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NITI Aayog

REPORT ON WATER NEUTRALITY FOR INDIAN INDUSTRY

Standardization of the definition and approach

In association with

Confederation of Indian Industry

CII-TRIVENI WATER INSTITUTE

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Message

Water is at the core of sustainable development given that it is critical for socio-economic development, healthy ecosystems, and human survival. India is experiencing increasing variability in availability, with differentials translating into iniquitous distribution and access. Deteriorating water quality is an add-on stressor with impacts on human health and ecosystems. The scenario therefore calls for immediate actions towards identifying and implementing appropriate strategies for an improved water scenario, water security and sustainability.

Industry over the years has been undertaking measures to improve their water usage towards attaining water neutrality. An overall framework that defines approach towards attaining neutrality is necessary such that a common understanding of "Water Neutrality" is developed ensuring its uniformity in terms of measurement, benchmarking, evaluation and best practices.

To streamline the process, NITI Aayog constituted a Steering Committee under the leadership of Prof. Ramesh Chand, Member, NITI Aayog, and in association with CII, formulated standards for defining and assessing water neutrality/ water positivity for Indian industry.

The document attempts to bring out a standard definition and approach for water neutrality/positivity status based on defining key principles on which water neutrality should be based. It holds immense importance to draw meaningful comparisons, enable learning from available good practices that can be replicable and scalable.

It is envisaged that the standardized definition, approach, and principles put forth, will benefit the industry immensely. It will also help in extending and evolving this approach to other sectors/areas of the economy such as for towns, and cities for a secured water future.

I would like to thank Dr. Kapil Kumar Narula; CEO, CII-Water Institute and his entire team at CII-Water Institute, Mr. ArunLal K., Associate, NITI Aayog, Dr. Snigdha Goel; Young Professional, NITI Aayog for contributing their expertise in preparing this report. I am optimistic that this exercise will facilitate a holistic approach to look at water neutrality to enable an improved water scenario in the country.

(Avinash Mishra)

Prologue

Water is vital for survival and supports health, resilience, development and prosperity of people and planet alike. It is key to the attainment of Sustainable Development Goals (SDGs). Safeguarding water and ensuring its availability in sufficient quantity and quality is therefore imperative. Manifestation of widening water demand-supply gaps are clearly visible with increasing water shortages, depleting groundwater tables and deteriorating resource quality. High spatial variability in rainfall and high inter-annual variability further exacerbates the prevalent water stress situation.

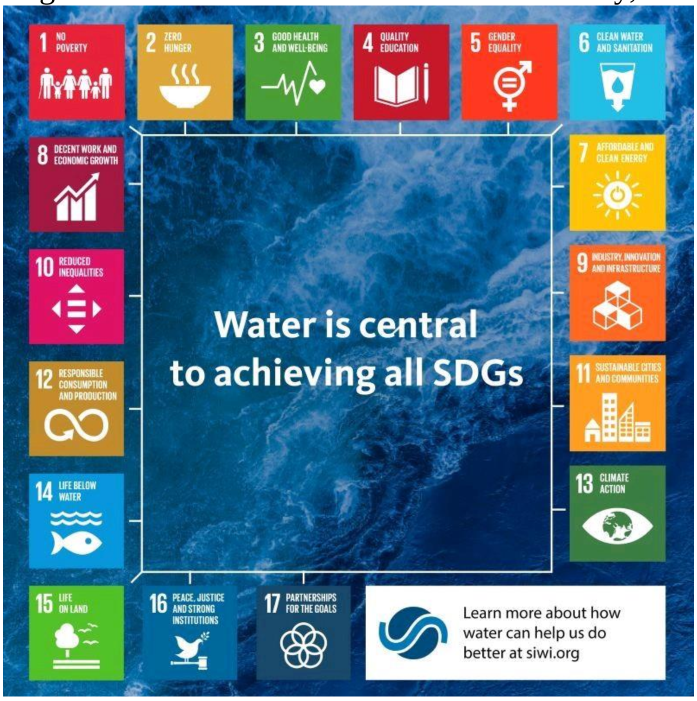
Given the above scenario of rising resource challenge, it is important to adopt strategies that can enable progress to an improved water scenario. Indian industry can increasingly play a pivotal role through to ensure water resources are managed responsibly, sustainably, and equitably.

This document is a humble beginning towards standardization of the existing definitions and frameworks on water status for the industry that can provide improved understanding and a robust framework for water status evaluation.

Attaining water neutral/water positive status is a journey that calls for collective accountability and responsible actions. It is a process that will evolve with time, given increasing climate variability impacting resource availability and demand pressures continuing to rise.
Cognizant of the challenges, it is imperative to take firm steps in taking this journey ahead.

CHAPTER 1: RATIONALE

The 21st century characterizes itself with rising environmental concerns like water scarcity, water pollution, increasing waste generation etc. It is also characterized by a universal drive for attaining sustainable development pathways. Apart from following the UN Sustainable Development Goals[1], struggle to repair the damage/ give back to the Earth is gaining momentum. One of the reasons why the term "sustainability" is key, is because resources are limited whereas demand is ever growing. Water scarcity and pollution has been identified as one of the top global risks to business today (WEF 2017).



Water is increasingly being reported as a financial risk to organizations. Considering the ***shared nature of water challenges, solutions are required both at site, and at the specific watershed scale*** *to meaningfully reduce risks (Reig et. al 2019).* [1] *In addition, understanding* ***water supply chains that are integral to operations is further relevant while addressing water sustainability.***

Due to the growing number of water challenges, investors expect firms to assess their internal and external water risks and disclose their progress. The central role of water as a catalyst for action and progress across all SDGs is increasingly being recognized (SIWI 2023). Usage of terms like water neutrality, water footprint, water positivity is gaining importance. It therefore

[1] https://sdgs.un.org/goals

remains important to recognize and understand the meaning and relevance of these terms, for ensuring standardization and correct usage.

First, understanding the concept of water footprint.

The water footprint of a product (good or service) is the total volume of fresh water used to produce the product, calculated across all stages of manufacturing process. It is a water use indicator that considers both direct and indirect water use. The volume of water consumed (evaporated) and/or polluted is referred to as water use. A consumer's water footprint is the sum of his or her direct water use, such as water used at home or in the garden, and indirect water use, such as water used in production and supply chains of the goods and services consumed (books produced in a paper and pulp industry require water for basic functioning). A company's water footprint consists of its direct water use for producing, manufacturing, and supporting activities, as well as its indirect water use like water used in company's supply chain *(Hoekstra, 2008).*There are three major components of water footprint:

- Green water footprint: water from precipitation that is stored in the root zone of the soil and evaporated, transpired or incorporated by plants. It is particularly relevant for agricultural, horticultural and forestry products.
- Blue water footprint: water derived from surface or groundwater resources that is either evaporated, incorporated into a product, or taken from one body of water and returned to another, or returned at a later time. Irrigated agriculture, industry, and domestic water use can have blue water footprint.
- Grey water footprint: volume of polluted water that associates with the production of goods and services. It is calculated as the volume of water that is required to dilute pollutants to such an extent that the quality of the water remains above agreed water quality standards.

In the above regard, it is necessary to also consider domestic sewage. Domestic water use has blue water footprint and after utilization it will generate domestic sewage which is considered as Grey Water Footprint.

Similar to Carbon Credits, water credits systems have to be promoted in Industries, Urban Local bodies in order to achieve water neutrality. This will also promote sustainable water consumption pattern.

Water neutrality accordingly means reducing an activity's water footprint as much as reasonably possible while offsetting the negative externalities of the remaining water footprint

(Hoekstra 2008). Water neutral is a strong concept as it attracts broad interest and invites for positive action *(Purnima & Nandan, 2015).*

> ***'Water Neutral'*** *may not only imply that freshwater use is reduced to zero, but rather that the negative economic, social, and environmental externalities are reduced to a large extent and that the remaining impacts are fully compensated.*

Net Positive

The concept of Net Positive promotes a holistic approach, placing core business activity at the heart of actions towards sustainable practice, and encourages recognition and prioritization of impacts related to business profitability, risk, and sustainability. In terms of water, it simply means to create more (>0) water than what is being used. Some ways to achieve this net positive value in households and businesses would be: optimizing consumption of water, recycling to the most efficient point and capturing water streams through rainwater harvesting, finding innovative ways to capture stormwater etc. (*United Nations Partnerships for SDGs Platform*, n.d.).

This concept is further discussed in the next chapter.

This document attempts standardization of definition and approach for industry for attaining water neutrality. The document incorporates comments and suggestions received from the Members of Inter-Ministerial Steering Committee constituted by NITI Aayog under the chairmanship of Prof. Ramesh Chand, Member, NITI Aayog. The Terms of Reference of the Steering Committee and the suggestions along with corresponding responses are provided in Annexure I and IV of the document.

CHAPTER 2: DEFINING WATER NEUTRALITY

According to Water Action decade initiative 2018-2028[2], there will be a steep fall of around 40 per cent in freshwater availability by 2030, which alongside of rising population will push towards a global water crisis. Today, around 1.7 billion people live in river basins where water usage is far more than its rate of recharge. Data by UN suggests that 40 per cent of global population is directly affected by the water scarcity and the numbers are predicted to rise in coming years. These numbers clearly reflect the challenge likely to be aggravated in the future, unless timely water resource management measures are undertaken.

The consequences of water shortages are experienced most acutely at river basin and local levels. These shortages are manifested by a lack of reliable access to safe and affordable water in many urban areas, an increased pressure on water to grow food and sustain livelihoods in rural or semi-rural areas and a rapid deterioration of the ecosystems that in turn supply water and depend on water for their proper functioning.

In the above regard, concept of water neutrality for managing water resources, alleviating water crises, and contributing to water stewardship particularly for new developments is increasing.

This Chapter discusses some of the available definitions on water neutrality, establishing the need for a standard definition on the subject.

2.1 What is meant by water neutrality?

The term "water neutrality" was coined by South African businessman Pancho Ndebele at the World Summit on Sustainable Development in Johannesburg in 2002. It provided delegates a means to offset their water consumption by purchasing credits to be invested in water efficiency efforts and extended clean water availability, similar to a carbon offset programme.

UNESCO-IHE 2008 Research Report further discussed water neutrality as a concept relating to reducing and offsetting the impacts of water footprints. Accordingly,[3] water neutrality is defined as reducing an activity's water footprint as much as reasonably possible while offsetting the negative externalities of the remaining water footprint. 'Water Neutral' may not only imply

[2] Water action decade 2018-2028 was an initiative launched by UN General assembly on 28th March 2018 to tackle water scarcity and manage water usage.
[3] Hoekstra 2008 - Water neutral: reducing and offsetting the impacts of water footprints

that freshwater use is reduced to zero, but rather that the negative economic, social, and environmental externalities are reduced to a large extent and that the remaining impacts are fully compensated. The concept's goal is to encourage individuals and corporations that engage in water-consuming or polluting activities to become "water neutral". This could be done by reducing water consumption i.e. improved operational efficiencies and/or investing in projects that promote sustainable and equitable use of water within the same hydrological unit. The compensation of negative impacts of pollution activities, also need to be addressed through similar means particularly, through investments in projects that promote sustainable and equitable resource usage within the same assessment (hydrological) unit (Also refer to Chapter 3 for definition of assessment unit). Compensation can be done by contributing to (investing in) a more sustainable and equitable use of water in the hydrological units in which the impacts of the remaining water footprint are located.

