COMPARATIVE ANALYSIS OF RAINFALL PATTERN AND RAIN WATER HARVESTING IN KALGHATAGI AND NAVALGUND TALUKS OF KARNATAKA

Mr. Prakash.S. Bilebal* & Prof. H. H. Bharadi**
*Research Scholar, Department of Economics, Karnatak University, Dharwad. PIN-580003
** Professor, Department of Economics, Karnatak University, Dharwad. PIN-580003

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ABSTRACT *The study looks at background and concept rainfall pattern, rain water harvesting, ground water and its importance. The study period is 2013 to 2018 and monthly time series data used for understanding the seasonal impact of rainfall on rainwater harvesting. The study is based on secondary data base which are collected from Karnataka State Natural Disaster Monitoring Council- Government of Karnataka, Ground Water Status from Central Ground Water Board- Government of India, watershed development programmes from Watershed Development Department-Government of Karnataka. Data analysis is undertaken with the help of simple statistical tools like percentage, share, average and compositions. The study attempted to examine the current status of surface water, rainfall, ground water and rain water harvesting through watershed development in the study area Kalghatagi and Navalgund taluks in Dharwad district. Surface water is major source of agriculture, industry and domestic use in the study area and ground water many areas in Navalgund taluk is contaminated due to over exploitation of ground water and less rain and improper water storage facility. On the other hand, this study found that Kalghatagi taluk has been getting descent rainfall compared to Navalgund taluk while rain water is not systematically utilized properly hence there is need a greater number of watershed development in order to recharge the ground water recharge.*

Keywords: *Surface water, Rainwater harvesting, Rainfall, Pre and Post Monsoon Rainfall, Ground Water, Watershed Development etc.*

1. Introduction

Water resources constitute mainly surface and groundwater, with rainfall being the basic source. The environmental concerns pertaining to water resources centre around water resource management, specifically relate to both quantity and quality issues. According to the latest report *Nature-Based Solutions For Water* by the United Nations World Water Development Report-2018, the global demand for water has been increasing at a rate of about one percentage per year with respect of growing population, economic development and changing consumption patterns and other factors. The global demand for water would further grow significantly in the coming decades and specifically industrial and domestic demand for water will increase much faster than agricultural demand, although agriculture will remain the largest overall user. The concern of water scarcity would occur in developing nations due to potential economic development and population growth where India is no exception for upcoming water scarcity.

The major source of surface water in Karnataka state is rainfall especially monsoon rains. Based on climate and geographical conditions in the state, there are mainly three climatic regions such as Arid, Semi-arid and Humid. Dharwad district comes under humid rainfall zone. The mean annual rainfall varies from 400 mm. (i.e. millimetre) in the Eastern parts to more than 4000 mm. in the Western Ghats and Coastal beach of the State. Average annual rainfall in Karnataka state is 1139 mm. The shower in the state is heavy during South-West monsoon that is June to September month and retreating monsoon rain starts during October to December which is also called as North-East Monsoon. Normal rainfall for Kharif, Rabi and Summer is of the order of 930 mms, 195 mms and 14 mms, respectively.

2. Literature Review

Gotur (2008) attempted to explore the economic benefits and impacts of Rooftop rainwater harvesting Programmes on the poor communities in the State. She analysed the impact of Domestic Rooftop rainwater harvesting programmes on productivity, employment and income of the poor households and also examined the economic viability. The study found that it had benefitted agricultural labourers, housewives, aged persons and students by saving their time for fetching water from nearby sources. Further it has assured availability of water for rearing live-stock, pottery production, hotel management and kitchen garden. This has led to increase in household income and reduction in production cost. Further it revealed

that for all the categories the Net Present Worth was positive, Cost benefit ratio was more than unity and IRR was more than that of referenced bank rate and Pay Back Period was very low. These all indicate that the investment in DRWH was financially found more feasible and adoption of DRWH technology in the study areas was economically attractive.

