# Water scarcity, water accounting and the Nexus (water, food, environment and energy): background paper

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## Water scarcity in the GMS

Water scarcity is emerging as a more immediate challenge than climate change in Asia and the Pacific region, driven by a range of demographic and economic pressures that increase water demand as well as by climate change itself. Agriculture, the major consumer of freshwater in the region, is a driver of water scarcity and is also impacted by competitive water development within the sector and, increasingly, from higher-value uses in industry, energy and water supply and sanitation.

Preparation undertaken since 2019 by the FAO Water Scarcity Program for Asia and the Pacific (WSP) highlights the lack of reliable information and data on water resources availability, quality and use. This underwrites the need for good water accounting and the development of clear and rational water allocation processes.

Work in scoping phase of WSP has included an analysis of the trends, types and characteristics of water scarcity, undertaken using global data sets and ensemble modelling (Aalto University and Amperes) and the authorship of country profiles for Cambodia, Laos, Myanmar, Thailand and Vietnam within the GMS region and others outside (Amperes and Alluvium). The country profiles included an analysis of stakeholders, institutional structures and key instruments (laws, regulations, policies) relating to the management of water scarcity from multi-sectoral perspectives. The Vietnam country profile contained a detailed analysis of water quality problems in the country.

This work was supported by a study of modelling capacity to do water accounting in Myanmar, Thailand and Vietnam and 4 other AP countries, undertaken by SEI Bangkok.

A third component of scoping was to undertake pilot water tenure analysis in Vietnam and Indonesia, to better understand the relationships and arrangements for water access by communities, the state and the private sector.

## Findings of FAO water scarcity scoping study

The GMS region contains a diverse range of countries and climates that experience water scarcity of varying types and severities – from absolute water scarcity[1] in arid and semi-arid regions (i.e., large parts of South Asia and East Asia) to seasonal or interannual scarcity where high variability means that scarcity is experienced for parts of the year (i.e., monsoonal Southeast Asia).

[1] Absolute water scarcity is defined as an insufficiency of supply to satisfy total demand after all feasible options to enhance supply and manage demand have been implemented. FAO. 2008. Coping with water scarcity – an action framework for agriculture and food security. FAO Water Report 38. Rome.

There are **four key dimensions of water scarcity** (see Fig. 1)[2]: too little water, too variable water, over-utilisation, and water quality. These can be quantified using three water scarcity indicators (water shortage using the Water Crowding Index (WCI, or water availability per capita), water stress using the Water Stress Index (WSI, proportion of reliable renewable water resources abstracted), and agricultural water scarcity using the Green-Blue Water Scarcity Index (a measure of the ability of available water resources to meet food security and basin scale food demand).

WSP assessed the water scarcity status and trends for the Asia-Pacific Region over the recent historical period of 1971– 2010[2]. There are strong seasonal differences in water availability across the Asia–Pacific region, largely due to the monsoon climate influencing a major part of the region. This, combined with an increasing population and changing water use patterns, leads to varying degrees of water scarcity across the region. These differing climate zones and associated water availability can be seen in Fig. 2 and the distribution of the three indices is shown in Fig.3.

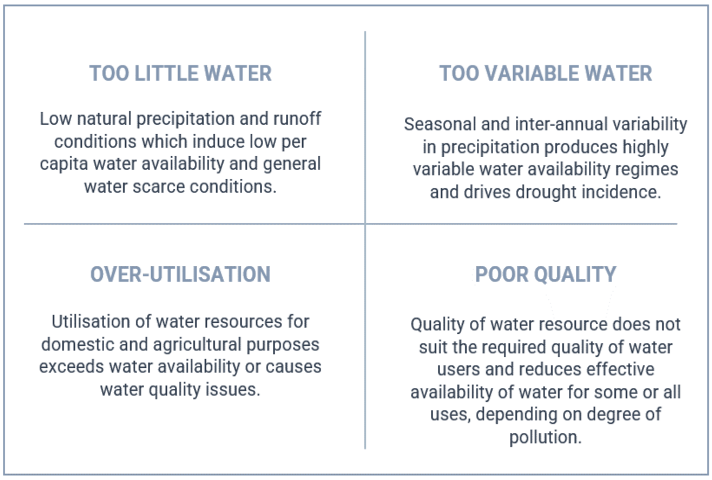


*Figure 1: Dimensions of water scarcity*

[2] Amperes, 2023. Managing water scarcity in the Asia-Pacific: trends, experiences and recommendations for a resilient future. Australian Water Partnership, Canberra.

