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Irrigation Practices and Water Security in the Tibetan Plateau

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Key Points

- Irrigated agriculture is the biggest consumer of water in the Tibetan Plateau, with nearly 40 per cent of land in the region under irrigation.
- Institutions at state, basin and regional levels are failing to adequately manage irrigation, leading to overexploitation of water resources.
- Continual overexploitation of water in the Tibetan Plateau jeopardises water and food security in the region. Large-scale environmental degradation as a result of irrigation has led to crop declines and a loss of wetland ecosystems.
- Water scarcity is also creating tension between riparian states over conflicting claims on shared water resources.
- If a water scarcity crisis is to be avoided, more responsive institutional models must be developed to manage water distribution and use in the region.

Summary

Inefficient water management practices have been the major driver of water scarcity throughout the Tibetan Plateau. Climate fluctuation and demographic changes in the region have also contributed to the diminishing water supply, but the rising threat of water shortage is most closely linked with ineffective government action to regulate irrigation practices. Research and development into modernising irrigation in the Tibetan Plateau is gaining momentum; however, more responsive institutional models to regulate irrigation practices must be developed if water use in the region is to be sustainably managed.

Analysis

Nearly 40 per cent of cultivated land in the Tibetan plateau region is under irrigation. As in the rest of the world, water in the Tibetan Plateau is facing increasing and competing demands. Climate factors, such as shrinking water tables, predicted changes to the monsoon and glacial melt are expected to significantly reduce water supplies in the region. Agriculture already consumes 95 per cent of total water use annually and agricultural productivity will need to increase to support a growing regional population. Present irrigation practices are so inefficient that in a business-as-usual scenario, states could face crippling water shortages. Regional institutions are failing to adequately manage water that is currently available, resulting in overexploitation of surface and groundwater, poor crop intensity and low productivity. Water markets throughout the region are underdeveloped and water pricing schemes under-regulated. Effective institutional models to deal with these issues are currently unavailable. The region suffers from both a lack of governmental transparency and cooperation between riparian states on trans-boundary water allocations.

The Importance of Irrigation Management

The effect of the Green Revolution

The Tibetan Plateau boasts some of the world's largest river systems and oldest irrigation schemes, including the Gand Anucut and the Indus Basin, which have supported regional food production for thousands of years. The Green Revolution in the mid-1960s caused states to abandon traditional models of irrigation. Fear of global food insecurity led governments and Western donors to invest heavily in Asian agriculture, introducing high-yielding crop varieties and enhanced irrigation technologies into the region. Between 1962 and 1985, the irrigated area in South and South-East Asia grew at an average of 2.7 per cent to 3 per cent per year. This enabled farmers to increase yields, stabilise production and create employment in rural areas.

