# SUSTAINABLE WATER MANAGEMENT RAINWATER HARVESTING AND GRAYWATER

## **Authors**

Elif Rabia GURBUZ & Satiprasad SAHOO Enviromental Engineer Water Resource Engineer



## © Copyright 2025

Printing, broadcasting and sales rights of this book are reserved to Academician Bookstore House Inc. All or parts of this book may not be reproduced, printed or distributed by any means mechanical, electronic, photocopying, magnetic paper and/or other methods without prior written permission of the publisher. Tables, figures and graphics cannot be used for commercial purposes without permission. This book is sold with banderol of Republic of Turkey Ministry of Culture.

ISBN Page and Cover Design

978-625-375-386-3 Yasin DİLMEN

**Book Title Publisher Certificate Number** 

Sustainable Water Management 47518

Rainwater Harvesting

and Graywater Printing and Binding

Vadi Matbaacılık

Authors

Elif Rabia GURBUZ **Bisac Code** Satiprasad SAHOO SCI092000

ORCID iD: 0000-0002-6490-7432

DOI

Publishing Coordinator Yasin DİLMEN 10.37609/akya.3570

## Library ID Card Gürbüz, Elif Rabia [and other...].

Sustainable Water Management Rainwater Harvesting and Graywater / Elif Rabia Gürbüz, Satiprasad Sahoo.

Ankara : Academician Bookstore, 2025. 116 p. : figure. ; 135x210 mm. Includes Resources. ISBN 9786253753863

## GENERAL DISTRIBUTION Akademisyen Kitabevi A.Ş.

Halk Sokak 5 / A Yenişehir / Ankara Tel: 0312 431 16 33 siparis@akademisyen.com

www.akademisyen.com

## **PREFACE**

Water is the foundation of life. However, climate change, rapidly increasing population and improper water management are deepening every day around the world. In this period when pressure on traditional water resources is increasing, we can produce alternative and sustainable solutions. At this point, rainwater harvesting and reuse of grey water offer us a great opportunity in the scope of water management.

This book is prepared as a concise guide on how water can be managed more efficiently and sustainably. Rainwater harvesting is a method that has been used throughout human history but has been forgotten by modern urbanization. However, when it is reintroduced into our lives with the right systems, it makes a great contribution to water saving. Similarly, recycling grey water discharged after domestic use is an important step towards preserving the ecological balance by preventing wasteful components of water.

The book includes successful water management models implemented in Turkey and around the world, and technical and practical aspects of how rainwater harvesting and grey water results can be planned and implemented are examined, and we also evaluate the economic and social benefits of these systems and offer suggestions on how they can be expanded for a sustainable future.

I would like to thank Satiprasad Sahoo, Water Resources Expert, for her contribution to the preparation of the book.

Water is our common heritage. It is our responsibility to protect it and pass it on to future generations in a healthy way.

## **CONTENTS**

CH	APTER 1	
SU:	STAINABLE WATER MANAGEMENT AND POLICIES	1
1.1	Importance of Sustainable Water Management Policies	5
	Solution Proposals for Sustainable Water Management	
	International Water Policies and Summits	
	APTER 2	
	TER RESOURCES AND MANAGEMENT IN TÜRKIYE	
	D THE WORLD	
	Turkey's Water Resources and Management Practices	
2.2	Successful Water Management Models in the World	23
СН	APTER 3	
	INWATER HARVESTING	29
	What is Rainwater Harvesting?	
	Rainwater Usage Areas	
	Importance of Rainwater Harvesting and	
	Historical Development	31
3.4	Rainwater Cycle and Hydrological Fundamentals	
	Components and Design of Harvesting Systems	
CП	APTER 4	
	AY WATER MANAGEMENT	52
	What is Grey Water?	
	Grey Water Reuse Areas	
	Properties of Grey Water	
	Grey Water Treatment Technologies	
4.5	Grev Water System Usage Examples Worldwide	5/

