

Water Security Risk – Part Seven

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The Role of Watershed Management in Strengthening Water Security and Sustainable Resource Management

At a time when water scarcity, soil erosion, and devastating floods are threatening the country's landscape, watershed management represents a smart strategy that goes beyond a purely technical measure. It offers a way to turn floods into opportunities and replenish Iran's thirsty land. Unlike costly dam-building and water-transfer projects, watershed management initiatives have achieved significant improvements in water and soil sustainability in many parts of the country at a much lower cost.

This approach not only prevents soil erosion and sediment accumulation in dams, but also revitalizes sustainable rural development by increasing groundwater recharge, restoring traditional qanats, and supporting both rain-fed and irrigated agriculture. By relying on indigenous knowledge and community participation, watershed management has created a sustainable bridge between natural-resource management and food security.

Beyond its economic benefits, its environmental achievements are also significant. Increased vegetation cover, habitat conservation, reduced dust and restoration of biodiversity are among the outcomes achieved through this approach. In other words, watershed management is an investment in the future—an investment in land, water, and life.

As one of the fundamental pillars of integrated natural-resource management, watershed management plays a key role in ensuring water security, reducing flood damage, and maintaining the country's ecological sustainability. In practice, watershed management creates a link between water, soil, and vegetation management and directly contributes to increasing groundwater storage, controlling soil erosion, and reducing sediment accumulation in dams. Given Iran's arid and semi-arid climate, expanding and adapting watershed-

management solutions to local conditions can serve as an effective tool for addressing water scarcity and increasing the resilience of the land.

1. Controlling Erosion and Sedimentation in River Basins

One of the most important challenges in water management in Iran is sediment accumulation in dams and rivers. Watershed-management measures, including planting vegetation in highland areas, stabilizing slopes, and constructing stone-and-mortar structures along flood channels, can significantly reduce the amount of sediment entering reservoirs. This not only extends the useful life of dams but also prevents the annual loss of millions of cubic meters of water.

2. Artificial Recharge and Increasing Groundwater Storage

Through flood-spreading projects, construction of earthen, stone, and gabion check dams, and directing surface water toward aquifers, the balance between groundwater extraction and recharge can be improved. These methods are among the most effective natural tools for combating declining groundwater levels in arid regions. Aquifer-recharge projects and underground dams that have been implemented on a pilot basis in different parts of the country can serve as indigenous models for developing natural water-storage capacity.

3. Using Simple, Community-Based Structures

Successful watershed management does not require complex or expensive tools. Instead, it can be based on simple, practical, low-cost measures implemented at the local level. Earthen reservoirs, rainwater-storage ponds, crescent-shaped bunds, and small flood-spreading channels are examples of measures that can be implemented with local community participation and collectively play an important role in increasing surface-water storage and reducing erosion.

4. Local Community Participation and Public Investment

Experience has shown that wherever local communities have actively participated in natural-resource projects, the success and sustainability of those projects have been greater. Establishing local watershed-management cooperatives, creating village funds for maintaining and repairing structures, and transferring part of resource management to local communities are effective ways to reduce costs and improve project efficiency. Combining

indigenous knowledge with engineering expertise can increase water productivity and reduce local tensions over resource use.

5. Economic and Environmental Added Value of Watershed Management

Watershed-management activities are not limited to water storage; they can also create sustainable income and employment opportunities for rural communities. Using dredged sediments in construction projects and soil restoration, producing seedlings and rangeland plants, and developing nature-based tourism are among the economic opportunities offered by watersheds. From an environmental perspective, reducing excessive extraction of natural materials, increasing vegetation cover, and restoring aquatic and terrestrial habitats are among the direct benefits of these measures.

6. Integrating Watershed Management with Broader Water-Management Policies

Integrating watershed-management policies with national water, agricultural, and environmental programs is unavoidable. Erosion-control, dredging, surface-water storage, and aquifer-recharge projects should be pursued within a coordinated and sustainable system. The use of satellite data, evaporation and runoff simulation models, and modern forecasting technologies can improve the accuracy and efficiency of watershed-management projects.

7. A Forward-Looking Approach to Watershed-Management Policy

Sustainable water-resource management is not possible without attention to watershed management. Policymakers should view watershed management not merely as an infrastructure project, but as a national strategy for water security and land restoration. Continuing this approach alongside education, public awareness, and financial incentives for community participation could become a turning point in transforming the country's natural-resource management.

Successful Watershed-Management Models at Home and Abroad and Their Economic Analysis

1. Successful Domestic Models

A. Aquifer-Recharge and Flood-Spreading Projects in Kerman Province

In the desert areas of Kerman, flood-spreading projects implemented across alluvial plains have led to a noticeable rise in groundwater levels and the restoration of traditional qanats.

