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Conjunctive Use of Surface and Groundwater as Agri-tourism Resource Facilitator: Discourse Analysis for Planning in Developing Nations

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Abstract: *Ecotourism is increasingly exhibited as a component of the conventional tourism that needs augmentation with enhanced availability of water resources in sustainable modes. This sustainability is attainable through conjunctive use of surface and groundwater. This paper reviews literature and theoretical ideas from various authors and practical examples of implementations in different countries. This is with an aim of analytically setting up general spotlights that can be relied upon with a focus on surface and ground water as ecotourism resource enabler in developing countries. The paper Introduction; the nuance of conjunctive use of water resources on agri-tourism; case studies; technical and management distinctions; and planning and management for conjunctive water use. The paper also covers spontaneous and planned conjunctive water use systems; key advantages; potential benefits; summary of significant aspects of conjunctive water use planning; overcoming the main impediments to planned conjunctive use; and proposed policy and institutional issues for developing nations. It relies heavily on authored work and all such information used here has been acknowledged in the references.*

Key Words: *Conjunctive Use; Surface Water; Groundwater; Discourse Analysis; Agri-tourism Resource; Planning*

I. Introduction

The concept of agri-tourism calls for harmonious combination of the use of all sources of water in order to minimise the undesirable physical, environmental and economical effects of each solution and to optimise the water demand/supply balance through proper planning as agri-tourism resource enablers. Ecotourism must not intrinsically be associated with the demand of engineered infrastructure, but rather geared towards sustainable appreciation of ecotourism products, (Okungu, Hayombe and Agong, 2014), but can be augmented with reservoir balance to ensure year-round availability. This further plays into the concept of conjunctive use of surface water and groundwater for enhancement of agri-tourism or farm-based tourism, which has been the way of life for several years world over.

As suggested by Achieng,' Hayombe and Agong,' (2014) positioning of ecotourism destination enhances brand imaging, but (Okungu, Hayombe and Agong, 2014) suggest that this cannot be sufficiently achieved without preliminary resource base – water to sustain agri-tourism - which ought to be enhanced through apt planning and management. Hence, agri-tourism development and water resources planning and management need to be deliberated in more detail as part of sustainable development processes. For that matter the availability of water for agri-tourism resources require complex combinations of cultural practices (Achieng,' et al, 2014), ecological sensitivity (Okungu, et al, 2014) in the forms of natural features, traditional crops, recreationable sites, and associated contemporary and cultural activities that are influenced by an array of factors. Any such factors do nt attract significance for evaluation if the major driving force – the water resource or water mass – is inadequately available for the subsistence of the tourism industry.

In a nutshell tourism industry requires water as a natural contributor to agri-tourism products and the same in its fresh potable mode is necessary for consumption by potential ecotourists. It is important to note that eco-tourists would not travel in areas which are adversely water-scarce, or those with food insecurity.

The surface and ground water resources are available in many forms in several developed and the developing nations. This is evident from a clear examination of the global water balance. However, the resources often dwindle because of the water cycle systems, which are naturally controlled by global climatic phenomena. The water cycle systems often deprive the availability of the water masses in the areas that are already earmarked as agri-tourism resource base and destinations. This is the reason why some identified areas experience severe floods while others are marred by severe aridity- all in unreliable and interchanging patterns.

For this reason there is a valid pointer to the perceived cause for alarm about the dying-off concept of agri-tourism ventures across potential destinations.

The lack of appropriate planning and management of the water resource compounds the challenges of sustainable surface and groundwater management in most developing nations and this is a further pointer to the inadequate water-based ecotourism in various areas of the developing nations. Major knowledge gaps have been observed in the unsustainable water availability as expressed above under the water based ecotourism context. It, therefore, calls for a clear understanding of the conjunctive use of surface and groundwater as ecotourism resource facilitator.

The Nuance of Conjunctive Use of Water Resources on Agri-tourism

Conjunctive of water use has been defined in more ways than one, but in general it is distinct as the allocation of surface water and groundwater in terms of quantity and/or quality with an aim of achieving various objectives while fulfilling certain limitations. Coe (1990) defines conjunctive use with reference to stream diversion systems as the management of groundwater and /or surface water in a synchronized progression to a clear conclusion. This implies that the total yield of such a system over a period of years exceeds the sum of yields of the detached components of the system resulting from an uncoordinated operation. Agri-tourism can be used as one of the ways of enabling socio-economic freedom for a nation, such coordination should be speeded up and specifically geared towards enhancing the abundance of surface water so that the needs of agri-tourism are fulfilled.