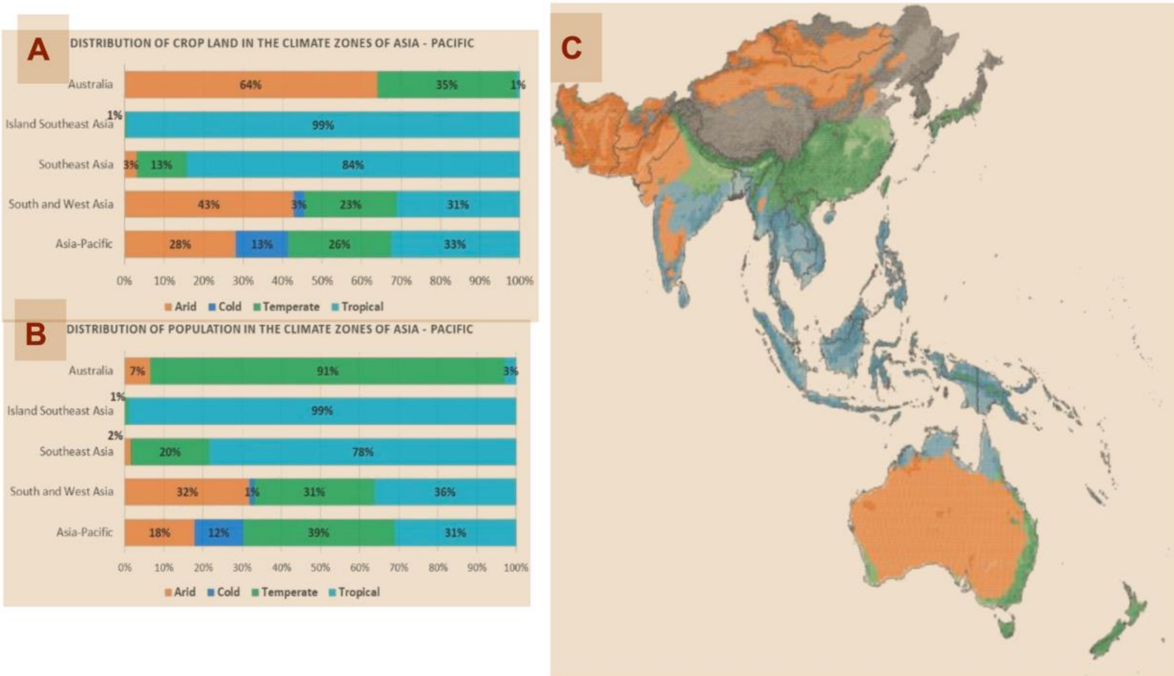


*Figure 2: Distribution of climate and landform across the sub-regions of the Asia–Pacific, where distributions of (a) cropland, and (b) population in the climate zones. (c) Shows a map of the spatial distribution of climate zones*

In general terms, Laos and Cambodia do net yet suffer water scarcity or water stress, but increasingly experience water shortage for multiple uses (not just agriculture) in the dry season as well as increasing severity and frequency of drought. Myanmar experiences water scarcity and stress on an annual and seasonal basis in the central dry zone, and some seasonal water shortage elsewhere. Declining water quality is an issue in rural and urban settings in all GMS countries. Vietnam and Thailand experience all four forms of water scarcity and competition for water in drought conditions and in hotspots, for example where recent hydropower development and release schedules has impacted urban water supply and coastal irrigation in the environs of Da Nang.