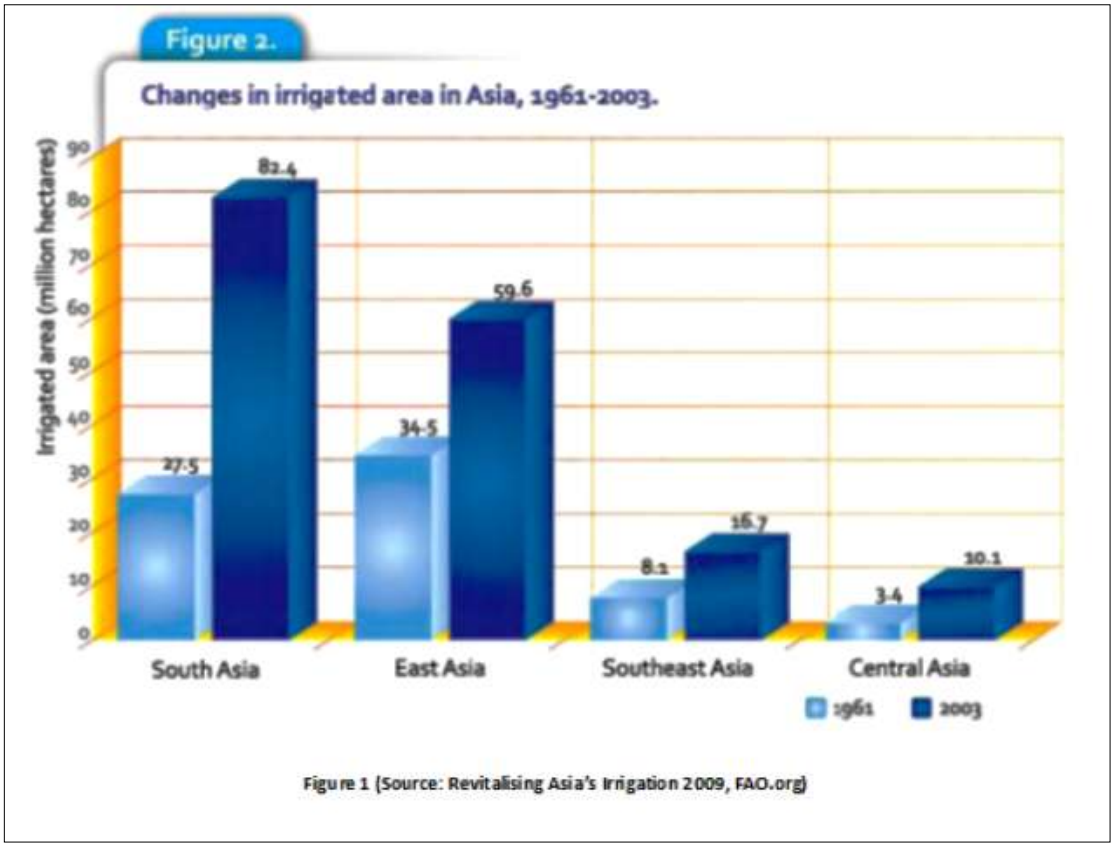

Figure 1 (Source: Revitalising Asia's Irrigation 2009, FAO.org)

A lack of foresight by policymakers during this period meant that the relative prosperity enjoyed during the Green Revolution was short-lived. As the region moved from a food deficit to a food surplus, oversupply of crops led to a decline in grain prices. Lender countries eventually withdrew support, expecting debtor states to maintain the established infrastructure, but in many cases this did not occur. Mass monoculture introduced during the Green Revolution has led to soil degradation. Irrigation introduced in upstream locations has affected biodiversity downstream and improperly designed irrigation schemes have led to increased salination and water-logging. Most significantly, the changes did not include efficient systems to manage the new irrigation systems were not put in place, and since the Green Revolution, the Tibetan Plateau has experienced marked overconsumption of irrigation water.

Water Pricing

In most countries worldwide, the state owns water resources, maintains infrastructure and sets a price for water use that covers the costs associated with maintenance. Public systems in the Tibetan Plateau region are notoriously lacking in transparency, which has led to deregulation. Reliable data on water requirements and use in the region is hard to obtain. In the Indian state of Andhra Pradesh, between 1996 and 1998, a transfer of irrigation management from government officers to water management groups, saw the official irrigated area 'quadruple'. In fact, few new irrigation systems were introduced; rather, this change indicates under-reporting of government managed schemes, so that government officials could pocket water usage fees for themselves.

Governments also have little incentive to maintain infrastructure, as donor countries tend to be far more eager to assist with rehabilitation projects, rather than maintenance. This has produced a further trend whereby states fail to act responsibly in the maintenance of infrastructure, allowing structures to fall into disrepair until rehabilitation is eventually required.

Atomistic Irrigation

Government inefficiency has also led to the development of atomistic irrigation throughout the Tibetan Plateau. Present regulatory systems in India permit anyone to sink a tube well into their land from which to draw water; this has produced a private groundwater market. Poor management of this market is causing a steady depletion of groundwater tables, particularly in the alluvial belts of Punjab, Haryana, Rajasthan and Uttar Pradesh. Approximately 62.4 per cent of irrigation potential in India comes from groundwater extraction and the Indian Ministry of Water Resources has estimated that approximately 58 per cent of replenishable groundwater in India has already been exploited.

