RESEARCH ARTICLE Agricultural Science Digest, Volume 46 Issue 1: 53-61 (February 2026)

An Investigation on the Effects of the Environment on Rainwater Harvesting and the Effectiveness of Watershed Management in Tamil Nadu's Dindigul District

A. David[1], R. Vasanthi[2], V. Sathishkumar[3]

10.18805/ag.D-6408

ABSTRACT

Background: Today, due to water pollution, the availability of potable water in nature is becoming scarce. Every day water sources as well as pure water get polluted by human activities. There are two types of precautionary measures: 1). preventive measures. It means measures which have to be taken to prevent water from pollution. For example, preventing untreated effluents to be discharged into rivers and other water sources. 2). Curative measures. It refers to purification of polluted water through various steps like waste water treatment; recycling all waste materials from polluted water. This study is an attempt to understand the effects of the environment on rainwater harvesting and the effectiveness of watershed management.

Methods: The study is based on primary data through questionnaire methods. Data was carefully compiled and coding for the analysis. The present study adopted multiple linear regression is a method of analysis for assessing the strength of the relationship between each of a set of independent variables. Since the study is involved many independent variables which is uncorrelated each other.

Result: From the multiple linear regression model findings indicating that the model is statistically significant and that the independent variables collectively explain a portion of the variance in potential improvements, as evidenced by the R^2 value of .929. This suggests that approximately 92.9% of the variance in potential improvements can be attributed to the factors analysed, which include positive environmental impacts (vegetation, wildlife), reduction in conflicts over water resources, community received government support, government efforts to promote watershed management. Among the independent variables, positive environmental impacts have the strongest influence on potential improvements, with a beta coefficient of .557 and a t-value of 12.737, both statistically significant at the 0.00 level ($p<0.001$). This finding emphasizes that enhancing positive environmental impacts are crucial for fostering potential improvements in the effectiveness of watershed management in Dindigul District.

Key words: Rainwater harvesting, Sustainable development, Water pollution, Watershed management.

INTRODUCTION

India is a diverse nation with a wide range of weather, landscapes and cultural customs, but water scarcity is a serious problem for it. Groundwater resources are being depleted and conventional water sources are drying up as a result of increased urbanisation, industrial growth and climate change. At the global level 70% of water is used for agricultural purposes, 25% of it is used for industrial activities and 5% for domestic purposes. Today a person needs 20 to 40 litres of water per day. At present more than 1 billion people around the world, have no access to pure water. The world's annual freshwater availability is estimated to 38000 cubic kilometres (Arumugham, 2010). Today man over exploits the natural sources and the result will be the pollution in water, air, soil and so on (Shawkat Ali and Khaled, 2014). Rainwater harvesting, a centuries-old technique that is currently receiving more attention as a sustainable and economical means of addressing water scarcity, is one possible answer to this problem.

Rainwater harvesting

Rainwater harvesting involves the collection and storage of rainwater from rooftops, land surfaces, or other catchment areas, which can then be used for various purposes like drinking, irrigation and domestic use. The process can be simple or complex, depending on the scale of implementation and the intended use of the water.

Scope of the study

India is home to a population of over 1.4 billion and the country's water demand is only increasing. However, despite the annual monsoon rains, India faces significant

[1]Pasumpon Muthuramalinga Thevar College, Usilampatti-625 532, Tamil Nadu, India.
[2]Department of Sociology, Pasumpon Muthuramalinga Thevar College, Usilampatti-625 532, Tamil Nadu, India.
[3]Department of Economics, Loyola College, Chennai-600 034, Tamil Nadu, India.

Corresponding Author: V. Sathishkumar, Department of Economics, Loyola College, Chennai-600 034, Tamil Nadu, india. Email: sathisanash@gmail.com
ORCID: 000-0003-1293-0320

How to cite this article: David, A., Vasanthi, R. and Sathishkumar, V. (2026). An Investigation on the Effects of the Environment on Rainwater Harvesting and the Effectiveness of Watershed Management in Tamil Nadu's Dindigul District. *Agricultural Science Digest*. **46(1):** 53-61. doi: 10.18805/ag.D-6408.

Submitted: 12-07-2025 **Accepted:** 30-10-2025 **Online:** 01-12-2025

challenges related to water availability. Here are some of the key reasons why rainwater harvesting is particularly important in India.

Increasing water demand

The growing population, coupled with urbanization and industrialization, has led to increased demand for water. With agriculture being the primary sector consuming water, finding sustainable alternatives is crucial for long-term water management. Gosain and Rao (2004) observed that due to the ever-increasing demand on water resources, the pressure on its judicious utilization is also increasing. Besides being precious, this resource is also complex to manage on account of its dynamic behaviour. It implies that the response to a unit of precipitation input is dependent on the state of wetness of the land mass and the environment prevalent at that time.