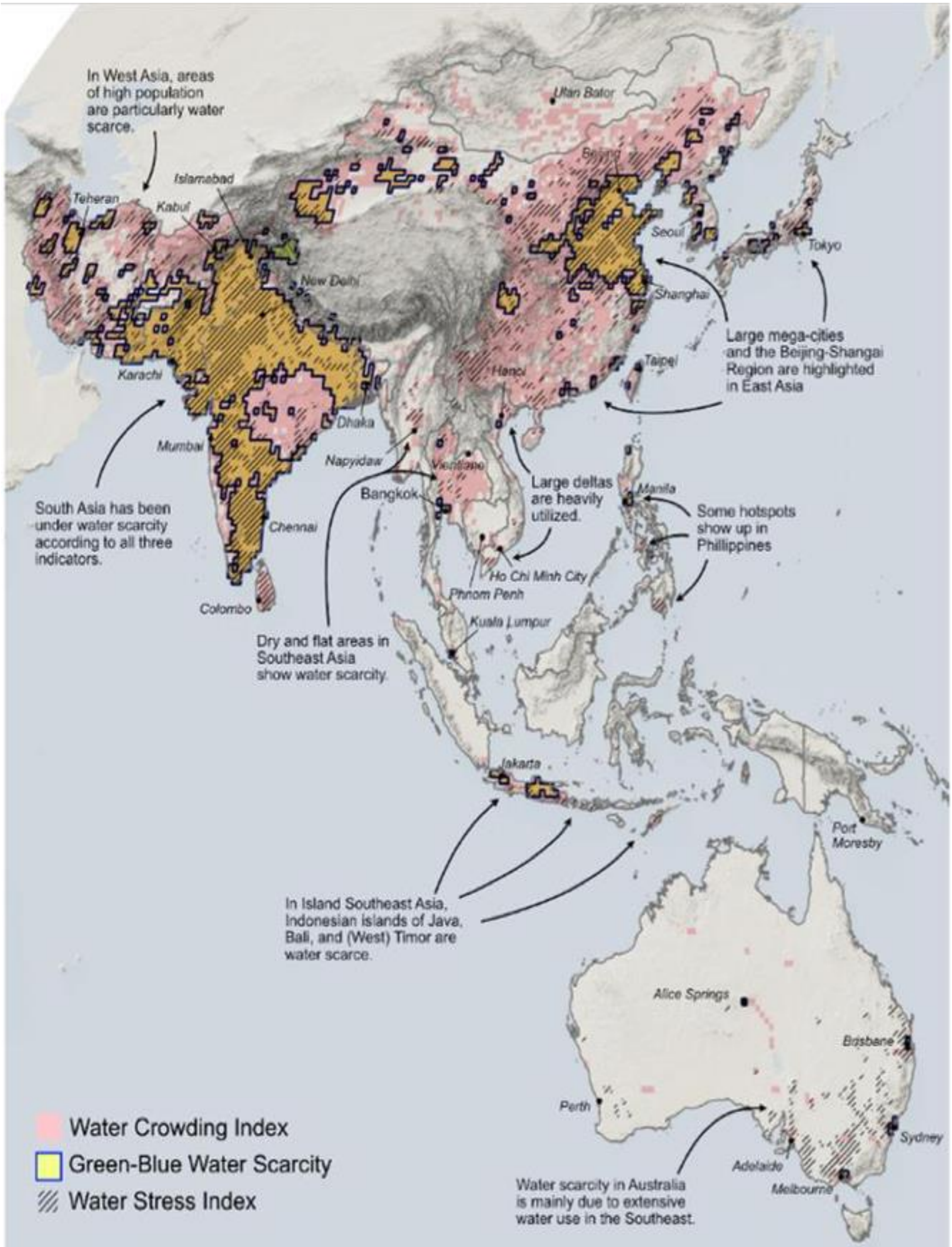


*Figure 3: Water scarcity hotspots in the region 1971–2010*

A very brief summary of findings from the country studies includes:

- Seasonal water scarcity predominates during the dry season in the monsoonal, wet tropical, and sub-tropical countries of the GMS. Absolute scarcity is evident in hotspots in central Vietnam, Hanoi, and Saigon, and fast-growing cities throughout the region. Myanmar experiences economic scarcity due to insufficient investments in water storage and supply infrastructure to meet dry season demands.

- Water quality is declining rapidly across the region due to agricultural and urban runoff and salinity poses a threat in central Myanmar, Thailand and Vietnam, whilst arsenic contamination of floodplain groundwater is recognised in Cambodia.
- Water scarcity management varies across the region – high-level regional and national water laws and policies are generally well-developed, but implementation and compliance are weak due to insufficient optimisation of water utilisation towards adaptive management that balances social, economic, and environmental outcomes. National laws and policies generally lack supporting regulations at provincial and local level and require greater support in terms of human resources and funding.
- Water quality issues need attention and political commitment through integrated planning and investment in city wastewater treatment, and pollution regulations for industry and agriculture.
- Countries not yet facing severe water scarcity have an opportunity to establish frameworks for water sharing and management before over-allocation occurs and climate change amplifies scarcity issues, through water accounting, safeguarding environmental flows, and formal allocation processes.

SEI's survey found that modelling capacity was strong in Vietnam and Thailand but that there are frequent changes in staff, preferred software and in continuity. It was also noted that water modellers thought they should make greater use of remote sensing science and products. The work also included interviews with policy makers to understand how modelling is used to inform and develop policy and whether they commission modelling studies to do so, and it was found that that this rarely happens. The respondents recognised that better use could be made of simulation modelling to inform policy options and predict expected outcomes in water resources development and management. Data management and access arrangements were found to be highly variable across the region.

The water tenure analysis[3] revealed that many water users have limited security of access and that informal customary and de-facto) rights to water are not well understood and not provided for under national water law. Further to that, water development by the state is rarely licensed, and therefore it is unclear who has access to how much water, when and where and that there is implied competition between state operated infrastructure that shares a common water supply system. The scoping studies confirm the sheer diversity of water tenure relationships. At the same time, the pilots selected by the national consultants illustrate quite different water tenure scenarios in the context of the (over-)abstraction from surface and groundwater resources and the management of a large multi-purpose irrigation scheme. Any fresh allocation of water resources, any re-allocation of water resources will affect existing uses and existing water tenure arrangements. The legal possibility of re-allocating water and modifying or even cancelling existing water tenure arrangements will in turn depend on the relative legal security of such arrangements. At the same time if water subject to weak tenure arrangements is reallocated to other users or uses this may cause significant negative social and economic impacts. In conclusion, water tenure analysis is an essential partner to water accounting in laying the foundations for functional, fair, transparent and inclusive water allocation.

# Drivers of water scarcity

The drivers of water scarcity are well known: population growth and associated economic development, industrialisation and urbanisation and associated energy demand, rising wealth, increased demand for food compounded by changing diets towards increased meat and dairy consumption, and expanding biofuel production. All of these will continue to drive the demand for water (and energy and land). The pattern of rapid urban development in Asia (predominantly coastal) is of most concern to planners and water managers.