Shrestha (2009) addressed the problem of water crisis in Kathmandu valley and possible solutions to overcome it. The study found that The Valley's current water demand is about 280 million litres per day (MLD), but the Kathmandu Valley Water Utility (KUKL) can only supply about 86 MLD during the dry season and 105 MLD during the wet season. To meet the supply-demand gap, groundwater from both shallow and deep aquifers (more than 200 metres) is being heavily extracted. This unregulated extraction is depleting the aquifers; especially the deep aquifers are not easily rechargeable due to the Valley's impermeable black clay. Rainwater harvesting and artificial recharge into shallow and deep aquifers offers a promising approach for reversing the trend of water resource exploitation and groundwater depletion because of the abundance of the rain water in the valley.

Kumari (2009) evaluated the design and policy issues involved in implementation of RWH in India and examined the RWH potential in India through successful case studies of Jamia Hamdard University and Tihar Jail and further emphasized by model calculations for large scale RWH implementation in South and Southwest Delhi. The study found that the time taken for providing financial assistance was in between four to eitht months and the maintenance was done once in a year. Further the ground water level has not depleted in the study area after adoption of RWH system, because they did not have to further deepen their tube wells in their localities. RWH scheme has created awareness among the public for avoiding wastage of water and also for adoption of conservation of water. The objective of ground water recharging will be served in a better way if all the institutions (school, colleges, universities, academic institutions, hospitals etc), office complexes, societies (Govt./Private) etc. which are covering large areas and having the scope of better rain water harvesting, adopt rain water harvesting. Also, it is more cost effective to install RWH for societies / communities than individual houses.

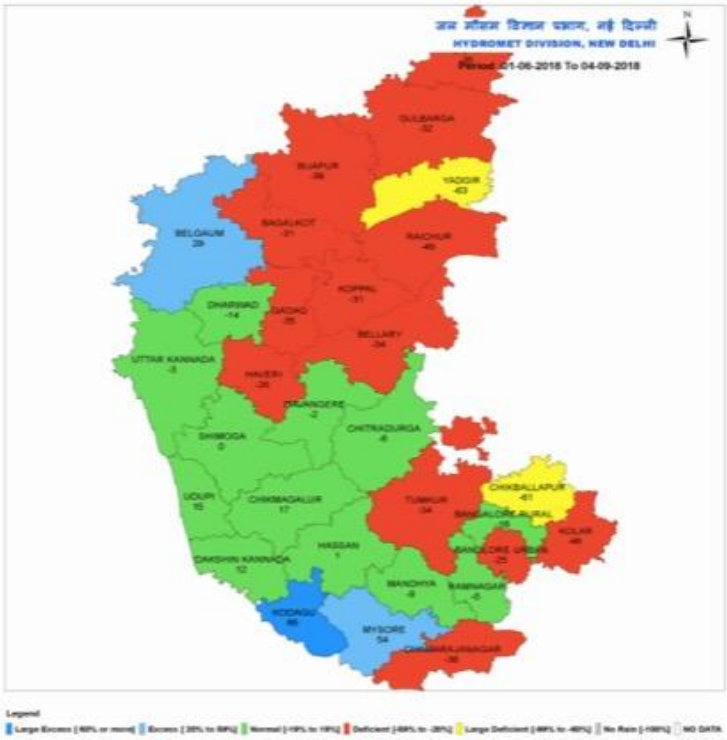
Tang (2009) analyzed the costs and benefits of rainwater harvesting in the Kuttanad region of Kerala, India. The major costs include the initial construction cost of rainwater harvesting system and the maintenance costs. The major benefits include an increase in household dispensable income, time and energy saved from collecting water and reduction of epidemic outbreaks and associated medical costs. It also ascertained the net benefits or costs from rainwater harvesting under a variety of scenarios for households in different existing water supply conditions. It is concluded that households with different existing water consumption pattern will benefit positively in various degree from investing in domestic rainwater harvesting systems. Continuous data collection and research are needed to validate the benefits and costs of rainwater harvesting in Kuttanad.

