

INDIA WATER WEEK 2026

Rethinking Irrigation for a Water Secure Asia and the Pacific

From water scarcity to water security — FAO's regional programme for climate resilience

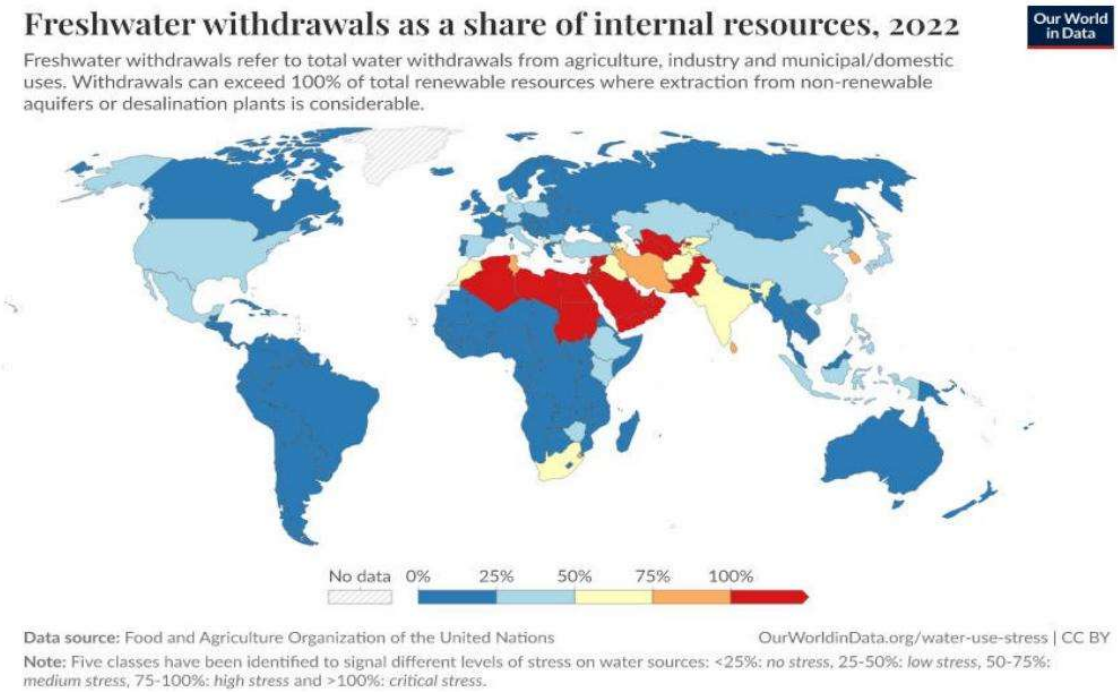
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FAO Regional Office for Asia and the Pacific

Bharat Mandapam, New Delhi
22–26 September 2026
Climate Resilient Water Management

Asia-Pacific: the world's most water-stressed populous region

SDG 6.4.2 · freshwater withdrawal as a share of available renewable resources, after environmental flows · AQUASTAT 2022





76.7% — **Southern Asia water stress**
AQUASTAT Snapshot 2025 · 2022

70.2% — **Central Asia water stress**
AQUASTAT Snapshot 2025 · 2022

72% — **of global withdrawals are agriculture**
AQUASTAT / SDG portal · 2022–23

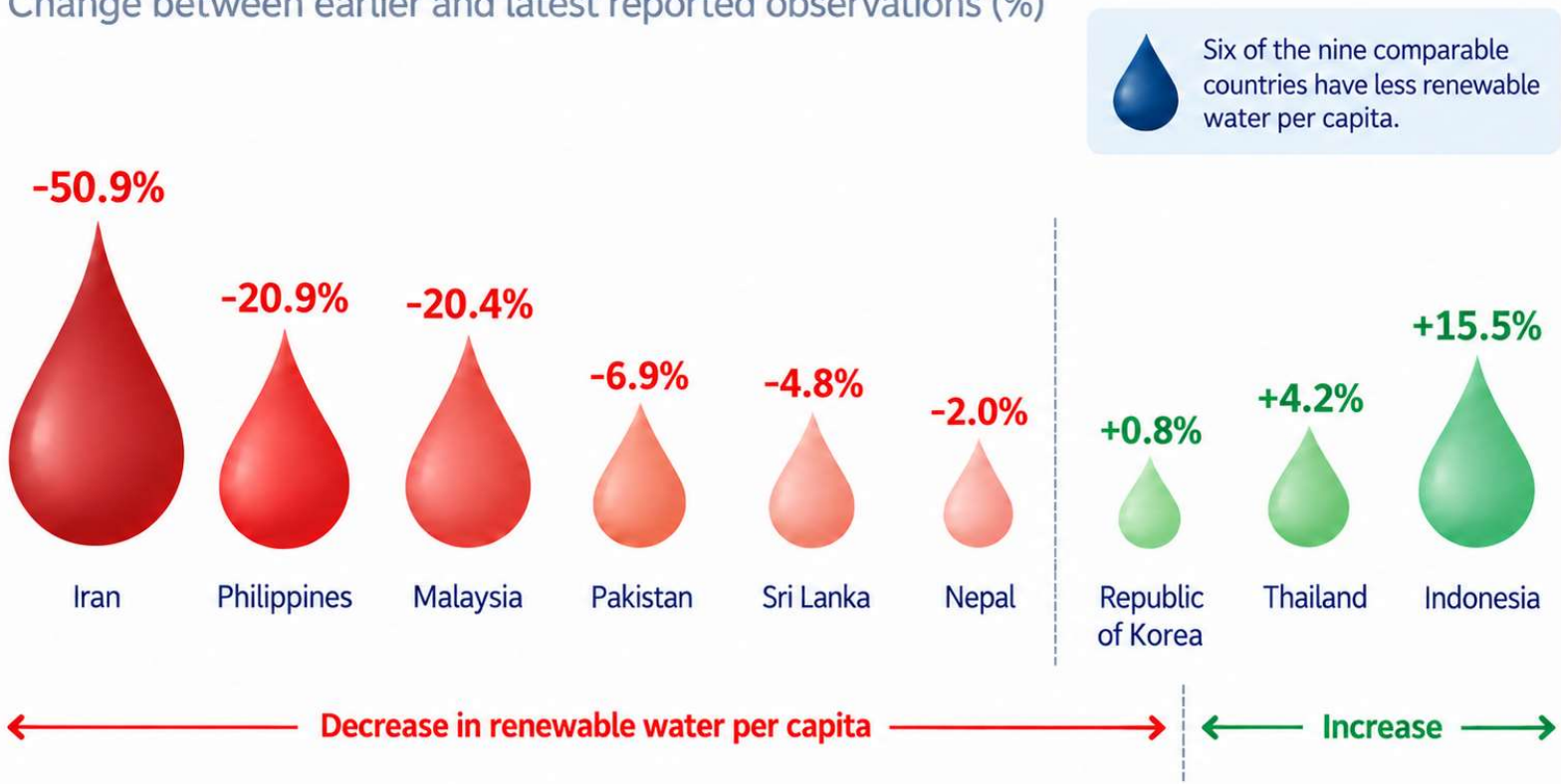
733 m — **people in high or critical-stress countries**
AQUASTAT Snapshot 2025 · worldwide

