Kalo: A Value Chain for the Future

Scott P. Lacasse

Green Mountain College

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The kalo (*Colocasia esculenta*), is irrefutably the most culturally significant plant of the Hawaiian people. They believed it to be primordial; originating with the god Kane who was the embodiment of procreation and was often identified with water and light (Handy et al., 1991). Kawena Pukui provided the following version of the mythological origin of kalo:

> The first Haloa [long stem], born to Wakea [sky father] and Ho'ohoku-ka-lani [his daughter], became the taro plant. His younger brother, also named Haloa, became the ancestor of the people. In this way, taro was the elder brother and man the younger - both being children of the same parents. (Handy et al., p. 80)

Therefore, Kalo is considered by the Hawaiians as the elder brother and the first ancestor of their people and "the important concept of *'ohana*, the extended family, is immediately derived from the word *'oha*, or the cormlets, of the taro that encircle the parent plant" (Nirav, 1992, p. 168).

Kalo, in addition to being the most culturally significant crop in State of Hawai'i, is also a multi-million dollar industry despite its consistent decline in production since the early 1800's. It is estimated that during the peak of kalo production, (pre-European contact), "areas under cultivation covered more than 20,000 acres (about 31 square miles) over six islands […] today, less than 400 acres of kalo are planted" (Cho et al., 2007, p. 3). Approximately 3.6 million pounds of raw taro, valued at $2.5 million, were produced in 2017 from those 350 acres (USDA, 2018). Ninety-two percent of the raw kalo produced was processed into *poi* (a fermented starchy paste) and represented an annual market value of approximately $16.2 million and generated nearly $0.7 million in tax revenue for the State in 2008 (Taro Security and Purity Task Force, 2009). These figures were representative of *poi* only and did not include the revenue generated by other value-added kalo products such as *kūlolo*, taro flour, *lū'au* leaf, taro burgers, chips, and hummus found at farmers markets, fairs, and restaurants. In order to meet increasing demand for kalo and its value-added products, Hawai'i regularly imports nearly 2 million pounds of taro

annually, or thirty percent of the 6.5 million pounds consumed by locals and visitors in Hawai'i (Vukovich, 2017).

There is a growing movement in Hawai‘i that seeks to address the important considerations of food security in the most geographically remote landmass on the planet (Kent, 2015). "About 85-90% of Hawaii's food is imported which makes it particularly vulnerable to natural disasters and global event[s] that might disrupt shipping and the food supply" (Office of Planning, 2012). With a resident population of 1.4 million people (Hawaii Population, 2018) and an annual transient population of 8.8 million visitors (Hawaii Tourism Authority, 2016), supplying enough safe and nutritious food is a challenging task. A study was conducted in 2009 that determined 29,000 acres of kalo production would be required to provide the entire State's population with 2.5 cups of taro per day per person for a year and that 1.2 million acres would meet all of Hawai‘i's food needs for a year (Taro Security and Purity Task Force, 2009). We must envision and create improved food supply and value chains that are structured in a way that promotes food security, self-sufficiency, and overall resilience in our current food system. One strategy of this redesign includes boosting the amount of locally grown staple foods such as kalo. The success of this design will require state support; innovation; collaboration between farmers, processors, and marketers; and increased consumer awareness and demand.

Kalo (*Colocasia esculenta*), a member of the Araceae family, is a coarse, succulent, perennial herb represented in present-day Hawai‘i by eighty-five varietals that are grown under wet conditions for *kalo lo'i* or in dry soils for the *kalo malo'o* (Handy et al., 1991). The *lo'i*, still in use today, are a series of banked, flooded, terraced plots constructed along the edges of streams and fed freshwater by a series of irrigation channels called *auwai*. In contrast to the marsh-like conditions of *kalo lo'i*, the traditional *kalo malo'o* were rain-fed and cultivated along forest edges among the "upland," drier slopes found in forest clearings (Krauss, 1993).