Glendenning (2009) made a thorough attempt to evaluate the impacts of RWH on larger catchment hydrological balances. The study found that the average daily potential recharge from RWH structures was between 12 – 52 mm/day, while recharge reaching the groundwater was between 3 – 7 mm/day. The large difference between recharge estimates could be explained through soil storage, and a large lateral transmissivity in the aquifer. Approximately 7% of rainfall was recharged by RWH in the catchment. The field study results suggested that RWH had a large impact on the groundwater supply, and that there is a large lateral flow of groundwater in the area. The analysis highlighted the important link between irrigation area and RWH area. If the irrigation area is increased at the optimal level of RWH, where the sustainability indices were greatest, the resilience of the system actually decreased. Nevertheless RWH in a system increased the overall sustainability of the water demand for irrigated agriculture, compared to a system without RWH. Also RWH provided a slight buffer in the groundwater store when drought occurred.

3. Importance of the Study

The main issues of concern are conservation of existing water resources and prevention of further degradation and depletion. The associated issues include rejuvenation of degraded traditional surface water bodies, enhancing the availability of water through water harvesting measures, and recharge of ground water resources. More important is the judicious and economic use of both ground and surface water for agricultural, industrial and domestic purposes. Karnataka is prone to repeated droughts.

Figure 1: Rainfall Departure Pattern Across Districts in Karnataka 2018



Source: Karnataka State Natural Disaster Monitoring Centre (KSNDMC)

Figure one shows the actual rainfall departure from normal rainfall across districts in Karnataka in 2018 (i.e. up to August 2018). This year monsoon rainfall is extreme in Kodagu district and heavy in Mysore and Belagavi districts compared to regular rainfall in these districts. Malanadu and coastal districts faced lesser rainfall than normal while north Karnataka region experienced scanty rainfall in this current year although all reservoirs are filled.

4. Objectives of the Study

- To overview surface water and ground water status in the Study are
- To examine rainfall pattern in Kalghatagi and Navalgund taluks in Dharwad district
- To review rainwater harvesting and watershed development in the study area

5. Hypothesis of the Study

- Rainfall pattern is uniform in Kalghatagi and Navalgund taluks
- Rainwater harvesting and watershed development programmes are helping to recharge water sources

6. Research Methodology

The present study is based on secondary data sources. The study period is last five years and monthly data is considered for identifying seasonal impact. It examines the trends and pattern of rainfall and ground water conditions in Kalghatagi and Navalgund taluks in Dharwad districts. It uses rainfall database from Karnataka State Natural Disaster Monitor Council-Government of Karnataka, ground water data is derived from Central Ground Water Board-Government of India, watershed development programmes details are collected from Watershed Development Department, Government of Karnataka. Simple statistical tools like percentage, mean, growth rates, share and composition are used for data analysis.

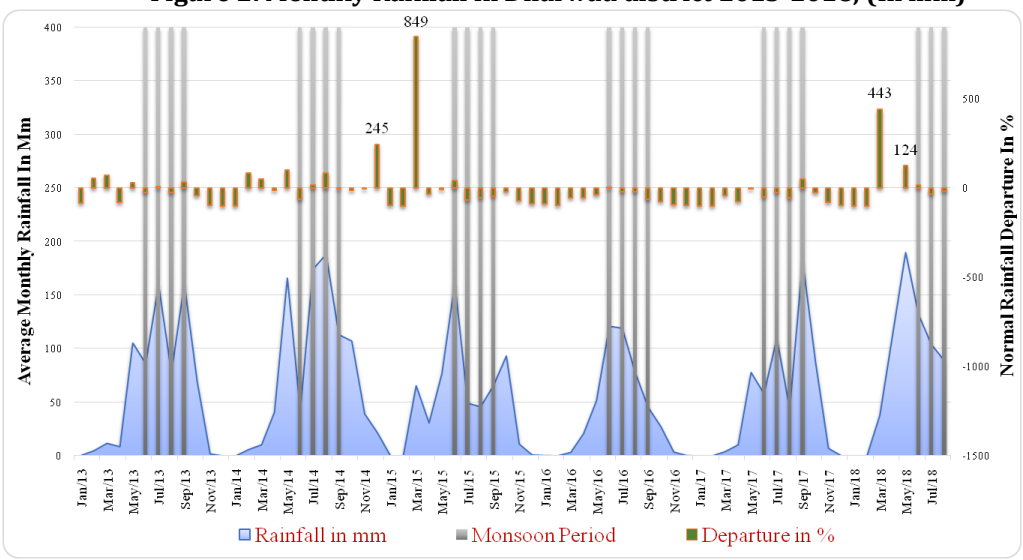
7. Analysis of Rainfall Pattern and Rain Water Harvesting