Country values (AQUASTAT 2022, SDG 6.4.2): Pakistan 110% · India 66% · ROK 85% · China 42% · Japan 37% · Indonesia 30% · Philippines 28% · Thailand 23% · Viet Nam 18% · Bangladesh 6% · Cambodia 1%. Hotspots (GRACE-FO / literature): Indo-Gangetic · North China Plain · Mekong Delta.

Thresholds: <25% no stress · 25–50% low · 50–75% medium · 75–100% high · >100% critical. RAP page uses ~70% agriculture; AQUASTAT latest global figure is 72%.

Renewable water per capita is declining in most countries

Change between earlier and latest reported observations (%)

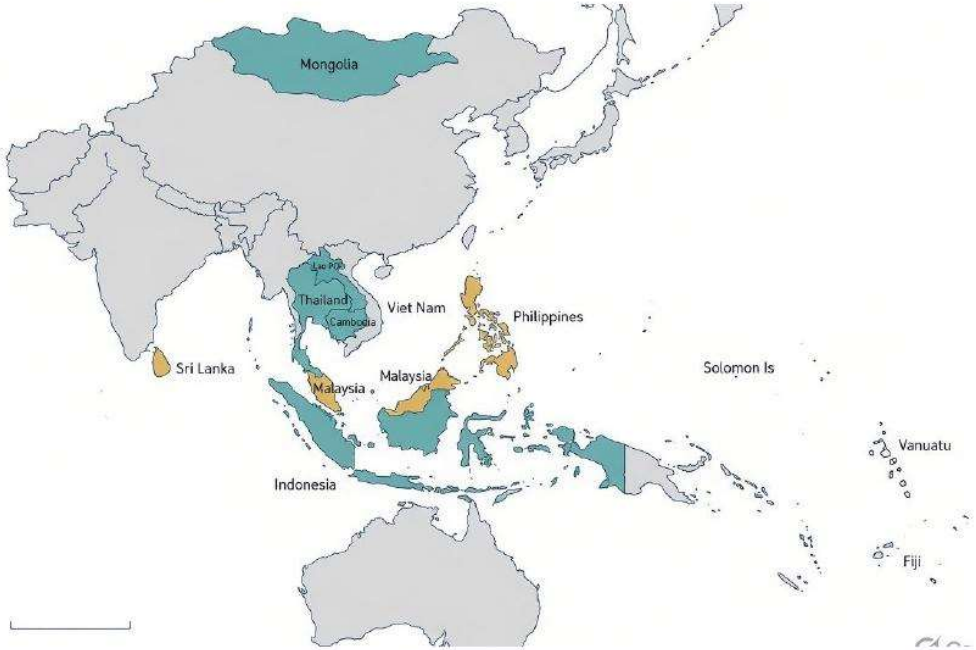


Source: FAO AQUASTAT country profiles (earlier and latest reported observations).
Note: Change calculated as (latest - earlier) / earlier × 100. India excluded because the supplied table does not provide a usable new value.

Even prior to current energy crisis, renewable water availability largely diminishing on a per-capita basis

A regional response — FAO RAP water, not one project

Water Scarcity Programme is pillar one. Tenure, transboundary and ecosystems sit beside it.



01 WSP accounting

Measure use and demand. WARMs. KH · LA · TH · VN · ID · MN

02 WSP allocation

Frameworks from the accounts. National water allocation.

03 WSP productivity

Farm and scheme. Real water savings. WaPOR.

04 WSP platform

iRTP-WS regional cooperative platform. AWP / DFAT.