Water neutrality therefore implies that water footprint of any activity is reduced as far as is practically possible and ensuring that the negative socioeconomic and environmental externalities are reduced as much possible, with any remaining impacts fully compensated by investing in sustainable water usage and water conservation measures. It proceeds towards achieving the water positive status after augmentation through various means such as rainwater harvesting and reuse/ recycling the treated water of suitable quality in the processes and subsequent storages. In the context of any new development, the established definition of water neutrality states that '…total demand for water should be the same after new development is

Box 1: Defining water neutrality in case of new development.

In case of any new development, total water use in the region after development must be equal to or less than total water availability in the region. Here there are three steps defined to achieving water neutrality:

(1) reducing water use by making the new development as water efficient as possible
(2) installing water reuse systems, such as rainwater harvesting or grey water recycling and
(3) offsetting any remaining demand in the existing local region (say local watershed).

Water neutrality could be achieved in a combination of ways:

- making new developments more water efficient;
- 'offsetting' new demand by retrofitting existing systems with water-efficient devices;
- encouraging existing commercial premises to use less water;
- implementing metering to encourage the wise use of water;
- education and awareness-raising amongst individuals.

Source: EEA 2004

built, as it was before. That is, the new demand for water should be offset in the existing community by making existing homes and buildings in the area more water efficient' (EEA 2009)[4] –Refer Box 1.

2.2 Need for a standard definition

Water conservation efforts by industries are considered into two ways:
On the one hand, it entails regulating a company's internal demand by increasing reliance on new and additional sources of raw water, recycling, reuse, and total water usage reduction. And on the other hand, companies must save water externally by collaborating with communities and assisting them in management of rainwater harvesting, construction of check dams, and other measures. The former has made significantly more progress, while the latter is currently being worked on.

While industry has been undertaking measures to improve their water usage across processes, and thereby claiming themselves as being water neutral and positive, many of the claims about being "water positive" are not independently validated and are vigorously opposed by environmental activists who contend that the concept of positive water effect lacks scientific foundation. Water neutrality/positive impact can only be assessed if water extracted, and water recharged/conserved are at the same location *(Manku, 2016)*. Furthermore, firms hire a third party to check the data they provide. The actual impact on the ground is rarely checked by the assessment bodies, raising questions on the validity of the claim verification. *(MacDonald, 2018)*

[4] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291675/scho1009bqzr-e-e.pdf

Box 2: How the cement factories worked towards water neutrality

Cement factories spread across various geographical locations face water issues not only for their operations but also for the communities living around their plants.

It is true that for any cement manufacturing company which is water intensive, a water neutral programme cannot be successful until the initiatives are taken beyond the boundaries of the cement plants.

Technology has enabled the cement companies to migrate to platforms that require less water intake. Previously, cement manufacturing was based on wet process, but now it has switched over to dry process. That has reduced the water footprint of cement factories considerably, limiting their consumption for captive power plant operations ranging from 16MW to 45 MW. Such plants were put up earlier by companies to meet their energy requirements. However, cement manufacturers are now opting for heat recovery plants, which are more sustainable and cost effective.

The second major water requirement is from the residential colonies in and around cement factories for domestic use. Third requirement is for dust suppression, dust quenching and horticulture.

Various Indian cement companies such as Ambuja Cement, Dalmia Cement, J K Cement, have adopted various measures, over the years to improve the water usage across processes. These companies have set sustainable targets for the next decade. Their water neutrality programmes include water storage, rainwater harvesting, groundwater level recharging, recycling of wastewater, availability of potable water to the communities, setting up of check dams and water storage facilities.

Interestingly, most of these initiatives are done with the involvement of the community and local body officials.

As a first step, most of the cement companies harvested water in the rehabilitated mining pits and cleaned it in the demineralisation (DM) plant before supplying as potable water. The water which is cycled through the DM plant and RO plant goes through a boiler. Similarly, wastewater is used for dust suppression and horticultural activities. Also, water from the factory colonies is treated and used for gardening and farming.

Source: https://www.indiancementreview.com/environment/water-neutrality-for-a-sustainable-future

Therefore, the proposed standard definition of water neutrality/positivity is:

"***Total freshwater consumption***

which is referred to as the sum total of direct freshwater use as well as estimated indirect or virtual water use as a part of water critical supply chains, applicable as on current date referred to as the date on which the evaluation is done,

should either be less than or equal to all the quantifiable (and verifiable) water savings

achieved through strategies undertaken as well as to be further (and futuristically) executed towards improving operational water use efficiencies, water conservation efforts (including rainwater harvesting, source diversification, rejuvenation, additional storages etc.,

both in plant's watershed as well as critical watersheds from where supply chains are derived

giving priority on neutralizing impacts in same watersheds or aquifers where high criticality exists and impact occurs".

The general equation (difining the general principle) is defined below (Refer to Equation 1).

Overall governing equation is provided in Chapter 3 (Refer Equation 2)

Water and Wastewater Management at Plant Level **(Within the Fence)**	+	Water conservation/ water use efficiency at Watershed scale **(Beyond the fence)**	+	Water conservation/ water use efficiency, water and wastewater management of **Supply Chain**	≥	Total water extraction or consumption measured and/or estimated as sum total of freshwater - all of the sources - Within the fence, Beyond the fence and as a part of Supply chains.

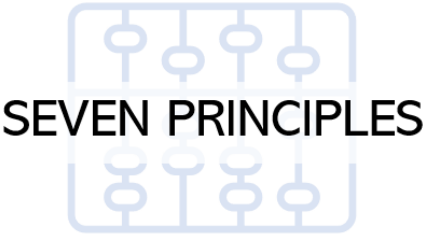
Equation 1: General equation for achieving water status

To apply the proposed standard definition, it is important to define boundary conditions under which the definition would apply.

This takes us to define key principles in which water neutrality should be based. The next chapter (Chapter 3) outlines these principles.

CHAPTER 3: DEFINING PRINCIPLES FOR WATER NEUTRALITY

Defining principles is important because it will guide to establish a clear and consistent framework for understanding water neutrality. Principles provide a set of fundamental rules or guidelines that help to clarify the meaning and purpose of each term and symbol in the equation. This makes it easier to interpret the equation, to understand how different parts of the equation relate to one another, and to apply the equation in different contexts or scenarios.



Moreover, defining principles can also help to identify potential limitations or assumptions of the equation, as well as any specific condition or criteria that must be met for the equation to be valid or applicable. This can be important for ensuring that the equation is used correctly and for avoiding errors or misunderstandings in its application.
There are seven principles.

Principle I: Water use efficiency through wastewater reuse, recycle and freshwater reduction

A key strategy to improve the water status in a plant is reduction in wastewater generation and increasing its reuse as well as reduction in freshwater use. The principle that needs to be considered here is that this reduction in wastewater should be visible through reduction in freshwater use i.e., optimization of freshwater usage* as well as source diversification especially if the freshwater source is groundwater located in a semi critical, critical or overexploited area as per CGWA classification of blocks.

**time series data preferably from digital meters need to be considered to understand daily/monthly/annual freshwater usage to be able to calculate the reductions in the same. Instantaneous values of freshwater consumption will not provide correct representation of usage.*

Accordingly, assessment should be on the basis of how consumptive water use is compensated from alternate water sources. For example, use of treated municipal waste water, recycling of surplus irrigation water from farm fields, saving by supporting domestic users and farmers in plant’s watershed to improve water use efficiency or by buying treated waste water from STPs. Rain water harvesting must be considered for evaluation only when the water harvested would otherwise have entered the drains/sewers.

Efforts made to offset balance water utilization through measures such as rainwater harvesting/ artificial recharge may only be counted if sustainability of ground water withdrawal/resources is reflected through perceptible improvement in water level trend (such as arresting earlier declining trend or improvement in water levels or keeping the decline to insignificant levels, say less than, 10cm/Yr). More Weightage to be given to those assessment units where stage of ground water extraction is signficantly high. [Also Refer to Section 4.2 on approach for considering Rainwater harvesting/artifical groundwater recharge for balancing the offset]

In case of watersheds, where ground water table is already high, and the watershed is already well endowed, water offsets need to be considered through various other means for the considered hydrological unit (Refer to the next Principle).

Principle II: Defining Assessment Unit: (Establishing spatial context)

The premise of assessing water neutrality is that it needs to be seen in synergy with impacts of an action/activity in the same hydrological and/or hydrogeological unit. This implies to attain a water neutral or positive status, industry has to first map the impacts from their actions in a defined hydrological unit. Therefore, the fundamental basis is **to undertake interventions where offsetting of impacts is to be done within the same hydrological and underlying hydrogeological unit where the impacts take place**. The size of the assessment unit should preferably be in the range of 50 -200 sq. km i.e. typical size of a watershed.

This principle applies both to plant’s watershed* as well as watersheds from where water intensive supply chains are emerging, especially, water critical supply chains**.

*Note: Plant’s watershed is the watershed from where it abstracts water directly for functioning or the watershed which the plant is a part of. It should consider all elements of the land phase of the hydrological cycle such as topography, drainages, land use and cover, soils, as well as aquifer occurrence and characteristics. The aquifer may be continuous across several nearby/ adjoining watersheds.

**Water critical supply chains would include:

- water dependent supply chains which are emerging from water stressed watersheds and/or
- high water intensive (i.e. with high embedded water) raw material (supply chain)
- direct water import from long distances i.e., outside plant watershed.

Further, water neutrality or positivity initiatives must focus on the sensitivity and conduciveness of the entire spectrum of interactions among ecological aspects vital for determining the natural ecosystem wholesomeness of the freshwater resources.

Principle III: Neutralizing impacts in the same watershed

As an extension of Principle I, it is imperative to consider that water depletion or pollution in one watershed/ groundwater system of a watershed cannot be compensated or neutralized by water saving or pollution control in another watershed. Also, both plant's watershed and watersheds of water critical supply chains would need to be looked at separately and in an integrated manner from overall perspective. This will be further discussed in the chapter on approach.

Principle IV: Source diversification

Source diversification (moving away from fresh water sources that are critical or stressed) is essential towards achieving neutrality. Alternate water sources such as use of treated wastewater, rainwater harvested, desalinated sea water, nature-based solutions, are few options that can be explored both for plant and supply chains.

Principle V: Mapping, Monitoring and Measuring

Impact evaluations and offsetting against total water consumed would need to be monitored to ensure whether the neutrality targets are being met. This principle therefore stresses the need to **achieve a measurable impact on availability, quality, and accessibility**.