Regardless of the cultivation method used, kalo was propagated by vegetative cuttings known as *huli* or by using the *'oha* (offshoots) from the *makua* (corm). The harvested plant was cut to

include the top part of the *makua* to just above the *mohala*, (unfurled leaf in the stalk). The *huli*, tied in bundles and covered with grass, were placed in the shade for a week to ten days until well-developed *huluhulu* (roots) formed. *Huli* were then planted along the edges of the plot, while the *'oha*, being the stronger of the two, were given a place in the center of the plot.

The kalo plant served the Hawaiians as an important and nutritious food staple. All parts of the plant were eaten; however, the *makua* was the most favored. The kalo is an excellent source of complex carbohydrates, high in calcium, phosphorous, and vitamins A and B, while the *lu'au* (leaf) similar to spinach, contains trace minerals as well as vitamins A, B, & C (Krauss, 1993). It is also one of the world's "most allergen-free foods – healthy, full of fiber, low in fat, high in potassium, and easy to digest" (Enos & Johnson, 1996, p. 21). Otto Degener, an esteemed botanist, said of kalo:

> As the entire plant furnished food for man, it has been estimated that from one square mile planted and diligently cultivated, over 15,000 people could subsist for an entire year. (Enos & Johnson, 1996, p. 21)

Once the *makua* has been washed and drained, it can be stored in the refrigerator up to two weeks after harvest. However, the *lu'au* is best eaten within a day or so of harvest but can be stored in a plastic bag in the refrigerator for a few days. The *makua* and the *lu'au* must be thoroughly cooked before eating to avoid the unpleasant "itchy throat" caused by the calcium oxalates found in kalo. But after cooking, they can be stored in the freezer indefinitely and steamed to replace some of the lost moisture.

Although *kalo lo'i* constituted the majority of pre-contact production (Fleming, 1994), modified *kalo malo'o* practices might offer an efficient solution to supplement traditional production methods. *Kalo lo'i* has a long and deep historical tradition of cultivation and typically yields higher quantities of taro, suppresses weeds more effectively, and allows for out-of-season

production (Onwueme, 1999). A well-run *lo'i* will typically yield 23,000 lbs of corms per acre every sixteen months (Fleming, 1994).

The Hawaiian civilization was labor-rich during the pre-contact era and they were able to dedicate entire families to the construction and maintenance of the *lo'i* and *auwai*. Today, however, labor costs are a significant influence on business solvency and profitability and are a key barrier to increasing production. By planting different varieties using upland methods, it may be possible for growers to substitute capital for labor in the form of mechanization and help meet the supply demands of present-day Hawai‘i (Hollyer et al., 1990).

Upland taro production, or dryland as it is more globally known, offers farmers an increased economy of scale in Hawai‘i and in regions across the globe. While flooded taro has distinct advantages, dryland operations can be modified to mitigate their shortcomings and increase production capacity. Efficient and sustainable upland farming methods that address weed control, soil health, and water management can yield upwards of 12,000 lbs of corms per acre every seven to eight months (Teves, 2015). Combining the reduced maturation times of dryland kalo with drip irrigation systems that are designed to supplement rainfall, allows for year-round production of upland varieties. Machinery could be employed to prepare the fields for planting and once mature, modified potato harvesters could be employed to remove the corms. Valenzuela & Sato (n.d.) suggested modeling the harvesting and packing methods used in South Florida's commercial packing sheds:

> The corms are conveyed to a machine with circular brushes which removes the soil, washes the corms, selects by size and the corms are then packed with the help of hand labor. A typically-sized machine packs eighty 50-pound boxes per hour with the help of seven laborers. At this point the product may be shipped to a buyer for placement in a cold room.

The agricultural statistics of commercial dryland taro farming - acres, inputs, outputs, yields, number of jobs, tons of fertilizer, and revenue for the State lend themselves towards producer classifications, by agencies and legislators, of either subsistence or commercial farmers, with the resources allocated accordingly (Taro Security and Purity Task Force, 2009). Within the context of creating a resilient food system in Hawai'i, it is critical to consider the role that each production method has to play in securing food sovereignty.

