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جامعة الأعمال والتكنولوجيا
UNIVERSITY OF BUSINESS AND TECHNOLOGY

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UBT ECONOMIC REVIEW

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التعليـم من أجل العمـل وريـادة الأعمـال
Education for Job Opportunities and Entrepreneurship

We're excited to share a new project at the University of Business and Technology – the launch of an Economic Review. As members of the Board of Trustees, we believe this initiative will greatly enhance our institution's academic excellence.

UBT Economic Review is a platform for in-depth analysis and discussions on economic issues that impact our society, both locally and globally. Additionally, this publication aims to enhance our academic community's knowledge and encourage collaboration among scholars and researchers from different fields.

We want to express our appreciation to the editorial committee for their hard work in making this project a reality. Their expertise and dedication will ensure that the Economic Review maintains high standards of academic quality and relevance.

Finally, we're thrilled to launch UBT Economic Review, and we look forward to its growth and influence in the coming years. Let's embrace this important initiative and continue our commitment to sharing knowledge, fostering intellectual excellence, and making a positive impact on society.

Sincerely,

Dr. Abdullah Dahlan

The Chairman of Board of Trustees

The University of Business and Technology

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Section 1: Total Real Estate Index (TREIX)

The Total Real Estate Index (TREIX) for the Kingdom of Saudi Arabia (KSA) and Riyadh reveals significant volatility during Q3 2024. The TREIX, which covers residential, commercial, and agricultural sectors, continues to highlight the dominance of residential properties, which account for 65% of the index's weight. The analysis for Q3 shows marked fluctuations in real estate transactions. In June 2024, total real estate transactions in Riyadh were valued at SAR 5.15 billion, with the TREIX at 78.40 points, indicating a sharp decline. However, July 2024 saw a substantial rebound, with transactions increasing to SAR 22.52 billion, pushing the TREIX to 106.48 points. By August 2024, the market slightly softened, with transactions of SAR 21.73 billion and the TREIX at 104.79 points, reflecting a minor dip but maintaining overall market strength.

In Riyadh, the real estate market experienced notable volatility during Q3 2024. The Residential Real Estate Index (RRIX) and Commercial Real Estate Index (RCIX) followed similar patterns, reflecting the impact of economic policies, seasonal trends, and broader macroeconomic conditions on market dynamics.

Section 2: Total Point of Sales Values, Foods and Cafes Sales Values, and Food and Drink Sales Values (SALEINDEX, FCAINDEX, FDINDEX)

The analysis of consumption trends across KSA for Q3 2024, using the SALEINDEX, FCAINDEX, and FDINDEX, indicates relatively stable consumer spending with minor fluctuations. The SALEINDEX, which measures total point of sales values, stood at SAR 48.57 billion in June 2024, slightly increasing to SAR 48.88 billion in July, and rising more significantly to SAR 52.37 billion by August 2024.

The Foods and Cafes Sales Index (FCAINDEX) followed a similar trajectory, starting at SAR 14.54 billion in June 2024, reaching SAR 14.64 billion in July, and stabilizing at SAR 14.61 billion in August. The Food and Drink Sales Index (FDINDEX) also exhibited minor fluctuations, with sales standing at SAR 7.22 billion in June, increasing to SAR 7.31 billion in July, and settling at SAR 7.23 billion in August 2024. These indices reflect stable but dynamic consumer behavior, influenced by seasonal trends and economic conditions.

Key Findings

1. Significant Volatility in Real Estate Markets: The real estate market in Riyadh showed substantial fluctuations during Q3 2024, with notable peaks in July following sharp declines in June, indicating the market's susceptibility to various economic factors.
2. Complex Dynamics in Residential and Commercial Sectors: The Residential Real Estate Index (RRIX) and Commercial Real Estate Index (RCIX) data for Riyadh reveal divergent trends in transaction values and market sentiment, suggesting underlying complexities and sector-specific influences.
3. Stable but Fluctuating Consumer Spending: The SALEINDEX, FCAINDEX, and FDINDEX for the Kingdom indicate generally stable consumer spending with minor monthly variations, driven by seasonal factors and broader economic trends.

"UBT Economic Review" (UBTER) Real Estate Index section examines the influence of the Saudi real estate market on the economy by analyzing trends, market dynamics, and socioeconomic consequences. It focuses on residential and commercial properties, identifying growth factors, trends, and investment opportunities.