Tenure — ScaleWAT

LK · TH · ID · VN · KH · LA · MY · PH

Transboundary — GEF IW

KH–VN · MY–TH · VN–LA · FJ–SB–VU · USD 33m

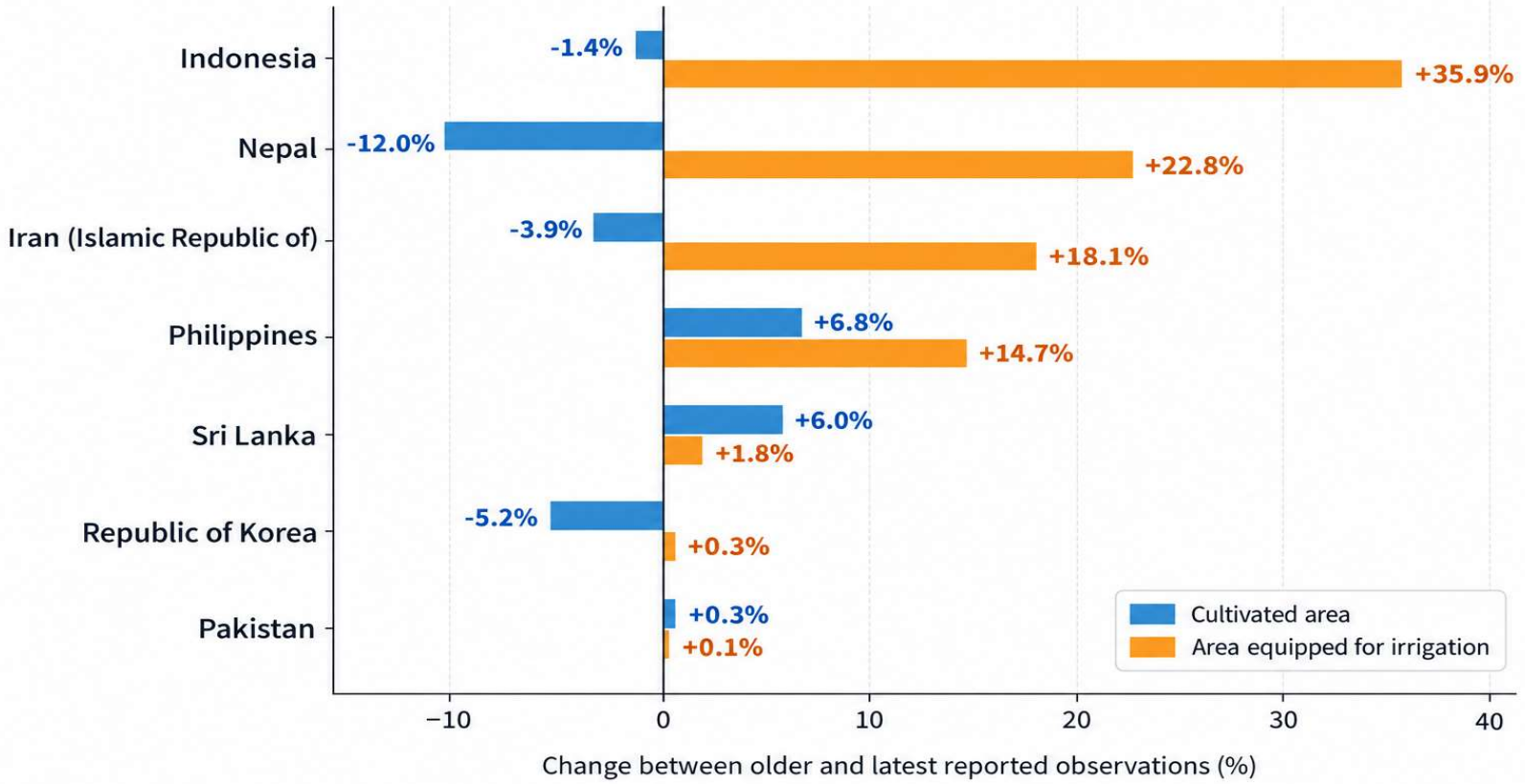
Ecosystems — CHO / ER

Viet Nam · Sri Lanka · source-to-sea

Map is schematic. Teal = WSP implementation. Gold = ScaleWAT (also overlaps WSP). Pacific dots = TWP volcanic groundwater. India · Pakistan · Bangladesh · Nepal are Rapid Assessment / irrigation-energy evidence — not WSP countries.

Irrigation Expansion Is Outpacing Cultivated-Area Expansion

Percentage change in cultivated area compared with change in area equipped for irrigation.