In Indian states where electricity is not freely available and farmers require diesel to power tube wells, an additional problem is becoming apparent. During the last decade, the price of diesel and other energy commodities has risen significantly across the globe, raising the cost of pumping groundwater. In response to this the Tibetan Plateau's groundwater economy is diminishing, as smallholder and share-crop farmers can no longer afford to draw enough water to irrigate their crops. Many farmers who have turned to atomistic irrigation, only to find that they can no longer afford it, are either switching to high risk crops that require less water or leaving farming altogether. Groundwater is being unevenly exploited: in areas using diesel, high fuel costs mean that the groundwater market is unsustainable; while in areas using electricity, groundwater is diminishing as a resource.

Implications

Ongoing overconsumption of water due to inefficient regulation will have serious implications for water and food security throughout the region. States are heavily reliant on current systems of agricultural production to feed their growing populations. Overexploitation of groundwater, coupled with a rise in energy prices threatens agriculture and rural communities. Smallholder farmers in particular, who can no longer afford to irrigate traditional crops, are investing in higher-risk crops, or being forced to leave agriculture and search for work in urban areas. Water as a resource is becoming scarcer, with water tables diminishing above and below ground.

Health risks associated with the unregulated practice of groundwater production are also beginning to emerge. Unsanitary groundwater pumping practices and the drawing of groundwater from excessively deep aquifers have been linked with outbreaks of arsenic poisoning in rural communities throughout Bangladesh and Western India. As the water

table continues to fall, the concentration of arsenic in the regional water supply is rising and contaminating crops and other parts of the food chain.

At the basin level, over-irrigation is contributing to large-scale environmental degradation. Rice production in the Mekong Delta, which is essential to food security throughout the region, is causing soil-acidification and the loss of wetland ecosystems. The majority of the rice crops are produced by flood-farming, which requires more than twice as much water as modern "dry" irrigation systems. Flood farming has been used for thousands of years, but traditionally more than 50 per cent of the water used re-entered the hydraulic system by downward percolation through the soil. Today, intensive farming and extensive use of chemical fertilisers has reduced soil productivity and contributed to water-logging. Instead of efficiently moving back into the natural hydraulic system, much of the water either evaporates or stagnates in the fields. The net effect is an increase in poverty, as soil becomes less fertile and farmers are forced to leave unproductive land.

Similarly, excessive withdrawals from the Indus basin, which provides the overwhelming majority of food for Pakistan and Northern India, has led to poor drainage of cropping areas, extensive use of pesticides and consequent soil deterioration and salinisation. The Indus Basin Irrigation System (IBIS) is the largest contiguous irrigation system in the world. Irrigation withdrawals in the Indus basin account for 93 per cent of total withdrawals and irrigation allocations often exceed average flows. Exploitation of the basin is governed by the Indus Water Treaty, which clearly defines the entitlements of riparian states around the basin. This is the only trans-boundary basin management mechanism in existence; however, the Indus basin lacks efficient water management institutions, which is contributing to the increasing tensions over water security between India and Pakistan.

Potential for Conflict over Water Rights

As water becomes scarcer, conflicting claims over shared water resources pose a major regional security challenge. Bangladesh, Bhutan, China, India, Nepal and Pakistan share twenty major rivers, which provide the vast majority of irrigation water to their related agricultural sectors. Water in the region is unevenly distributed, meaning that downstream riparian states are vulnerable to the practices of upstream riparian states. This explains why Pakistan, the lower riparian to India, is such a strong advocate of the Indus Treaty, which prohibits any construction that facilitates the storage or diversion of river water. Dam construction in Northern India is a constant source of bilateral tension, as the cumulative effect of many dam projects in India enables it to withhold water supply from Pakistan. The construction of the Baglihar dam in Northern Punjab has caused particular tensions between the two states. Pakistan views the project as an Indian 'conspiracy' to withhold water from Pakistan.

Similarly, India and Bangladesh have long been engaged in disputes over the sharing of the waters of the Ganges River. Bangladesh has tended to view India as striving for regional hegemony and has reacted defensively towards all Indian attempts to control water distribution from the Ganges. The construction of the Farakka

Barrage in 1975 created significant tension between the two states. The barrage was constructed to divert water from the Ganges River to Calcutta during the dry season, to protect the city's water security. Since 1996, a bilateral treaty has been in place to regulate the sharing of waters at Farakka. This treaty sets rules for water allocations of water during the dry season and prevents unreasonable withholding of water by India, but fails to address the reasons why the water flow is dwindling. On both sides of the border, agricultural irrigation is the largest consumer of water and a major contributor to water scarcity. Both India and Bangladesh must establish more efficient irrigation management practices if they hope to reduce tensions over water security.