[3] Hodgson S. 2022. Water tenure in the Asia Pacific region: water tenure scoping studies in Indonesia and Vietnam. FAO RAP, Bangkok

Agriculture is both a driver and a victim of water scarcity. Agriculture drives water scarcity because evapotranspiration from irrigated agricultural land is by far the largest consumptive use of water withdrawn for human use. In some countries, 90 percent or more of diverted water resources are used in irrigation, with the remainder used for drinking water supply, sanitation, industry, mining, navigation, amenity and environment.[4] In countries that are highly dependent on irrigation, such as Pakistan, irrigated agriculture consumes more than 70 percent of annual average water resource availability.[5]

Privately developed groundwater now supports a larger area of irrigation in India than the area supported by all the surface irrigation investment by the states. It is unregulated, unsustainable in many places, and a key player in the electricity crises facing at least three major states.6 Private and state sponsored groundwater development is established many countries in the GMS, and over development has been evident in several locations, including the upper Mekong Delta, the Central Highlands of Vietnam, most large cities in the region and in the central dry zone of Myanmar.

# Implications for water resources management

Competition for water is emerging between sectors, most commonly: a) between agriculture and human settlements, especially in peri-urban areas of fast-growing cities; b) between agriculture and the environment as large consumptive users and c) between energy and reservoir storage management (mostly for hydropower) with all sectors (in Vietnam, Thailand and China).

In China, where industrialization and urbanization have accelerated over the past 20-30 years, the proportion of total water use by agriculture has fallen from around 90 percent of diverted water resources to around 60 percent and is expected to decline to 50 percent by 2030. Countries in the rest of Asia are likely to follow this pattern, but in a less extreme way.

A failure to confront the impacts of freshwater scarcity results in suboptimal use of water and negatively impacts food production in Asia in a variety of ways. Farmers (usually poor, marginalized and/or at the tail end of irrigation schemes) may lack sufficient water to irrigate crops when needed, leading to reduced yields and incomes or complete loss of crops and the capital invested in them.[7] Water scarcity may prevent farmers from flushing salts from the soil, reducing future productivity or requiring the land to be abandoned.[8]

Critically, water scarcity and unsustainable water use impact not only agricultural production, but the ecosystem services upon which our food production systems and overall food security depend.[9] Regulation and reduction of natural flows by dams, water withdrawals, diversion and land use changes for irrigation have already impaired the ability of many ecosystems to provide valuable ecosystem goods and services, including flood protection, water purification, biodiversity and critical habitats including wetlands and estuaries.[10] A number of iconic Asian rivers, including the Indus in South Asia and the

[4] WWAP (World Water Assessment Programme). 2012. The United Nations World Water Development Report 4: Managing Water under Uncertainty and Risk. Paris, UNESCO. (Available at: http://unesdoc.unesco.org/images/0021/002156/215644e.pdf).

[5] Young, W. J., Anwar, A., Bhatti, T., Borgomeo, E., Davies, S., R. Garthwaite III, W., E. Gilmont, M., Leb, C., Lytton, L., Makin, I., & Saeed, B. 2019. "Pakistan: Getting More from Water." Water Security Diagnostic. World Bank, Washington, DC.

[6] Shah, T. 2009. Taming the anarchy: groundwater governance in South Asia. Washington, DC, USA: Resources for the Future; Colombo, Sri Lanka: International Water Management Institute (IWMI). 310 pp.

[7] Hussain, I., Yokoyama, K., & Hunzai, I. 2001. Irrigation against Rural Poverty: An Overview of Issues and Pro-Poor Intervention Strategies in Irrigated Agriculture in Asia. National Workshops on Pro-Poor Intervention Strategies in Irrigated Agriculture in Asia.

[8] Seckler, D., Molden, D., & R., B. 2006. Water Scarcity in the Twenty-First Century. International Journal of Water Resources Development.

[9] Postel, S., & Carpenter, S. R. 1997. Freshwater ecosystem services. In G. Daily (Ed.), Nature's services (pp. 195–214). Washington, D.C., USA: Island Press.

[10] Rijsberman, F. R. 2004. Water scarcity: Fact or fiction? Proceedings of the 4th International Crop Science Congress, 1 26 Sep – 1 Oct 2004, 80, 5–22. https://doi.org/10.1016/j.agwat.2005.07.001

Yellow in China, no longer reach the sea for parts of the year.[11] Many rivers have become so depleted that they lose their ability to support productive fisheries[12] or dilute pollutants.

The productivity of agricultural water use, particularly in irrigation, will need to increase to match food demand and meet food security policy targets; indeed, agriculture will need to use the same amount of water, or in many cases even less, than in the past. Although the need to preserve and enhance natural ecosystems is well appreciated, water policy and water allocations do not yet address needs for environmental water, and as they begin to do so, there will be further pressure on agricultural water supplies.

## NEXUS perspectives

The expected **impact** of ADB TA 9916 is: **'GMS vision of being a leading supplier of safe and climate-friendly agri-food products realized'**. The **outcome** of the TA is: **'GMS investments in and capacity for climate-friendly, safe, and sustainable agri-food value chains increased'.** Water accounting is implied in the third output: *climate-adaptive agriculture in the context of the water-energy-food security nexus enhanced*.

The Nexus approach clarifies the nature of trade-offs helps navigate the implementation of SDGs in the dynamic context of climate change, population growth and other drivers. Four key topics emerged from a workshop on climate smart agriculture in the context of the water-food-energy nexus.