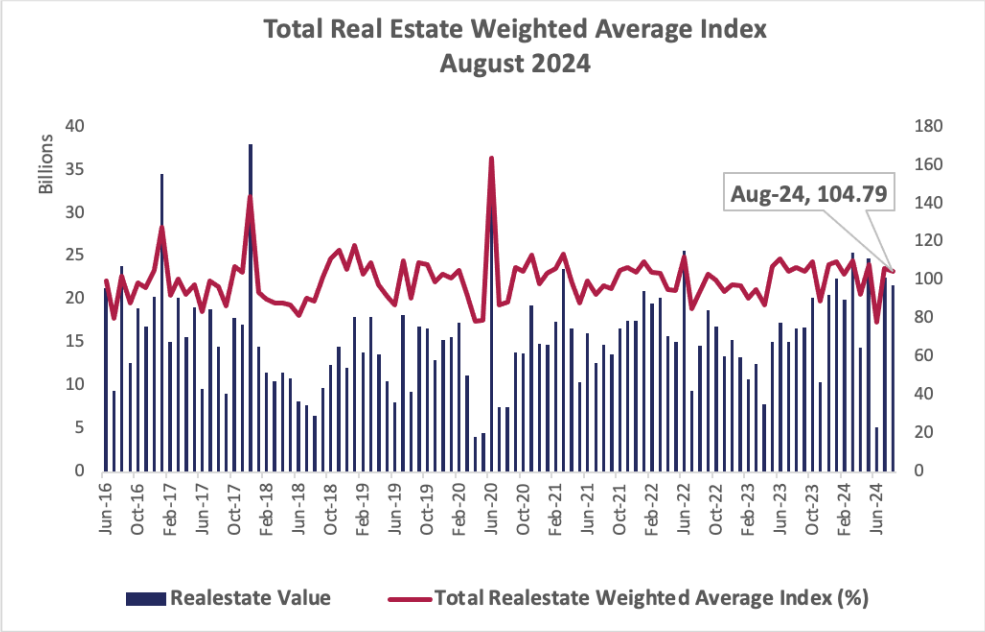
01

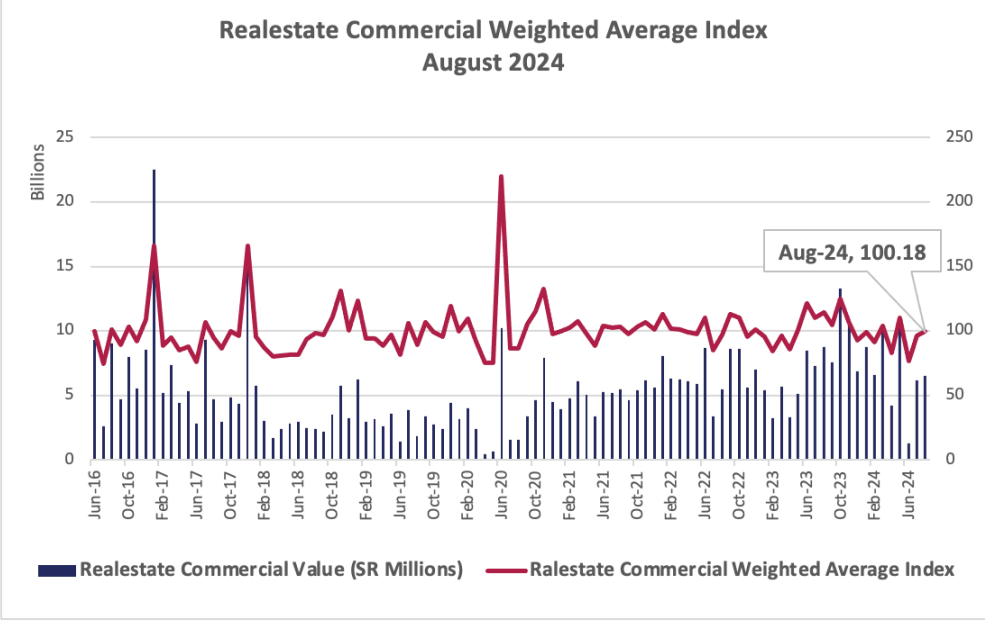
Real Estate Index

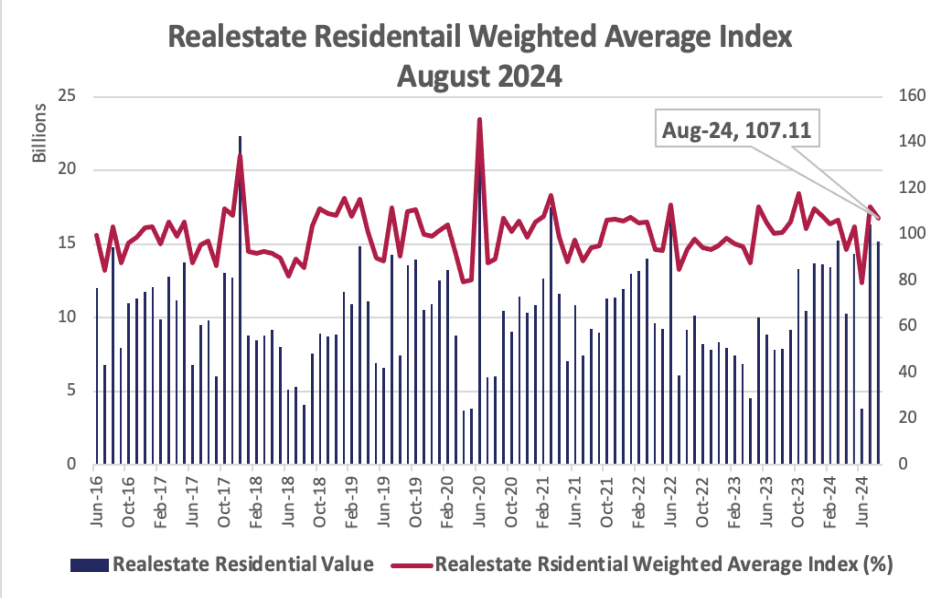
Total Real Estate Index (TREIX)

Overview

The Total Real Estate Index (TREIX) serves as a comprehensive measure of real estate performance across the Kingdom of Saudi Arabia (KSA), including detailed insights into Riyadh. This index quantifies the total value of transactions by incorporating three key sectors: residential (65% weightage), commercial (31%), and agricultural (3%). Despite considering various real estate outputs like plots, villas, and apartments, plots of land are transacted among the investors, carrying the greatest weightage.







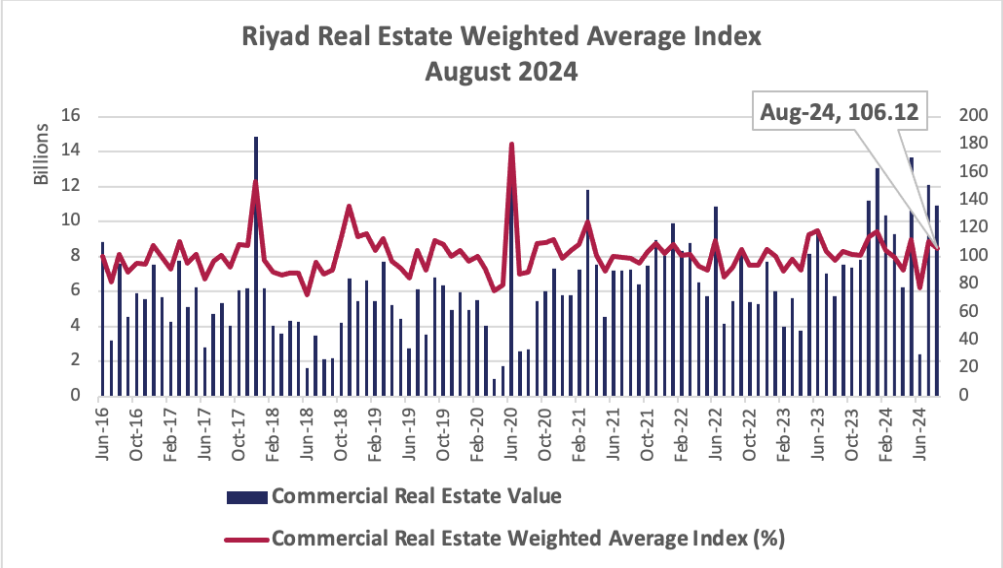
KSA Real Estate Market Analysis

The Kingdom of Saudi Arabia's real estate market exhibited significant volatility throughout Q3 2024. The Total Real Estate Index (TREIX) demonstrated notable fluctuations, with considerable shifts in transaction values across residential, commercial, and agricultural sectors.

- In June 2024, the total real estate transactions across the Kingdom stood at SAR 5.15 billion, with the TREIX falling to 78.40 points.
- This decline marked a sharp contraction in market activity compared to previous months. However, the market rebounded strongly in July 2024, with total transactions surging to SAR 22.52 billion, which lifted the TREIX to 106.48 points, representing a significant recovery of 35.82%.
- By August 2024, market activity slightly softened but remained robust, with transaction values of SAR 21.73 billion and the TREIX standing at 104.80 points, a minor -1.58% decline from July.

This analysis of Q3 2024 demonstrates the resilience of the market following a mid-year dip and suggests that external factors such as economic conditions and policy adjustments will continue to play a pivotal role in shaping the market's future trajectory.

Riyadh Real Estate Market Analysis

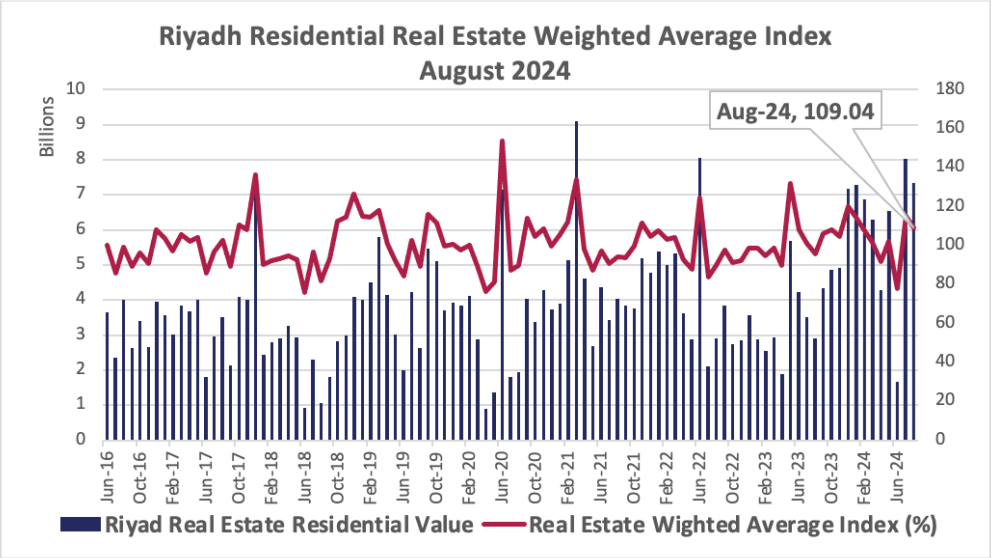


The real estate market in Riyadh mirrored national trends, with considerable volatility observed in Q3 2024.

- June 2024 saw transactions valued at SAR 2.41 billion, resulting in a TREIX of 77.43 points, reflecting a -31.13% decline from May. This downturn marked a significant contraction in market activity.
- In July 2024, the market showed a strong recovery, with transactions rising to SAR 12.12 billion, pushing the TREIX to 110.43 points, a 42.62% increase compared to June, driven by revitalized demand across both residential and commercial sectors.
- By August 2024, market activity slightly softened, with transactions totaling SAR 10.93 billion, and the TREIX adjusting to 106.12 points, a -3.89% decline from July, yet reflecting sustained market strength despite minor fluctuations.

