WATER NEEDS FOR SUSTAINABLE TARO CULTURE IN HAWAI'I

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Abstract

Taro is a spiritual and nutritional center of Hawaiian culture, and the future of sustainable taro culture in Hawai'i depends upon water. Water needs for expanded wetland and dryland field systems can be filled if physical and institutional changes are made. Potential for making such changes grows as agroeconomic alternatives for taro-based farming systems expand. While lands historically used for wetland taro cultivation hold strongly protected water rights, their water needs and those of other taro-producing lands continue to be strongly denied.

Sustainable Taro Culture

Taro is a spiritual and nutritional center of Hawaiian culture, and the future of sustainable taro culture in Hawai'i depends upon water. Consider this analogy:

SUSTAINABLE	TARO	CULTURE
HA	WAI	I

WAI (water) is at the center of sustainable taro culture. **WAI,** god-given and life-giving, feeds **TARO,** child of the gods. **TARO,** older brother of Hawaiian people, feeds the family. As in other Pacific areas, taro culture in Hawai'i is filled with family connections. Those who built field and irrigation systems are remembered and honored, and names and practices of individual fields, water sources, and taro cultivars are passed down.

The role of water in taro culture is somewhat unique in Hawai'i, where cultivation of irrigated taro pondfield systems is more extensive than in other Pacific islands. However, irrigation systems also play prominent roles in taro culture of the Solomons, Vanuatu, Tahiti, and elsewhere. Thus, in promoting sustainable taro culture for the Pacific, understanding cycles of traditional irrigation, its disappearance, and its resurgence is an important focus.

Wetland Taro Agriculture

Taro field systems contribute to agricultural and environmental sustainability as well as cultural sustainability. While both wetland and dryland field systems were important and extensive in early Hawai'i, the impression taken from other presentations at this conference might be that the future of sustainable taro culture in Hawai'i mostly involves dryland planting. However, because of their greater fluidity, diversity, and more obvious connectivity with surrounding environments, I believe that wetland systems are the preferred future for this sustainable culture.

Sustainable Taro Culture in the Pacific - The Farmer's Wisdom

(LISA Project 1992) offers some examples of wetland taro's contributions to agricultural and environmental sustainability:

> These taro patches act as traps for silt that would otherwise flow downstream into the ocean (p. 2).
>
> Plantings on dikes between wetland terraces provide food, medicine, mulch, and green manure as well as stabilizing the dikes (p. 2).
>
> ... water levels are raised to drown weeds during taro growth. Azzolla or duckweed shades the surface of the water, keeping temperatures as well as weeds down. In addition, a nitrogen-fixing, blue-green algae living in aazzolla leaves can provide a large amount of nitrogen to crops (p. 5).
>
> ... a constant flow of water ... will keep soil temperatures lower, and thus decrease disease incidence (p. 10).

Along with these contributions to sustainable agriculture, taro pondfield systems also provide aquatic habitat for other useful organisms and water for other agricultural and domestic uses. On a watershed scale, wetland systems enhance environmental sustainability by maintaining aquatic and riparian habitat, integrity of the hydrologic cycle (especially coastal discharge, stormflow dissipation, and groundwater recharge), instream flow for other water uses, and integrity of the cultural landscape.

Taro Water Needs

Current research in the Department of Geography focuses on quantifying water needs for wetland taro field systems. We monitor hydrological conditions in taro pondfield systems, model system water requirements based on measured interactions between hydrologic conditions

and taro growth, and use modelling results as a baseline for quantifying water rights defined by historical water use regimes. While previous studies and court orders have maintained a minimum water requirement of about 50,000 gad (gallons per acre per day), or 1.14 gsfd (gallons per square foot per day), preliminary monitoring results show much greater water use in existing pondfields. In fields from 870 to 12,200 sf, water use ranges from 1.47 to 65.5 gsfd, with the highest use per unit area in the smallest field. Commercial farmers using sprinkler irrigation on dryland fields told us they use 20,000-25,000 gad, or 0.46-0.57 gsfd. In some areas of Hawai'i island, dryland fields rely solely upon rainfall of 50-100 inches/year (Kona) and 75-200 inches/year (Hamakua), or 0.085-0.34 gsfd.

In addition to agronomic and legally-defined water needs, sustainable taro culture incorporates water needs of other cultural practices and cultural use areas and of overall agricultural and environmental sustainability. Water needs for expanded wetland and dryland field systems can be filled if physical and institutional changes are made. Such changes might involve:

1. Restoring ecosystems and agricultural systems to earlier forms and adapting them to contemporary agricultural and engineering practices.
2. Reorienting society to more highly value Hawaiian and agrarian lifestyles and resources.
3. Shifting control over water resources from big companies and government to communities and small water users.

Taro Water Alternatives

The potentials for making physical and institutional changes supporting sustainable taro culture grow as agroeconomic alternatives for taro-based farming systems expand. Taro can serve as the foundation of integrated farming systems which fulfill economic, cultural, and environmental rationales for releasing water to supply them. Diversification of wetland systems can include other food crops such as lotus root, *ung choy*, watercress, and water chestnut. Linking aquaculture and livestock operations with taro production can revitalize previously successful Hawaiian farming strategies and can draw on vast Asian experience in exploiting these linkages to increase system productivity and sustainability. Nurseries of aquatic ornamentals, natives, and high-uptake plants may find growing markets as water gardens, wetland habitat restoration, and alternative wastewater treatment and waste bioremediation gain popularity. Coupling of wetland and dryland systems through extension of irrigation systems, along with greater diversification and multi-cropping of dryland field systems, also deserves attention.