According to Evans et al (2013), conjunctive use of water refers to the practice at the farm level of sourcing water from both wells and irrigation canals. It also refers to a strategic approach at the irrigation command level where surface water and groundwater inputs are centrally managed as an input to irrigation systems. Agricultural & Rural Development (2006) illustrate that conjunctive water use imply the instantaneous utilization of surface water and groundwater to meet crop demand.

Otherwise FAO (1995) illustrate that it is possible to harmoniously combine of both sources of water in order to minimise the undesirable physical, environmental and economical effects of each solution and to optimise the water demand/supply balance. Considering all these definitions, the aim of conjunctive use and management is to maximise the benefits that might arise from the natural characteristics of surface and groundwater water use; characteristics that through planned integration of both water sources, provide complementary and optimal productivity and water use efficiency outcomes.

Due to tourism's linkage with other sectors, it can have a high multiplier effect on the agricultural economy, which can be boosted by the culture of agri-tourism and as a result the capacity to stimulate demand for locally-produced goods and services, may provide a wide market for agricultural products, promote regional development, and even create new commercial and industrial enterprises (Achieng,' et al, 2014).

II. Case Studies: Successes and Failures of Conjunctive Use

The National Survey on Recreation and the Environment 2000-01 indicate that each year about 63 million Americans travel several miles to visit Agri-tourism farms and spend between \$5 to \$50 per person in farm recreational activities (George & Rilla, 2008). Such a venture would be enhanced is water resources are sustainably available and the concept of conjunctive use would ensure this. In Morocco and Argentina foster unstructured conjunctive use of groundwater and surface water is practiced for irrigation purposes through irrigation canal commands. These canals have largely arisen due to inadequate surface water supply to meet irrigation demand. In other cases the water is made abundant for tourism venture purposes. Many other examples from developed countries also show that it is not simply a developing country problem – it is approaching an inherent problem wherever canal-based irrigation is practiced and where there are challenges in terms of reliability of water supply and quality (Steenberge, 2011).

In India, in the course of a collaborative study, which lasted for ten years, specialists from the International Water Management Institute (IWMI), Roorkee University, the Water and Land Management Institute, and the Uttar Pradesh Irrigation Department established that the utilization of the modified drains for monsoon flood irrigation yielded a lot of benefits which included the following: a 26% augmentation to the disposable income to the farmer; a decline in the average depth of groundwater from 12 meters in 1988 to 6.5 meters in 1998; annual savings on energy of 75.6 million kilowatt hours and savings of pumping cost of Rs. 180 million; an increase in canal irrigation from 1,251 hectares in 1988 to 37,108 hectares in 1998; a 15-fold increase in rice area; and a 50 percent reduction in conveyance losses in canals (IWMI 2002).

Mendoza Aquifers in Argentina, are exceedingly developed within and outside of existing irrigation-canal commands. The aquifers are characterized by an upstream arid outwash Peneplain hydrogeological setting. The aquifers are recharged directly from the Mendoza and Tununyan rivers as they emerge from the Andean mountain chain and indirectly from irrigation canals and irrigated fields (Foster and Garduno, 2006). The Departamento General de Irrigacion (DGI) is the independent water resource authority that is responsible for water management in the entire province, down to the primary canals and the delivery of water to Water Users' Associations. Groundwater abstraction is the main source of water for irrigation outside the command of main canals and is used to supplement surface water during critical crop demand in years of low flow and this enhances chances of sustainability of agri-tourism in such regions.

In Australia, numerous water resource systems are considered when attempts are made to address issues of conjunctive use of groundwater and surface water in the Burdekin delta area, Queensland, Australia. Within this arrangement, there is significant interaction between surface water and groundwater resources; hence, harmonized policies have been formulated and enacted for surface water and groundwater planning and management. The Burdekin delta is a major sugar production region in Australia and overlies a shallow groundwater aquifer which is hydro-geologically linked to the environmentally sensitive wetlands, waterways, estuaries and the Great Barrier Reef. In addition to irrigation supply, the aquifer also supplies potable water for three towns in the delta (Hafi, 2002). This inadvertently enhances agri-tourism culture.