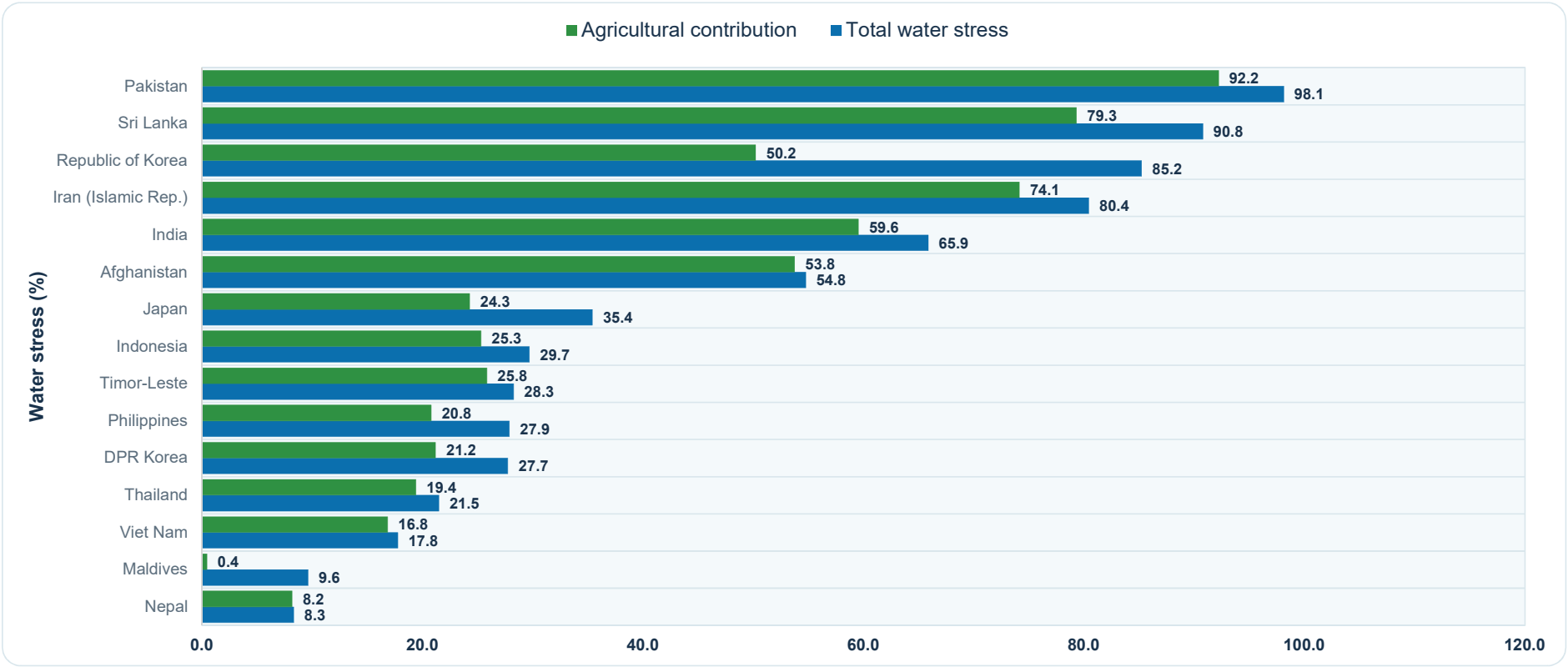


Intensification Is Increasing Harvest Capacity Beyond

Source: FAO AQUASTAT DATA, 2025-26 update compared to data from 2011 (India in 2015, Iran in 2008)

Water Stress Hotspots in the 2023 AQUASTAT Sample

Agriculture accounts for most water stress in the highest-pressure countries.

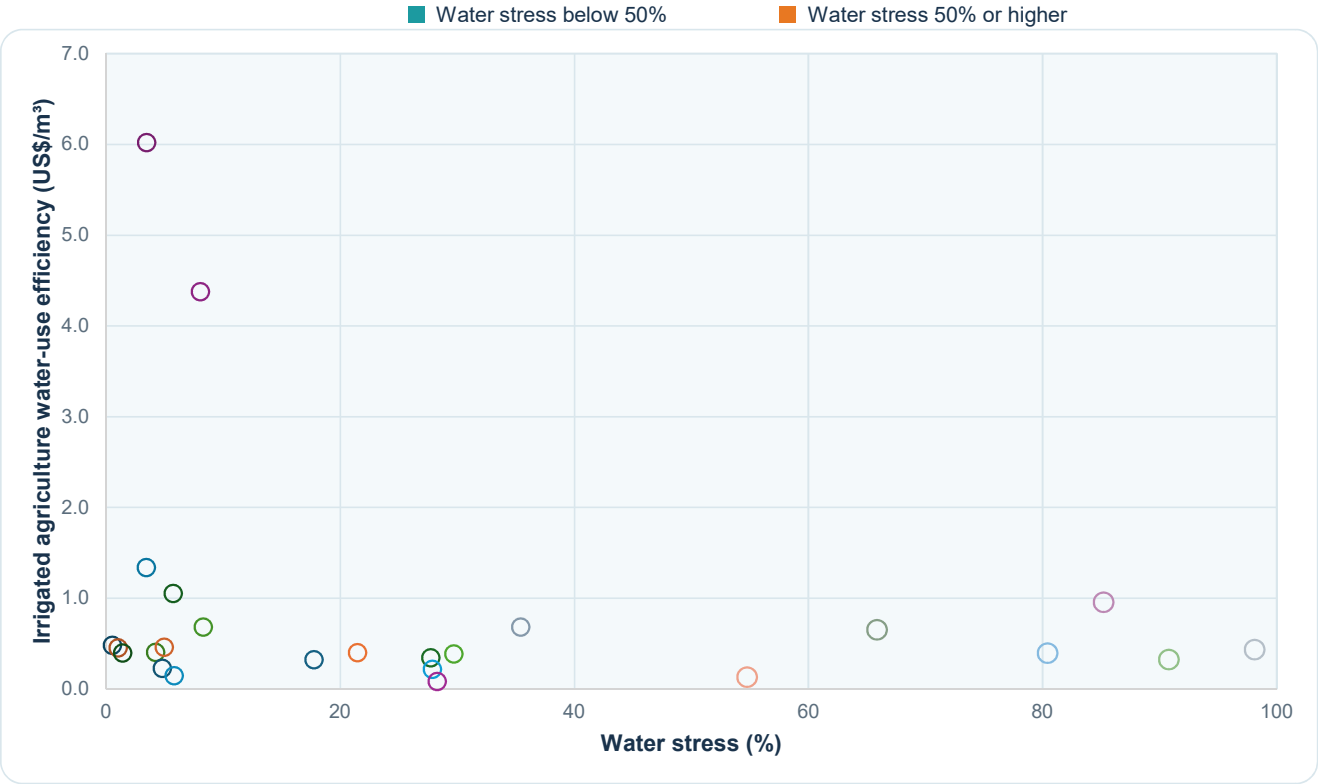


Pakistan and Sri Lanka exceed 90% total water stress; agriculture drives most pressure across the top 15.