Erratic rainfall

India's rainfall distribution is uneven, with certain regions experiencing heavy monsoon rains while others remain dry for most of the year, even within the monsoon season, rainfall patterns have become unpredictable due to climate change. As a result, regions that depend on seasonal rains face long dry spells and water shortages. Rajanbabu *et al*. (2022) observed that there are several causes of instability and growth-affecting elements in the agriculture sector; in the case of spices, previous research has shown that price fluctuations and weather variations are crucial. Support for policy research and analysis is crucial for increasing productivity in rain-fed regions and protecting the agricultural industry from fluctuations in rainfall from year to year.

Depleting groundwater levels

Groundwater is a vital source of drinking water in India, especially in rural and semi-urban areas. Over-extraction for irrigation and other uses has caused groundwater levels to plummet in many parts of the country. Rainwater harvesting can help recharge aquifers and reduce dependency on groundwater.

Climate change and decreased surface water availability

Rivers, lakes and reservoirs in India are drying up due to reduced rainfall, pollution and over-extraction. Harvesting rainwater can be a reliable backup source of water for agricultural, domestic and industrial use, especially during times of drought.

Benefits of rainwater harvesting

Rainwater harvesting is not just a solution to water scarcity; it also offers a range of other benefits:

Cost-effective

The setup cost for a rainwater harvesting system is relatively low compared to the construction of new dams or water treatment plants. Additionally, it reduces water bills for households and industries by using stored rainwater for non-potable uses like irrigation and cleaning.

Reduces flooding and soil erosion

In urban areas, rainwater often drains into stormwater systems, causing flooding. By collecting rainwater, the flow is slowed down, reducing the risk of floods. Additionally, rainwater harvesting helps to prevent soil erosion in rural areas, particularly during heavy rains.

Improved groundwater recharge

The rainwater harvested from rooftops and other surfaces can be used to recharge underground aquifers, improving groundwater levels over time. This is particularly important in areas where groundwater levels are rapidly depleting. Ingle Nandulal Sagar *et al*. (2025) stated that the adoption of these advanced technologies has revolutionized soil and groundwater assessment. Digital soil mapping enhances understanding of land resources, while remote sensing and GIS facilitate environmental conservation and sustainable agriculture. This study systematically underscores the role of these technologies in soil and groundwater management, highlighting their importance in resource sustainability. Kumar and Krishna (2018) study evaluated groundwater potential in hard-rock regions of India affected by coal mining is referenced in this citation. In order to map groundwater potential zones, the study combined geospatial technologies with the Analytic Hierarchy Process (AHP). The results demonstrated the value of this integrated method in locating possible recharge zones and guiding sustainable groundwater management.

Sustainable water supply

By collecting rainwater, communities and individuals can create a reliable, local and sustainable water source. This is especially useful in rural areas where access to clean water can be limited.

Environmental benefits

Rainwater harvesting reduces the strain on existing water resources, which helps preserve natural ecosystems and reduces the energy required to pump water from distant sources.

Methods of rainwater harvesting

Rainwater harvesting methods can vary from simple to advanced systems. Some of the common methods used in India include.

Rooftop rainwater harvesting

This is the most common form of rainwater harvesting in urban areas. It involves installing a collection system on rooftops, where water is directed through pipes into storage tanks or pits. The stored water can then be used for various purposes, including irrigation and household use.

Check dams and ponds

In rural areas, small check dams and ponds are built to collect rainwater and store it for use during dry spells. These structures are typically constructed on rivers or small

streams to prevent water from flowing away and to replenish groundwater.

Percolation pits

These are small pits or trenches filled with stones or gravel that allow rainwater to percolate into the ground, recharging groundwater levels. They are simple to construct and are often used in agricultural fields and urban landscapes.

Rainwater harvesting pits

Similar to percolation pits, these are larger pits dug in the ground to capture rainwater. The water is stored in the pit and slowly filtered into the soil, replenishing the water table.

Recharge wells

Recharge wells are vertical structures that are dug deep into the ground to allow rainwater to flow directly into the aquifer. These wells help replenish groundwater reserves and maintain the health of local water tables.

Rainwater harvesting in India: Government initiatives and awareness

In recent years, the Indian government has made significant efforts to promote rainwater harvesting across the country. Several state governments have introduced policies and schemes that encourage the adoption of rainwater harvesting systems. Notable initiatives include:

The national water policy (2012)

This policy recommends the implementation of rainwater harvesting across the country, especially in urban areas, to reduce dependence on surface water and groundwater resources.

