



Hawaii Department of Agriculture
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Inshipment Trend and Its Implications on Hawaii's Food Security

FINAL

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By Mana Southichack, Ph.D.

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Executive Summary

Between 1960 and 2005, imports of fruits and vegetables grew substantially, especially between the mid-1960s and 1990, when population and the tourism industry expanded most rapidly. Over this 45-year period, import share for fruits grew from 49.1% to 58.9% and for vegetables, from 43.6% to 65.5%. The per capita imported fruits grew from 41.1 pounds in 1960 to 84.7 pounds in 2005 and imported vegetables from 67.7 pounds in 1960 to 132.3 pounds in 2005. Hawaii's per capita fruit production grew from 42.5 pounds in 1960 to 108.1 pounds in 1990, but it plunged considerably after that to 59.2 pounds by 2005. Hawaii's per capita vegetable production shrank from 87.6 pounds in 1960 to 69.8 pounds in 2005. When vegetables and fruits are combined, the per capita production declined 0.9%.

The rising import shares in Hawaii's total fruit and vegetable supplies, with increasing per capita import volumes and declining per capita local production together, suggests that Hawaii's food security status in 2005 was worse than that in 1960. With visitor population included, the per capita vegetable and fruit production in 2005 is reduced by 13.4%, worsening Hawaii's food security status. Less local production means a higher probability of a food shortage incidence. Therefore, more stockpiling of essential food items and crop seeds are needed to prevent food shortages in an emergency situation.

Between 1960 and 2005, farm land in Hawaii shrank from 2.6 to 1.3 million acres, due almost entirely to the decline in the export-oriented sugarcane and pineapple industries. Of the remaining 1.3 million acres of farmland, Hawaii needs roughly 5% to produce enough vegetables and fruits for both residents and visitors, leaving 95% of farmland for other crops and livestock, more than enough for self-sufficiency during a crisis. Although the decline in farm acreage to present has not yet reached the "*critical point*" where Hawaii's food security would be threatened, the trend is a warning sign for Hawaii's future food security.

What is more critical for food security than the declining farm land is that Hawaii does not commercially produce essential food crops for everyday dietary needs such as grains, potatoes, among others. Currently, only sweet potatoes are grown commercially in Hawaii. Land-scarce Hawaii is not suitable for rice production, which requires an extended track of land. Potatoes are not grown commercially in Hawaii because of the availability of inexpensive imports. Vegetables, including potatoes, and fruits are only part of the daily dietary needs that local production has not been keeping up with. Also, Hawaii's production of protein food sources (cattle, hogs, milk, eggs) has not only been lagging behind population growth, but has been declining since the late 1980s/early 1990s (not discussed in the main text).

Policy recommendations:

In complete isolation, local production would be the only option available for the survival of the population. To enhance the state's food security status, not only does Hawaii need to preserve agricultural land, but also the production of essential food crops and the means of proliferation when situations demand them. In fact, keeping agricultural land active is the most effective way to preserve agricultural land and strengthen Hawaii's food security status. To improve Hawaii's food security status, this paper suggests the following actions:

- **Continue to promote the existing crops that are market-driven through marketing support, pest control and research.**
- **Promote food crop diversification by encouraging laboratory research and field experimentation in both production and marketing through a public-private partnership program.** Hawaii is a high-cost location for agriculture. A profitable crop today could lose its competitiveness and become unprofitable tomorrow, meaning that a continual search for new products with market potential is a must. Some diversified food crop production may not necessarily replace imports. It may be grown mainly to supply the out-of-state markets. Should exporting or importing food become impossible, export-oriented crops could serve, or adapt to serve, local markets.
- **Promote and sustain the production of *essential crops* through joint private-public marketing campaigns, tax incentives, and land subsidies.** Crops that are deemed critical to the daily human diet such as potatoes, soy and various other beans, among others, must be produced in order to attain some supply-readiness and production infrastructure, and to maintain farming knowledge of these crops. In addition to the existing “Buy Local” campaign to the general consumers, actively promote linkage between fine dining restaurants and local-grown produce classified as “essential crops.” A tax incentive may be needed to encourage the consumption of local-grown essential crops. The classification of essential crops and tax incentive program possibilities require detailed research under two separate studies.
- **Promote saltwater aquaculture.** Hawaii is surrounded by ocean and rich with aqua resources that could be directly utilized or farmed to provide protein and other nutrients for human consumption. This area should be explored extensively.
- **Stockpile food supplies and seeds of essential crops.** A large scale government-controlled program is required. Stockpiling food supplies is an expensive project. The right amount of food to stockpile is one that minimizes public burden while ensuring an adequate essential food supply until local production can catch up with demand. This requires a careful and detailed study.

The conclusion made in this paper is considered a preliminary finding. A more detailed and in-depth study is required for drawing a more comprehensive and precise conclusion about Hawaii's food security status and its future. A formal *Food Security Index* measuring food security status and trend needs to be developed in order to attain a more concrete interpretation of Hawaii's food security status at any given point in time. Food security is a function of multiple factors, not just local supply and not simply the aggregate volume of output. These factors include the likelihood that transportation will be severely disrupted for a long time; that the majority of Hawaii's existing suppliers of imported foods will be severely handicapped; and that Hawaii would not be able to find alternative suppliers should such a severe crisis occur.

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Inshipment Trend and Its Implications on Hawaii's Food Security

1. Introduction

Hawaii's fruit and vegetable inshipments have been growing while local production has been declining in the past five years, and farmland has been continually shrinking over the last four decades. These are alarming signs for Hawaii's food security, which has heightened since the 9/11 terrorist attacks and the ongoing H5N1 avian influenza flu (bird flu) phenomenon in East Asia, which could potentially evolve into a global pandemic. This paper reviews fresh fruit and vegetable inshipment trends and their association with local supply, analyzes their implications on food security in Hawaii and offers policy recommendations. Hereafter *import* and *inshipment* are used interchangeably.