Source: FAO AQUASTAT Dissemination System (7)(1), 2023; top 15 of 28 non-aggregate countries.

Water Stress vs Irrigation Water-Use Efficiency

Across 25 countries, high water stress does not automatically coincide with strong irrigation efficiency.



Selected country values

Country	Stress	Efficiency
Brunei Darussalam	3.5%	6.02
New Zealand	8.0%	4.37
Bangladesh	5.7%	1.05
Nepal	8.3%	0.68
Japan	35.4%	0.68
India	65.9%	0.65
Republic of Korea	85.2%	0.95
Iran (Islamic Rep.)	80.4%	0.39
Pakistan	98.1%	0.43
Sri Lanka	90.8%	0.32
Afghanistan	54.8%	0.13

Each point is one country.

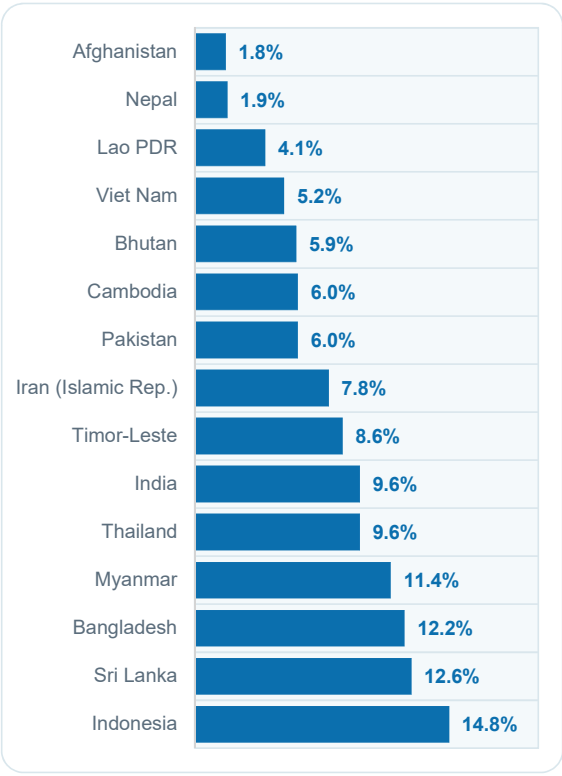
The expanded sample confirms that high water stress and high irrigation efficiency do not move together consistently.

Source: FAO AQUASTAT Dissemination System (7)(1), 2023; 25 countries with complete observations.

Agriculture Dominates Water Stress

Share of total water stress attributable to agriculture across the expanded 2023 AQUASTAT sample.





In every country in the top 15, agriculture accounts for at least 85% of total water stress.

Source: FAO AQUASTAT Dissemination System (7)(1), 2023; top 15 agriculture shares of total stress.

The Level of Energy Impacts on Irrigated Agriculture

- Fuel price hike is significant across the region, but impacts on irrigation are **varied**
- Impacts depend on **irrigation water supply, crop, region and pump type** (surface or groundwater reliance)
- Mostly **dry season crops** are affected: dry season rice in Thailand, wheat in Nepal and Pakistan, Boro rice in Bangladesh
- Irrigation is **5–10% up to 30–50%** of total production cost (Boro rice >30%; Thailand >20% in GW-dependent areas)
- Where cost rose sharply, farmers **skip dry season crops** — e Cambodia, Laos
- Irrigation energy impact is **smaller than other inputs** (fertilizer, transport, machinery): higher input cost, lov profit margin***
- > Bottom line: irrigation energy is a secondary cost driver overall, but decisive for dry-season, groundwater-dependent cropping — most acutely in South Asia.



Picture source: cgs-bd.com/article/3643/Backward-Irrigation-Practices-Costing-Bang



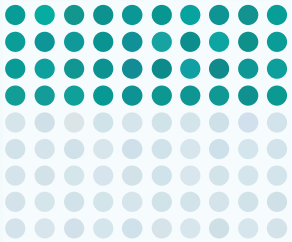
THE WATER-FOOD-ENERGY CONNECTION

Groundwater's Outsized Energy Footprint

72% of freshwater withdrawals globally are used by agriculture

+20–25% Projected *increase* in global water demand by **2050**

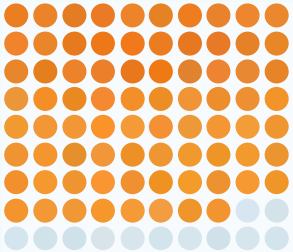
GROUNDWATER: **LAND SHARE** vs **ENERGY SHARE**



40%
of **irrigated land** relies on **groundwater**

Each dot = **1 percentage** point of **total**

Groundwater occupies a **minority** share of irrigated **land**, but **a dominant** share of irrigation **energy**

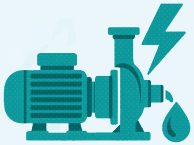


89%
of irrigation energy *goes* to groundwater pumping

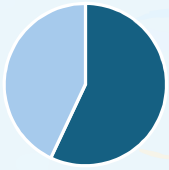
GROUNDWATER PUMPING: MODE SHARE AND ENERGY BURDEN



74%
of groundwater-pumping **energy** use is **diesel**



26%
is **electric**



57% **of total irrigation energy consumption** comes from groundwater **extraction** using **diesel pumps** together with **surface irrigation** systems

Groundwater **supports 40%** of **irrigated agriculture, but *absorbs* 89%** of irrigation **energy and diesel** is the **dominant** source of **that burden.**

Sources: FAO AQUASTAT; WRI (2023); Qin J. et al. (2024), Nature Communications 15, 3084.