Swachh bharat mission (2014)

Under the Swachh Bharat Abhiyan, the government has included rainwater harvesting as part of its efforts to improve sanitation and water management in rural and urban areas.

State-level incentives

Many Indian states have introduced tax rebates, subsidies and awareness campaigns to encourage households, businesses and institutions to install rainwater harvesting systems.

Public awareness campaigns

Non-governmental organizations (NGOs) and community groups are actively engaged in educating people about the importance of rainwater harvesting and how it can be implemented in various regions of India.

Statement of the problem

Rainwater harvesting has several advantages, but adoption in India is fraught with difficulties. Lack of knowledge and instruction regarding the technology, particularly in rural areas, is one of the main challenges. Furthermore, even if the initial setup costs are minimal, low-income households may still find them to be a barrier.

Furthermore, space limits are a common problem in densely populated urban areas, making the installation of rainwater harvesting devices challenging. In certain locations, inadequate construction and maintenance of current systems might lessen their efficacy.

Focussing on education, offering financial incentives and providing technical help are crucial in addressing these issues and ensuring that rainwater collecting systems are installed and maintained correctly.

Objectives

1. To study the public awareness about rainwater harvesting and watershed management.
2. To examine the efficacy of the rainwater harvesting system.
3. To assess the environmental impact of the watershed management.

Testing of hypotheses

- There is a significant association between Public Awareness and increasing the efficacy of the rainwater harvesting system.
- There is a significant positive environmental impact of the watershed management and potential improvements.

MATERIALS AND METHODS

In the present study, the researcher has adopted a descriptive research design. This design allows for the use of both qualitative and quantitative data. The focus of this approach is on description rather than judgment. It is known for being quick and economical, offering greater flexibility in selecting instruments for data collection. Descriptive research design aids in systematically and accurately analyzing the data and characteristics of a given population. Due to its flexible nature, this method is conducive to further investigation when new questions or issues arise during the study. This approach is particularly suited to this research study as it enables the researcher to capture the real-life situations of the respondents. It also allows for an authentic description of the environmental conditions in the study area. By employing this method, the researcher aims to analyze the effects of anthropogenic hazards of water pollution on human health and to scrutinize the underlying reasons and resulting problems. The head of each household was chosen at random to participate in the survey as a respondent. For the investigation, the simple random sampling method has been appropriately used. 400 study participants make up the samples that were so selected. The surveyed data were manually edited, coded and then, entered into statistical package for analysis. After verification, it was found that the independent variables namely positive environmental impact (vegetation, wildlife), reduction in conflicts over water resources, community received government support, and government efforts to promote watershed management are significantly impact on the potential improvements of watershed management.

This suggests that approximately 92.9% of the variance in potential improvements can be attributed to the factors analysed. For the analysis Multi Linear Regression method was used.

RESULTS AND DISCUSSION

Human activities irreparably pollute natural resources. Various studies show that human actions have become hazardous to nature, with rivers and streams polluted by inorganic and non-degradable wastes, significantly affecting water quality. Quality of life is largely influenced by health status. Health is a central factor that affects daily activities and participation in social and community life. It is not merely the absence of disease but encompasses physical, social and emotional well-being. Disease disrupts normal human life, rendering a person unable to work effectively and making them dependent on others to complete their tasks. Human health is more valuable than wealth, as a fulfilling life is not solely based on material possessions but also on good health. Good physical health includes lifestyle habits such as eating a nutritious diet, drinking clean water, sleeping well, minimizing exposure to toxic chemicals and avoiding alcohol consumption, among other factors.

Several studies examining the effects of water pollution on health have suggested that drinking polluted water is akin to consuming slow poison. Birundha Dhulasi (2004) analyzed various types of water pollutants, noting that pollutants are harmful substances produced by natural sources or human activities, with adverse effects on the environment. Water pollutants can be categorized as physical, chemical, or biological. Physical pollutants include taste, odor, temperature, color, solids and radioactivity. Chemical pollutants consist of pH, alkalinity, acidity, organic matter, oil and grease, residual chlorine, fluoride, arsenic, cadmium, lead, mercury, nickel, selenium, zinc, ammonia, nitrogen, phosphates, sulfates, chlorides, nitrates and carbon. Biological pollutants are mainly microorganisms, including pathogenic bacteria. These pollutants pose serious health risks.