A robust system of measurement, monitoring and evaluation of the quantities is imperative in this regard, that makes use of IoT based digital fingerprinting-based instruments. Subsequently, the industry should establish adequate treatment system so as to ensure that the quality of water which is being released to the ecosystem or recycled back into the industry processes complies to the stipulated environmental norms (Also refer to section 4.2, steps 4 and 5). Thus, precise and reliable measurement of both quantities and qualities is important for a water neutral industry.

A menu of strategies to enable a water neutral pathway needs to be built on **3M-7R** approach as depicted below.

Again, as in the previous case, 3M-7R approach would need to be applied separately and in an integrated manner for watersheds delineated both for plant as well as water critical supply chains.

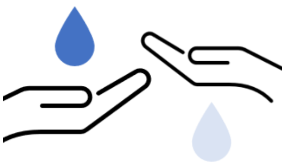
Principle VI: Defining Water Neutrality: Temporal context

Defining water status (i.e., neutrality or positivity) along with spatial context, **temporal parameters that are distributed both in space and time,** must be considered. The balance offset should be established in terms of both quantity and quality of the water drawn and replenished and also at the right time period, only then the industry may be called a water-neutral industry. Furthermore, by efficient use of existing water resources in the system and enhancing the augmentation of water, thus returning more water of good quality than consumed leads to a water positive industry. Here defining the period for assessment is critical i.e., defining neutrality from a long-term perspective, annual/bi-annual. The re-assessment will be undertaken after every 3 years.

Developing an understanding especially with respect to the spatial/temporal dynamics of achieving neutrality are imperative so that it becomes a useful concept to apply operationally. Also, climate extremes such as droughts need to be adequately addressed. So, water neutrality for a drought year would also cover efforts or preparedness that include choices such as:

- Reduction in relative scale of operation
- Diversification of freshwater sources
- Diversification in water critical supply chains
- Increase in reuse, recycle, recovery mechanisms
- Stop-gap arrangements e.g., tankers from areas not impacted by droughts.
- Other adaptive measures in consideration with hydrological and watershed balances.
- Focus on nature-based solutions.

Principle VII: Elements of estimating credits and debits



Operational efficiency, operational sustainability, and supply-chain systems, all inclusive, form elements of estimating credits and debits towards defining water status (i.e water neutral, water positive, and water negative). Through water neutrality a system of accountability and responsibility for water footprint of the industry is established such that there is a transparency of all the water usages of the system.

In adherence to defined principle, for achieving measurable and a net positive impact on availability, quality and accessibility of water, the following needs to be considered.

$$\left[\sum_{t}^{t+1}\begin{pmatrix}\text{water and wastewater}\\ \text{management}\\ \text{at plant level}\\ (\text{operational efficiency})\end{pmatrix}_{x_1,t+1} + \sum_{t=0}^{t}\begin{pmatrix}\text{water conservation}\\ \text{in plant's watershed}\end{pmatrix}_{x_1,t} + \sum_{t}^{t+1}\begin{pmatrix}\text{additional water conservation}\\ \text{in plant'swatershed}\end{pmatrix}_{x_1,t+1} + \sum_{0}^{t}\begin{pmatrix}\text{water conservation}\\ \text{in supply chain watersheds}\end{pmatrix}_{x_{n\,(n\neq 1)},t} + \sum_{t}^{t+1}\begin{pmatrix}\text{additional water conservation}\\ \text{in supply chain watersheds}\end{pmatrix}_{x_{n(n\neq 1)},t+1} + \sum_{t}^{t+1}\begin{pmatrix}\text{additional water and wastewater}\\ \text{management}\\ \text{at plant level in supply chains}\\ (\text{operational efficiency})\end{pmatrix}_{x_{n(n\neq 1)},t+1}\right]$$

$$\geq$$

$$\left[\sum_{0}^{t}\begin{pmatrix}\text{Direct fresh water withdrawals or use or consumption}\\ \text{in the plant as well as in the supply chain}\end{pmatrix}_{x_1,t} + \sum_{0}^{t}\begin{pmatrix}\text{additional estimation of direct fresh water withdrawals}\\ \text{or use or consumption}\\ \text{in the plant as well as}\\ \text{in the supply chain (near future expansion)}\end{pmatrix}_{x_1,t+1}\right]$$

Equation 2: Overall governing equation for achieving water status.

Note: The equation aims to capture the components of "space" (defined as 'x' and "time" defined as 't').

1. Water used for conservation in watersheds should be of the quality which is at least similar or preferably better than the quality of water of the ecosystem that receives it. **Only then will it be used for calculations of water status**. All interventions which do not measure quality as a function of conservation effort or strategy undertaken will not be used for calculation of water status.
2. x_1 = plant's watershed or plant's location
3. x_n = supply chain watersheds or supply chain locations
4. t = time step (i.e., current date on which water status evaluation is conducted)
5. t+1 = future time step (since certain intervention that the plant chooses to undertake could be futuristic in nature in order to achieve status of neutrality or positivity). In such a case certification could be offered as provisionally valid for a certain time period basis the written commitment provided by the plant for undertaken futuristic interventions.

It implies: Total current offset should be less than or equal to all quantifiable and verifiable water savings currently and futuristically achieved in water stressed watersheds (plant's as well as its supply chains') as well as through *further and future* improvement in operational water use in the plant and its supply chains.

Equation 2 will be applied to define the "first forward difference" which will be the key technique for estimating the value of the function namely, water status.

The use of these principles has been made in outlining the approach and methodology. This is subsequently discussed in Chapter 4.

Water Status
Positive implies giving back to the ecosystem **More**
Neutral implies giving back to the ecosystem **Same**
Negative implies giving back to the ecosystem **Less**

water than what is extracted and consumed in first place

Operational efficiency, Operational sustainability, and Supply-Chain systems, all inclusive, form elements of estimating credits and debits towards defining water status (water neutral, water positive, water negative processes).

CHAPTER 4: APPROACH AND METHODOLOGY

The approach for conducting and evaluating whether a company is undertaking water neutral water positive or water negative processes, it is important to adhere to the principles mentioned in Chapter 3.

General approach is shown in Figure 4.1:

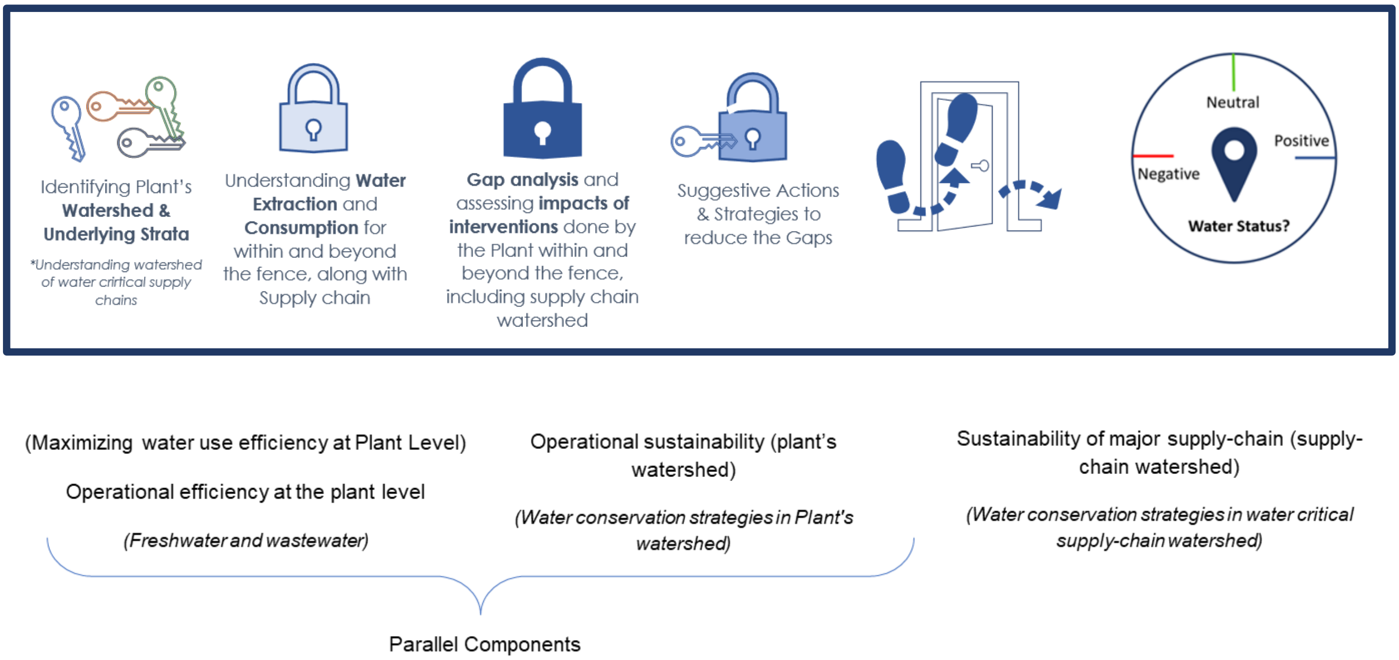


Figure 4.1: General approach for assessing water neutral/positive/negative status

4.1 Ensuring operational efficiency (Objective: Maximising operational water use efficiency)

The key objective of "ensuring operational efficiency" is to try and maximize operational water use efficiency levels such that the balance water utilization (compared to the total water consumption i.e., both direct and virtual) then defines the resource offset that needs to be undertaken at the plant's watershed level as well as supply chain water critical watersheds.

Operational Efficiency denotes water use efficiency within the industry (e.g. plant operations /manufacturing unit). Increasing operational water use efficiency in industry can reduce freshwater use and result in various environmental and socio-economic benefits. Behavioral, operational, and technological changes can all contribute to improved water use efficiency in industrial production.

The key water efficiency actions undertaken in an industry relate to 3Rs (recycling, reuse, and reduction of water consumption). In this regard, three activities are necessary that include, 3Ms for 3Rs namely, **measuring** the amount of water used, **mapping** of the current and the diversified pool of fresh as well as recycled or reused water sources, and **monitoring** quality of the resources, including discharges and quality of land or water sources that receive treated discharge.

Measuring

The first step in assessing water status of a facility is measuring total water consumption by a plant under various processes. This includes two components, measuring real water (groundwater, surface water and rainwater) and virtual water usage.

Real water usage can be calculated through result from water audit that identifies and quantifies water uses and losses from a water system.

The first step in reducing water use in the industry is one of the most straightforward performance metric i.e., total volume of water consumption in an industry, measured in liters (L) or cubic meters (m^3), i.e. absolute performance. However, industries vary widely in size and functions. Therefore, water performance of a plant/manufacturing unit has to be defined by a more precise metric, and the total water consumption correlated with another parameter that influences water use.

A comprehensive water audit gives a detailed profile of the distribution system and water users, thereby facilitating easier and effective management of the resources with improved reliability. Moreover, it is a practice to ensure optimal utilization of water per unit production. Hence it is important to prepare benchmarking for each of the water using sectors for annual water auditing through certified auditors accredited by Government Agency.

