



Ka 'Oihana Mahi'ai



Taro Production and Market Landscape in Hawai'i, 2021

Photo Caption: Hanalei, Kaua'i, Taro Capital of Hawai'i.

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1428 South King Street
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October 20, 2023**

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Abstract – The different dimensions of taro activity in Hawai‘i, including crop type, farmland acreage, production volume, sales value, marketing channels, interisland trade, and the local market by supply sources can provide valuable input to research and policy planning of local crops grown. This article updates relevant measures of production and markets in the taro supply chain. The authors estimate statewide production of taro with three general product offerings at 4.8 million pounds and valued at \$6.4 million in 2021. If huli is included, it yields another \$1.4 million. A majority of taro available for local consumption is sourced locally (84 percent) and the balance is imported from the continental United States (10 percent) or countries in the Pacific (6 percent). The extent of taro localization in Hawai‘i as measured by the Self-Sufficiency Ratio (SSR) is at a respectable 90 percent. This metric is in sharp contrast to the SSR for the statewide food system, currently estimated at 10 percent.

Introduction

In the Hawaiian creation story, the cultural significance of taro (*Colocasia esculenta*; *kalo in Hawaiian*) extends beyond food sustenance. Over time, the traditional practice of taro farming has evolved into a strong part of Hawai‘i’s cultural identity. In contemporary Hawai‘i, taro is still highly esteemed as an authentic Hawaiian food. A modest reference to poi, squid lū‘au, lū‘au stew or kūlolo could invoke an immediate Hawaiian food response, fond memories of the ohana (family), connections to kupuna (elderly/ancestor) and/or ‘aina (land). Within the realm of taro production in Hawai‘i, much physical, mental, emotional, and spiritual energy has been shed relating to land leases, water rights, leaf blight, aphid infestation, apple snails, biotech trials, yield estimates, and import levels.

This article focuses on the statistics relating to the measurement of taro production and its market in Hawai‘i and elsewhere. The goal is to provide an update on the state of the taro industry in Hawai‘i and to inform of new developments and emerging trends that may arise in the local taro supply chain. USDA-NASS last published statistics on Hawai‘i taro in 2018. It estimated the statewide farmgate value of taro (corm) at \$2 million, off production sales of 2,985 thousand pounds, and harvested from 310 acres.¹ The yield per acre was 9,630 pounds and the marketed price was sixty-six cents per pound.

Across the local taro industry, many felt the statistics published were an underestimation. The acreage for instance, was almost half the size reported in a well circulated agricultural land use baseline study (Melrose et al, 2015). In a separate document, a subject matter expert testified that yield per acre was 54,300 pound (five times higher) on a

¹ See USDA-NASS, Quick Stats Searchable Database for State of Hawai‘i Survey on taro production, 2018.

single commercial taro farm in Kauaʻi (Tanji, 2020). However, Melrose and colleagues estimated planted acreage in comparison to the USDA-NASS, which estimated harvested acreage. Planted acreage doesn't account for non-harvested crops for various reasons, including inclement weather, damaged crops, pest infestation, crop rotation, and labor shortages.

In contrast, overstated estimates on taro production are also known to exist. In 2022, a host of legislative bills offered at the Thirty-First Legislature (e.g., HB 694, HB 2466, SB 341, SB 2664, and SB 2983) featured preamble with the statements "Annual reported production averages four million tons" and "Taro imports are estimated to soon exceed local production" (Hawaiʻi State Legislature, 2022). It is more likely the drafter(s) of these measures inadvertently used tons instead of pounds. If the statement was true, the four million tons would translate into eight billion pounds of taro.² This amount is 2,680 times higher than the USDA-NASS estimate in 2018. And applying the taro farmgate value of 66 cents per pound (2018), this would contribute \$5.3 billion to the local agriculture economy. Total farm sales for all commodities in Hawaiʻi was estimated at \$590.8 million in that same year (USDA/HDOA). A year earlier, the 2017 Census of Agriculture's estimate for the same measure was \$563.8 million. Furthermore, taro imports are unlikely to come close to exceeding local production.

Beyond that, the focus on the local taro industry has been on loʻi (wet land) taro and poi production. Kauaʻi has a virtual monopoly, growing almost all loʻi taro and exporting them off to Honolulu for processed poi. There is also a vibrant market for upland taro and lūʻau leaf. A majority of these products are grown on other islands away from Kauaʻi. Additionally, there is an emerging market for taro stems and an informal market for taro huli (shoot). In the past, huli was shared or given away by growers.