Nanda and Almas Ali (2006) highlighted that a population's health status reflects the socio-economic development of a country and is influenced by various factors such as income levels, living standards, housing, sanitation, water supply, education, employment, health consciousness, personal hygiene and access to affordable healthcare. Poor health is often the result of inadequate nutrition, lack of access to clean water and insanitary living conditions, leading to air-borne and water-borne diseases. Deprivation of essential amenities like safe water and sanitation results in high rates of illness and higher mortality.

Ali *et al*. (2025) study revealed that the power plant area was significantly contaminated by water and soil due to industrial activity. Lead and cadmium concentrations in the water were higher above the WHO's safety guidelines, ranging from 0.1-1 ppm and 0.01-0.1 ppm, respectively. After being released into the Tigris River, the concentrations slightly decreased but were still higher than natural levels.

Considering these factors, this study examines the impact of anthropogenic hazards, specifically water pollution, on human health. The analysis is divided into two key areas: (1) the types of diseases that humans contact from polluted water and (2) how toxic materials in water affect human health.

Fig 1 illustrate the respondents' opinions on whether drinking polluted water affects their health. A significant majority (57 per cent) agreed with the statement, while nearly 3 per cent disagreed. Additionally, 34.5 per cent of the respondents strongly agreed to the statement, while a small portion (2.2 per cent) strongly disagreed. About 3.3 per cent of the respondents had no idea. Balamurugan Palani *et al*. (2021) investigated the anthropogenic sources of mercury contamination in Kodaikanal Lake. Their study reveals high levels of contamination and ecological risk due to mercury, underscoring the need for urgent remediation efforts to protect the environment and public health. From these empirical findings, it is clear that nearly 92 per cent of the respondents agreed that drinking polluted water affects their health, while around 3 per cent were

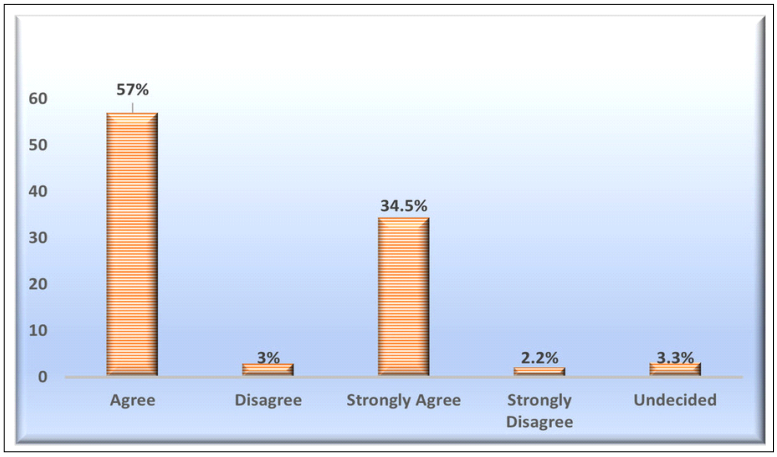


Fig 1: Aware that drinking polluted water affects health.

uncertain. This clearly indicates that awareness on drinking polluted water has a significant impact on the health of people in the study area.

Water-borne diseases

There are various diseases that affect human health and water-borne diseases result from consuming polluted water. Gangadharan (2006), in his analysis of urban morbidity, noted that communicable diseases often occur in areas where resistance levels are low and environmental conditions are weak in preventing disease spread. Poor nutrition, especially in young individuals, exacerbates the problem and overpopulation can further worsen the situation. Environmental factors that contribute to the spread of communicable diseases include unsafe water supplies, poor sanitation, inadequate drainage of surface water, improper waste disposal, poor domestic hygiene and inadequate housing.

Common water-borne diseases such as diarrhoea, typhoid, amoebiasis, gastroenteritis and guinea worm are prevalent under these conditions. Taking these factors into account, a thorough study was conducted in the research area and the results are presented in the table.

The above analysis (Table 1 Diarrhoea is caused by Mercury, Cadmium and Cobalt Containing in drinking water) and Fig 2 envisage the opinion of the respondents on the statement that whether diarrhoea is caused by mercury, cadmium and cobalt in drinking water. A vast majority of the respondents (50.8 per cent) agreed the statement. Another 3 per cent of the respondents disagreed the statement. Of the total 36.8 per cent of the respondents strongly agreed it. Only1.0 per cent of the respondents strongly disagreed and 8.4 per cent of the respondents had no idea.

Hence it was apparent from the empirical findings that the nearly 88 per cent of the respondents agreed upon the statement and nearly 9 per cent of the respondents didn't have any opinion on the statement which emphatically implies that the respondents agreed that diarrhoea is spread by drinking contaminated water.