1. The GMS countries need to facilitate an effective cross-sector dialogue on water, food, and energy interactions, which includes the need for improved transboundary dialogue and the need to bring in the finance sector.
2. Better tools are required, including decision support systems, indices and other tools to support assessments, monitoring and information sharing.
3. Nexus patterns of trade-offs and synergies must be understood to develop solutions for each relevant trade-off risk.
4. Data (e.g., water accounting) is fundamental and effective allocations need to be made and enforced.

## Climate change

As climate changes and the world warms, the water cycle speeds up and global rainfall volume increases, while local rainfall becomes more variable in intensity, duration and location.[13] It is therefore expected that current challenges will be exacerbated by climate change in the form of more frequent and intense droughts, floods and cyclones, melting glaciers, shifting monsoons, higher temperatures and disruption to groundwater recharge.[14] [15] Drought can be considered a primary form of water scarcity, and the frequency of droughts, already severe in countries such as Pakistan and India, is rising across the region, including in Indonesia, Viet Nam and large parts of Southeast Asia.[16]

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[11] Postel, S. L. 2000. Entering an Era of Water Scarcity: The Challenges Ahead. Ecological Applications, 10(4), 941–948.

[12] Welcomme, R. L., Baird, I. G., Dudgeon, D., Halls, A., Lamberts, D., & Mustafa, M. G. 2016. Fisheries of the rivers of Southeast Asia. In J. F. Craig (Ed.), Freshwater Fisheries Ecology (pp. 363–376). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781118394380.ch29

[13] IPCC. 2013. In: Stocker, T.F., Qin, D., Plattner, G.-K., Tignor, M., Allen, S.K., Boschung, J., Nauels, A., Xia, Y., Bex, V., Midgley, P.M. (Eds.), Climate Change 2013: the Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA 1 535 pp.

[14] Taylor, R. G., Scanlon, B., Döll, P., Rodell, M., Van Beek, R., Wada, Y., Treidel, H., *et al.* 2013. Groundwater and climate change. Nature Climate Change, 3(4), 322–329.

[15] UNESCO. 2012. World Water Development Report Volume 4: Managing Water under Uncertainty and Risk. UN Water Report (Vol. 1). https://doi.org/10.1608/FRJ-3.1.2

[16] ESCAP. 2019. Ready for the dry years: Building resilience to drought in Southeast Asia. Bangkok. ISBN: 978-92-1-120787-3

Climate change will raise evaporative demand and therefore water demand, and in some locations, temperatures will rise sufficiently to limit crop production and require changes in seasonality or crop pattern, possibly resulting in considerable changes in agricultural landscape. In others, higher temperatures and water demand will restrict crop yield.

## Role of water accounting

To understand water scarcity, we need to know and quantify how much water is available for human use and how much is being used. Equally importantly, we need to know where and when that water is available, and this requires an understanding of the pathways through which water flows and is stored (particularly because water is a "fugitive" resource that seeps and flows across the landscape, vaporizes into the air and falls as rain and snow). In natural conditions, water is stored in lakes, which nevertheless drain continuously, and in underground water, where it may rest for years, even centuries.

Quantifying water availability and use is known as water accounting.[17] It is desirable to be able to account for water long before water scarcity is apparent, and it is essential once there is competition between different uses and users, including those in the same place and those far apart but connected to the same river or aquifer. Water accounting is fundamental to allocate scarce water resources effectively and efficiently to different uses and users.

The main technical approaches to water accounting are based on water balances derived from:

- the measurement of flows and stocks in space and time (flow-based accounting)
- the measurement or estimation of net consumptive use and rainfall (generally from remote sensing)
- hybrids of flow and consumption-based accounting and the use of simulation modelling.

It is important to distinguish between consumptive water use, where water is evaporated to atmosphere, from non-consumptive use, where water can be re-used, even though this may often require some treatment. Accounting for consumptive use is important in determining the amount of return flow from a system (say an irrigation scheme or water supply network). In turn, it is very useful to understand what proportion of that return flow is re-used downstream in a river basin or within connected groundwater systems.

The basic process of water accounting is summarised in Fig 4 [18], below:

[17] FAO. 2017. Water Accounting and auditing – a source book. FAO Water Report 43. Rome.

[18] FAO, forthcoming. Water Accounting Protocol, FAO Rome. In edit.