In Pakistan, most groundwater exploitation occurs via conjunctive use with surface water and conjunctive use of groundwater and surface water allows farmers to cope with the unreliable surface water supplies and to achieve more secure and predictable yields. However there are adverse impacts of conjunctive use where poor quality groundwater is utilized adding large amounts of salt in the root zone, and hence causing additional salinization problems to those arising from shallow water tables. In some areas, the salinity of the groundwater resource is such that there is full reliance upon canal deliveries to sustain irrigated agriculture. Even in regions in which groundwater is considered to have been put to extensive use; the briny nature of the resource commonly requires mixing with surface water prior to application to crops. However Qureshi et al, (2004) noted that farmers are not fully aware of the ratios required when mixing the two water types and hence negative consequences of irrigating with high salinity water have been observed.

In Utter Pradesh, a planned approach was implemented at the regional scale aimed at effecting changes to the water supply/demand balance by considering the nature of the complete water cycle for the area and how this behaved spatially and temporally (Evans et al, 2013). A series of actions were then undertaken to optimize the existing infrastructure so as to enable a larger amount of water to be accessed in a more efficient manner. It seems there was little in the way of State-sponsored investment and no apparent changes to management and/or regulation levels. However local ownership was focused on increasing the total water availability. The benefits of these actions have been widely reported.

In Spain, there was an evolution of conjunctive use as a process associated with the expanding irrigation industry during wet years via surface water diversions. As groundwater resources were identified through the region, more and more groundwater abstraction was incorporated into the system. In response to an expansion in the irrigated area, more intense use of surface water during wet years increased, leading to substantial increases in overall use. These examples demonstrate a bottom-up approach that earlier proposed and implemented by irrigators that have now been incorporated into legally sanctioned schemes (Sahuquillo, 2005).

The basin is characterized by large surface water reservoirs situated over a karstic limestone aquifer, with resulting high leakage rates to groundwater. In addition, the Mijares River also leaks and recharges the local alluvial water table aquifer. Surface water or groundwater is used as the water source depending on water availability, both in stream and in storage. The beneficial aspect of the relationship between surface water and aquifer is that whenever more surface water is available, and hence irrigators are using from this source, recharge rates to the groundwater system are higher. This provides a natural counter-cyclical process where the groundwater resource is recharged during periods of low groundwater demand.

In the United States surface water was generally first developed and used to its maximum to undertake irrigation – usually fully developed by the early 1900s (Bredehoef, 2011). Bredehoeft points out that a large number of these river valleys contained alluvial deposits whose groundwater systems were well connected to the rivers. As surface water was fully appropriated, and as knowledge of the groundwater systems grew, groundwater became the new water source and development followed, in a generally unregulated fashion. Institutions to manage abstraction have evolved over time, however, they have generally favored the prior rights to water and required the newer water users, that is, the groundwater users, to provide new water to offset their pumping impacts. Consideration of opportunities to solve these challenges does not appear to have explored conjunctive resource management.

These examples highlight a common history and common challenges world over. In nearly all cases where conjunctive use is being practiced (either spontaneously or in a planned manner) surface water remains the dominant historical water source. Either through expansion, technology uplift, new knowledge or deteriorating water access/quality there the literature cite attempted moves towards incorporating groundwater into the water management system. The sustainability of these systems are a sure way of ensuring that water is available for agriculture either through irrigation or through the natural cycle. These can ultimately enhance the desired year-round provision for agri-tourism development in most countries. As such economic development would be achieved.

The Planning Concept of Conjunctive Water Use and Implication on Agri-tourism

A key characteristic of planning the conjunctive use is that it usually aims at the use of very large natural groundwater storage associated with most aquifers to 'buffer' the availability of surface water against the high flow variability and drought susceptibility of various surface watercourses – making it particularly important for the sake of mitigating climate changes impacts, which in many scenarios lead to increased droughts intensity (World Bank, 2010). A second important feature is that planning the conjunctive use of water is often the best way to confront serious problems of groundwater saline and soil water-logging on alluvial plains.