The above analysis Fig 3 pictures the opinion of the respondents on the statement that which typhoid is caused by drinking contaminated water. A vast majority of the respondents (53.4 per cent) agreed the statement. Nearly 4.5 per cent of the respondents disagreed the proclamation. About 10.3 per cent of the respondents strongly agreed to the statement and 8.3 per cent of the respondents strongly disagreed to it. Another 23.5 per cent of the respondents had no idea upon the statement, hence it was apparent from the empirical findings that the nearly 64 per cent of the respondents agreed upon the statement and nearly 24 per cent of the respondents didn't have any idea which emphatically implies that the respondents accept that typhoid is the result of drinking polluted water.

The analysis of the Fig 4 presents the respondents opinion on the statement whether Jaundice occurs due to drinking of contaminated water. A vast majority of the respondents (41.7 per cent) agreed to the statement. Among

Table 1: Causes for water-borne diseases.

Particulars	Respondents' opinion					
	Agree	Disagree	Strongly agree	Strongly disagree	No idea	Total
Diarrhoea is caused by mercury, cadmium and cobalt containing in drinking water	203 (50.8%)	12 (3.0%)	147 (36.8%)	4 (1.0%)	34 (8.4%)	400 (100%)
Typhoid caused by drinking contaminated water	214 (53.4%)	18 (4.5%)	41 (10.3%)	33 (8.3%)	94 (23.5%)	400 (100%)
Jaundice occurs due to drinking of contaminated water	167 (41.7%)	18 (4.5%)	48 (12.0%)	33 (8.3%)	134 (33.5%)	400 (100%)
Lever and kidney damages the result of drinking the polluted water	183 (45.6%)	29 (7.3%)	25 (6.3%)	12 (3.0%)	151 (37.8%)	400 (100%)
Amoebiasis	201 (50.3%)	22 (5.5%)	33 (8.3%)	21 (5.3%)	123 (30.6%)	400 (100%)
Gastroenteritis is caused by drinking contaminated water	172 (43.0%)	25 (6.2%)	25 (6.3%)	22 (5.5%)	156 (39.0%)	400 (100%)
Schistosomiasis and guinea worm are caused by drinking contaminated water	250 (62.5%)	27 (6.7%)	17 (4.3%)	24 (6.0%)	82 (20.5%)	400 (100%)

Source: Computed from primary data.

them 4.5 per cent of the respondents disagreed to the proclamation. Nearly 12.0 per cent of the respondents strongly agreed to it. Only 8.3 per cent of the respondents strongly disagreed to it. Out of the total 33.5 per cent of the respondents had no opinion upon the statement.

It was clear from the above table that majority of the respondents (54 per cent) had agreed to the statement and nearly 34 per cent of the respondents didn't have any idea about the statement. Hence the respondents had accepted that drinking polluted water becomes the cause of spreading the disease Jaundice.

The above analysis of the Fig 5 explained the opinion of the respondents on the statement that whether lever and kidney damage is the result of drinking the polluted water. A very high percentage (45.6 per cent) of the respondents agreed to the statement. About 7.3 per cent of

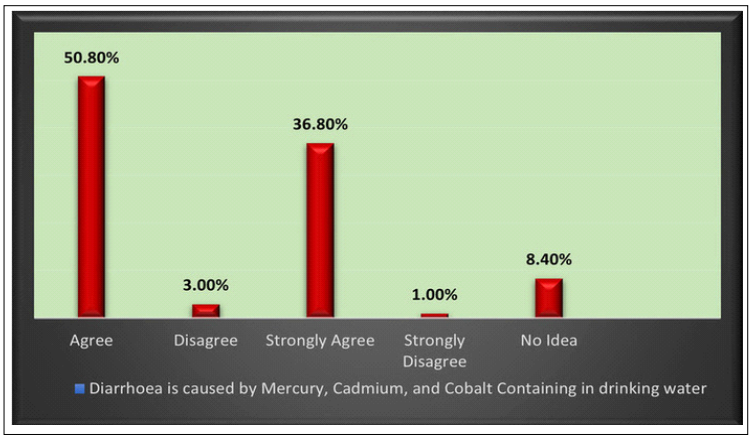


Fig 2: Diarrhoea is caused by mercury, cadmium and cobalt in drinking water.