Current Strategies to Address Water Scarcity

Policymakers in the Tibetan Plateau face numerous obstacles to success. The region is marked by a general lack of governmental transparency, financial weakness of states and weak institutional frameworks. Nonetheless, several strategies are currently in place to attempt to deal with water scarcity in the region.

Modernisation of irrigation technology

Investment in the modernisation of the irrigation technologies used throughout the Tibetan Plateau is increasing. Inadequate regulation of groundwater has had terrible consequences for India. Strategies for enhancing groundwater management, such as controlled use of groundwater for agriculture and increased regulation and contamination checks, are currently being initiated. Many states are shifting to the use of sprinkler and drip irrigation systems, which are far more efficient in their use of water. The use of chemical sprays on reservoir surfaces and mulches on soils can also prevent water loss through evaporation. Increased focus is also being placed on enhancing production from rain-fed agriculture, which is an inexpensive and time-efficient means of enhancing both food production and water security. Several assessments of global food production have hypothesised that 70 per cent of the food deficit in the region could be met by enhancing the yield of rain-fed crops.

China, which has one-fifth of the world's population but only seven per cent of its water resources, is beginning to modernise irrigation very effectively. The Shanxi province is currently undertaking an Integrated Agricultural Development project, funded by the Asian Development Bank. Modern drip sprinkler systems, micro-sprinklers suspended in mesh tents and modernised greenhouse irrigation systems have all been implemented. Reduced water wastage and energy consumption have been observed, as well as increased crop yields with lower labour inputs. In Pingshun county, micro-sprinkler use is also improving the quality of leafy vegetables, by flushing out aphids and allowing pesticide use to be reduced.

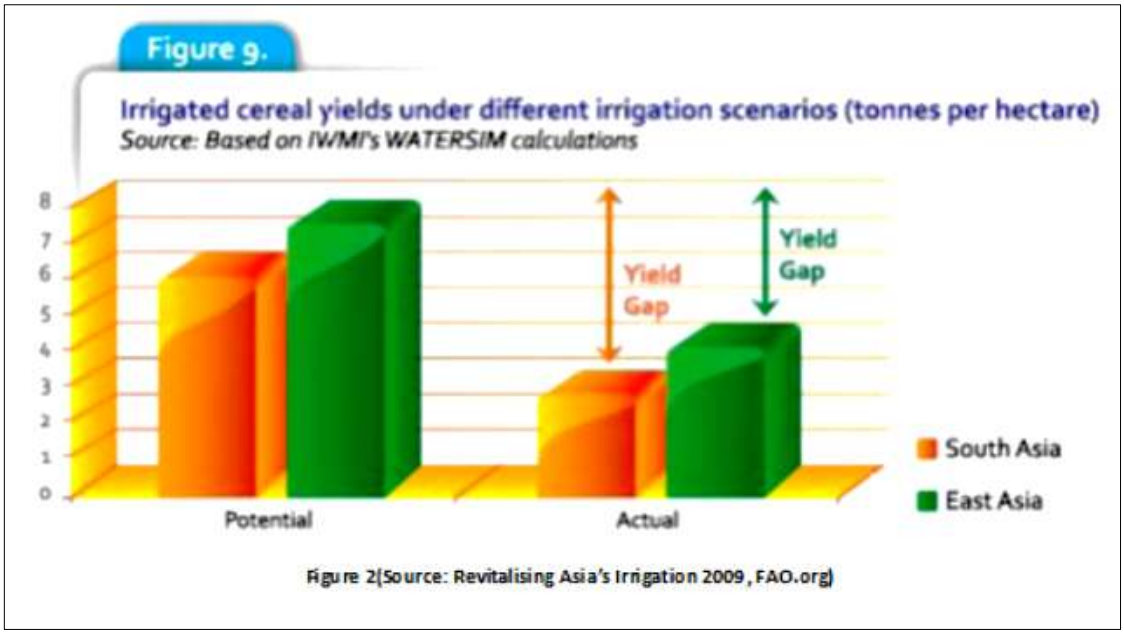

Figure 2(Source: Revitalising Asia's Irrigation 2009, FAO.org)