The planning concept of conjunctive water use implies utilization of the overall fresh water supply more efficiently: groundwater use by individuals supplement limited surface water supplies as conjunctive water use. On the other hand conjunctive water use is a large, elaborate regional water management programs that store large volumes of surface water below ground during normal and high rainfall years and then pump large volumes of groundwater from storage during drought years. Fundamentally, all these illustrate conjunctive water use even though they may differ in scope, scale, and the degree of coordination required among water users. Both approaches use surface water and groundwater together to improve the overall availability and reliability of water as agri-tourism resource enabler. Both may share common purposes for using surface water and groundwater in combination such as managing diminishing surface water supplies, convenience, economics, and using water reasonably and beneficially.

Conjunctive use of water primarily changes the timing in the flow of existing water sources by shifting when and where it is stored but does not result in new sources of water. The use of water conjunctively is often incidental as water users intuitively shift between surface water and groundwater sources to cope with changes and shortages (Dudley, & Fulton, 2006). While conjunctive use may prove to be successful for individuals or groups of water users to manage an instantaneous situation, it is also possible for conjunctive use to inadvertently harm the groundwater basin and other groundwater users that are not really involved in conjunctive use but that rely on similar groundwater basin.

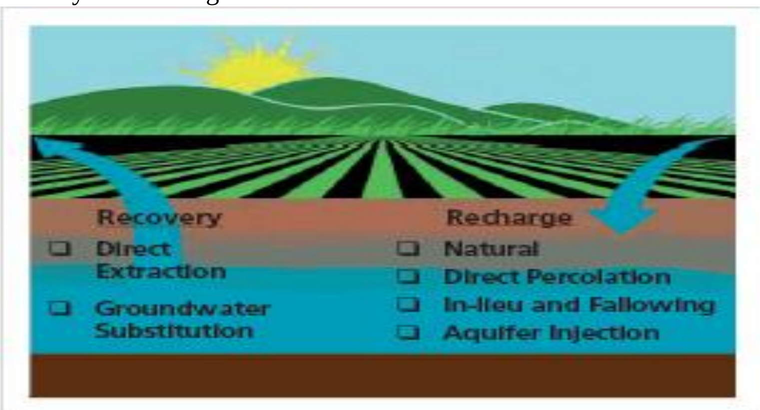

Fig. 1: Recovery and recharge - two principle operational components of conjunctive water management (source: Dudley, & Fulton, 2006).

Evans et al, (2013) illustrates that whilst the groundwater aquifer provides natural storage systems to source groundwater during periods of peak demands, most favorable management may take advantage of underutilized or unutilized storage capacity through properly managed aquifer recharge whereby recharge is enhanced for future recovery. From a conjunctive use point of view, such management advancement facilitates surplus surface water to be confined and made use of at times when a reservoir or stream flow is depleted and when the water is considered important for other purposes. This further ensures that natural water balance is enhanced for agri-tourism development. Groundwater recharge enhancement can be ensured via injection down recharge wells, storage of water in infiltration basins or slowing the natural flow of surface waters to induce additional groundwater recharge.

Technical and Management Distinction between Surface Water and Groundwater

The characteristics of the two primary water sources associated with conjunctive use and management (i.e. groundwater compared with surface water) are inherently different; differences that must be appreciated when optimizing their use. A summary of typical characteristics associated with groundwater and surface water resources is provided in Table 1.

Table 1 Typical characteristic of groundwater and surface water (Source: Evans et al, 2013)

	Characteristic	**Groundwater**	**Surface water**
1.	Response time	Slow	Quick
2.	Time lag	Long	Short
3.	Size of storage	Large	Small
4.	Security of supply	High	Low
5.	Water quality	Poor	Good
6.	Spatial management scale	Diffuse	Linear
7.	Ownership	Private	Public
8.	Flexibility of supply	Very flexible	Not flexible

Physical differences and differences in the history of development of the two resource types provide both challenges and benefits to conjunctive management and use. To make progress on conjunctive management, the specific characteristics of groundwater and surface water in the target region must be assessed.

Planning and Management for Conjunctive Water Use

Conjunctive planning and management of water resources, in this case the surface water and groundwater, occurs when system administrators plan and control ground and surface water simultaneously (Agricultural & Rural Development, 2006). This may be achieved by modifying the configuration of the surface system and its operating procedures. It is less extensive than conjunctive use because it necessitates institutional and coordinating mechanisms that few countries do not have. Conjunctive management of water is complex and can be controversial. However, it can be dominant, particularly in water-scarce areas and during the times of drought. This is because the failure to integrate conjunctive water resources might result in groundwater overexploitation.