### Contents

CHAPTER 5		
APPLICATIONS AND TECHNOLOGIES		
5.1 Traditional and Modern Rainwater Harvesting Techniques61		
5.2 Rainwater Harvesting: Solutions in Urban and Rural Areas71		
5.3 Rainwater Storage, Distribution and Treatment Solution79		
CHARTER		
CHAPTER 6		
ECONOMIC EVALUATION OF RAINWATER HARVESTING89		
6.1 Cost-Benefit Analysis89		
6.2 Rain Water Your harvest Environmental His evaluation93		
CHAPTER 7		
CONCLUSION103		
RESOURCES105		

#### RESOURCES

- Rain Water Your harvest Importance And Use Possibilities : Antalya Example (Turkey).
- Correction: Water Science And Technology: Water Supply 16 (1), 97–103: Rain water harvest in their systems care importance: one case work by Ju Young Lee and others, doi: 10.2166/ws.2015.115
- https://www.nextias.com/blog/rainwater-harvesting/
- https://theconstructor.org/water-resources/rainwater-harvesting-components/6739/
- https://groundwater.org/hydrological-cycle/
- Avila,FG , Suarez,MG , Galarza,JG , Torres , RC,Gonzales,LV ,(2023):Rainwater harvesting and storage systems for domestic water supply: An overview of research for water scarcity management in rural areas, Engineering, Volume, DOI: https://doi.org/10.1016/j.rineng.2023.101153 .
- Aziz,S , Mazhar,AR ., Ubaid,A ., Shah,SMH ., Riaz ,Y ., Talha,T ., Jung,DW ., (2024): A comprehensive review of membrane based water filtration techniques, Applied Water Science, 14:169 https://doi.org/10.1007/s13201-024-02226-y .
- Adham , A., Sayl , K. N., Abed , R., Abdeladhim , M. A., Wesseling , J. G. , Riksen , M., Fleskens , L., Karim , U., Ritsema , C. J. , (2018): A GIS-based approach to identifying potential areas for rainwater harvesting in the Western Desert of Iraq, International Soil and Water Conservation Survey, International Soil and Water Conservation Survey Volume 6, Issue 4 , pp. 297-304.
- Antwi , DMB, Amankwaa , IK, Johannes , A., Amaniampong, EAD ., Agyekum, TO , Boateng, HK ., (2024): A study on the need for incorporating rainwater harvesting systems as an alternative domestic water source in Ghana, Journal of Applied Science, Engineering, Technology and Management, Institute of Science and Technology (FISAT), Kerala , India, Volume 02, Issue 02, 2024 pp. 15–24.
- Bhattacharya,S., (2015): Traditional water harvesting structures and sustainable water management in India: A socio -hydrological review, International Journal of Natural Sciences Letters, Vol. 37, pp. 30-38, SciPress Ltd., Switzerland, doi:10.18052/www.scipress.com/ILNS.37.30
- Jha,MK, Markande,Y., Markandey,DK., Dev.M., (2024): Assessment of Status of Groundwater Supply and Its Recharge through Rainwater Harvesting in NCR and Surrounding Areas: Cornerstone of Sustainable Development: A Case Study, International Journal of Recent Engineering and Management Research, Vol.09, pp.01-10.
- Mekdaschi Studer, R. and Liniger, H. (2013): Water Harvesting: Good practice guidelines. Bern: Centre for Development and Environment (CDE).