A water audit defines the process of accounting for water inflows and outflows as well as changes in water storage such as changes in the water levels in water storage tanks within a plant. This involves detailed analysis of water use at a given site for a certain duration and includes all sources of water intake, storages, and various uses in functional process units and operations of the plant. Audit acts as an important step in water management hierarchy (Figure 4.2)[5].

The approach involves a detailed examination of where and how much water enters the system, and where and how much water gets distributed in the system. This helps in assessing current water supply within the plant.

In the above regard, metering is the most basic activity practiced determining hourly, daily, monthly, seasonal and average consumption rates. Metering refers to measuring water flow rates and quantities at various points of uses. These readings of water measurement at various points can be developed into a database or water record of for the industry.

As per the General Guidelines for Water Audit and Conservation provided by the Central Water Commission, Ministry of Water Resources, Government of India, 2005,

"Comprehensive water audit helps in correct diagnosis of the problems faced in order to suggest optimum solutions. It is also an effective tool for realistic understanding and assessment of the present

[5]Alwi S R et al. 2008, A holistic framework for design of cost-effective minimum water utilization network, Journal of Environment Management 88 (2008) 219-252 pp.

performance level and efficiency of the service and the adaptability of the system for future expansion and rectification of faults during modernization."

One important step towards becoming a water neutral or positive is that the industry must mandatorily carry out the water audit at regular intervals by a certified agency so as to obtain a water balance, inventorying all the water usages by measuring flow of water from the site of water withdrawal or treatment, through the distribution system, and into areas where it is used and finally discharged.

Going forward, benchmarking for each of the water using sectors needs to be prepared for annual water auditing through certified auditors accredited by Government Agency.

Water Balance

A detailed water balance is prepared based on the analysis of secondary data and assessment based on various metering and monitoring devices like ultrasonic flow meters and water testing kits.

Water flow measurements are conducted at various intake and discharge points with ultrasonic flow meters. These measurements are cross checked with the operating capacities of related pump and other equipment, to assess the exact consumptions (wherever possible) in the different areas/processes of the plant.

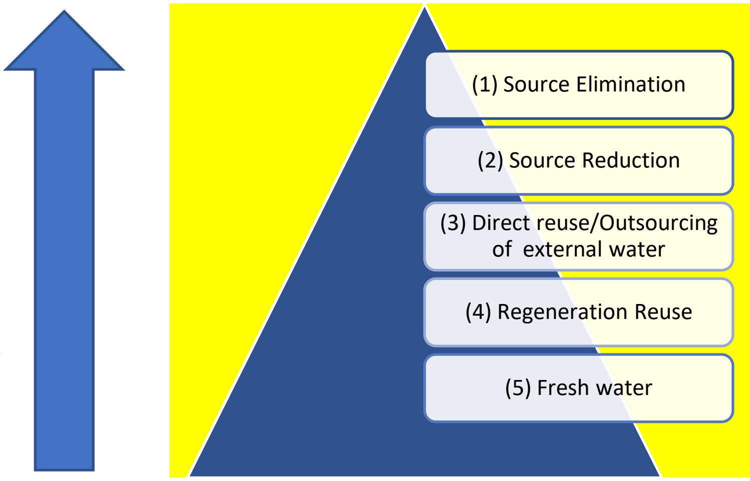


Figure 4.2. Framework for design of cost effective minimum water utilisation network
Source: Alwi S R et al. 2008[2]

Based on the audit findings, the approach is to maximize operational efficiency through adoption of 3M-7R approach as also discussed in the earlier sections. Operational efficiency can be maximized through actions that help in reducing freshwater usage in the plant/facility i.e.

- reduce usage of fresh water sources (from rivers, ground water)
- store more of rainwater
- increase recycling and reuse of grey water (treated water)
- increase awareness for conservative use of water among all stakeholders – community, industry etc.

In brief, the following steps need to be followed to achieve the above targets.
Step 1: Water network mapping
Step 2: Water discharge/consumption point identification
Step.3: Water measurement format development and measurements
Step 4: a) Identification of improvement points.
b) Identification of potential for rainwater harvesting and its use Also Refer to section 4.2, Step 2)
c) Use of treated water/closing the loop
Step 5: Implementation of points identified.

The key objective of "ensuring operational efficiency" is to try and maximize operational water use efficiency levels such that the balance water utilization (compared to the total water consumption i.e., both direct and virtual) then defines the resource offset that needs to be undertaken at the plant's watershed level as well as *supply chain water critical watersheds.*

4.2 Ensuring operational sustainability (including supply chains) and balancing the offsets (Objective: Define Offset wrt both direct water use and virtual water)

After undertaking improved operational efficiency measures, i.e., all reasonable possible strategies implemented to reduce the existing water usage, the remaining (balance) water consumption, needs to be offset by making investments in supporting projects that aim at sustainable and equitable water usage.

The basic neutrality principle underlying ensuring resource sustainability is that water depletion or pollution in one river basin cannot be neutralized by water saving or pollution control in another basin i.e., offsetting has to be done within the same hydrological unit where the impacts take place.[6]

Note: The size of the investment (the offset) should be a function of vulnerability of the region where the impact has been undertaken. To elaborate, an impact in a water scarce area or during critical periods when water situation is worse, requires a larger offset effort than the same size impact in a water abundant region or period.

The steps involved while assessing resource sustainability include:

Step 1. Map watersheds – plant and supply chain (key water intensive raw material only)
To undertake evaluation for water neutrality of a given plant, first step involves delineation of the plant watershed. This provides the hydrological boundary for the assessment. In addition, watersheds for the respective supply chains (for key raw materials) that are water dependent or water intensive, are also mapped/ delineated.
In addition to understanding the hydrological (watershed), mapping key freshwater sources, on which the plant and identified supply chains depends such as, ground water, surface water is also required.

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[6]In this respect, the water-offset concept differs from the carbon-offset concept, since for the purpose of CO_2 emission reduction it does not matter where at Earth this reduction is achieved. Refer to Hoestra 2008, for detailed discussion; Water neutral: reducing and offsetting the impacts of water footprints accessible at <http://waterfootprint.org/media/downloads/Report28-WaterNeutral.pdf>

Step 2: Map and characterize hydrological & hydrogeological variables for watersheds
Building on Step 1, it is imperative to assess baseline water stress, groundwater categorization that enables understanding of the regional stress (plants are increasingly facing shut down due to external stress factors!). More weightage needs to be given to those assessment units where stage of ground water extraction is more (i.e. OCS category).

Step 3: Identification of strategies to balance water quantity offset
Plants under their sustainability agenda, are increasingly working in their respective watersheds with stakeholders (largely community) on implementation of strategies for improving water resource management. All strategies, interventions undertaken by the plant need to be geotagged and superimposed on the watersheds delineated as in Step 1.
In addition, the likely offsets from each of the strategy implemented needs to be verified and fully assessed.

To offset balance water utilization through measures such as rainwater harvesting/ artificial recharge, it is important to note that these will be considered for offset, if sustainability of ground water withdrawal/resources is reflected through perceptible improvement in water level trend (such as arresting earlier declining trend or improvement in water levels or keeping the decline to insignificant levels, say less than, 10cm/yr).

Step 4: Addressing water quality offset
Assessing of water quality is as important as water availability as poor quality resource cannot be considered for offsetting impacts for attaining water neutrality status. In this regard it is important to,

- measure quality of operational water usage and treated wastewater usage
- measure quality of receiving ecosystem before and after operational water use and treated wastewater generation
- compare quality of receiving ecosystem regarding its designated best use

The above steps help in defining water quality offset.

Step 5: Identify strategies to balance the quality offset regarding operations
This implies that if receiving ecosystem is of better quality than the treated wastewater, it needs to be ensured that treatment at least compares with the quality of existing receiving ecosystem. Monitoring of ecosystem quality on a regular basis would need to be verified

4.3 Ensuring sustainability of major supply chains

Supply chain disruptions are increasingly leading to higher risks to businesses. Water is required for growth and production of raw materials, manufacturing of raw goods into consumable products, and distribution of products to the market. For instance, agricultural commodities such as cotton, wheat and sugar are used as raw material inputs in a wide variety of products in the food, beverage, retail and apparel sectors. Supply chains for these products can be complex, with multiple tiers and a variety of intermediaries across a range of sizes all playing a role and contributing to uncertainties around who is sourcing what from where. Furthermore, many manufacturers do not have clear visibility of their supply chains, including where they are sourcing from and what parties are involved at different steps.

Risks and challenges associated with supply chains could be varied, such as,[7]

- **Operational Risks**

As water availability or quality decreases, water costs increase. Scarcity can also lead to conflict in communities or with companies that are big users. The operational impact works its way up the supply chain mainly in price increases for raw materials. Scarcity and more frequent/longer droughts can halt production and disrupt the value chain at any point. One single link in supply chain stops, and the entire chain is impacted to the point of costly delays and shortages.

- **Reputational Damage**

Companies operating or working with suppliers in regions where the population has limited access to water can significantly harm a brand. Consumers are unlikely to support competition between a business's needs and those of humans or even livestock which may be the livelihood of entire communities.

Stakeholders can also blame an organization for buying from sources that disregard proper water management and have little concern over polluting freshwater bodies.

- **Regulatory Impacts**

Restrictions are also a risk factor. Countries under water stress are implementing these measures, putting pressure on their main utilities and thereby threatening production facilities.

- **Water Governance: Measuring Water and Mapping Risks**

The impact of a product on global water resources can only be relevantly measured if the whole supply chain falls under the assessment scope. While the environmental impact of consumption and pollution is material, an impact assessment is more a measuring process: how water is appropriated for human purposes.

4.3.1. Supply – Chain water management approach

This framework uses a state-of-the-art two-pronged approach:

1. a top-down approach to identify the firms within its supply chain operating in high water-risk areas based on their geographic locations (*supply chain mapping*). Thus, in terms of supplier management, resources can be directed to, for example, manage high risk areas with a high density of suppliers, or to manage strategic suppliers located in high risk areas. This allows decision makers to define regional sourcing strategies.

[7] Parts of this section are adapted from <www.sourceintelligence.com>

2. a bottom-up approach, where a firm uses water consumption data to identify key product categories or processes or raw materials. Current and potential suppliers of these categories/ processes/ materials are then evaluated at the site level using aggregated water risk indicator eg. Water stress, specific water consumption, freshwater use per day.

Approach

A unit direct water use coefficient of an economic sector is defined to be the total water consumption for production by the economic sector (say industrial plant) divided by the total products produced, i.e.,

$$f_i = {W_i}/{X_i}$$

where,
f_i is direct unit water usage of the ith unit
W_i is the total water consumption in production
X_i is the total quantity of product produced
Here the water usage can be based on the monetary value of product, however, it may also be based on the quantity of production.