South Asia (Bangladesh, Nepal, Pakistan)



Pakistan

1.3M tubewells

- 80% diesel-powered, with low pump efficiency
- Punjab alone: 60–70% of agricultural production



Bangladesh

1.72M GW pumps

- ~80% of all irrigation; some electric pumps
- High groundwater degradation rate



Nepal

90% electric pumps

- 80% of irrigation is gravity-fed
- High grid coverage limits fuel exposure

South Asia is the region most exposed to fuel price surges — crop production depends heavily on groundwater pumping.

IRRIGATION DEPENDENCE ACROSS ASIA AND THE PACIFIC

Groundwater-Irrigated Area by Country

In terms of area, the India sub-continent constitutes the overwhelming majority of groundwater-irrigated land.

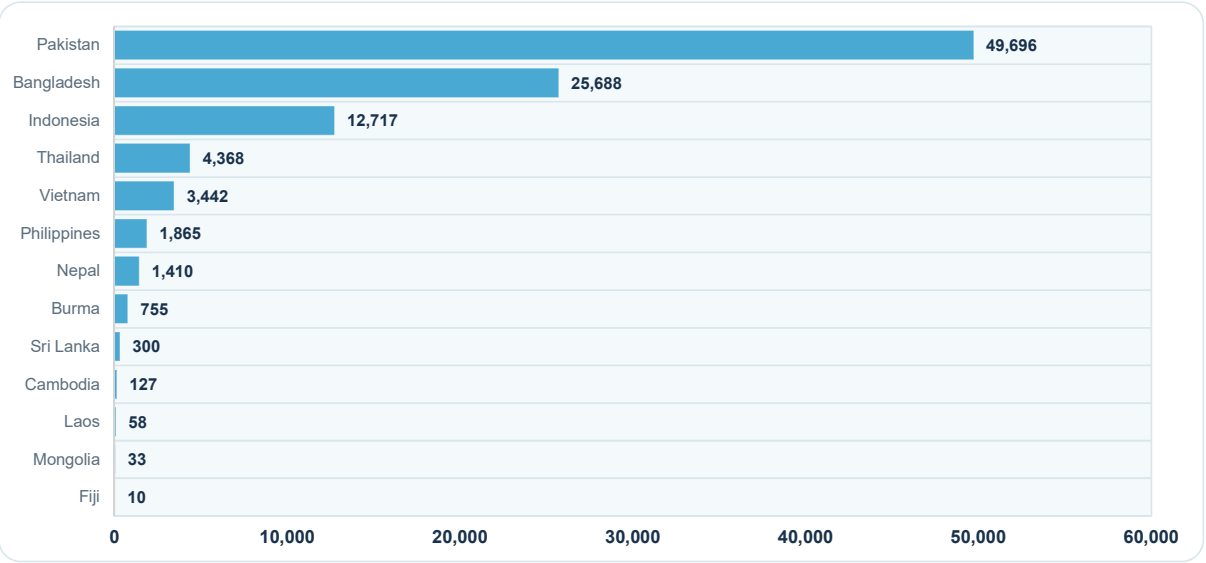
INDIA

322,209 km²

76.2%

of the total area shown

Remaining countries



CONCENTRATION OF AREA SHOWN

94.1%

India, Pakistan, and Bangladesh account for 94.1% of the total.



India	76.2%
Pakistan	11.7%
Bangladesh	6.1%
All other countries	6.0%

From major agricultural heartlands to small island nations, groundwater plays a vital role across the region but its use is highly uneven.

Groundwater irrigation is highly concentrated, with India overwhelmingly dominating the regional footprint.

Areas shown in km².

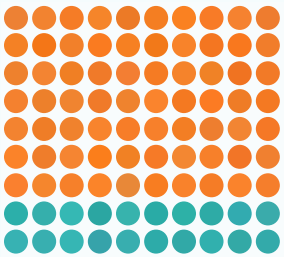
THE WATER-FOOD-ENERGY CONNECTION

Diesel Pumping Drives Irrigation's Global Energy Footprint

40% of **total irrigated agriculture relies** on groundwater **pumping globally**

89% of **total irrigation energy** consumption is **used for groundwater pumping**

GROUNDWATER PUMPING: MODE SHARE AND ENERGY BURDEN



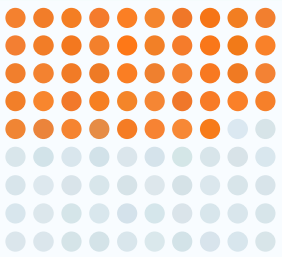
74%

of **groundwater-pumping energy use**

diesel

26% **electric**





57%

of total **irrigation energy consumption**

comes from **groundwater extraction** using diesel pumps together with surface irrigation systems.

Most groundwater pumping energy comes from diesel-powered pumping.