In some basins, such as Daq-e Fahraj and Rafsanjan, groundwater levels increased by 3 to 5 meters after three to five years of project implementation, while water quality also improved.

Studies by Iran's Ministry of Agriculture indicate that every 10 billion rials invested in aquifer-management projects is equivalent to saving 40 to 50 billion rials in groundwater resources and preventing land subsidence.

B. Community-Based Watershed-Management Projects in Khuzestan and Fars

In these regions, farmers have established local cooperatives and undertaken the construction of earthen check dams and water-storage ponds.

As a result, agricultural production stability has increased by up to 30 percent, while flood damage and soil erosion have been reduced.

In addition, local community participation has reduced the cost of maintaining and repairing the structures by up to 60 percent.

C. Watershed-Management Experience in Golestan Province after the 2019 Floods

The implementation of stone-and-mortar structures, construction of small dams, and management of surface runoff in the upstream areas of the Gorganrud basin reduced the intensity of seasonal floods by 40 percent.

As a result, the security of downstream habitats, including the Gomishan Wetland, improved, while annual damage to agricultural land decreased by approximately 35 percent.

2. Successful International Models

A. Spain – Participatory Management of Dry Mediterranean Basins

In the arid regions of southern Spain, particularly Murcia and Almería, local cooperatives have implemented watershed-management and rainwater-

harvesting projects, increasing agricultural water productivity by up to 45 percent.

The Spanish government has reported an economic return of approximately 3 to 4 euros for every euro invested in watershed management, through increased production, reduced erosion, and resource conservation.

B. India – Community-Based Watershed Projects in Maharashtra

Through simple measures such as constructing storage ponds, controlling runoff, and planting drought-resistant trees, vegetation cover and groundwater recharge have improved significantly.

In these areas, average agricultural production of wheat, pulses, and vegetables increased by 30 to 50 percent after four years.

In addition, local employment and rural job opportunities increased by 25 percent.

C. Australia – Integrated Watershed Management Using Data-Driven Technology

In Australia's arid states, the use of intelligent rainfall-runoff models and the design of rainwater-storage systems have increased the volume of water recharging aquifers by up to 20 percent.

The result has been greater agricultural sustainability and lower irrigation costs for farms.

Economic Justification and Investment in Watershed Management

On average, every one unit of investment in watershed management generates 4 to 6 units of direct or indirect economic returns through reduced damage, increased production, and sustainable employment.

Impact of Watershed Management on Agricultural Production

Increased crop yields: In areas covered by watershed-management projects, the yields of rain-fed crops such as wheat, barley, and chickpeas have increased by 30 to 50 percent.

Reduced water stress: Reliable water supplies during dry seasons reduce irrigation costs by 20 to 30 percent.

Improved soil quality and fertility: Reduced erosion and increased soil organic matter lower the need for chemical fertilizers and improve product quality.

Restoration of abandoned land: In some central regions of the country, unused land has returned to agricultural production following watershed-management interventions.

Legal and Executive Measures for Expanding Watershed Management with Parliamentary and Government Support

The expansion of watershed management in Iran requires sustainable support at the legislative, budgetary, and administrative levels. Although effective measures have been taken in recent years, the absence of permanent and coordinated mechanisms has limited the continuity and expansion of these projects. To overcome this situation, a range of legal, institutional, and financial measures can be considered:

1. Developing a Comprehensive Watershed and Aquifer-Management Law

The first step is to adopt a comprehensive and up-to-date law defining the position of watershed management within the country's natural-resource management system. The law should clearly establish the responsibilities of government agencies, budget-allocation mechanisms, public participation, and the framework for using water and soil resources. Under such a framework, the government would be required to allocate a fixed share of the annual public budget to watershed-management projects.

2. Establishing an Independent and Sustainable Budget Line

Watershed management should have an independent budget line in annual budget bills so that its funding does not depend on temporary decisions. Part of the funding allocated to dam construction, dredging, and flood-control projects could be redirected toward watershed management, as this approach can reduce government costs and deliver greater long-term effectiveness.

3. Establishing a National Watershed Management and Land Restoration Fund

Creating a dedicated fund to finance watershed-management projects, with participation from the government, banks, and the private sector, could ensure

the continuous implementation of projects. The fund could be financed through environmental levies on industries, rural-development allocations, and international assistance. Its role would be to provide low-interest financing to cooperatives, municipalities, and local project operators.

4. Strengthening Public Participation and Local Cooperatives

Experience has shown that public participation is a key factor in the success of natural-resource projects. Regulations should be developed for establishing local watershed-management cooperatives so that rural communities can participate directly in project implementation. The government should also support these cooperatives through tax exemptions and banking facilities.