With the issues presented, this article serves to fill the existing knowledge gaps and to provide a better empirical framework for the local taro industry in Hawaiʻi. Production levels, product offerings, and markets are key to this understanding. The analytical framework offered could then be applied to other local crops, particularly the "canoe" crops such as banana (maiʻa), breadfruit (ʻulu), sweet potatoes (ʻuala), and yam (uhi). These crops are of interest since Hawaiʻi imports almost all of its "starch," and leaving the state vulnerable to food security in that food category.

² One U.S. ton is equivalent to 2,000 pounds.

Methods

Sample, Procedure and Data Sources:

The farm and market assessment employed a stratified convenience sample by fielding a survey to taro producers in all counties across the state. The sample was derived from known producers, referrals from trade associations, community groups, hui groups, UH-Cooperative Extension agents, and other non-government organizations. After three weeks of fielding the survey, reminder emails were sent to producers who did not respond. After another week, follow-up phone calls were made to producers who did not respond back to the emails sent.

Since not all producers are included in the sample frame, survey estimates are subject to a degree of sampling variability. Survey results are also subject to non-sampling errors such as omission, duplication, and mistakes in reporting, recording, and processing the data. While the effects of these errors are not measurable directly, they are kept to a minimum through stringent quality controls in the data compilation process and a careful review of all reported data for accuracy, consistency, and reasonableness.

Beyond that, the survey data was complemented by other market specific data, sourced from the U.S. Department of Commerce, Bureau of Labor Statistics (DOC-BLS), and local taro processors.

Measures:

The measures of interest are broadly categorized into production and marketing. Production metrics include planted acreage, fallow acreage, harvested acreage, crop type, and taro variety grown. Marketing metrics include sales volume and value; net imports, on-island, off-island sales and market outlets (wholesale, retail/restaurant, on farm, and online). Barriers or challenges cited by local taro producers is another included measure.

Results

Food Supply Analysis:

In traditional reporting of taro, the focus has been on commercial lo'i taro destined for poi production. Upland taro and lū'au leaf have become important commercial products over time and now deserve due attention. The *Taro Production Survey* fielded 131 questionnaires to identified taro growers statewide and ended with a response rate of 76.3 percent. With a 95 percent confidence level, the margin of error for this survey sample is +/- 4.7 percentage points. The findings from this survey reveal total taro production in Hawai'i at an estimated 4.8 million pounds and valued at \$6.4 million in 2021.

Naturally, lo'i taro³ led the way in both production and value of 2.6 million pounds and \$3.3 million, respectively. Lū'au leaf⁴ came in second at 1.9 million pounds and \$2.5 million correspondingly. Upland taro⁵ accounted for 257 thousand pounds, valued at \$563 thousand (see Table 1). In terms of harvested acreage statewide, lo'i taro was harvested from 189 acres, followed by lū'au leaf, harvested from 76 acres and upland taro, 27 acres. A total of 292 acres were reported as harvested out of 374 planted acres, resulting in a 78 percent harvested rate. Another sixty-four (64) acres were reported as fallow land.

Table 1
Taro Acreage, Production, Yield, Value, and Price by Crop Type, Hawai'i 2021

Crop Type	Planted Acreage (Acres)	Harvested Acreage (Acres)	Production (1,000 pounds)	Yield Per Acre (pounds)	Crop Value (1,000 dollars)	Price Per Pound (dollars)
Lo'i taro	269	189	2,632	13,926	3,275	1.24
Upland taro	29	27	257	9,519	563	2.19
Lū'au leaf	76	76	1,928	25,368	2,521	1.31
State total	374	292	4,817	16,497	6,359	1.32

Within the Hawai'i context, the utilization of lo'i taro, upland taro, and lū'au leaf in food preparation shares both common and unique practices, particularly in the various Polynesian communities, including Hawaiians, Samoans, Tongans, and Micronesians. Lo'i taro is used exclusively to produce poi, which is made by pounding cooked taro corms into a smooth, sticky paste. Besides poi, lo'i taro is cooked and served as a starchy side dish, accompanying fish or meat. Upland taro is grown in well-drained soil, away from standing water. The absence of excessive water results in a texture and taste that is firmer and slightly sweet flavor.