Conjunctive planning and management of water may entail a variety of water resources planning mechanisms and different operational and administrative approaches that might cross over various institutional and political (Dudley, & Fulton, 2006). Clearly, there is no perfect approach to conjunctive water management. Rather, it requires balancing recharge with recovery and monitoring to validate the conjunctive water management. Management should occur at local levels where the unique set of conditions is well comprehended and where the concerned water users can take part and stay informed. The political climate, environmental concerns, institutional constraints, and economic considerations, are important when put into practice the conjunctive water management.

Conjunctive water management employs the ideologies of conjunctive water use, where surface water and groundwater are utilized in amalgamation so as to improve water availability and reliability. But, it also comprises important components of groundwater management such as monitoring, evaluation of monitoring data to develop local management objectives, and use of monitoring data to establish and enforce local management policies. Scientific studies are necessary in order to sustain conjunctive water management. They provide important information that enhances understanding of the geology of aquifer systems, how and where surface water replenishes the groundwater, and flow directions and gradients of groundwater.

At the farm scale, conjunctive use is often implemented on a day to day basis with management characterised by low level decisions incorporating factors such as resource availability, costs of delivery to the crop, tradability of unused allocation and water quality (Evans et al, 2013). Jointly, these aspects contribute to cost reduction, optimising production scale and profit maximization. Nevertheless, at the irrigation command level, planned conjunctive water use and management aims at advanced objectives. Planned conjunctive use is expected to optimise productivity and equity in the management of surface water and groundwater resources (World Bank 2006) and promote agri-tourism development and overall, the economic, environmental and social sustainability.

Based on the relative volumetric mix of the two resources, and the manner in which associated irrigation has been historically evolved, the nature of conjunctive use at any one irrigation command may be significantly different. For instance, management approaches should be diverse where a majority of the available water is obtained from one of the two resources as compared to the situation where neither resource supplies a majority. Additionally, groundwater may have detached roles within a conjunctive management structure; it can be considered as a storage mechanism to smooth out the supply/demand balance either across seasonal patterns of water availability; ,it may be used as an alternative method to distribute water across irrigation commands or across climate variability; or it can be used to manage shallow water tables so as to reduce salinity and water-logging. Management (and governance) approaches must be aware of these subtleties in attributes and plan appropriately. The table below presents summary of types of aquifer recharge planning strategies

Table 2 Summary of types of aquifer recharge planning strategies (Foster et al. 2003)

Type	General Features	Preferred Application
Water harvesting	- **Dug shafts/tanks** to which local storm runoffs are led by gravity for permeation - **Field soil/water conservation** through terracing or contour ploughing or afforestation	- In communities of fairly low-density population with leaky subsoil - Extensively appropriate, particularly on sloping land in upper catchments
In-channel structures	- **Check/rubber dams** to confine runoff by sediment retention and clear water generation - **Recharge dam** with reservoir used for bed permeation to generate clear water - **Riverbed baffling** to redirect surge and amplify permeation - **Subsurface cut-off** by impervious membrane and/or puddle clay in furrow to impound base flow	- In gullies with uncertain runoff frequency and high stream slope - Upper valley with sufficient runoff and on deep water-table aquifer - Wide braided rivers on piedmont plain - On broad basins with thin alluvium overlying impervious bedrock
Off-channel techniques	- **Artificial basins/canals** into which storm runoff is diverted with pre-basin for sediment removal - **Land distribution** by overflow of riparian land occasionally cultivated with flood-tolerant crops	- On superficial alluvial deposits of low permeability - On permeable alluvium, with flood relief benefits also
Injection wells	- **Recharge boreholes** into permeable aquifer horizons used alternately for injection/pumping	- Storage/recovery of surplus water from potable treatment plants

On a broad perspective the benefits attributed to optimizing conjunctive use of surface and groundwater has been investigated for several years through theoretical replica and investigations of physical schemes (Evans et al, 2013). These benefits take the form of: Increases in productivity; Increased capacity to irrigate via larger areas; Economic gains; Energy savings; Infrastructure optimization; and Water resource efficiency.