7.1 Rainfall Pattern in Dharwad District

Monsoon rainfall is the major surface water source in the study area. Rainfall pattern and intensity is not uniform throughout the year while intensity of rainfall is more dynamic in nature in Dharwad district.

Figure 2 illustrates the monthly rainfall pattern in Dharwad district during last five years. Monsoon rainfall is high during June to September months and it is clear that rainfall in Dharwad district is mainly during rainy season and remaining season rainfall is not uniform while during summer season there is thunderstorm rain in few parts in the district. Figure 2 also shows the departure of rainfall from normal in percentage where March month of 2015 experienced heavy rainfall that is 849 mm followed by 443 mm rainfall in the same month in 2018 which is mainly because of unexpected conventional rainfall effect. However, majority of months rainfall is below the average from normal rainfall level. It shows that rainfall in recent years has been decreasing continuously.

Figure 2: Monthly Rainfall in Dharwad district 2013-2018, (In mm)

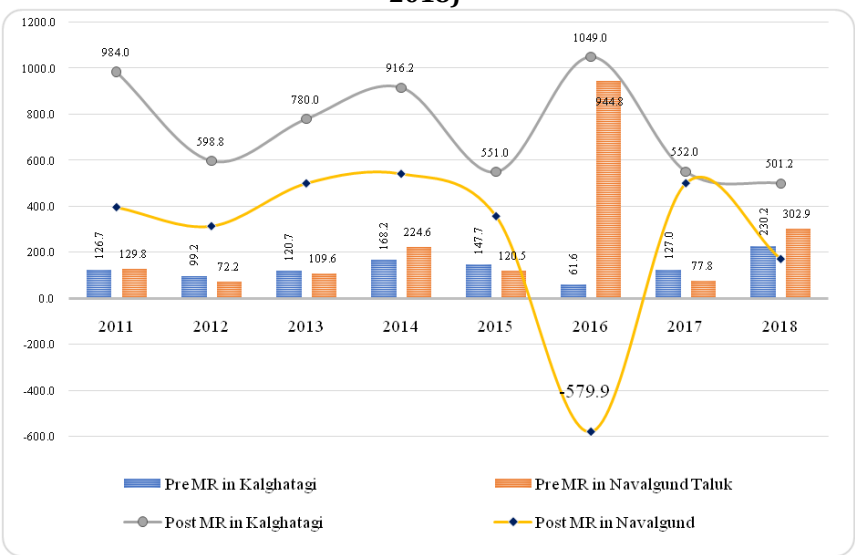


Source: Author creation based on KSNDMC data

7.2 Trends and Pattern of Rainfall in Kalghatagi and Navalgund Taluks

All season average rainfall has been high in Kalghatagi taluk compared to Navalgund taluk which is showed in figure three. It is clear that average all season rainfall in Navalgund taluk is lesser than Kalghatagi taluk that is 522.7 mm and 805 mm respectively. Kalghatagi taluk has more vegetation and near to western ghats compared to Navalgund taluk hence surface water in Kalghatagi taluk is naturally high. However, ground water level condition is more vulnerable in Navalgund taluk than Kalghatagi taluk while irrigation and industrialization have been pressurizing groundwater in Navalgund taluk hence rain water harvesting is need for proper management of surface water.