One common use of upland taro is to make taro chips. Thinly sliced taro corms are fried until crispy, and serve as a delicious snack. Another popular dish made with upland taro is laulau. Pork, chicken, or fish is often wrapped in luau leaves and pieces of upland taro, and the bundle is then steamed to savory perfection. Lū'au leaf, also known as young taro leaves, have a unique flavor that becomes milder when cooked. They are commonly used in soups, including the classic "sour soup," where coconut milk is cooked with a souring agent such as fermented taro to produce a hearty soup.

It is interesting to note that the farm-gate price for upland taro fetched the highest price at \$2.19 a pound in 2021. This was followed by lū'au leaf at \$1.31 a pound, and lo'i taro at \$1.24 a pound. The latter is sold primarily to poi millers/processors in Honolulu.

Equally noteworthy is that lo'i taro, which comprised 65 percent of total harvested acreage accounted for only 51 percent of total crop value and 55 percent of total production

³ Crop grown in wetland environment.

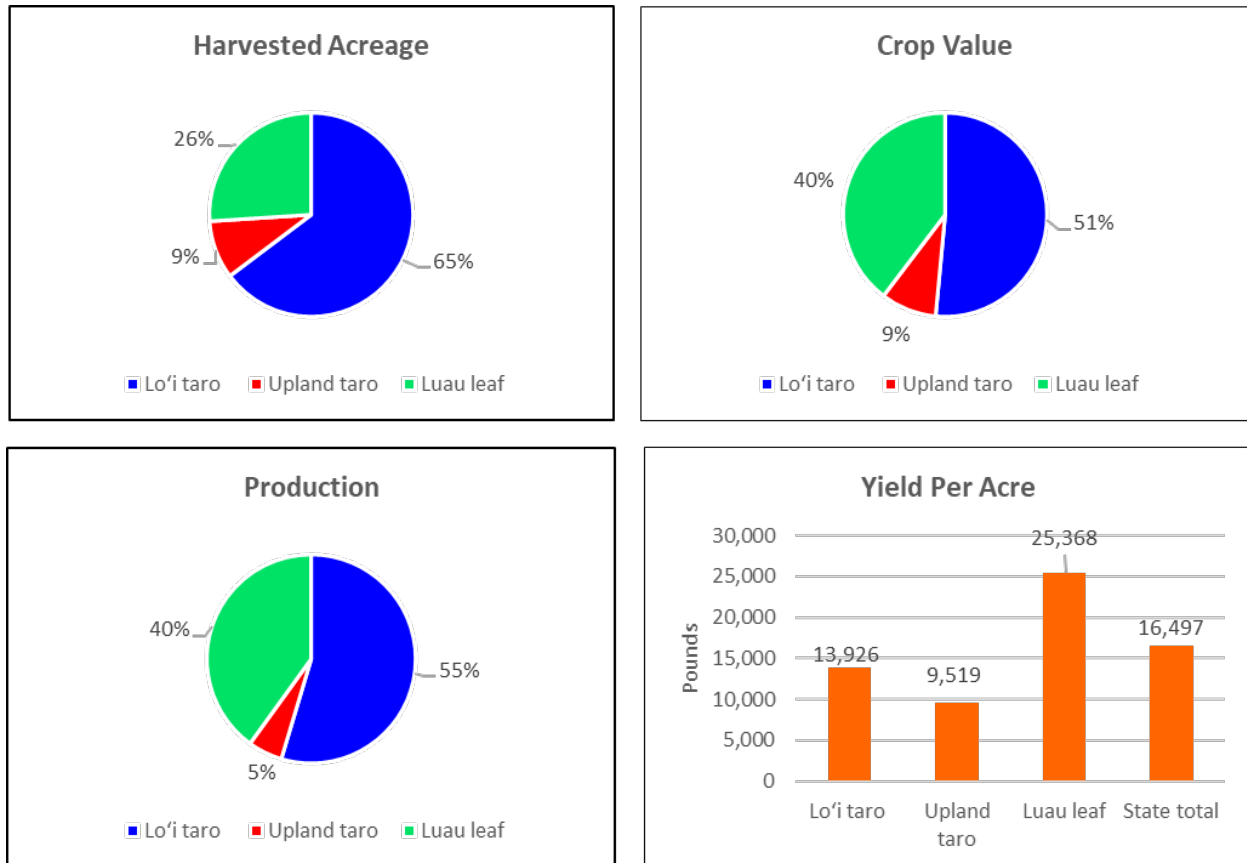
⁴ Taro crop grown for edible leaf.