Why this matters for Asia and the Pacific

Higher Vulnerability

Heavy **fossil-fuel reliance**

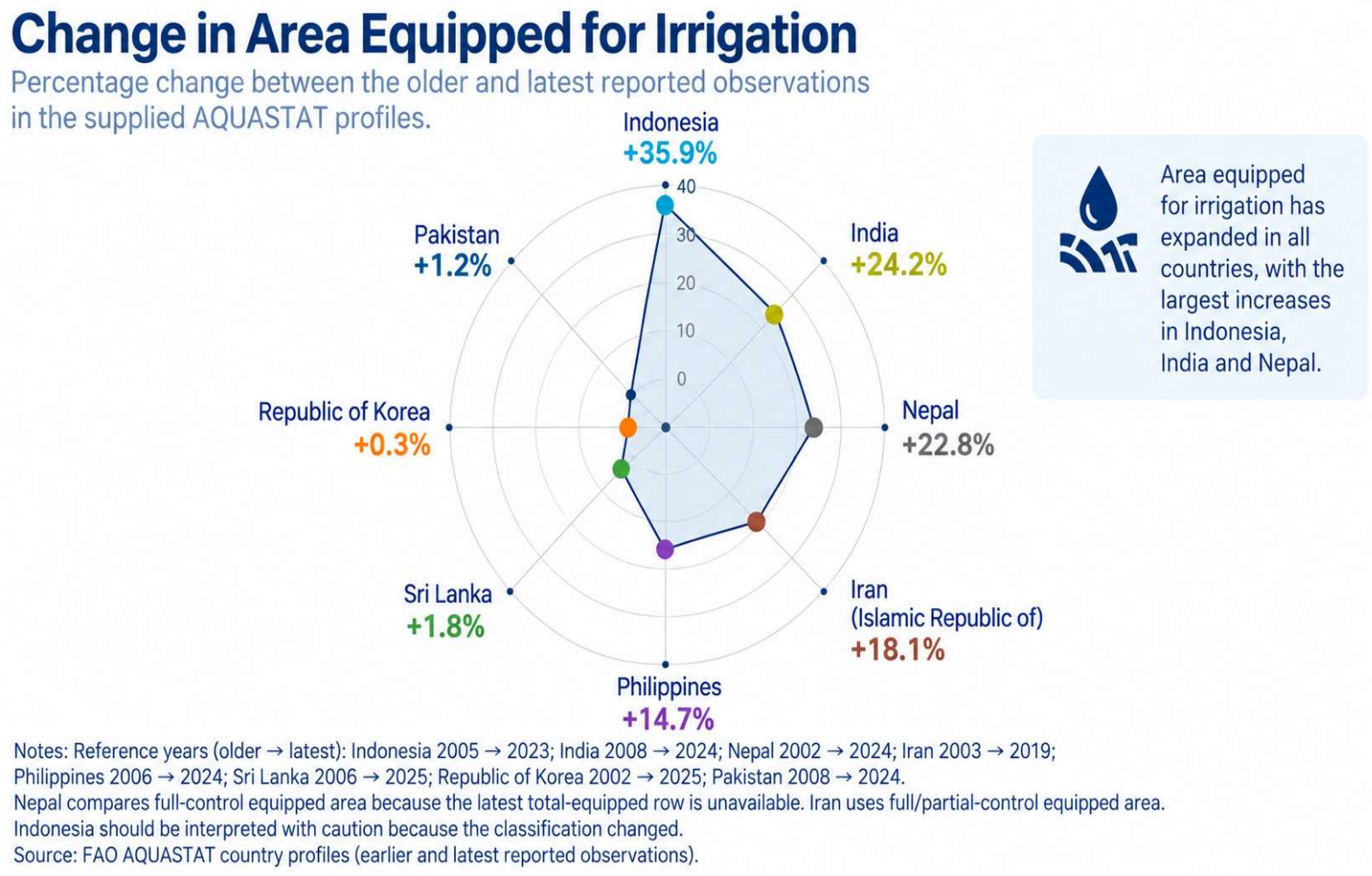
Exposure to **price** shocks

1. **Diesel pump** reliance remains a major **irrigation-energy vulnerability** across the region.
2. Diesel pump share by country can serve as a **key indicator** of irrigation systems' **reliance** on **fossil fuel.**
3. Countries with high **diesel-pump dependence** are more **exposed** to **fuel-price shocks** and **energy insecurity.**

Groundwater supports 40% of **irrigated agriculture,** but **absorbs 89% of** irrigation **energy and diesel** is **the** dominant **source of that burden.**

Source: Qin J. et al. (2024), Nature Communications 15, **3084.**

- Irrigation-equipped area has continued to expand even where cultivated-area growth has slowed or reversed.
- This suggests irrigation investment is becoming increasingly important to raising output from the existing land base.



As Cultivated Land Expansion Stalls, Irrigation Equipped Area Growth

Irrigation Energy Solutions across the Region

- **Broad renewable energy goals** region-wide, but implementation varies
- **Fragmented institutions** are the key challenge — limited in SEA, advanced in South Asia; smallholders benefit least
- **Solar dominates** the irrigation energy transition; few other RE options, often solar paired with HEIS
- **Investment models vary** in South Asia: individual, collective, fee-for-service, pay-as-you-go

> Policy ambition is broad; delivery is uneven. Solar plus efficient irrigation, backed by workable finance models, is the practical entry point.