However, there are few published analyses of the actual socio-economic benefits that can be attributed to the implementation of conjunctive use management in specific irrigation commands. This is a major impediment to further communicating the positive messages regarding conjunctive use. However, an example of such studies includes Bredehoeft and Young (1983), who modelled a twofold increase in net benefit arising from conjunctive management. Another is the Agriculture and Rural Development Group, World Bank (2006), which reported a 26 percent increase in net farmer income, substantial energy savings, increased irrigation and substantial increase in irrigated crop area for Uttar Pradesh, India, as a result of conjunctive management of monsoon floodwaters in combination with a regional groundwater system.

Spontaneous and Planned Conjunctive Water Use Systems

Planned conjunctive surface water and groundwater management and use is usually practiced at the state or regional level and can optimize water allocation with respect to surface water availability and distribution. It can, hence reduce the evaporative water losses in surface water storages and minimizing energy costs of irrigation in terms of kWhr/ha (Foster et al. 2010). Planned conjunctive management is best implemented at the beginning of development initiatives, for instance those that are geared towards initiation of agri-tourism development. This may, however, be difficult to achieve when attempts are made to redesign the approach, once water resource development is well advanced, like in the developed countries.

Where groundwater and surface water is used conjunctively in various parts of the world, spontaneous use prevails. As asserted by Foster and Steenbergen (2011) unstructured conjunctive use of shallow aquifers in irrigation-canal-commands is driven by the capacity for groundwater to buffer the variability of surface water availability. Because agri-tourism belongs to the niche products which include cultural tourism, eco-tourism, sports tourism and lake tourism, there is need to enable the following aspects of water and environmental sustainability:

(1). Greater water supply security;
(2). Avoidance of excessive surface water or groundwater depletion.
(3). Securing existing crops and permitting new crop types to be established;
(4). Larger water yield than would generally be possible using only one source;
(5). Better timing for irrigation, including extension of the cropping season;
(6). Reduced environmental impact;

According to Foster et al. (2010) the most common state of affairs in which spontaneous conjunctive use of surface water and groundwater resources occurs is where canal-based irrigation commands are:

a) Inadequately maintained and unable to sustain design flows throughout the system;
b) Poorly administered, allowing unauthorized or excessive off-takes;
c) Over-stretched with respect to surface water availability for dry season diversion;
d) Tied to rigid canal-water delivery schedules and unable to respond to crop needs.

Moreover, unplanned conjunctive use is driven to a greater extent by the poor reliability of quality of surface water supplied for agricultural utilization. Ground water harnessed through tube wells are an insurance against this unreliability. Poor quality of water is a common factor at the tail of most irrigation canal systems and usually reflects poor infrastructure maintenance. These factors lead to inadequate irrigation services. As a result, the drilling of private water wells usually proliferates and a high reliance on groundwater often follows (Foster et al. 2010).

Key Advantages of Better Planned Conjunctive Use

- The benefits that can build up from improving the planning and management of conjunctive use, for existing and new agricultural irrigation areas, are outlined in Fig. 2.
- Integrated numerical modeling of irrigation canal flows, aquifer response and appropriate groundwater use, soil-water status and crop water-use are a great support to the evaluation of the potential benefits of varying the spatial and temporal utilization of groundwater and distribution of surface water, and thus of improving conjunctive use efficiency and sustainability for agri-tourism purposes.
- The most significant advantage, however, is that agricultural production can be amplified extensively without compromising groundwater use and sustainability.
- Adequately organized, planned and managed conjunctive use efforts offers the ability of being in control of groundwater availability and yields and seasonal variation of shallow alluvial aquifer, and the different engineered groundwater table depths in the area of influence of conjunctive use supply schemes
- In the most deterministic and planned conjunctive use schemes for agri-tourism oriented cultural irrigation, abstraction of water from the respective sources can be optimized, not only with respect to surface water resource availability and distribution but also with respect to reducing evaporation water losses from the surface water storage reservoirs or minimizing the actual costs of energy for irrigation.
- In cases where there exist alluvial plains downstream of major urban areas, large quantities of specifically partially-treated wastewater are available for agricultural irrigation for purposes of agri-tourism development. .

Potential Benefits of Conjunctive Water Use for Agri-tourism Development in Developing Nations

The figure below illustrates a range of aspects illustrating benefits of conjunctive use of groundwater and surface water that for developing nations.