This quarter highlighted the dynamic nature of Riyadh's real estate market, with sharp declines followed by strong rebounds, maintaining overall resilience.

Residential Real Estate Index (RRIX)

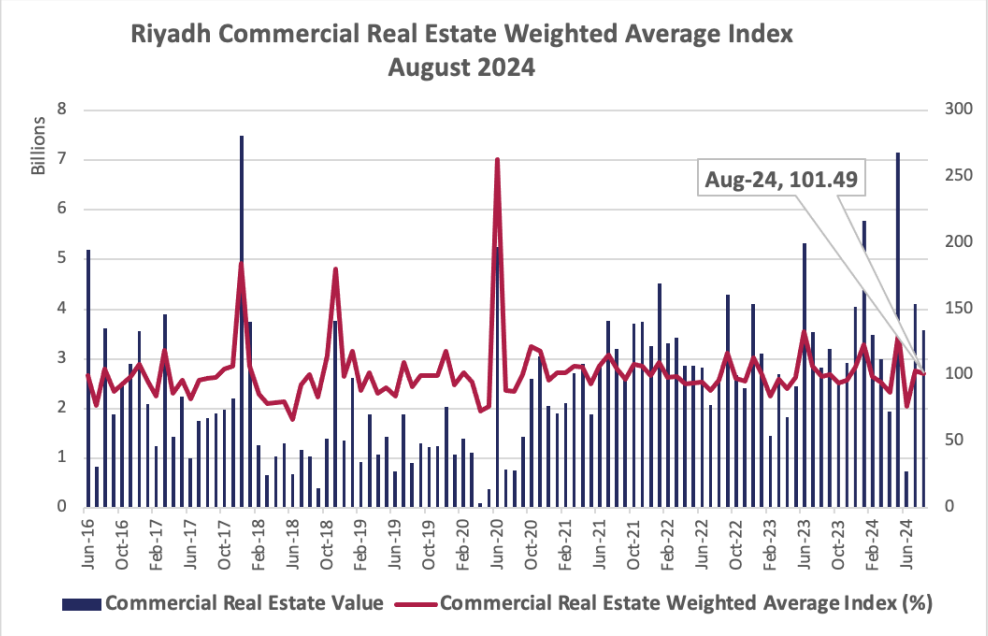


The Residential Real Estate Index (RRIX) for Riyadh highlights the residential sector's response to market dynamics in Q3 2024.

- In June 2024, the RRIX showed a significant decline, with transaction values reaching SAR 1.66 billion and an index score of 77.80 points, reflecting a sharp downturn in the market.
- July 2024 saw a remarkable recovery, with the RRIX surging to 115.19 points, driven by transactions worth SAR 8.02 billion, marking a strong rebound in residential activity.
- In August 2024, the RRIX slightly decreased to 109.04 points, with residential transactions totaling SAR 7.35 billion, indicating a slight softening of the market compared to July.

These trends reveal that the residential market in Riyadh is subject to significant fluctuations, with strong recoveries following declines. The variations in the RRIX and transaction values suggest that multiple factors, including economic conditions and market sentiment, play a role in shaping the residential sector's performance.

Commercial Real Estate Index (RCIX)



The Commercial Real Estate Index (RCIX) for Riyadh illustrates the commercial sector's performance in response to market dynamics during Q3 2024.

- In June 2024, the RCIX showed a sharp decline, with transaction values at SAR 743.62 million and an index score of 76.90 points, marking a -41.53% drop from May. This reflects a significant slowdown in commercial real estate activity.
- July 2024 saw a recovery, with the RCIX rising to 103.62 points, corresponding to commercial transactions worth SAR 4.11 billion, representing a 34.74% increase over June.
- In August 2024, the RCIX slightly decreased to 101.49 points, with commercial transactions totaling SAR 3.59 billion, indicating a minor decline of -2.05% from July but maintaining overall market strength.

These trends reveal the volatility within the commercial real estate market in Riyadh during Q3 2024, driven by varying demand and economic factors. Despite the significant drop in June, the market exhibited a strong recovery, with July and August maintaining a stable, albeit slightly fluctuating, performance.

"UBT Economic Review" (UBTER) conducts an analysis of the Point-of-Sales Index in order to gain insights into the Saudi retail industry, including consumer behavior, sales patterns, and the overall health of the sector. The analysis emphasizes Total Point of Sales Values and Foods and Cafes Sales Values, aiming to uncover consumer preferences and market sentiments. In essence, UBTER acts as a platform for exploring the implications of the Point-of-Sales Index, fostering discussions that contribute to the growth and development of the retail industry in Saudi Arabia.

02

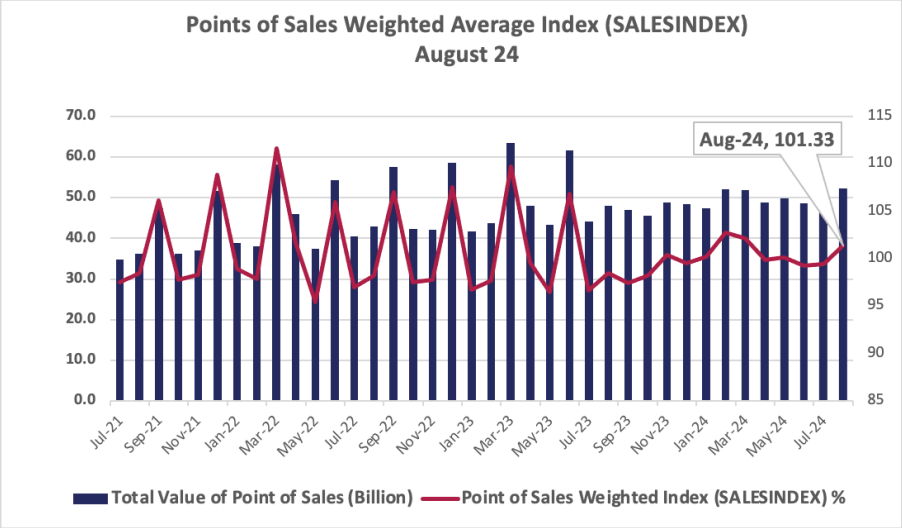
Point of Sales Index

Total Point of Sales Values, Foods and Cafes Sales Values, and Food and Drink Sales Values (SALEINDEX, FCAINDEX, FDINDEX)

Overview

This section analyzes consumption trends in KSA using three main indicators: Total Point of Sales Values (SALEINDEX), Foods and Cafes Sales Values (FCAINDEX), and Food and Drink Sales Values (FDINDEX). These indicators reflect public and private sector expenditure on goods and services, crucial components of aggregate demand.

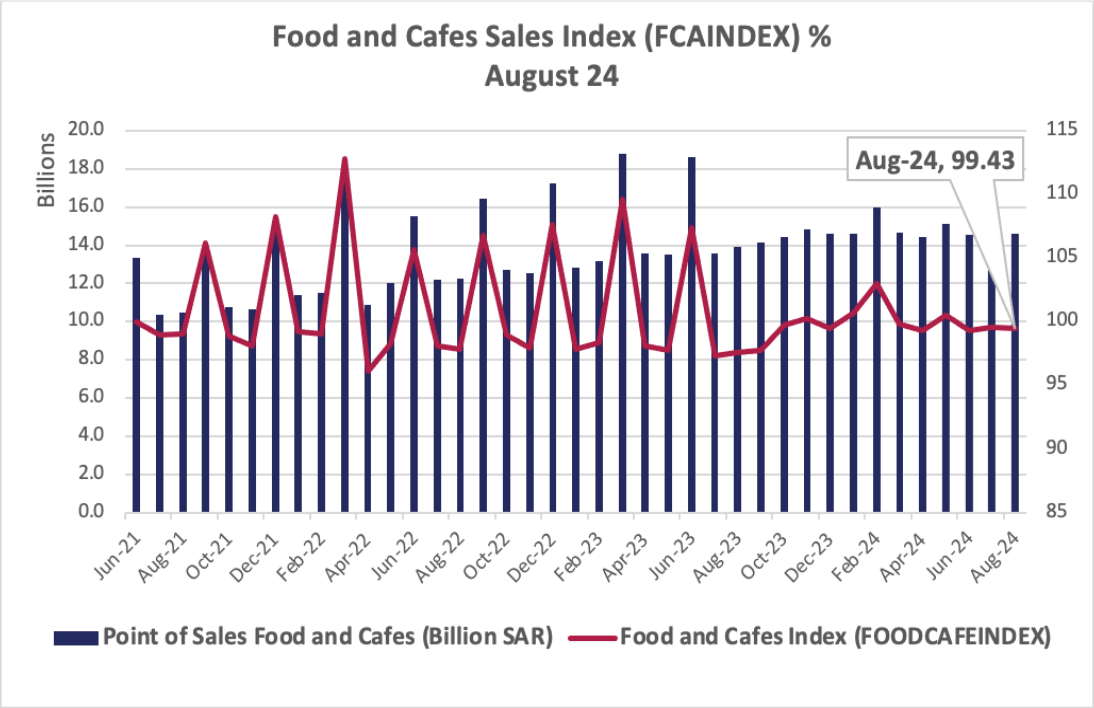
Total Point of Sales Values (SALEINDEX)