Given that intermediate inputs (e.g. as part of supply chain) are usually required in production process, we introduce a unit total water usage coefficient by

$$f_i^t = f_i + \sum_{k=1}^{n} f_k^t \, a_{ki}$$

Here, f_i^t is the unit total water usage of the ith unit, and

$$a_{ki} = {u_{ki}}/{\sum_{k=1}^{n} u_{ki}}$$

is the relative share of the **kth product** inputted for the **ith sector's** production, and where
u_{ki} is the input of kth sector product by the ith sector. The first term on the right hand side represents direct water consumption, and the second term refers to the water content of the indirect water consumption of the sector i. [8]

Therefore, supply chain evaluation has two main aspects, namely, supply chain mapping and supply chain monitoring.

Based on the combination of the two, the approach would prioritize both plant and watershed based on water criticality aspect. For instance, this would include identification of those supply chain links that are:

[8] Also refer to Annexure II on Approach

a. both high water dependent, groundwater dependent as well as emerging from water stressed watersheds (priority one)
b. moderately or low water dependent but emerging from high water stressed watersheds
c. high water dependent but coming from water non-stressed watersheds, and
d. direct water import from long distances i.e., outside plant watershed.

Following information will be collected to apply the above approach:

a. Name of unit of supply chain
b. Tier or layer (1, 2, 3, …) (to be understood from main
c. Name products manufactured as well as annual production of each product (state units such as: tons, kg, number etc) for last 3 years
d. Cost of production (Rs) for last 3 years – product wise (if possible) and total
e. Total product inputted as part of this supply chain (name of product and total amount)
f. Total annual fresh water consumed and/or average daily (state units such as: cu.m/year, cu.m/day) for last 3 years
g. Is the unit facing any water related challenge (scarcity, drought, water not enough, poor quality, any community related issue on water etc.)

Template on information to be collected for supply chain

A	B	C	D	E	F	G	H
Name of the Supply chain unit	Location of the supply chain (tier)	Products Manufactured (Names) List of all products	Annual Production (tons, kg, number etc.) for each product as shown in Col C	Cost of production (Rs.) (for each product as per Col C and D)	How much of this product is part of current supply chain (tons, kg, number etc.)	Total annual fresh water consumed and/or average daily (state units such as cum./year, cu.m/day)	Is the unit facing any water related challenge (scarcity, drought, water not enough, poor quality, any community related issue on water etc.) Yes/No; If yes who problem

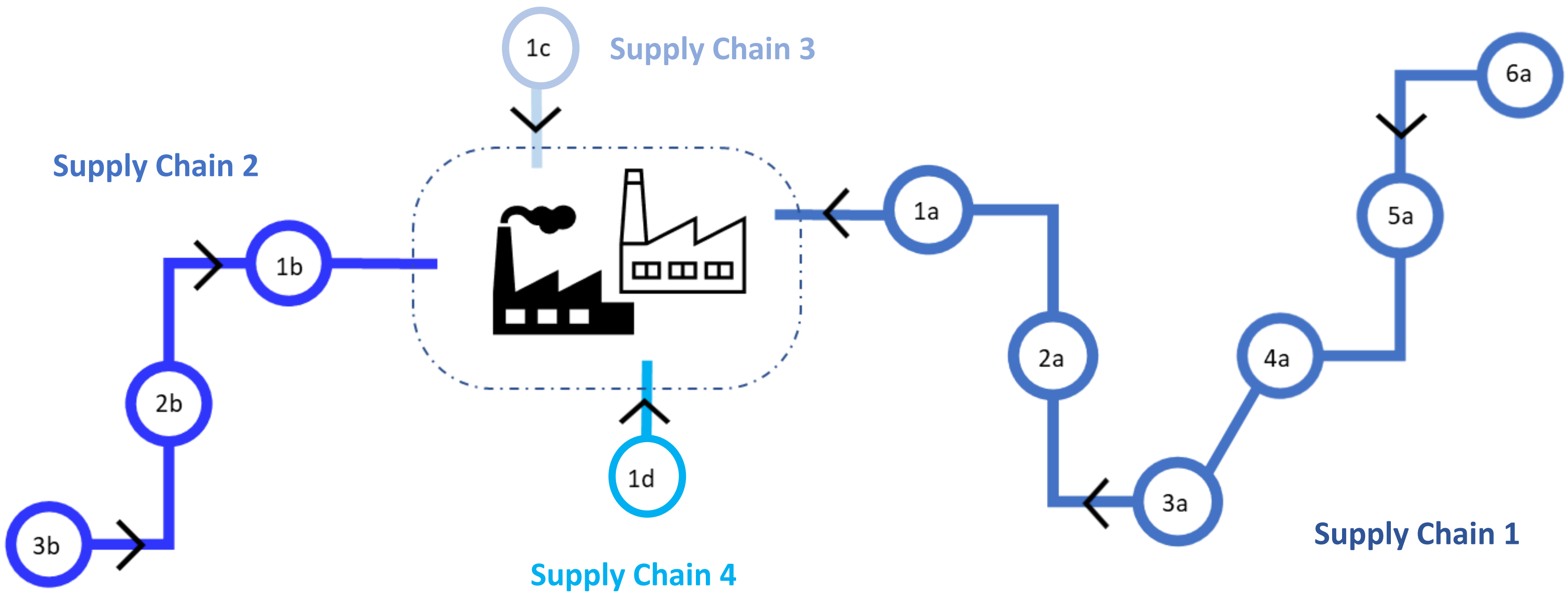


Figure 4.3: Supply Chain Visualization system with tiers or layers

e.g., supply chain 1 is for input 'a' which in turn as has 6 tiers of supply chain associated with it

Based on collected data, one can map risks across the supply chain and rate sustainability results. This can facilitate decision making. If a component is scored unsustainable for instance, it can be removed from production process.

Given the above steps, it is important to work with suppliers as agreement on reduction targets encourage transparency and commitment. Other solutions may be to invest in communities or compensate users who are affected by water use.

Given the above context, assessing neutrality for the supply chains is a complex process wherein a plant may have many supply chain segments and/or multiple layers or tiers. Refer to Figure 4.1 for illustration of a complex supply chain with multiple tiers. This is simplified in the present context to depict Supply Chain Visualization system as in Figure 4.2.

In this complex system assessment of water neutrality will involve assessing where are the highest risks.

4.4 Applicability of water neutrality

Primary aim of water neutrality concept is to reduce demand for water (i.e., maximize operational efficiency through 3M-7R approach). While doing this it is important to note that,

1. water neutrality is not regarded as a replacement for existing regulatory tools
2. analysis is undertaken using water company data for either the annual average or critical period.
3. analysis considers uncertainty associated with supply and demand data to assess how water neutrality activity is going to be effective at reducing demand.
4. while assessing role of rainwater harvesting, possible effects of rainwater harvesting on local hydrology and hydrogeology should be assessed on a site-to-site basis. In areas where there is little or no hydrological impact then rainwater harvesting can contribute to reducing demand.
5. Similarly, grey water, recycling systems can also contribute to reducing demand.

Achieving a 100% level of water neutrality is an aspiration. There will be 'drivers' and 'constraints' that will define what level of neutrality (between 0% and 100%) is appropriate.

- Drivers include environmental factors, climate analysis, and cost-effectiveness.
- Constraints include the relative size of the operations, consumption rates and predicted consumption in case of new development/ expansion/ growth in operations.

Temporal context

- If offsetting and neutrality can be realised at an annual timescale it may be possible to permit additional / diversified supply during a period where water resource is available for abstraction /use (e.g. additional storage during monsoon) which would be used at periods of high demand, or by balancing demand and supply within the system.

- The dry year annual average demand scenario is considered the most appropriate 'default' context for analysing water neutrality; however, it may be necessary to achieve water neutrality for the peak period demand scenario if peak period demands cannot be managed with additional storages or source diversifications and is therefore critical.

- Offsetting of peak period demand will require focused attention to minimize the demand.

4.5 Role of monitoring

In the process of setting targets for water neutrality, monitoring how effective the new development is in meeting the targets, should be considered. Demand and demand offsetting will need to be monitored to determine whether neutrality is being met. Monitored data would need to be reviewed (in quantifiable terms) to determine whether progress towards neutrality is in line with all the claims being made. This performance assessment will then trigger further actions, if required.

Applicability of the neutrality standards

Water neutrality analysis needs to be revisited at regular (e.g. 2-3 year intervals) with reassessment of uncertainty. Further, the approach to accounting this uncertainty also needs to be revisited periodically. This may result in modifications to water neutrality strategies (e.g. more retrofitting or higher targets for new buildings), which will then need to be reviewed at the next review point.

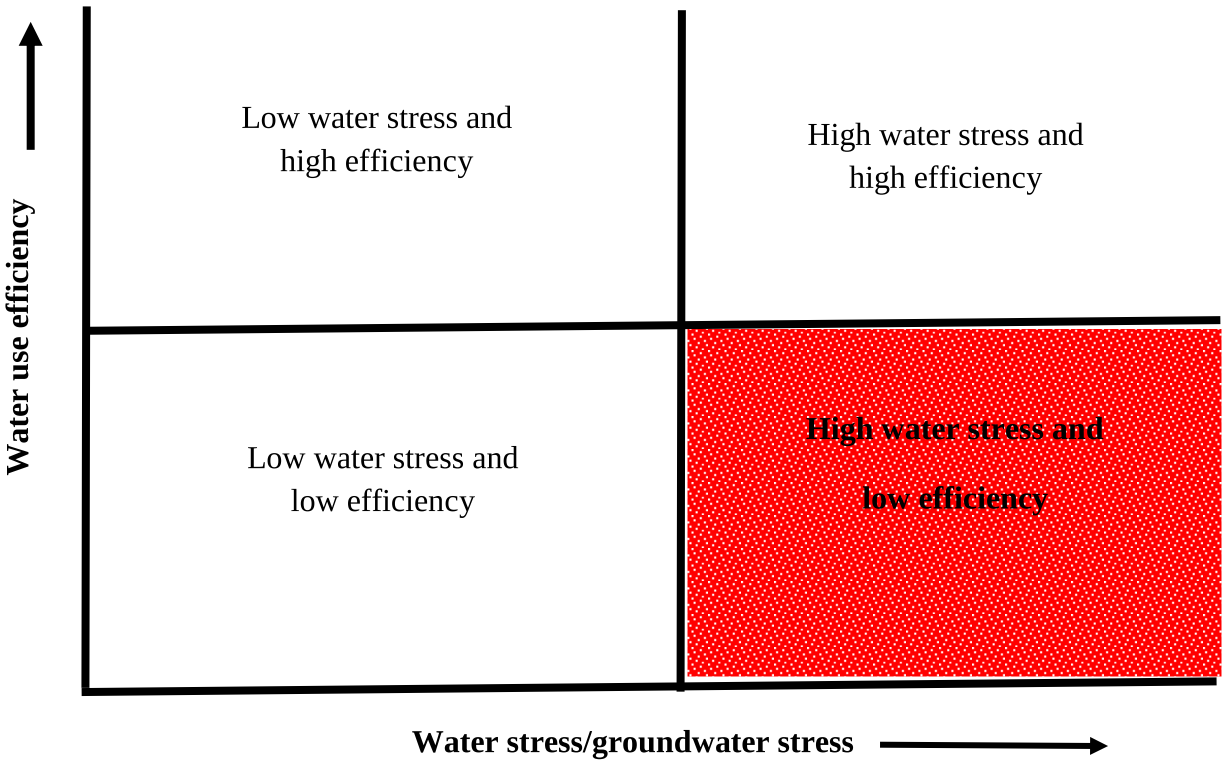


Figure 4.4: Supply chain analysis for strategic decisions for achieving water neutrality

CHAPTER 5: CERTIFICATION PROCESS

Water neutrality/ positive certification process refers to steps and procedures that an organization must follow to obtain a certificate or credential that validates their efforts towards becoming water neutral/positive. This certificate process could be done both scope-wise and in totality depending up on the initial requirements under each scope as defined in the Table 5.1.