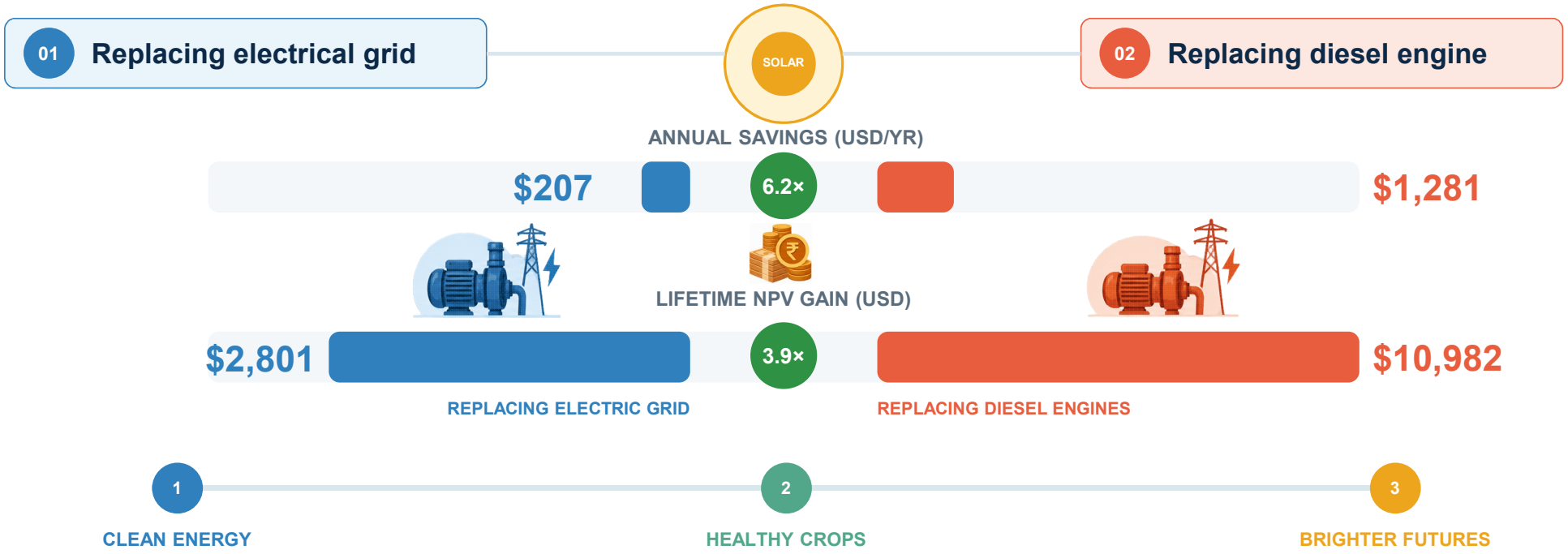


Solar Irrigation Savings

Electricity and diesel savings from switching to solar pumping

SAVINGS BY REPLACED POWER SOURCE

The two alternatives use the same solar-pumping intervention but replace different energy sources.



Switching from diesel to solar delivers about 6.2× higher annual savings and 3.9× larger lifetime NPV than switching from grid electric.

Source: Siyal and Gerbens-Leenes (2022).

What is being done to address immediate impacts on agriculture and irrigation?

- **Broader fuel subsidy programs** — fuel price caps and stabilization funds
- **No direct relief** for irrigation energy impacts (cash transfer in the Philippines; Kisan Card in Pakistan)
- **Electricity tariffs** for agricultural use and public irrigation water services are mostly subsidized.
- **Solar Irrigation Pumps (SIP)** and other RE technologies, where programs pre-date the price shock
  - **Early stage in Southeast Asia**: Laos, Cambodia, Indonesia, Vietnam — donor projects and private initiatives (except Thailand)

> Response is mostly indirect: economy-wide fuel and tariff subsidies rather than irrigation-specific relief. Solar irrigation is the main structural lever.







Where Smart Irrigation Delivers Additional Energy Savings

A PATHWAY TO HIGHER EFFICIENCY

Start with quick wins, build momentum, and unlock the largest savings with system upgrades and AI advisory.

The biggest single gain comes from low-pressure irrigation paired with AI advisory.

01 Mechanical retrofit
0–6 months



25–35%
ENERGY SAVINGS

02 Motor-health remediation
6–12 months



10–15%
ENERGY SAVINGS

03 Smart monitoring + adaptive control
12–18 months



5–10%
ENERGY SAVINGS

04 Low-pressure irrigation + AI advisory
Ongoing
(implementation varies)



40–60%
ENERGY SAVINGS

1 GREATER PRODUCTIVITY WATER

2 STRONGER RURAL ECONOMIES

3 A MORE RESILIENT TOMORROW

Each intervention delivers additional savings, but the different baselines mean the percentages should not be added together.

Recommendations to Strengthen Energy Crisis Resiliency and Promote Sustainability

- Gate public irrigation money on water accounts and aquifer status (CGWB, CWC stress line; WSP/CBWM/WaPOR) before new solar pumps or canal packages.
- Recalibrate subsidies from kilowatts installed to litres lifted, and fund year-6 parts/service; redesign PM-KUSUM with IDCOL-style groundwater screening and pump-clinic evidence.
- Make group tenure/ownership the default for PM-KUSUM/PMKSY so marginal and tenant farmers are included, using ScaleWAT diagnostics.
- Fix the existing pump fleet and use trusted delivery channels (OFWM/utilities) before adding solar megawatts; promote hybrid solar-grid-diesel for reliability, not diesel exit.
- Treat modernisation as a WEFE/consumption problem, not just lining and drip; use real-savings briefs, Follow the Water, and a 2027 India–Nepal–Bangladesh exchange, while respecting guardrails (Nepal gravity-dominant; 0.08 kWh/m^3 aspirational).