The Total Point of Sales Index (SALESINDEX) for KSA reflects the consumer spending trends and overall market activity in Q3 2024.

- In June 2024, the SALESINDEX stood at 99.31 points, with total point of sales values amounting to SAR 48.57 billion, representing a -0.83% decline from May, indicating a minor reduction in consumer spending during the month.
- In July 2024, the market showed slight improvement, with sales values rising to SAR 48.88 billion and the SALESINDEX increasing to 99.47 points, reflecting a 0.16% gain over June.
- By August 2024, consumer spending saw a notable rise, with sales values reaching SAR 52.37 billion and the SALESINDEX improving to 101.33 points, marking a 1.88% increase from July.

These figures suggest that while there were minor fluctuations in consumer spending across the quarter, the market demonstrated resilience, with August showing a strong rebound in overall sales activity.



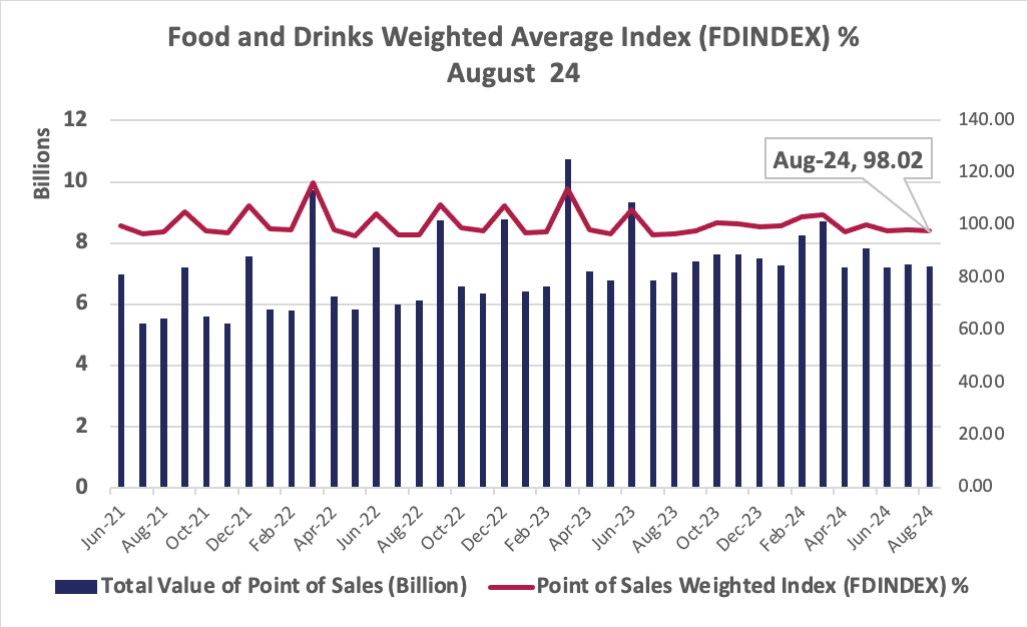
The FCAINDEX in the first half of 2024 exhibited interesting trends:

The Foods and Cafes Sales Index (FCAINDEX) for KSA reflects consumer spending trends in the food and cafes sector during Q3 2024.

- In June 2024, the FCAINDEX stood at 99.32 points, with total sales in this sector amounting to SAR 14.54 billion, reflecting a -1.17% decline from May, signaling a slight decrease in consumer spending.
- In July 2024, the market showed minor improvement, with sales increasing to SAR 14.64 billion and the FCAINDEX rising to 99.53 points, marking a 0.22% gain over June.
- By August 2024, the FCAINDEX slightly dipped to 99.43 points, with total sales standing at SAR 14.61 billion, reflecting a marginal -0.09% decline from July.

These trends suggest that while the food and cafes sector experienced minor fluctuations throughout Q3, the overall consumer spending remained relatively stable, with only slight variations between the months.

Food and Drink Sales Values (FDINDEX)



The Food and Drink Sales Index (FDINDEX) for KSA reflects consumer spending trends in the food and beverage sector during Q3 2024.

• In June 2024, the FDINDEX stood at 97.91 points, with total sales in the food and drink sector amounting to SAR 7.22 billion, marking a -2.31% decline from May, indicating a slight decrease in spending in this category.

• In July 2024, the market showed a minor recovery, with sales increasing to SAR 7.32 billion and the FDINDEX improving to 98.42 points, reflecting a 0.52% rise from June.

• By August 2024, the FDINDEX slightly decreased to 98.02 points, with total sales of SAR 7.23 billion, marking a minor -0.40% dip from July, but maintaining relative stability in consumer spending.

These trends suggest that while the food and drink sector experienced some fluctuations during Q3, overall spending remained relatively consistent, with only slight variations across the months.

UBT Economic Review (UBTER) functions as a platform for in-depth examination of global issues, with a focus on understanding their complexities and providing room for diverse perspectives, research findings, and innovative ideas. It aims to gain deeper insights into the root causes, dimensions and of these issues while also connecting this analysis to Saudi Arabia's Vision 2030, making global issues relevant to national goals. Essentially, this section offers space for reflecting on global issues and exploring emerging topics.

03

Reflecting on Current Issues

The Economic Imperatives of Global Water Security: Challenges, Opportunities, and Strategic Interventions

Water security, a critical determinant of economic stability and growth, has emerged as one of the most pressing global challenges in the 21st century. As the world grapples with climate change, population growth, and increasing urbanization, the economic implications of water scarcity and mismanagement have become increasingly apparent. This study examines the economic dimensions of global water security, exploring regional challenges, financial burdens, and potential solutions for a water-secure future.

1. Understanding Water Scarcity

Water scarcity refers to the inadequate availability of water resources to meet the water usage demands within a region. It can arise from various factors including physical water shortages, inadequate infrastructure, and poor water resource management [1]. Fresh water, which contains minimal dissolved solids (typically under 1,000 mg/L), is vital for life and human activities. Despite comprising only 2.5% of the Earth's water supply, freshwater from glaciers, rivers, lakes, and groundwater is crucial for drinking, agriculture, industry, and ecosystems. Unlike saltwater in oceans, freshwater is directly consumed without desalination.

The most widely accepted method for measuring water scarcity is the Falkenmark Indicator or Water Stress Index, which categorizes countries based on the amount of renewable freshwater available per person per year [2]:

- Water stressed: Less than 1,700 cubic meters per person per year
- Water scarce: Less than 1,000 cubic meters per person per year
- Absolute water scarcity: Less than 500 cubic meters per person per year

Another important measure is the Water Exploitation Index (WEI), which represents the mean annual total demand for freshwater divided by long-term average freshwater resources. A WEI above 20% implies water scarcity, whereas values above 40% indicate severe water scarcity [3].