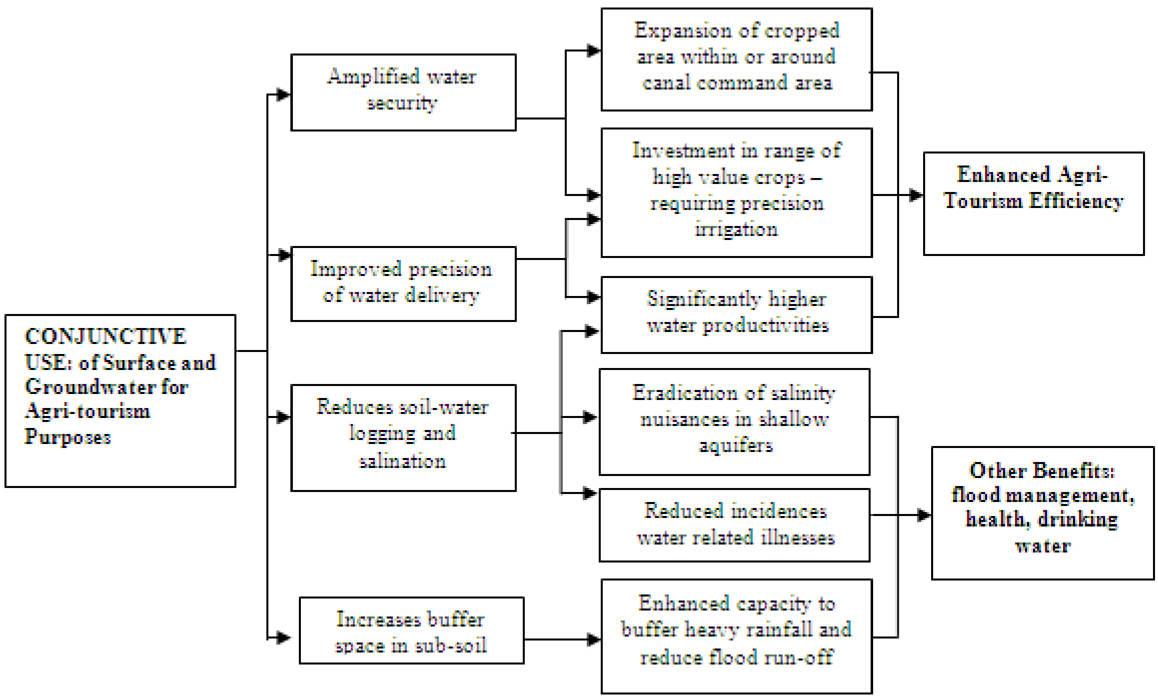

Figure 2: Range of potential benefits of conjunctive Water Use for Agri-Tourism Development in Developing Nations (Adopted from World Bank, 2010)

S

ummary of Significant Aspects of Conjunctive Water Use Planning

Various areas have been considered significance and appropriate for investment for the agri-tourism concept and they involve the following conditions:

1. Reconfiguring Surface Irrigation Projects.

For nations with initial irrigation projects, several surface irrigation projects that were earlier designed were approached with outmoded conjectures about cropping patterns and hydraulic infrastructure. Hence, re-configuring the main system, rationalizing the operating rules and practices, and training system managers to operate the modernized system in a conjunctive management mode offers a major investment opportunity, especially for agri-tourism development.

2. Groundwater recharge to support intensive groundwater irrigation and agri-tourism development.

The strengthening of well irrigation in regions where rainfall precipitation is high remains a significant source of groundwater recharge. Local communities and governments should resort to constructing local water harvesting and recharge structures on a massive scale with the principal objective of increasing groundwater availability for improved drinking-water security, drought proofing, and protecting rural livelihoods and agri-tourism development.

3. Conjunctive use with relatively poor-quality water

As seen in a previous study, various human activities generally contribute to undesirable hygiene and sanitation condition surface water and groundwater and this can adequately be dealt with through policy formulation and planning. (Okungu, et al, 2014). However, intricacies and costs involved in disposing of wastewater often present new opportunities for conjunctive use, especially for agriculture which is meant for tourism attraction. Emergent wastewater use in peri-urban agriculture in cities around the world is a case in point. Peri-urban farmers to use urban wastewater and groundwater conjunctively for irrigation (Buechler and Devi 2003).