For undertaking the certification there are certain certificate levels defined – purpose of these levels is to understand and acknowledge the efforts of companies in promoting environmental sustainability, supports corporate responsibility, and actions to mitigate water-related risks.

There are three certification levels considered.

1. **Level I - Water Neutral/Positive Aspiring Company** - Companies/ organizations/ institutes undertaking the evaluation of their water status and the components mentioned under scope I will be certified as **Water Neutral/Positive Aspiring Company.**

2. **Level II - Water (Neutral/Positive) Rising Plant Company** - Companies/ organizations/ institutes completed the evaluation of components mentioned under scope II will be certified as **Water (Neutral/Positive) Rising Company.**

3. **Level III - Water (Neutral/Positive) Achieved Company** - Companies/ organizations/ institutes that complete the components mentioned under scope III are certified as **Water (Neutral/Positive) Achieved Company.**

For each certification level the scope defined in Table 5.1.

Table 5.1: Components under Water Neutral/Positive status companies

Certification	Scope	Components
Water Neutral/Positive Aspiring Company **Focus: Operational efficiency gains maximization**	Scope I Defining real water resource offsets covering both quantity and quality offsets (based on direct or real water used for plant operations)	i. Measure water consumption – direct or real ii. Maximize (operational efficiency) through 3M7R approach. iii. Define direct/ real water resource offset. iv. Map and delineate plant's watershed. v. Measure quality of operational water use and treated wastewater used for disposal to ecosystem vi. Measure quality of receiving ecosystem and compare with treated wastewater quality from the plant. vii. Compare quality of receiving ecosystem regarding its designated best use and define water quality offset.
Water (Neutral/Positive) Rising Plant Company **Focus: Operational sustainability including gaps in offsets, supply chains**	Scope II	i. Map and characterize hydrological and hydrogeological variables for watersheds (plant as well as key water intensive supply chains). ii. Identify water critical supply chains iii. Estimate Virtual Water Use iv. Define combined offset (Direct water + Virtual Water) v. Identify strategies to balance combined offset in plant and supply chain watersheds vi. Measure quality of operational water use and treated wastewater used for disposal to ecosystem (direct plant water) vii. Measure quality of receiving ecosystem before and after operational water use and treated wastewater generation of the plant. viii. Compare quality of receiving ecosystem regarding its designated best use ix. Define quality offset (is it met or not for every intervention which is used for calculation of water status as defined in Governing Equation 2. x. Identify strategies to balance the quality as well as quantity offset (note: if receiving ecosystem is of better quality than your treated wastewater, ensure that treatment at least compares with the quality of existing ecosystem)
Water (Neutral/Positive) Achieved Company	Scope III	Validation, Monitoring and Verifications of strategies undertaken and implemented. This will ensure: i. Monitoring and verification systems

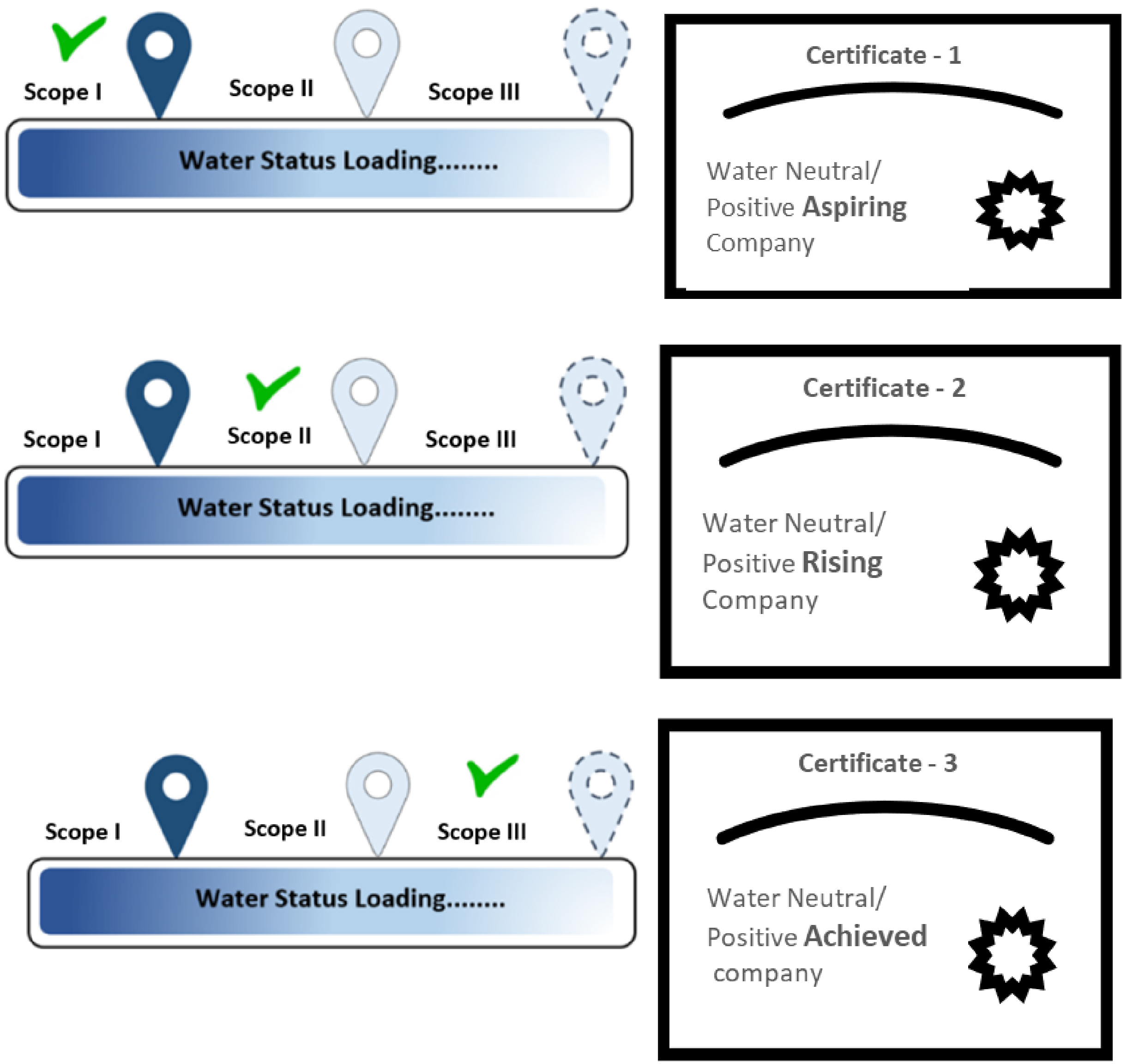
Focus: Validation, Verification and Reporting	ii. Reporting systems iii. Source diversification is established iv. Total reduction in freshwater consumption is established v. Ecosystem health is established

Water neutrality analysis needs to be undertaken using water company data for both capturing the annual average as well as critical periods especially if frequented by droughts.

This certification process will help companies and organizations to better manage their water usage and reduce their impact on water resources along with promoting environmental sustainability and ecosystem health by ensuring that the amount of water used is balanced with the amount of water replenished. Refer to Figure 5.1 for schematic on step wise approach.

<u>Minimum requirements and qualifications for agencies who can assess, audit and certify water neutrality</u>

- Non-Governmental Organizations (NGOs), autonomous bodies or consulting firms of repute having worked in the water resources sector not less than for a period of 15 years could be employed for the purpose of assessing, auditing and certifying water neutrality.
- The assessing, auditing and certifying team should have qualified personnel possessing a B.Tech./B.E. in Civil, Chemical, Mechanical Engineering or Post Graduation in Water Resources, Environmental Sciences, or allied subjects.


Scope I
Scope II
Scope III
Water Status Loading........
Certificate - 1
Water Neutral/
Positive Aspiring
Company
Scope I
Scope II
Scope III
Water Status Loading........
Certificate - 2
Water Neutral/
Positive Rising
Company
Scope I
Scope II
Scope III
Water Status Loading........
Certificate - 3
Water Neutral/
Positive Achieved
company