⁵ Crop grown in dryland environment.

(see Figure 1). In sharp contrast, lū'au leaf, which accounted for 26 percent of harvested acreage earned 40 percent of crop value and 40 percent of total production. Lū'au leaf also recorded the highest yield at 25,368 pounds per acre. With these encouraging statistics, lū'au leaf offers an appealing and efficient crop for local farmers to grow. Additionally, it provides more frequent harvesting and consistent cash flow over time. Lo'i taro garnered the next highest yield at 13,926 pounds per acre.

Figure 1.

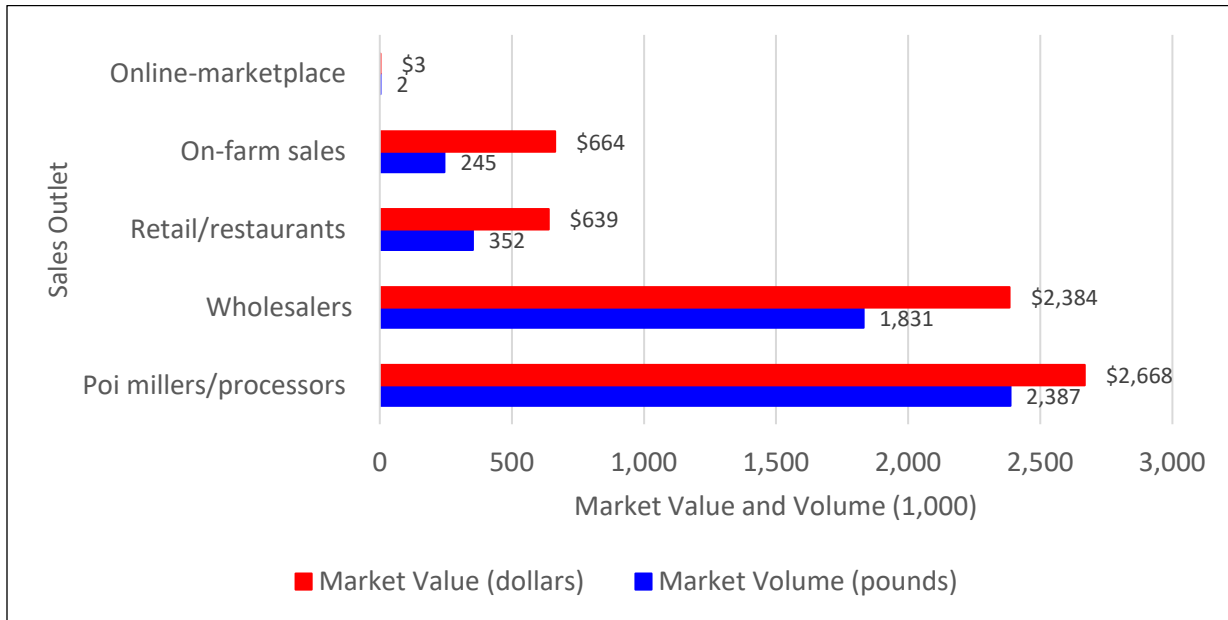
Crop Type Proportion by Harvested Acreage, Production, Value, and Yield, Hawai'i 2021



Sales Outlet:

On taro marketing by sales outlet, an estimated 2,387 thousand pounds or 49.6 percent of total market volume were sold to poi millers or processors (see Figure 2). Another 1,831 thousand pounds (38 percent) were sold to wholesalers while sales to retail/restaurants peaked at 352 thousand pounds (7.3 percent). On-farm sales recorded an additional 245 thousand pounds (5.1 percent).