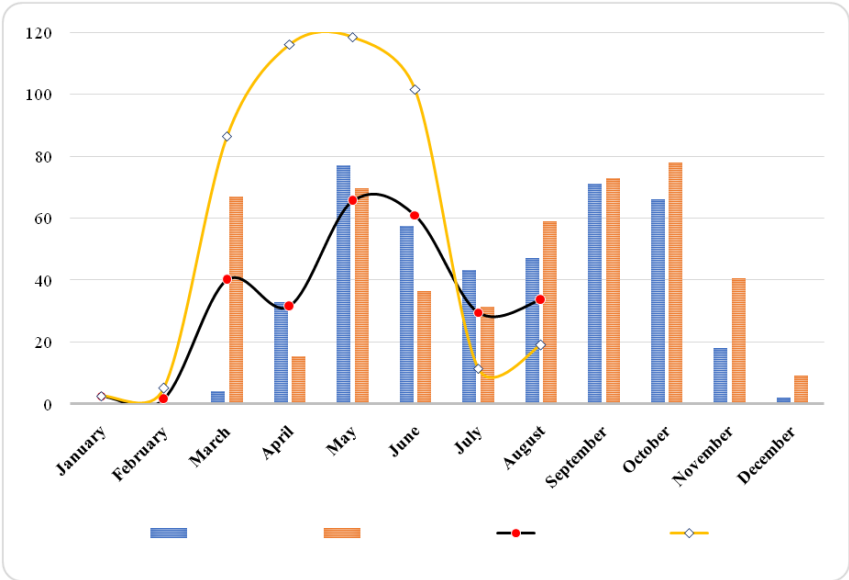
Figure 3: Pre and Post Monsoon Rainfall Pattern in Kalghatagi and Navalgund Taluks (2011-2018)



Source: Author creation based on KSNDMC data

Compared to 2017-year rainfall is high in 2018 calendar year in Navalgund taluk and average 40 mm rainfall monthly recorded in Kalghatagi and Navalgund taluks which is illustrated in the figure four. Trend line shows that rainfall concentrated during May to October months in 2017 but it is slightly different scenario in 2018 where rainfall concentrated during months of March to June in Navalgund taluk.

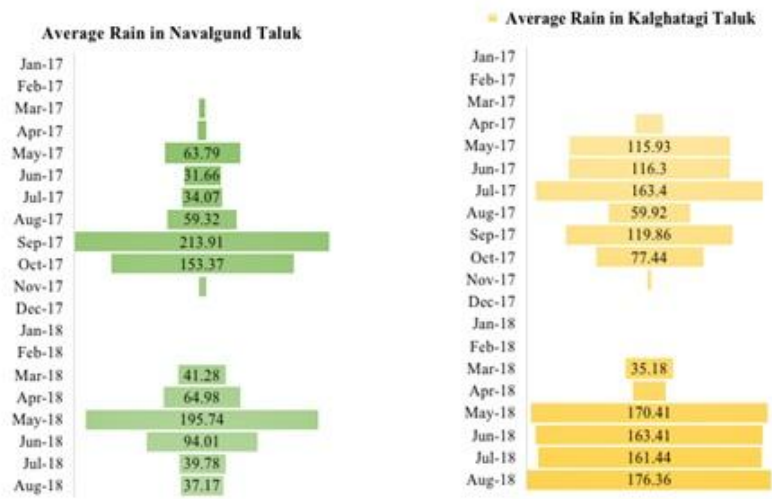
Figure 4: Monthly maximum Rainfall in Kalghatagi and Navalgund Taluks (2017-2018)



Source: Author creation based on KSNDMC data

For understanding the cumulative rainfall figure five assists. In Navalgund taluk average rainfall was high during September and October months of 2017. Similarly, it is high in May moth of 2018 but average rainfall in Kalghatagi taluk has got more during May to July months of 2017 but during May to August rainfall in Kalghatagi taluk spurted due to good monsoon this year. It is clear that there is no uniform rainfall pattern in Kalghatagi and Navalgund taluks even though both are getting monsoon rainfall therefore, first hypothesis of the study that is there is uniform rainfall pattern in Kalghatagi and Navalgund taluks would be rejected and accepted alternative hypothesis as there is no uniform rainfall in two taluks.

