest Project, Western Ghats Project, etc.

Apparently, the water conservation activities, watershed schemes are not implemented convincingly by majority GPs in Mangalore taluk. In some instances comprehensive information on watershed activities, grants utilized on various schemes and projects are not reported by the GPs during the study.

**Findings and suggestions**

On the background of the results and discussions of the study, the following suggestions can be offered for the overall improvement of drinking water scenario in the rural Mangalore Taluk in general.

1. Undue dependency on groundwater has already resulted in groundwater depletion, poor water quality etc. Villages are blessed with rivers and many streams. Therefore, GPs should plan to make use of available surface water through proper projects. Existing ponds/lakes have to be protected and well maintained. This will also help to recharge the groundwater. Joint projects to share the river water among the neighbouring villages should be carefully planned and expeditiously implemented. State government and district authorities should encourage such joint projects with suitable financial support.
2. There is a need to protect and rehabilitate traditional water

harvesting techniques and structures like local construction of *'Katta'* (small earthen dam) to the streams at villages. There is a vast extent of common land, generally classified as fallow in village records, which must be converted into collection areas for rainwater harvesting. This is one of the best ways of augmenting local water resources for drinking and agricultural needs. Unauthorised encroachment of water bodies and forests must be firmly prevented.

3. All forms of local individual and institutional rainwater harvesting efforts should be identified and encouraged. Financial incentives like house tax rebates, subsidies, progressive water tariff have to be given to such harvesters.
4. The activities under the MGNREGA must be speeded up in the rural areas of the taluk with intense efforts and should be linked to water conservation activities like de-silting of ponds and wells, construction of local *'Katta'*, percolation pits, farm ponds, new ponds, bore-well recharging activities, renovation of '*nalas'* (small streams), afforestation activities etc. Already implemented rainwater harvesting projects at schools must be well maintained as models to young minds.
5. It is crucial to make sure that groundwater resource is used in a sustainable manner. Increase in sea level due to global warming and failure on our part to hold the depletion in groundwater may result in intrusion of saline water into the coastal fresh water aquifers. Thus, immediate action is called for to bring in uniformly applicable legislative measures in setting limits to tap groundwater and prevent in particular its commercial exploitation.
6. Rainwater harvesting and groundwater recharge should be made to go hand-in-hand, with every member of the village community taking part in this effort. A process of social mobilization needed to involve and encourage communities and households to undertake local water management to meet their water needs. This needs a fresh look at the role of the government, institutional and financial mechanisms, legal

framework and technical supports. A mass movement in this direction is needed, not the pretentious plans of diverting/linking rivers, which will solve local, state and national water shortages and result in a sustainable development.

Whenever possible groundwater extracted must be justified and suitably recharged, and water used must be recycled and reused. In a rush to meet the ever increasing demand for water from current users, we should not jeopardize the ability of future users to depend on the same natural resource.

## Conclusion and Recommendations

Simply pumping more to meet increasing water demand results in groundwater overdraft and it is found in the entire rural Mangalore taluk. Groundwater depletion has also resulted in saline water and undue mineral contents in deep borewells making water non-potable. During summer, through new borewells, temporary measures are taken by GPs to keep their residents relaxed. But little sustained effort has been made to deal with the root of the problem - the overuse of precious groundwater and the inadequate measures taken to replenish it. As a result, water level has fallen penetratingly. Alarmingly the depth of borewells reported in a few instance is at 650 feet in rural Mangalore taluk, which is located near to Arabian Sea.

Mere increased spending on water can not improve the water scenario. Mangalore Taluk is neither having major nor minor irrigation projects to tap the rainwater. Village-scale rainwater harvesting methods can ease water stress. Given the fact that taluk is one of the well-endowed taluk in the state in terms of average annual rainfall, there is no reason why it should suffer from water stress.

## References

**Agarwal, A, Sunita Narain and Indira Khurana, ed.** (2001): *Making Water Everybody's Business: Practice and Policy of Water Harvesting* (New Delhi: Centre for Science and Environment)

**Bala, Jagadisha** (2012): *Evaluation of Rain Water Harvest Management by Grama Panchayaths - A Study at Mangalore Taluk in Coastal Karnataka,* UGC sponsored Minor Research Project.

**Bhadti, Radhakrishna S.** (2010), Amritadhaare, (a collection of articles on water resource), SahityaPrakashana, Hubli.

**Editorial** (2007), *Kurukshetra*, September 2007, Vol. 55, No. 11.

**Editorial** (2012): "When the Water Runs Out", *Economic & Political Weekly*, June 2, Vol. 47, No. 22. p 7.

**Gujja, Biksham and Shaik, Hajara** (2005), A Decade For Action: Water For Life - When Will India Cover The 'Uncovered'? *Economic and Political Weekly*, March 19, 2005, 1086-1089.

**Hemalatha, B, YVR Reddy and MS Prasad** (2007): "Watershed Development Programme in India- Realities or Myths", *Kurukshetra*, September, Vol. 55, No. 11, pp 23-28.

**Iyer, Ramaswamy R** (2011): "National Water Policy: An Alternative Draft for Consideration", *Economic and Political Weekly* Supplement, 25 June, Vol. 46, No. 26 & 27, pp 201- 214.

**Iyer, Ramaswamy R** (2012): "River Linking Project - A Disquieting Judgment", *Economic and Political Weekly*, 7 April, Vol. 47, No. 14, pp 33-40.

**India Meteorological Department, Hydromet Division, New Delhi** (2014): "District wise Rainfall Information", Ministry of Earth Sciences, Government of India, Viewed on 29 July 2014 (http://www.imd.gov.in/section/hydro/distrainfall/webrain/karnataka/dakshinkannada.txt).

**Madhyastha, N. A.** (2007), *Traditional Water Management Practices in Coastal Karnataka*, National Seminar on Water & Culture, Hampi, Bellary Dist. June 2007.

**Mehta, Lyla** (2000), Drought Diagnosis Dryland Blindness of Planners, Economic and Political Weekly, July 1, 2000, 2437 –2443.

**Ministry of Water Resources** (2012), National Water Policy-2012, Government of India, New Delhi.