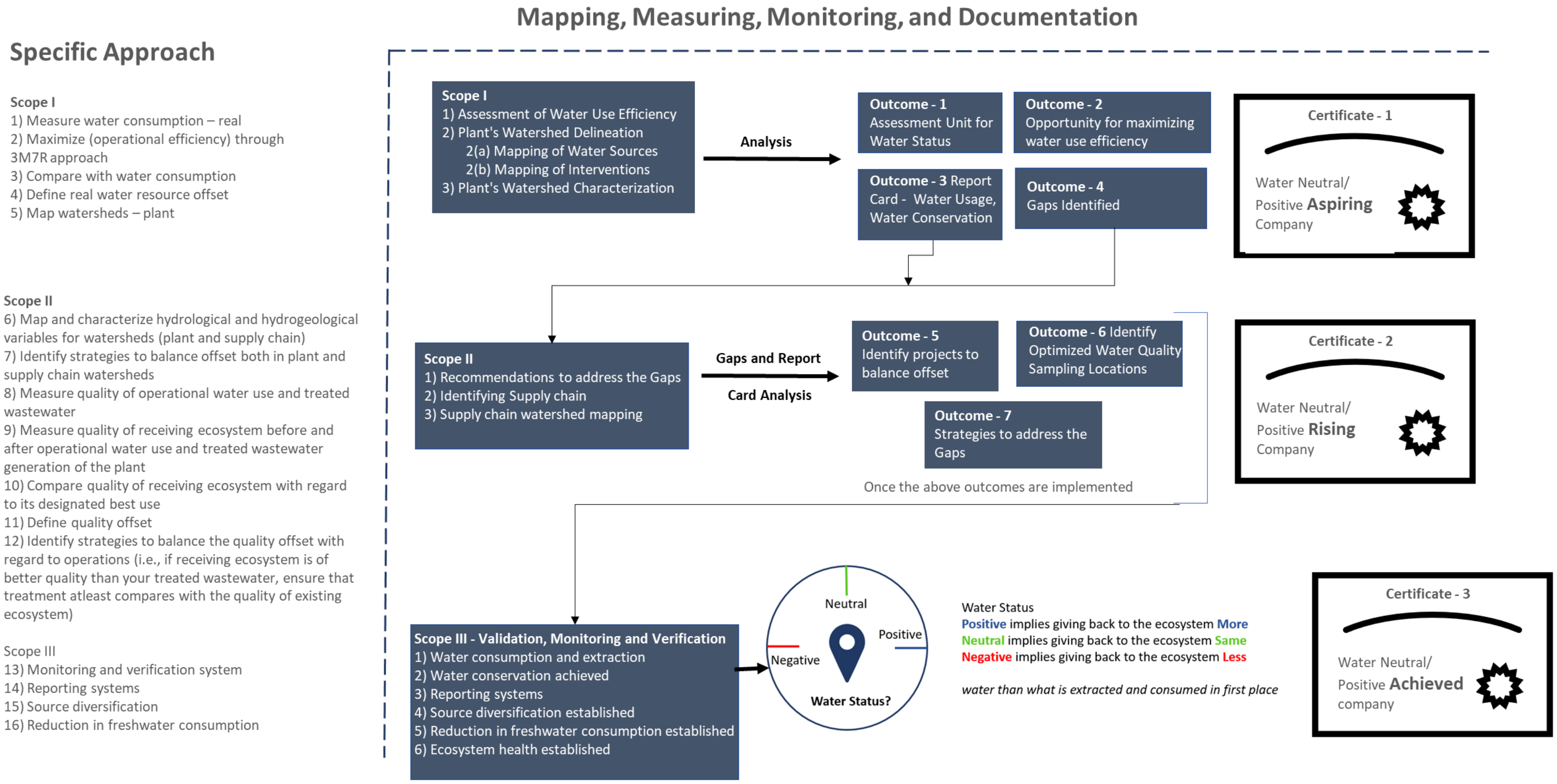


Figure 5.1: Water Neutrality – Step wise approach for certification

CHAPTER 6: ESTIMATE/TARGET OF WATER SAVINGS

The projected water demand in the report of National Commission on Integrated Water Resources Development (NCIWRD, 1999) is considered to estimate the present water demand. The report has a low and a high scenario for each sector. The high-end scenario for agriculture, industry and domestic is used to set target for water savings in the next 10 years through practicing water neutrality standards.

The NCIWRD data is considered a reliable estimate of industrial water demand since reports industrial water demand for the years 1990 and 1998, based on industrial production data and water demand per unit production data collected by the survey of 17 major categories of industries, and this data is used together with per-unit-water use figures for that year obtained from CPCB. Also, the dataset shows an increasing trend in water demand with time, which is deemed realistic, and the upward trend is consistent with growing industrial production and population during the same period (Naveen Joseph et. al., 2019)[9].

Table 6.1: Projected water demand in India in billion cubic metre (BCM) (NCIWRD, 1999)

	Agriculture	Industry	Domestic
2010	557	37	43
2025	611	67	62
2050	807	81	111
Present demand (interpolated for 2023)	**603.8**	**63**	**59.47**

Achievable target of systematic savings of 2% every year is expected in direct use of industry sector within the plant boundary and supply chain. Further, the industrial units shall explore possibility of savings beyond their plant boundary and supply chain, but within the same hydrologic unit, in agriculture and domestic consumption by supporting farmers to adopt water conservation measures and efficient irrigation methods, and by encouraging domestic users to use water efficient fixtures. By this way, average annual water savings of 2% is targeted in agriculture and domestic sectors, starting from 1.6% in the first year, and gradually increasing to 2.5% in the tenth year. Annual growth in demand is also taken into account. Annual growth in industrial demand is taken as 3%, considering the annual growth of economy at 6% and then

[9] Naveen Joseph, Dongryeol Ryu, Hector M. Malano, Biju George, K.P. Sudheer, Anshuman, Estimation of industrial water demand in India using census-based statistical data, *J. Resources, Conservation and Recycling*, Volume 149, 2019, Pages 31-44, ISSN 0921-3449, https://doi.org/10.1016/j.resconrec.2019.05.036.

offsetting 3% for the operational efficiency in the processes. To calculate annual growth in agriculture demand, average growth during the period 2014-15 to 2018-19 (the data available in the latest RBI Handbook of Statistics of Indian States 2021-22) is considered, as depicted in Table 6.2.

Table 6.2: Year on year in irrigated area; Source: RBI, 2022[10]

Year	YoY growth in irrigated area (%)	Average annual growth
2014-15	1.04	1.41%
2015-16	0.03	
2016-17	1.41	
2017-18	1.96	
2018-19	2.59	

The domestic water demand growth is taken as 1% annually, in view of the United Nations' data on population growth for the period 2017-2020.

Table 6.3: Targeted water saving in next 10 years through water neutrality standards

Year	Annual Demand (increases by 3% on Col C. demand after saving, from the year 2024 onwards)	Demand after annual savings b/w 1.6% to 2.5%	Annual Demand (increases by 1.41% on Col E. demand after saving, from the year 2024 onwards)	Demand after annual savings b/w 1.6% to 2.5%	Annual Demand (increases by 1% on Col G. demand after saving, from the year 2024 onwards)	Demand after annual savings b/w 1.6% to 2.5%
	Industry		**Agriculture**		**Domestic**	
A	B	C	D	E	F	G
Present demand (2023)	**63**	**61.99**	**603.8**	**594.14**	**59.47**	**58.52**
2024	63.85	62.76	602.52	592.28	59.11	58.11
2025	64.64	63.48	600.63	589.82	58.69	57.63
2026	65.38	64.14	598.14	586.78	58.21	57.1
2027	66.06	64.74	595.05	583.15	57.67	56.52
2028	66.68	65.28	591.37	578.95	57.09	55.89
2029	67.24	65.76	587.11	574.19	56.45	55.21
2030	67.73	66.17	582.29	568.9	55.76	54.48
2031	68.16	66.52	576.92	563.07	55.02	53.7
10th year (2032)	**68.52**	**66.81**	571.01	556.73	**54.24**	**52.88**
Targeted/expected savings		**-4.82**		**37.41**		**5.64**

Thus, a total saving of **38.23 BCM** is expected/targeted by 10th year through practicing water neutrality standards. (Refer to Annexure III).

[10] RBI (Reserve Bank of India) 2022, Handbook of Statistics on Indian States 2021-22, Reserve Bank of India.

CHAPTER 7: CONCLUSION

Water neutrality/positivity is a journey to enable appropriation of practices and measures for an improved water scenario considering both water resource availability and water quality. The concept implies that water footprint of activities are reduced as far as is practically possible and ensuring that the negative socioeconomic and environmental externalities are reduced as much possible, with any remaining impacts fully compensated by investing in sustainable water usage and water conservation measures. It proceeds towards achieving the water positive status after augmentation through various means such as rainwater harvesting and reuse/ recycling the treated water of suitable quality in the processes and subsequent storages.

Industry over the years has been undertaking proactive measures to improve their water usage across processes, claiming themselves as being water neutral and positive. Some of these claims on account of not being independently validated often lead to opposition and ambiguity.

To streamline the process, this document has attempted to bring out a standard definition and approach for water neutrality/positivity status based on defining key principles on which water neutrality should be based. It holds immense importance to draw meaningful comparisons, enable learning from available good practices that can be replicable and scalable.

The document incorporates the comments and suggestions received from the Members of Inter-Ministerial Steering Committee constituted by NITI Aayog under the chairmanship of Prof. Ramesh Chand, Member, NITI Aayog. The Terms of Reference of the Steering Committee and the suggestions along with corresponding responses are provided in Annexure I and IV.

It is envisaged that the standardized definition, approach, and principles put forth, will benefit the industry immensely. It will also help in extending and evolving this approach to other sectors/areas of the economy such as for towns, and cities for a secured water future.

ANNEXURE I: TERMS OF REFERENCE OF THE STEERING COMMITTEE CONSTITUTED TO PREPARE THE REPORT ON WATER NEUTRALITY

[1] Define the terms water neutrality, water positivity and water negativity unambiguously

[2] Prepare standards and guidelines for assessing water neutrality, water positivity and water negativity

[3] Formulate criteria of evaluation of water neutrality, water positivity and water negativity

[4] Define the minimum requirements and qualifications for agencies who can assess, audit and certify water neutrality, water positivity and water negativity.

[5] Estimate the water savings that could be achieved through practicing water neutrality standards in the next 10 years

ANNEXURE II: INPUT – OUTPUT ANALYSIS

An input-output model of an economy may be represented by the matrix relation (Schaefer et.al., 2019[11])

$$X = (I - A)^{-1}(Y_D + Y_E - Y_M)$$

$$\Delta X = (I - A)^{-1}(Y_D + Y_E - Y_M) - (I - A)^{-1}(Y_D)$$

$$\Delta X = (I - A)^{-1}(Y_E) - (I - A)^{-1}(Y_M)$$

$$\Delta X = \Delta X_E - \Delta X_M$$

where,
X is vector of output quantities
Y_D is the final domestic demand
Y_E is the exports
Y_M is the imports
A is the matrix of technical coefficients representing the inter-industrial interdependence
I is the Identity matrix
$\Delta X = (I - A)^{-1}(Y_E)$ is the increase in total output that is required to cope with the exports Y_E
$\Delta X_M = (I - A)^{-1}(Y_M)$ would be the additional total output required should the imports Y_M be produced domestically.