Subsistence production is synonymous in Hawai'i with the long-term sustainability of small family farms. Support must be given to these small scale operations that collectively contribute to commercial taro production statewide, while using small amounts of natural resources and fossil fuels. They reduce the State's global warming footprint and should we lose access to fuel, these farmers could still produce food (Taro Security and Purity Task Force, 2009). These considerations, coupled with the strong community connections that evolve from smaller-scale farming, place "subsistence" producers on a level that is equally deserving of fair treatment and access to aid by the State. Future goals at increasing local food production must blend traditional *kalo lo'i*, *kalo molo'o*, and sustainably modified dryland production in a holistic supply strategy.

Local government can also help increase production of Kalo. By offering tax credits for landowners who conserve taro systems on private lands, decreasing tax rates to match agricultural rates, and offering reduced long-term lease rates on State lands, local government can incentivise a return to farming and improve access to agricultual lands (Taro Security and Purity Task Force, 2009). Only in this way will we begin to put enough land back into taro production and reach the 29,000 acre goal required for food security.

Decreased supply is but one concern when considering the creation of a sustainable value chain. One must also consider the barriers created by processing and marketing this important crop. Once the challenges of increasing production are overcome, the supply side can oftentimes "push" a product through the chain while consumer marketing and education initiatives "pull"

the product all the way through. This "push-pull" strategy is particularly useful in local production systems where demand is stable (Dreyer et al., n.d.).

Processing equipment and labor is expensive; regional farmers should cooperate in their use of these resources (Hollyer et al., 1990). In an industry where many small farmers have second jobs or rely on their family members for health insurance and financial support, there is little money left to invest in technology that will increase their profit margins. However, increasing the amount of community-run processing facilities and kitchens would allow farmers to collectively boost profit margins with a minimum of investment. In remote areas that are not conducive to a centralized facility, mobile processing equipment is a potential solution. Resources in the form of small business loans and capital improvement programs must be implemented to foster the development of these entrepreneurial activities (Taro Security and Purity Task Force, 2009).

Farmgate prices of raw kalo are currently at $0.7/lb (USDA, 2018). Processed *poi*, on the other hand, is commanding prices around $12/lb at the farmgate. What once was a staple, has now become a luxury item. In order to become a more accesible food product, prices must come down. In the meantime, however, this is a perfect opportunity for local farmers to add value to their product and make a living. Laudan (2011) argued "at the current farmgate price for taro, which is what the poi mills are paying, [you would] have to grow 100,000 pounds of taro to make $60,000 a year. But if [you] sustainably farm and pound [your] own taro, [you] can make $70,000 by selling just 7,000 pounds per year, and all [you] need is one acre." Numbers like those are compelling, if you can get your product to market. Taro-specific labeling campaigns are one strategy to support the economic revitalization of this important food crop. "Buy Local," "Grown Local," "Island Made," "Seal of Quality," and "Low Food Miles" are successful labels that help consumers make informed choices (Taro Security and Purity Task Force, 2009).

If produced and marketed well, taro has the potential to become one of the State's most profitable crops. Hawai'i's Office of Planning (2012) suggested, "Replacing just 10% of the

food we currently import would amount to approximately $313 million. Assuming a 30% farm share, $94 million would be realized at the farm-gate which would generate an economy-wide impact of an additional $188 million in sales, $47 million in earnings, $6 million in state tax revenues, and more than 2,300 jobs" (p. ii). Hawai‘i kalo farmers have an opportunity to capitalize on this by working with their present customers and establishing new markets.

A diversity of value-added products is critical for increasing consumer demand for taro-based food products. Traditional taro-based products such as taro chips, *lu'au*, *pa'i'ai*, *poi*, and *kūlolo* currently hold the market share. However, innovative products like taro burgers, hummus, pudding, flour, and baby food might boost demand, increase local production, and create a viable export business.

Further research is necessary to properly ascertain the baseline of taro production and marketing potential in the State and to mitigate the multitude of bottlenecks. However, if done efficiently and effectively, kalo could regain its rightful position as the chief crop in the State, while adding increased diversity and real food products that contribute to food system resiliency and security in the Hawai'i.

The kalo plant's dependability, due to its drought-resistant nature, ease of propagation, ability to thrive on excess moisture, and prosper under a wide variety conditions affected by altitude, soil, and humidity, secured its position at the top of the Hawaiian horticultural complex (Handy et al., 1991). Perhaps it is time for kalo to reclaim its rightful title.

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