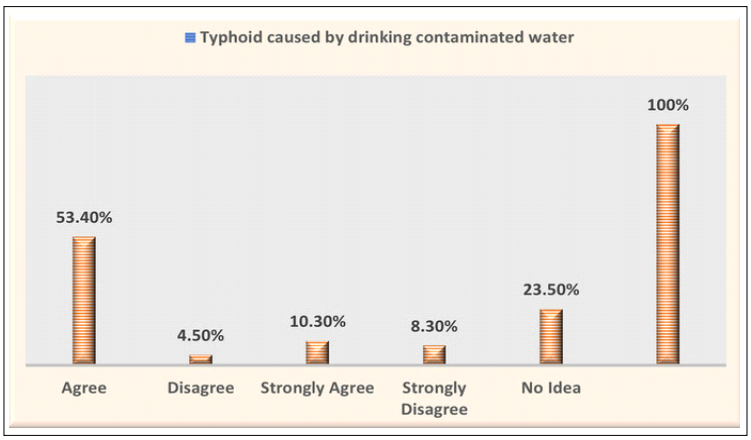


Fig 3: Typhoid.

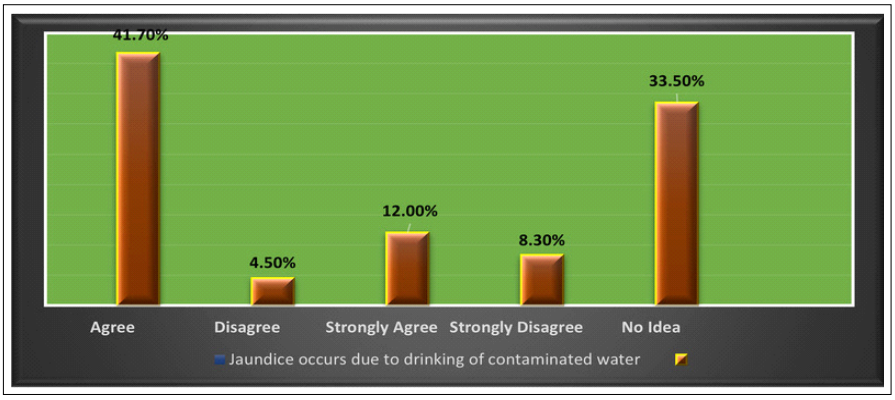


Fig 4: Jaundice.

the respondents disagreed to the statement. Nearly 6.3 per cent of the respondents strongly agreed to the reason that drinking polluted water affects lever and kidney of the respondents. Among them 3.0 per cent of the respondents strongly disagreed to it. Remaining 37.8 per cent of the respondents had no idea about the statement. Thashlin Govender *et al*. (2011) also focused on diarrheal diseases in South Africa, which account for 3.1% of total deaths. They suggested that improving water disposal, sanitation infrastructure and water quality could significantly reduce the incidence of such diseases.

The above data analysis revealed that the nearly 52 per cent of the respondents agreed to the statement and nearly 38 per cent of the respondents didn't agree to the statement which emphatically implies that drinking polluted water is the cause for lever and kidney problems.

Correlation analysis of awareness and importance of rainwater harvesting

The correlation analysis presented in Table 2 indicates a positive relationship between awareness of rainwater harvesting and the level of awareness among respondents. The Pearson correlation coefficient of 0.705 suggests a strong positive correlation, which is statistically significant at the 0.01 level ($p<0.001$). This finding implies that as awareness of rainwater harvesting practice has increased significantly, there is a corresponding increase in overall awareness regarding the implications of water level, usage of water, causes of water borne diseases and proper hygiene. Snelling Lamond *et al*. (2023) implicit attitudes are generally more positive than explicit, especially in respondents with RWH systems, implying that the positivity is deep-seated in their subconsciousness. We also reveal differences between subconscious (implicit) beliefs and practical difficulties (explicit opinions). Outdoor uses of rainwater are preferred; hence, more work in promoting indoor uses is needed to maximise the resource potential of UK rainfall and uptake of RWH systems. The significance of this relationship underscores the importance of educational initiatives aimed at enhancing public knowledge about awareness of rain harvesting, as greater awareness may lead to improve the water level and quality.

Table 2: Relationship between awareness and rainwater harvesting.

Awareness	Rainwater harvesting
Pearson correlation	705**
Sig. (2-tailed)	.001**
N	150

**Correlation is significant at the 0.01 level (2-tailed).

Source: Primary data.

Table 3: Relationship between environmental impact and potential improvement of watershed management.

Environmental impact	Potential Improvements of watershed management
Pearson correlation	.671**
Sig. (2-tailed)	.000**
N	150

**Correlation is significant at the 0.01 level (2-tailed).

Source: Primary data.