### SUSTAINABLE WATER MANAGEMENT RAINWATER HARVESTING AND GRAYWATER

- Pandey,OC., Qidwai,S., Chahal,R., and Verma,SK.,(2023): Chapter -11 Rain Water Harvesting and Watershed Management System, In Book: Agriculture and Agroforestry Textbook, Publisher: AkiNik Publications pp.121-129.
- Rainwater harvesting: Retrieved from (https://en.wikipedia.org/wiki/Rainwater\_harvesting). Accessed 7 January 2025.
- Rainwater Harvesting Techniques to Augment Groundwater, Central Groundwater Board, Ministry of Water Resources, retrieved from https://cgwb.gov.in/en, accessed January 7, 2025.
- Ancient and Modern Methods of Rainwater Harvesting. Retrieved from https://www.rainyfilters.com/about-us/blogs/ancient-method-vs-modern-technology, accessed January 8, 2025.
- Rainwater Harvesting Techniques to Augment Groundwater, Central Groundwater Board, Ministry of Water Resources, retrieved from https://cgwb.gov.in/en, accessed 9 January 2025.
- Robert C. Brears (2024): Innovative Rainwater Harvesting: Smart Technologies and Sustainable Solutions for Urban Resilience, https://medium.com/mark-and-focus/innovative-rainwater-harvesting-smart-technologies-and-sustainable-solutions-for-urban-resilience-8ed0df02ee78
- The Hindu Paper, Tiruvarur Collector comes up with idea to increase water supply, 09 June 2013, Tiruvarur, Retrieved on: https://www.thehindu.com/news/national/tamil-nadu/subsurface-dyke-built-across-vennar/article4797174.ece, accessed 8 January 2025.
- Vashisth,A., (2019): Rainwater Harvesting (RWH) Techniques for Urban and Rural Areas. Retrieved from https://www.researchgate.net/publication/331477249\_Rainwater\_Harvesting\_RWH\_Techniques\_for\_Urban\_and\_Rural\_Areas, accessed 10 January 2025.
- Despins , C.; Farahbakhsh , K.; Leidl , C. (2009): Assessment of rainwater quality from rainwater harvesting systems in Ontario , Canada. J. Water Supply Pic . Technol . AQUA 2009, 58, 117–134.
- Handbook of Drinking Water Treatment Technologies. Retrieved from https://ejalshakti.gov.in/misc/Docs/ProvenTech.pdf, accessed 17 January 2025.
- Feasibility and design of rainwater harvesting system for Panch lok, Raj Nagar, Kavi Nagar, Kamla Nehru Nagar and Shastri Nagar. Jamia Millia Islamia, New Delhi, Retrieved from https://www.jmi.ac.in/upload/menuupload/fet\_ci\_projects\_Project-GM\_3.pdf. Accessed 16 January 2025.
- Mintz , E. D., Bartram , J., Lochery , P., Wegelin , M. (2001): Not just a drop of water: Expanding access to point-of-use water treatment systems, Am . J. Public Health , 2001, 91, 1565–1570.
- Rainwater harvesting guidelines, Centre for Water and Sanitation, CEPT University, Urban water security planning toolkit, June 2024, accessed at https://cwas.org.in/resources/file\_manager/module\_3-3\_1\_rwh\_guidelines.pdf . Accessed 16 January 2025.