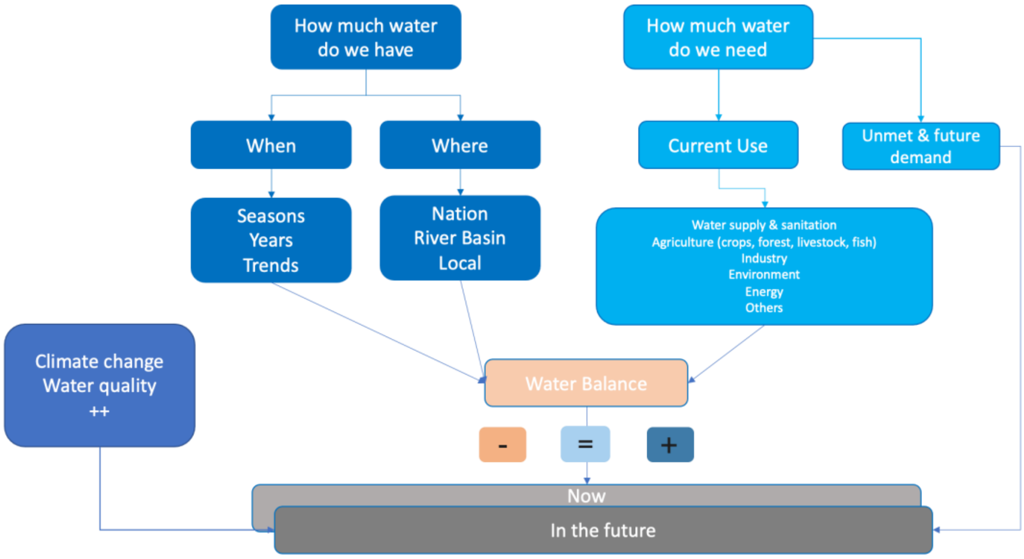


*Figure 4: What is water accounting?*

A water accounting 'system' can be considered to comprise 12 building blocks across three groups, as illustrated in Fig. 5 .

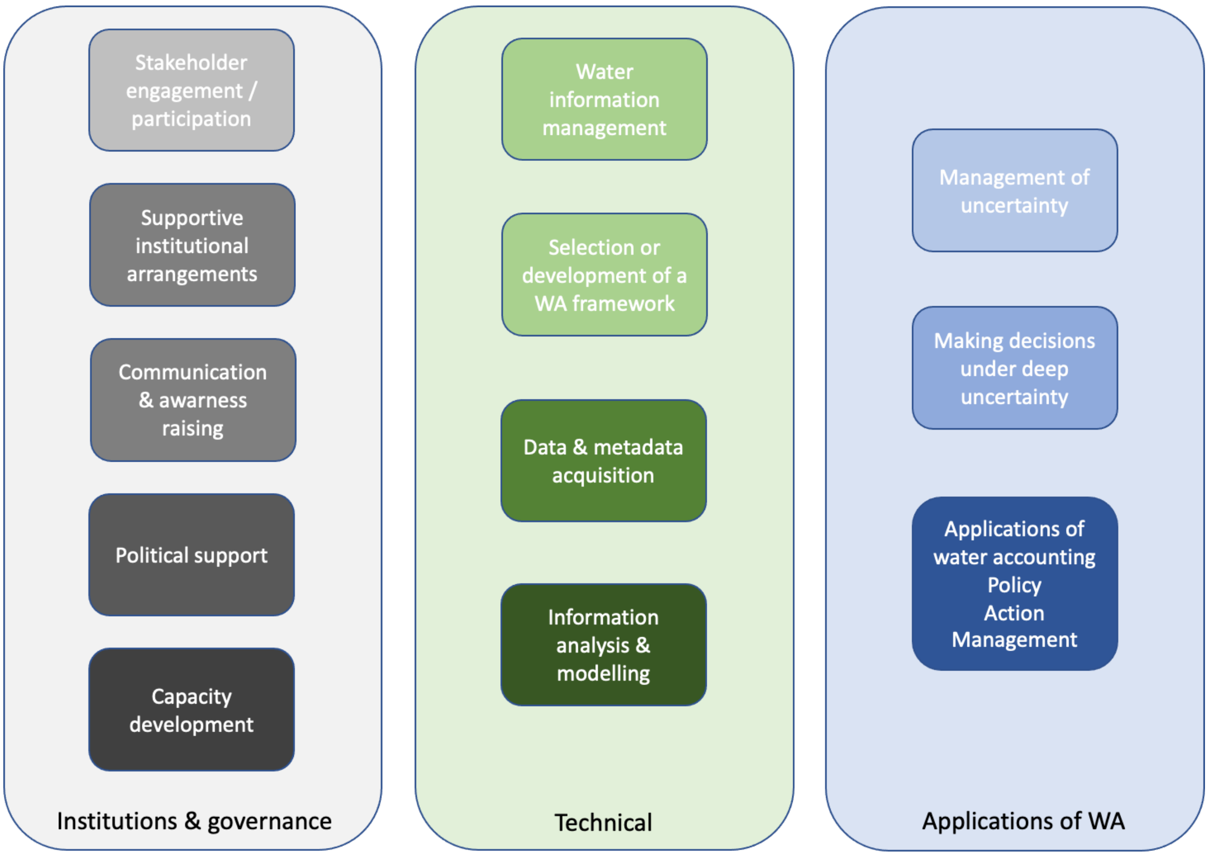


*Figure 5: Building blocks for water accounting*

Potential users of water accounting include: water resources policy makers, water resources planners and managers, water and development economists, regulatory agencies, environmental stewards, gender and inclusion experts, agricultural and food security policy makers and planners, irrigation users and farmers, livestock producers, hydropower sector planning and management, public health community, local government, water supply and sanitation utilities, and private sector business.