In Table 3, the correlation between environmental impact and potential improvements of watershed management shows a stronger positive relationship, with a Pearson correlation coefficient of 0.671, also significant at the 0.00 level ($p<0.001$). This indicates that perceptions of environmental impact are positively associated with views on potential improvements in addressing industrial wastage, household wastage and various natural externalities. A higher perceived environmental impact correlates with a greater belief in the necessity for improvements, suggesting that individuals who recognize the negative environmental effects of government initiatives are more likely to advocate for reforms and enhancements in strengthening watershed management and public education. This finding highlights the need for targeted interventions that not only address legal aspects but also consider the broader environmental implications to foster a more informed and engaged public. Effectiveness of Watershed Management is described in Table 4.

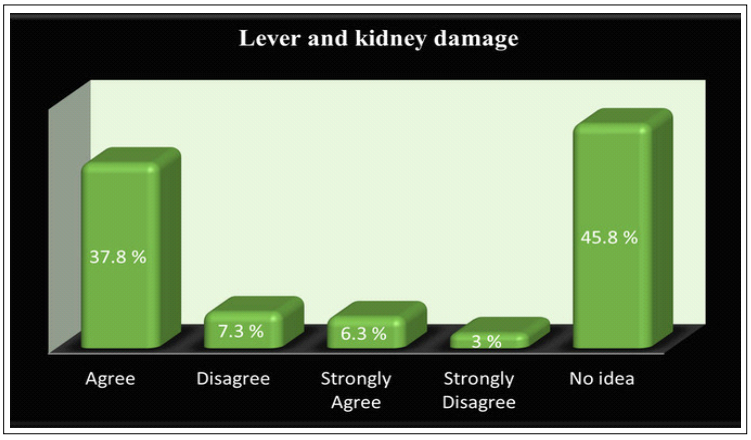


Fig 5: Lever and kidney damage.

Table 4: Multiple linear regression analysis of effectiveness of watershed management.

DV	Summary of path analysis							
	F value	P value	R^2	IV	Beta	t	Sig	Collinearity statistics
								Tolerance	VIF
Potential improvements of watershed management	274.65	.000**	.929	Positive environmental impacts (vegetation, wildlife)	.557	12.737	.000**	.931	1.074
				Reduction in conflicts over water resources	.428	12.756	.000**	.945	1.058
				Community received government support	.062	.432	.029**	.894	1.118
				Government efforts to promote watershed management	.051	.334	.000**	.930	1.075

**Significant at 1% level, *Significant at 5% level.

The path analysis summary presented indicates a significant relationship between various independent variables (IVs) and the dependent variable (DV), which is the "Effectiveness of Watershed Management in Dindigul District". The overall model shows an F value of 274.65 with a p value of .000, indicating that the model is statistically significant and that the independent variables collectively explain a portion of the variance in potential improvements, as evidenced by the R^2 value of .929. This suggests that approximately 92.9% of the variance in potential improvements can be attributed to the factors analysed, which include positive environmental impacts (vegetation, wildlife), reduction in conflicts over water resources, community received government support, government efforts to promote watershed management. Vishal Kumbhar *et al*. (2013) stated that, actual implementation of watershed management options such as farm pond, gully plugs, contour trenching there is found that 3060 cum. Means there is water available for irrigation to farmer form his own land after watershed management options. Also, after implementation of intercropping pattern, there is also found that change in total crop production from farmers land is 15 ton per annum before watershed management to 20.75 ton per annum after watershed management. Finally, it is found that after implementation of watershed management technique, per capita of farmers family, increases by Rs. 878 (4.64%). Among the independent variables, positive environmental impacts have the strongest influence on potential improvements, with a Beta coefficient of .557 and a t-value of 12.737, both statistically significant at the 0.00 level ($p<0.001$). This finding emphasizes that enhancing positive environmental impacts are crucial for fostering potential improvements in the effectiveness of watershed management in Dindigul district. From the analysis the next independent variable "reduction in conflicts over water resources" also plays a significant role with a Beta of .428, while "community received government support" shows a smaller but still meaningful effect with a Beta of .062 ($p = 0.029$). The collinearity statistics reveal acceptable tolerance levels and VIF values for all independent variables, indicating that multicollinearity is not a concern in this analysis. Naresh *et al*. (2025) observed that the model was calibrated by using the data from first four years of the study period. In the calibration process, the assigned weights were modified to improve the correlation coefficient between model computed values and the observed values. The values of these improved weights for each parameter were used to calculate the regression equation for each block of the study area. These regression equations were then used to validate the model for the next four-years. Statistical analysis (Root Mean Square Error and Average Absolute Error) was carried out to compare the model output with the observed values at different grid cells and found good agreement between different statistical parameters. The modified weights can be used for future estimation of nitrate as well as any other pollutants of the groundwater in the

areas of similar conditions. Overall, these results highlight the importance of focusing on potential improvements of watershed management and effectiveness of watershed management to drive improvements of water usage and water condition in Dindigul District.