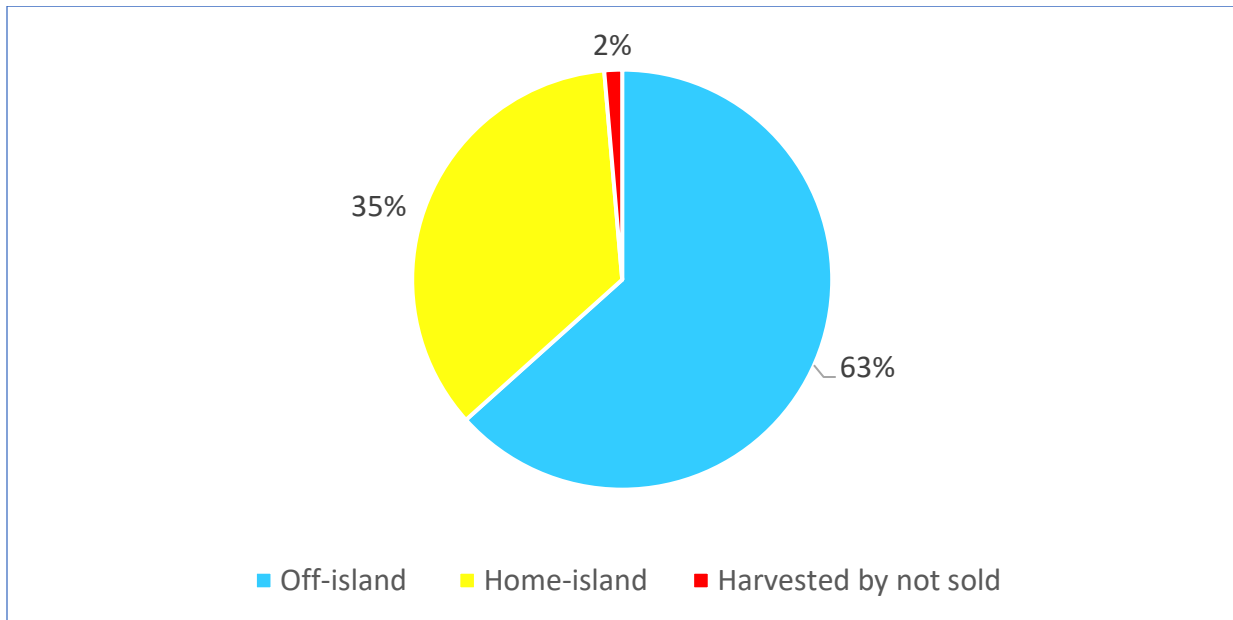
Figure 2
Taro Marketing by Sales Outlet, Hawai'i 2021



Inter-island Trade:

In tracking inter-island trade flows of taro products, the marketing channel for off-island sales accounted for 3.05 million pounds or 63.4 percent of all taro sales by market volume (see Figure 3). Much of these sales are generated by lo'i taro from Kaua'i destined for poi millers and processors on O'ahu. These off-island sales are further complemented by lū'au leaf heading to neighbor islands and the continental United States. Overall, home-island sales, which represent the crux of taro self-sufficiency were lower at 1.7 million pounds or 35.3 percent of the total sales. Taro crops harvested but not sold, fill the balance at 1.3 percent of all sales.