The most strategically important use of water accounting is in defining and monitoring water allocations and use. It has many other applications including: a) resource assessment for water infrastructure development and planning; b) groundwater area monitoring and compliance (which becomes a system-level application if the aquifer is bounded and independent); c) environmental flow assessment and management; d) understanding the economic value generated by water use for use in national accounts and national economic policy; e) irrigation system performance assessment, which has operational use and can contribute to water resources level management but does not address a bounded hydrological system; f) design and assessment of rainwater harvesting systems – upstream-downstream impacts; g) performance of potable and industrial water supply systems – financial savings, investment priorities, cost recovery and; pollution monitoring, management and control (with additional information on water quality variables)

A key objective of water accounting, auditing and allocation should be to ensure sufficient water for the vital ecosystem services that underpin sustainable food systems. However, provisions for effective environmental water management are weak throughout the region. China has demonstrated new and innovative efforts in this regard with its "Ecological Red Lines" policy that contains targets to restore river and other aquatic water quality and ecological function across the entire country.[19] However, in most countries environmental water allocation is considered at best to be a residual use after anthropogenic demands – and agricultural ones in particular – have been satisfied. South Africa established strong environmental controls and targets in its seminal water law, but there has been disappointment with its implementation in the succeeding 20 years.[20] Regulatory and environmental oversight have been formally established in Thailand (by the Office for National Water Resources) and in Viet Nam (by the Ministry of Natural Resources and Environment), but many practical challenges remain in balancing sustainable and effective ecosystem management with irrigation in a harmonious manner. The region is still in need of a good role model for ecologically sensitive water management.

Water accounting in the GMS has mostly been conducted as short-term, large-scale studies, often on the basis of remote sensing, where flow data is insufficient or inaccessible. Typically, they have been undertaken as research studies that have limited application to day-to-day water management. **There is an urgent need to institutionalise water accounting** activity within individual countries, to support river basin management, irrigation management, the specification and provision of environmental flows and to build towards sustainable allocation and use across all concerned sectors. This requires planning, financing, capacity development and the provision of better data. Water accounting may start crudely, but can be refined continuously to support policy, planning and management of water resources.

# Challenges to better water allocation and sustainable use.

Responses to water scarcity primarily focus on **demand management**. In countries OEDC countries, it has proved relatively easy to reduce water use in industry, as this generally improves profitability. Although, the volume of water required to satisfy urban demand for drinking water and sanitation is small compared to agriculture, densely populated European countries are increasingly concerned about their ability to meet such demands with climate change, for example in the east of the UK[21]. Programs to limit urban and amenity demand have been successful in times of drought in countries such as Australia, but there are clear limits to the minimum daily needs for water supply and sanitation, and most GMS countries are targeting considerable increases in both to improve human health and well-being.

[19] China Water Risk 16 April 2015. China's most comprehensive water policy to date, which will ultimately transform China's environment & economy. http://www.chinawaterrisk.org/notices/new-water-ten-plan-to-safeguard-chinas-waters/

[20] The Conversation, February 6, 2018. South Africa needs good water management - not new water laws. https://theconversation.com/south-africa-needs-good-water-management-not-new-water-laws-91253

[21] Anglian Water PLC. 2019. Water Resources Management Plan 2019

Historically, the response to localised water scarcity is to **augment supply** through new development of surface and groundwater or to store more water for dry season or annual use, with corresponding impacts on river and aquatic ecosystem health. In the absence of water accounting and recognition of the need and value for environmental flows, water is often claimed to be available when reliable renewable water resources are at or close to full abstraction. Where it is recognised that water resources in a basin are fully exploited, the supply side response is to transfer water from other basins (inter basin transfer IBT) that have "surplus" supply although this may in turn propel water scarcity in the donor basin.

In response to rapid urbanization and a significant lag in sanitation and water treatment, there has been an explosion in the use of wastewater, particularly by peri-urban farmers.[22] It is effectively a reuse of non-consumptive allocation for drinking, industrial and sanitation purposes, with a considerable downside for water quality and public health. While volumes can be significant in a local sense, they are unlikely to be a large portion of total beneficial water use when urban and industrial use only accounts for 5-10 percent of diverted water use.

Where **reallocation** of water is required because existing resources are fully exploited and IBT's are not possible, agriculture and environment as the large volumetric consumers of water, are the most likely sources of additional water for increased higher (social and economic). As the need for allocating water to the environment becomes increasingly understood and accepted, water will likely mostly be re-allocated from irrigated agriculture in Asia, including the GMS.

**Reallocation** is expensive and administratively complex and is best avoided through planning for sustainable water resources development and management. The cost of recovering about 20% of irrigation entitlements for environmental use in Australia (2014-to present) has been around Au$ 10 billion!