CONCLUSION

Rainwater harvesting has the potential to be a game-changer for India's water crisis. With the right policies, investments and public awareness, this ancient practice can significantly alleviate water scarcity, reduce dependence on groundwater and create a sustainable water supply for generations to come. Both urban and rural areas can gain from this solution, which gives people and organisations the ability to manage their water supplies and help create a more sustainable future. The technical answer to water constraint is only one aspect of water harvesting. This technique has enormous potential for positive social, economic and environmental effects. It contributes to a more sustainable future by empowering communities, ensuring a more dependable water supply and minimising environmental harm. Rainwater collection is a practical and compassionate solution in a world where climate change is still affecting water availability, guaranteeing that future generations will be able to enjoy the same natural resources that we do.

ACKNOWLEDGEMENT

Disclaimers

The views and conclusion expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the manuscript.

Conflict of interest

This statement attests to the fact that each author has reviewed and approved the submitted article. We guarantee that the article is the author's original creation. We guarantee that the article has never been published before and is not being considered for publication anywhere else. The corresponding author will be fully responsible for the submission on behalf of all co-authors.

REFERENCES

Nanda, A.R. and Ali, A. (2006). Health Sector Issues and Challenges. Social Development Report, Council for Social Development, Oxford University Press.

Ali, Q.I., Ahmed, K.F., Abdalkader, L.S., Al-Ibady, K.A.A.N.Q., Shahla, H.H. (2025). Applications of bacterial biotechnology in the bioremediation of water contaminated with heavy metals. *Agricultural Science Digest*. **45(5):** 878-884. doi: 10.18805/ag.DF-694.

Arumugam, A., Ahmed, A. and Davies, J. (2010). Public engagement in integrated urban water management in Saudi Arabia: Teachers' perceptions in relation to water awareness. *Water Supply.* **15(4):** 10.

Birundha, D. (2004). Water security and rainwater harvesting: A conceptual framework and candidate indicators. *Applied Geography*. **76:** 75-84.

Gangadharan, K. (2006) Utilization of Health Services in Urban Kerala: A Socio-economic Study. Serials Publications, New Delhi.

Gosain, A.K., Rao, S. (2004). GIS-based technologies for watershed management. *Current Science*. **87:** 948-953.

Ingle, N.S., Bhabani, M.P., Chandrabhan, P. and Jagdish, P. (2025). Leveraging remote sensing and geospatial technologies in soil and water resources mapping and characterization: A review. *Agricultural Reviews*. **46(5):** 703-711. doi: 10.18805/ag. R-2789.

Kumar, A., Krishna, A.P. (2018). Assessment of groundwater potential zones in coal mining impacted hard-rock terrain of India by integrating geospatial and analytic hierarchy process (AHP) approach. *Geocarto International*. **33(2):** 105-129.

Naresh, R., Jain, K.A., Kumar, S. (2011). Calibration and validation of groundwater pollution vulnerability assessment model drastic for Ludhiana, Punjab. *Agricultural Science Digest*. **31(3):** 167-172.

Palani, B. *et al*. (2021). An investigation on the assessment of mercury concentration and its spatial distribution in Kodaikanal Lake sediments, South India. *Arabian Journal of Geosciences*. **14(16):** 1629.

Rajanbabu, R., Elango, P.J., Sathishkumar, V. (2022). Growth and instability in significant spices in India: An empirical analysis. *Agricultural Science Digest*. **42(4):** 449-453. doi: 10.18805/ag.D-5487.

Shawkat, A., Khaled, (2014). A critical review on rainwater harvesting and case study-way ahead to sustainability. *International Journal for Scientific Research and Development*. **6(3):** 2114-2119.

Snelling, A.M., Lamond, J., Everett, G., O'Donnell, E.C., Ahilan, S. and Thorne, C. (2023). Public perceptions of rainwater harvesting (RWH): Comparing users and non-users of RWH systems. *Urban Water Journal*. **21(2):** 181-189.

Thashlin, G., Barnes, J.M. and Pieper C.H. (2011). contribution of water pollution from inadequate sanitation and housing quality to diarrheal disease in low-cost housing settlements of Cape Town, South Africa. *American Journal of Public Health*. **101(7):** e4-e9. https://doi.org/10.2105/AJPH.2010.300107.

Vishal, P.K., Swami, V.A., Kulkarni, S.S. (2013). Effectiveness of watershed management- means of economic development- A case study. *IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)*. **6(6):** 7-14. e-ISSN: 2278-1684, p-ISSN: 2320-334X.