Figure 3
Taro Marketing by Sales Channel, Hawaii 2021



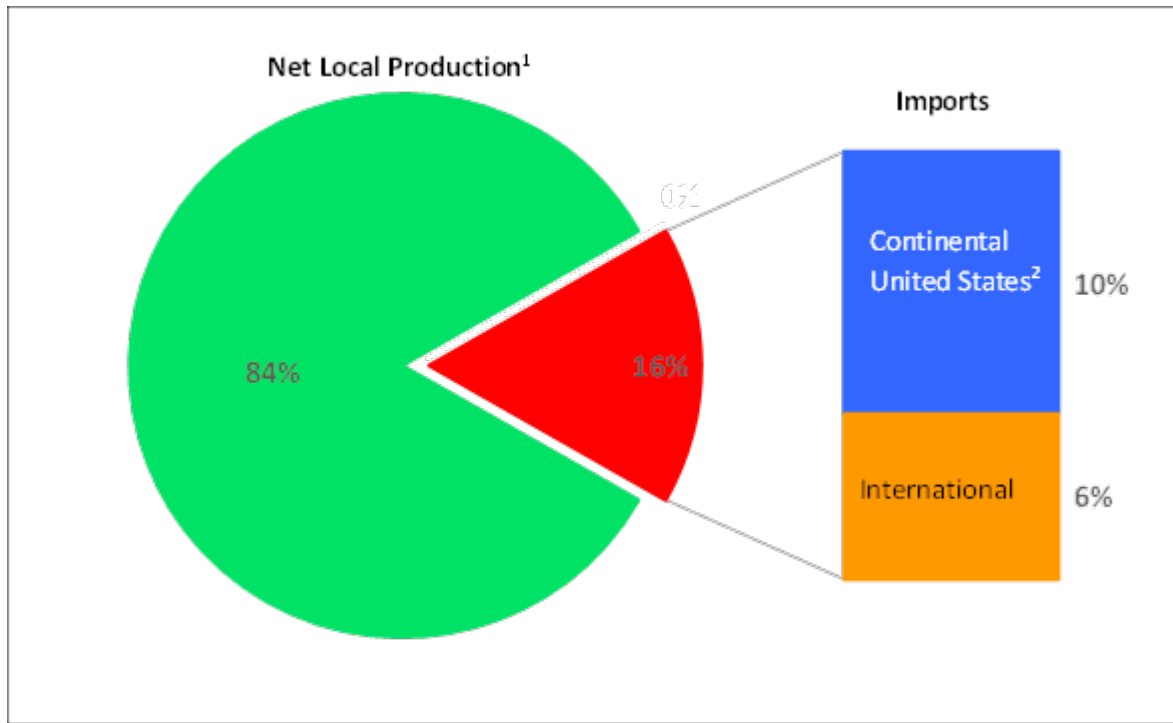
Taro Market by Supply Sources:

One approach to assess the extent of food localization is to map the existing food market flows from various supply sources. This food self-sufficiency ratio (SSR)⁶ is conceptually simple but its application may prove more challenging. Local production of taro and related imports are estimated at 5,682 thousand pounds in 2021. Most of the taro imports from the continental United States are reportedly sourced from Mexico, Costa Rica, and Ecuador. Leading taro imports from international sources include Samoa, Fiji, Tonga, and the Philippines.

In contrast, taro exports are estimated at 334 thousand pounds, leaving total available taro for consumption in the local market at 5,244 thousand pounds. Taro exports from Hawai'i represent seven percent of local production and are predominantly lū'au leaf destined for the continental United States. Figure 4 shows the Hawai'i taro market by supply origin. Finally, the SSR for taro in Hawai'i is estimated at 90 percent.

⁶ SSR = $P/(P+M-X)$ where P = local taro production; M = taro imports; and X = taro exports (Loke and Leung, 2013).

Figure 4
Taro Market by Supply Origin, Hawai'i 2021



Notes:

¹ Less exports.

² Reportedly sourced from Mexico

Discussion

The 2017 Census of Agriculture reported two hundred and seven farms and four hundred ninety-five acres of harvested taro production (USDA-NASS, 2019). Industry observers believe two hundred to three hundred additional acres are unreported or in subsistence taro cultivation (Hawai'i State Legislature, 2023). Proceeding along this train of thought, total harvested production is between 695 acres to 795 acres statewide. This estimate range is slightly below the projection of 805 acres in the 2020 statewide agricultural land use baseline study, commissioned by the HDOA (Perroy and Collier, 2022; p. 5).

In another study that touched on commercial taro production, the author suggested taro acreage hovers around 400 acres and 105 farms (Levin, 2015; p. 55). An estimated 190 acres nestled in the Hanalei National Wildlife Refuge were exclusively in wetland production. When small unrecorded commercial growers, subsistence farmers, educational and cultural lo'i were considered, perhaps 600 acres of lo'i kalo continue to be grown across the state (Levin, 2015; p. 58).

In this Taro Production Survey, the respondents collectively reported 438 acres. Kaua'i alone contributed 212 acres with a survey response rate of 94 percent. Of the 131 producers, some were groups of small, non-commercial producers, aggregated and masked as single entities (hui). Many of these small farmers were willing to share information but simply did not wish to be identified. This reporting issue resulted in an under counting of individual taro producers across the state. Production levels were less affected.