5. Using Innovative Financial Instruments

To secure sustainable financing, mechanisms such as green participation bonds, public-private partnerships (PPP), and Build-Operate-Transfer (BOT) schemes can be used. These methods can attract non-governmental capital while increasing private-sector participation in natural-resource conservation.

6. Incorporating Watershed Management into Development Policies and Plans

Watershed management should have a clear position in the country's five-year development plans. Requiring government agencies to prepare a "watershed-management annex" for infrastructure projects such as dam construction and road building could help prevent the destruction of watersheds and the waste of resources.

7. Providing Financial and Insurance Support for Projects

Commercial banks and the National Development Fund can provide long-term preferential loans for flood-spreading projects, rangeland restoration, and artificial groundwater recharge. Establishing specialized natural-resource insurance to compensate for losses caused by floods or droughts would also help increase the confidence of local communities.

8. Expanding Scientific Monitoring and Data-Driven Technology

Successful watershed management requires accurate data and continuous monitoring. Establishing a "National Watershed Data Center" and using remote

sensing, GIS, and intelligent rainfall-runoff models could provide a scientific and targeted foundation for decision-making in watershed management.

The Role and Importance of Education in Sustainable Water Security

Water security cannot be achieved solely through technical measures such as constructing check dams, aquifer management, or flood spreading. A significant part of it depends on public knowledge and awareness. Education plays a vital role both at the level of local communities and at the policymaking level:

1. Increasing Public Participation:

Successful watershed-management projects in Khuzestan, Fars, and Kerman demonstrate that the active participation of local communities is essential for the sustainability of projects. Educating people about the importance of conserving water and soil resources, as well as simple methods of flood spreading, constructing ponds, and building earthen check dams, enables communities to play an active role in resource conservation and helps reduce maintenance costs.

2. Promoting Indigenous Knowledge and Combining It with Modern Technologies:

Education enables local communities to combine their traditional knowledge with modern technologies such as GIS, remote sensing, and rainfall-runoff modeling. This integration increases water-use efficiency and makes watershed-management measures more effective.

3. Creating a Culture of Sustainable Resource Management:

Continuous education in schools, universities, and non-governmental organizations helps develop a long-term attitude toward conservation, efficient use, and protection of water resources. Awareness-building, particularly in arid and semi-arid regions through provincial broadcasting networks, is key to preventing excessive water extraction and reducing water-related tensions.

4. Reducing Risk and Increasing Resilience to Crises:

Educated communities are better able to respond to floods, droughts, and soil erosion. Public information and training on simple flood-spreading structures, runoff management, and vegetation conservation can reduce the risks associated with water scarcity and flood damage.

5. Empowering Decision-Makers and Policymakers:

Specialized training for officials and managers responsible for water and soil resources enables major watershed-management policies and programs to be developed from a scientific and forward-looking perspective. This strengthens the country's water security while reducing implementation and environmental costs.

Conclusion:

Education is a complementary link between watershed management and integrated water-resources management. Without public information, awareness-building, and the empowerment of communities and managers, even the best technical projects will not achieve full sustainability. Therefore, sustainable water security can only be achieved through the integration of technical measures, public participation, and targeted education.

Watershed management is an investment in the future of the land—a low-cost, high-return approach to preserving water, soil, and life in Iran. If Parliament facilitates this process by adopting supportive legislation, and the government by providing sustainable funding and financial facilities, it will be possible to transform the threat of floods into an opportunity for sustaining life. Such a policy would not only promote environmental sustainability but also contribute to the expansion of rain-fed agriculture, rural employment, and national water security.

Successful domestic and international models demonstrate that watershed management is not merely an environmental approach, but also a highly effective economic and social investment. This approach delivers the greatest return to the land at the lowest cost. Experience has shown that the cost of implementing watershed-management projects is significantly lower than that of dam construction and water-transfer projects, while their return on investment can be several times the initial cost, reflected in increased

agricultural production, reduced flood damage, and the conservation of natural resources.

By drawing on indigenous knowledge, modern technologies, and the participation of local communities, watershed management can simultaneously ensure the sustainability of water and soil resources, create employment, and strengthen food security. Large-scale, community-based implementation of these projects can reduce flooding and control erosion while increasing groundwater recharge and preserving surface-water resources.

In fact, watershed management is the missing link in integrated water management in the country—a link that can help Iran break out of the cycle of erosion, water scarcity, and the deterioration of natural resources and move toward a sustainable, resilient, and greener future.

Therefore, developing and investing in watershed management is not a choice but a strategic necessity for achieving water security, restoring the land, and promoting sustainable agriculture in Iran...