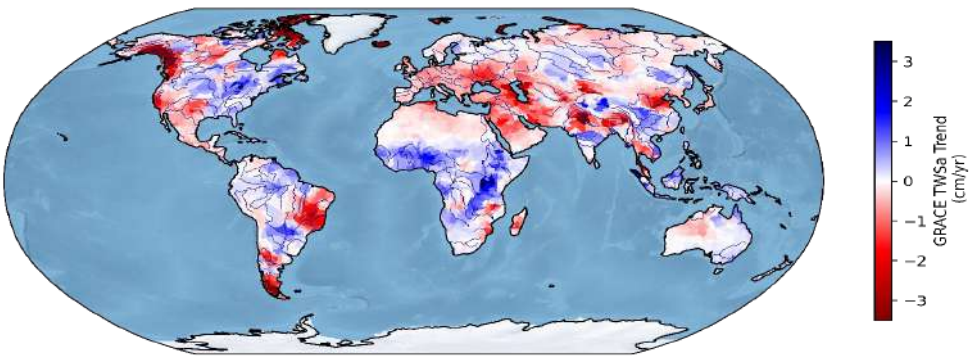


Fig: 1. Trends in total water storage from NASA GRACE and GRACE Follow-On Missions from to 2002-2022. Red areas have lost water over the last 20 years, whereas blue areas have gained water. [19]

Table: 1. Global Freshwater Distribution and Key Water Resource Statistics [29].

Freshwater Source	Percentage of Earth's Freshwater	Additional Information
Glaciers and ice caps	68.7%	~198,000 glaciers worldwide
Groundwater (including aquifers)	30.1%	Millions of aquifers globally
Surface water	1.2%	Includes lakes, rivers, wetlands
Soil moisture	0.05%	-
Atmospheric water	0.001%	Includes water vapor, clouds

Additional breakdown of surface water and other sources

Source	Quantity
Lakes	~117 million total, ~27 million larger than 1 hectare
Rivers	Estimated 1 65,000-177,000 worldwide
Wetlands	Cover about 5-8% of Earth's land surface
Large dams	Over 57,000 worldwide
Global annual precipitation	~1,000 mm (39 inches) average, varies by region

Table: 2. Global Water Security Challenges: Key Statistics and Indicators

Statistic	Approximate Value	Source
Population without access to safe drinking water	~2 billion	WHO/UNICEF
Population without access to sanitation	~2.3 billion	WHO/UNICEF
Countries facing high water stress	About 40% of the global population	World Bank
Annual global water withdrawals	Approximately 4,600 cubic kilometers	UN-Water

2. Economic Landscape of Global Water Security

The global water sector represents a significant economic force, with the value of water and wastewater services estimated at $1 trillion annually [4]. However, this vital sector is facing substantial challenges. According to the United Nations, approximately three-quarters of the world's population currently resides in water-insecure countries [5]. This insecurity translates to tangible economic costs across various sectors.

Agriculture, which contributes approximately 4% to the global GDP, is particularly vulnerable to water scarcity [6]. This sector accounts for approximately 70% of global freshwater withdrawals, making it highly sensitive to changes in water availability [7]. Industrial production, energy generation, and public health are also significantly affected by water insecurity, creating a complex web of economic challenges.

2.1 Industrial production:

- Water use in industry accounts for about 19% of global water withdrawals
- By 2050, manufacturing water demand is projected to increase by 400%
- Water-related risks to businesses could result in financial impacts of over $300 billion annually

2.2 Energy generation:

- The energy sector accounts for about 10% of global water withdrawals
- Hydropower provides about 16% of global electricity production
- By 2040, global water withdrawals for energy production could increase by 20%

2.3 Public health:

- 2 billion people lack access to safely managed drinking water
- 3.6 billion people lack access to safely managed sanitation
- Water-related diseases cause about 3.4 million deaths annually

2.4 Economic impacts:

- Water scarcity could cost some regions up to 6% of their GDP by 2050
- Improving water management in agriculture could add $200 billion to global annual GDP

3. Regional Economic Challenges

3.1 Africa: With 54% of its population lacking access to safe drinking water, Africa faces severe economic constraints owing to water scarcity [8]. The World Bank estimates that some countries in sub-Saharan Africa lose up to 5% of their GDP annually because of inadequate water and sanitation [9]. Ethiopia, which is heavily reliant on rain-fed agriculture, faces significant economic vulnerabilities due to water scarcity. Nigeria, Africa's largest economy, grapples with water pollution and rapid population growth, straining its water resources and economic development [10].

3.2 Asia: In South Asia, 43% of the population lacks access to safe drinking water, which hinders economic growth and productivity [11]. The Asian Development Bank projects that the region needs to invest $800 billion in water infrastructure by 2030 to meet growing demand [12]. India, the region's largest economy, faces critical water scarcity issues, with 600 million people experiencing high-to-extreme water stress, potentially costing 6% of its GDP by 2050 [13]. Despite its economic potential, China struggles with uneven water distribution and pollution, necessitating massive investments in water transfer projects.

3.3 Middle East: As one of the most water-stressed regions in the world, the Middle East faces unique economic challenges. Countries such as Saudi Arabia and the UAE invest heavily in desalination, accounting for over 85% of their water supply [14]. The high energy costs associated with desalination affect economic competitiveness and sustainability. Jordan, one of the world's most water-scarce countries, spends about 4% of its GDP on water and wastewater services, significantly higher than the global average [15].

3.4 Europe: While generally water-secure, Europe faces economic challenges related to aging infrastructure and climate change. The European Commission estimates that water scarcity could cost the EU economy up to €65 billion annually by 2030 if not addressed [16]. Southern European countries such as Spain and Italy are particularly vulnerable. Spain, for example, has invested heavily in desalination plants to combat water scarcity, with economic implications for both water pricing and agricultural competitiveness [17].

Table. 3: Trend of Agriculture's Contribution to GDP for Countries with Abundant Water Resources

Country	General Trend of Agriculture's Contribution to GDP	Estimated Range (%)
Brazil	Decreasing, but still significant	4-6%
Canada	Slowly decreasing	1.5-2%
Russia	Fluctuating, slight overall increase	3-5%
Indonesia	Slowly decreasing, but still important	12-14%
China	Steadily decreasing	7-9%
US	Gradually decreasing	0.9-1.1%
Syria	Fluctuating due to conflict, historically important	15-20%
Turkey	Slowly decreasing	6-8%
Morocco	Fluctuating, weather-dependent	11-14%
Egypt	Slowly decreasing, but still significant	11-13%

4. The Financial Burden of Water Security

Addressing global water security requires substantial financial investment. The World Bank estimates that achieving Sustainable Development Goal 6 (clean water and sanitation for all) will require $114 billion annually by 2030 [18]. Currently, the water sector attracts less than 2% of global public spending, with similar levels of private investment in low- and middle-income countries [19].

Water infrastructure alone is projected to require $6.7 trillion by 2030 and $22.6 trillion by 2050 [20]. Current water management technologies and methods include advanced treatment systems (membrane filtration and UV disinfection), smart metering, precision irrigation, water reuse and recycling, AI-driven infrastructure optimization, rainwater harvesting, aquifer recharge, and desalination. Nature-based solutions, such as constructed wetlands, have also been employed. These approaches are complemented by policy measures such as water pricing and conservation incentives to promote sustainable water use.

The water sector requires substantial investments across various infrastructure categories, presenting challenges and opportunities for economic growth and job creation. These include water supply systems, wastewater management, irrigation infrastructure, dams and reservoirs, water resource management systems, and disaster preparedness infrastructure.

Fig: 2. The challenges that cities face, Circular Cities [22]

5. Economic Impacts of Water Scarcity

The costs of water scarcity are multifaceted and far-reaching:

5.1 Agricultural Productivity: Water scarcity leads to reduced crop yields and increased food prices. The FAO estimates that water scarcity could reduce global food production by up to 40% by 2050 [21].

5.2 Industrial Losses: Water-intensive industries face increased operational costs and production disruptions. A Carbon Disclosure Project (CDP) report found that water-related risks cost businesses $38 billion in 2018 alone [22].