It is important to understand that there are only a few means of constraining water demand in agriculture: (1) reducing non-productive evaporation; (2) improving the efficiency of transpiration; (3) reducing net water consumption of crop production systems through modifying crop patterns (crops, varieties and planting dates); and (4) minimizing non-recoverable losses in water delivery systems. Of course, it is possible to reduce the area of irrigated and rainfed crops to reduce water demand, but this results in lost production. However, as climate change and water scarcity worsen, broader-scale reshaping of national agricultural systems becomes increasingly likely, with land retirement in some areas and substitution in others. China, for example, is a large country with varying climatic regions, and so it has been partially successful in relocating wheat production from the water-stressed North China Plain to wetter, lower-demand areas north of the Yangtze River.[23]

# Governance issues in improving water allocation and establishing good water accounting

Humanity increasingly shares dependency on limited resources and changing global dynamics around water, land, food, climate, energy and finance. Geopolitical factors further contribute to this complexity. This complexity embraces coordination across sectors, administrative levels (national, provincial and local), at community level and between biophysical and administrative boundaries (river basin and local government for example). This in turn requires stakeholder identification, consultation and partnership and a high degree of cooperation, supported by good communication.

[22] WWAP (United Nations World Water Assessment Programme). 2017. The United Nations World Water Development Report 2017. Wastewater: The Untapped Resource. The United Nations World Water Development Report. Wastewater. The Untapped Resource. Paris: UNESCO. Retrieved from http://unesdoc.unesco.org/images/0024/002471/247153e.pdf

[23] IWHR, Pers. Comm. and internal presentation. September 2019

Ensuring the sustainability of water resources presents a significant governance challenge in addressing key trade-offs between the maximization of economic benefits, equity and environmental sustainability.

The OECD has proposed three key principles involved in addressing future challenges in water management:

- ***Effectiveness*** relates to the contribution of governance to define clear sustainable water policy goals and targets at all levels of government, to implement those policy goals, and to meet expected targets.
- ***Efficiency*** relates to the contribution of governance to maximise the benefits of sustainable water management and welfare at the least cost to society.
- ***Trust and Engagement*** relate to the contribution of governance to building public confidence and ensuring inclusiveness of stakeholders through democratic legitimacy and fairness for society at large.

Water accounting and water governance analysis are mutually supportive and should be carried out in parallel. A water governance assessment connects water accounting with institutional, social, political and legal constraints and the changes required to improve water management. Governance analysis can contextualise shortage, imbalance and disparity in water access by identifying who or what are preventing the solutions to problems and who is impacted most, usually on the basis of an analysis of water tenure.

FAO's recent Methodological Guide on Water Governance Assessment[24] sets out an analytical and empirical methodology for water governance analysis. The objective is to understand *real situations and their causes* through analysis of physical, social and institutional factors associated with water resources in a country or river basin. The Guide recommends a problem-focused approach to engage stakeholders, so that they actively contribute to the identification and characterization of the problem, as well as developing potential solutions.

The analysis follows four phases that constitute a theory of change, as shown below in Fig. 6:

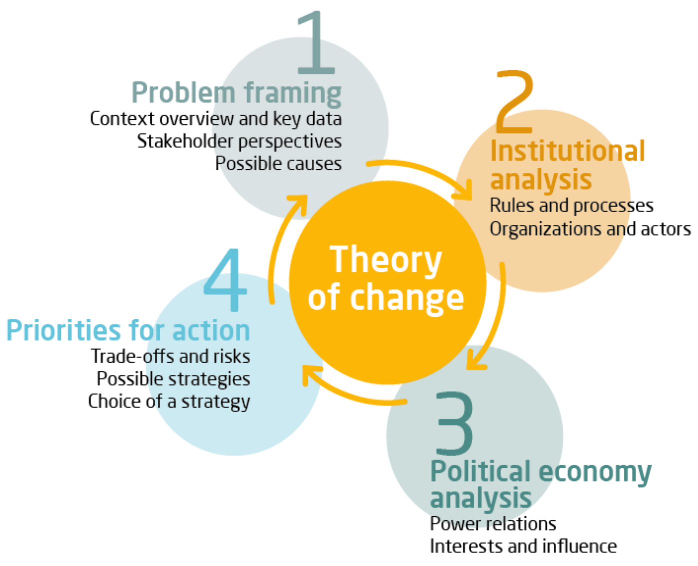


*Figure 6: Analysis of water governance*

[24] FAO 2023, in print

The first phase examines the various perspectives on the priority problem(s). This involves a rapid overview of the country and its sectoral context, stakeholder mapping, technical analysis, as well as the perspectives of key stakeholders. The second phase involves an in-depth analysis of the institutional setting related to the problem. It attempts to identify the main drivers or sources of the identified problem(s) and their possible solutions, given the existing rules, structures and processes.

The third phase focuses on key actors and examines the political economy factors behind the main problem drivers (i.e., socio-economic issues, gender and power relations, interests and influence of the concerned actors and organizations, etc.), which will need to be considered in formulating the strategy for change and the coalition for implementation.

Building on the findings of the second and third phases, the fourth phase identifies strategies for change that are both technically valid and politically feasible. In this phase, the stakeholders recognize trade-offs and risks of different courses of action and seek to build consensus. The key outputs of this final phase are an agreed theory of change and a recommended course of action.

The four parts of governance analysis are strongly interlinked, and the entire process is iterative. This reflects social learning in which different findings are continuously revisited and generate more knowledge and new questions through each cycle.

The framework relies on a multi-stakeholder engagement allowing to co-create knowledge with key stakeholders while helping to build trust and create a coalition for transformative action.