These systems can be created through individual action, partnerships, coalitions, and cooperatives, and supported by administrative, legislative, and judicial initiatives. The two biggest roadblocks to such creation are lack of economic opportunity in agricultural employment and lack of water.

Water Needs Denied

While lands historically used for wetland taro cultivation hold strongly protected water rights, their water needs and those of other taro-producing lands continue to be strongly denied. Competition for water is increasing, and taro water needs have trouble competing against entrenched water allocation patterns and practices that are guided by closed market mechanisms, inconsistent policies, contradictory legislation, and adversarial legal principles. The following synopsis gives examples of how these operate to deny, and sometimes protect, taro water needs throughout the islands.

Kaua'i

Hanalei. Plans to reactivate diversions from the Hanalei River to service new hydroelectric power plants in a different watershed raised public concerns about water availability for taro farming, wildlife conservation, instream flows, and control of diversions. In a landmark decision, the State Water Commission denied the developer's applications for stream channel alteration and diversion works.

Wainiha. The State of Hawai'i replaced a loose-stone diversion dam with concrete. The concrete dam channelled and accelerated storm waters into the irrigation system, whereas the loose-stone dam would have broken out to minimize storm waters entering the *auwai* (irrigation ditch) and *lo'i* (pondfields). As the *auwai* silted up and was strewn with boulders, the streambed was scoured at the base of the new dam. Stream water levels dropped, the *auwai* bed rose, and it became more and more difficult to divert sufficient water into the irrigation system. Finally, the concrete dam broke and further choked the *auwai*, and the State refused to repair the damage.

Anahola. Private developers want to hook up their waterlines to wells on Hawaiian Home Lands, which are managed by the County Water Supply Department. Homesteaders are concerned about their ability to reclaim water from these sources when it is needed in the future.

Waimea. Diversions to the famous *Pe'eke auwai* (Menehune Ditch) formerly came directly from the Waimea River. Plantation diversions upstream caused river water levels to drop, and the *Pe'eke* diversion ceased functioning. Now, diversions from the plantation ditch to the *'auwai* flow through a series of reducing pipes. When heavy rains hit the mountains, the ditch system clogs up, plantation repairs are slow, and taro farmers receive no water for days or even weeks. Maintenance of *Pe'eke* was formerly a cooperative endeavor, in which all ditch-front landowners and water users participated. As lands went out of production, maintenance slacked. Now, a handful of downstream farmers must maintain almost the entire length of the *'auwai* to assure adequate water supplies.

O'ahu

Island-wide. Widespread filling of wetlands and fishponds for real estate development began in the 1920s in Waikiki and has continued ever since.

Windward Valleys. Ground and surface waters diverted to leeward plantations reduce streamflows and availability of agricultural water. Groundwater extractions supplying municipal systems also reduce streamflows.

Laie. Faulty wastewater treatment caused foul water to be released into taro pondfield irrigation systems. Citizen lawsuits charging Clean Water Act violations resulted in plans to upgrade treatment facilities and fund a community foundation.

Punalu'u. Corporate control over the traditional irrigation system takes water away from small farmers and charges exorbitant rates for water delivery.

Pearl Harbor. Exceptional taro lo'i and fishpond complexes were filled or otherwise destroyed by military activity. Water quality in Pearl Harbor suffers because of pollution and lack of inflow from these obliterated sources.

Moloka'i

Competition between resort developers and Hawaiian Home Lands for potable water and the inability of the State Department of Hawaiian Home Lands to deliver irrigation water to its beneficiaries are the focus of water disputes on Molokai.

Lana'i

Springs formerly irrigating taro pondfields dried up, perhaps as a result of nearby groundwater extractions or other development activity.

Maui

Honokohau. Private corporations control streamflow diversions from the upper watershed to service plantation agriculture, resorts, and municipal systems on the west Maui coast. As more taro lands are replanted in the valley and more people want to enjoy instream values, more streamflow is needed. The State Water Commission, in response to citizen complaints, is hoping to negotiate a settlement which would allow more water to flow under the existing diversion.

East Maui Valleys. Over one hundred years of large-scale surface water diversion resulted in displacement of small farmers and loss of streamflows. Water licensing is on a year-to-year basis until watershed management planning can be implemented, including determinations of water quantity to be left in streams below existing diversions.

Hawai'i

Kohala Valleys. Streamflows formerly diverted for plantation use are now subject to reallocation as existing water licenses have expired. State agencies have not provided plans for future use of this water.

Waipia. Diversions to the Hamakua Ditch may no longer be necessary as the sugar plantation continues to decline. While the ditches are privately owned, the water in them is a public trust.

Waimanu. Two hundred wetland acres of Hawaiian Home Lands is surrounded by scientific and natural area reserves, augmenting the difficulty of returning the wetlands to cultivation.

Dryland field systems. Planting areas originally converted to plantation or pastoral use are either deteriorating into scrubland or being proposed for golf course and resort development.

Taro Culture Sustained?

The University of Hawai'i is the scene of one of the most troubling disputes over sustainable taro culture. Portions of *Kapapa Lo'i O Kanewai*, the last remnant of extensive Waikiki taro pondfield systems, and its surrounding environment would be displaced by the currently planned alignment of the new Center for Hawaiian Studies building. Bitter differences of opinion within and outside of the University community continue--should a cultural use area be sacrificed to a facility for academic cultural scholarship?

The Editor

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