5.3 Health Costs: Inadequate water and sanitation lead to increased healthcare expenditures and reduced workforce productivity. The World Health Organization estimates that achieving universal access to safe water and sanitation would result in $170 billion of economic benefits annually from reduced healthcare costs and increased productivity [23].

5.4 Energy Production: Water scarcity impacts energy production, particularly in hydropower and thermal power plants. The International Energy Agency projects significant impacts of water constraints on energy production, potentially affecting economic growth in many regions. Current global water withdrawals for energy production account for about 10% of the total, with projections indicating a 20% increase between 2020 and 2040 [30].

6. Economic Opportunities in Water Security

Addressing water security challenges presents significant economic opportunities:

6.1 Infrastructure Development: Investments in water infrastructure can stimulate economic growth and job creation. The U.S. Environmental Protection Agency estimates that every $1 million invested in water infrastructure creates 15 jobs throughout the economy [25].

6.2 Technological Innovation: The growing demand for water-efficient technologies and innovative water management solutions presents opportunities for businesses and entrepreneurs. The global water technology market is projected to reach $832 billion by 2027 [26].

6.3 Green Growth: Investing in nature-based solutions for water management can contribute to green growth strategies. The World Bank estimates that natural infrastructure can provide cost-effective solutions for water security while generating additional economic benefits [27].

6.4 Circular Economy: Wastewater treatment and reuse present economic opportunities in the circular economy. The market for water recycling and reuse is expected to reach $22.3 billion by 2025 [28].

Table: 4. Economic Impacts of Water Scarcity and Benefits of Water Management: A Global Perspective

Statistic	Value
Global Economic Value of Water & Wastewater Services	$1 trillion annually
Agriculture's Contribution to Global GDP	~4%
Cost of Water Scarcity (Reduced Agricultural Productivity)	~$260 billion annually
Cost of Water Scarcity (Industrial Losses)	~$120 billion per year
Cost of Water Scarcity (Health Costs)	~$180 billion annually
Cost of Water Scarcity (Reduced Economic Growth)	Up to ~6% of GDP in some water-stressed regions
Economic Benefits of Water Management (Increased Agricultural Productivity)	Potential gains of ~$100-200 billion annually
Economic Benefits of Water Management (Industrial Efficiency)	~$40-80 billion per year
Economic Benefits of Water Management (Improved Public Health)	Reduces healthcare costs, ~$50-100 billion in annual health cost savings
Economic Benefits of Water Management (Tourism & Recreation)	$20-50 billion in additional revenue annually

7. Strategic Interventions for Economic Water Security

Addressing global water security requires a multi-faceted approach that combines policy interventions, technological innovations, and financial strategies:

7.1 Policy and Governance:

- Implement water pricing mechanisms that reflect the true economic value of water while ensuring affordability for basic needs.
- Develop regulatory frameworks that incentivize water efficiency and conservation in industries.
- Promote public-private partnerships to leverage private sector investment in water infrastructure.

7.2 Technological Innovation:

- Invest in research and development of water-efficient technologies for agriculture and industry.
- Promote the adoption of smart water management systems to optimize resource use and reduce losses.
- Support the development of cost-effective desalination technologies powered by renewable energy.

7.3 Financial Strategies:

- Develop innovative financing mechanisms, such as green bonds and water funds, to attract private investment.
- Integrate water security considerations into national economic planning and budgeting processes.

- Leverage international climate finance to support water security projects in developing countries.

7.4 Capacity Building and Education:

- Invest in water-related education and training programs to develop a skilled workforce for the water sector.
- Support knowledge transfer and best practice sharing between countries and regions.
- Promote water entrepreneurship and innovation through incubator programs and startup support.

Water security is intrinsically linked to economic security and sustainable development. As the global community grapples with increasing water scarcity and related challenges, it is crucial to recognize the economic imperatives of addressing water security. By viewing water as a valuable economic resource and investing in sustainable water management, countries can not only mitigate the economic risks associated with water scarcity but also unlock new opportunities for growth and innovation.

The path to global water security requires concerted efforts from governments, businesses, and international organizations. By implementing strategic interventions that combine policy reform, technological innovation, and financial investment, we can work towards a water-secure future that supports sustainable economic growth and prosperity for all.

As we move forward, it is essential to prioritize water security in economic planning and decision-making at all levels. The economic costs of inaction are too high to ignore, and the potential benefits of addressing water security are too significant to overlook. By embracing the challenge of water security as an economic opportunity, we can build a more resilient, sustainable, and prosperous global economy for generations to come.

Section four of UBT Economic Review highlights a groundbreaking economic discovery or achievement by a Saudi corporation, showcasing the innovative strides and advancements made within the country's business landscape. The section delves into the details of this noteworthy development, shedding light on its significance and impact on the local economic scene.

04
Economic Achievement

Arid Ambitions: Navigating the Complex Landscape of Water Security in Saudi Arabia

This article examines the critical issue of water security in Saudi Arabia, focusing on both the supply and demand sides of the water economy. It provides a detailed analysis of various water sources, including rainfall patterns, aquifers, dams, desalination plants, and water consumption patterns across different sectors. The study aims to present a comprehensive overview of Saudi Arabia's water resources, their distribution, capacity, and utilization, with a particular emphasis on numerical estimates and economic implications. By analyzing current challenges and potential strategies, this paper contributes to the ongoing dialogue on sustainable water management in the Kingdom.

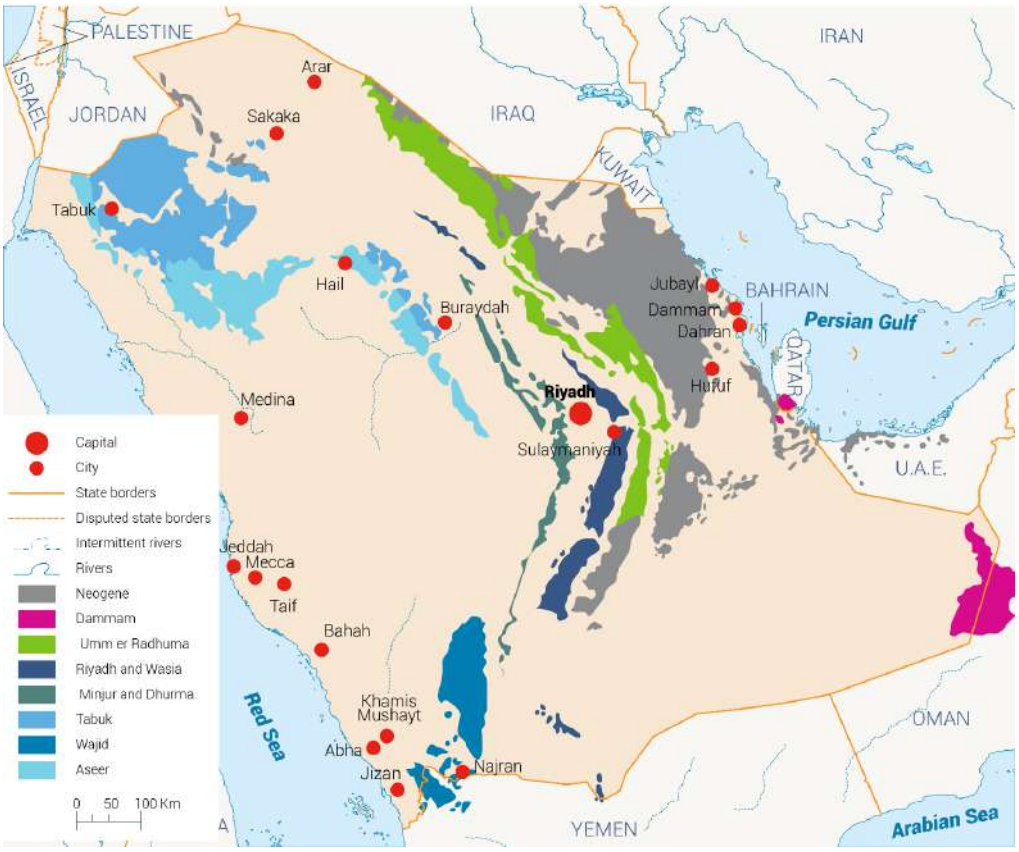


Figure 1: Principal groundwater aquifers in KSA [44].