Modernisation of Institutional Management Systems

Decentralisation of irrigation management can be observed throughout the region. In India in particular, the national government is actively encouraging Participatory Irrigation Management (PIM), whereby farmers' organisations and water users' associations take an active role in managing resources. These organisations allow for more participatory decision making and the involvement of farmers themselves in irrigation management. Empowering farmers with a management role fosters a sense of community responsibility. PIM schemes are raising agricultural productivity and improving the maintenance of irrigation systems. In centrally managed systems, such as India, PIMs are also an effective means of combating the lack of government transparency.

The Vietnamese government is engaged in a long term plan, backed by the World Bank, to encourage participatory management. In 2007 the government introduced an Irrigation Service Fee waiver, aimed at supporting the responsible management of infrastructure and boosting agricultural productivity. The policy has delivered both economic and environmental benefits in its initial years. This trend is slowing due to inflation and a lack of commitment to institutional reforms by provincial authorities. Nonetheless, it has been an effective starting point for the future development of a PIM system in Vietnam.

Bilateral agreements, such as the Indus and Ganges Treaties, have been relatively successful in offering frameworks for managing basin-related issues between riparian states. These treaties create mechanisms for diplomatic water management and have had a positive impact on bilateral relations. In this way, although water scarcity creates risk of conflict, it also presents an opportunity for regional cooperation.

Modernisation of Economic Management

Enhanced water pricing schemes have often been cited as a solution to excessive water consumption in the region. Water pricing is an economically efficient means of allocating water and has been used with great success in managing Australia's Murray-Darling basin. But, for many reasons water pricing, or at least the Murray-Darling model, is inappropriate for the Tibetan Plateau. An effective water pricing system presupposes a system of clearly defined property rights, verifiable measurement and credible enforcement mechanisms. Water demand and consumption must be actively managed through transparent regulatory systems and a basic level of equality of social and human capital is required for a pricing system to work. These preconditions are not in existence in the Tibetan Plateau.

Much of the water supply and infrastructure is owned by private institutions, which compete with each other to set prices on water use. Nonetheless, a Water Technology Partnership has recently been initiated between Australia and India, with the hope that some of the Murray Darling Framework's mechanisms can be implemented successfully in India. Future Directions published an article on the Water Technology Partnership in 2013.

Improving the efficacy with which water is used in irrigation has the potential to improve both food and water security and over time, could even result in net water savings.

Conclusion and Policy Recommendations

Unsustainable agricultural water management is the primary cause of water scarcity in the Tibetan Plateau. If food and water security in the region are to be maintained, responsive and transparent intuitional models need to be developed at state, basin and regional levels, to manage water distribution and use. Enhanced research and development into water-saving agricultural methods might result in a net saving of water over time; however, this saving will be wasted if management schemes are not modernised. Local management institutions must evolve to provide responsible services and minimise the tendency for farmers to invest in unregulated access to irrigation from groundwater or surface waters.

Governments need to improve the education levels of the primary workforce. Smallholder farmers are typically risk-averse, so education and demonstration of the success of new technologies is crucial. The Australian government can assist by contributing technology and management structures that have proven to be successful in Australia. Though the Western model of water pricing is inappropriate for the Tibetan Plateau, implementation of a modified Murray-Darling structure might be very successful, if differences in demographics and economy are accounted for. In this respect, water quotas might be a more successful management tool in the region than water pricing. Water quotas can be tailored to equity considerations, so a working system need not presuppose social equality.

The Asian Development Bank has estimated that every US$1 invested in the modernisation of irrigation services improves rural GDP by almost US$2. A key requirement in managing agriculture will be to boost production from irrigated land, rather than to create more irrigated land. Research and development into rain-fed cropping and more intensive farming of rain-fed areas ought to be supported. Furthermore, the region would benefit immensely

from the development of an intergovernmental institution to manage trans-boundary water allocations. Enhanced cooperation between riparian states would allow state governments to focus less on water security vis-à-vis their neighbours and instead concentrate on developing more efficient internal management structures.

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