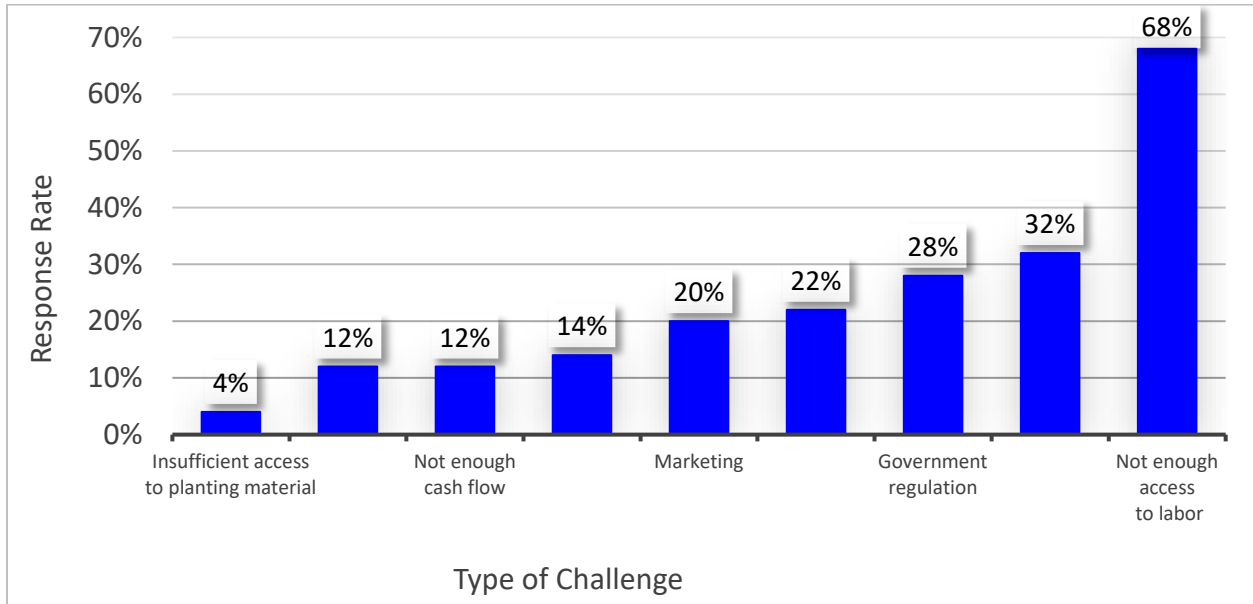
On non-responsive producers, the survey listing was fairly consistent overall across the state, except for the producers in Waipi'o Valley on the Island of Hawai'i. The farmers contacted in that district for the survey reported lower planted acreage than was expected. During the survey period, site visitation to the Valley was not possible as road access was closed off due to land- and rock- slides by the County of Hawai'i.

One interesting estimate that we uncovered from this survey was the value of huli (shoot) across the state. To some industry analysts and cultural practitioners, this is a grey (informal) market where most transactions are exchanged free of charge. Other commentators have viewed this market as out-of-bound as huli is considered as 'ohana (family) and not subject to trade and commercialization (OHA, 2023). In any case, the market value of huli, based on reported transactions is estimated at \$1.4 million in 2021.

Challenges and Opportunities:

Just like many other farmers and ranchers in Hawai'i, taro producers are facing insufficient access to labor across the state. Some 68 percent of survey respondents reported this as the leading challenge. Insufficient access to adequate water came in a distant second with 32 percent of respondents, and government regulation came in third with 28 percent (see Figure 5). Relatively low profit margin and marketing round up the top five ranking challenges facing taro producers at 22 percent and 20 percent, respectively. Reflecting the high volume of *off-island sales*, some 14 percent of respondents cited the cost of shipping/transportation as a challenge to their taro operation. Insufficient access to capital and not enough cash flow were also cited as challenges. Fortunately, insufficient access to planting material (huli) was noted by only four percent of survey respondents. All told, the challenges facing taro producers at face value does not appear unique nor distinct from other local farmers.

Figure 5
Challenges Facing Taro Producers, Hawai'i 2021*



*One or more challenges can be reported by producers in the survey.

In identifying opportunities, the taro producers themselves reported growing demands from consumers despite declines in farming this local staple crop (Lyle, 2023). Increasing demand and declining supply of taro are the winning combination to higher market prices and more resilient profit margins. Contrary to market conditions in pre-COVID 19, market dynamics has shifted and existing taro imports account for only 16 percent of the local market share. Additionally, taro exports (lū'au leaf) is expanding beyond the west coast states of California and Washington to Nevada, Utah, and Texas. Anecdotal information even suggests that Hawaiian *lau lau* are now being manufactured in California, and making their way back to serving tables in local lū'au. In time, complementary products such as poi, kūlolo, and lū'au stew are equally likely to experience a bounce in demand.