Figure 5: Monthly Cumulative Rainfall in Kalghatagi and Navalgund Taluks (2017-2018)



Source: Author creation based on KSNDMC data

7.3 Ground water Status in Dharwad District

In Karnataka, ground water in more than 37 percentage of rural habitations and surface water in some rivers are contaminated at the points of effluent discharge and also around urban areas. Habitations in

Bagalkot, Bangalore Urban, Bijapur, Chamarajnagar, Chitradurga, Haveri, Mandya, Tumkur, Bellary, Davanagere, Kodagu, Kolar, Raichur and Koppal districts have serious ground water quality problems, ranging from 50-79 percentage. More specifically, excess fluoride in ground water is a major problem in 14 districts, ranging from 10-67 percentage of the total habitations of each district. Similarly, excess brackishness in 13 districts (in the range of 10-27 percentage of the habitations), excess nitrate in eight districts (10-51 percentage of habitations) and excess iron in 12 districts (10-63 percentage of habitations) is adversely affecting drinking water quality.

Dharwad district is covered by various river basins such as Malaprabha and Ghataprabha, Tungabhadra, Kalinadi. As per Ground Water Year Book of Karnataka State 2016-17, Karnataka state has total 1494 groundwater monitoring centres where Dharwad district had 26 groundwater monitoring centres. Although having good number of rivers and decent rainfall in Dharwad district the underground water has been depleting due to human economic activities. The recent data from central groundwater boar, Government of India, average elevation of ground water in Kalghatagi taluk is 556 meters while it is 612 meters in Navalgund taluk. It shows that ground water level is depleting over the period in Navalgund taluk compared to Kalghatagi taluk in Dharwad district. The quality of water in Dharwad district varies from area to area. Average water pH level in Kalghatagi taluk is 9.5 whereas it is 8.2 in Kalghatagi taluk while chloride and fluoride concentrations are high in groundwater in Navalgund taluk compared to Kalghatagi taluk.

7.4 Rainwater Harvesting and Watershed Developments in Dharwad

Water is the life of living and non-living beings in this world. Similarly, rainwater harvesting (RWH) has many advantages for ecosystem and mankind. For example it is environment friendly and easy approach for water requirements, it is an ideal solution for water requirements in areas having inadequate water resources, it Increases ground water level and improves the ground water quality, it mitigates the negative effects of drought, reduces the runoff and soil erosion, reduces flooding of roads and low-lying areas, it is economically feasible and cost effective along with easy to maintain, RWH is economical and saves water and electricity bills.

Dharwad district is one of the major agricultural districts with more than 70 percentage of the population depending on it. District agriculture is dependent on monsoon which is not uniform over the years. Nearly three fourths of the cultivable land are dependent on monsoon, which is contributing nearly 42 percentage of the total production from agriculture. The productivity of any crop mainly depends on two natural resources- land and water in addition to management practices. Therefore, the conservation, up gradation and utilization of these two natural resources on scientific principles is essential for the sustainability of rain fed agriculture. The watershed concept for development of rain fed agriculture is gaining importance over the years and it amply demonstrated that watershed developmental tools are very effective in meeting the needs of farmers and households in rural area. Karnataka state had five major river basins where it had 218 identified watersheds while Dharwad district had two major river basins and nine major watersheds, and 682 micro watersheds are identified for development (Source: Watershed Development Department, Government of Karnataka). Therefore, second hypothesis of the study would be accepted as rainwater harvesting and watershed development programmes are helping to recharge water sources.

8. Conclusion

Water is the source and life for being and non-being in our planet. In this chapter the study looks at background and origin of concept rain water harvesting, ground water and its importance. The study attempted to examine the current status of surface water, rainfall, ground water and rain water harvesting through watershed development in Karnataka and in the study area Kalghatagi and Navalgund taluks in Dharwad district. Surface water is major source of agriculture, industry and domestic use in the study area and ground water many areas in Navalgund taluk is contaminated due to over exploitation of ground water and less rain and improper water storage facility. On the other hand, Kalghatagi taluk has been getting descent rainfall while rain water is not systematically utilized properly hence there is need watershed development more to feed the ground water recharge.

Even though having various water conservation and ground water recharge programmes by government is not getting much expected results. Therefore, present study also looks at micro level study regarding ground reality of surface water and rain water harvesting status in the consecutive chapters.

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