1. Introduction

Water security is a paramount concern for Saudi Arabia, a nation characterized by its arid climate and rapid economic development. As the largest country in the Arabian Peninsula, with a land area of approximately 2,150,000 square kilometers, Saudi Arabia faces significant challenges in managing its limited water resources [1]. This article delves into both the supply and demand sides of Saudi Arabia's water economy, examining various sources, their contributions to the Kingdom's water security, and the patterns of water consumption across different sectors.

The urgency of addressing water scarcity in Saudi Arabia is underscored by stark statistics. The Kingdom is classified as one of the most water-scarce nations globally, with only 89.5 cubic meters of water per capita per year, far below the absolute water scarcity level of 500 cubic meters per capita [2]. This scarcity is exacerbated by the country's rapid population growth from just over 4 million in 1960 to approximately 35.5 million in 2022 [3]. By 2050, the population is projected to increase by 77% to more than 56 million, placing even greater strain on the country's limited water resources [4].

2. The Supply Side: An Overview

The water supply in Saudi Arabia comes from three main sources: groundwater from aquifers, surface water collected from dams, and desalinated seawater. Each of these sources plays a crucial role in meeting the country's water demand, which has been increasing owing to population growth, urbanization, and industrial development [5].

- 2.1 Groundwater

Groundwater extracted from aquifers has traditionally served as the primary water source in Saudi Arabia, constituting approximately 98% of the national water supply in the 1970s. However, this proportion has substantially diminished in recent decades owing to aquifer overexploitation and the diversification of water resources [6]. The total groundwater reserves in Saudi Arabia are estimated to be around 500 billion cubic meters, but the annual recharge rate is only about 3.5 billion cubic meters, raising serious concerns about the sustainability of groundwater extraction [7].

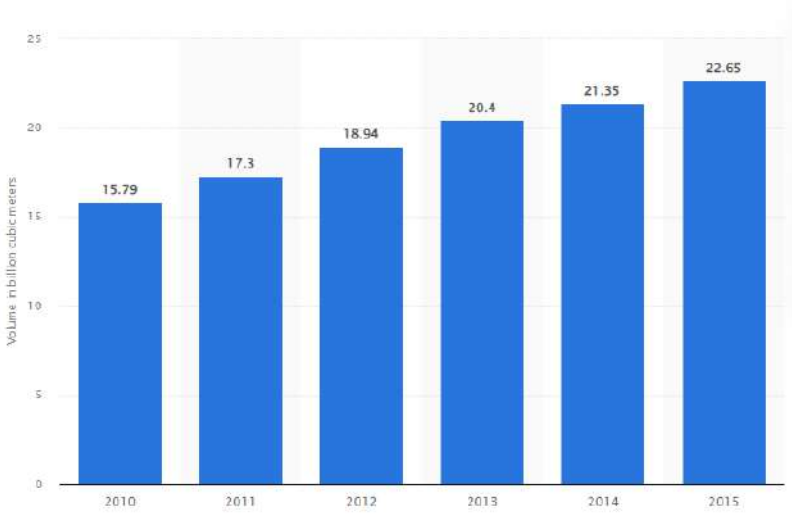


Figure 2: Volume of extracted groundwater in Saudi Arabia from 2010 to 2015(in billion cubic meters). [47]

- 2.2 Surface Water

Surface water, primarily collected through dams, contributes to a small but important portion of the kingdom's water supply. The amount of available surface water varies greatly depending on annual rainfall. As of 2021, there are 521 dams across the Kingdom, with a total storage capacity of approximately 2.27 billion cubic meters [8].

- 2.3 Desalinated Water

In recent decades, Saudi Arabia has invested heavily in desalination to meet its growing water demand. The country is currently the world's largest producer of desalinated water. As of 2021, the Kingdom operates 33 desalination plants with a total capacity of approximately 7.6 million cubic meters per day, equivalent to about 2.77 billion cubic meters annually [9].

3. Rainfall and Aquifers

- 3.1 Rainfall Distribution

Saudi Arabia is characterized by its arid climate, with limited and highly variable rainfall. The country's average annual rainfall is approximately 59 mm; however, this figure varies significantly across different regions [10]. The regional rainfall distribution is as follows:

- Southwestern Region (Asir Mountains): 300-500 mm annually
- Western Region (Hijaz Mountains): 100-200 mm annually
- Central Region: 100-200 mm annually
- Northern Region: 50-100 mm annually
- Eastern Region: 50-100 mm annually
- Empty Quarter (Rub' al Khali): Less than 50 mm annually [11]

It is important to note that these are average figures, and the actual rainfall can vary significantly from year to year. For instance, in 2016, Riyadh received 107 mm of rainfall, whereas in 2017, it received only 31 mm [12].

- 3.2 Aquifer Systems

Saudi Arabia's water supply is predominantly dependent on its extensive aquifer systems, which comprise both renewable and nonrenewable (fossil) groundwater resources. The main aquifer systems include:

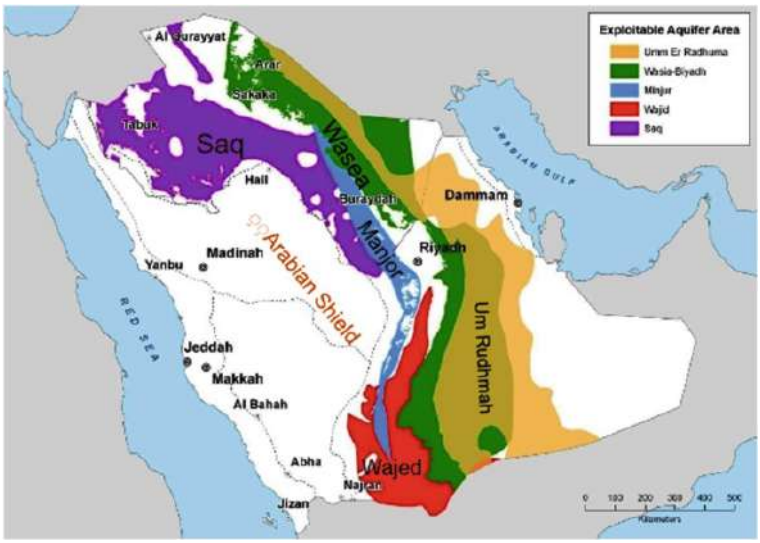


Figure 3: Principal aquifers for groundwater in Saudi Arabia [54]

1. Saq Aquifer: Located in the northern and central regions, covering an area of approximately 375,000 square kilometers [13].
2. Wajid Aquifer: In the southwestern region, covering an area of approximately 94,000 square kilometers [14].
3. Umm Er Radhuma Aquifer: Extends across the eastern region and parts of the Empty Quarter, covering an area of approximately 1,485,000 square kilometers [15].
4. Dammam Aquifer: Located in the eastern region, covering an area of approximately 640,000 square kilometers [16].

Overexploitation of these aquifers, particularly for agricultural purposes, has led to a significant depletion of groundwater resources. This situation has prompted the Saudi government to implement stricter regulations for groundwater extraction and seek alternative water sources.

4. Dams and Desalination

- 4.1 Dams

Saudi Arabia has invested heavily in dam construction to capitalize on limited surface water resources. As of 2021, there are 522 dams across the Kingdom, with a total storage capacity of approximately 2.30 billion cubic meters [17]. The distribution of dams and their capacities varies by region, as shown in the following table:
The total desalination capacity of Saudi Arabia reached approximately 7.6 million cubic meters per day in

Table 1: Distribution of Dams and Their Capacities by Region [18-20]

Region	Number of Dams	Total Capacity (MCM)	Average Annual Rainfall (mm)
Asir	118	521.13	300-500
Riyadh	107	106.96	100-200
Mecca	60	883.32	100-200
Eastern Province	46	87.40	50-100
Other Regions	190	701.19	50-200

The total amount of utilized water from dams is about 1.6 BCM/year, with 73% of this usage concentrated in the regions of Asir, Mecca, and Jazan.