[11] Schaefer Torben, Maximiliano Udenio, Shannon Quinn, Jan C. Fransoo (2019). Water risk assessment in supply chains. Journal of cleaner production. Elsevier. 208 (2019) 636-648

ANNEXURE III: TARGETED WATER SAVING IN NEXT 10 YEARS THROUGH WATER NEUTRALITY STANDARDS

	Direct use by Industry sector		Other sectors through interventions by industries operating in the hydrologic unit			
			Agriculture		Domestic	
Year	Demand (increases by 3% on Col C. demand after saving, from the year 2024 onwards)	Demand after saving @ annual savings b/w 1.6% to 2.5%	Demand (increases by 1.41% on Col E. demand after saving, from the year 2024 onwards)	Demand after saving @ annual savings b/w 1.6% to 2.5%	Demand (increases by 1% on Col F. demand after saving, from the year 2024 onwards)	Demand after saving @ annual savings b/w 1.6% to 2.5%
A	B	C	D	E	F	G
Current Year (2023)	**63**	**61.99**	**603.8**	**594.14**	**59.47**	**58.52**
2024	63.85	62.76	602.52	592.28	59.11	58.11
2025	64.64	63.48	600.63	589.82	58.69	57.63
2026	65.38	64.14	598.14	586.78	58.21	57.1
2027	66.06	64.74	595.05	583.15	57.67	56.52
2028	66.68	65.28	591.37	578.95	57.09	55.89
2029	67.24	65.76	587.11	574.19	56.45	55.21
2030	67.73	66.17	582.29	568.9	55.76	54.48
2031	68.16	66.52	576.92	563.07	55.02	53.7
10th year (2032)	**68.52**	**66.81**	571.01	556.73	**54.24**	**52.88**
Targeted/expected savings		**-4.82**		**37.41**		**5.64**

Savings % used for calculations	
Year	Annual savings in %
Current year (2023)	**1.6**
2024	**1.7**
2025	**1.8**
2026	**1.9**
2027	**2**
2028	**2.1**
2029	**2.2**
2030	**2.3**
2031	**2.4**
10th year (2032)	**2.5**

Growth % used in calculation	
Industry	**1.03**
Agriculture	**1.0141**
Domestic	**1.01**

ANNEXURE IV: COMMENTS RECEIVED FROM STEERING COMMITTEE

I. Department of Water Resources, River Development & Ganga Rejuvenation (DoWR RD&GR)

Central Ground Water Board (CGWB)

The report is exhaustive and covers practically all aspects for defining and assessing water neutrality for industries. There are a few observations from Central Ground Water Authority (CGWA) which are as follows:

1. **Criteria for considering Rainwater Harvesting/ Artificial Recharge interventions as offsetting impact and its weightage in assessment:**

The temporal impact assessment may include criteria of water level behaviour within and/or in the vicinity of the plant for considering Rainwater Harvesting/ Artificial Recharge interventions as offsetting impact. This is analogous to the criteria for quality offset (**Para 4.2, Step-4 & 5**), where quality of treated water is to be at least comparable to the water quality of ecosystem. Poor quality resource cannot be considered for offsetting impacts for attaining water neutrality status. Likewise, efforts made to offset balance water utilization through measures such as rainwater harvesting/ artificial recharge **may only be counted** if sustainability of ground water withdrawal/resources is reflected through perceptible improvement in water level trend (such as arresting earlier declining trend or improvement in water levels or keeping the decline to insignificant levels, say less than, 10cm/Yr). More Weightage to be given to those assessment units where stage of ground water extraction is more.

Response: Incorporated under the heading Principle I: Water use efficiency through wastewater reuse, recycle and freshwater reduction in Chapter 3.

2. **Water Audit for ensuring Operational Efficiency:**

Water auditing is a practice to ensure optimal utilization of water per unit production. The benchmarking for each of the water using sectors need to be prepared for annual water auditing through certified auditors accredited by Government Agency.

Response: Incorporated under sub-heading Measuring in Para 4.1 in Chapter 4.

3. **Phase-wise Implementation of Water Neutrality Assessment:**

The assessment may be implemented in 2 phases. In Phase-I, bulk water consumers need to be targeted to optimize their water use efficiency against the international benchmarks or those set by Government of India.

In phase II, the smaller quantum users who are large in numbers shall be taken up to implement such measures. The measures should focus on optimizing the water consumption in the process workflow.

Response: Since the implementation of water neutrality principle is the choice of individual industrial units, it may not be necessary to segregate the units in terms of their sizes. It is also possible that the smaller units come forward pro-actively to adopt water neutrality practices.

National Mission for Clean Ganga (NMCG)

Comments on the NITI Aayog document on the water neutrality – standardization of definition and approach for industry:

1. Water neutrality is achieved when amount of water drawn from various sources in the ecosystem (surface or ground water) is replenished by the industry including a set of additional criteria as mentioned in the document. Therefore, water footprint of any and all activities are reduced as far as is practically possible and ensuring that the negative socioeconomic and environmental externalities are reduced as much possible, with any remaining impacts fully compensated by investing in sustainable water usage and water conservation measures. It proceeds towards achieving the water positive status after augmentation through various means such as rain water harvesting and reuse/ recycling the treated water of suitable quality in the processes and subsequent storages.

   Response: The essence of this paragraph is addressed in the document (Chapter 1 pg 9-10).

2. Water neutrality or positivity initiatives must focus on the sensitivity and conduciveness of the entire spectrum of interactions among ecological aspects vital for determining the natural ecosystem wholesomeness of the freshwater resources.

   Response: The point has been incorporated in the document (Principle II, Chapter 3).

3. Through water neutrality a system of accountability and responsibility for water footprint of the industry is established such that there is a transparency of all the water usages of the system.

   Response: Yes. The comment does not suggest any change in the document. The essence has been included.

4. Further for achieving water neutrality, there must be a robust system of measurement monitoring and evaluation of the quantities using IoT based digital fingerprinting-based instruments. Subsequently, the industry should establish adequate treatment system so as to ensure that the quality of water which is being released to the ecosystem or recycled back into the industry processes complies to the stipulated environmental norms. Thus, precise and reliable measurement of both quantities and qualities is important for a water neutral industry.

Response: Yes, quality and measurement are already addressed in the document. This point has been incorporated (Principle V: Mapping, Monitoring and Measuring; Chapter 3).

5. Therefore, the balance should be established in terms of both quantity and quality of the water drawn and replenished and also at the right time period, then only the industry may be called a water-neutral industry. Furthermore, by efficient use of existing water resources in the system and enhancing the augmentation of water, thus returning more water than consumed leads to a water positive industry.

   Response: Yes, quality and measurement are already addressed in the document. The above point has also been included under Principle VI, Chapter 3.

6. One important step towards becoming a water neutral or positive is that the industry must mandatorily carry out the water audit at regular intervals by a certified agency so as to obtain a water balance, inventorying all the water usages by measuring flow of water from the site of water withdrawal or treatment, through the distribution system, and into areas where it is used and finally discharged.

   Response: Water audit is included in the document (Chapter 4, Section 4.1).

7. There should be separate provision or criteria for water neutrality and water positive as the water positive is one step ahead of a water neutral industry. Besides, there should also be a provision or criteria for labelling a water negative industry which is having a significant water footprint, consumption and wastages so that it prompts them to improve their existing systems and proceed towards being water neutral or positive and adopt appropriate strategies so as to offset the impacts of water depletion or pollution.

   Response: Yes, this is detailed in Chapter 3. Equations and criteria are given under sub-head Principle VII: Elements of estimating credits and debits.

Central Water Commission (CWC)

1. With reference to the said report, there are no specific comments/observations. However, the main principles stated in the said report are regarding optimization and monitoring of freshwater usage, reuse of wastewater and improving water use efficiency for industries. As such the relevant guidelines of Ministry of Jal Shakti, CWC and other ministries for Reuse of waste/treated water, etc. may also be referred.

   Response: Since industries are already being advised to adopt reuse of treated wastewater, this need not be specified in the document again. This document is intended to provide water neutrality assessment principles. Each industrial unit is free to choose their strategies including reuse of waste/treated wastewater.

II. Department for Promotion of Industry and Internal Trade (DPIIT), Ministry of Commerce and Industry

Leather Sector

Draft report on Water Neutrality in Indian industries	**Comments**
Point No. 3 of Draft Report (p 9 of draft report) **Grey water footprint:** volume of polluted water that associates with the production of goods and services. It is calculated as the volume of water that is required to dilute pollutants to such an extent that the quality of the water remains above agreed water quality standards.	lt is necessary to consider domestic sewage also. Domestic water use has blue foot print and after utilization it will generates as domestic Sewage and considered as Grey Water Foot Print also. Similar to Carbon Credits, water credits systems have to be promoted in Industries, Urban Local bodies in order to achieve sustainable water neutrality. This will promote the sustainable water consumption pattern.
Response	The point is incorporated in document (Pg 9).
Page No.12 Box: 1: Defining water neutrality in case of new development	In case of any new development, total water use in the region after development must be equal to or less than total water availability in the region.
Response	The point is incorporated in Box 1.
Page No.24, Figure No.4.2: Framework for design of cost effective minimum water utilization network	The approach must be inverted (the triangle must be inverted) w.r.t. the order as mentioned in the report i.e. (i) Source Elimination will be the base of the triangle and fresh water utilization must be minimum so that cost effective water utilization network can be designed and can be achieved.
Response	This is a representation from source, quoted in the document.
Chapter 5	Voluntary industry specific Water Neutrality certification programmes have to planned although most of the industries have started practicing it considering the need of their required for example Tanning Industry, Textile, Pharma, Pulp and Paper Industries etc. However, for better implementation, it should be linked with green rating of industries concept and incentives may be provided to encourage more industry participation.
Response	This is noted.

Page No.40 of Draft Report Table 6.1 Projected water demand in India in billion cubic metre (BCM) (NCIWRD, 1999)	It was observed from the Table 6.1 that agricultural water demand is much higher than the industrial and domestic demand. In order to bring water neutrality in the agriculture sector, more awareness programmes have to be organized in association with Agricultural departments/irrigation department/ water use associations for optimal use of water based on crop specific/ region specific and terrain specific. Also, more focus has to be given for development of devices/ fixtures in order to achieve water neutrality for every drop of water.
Response	Yes, noted.

Cement Sector

- Cement plants/industry are already preparing water balance sheets as part of EIA/EMP and water audits being undertaken as per CGWA guidelines, therefore this ***water neutrality certification concept should*** *"be* ***integrated with*** *the existing framework instead* ***of creating*** *newer audit requirements".* The certification of water neutrality may be done as a onetime exercise to establish and verify the claims of the industry.

  Response: Yes, we will begin with one time exercise and then assess the periodicity going forward (Refer Chapter 3, Principle VI: Defining Water Neutrality: Temporal context)

- Water Positivity/water Neutrality certification may *be* ***a voluntary initiative*** instead of compulsory requirement for the industry.

  Response: This is noted.

- For each industry, the scope and boundary of the process should be defined e.g. some cement plants include water consumption in mining, colony, power plant along with plant consumption whereas some may only give water requirement in colony and plant etc. Therefore, a proper boundary rules may be defined for each of the industry.

  Response: Yes, the supply chain management approach detailed out in the section 4.3.1, Chapter 4, provides the boundary rules that will be specific for each industry.

- Cement plants which are located on hilly terrain, may not be able to conserve water in old mine pits. Even check dams formed may not be able to sustain water due to perforated rock structure. ***Considering the peculiar scenario, exemption should be provided on case-to-case basis.***

Response: Point noted. This will be taken on case to case because water neutrality needs to ultimately be ensured by every plant.

- Any new cement plant won't have the advantage of old mined out pits for water harvesting, therefore, *for new plants some gestation period should be given to achieve water positivity or water neutrality.*

  Response: This is noted.

- The frequency of certification of water positivity/ neutrality for an industry may also be defined.

  Response: This is defined in the document (Chapter 3, Principle VI).

- The minimum requirements of 15 years' experience for agencies *who can assess, **audit** and certify water neutrality is too high. The number of years may be revisited.*

  Response: We can revisit this aspect after 1 year of implementation of water neutrality standards.

- *Capacity building and training of internal auditors at industry level as well as consulting agency level should be taken up before implementing any standards for water neutrality.*

  Response: Yes, noted.

- Any requirement of certification like ISO 17029 is proposed for the agencies/consultants certifying water neutrality may be considered appropriately.

  Response: Yes, noted.