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Water shortages, quality deterioration and flood impacts are main challenges which require greater attention and an integrated action**.** The right tool to do so is the Integrated Water Resource Management (**IWRM**) which can assist countries in their endeavour to deal with water issues in ***a cost-effective*** and ***sustainable way***.

4.1. Definition of IWRM: is ***a process*** which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. It consider that all parts of the water cycle (rivers, lakes, groundwater, rainfall) ***are interconnected*** and that water use in ***one area affects others***.

IWRM is no longer the old "**silo**" **approach** (e.g., a department for drinking water, a separate one for irrigation, another for wastewater) towards a holistic, cross-sectoral, and participatory approach.

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4.2. The main challenges of IWRM:

4.2.1 Securing water for people: Most countries give first priority to satisfaction of basic human needs for water, one fifth of the world's population is without access to safe drinking water and half of the population is without access to adequate sanitation.

4.2.2 Securing water for food production: Water is increasingly seen as a key constraint on food production, on a par with (à égalité avec), if not more crucial than, land scarcity. Irrigated agriculture is already responsible for more than 70% of all water withdrawals (more than 90% of all consumptive use of water). Even with an estimated need for an additional 15-20% of irrigation water over the next 25 years - which is probably on the low side - serious conflicts are likely to arise between water for irrigated agriculture and water for other human and ecosystem uses.

4.2.3 Developing other job creating activities: All human activities need water and produce waste, but some of them need more water or pro duce more waste per job than others. This consideration has to be taken into account in economic development strategies, especially in regions with scarce water resources. (IWRM: Global Water Partnership)

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4.2.4 Protecting vital ecosystems: Terrestrial ecosystems in the upstream areas of a basin are important for rainwater infiltration, groundwater recharge and river flow regimes. The ecosystems depend on water flows, seasonality and watertable fluctuations and have water quality as a fundamental determinant. Land and water resources management must ensure that vital ecosystems are maintained and that adverse effects on other natural resources are considered and where possible ameliorated when development and management decisions are made.

4.2.5 Dealing with variability of water in time and space: All the freshwater available for human use originates from precipitation, which varies immensely over time and space. Most tropical and sub-tropical regions of the world are characterized by huge seasonal and annual variations in rainfall, often compounded by erratic short-term variations. The challenge in managing variability is clearly greatest in the poorest countries with the least financial and human resources to cope with the water problems. The effects of global climate change may add further to this challenges.

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4.2.6 Managing risks: Variations in water flows and groundwater recharge, whether of climatic origin or due to land mismanagement, can add to drought and flood events, which can have catastrophic effects in terms of large scale loss of human life and damage to economic, social and environmental systems. Water pollution creates another set of risks, affecting human health, economic development and ecosystem functions. Economic risks are also important in water resources manage ment and development due to the often large-scale and long-term character of the investments required. Political instability and change represents yet another important risk factor for IWRM example Egypte- Ethiopia.

4.2.7 Creating popular awareness and understanding: Public awareness is needed in order to mobilize effective support for sustainable water management and induce the changes in behaviour and action required to achieve this. Additionally, public awareness and subsequent pressure for action may be vital in fostering the political will to act.

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4.2.8 Forging the political will to act: In a world of scarce resources financial as well as natural – political attention and commitment are vital to ensure good decision-making and the necessary investments in the development and management of water resources. Bringing water resources issues ***to the top of the political agenda*** is fundamental to the long-term success of sustainable water resources management.

4.2.9 Ensuring collaboration across sectors and boundaries: ;The traditional sectoral and fragmented approach to water resources management has often led to governing bodies representing conflicting interests. Policy objectives have been set without consideration of the implications for other water users and without consultation across sectoral and institutional boundaries. As a result available financial and physical resources (including water) have not been employed efficiently. There is a need to find appropriate ways to co-ordinate policy-making, planning and implementation in an integrated manner across sectoral, institutional and professional boundaries of national and international watercourses.

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4.3 The IWRM Principles: The principles, approaches and guidelines relevant to IWRM are numerous and each have their areas of appropriate application. They aim to promote changes and to improve water resources management. The International Conference on Water and the Environment in Dublin, 1992 have been set four principles for the IWRM which are:

1. Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.
2. Water development and management should be based on a participatory approach, involving users, planners and policy makers at all levels.
3. Women play a central part in the provision, management and safeguarding of water.
4. Water has an economic value in all its competing uses and should be recognized as an economic good.

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4.4 The Pillars to implement IWRM: For IWRM to be effective, it must be built on three interconnected pillars. All three must be strong; if one is weak, the whole system fails.

Pillar	What it means	Practical Examples
Enabling Environment (Policies & Laws)	The "rules of the game." This pillar creates the legal, policy, and strategic framework for integrated water management.	National water laws that allocate water rights. - Policies that price water fairly. - Regulations to control pollution and protect ecosystems. - River Basin Management Plans.
Institutional Framework (Organizations & Roles)	The "players" and how they coordinate. This pillar establishes the organizations and mechanisms needed to implement the policies.	- A single River Basin Authority for a transboundary river. - Platforms for coordination between agriculture, energy, and environment ministries. - Clear roles for local governments, water user associations, and private operators.

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Pillar	What it means	Practical Examples
Management Instruments (Tools & Actions)	The "tools of the game." This pillar provides the practical methods, data, and tools to make decisions and manage water on the ground.	- Water permits and licenses. - Monitoring networks (real-time flow, quality, groundwater levels). - Economic instruments (water tariffs, subsidies, pollution fines). -Water allocation models and drought early warning systems.

4.5 The Cycle of implementation: The Enabling Environment (laws) shapes the Institutions (organizations), which then use Management Instruments (tools) to manage water. Feedback from the tools informs changes to policies and institutions.

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4.6 Benefits of IWRM in the Water Sector: Adopting IWRM transforms the water sector from a fragmented, reactive system into a coordinated, proactive, and resilient one. The key benefits include:

4.6.1 Enhanced Water Security & Reduced Risk: IWRM helps By managing surface water, groundwater, and land use together (e.g., recharging aquifers in wet years for use in dry years) and coordinating floodplain management. It is a greater resilience to droughts, floods, and climate change impacts.

4.6.2 More Efficient & Productive Use of Water: Encouraging water recycling (using treated wastewater for irrigation), reducing leakage, and allocating water to the highest-value economic uses rather than wasteful ones. Finally it is doing more with less water (improved water productivity).

4.6.3 Improved Ecosystem Health & Water Quality Establishing minimum environmental flows, managing pollution from all sources (factories, farms, cities) in an integrated way, and protecting critical habitats. As benefits we will have healthier rivers, lakes, and wetlands, and cleaner water downstream.

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4.6.4 . Equitable Access & Reduced Conflict: Through participatory decision-making platforms and transparent water allocation rules, reducing "water wars" at local and transboundary levels. As a result a fairer allocation of water between different users (farmers, cities, industry, environment) and between upstream/downstream communities.

4.6.5 Financial Sustainability & Lower Long-Term Costs: Avoiding costly, single-purpose projects (e.g., a dam for hydropower that kills a downstream fishery). Instead, it promotes "nature-based solutions" (e.g., restoring a wetland for flood control is often cheaper than a concrete barrier) and full-cost recovery pricing. The benefit from this action is more cost-effective infrastructure and operations.

4.6.6 Better Data & Informed Decision-Making: It requires integrated monitoring systems (e.g., one database for water quantity, quality, and use) which allows managers to see trade-offs and predict consequences of a decision. The decisions will be based on facts, not politics or crisis.