Outstanding Issues:

Keeping in mind the significant importance of taro production and related identity of traditional/customary practices of Native Hawaiians, it appears the ecological and social dimensions of a sustainable food system are already well defined. Pursuant to Section 226-7 (b) (17), Hawai'i Revised Statutes, the Hawai'i State Planning Act has a mandate to "perpetuate, promote, and increase use of traditional Hawaiian farming systems," including the use of loko i'a, māla, and irrigated lo'i, and growth of traditional Hawaiian crops, such as kalo, 'uala, and 'ulu. What is less clear is the resiliency of the economic dimension. With an increasing frequency of fluctuation in business cycles, taro production as a farming enterprise is not

immune to the challenges of labor shortages, supply chain constraints, inadequate access to capital, and energy or input price spikes.

A business enterprise needs to realize profits to remain sustainable. This means the ability to generate revenues by offering more products and growing markets. Some innovative products, in different stages of commercialization include taro ice cream, taro hummus, taro flour, and pre-steamed luau leaf. Equally important is the capacity to increase crop productivity and to contain production costs. Increased crop productivity are normally realized by growing higher yielding, disease resistant varieties in nourishing soil mediums. Production costs are usually contained with mechanization, adoption of technology, prudent farm management tools, and economy of scale. It is this economic dimension that traditional practitioners and contemporary producers may have the most disagreement over the means of production in this sustainable food system framework.

Conclusion

This article assesses different dimensions of taro activity in Hawai'i, including crop type, farmland acreage, production volume, sales value, marketing channels, interisland trade and the local market by supply sources. With three product offerings (lo'i taro, upland taro, and lū'au leaf), total production statewide is estimated at 4.8 million pounds and valued at \$6.4 million in 2021. The inclusion of huli would add another \$1.4 million.

In the marketplace, a majority of taro available for local consumption is sourced locally (84 percent) and the remainder is imported from the continental United States (10 percent) or countries in the Pacific (6 percent). The extent of taro localization in Hawai'i as measured by the Self-Sufficiency Ratio (SSR) is at a respectable 90 percent.⁷ It further indicates that taro in Hawai'i is competitive and exports could be diverted back to the local market whenever the need arises. The threat of taro imports to soon exceed local production is most unlikely to materialize in the near future.⁸ In all likelihood, the demand for taro as a healthy, staple food is expected to increase in both Hawai'i and select states in the continental United States with an increasing concentration of residents originating from Hawai'i.

The compilation of primary data imposed some challenges to this research effort. Many responses from the smaller farmers were incomplete, and follow-up efforts by emails and phone calls were elusive. Of those contacted, most were polite but reluctant to fully disclose information sought after.

⁷ A higher score denotes a higher level of food self-sufficiency or less dependency on imports. In sharp contrast, Hawai'i has an overall food SSR of 15.7 percent as estimated in Loke and Leung (2013).

⁸ All bets are off in the advent of taro diseases. In the case of the taro leaf blight disease (*Phytophthora colocasiae*), it reduced taro production by 97 percent upon reaching the islands of Samoa in the early 1990s and wiped out completely the taro production in Puerto Rico in 2004 (UH-CTAHR, 2009).

Similar to the experience of other local farmers, taro producers will continue to confront the challenges of insufficient labor, adequate access to clean water, burden of government regulation, and relatively low profit margin for their crops. An increasing number of them are producing complementary, value-added products to supplement their primary crop income. This is a healthy and enterprising trend to improving local farm resiliency and sustainability. More research efforts should be devoted to track and measuring the extent of this diversification within the taro and general farming industry.

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Acknowledgement

The authors acknowledge and thank Dr. Marie Kainoa Fialkowski Revilla, Associate Professor in Human Nutrition, University of Hawai'i at Manoa, Dr. Eugene Tian, Chief State Economist, Hawai'i Department of Business, Economic Development, and Tourism (DBEDT), Joshua Silva, Associate Extension Agent, Edible Crops, University of Hawai'i Cooperative Extension Service for their critical review and constructive comments. We are also indebted to William Tehero and Cheresa Coles for their able assistance. The views expressed and responsibility for the final content rests with the authors and do not necessarily reflect the position of the Hawai'i Department of Agriculture.

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