- 4.2 Desalination

Saudi Arabia is the world's largest producer of desalinated water, with a rapidly expanding desalination sector. As of 2021, the Kingdom operates 33 desalination plants [24]. The major desalination plants and their capacities are as follows:

Table 2: Major Desalination Plants and Their Capacities (2021) [25]

Desalination Plant	Location	Capacity (MCM/day)	Annual Production (BCM)
Ras Al Khair	Eastern Coast	1.025	0.374
Jubail	Eastern Coast	1.400	0.511
Shuaiba	Western Coast	1.300	0.474
Yanbu	Western Coast	0.500	0.183
Jeddah	Western Coast	0.400	0.146

2021, equivalent to about 2.77 billion cubic meters annually [26]. The regional distribution of desalination capacity is:

- Eastern Province: 40% of total capacity
- Makkah Region: 30% of total capacity
- Madinah Region: 20% of total capacity
- Other regions: 10% of total capacity [27]

Of the total desalinated water currently produced:

- 77.5% is produced by Multi-Stage Flash (MSF) plants
- 20.5% is produced by Reverse Osmosis (RO) plants
- 2% is produced by Multi-Effect Distillation (MED) plants [28]

5. Water Infrastructure and Distribution

The Kingdom of Saudi Arabia has made significant investments in water infrastructure to manage its limited resources effectively. Saudi Arabia's main water pipelines extend more than 8,000 km, with the majority owned and operated by the Saline Water Conversion Corporation (SWCC) [29]. As of 2019, the total length of the water network was 121,356 km, with 2.26 million domestic water connections. The wastewater collection network extended 43,729 km, serving 1.46 million domestic connections [30].

There are 353 water treatment plants built on dams and groundwater wells across the Kingdom, with an overall production capacity of 2.07 million cubic meters per day [31]. The regional distribution of these plants includes:

- Riyadh Region: 87 plants (1,060,333 m^3/day capacity)
- Eastern Region: 61 plants (21,548 m^3/day capacity)
- Qassim Region: 27 plants (415,269 m^3/day capacity)
- Mecca Region: 7 plants (118,238 m^3/day capacity)
- Other regions: 171 plants (various capacities)

Saudi Arabia operates 99 wastewater treatment plants (WWTPs). The major WWTPs and their capacities include Manfouha-Riyadh (600,000 m^3/day), Hayer-Riyadh (400,000 m^3/day), Medina (460,000 m^3/day), Dammam (215,000 m^3/day), and Taif (190,000 m^3/day) [32].

(Table 3: Regional distribution of Wastewater Treatment Plants (WWTPs), Treated Wastewater (TWW) quantities and reuse in KSA could be inserted here)

6. Water Consumption Patterns and Economic Analysis

- 6.1 Water Demand and Consumption

Water demand in Saudi Arabia can be broadly categorized into:

- Domestic (Municipal) Use: Includes household consumption, public services, and commercial activities in urban areas.
- Agricultural Use: Irrigation for crop production and livestock.
- Industrial Use: Water used in manufacturing processes, cooling, and other industrial applications.
- Environmental Use: Water required to maintain ecosystems and combat desertification.

The distribution of water consumption across different sectors in Saudi Arabia as of 2020 was:

Table 3: Water Consumption by Sector (2020) [49]

Sector	Water Consumption (BCM/year)	Percentage of Total Consumption
Agriculture	21.84	84%
Domestic	3.12	12%
Industrial	1.04	4%

Table 4: Regional distribution of Wastewater Treatment Plants (WWTPs), Treated Wastewater (TWW) quantities and reuse in KSA.[53]

Region	Number of WWTPs	TWW (MCM/yr)	Amount of treated water (MCM/d)	Amount of reused TWW (m3/d)	Wastewater reuse (%)
Riyadh	15	540.111	1.480	137,575	9.30
Mecca	7	456.263	1.250	64,897	5.19
Medina	4	105.124	0.288	139,639	48.50
Qassim	5	79.887	0.219	59,819	27.33
Eastern	16	423.123	1.159	382,846	33.03
Asir	17	76.478	0.210	40,110	19.14
Tabuk	3	46.288	0.127	2,610	2.06
Hail	2	24.445	0.067	4,516	6.73
Northern Border	3	7.218	0.020	6.58	0.03
Jazan	13	21.749	0.060	8,020	13.46
Najran	3	4.237	0.012	10,621	91.50
Baha	9	0.492	0.001	742	55.03
Al-Jawf	2	16.464	0.045	905	2.01
Total	99	1801.874	4.936	852,307	17.26

It is worth noting that despite consuming the lion's share of water resources, agriculture contributes only approximately 2% of Saudi Arabia's GDP [33].

- 6.2 Economic Impact of Water Sector

The water sector plays a crucial role in Saudi Arabia's economy, both as a vital resource for various industries and a significant area of government expenditure and investment. Although the direct contribution of the water sector to Saudi Arabia's GDP is relatively small, its indirect impact is substantial. As of 2020, the water, electricity, and gas sectors have contributed approximately 1.8% of the Kingdom's GDP [37].

The Saudi government has consistently allocated substantial funding to water-related projects. In the 2021 budget, SAR 141 billion (approximately $37.6 billion) was allocated to the environment, water, and agriculture sectors [38]. This significant investment reflects the critical importance of water security in the kingdom's economic and social development.

Water scarcity poses a significant economic risk to Saudi Arabia. A World Bank report estimated that water scarcity could cost some regions up to 14% of their GDP by 2050 if not addressed [40]. For Saudi Arabia, this could translate to billions of dollars in lost economic output.

The cost of desalination, a crucial water source for Saudi Arabia, is high in both economic and environmental terms. The average cost of desalinating a cubic meter of water is $0.5 to $1, which is significantly higher than the cost of extracting groundwater or treating surface water [34]. Moreover, desalination plants require substantial energy inputs, which contribute to carbon emissions.

7. Future Projections and Challenges

- 7.1 Projected Water Demand

Water demand in Saudi Arabia is projected to increase significantly in the coming years:

- Total water demand is expected to reach 22.3 billion cubic meters per year by 2030, an increase of over 20% from current levels [41].
- Domestic water demand is projected to grow at an annual rate of 2.1% between 2019 and 2025 [51].
- Industrial water demand is estimated to increase by 0.5-1% annually through 2030 [52].
- Agricultural water demand is expected to decrease slightly due to policy interventions, with a projected annual reduction of 0.5-1% through 2030 [52].

- 7.2 Climate Change Impact

Climate change is expected to exacerbate water scarcity in Saudi Arabia. Projections suggest that by 2050, climate change could reduce renewable water resources in the Middle East and North Africa region by 20-30% [42]. This could lead to increased reliance on desalination and potentially higher water costs.

- 7.3 Technological Innovations and Policy Challenges

Addressing future water challenges will require innovative solutions. Some promising technologies being explored include advanced membrane technologies for more efficient desalination, solar-powered desalination plants, smart water management systems using IoT and AI for leak detection and usage optimization, and atmospheric water generation technologies [43].

Key policy challenges for the future include:

- Balancing water conservation with economic development goals
- Reforming agricultural policies to reduce water consumption while maintaining food security
- Implementing water pricing reforms that encourage conservation without overburdening low-income households
- Developing regional cooperation on shared water resources

8. Conclusion

Water security in Saudi Arabia is intrinsically linked to its economic future. The Kingdom faces significant challenges in managing its scarce water resources, including rapid population growth, increasing water demand, and the impact of climate change. However, it has also made substantial investments in water infrastructure, particularly desalination capacity and water distribution networks.

Moving forward, a multi-faceted approach will be necessary to ensure long-term water security. This will likely include continued investment in water infrastructure, implementation of more stringent water conservation measures, expansion of wastewater treatment and reuse programs, reform of water pricing structures, investment in research and development of water-saving technologies, and public education campaigns to promote water conservation.

By addressing these challenges and implementing sustainable water management strategies, Saudi Arabia can support its economic diversification efforts, maintain the quality of life of its growing population, and set an example for water management in arid regions worldwide. The Kingdom's ability to effectively manage its water resources is a critical factor in its long-term economic stability and growth.

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