4. Conjunctive use with relatively saline groundwater.

In regions with permanent or prime salinity, conjunctive use of surface and groundwater exhibits exclusive challenges and prospects. In such places the aim of conjunctive management is to uphold both water and salt balances. In this situation, great control and precision should be enhanced in water supply to different parts of supply areas so as to sustain an optimal ratio of fresh and saline water for irrigation for agriculture and tourism satisfaction.

5. Conjunctive management opportunities in urban set ups.

Rapid urbanization in several parts of the world have yielded fresh intimidation for peri-urban agriculture, thus agri-tourism faces eminent hindrance of growth or development. However, conjunctive management of rainfall, surface water, and groundwater creates new opportunities to meet these threats.

Overcoming the Main Impediments to Planned Conjunctive Use

Though agri-tourism provides a platform for local farmers to acquire alternative tangible and intangible income benefits, protect rural landscapes and agricultural lands and educate the population about food production and environmental protection, there are a number of pitfall that are worth noting. For that matter the most common impediments to the full development of conjunctive use of water for agri-tourism development and also for urban water supply in the developing world include the following:

- Frequently split responsibility for surface water and groundwater management between local government, municipal authorities, and sometimes even involving national government, resulting in failure to identify and to engineer opportunities for planned conjunctive use
- Lack of sound and intelligible information about conjunctive use opportunities, which can be Communicated to politicians and the general public, because of the absence of an ‘information and communication unit’ at the relevant level of local water resource agencies
- Urban water-service utilities are often politically or institutionally constrained from putting forward the development and protection of urban well fields in favorable areas, located outside the city’s municipal limits.
- Urban water engineers often tend to look only for operationally-simple set-ups, such as a major surface water-source and large treatment works, rather than more secure and robust conjunctive use solutions and do not adequately appreciate the benefits which rational development of groundwater resources offers
- Inadequate understanding of the extent of private in-situ self-supply with groundwater from shallow aquifers, its benefits and its risks.

Summary of Proposed Policy and Institutional Issues for Developing Nations

i. A basin perspective for conjunctive management of water use for agri-tourism

The benefits accrued from conjunctive water use can be enhanced by planning and managing water resources at the catchment levels. Agri-tourism can be sustained anywhere in the world and this can be achieved if the river basin becomes part of the water and land management unit.

ii. Reform of water resources management institutions.

The fragmented structure of water sector institutions and players contribute to the bottlenecks to conjunctive planning and management of water. This arises because of the duplication of roles and confusions in the various policy structures. An inter-departmental coordination unit should be initiated for the respective sources, which etail tourism or ecotourism, irrigation, groundwater, and energy supply for groundwater pumping by an electricity utility.

iii. Monitoring of groundwater and surface water infrastructure

A good number developing countries have had poor monitoring of their infrastructure. This precludes spatially coordinated use of groundwater and surface water that is critical in a certain saline environment. A priority should, therefore, be set with an aim of improving the monitoring of groundwater behavior and use patterns in the conjunctive management domain (Agricultural & Rural Development, 2006).

iv. Adoption of public-private partnership

Public-Private partnership model of asset planning, development and management should be adopted for surface irrigation systems, public tubewells so as to stop water logging and secondary salinization due to surface irrigation. This would ensure adequacy and sustainability of agri-tourism and other water uses without the much feared water scarcity.

v. Rehabilitation and augmentation.

Where groundwater levels are shallow, soils are saline but still favorable, soils are coarse rather than fine, and canal seepage is abundant, it is important to consider reshaping the hydraulic infrastructure.

III. Conclusion

In conclusion, for developing countries, conjunctive use should be planned and executed for purposes of enhancing agri-tourism development. Additionally the hindrances to planned conjunctive use need to be deal with by national water resource agencies that closely handle local or county agriculture and tourism issues and the corresponding water utility, and in some cases even with the national water resource agency.

Systematic and realistic studies need to be undertaken of technically sound and administratively reasonable options for fully-integrated conjunctive use of groundwater and surface water that would be in the long-term interest of urban water-supply security and agri-tourism development. In so doing an important corollary that must be addressed concomitantly is making best use of the growing wastewater resource being generated from urban areas, which should be integrated as part of overall water resource planning for conjunctive use in urban water supply.

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