- Rainwater Harvesting, Retrieved from https://rainwaterharvesting.tamu.edu/after-storage-treatment/ Accessed January 17, 2025.
- Rainwater Harvesting for Ponds, Source: https://aquascapes.com/rainwater-harvesting-for-ponds/, Access date: January 17, 2025
- Sharma , A. , (2022): Rain Water Harvesting, GSFC University, Gujrat , Thesis Received from-
- https://www.researchgate.net/publication/359548244\_Rain\_Water\_Harvesting., Accessed January 17, 2025.
- Texas Rainwater Harvesting Manual (2005) 3rd edition, Texas Water Development Board, Austin, TX, USA, Retrieved from: https://www.twdb.texas.gov/publications/brochures/conservation/doc/RainwaterHarvestingManual\_3rdedition.pdf. Accessed January 16, 2025.
- Water purification, Retrieved from https://en.wikipedia.org/wiki/Water\_purification, Accessed January 17, 2025.
- Brears , RC, (2024) : Innovative Rain Water Harvest : Urban Durability For Clever Technologies And Sustainable Solutions Access date : https://medium.com/mark-and-focus/innovative-rainwater-harvesting-smart-technologies-and-sustainable-solutions-for-urban-resilience-8ed0d-f02ee78 , January 10 2025.
- Ferrand, E. A., and Cecunjanin, F., (2014): In a Waterless World Rain Water Your harvest Potential: Ancient And Traditional Rain Water Harvest To their applications A Study on Geography Compass, pp. 395–413.
- Jha,MK, Markande,Y., Markandey,DK., Dev.M., (2024): NCR and Around In the fields Underground Water Supply And Rain Water Harvest with Renewal of Your situation In its evaluation Sustainable Development of Basis Move: A Case Study, International Latest Engineering And Management His researches Journal, Volume 09, pp. 01-10.
- Urban In the fields Revolution : 5 Innovators Rain Water Harvest Technique (2025): From Retrieved from : https://smartwateronline.com/news/revolutionising-urban-spaces-5-innovative-rainwater-harvesting-techniques . Accessed January 10 , 2025
- Selected case Studies Rain Water Harvest And Artificial Filling , Central Underground Water Board of Directors This Resources Ministry of Health , New Delhi, May 2011, Access date : https://prod-qt-images.s3.amazonaws.com/indiawaterportal/import/sites/default/files/iwp2/Case\_studies\_on\_rainwater\_harvesting\_and\_artificial\_recharge\_CGWB\_2011. pdf , January 10 Accessed 2025 .
- Vashisth,A., (2019): Urban And Rural Areas for Rain Water Harvesting Techniques (HWT). Access date: https://www.researchgate.net/publication/331477249\_Rainwater\_Harvesting\_RWH\_Techniques\_for\_Urban\_and\_Rural\_Areas, January 13 2025.
- https://www.bluebarrelsystems.com/blog/environmental-benefits-of-rainwater-harvesting/

## SUSTAINABLE WATER MANAGEMENT RAINWATER HARVESTING AND GRAYWATER

- https://www.mdpi.com/2673-4117/4/2/65
- Andualem, TG, Hagos, YG and Teka, AH (2020). Assessment of rainwater harvesting potential for non-potable use in urban areas. Sustainable Water Resources Management, 6(6), 104.
- Bandyopadhyay, S., Sharma, A., Sahoo, S., Dhavala, K., & Sharma, P. (2021). Potential for water carrier storage and recovery (ASR) in South Bihar, India. Sustainability 13 (6): 3502.
- Biswas, S., Sahoo, S., Debsarkar, A., & Pal, M. (2021). Assessing the potential of adopting rooftop rainwater harvesting in combating water scarcity: A case study of North 24 Parganas district of West Bengal, India. Arabian Journal of Geosciences, 14, 1-16.
- Biswas , S., Sahoo , S., Debsarkar , A., Pal , M., Ray , S.P.S., & Al- Quraishi , A.M.F. (2024). Site selection and storage system design for rainwater harvesting with artificial recharge based on hydrogeological and socioe-conomic assessments in qualitative and quantitative water stressed areas of North 24 Parganas district, India. Arabian Journal of Geosciences , 17 (11), 288.
- Huq, MH, Rahman, MM and Hasan, GJ (2024). Social perception of rainwater harvesting and wastewater reuse: Opportunities and challenges of a rapidly growing township in Dhaka. Cleaner and Responsible Consumption, 12, 100168.
- Ssekyanzi , G., Ahmad , MJ, & Choi , KS (2024). Sustainable Solutions to Alleviate Water Scarcity in Developing Countries: A Comprehensive Review of Innovative Rainwater Storage Systems. *Water* , *16* (17), 2394.
- Saeedi, I. and Goodarzi, M. (2020). Rainwater harvesting system: A sustainable method for landscape development in semiarid regions, the case of Malayer University campus in Iran. Environment, Development and Sustainability, 22 (2), 1579-1598.
- https://www.rainyfilters.com/about-us/social-awareness
- Water Resources Management and Security Special Commission Report (2018)
- Ministry of Agriculture and Forestry Grey Water Usage Guide
- Ministry of Agriculture and Forestry Rainwater Use Guide Document