Hawaii imports the majority of its food supply, as the state's climatic conditions are not suitable for the production of many food items that Hawaii's residents and visitors prefer. Additionally, high costs prohibit the production of certain commodities that are suitable for Hawaii's climate. Hawaii is unique from the rest of the 49 states in the union. It is comprised of a chain of islands at the center of the Pacific Ocean, isolated from the rest of the United States and the world by thousands of miles. Thus, maintaining a smooth functioning of the food supply chain and the transportation network is critical for Hawaii's food security at the present. The concern over H5N1 global pandemic potential is that it could initially disrupt the transportation network and jeopardize Hawaii's food security. Depending on the severity of the pandemic, food supply could be disrupted at its sources, which could have a longer lasting effect. Similarly, biological and chemical terrorism could severely jeopardize Hawaii's food supply through contamination and disruption of the transportation network and/or damage to its sources.

To enhance Hawaii's food security, some have suggested that Hawaii must adopt a food self-sufficiency policy, a term with various versions of definitions among government officials, activists, academia and analysts. Regardless which version is most appropriate and economically sound (which will not be elaborated upon in this paper), it is clear that Hawaii must have a strategic plan to assure food security for residents and visitors in the event of a long-lasting disruption in food imports.

Next, we proceed by briefly discussing methodology and data, followed by a brief discussion on Hawaii's food security and risks. After that, fresh fruit and vegetable inshipment trends and local production trends will be reviewed. Then, their implications on Hawaii's food security will be analyzed. Finally, policy recommendations and a conclusion will end the paper.

2. Methodology and data

Imports and local production of fresh fruits and vegetables are used as a proxy for analyzing Hawaii's food security status and trend. Reasons: Fresh fruits and vegetables are essential components of everyday meals; they provide primary inputs for processed foods and animal feeds; their production requires basic infrastructure and resources which are also necessary for other agricultural production; and consistent, time series import and production data are available.

Interstate inshipment data of fresh fruits and vegetables are gathered annually by the Hawaii Department of Agriculture (HDOA), Agricultural Development Division (ADD), Market Analysis and News Branch (MAN). Direct foreign import data are obtained from U.S. Department of Commerce (USDOC) Bureau of Census. Visitor and population data are obtained from Hawaii Department of Business, Economic Development and Tourism (DBEDT). Production and farmland data are obtained from the *Statistics of Hawaii Agriculture*, published by USDA-NASS Hawaii Field Office in cooperation with the HDOA. Processed fruits and vegetables are excluded from the analysis because of a lack of comparable import data. Pineapples and sugarcane are excluded from the analysis, although they remain important food crops, because they are considered traditional crops and have been declining since the 1960s. Together sugarcane and pineapples still covered 53.2% of all cropland in 2005.

3. Hawaii's food security and risks

Food security is a term that has different meanings under different contexts. Under normal circumstances, food security tends to focus on low-income households. In many developing economies, food security tends to focus on poor communities, which are commonly isolated from the country's mainstream market system. Food security may be an issue of nutritional concern; it may be viewed as a concern over the ability to purchase food as desired. Food security is often defined as "access by all to enough food for an active, healthy life."

Food security in association with the potential global flu pandemic and biological/chemical terrorism has been an issue focusing on food safety and defense, on the prevention of biological/chemical terrorism, and on response to a crisis. In this paper, food security issues focus on the ability to sustain the food supply to meet the demands of local residents and visitors during a crisis. As an island state located thousands of miles from the U.S. Mainland and the rest of the world, the ability to be self-sufficient in food to survive the prolonged crisis is critical for Hawaii.

Hawaii's food security risks have various sources. Natural disasters such as strong earthquakes, hurricanes, or tsunamis could destroy the existing food supply and farm infrastructures, and hence Hawaii's food production capacity. Should any of these disaster scenarios result in a food shortage, it could be solved within a relatively short time period. As long as transportation remains open, food can be shipped into Hawaii from elsewhere. However, an H5N1 pandemic or terrorist attack, causing biological or chemical contamination, poses greater risks to Hawaii's food security than natural disasters.

In the event of an H5N1 pandemic or terrorist biological attack (either in Hawaii or in a major U.S. city), all means of transportation and hence food shipment into Hawaii may be halted temporarily to prevent the spread of the biological agent. However, with measures in place to prevent the spread, transporting food into Hawaii would still be possible, though food would enter Hawaii's shore at a slower pace. A widespread food contamination at its origins could cut out Hawaii's food supply for an extended time period before contaminants are cleared. Depending on the severity of the crisis, Hawaii's food suppliers may cease to function as production and distribution of food at some or all stages could be greatly disrupted due to human

immobility—a great number of people not working for fear of exposure to the virus or ordered into quarantine by authorities. If so, Hawaii must be self-sufficient. This requires that a sufficient production capability be maintained.

4. Hawaii's fresh fruit and vegetable inshipment trend and local production

For statistical convenience, this paper examines a 45-year period between 1960 and 2005, which should provide a sufficient time-span for analyzing trends associated with Hawaii's food security. Over this period, both local production and imports of fresh fruits and vegetables substantially grew, especially from the early 1970s through the late 1980s for fruits. Unless specified, pineapples are excluded from fruit discussion.¹

In 1960, Hawaii's fruit imports and production were respectively 25.99 million pounds and 26.91 million pounds. Hawaii's fruit production peaked in 1988, when fruit imports and production respectively reached 90.78 million pounds and 121.59 million pounds. However, Hawaii's fruit production began to slip after that and fluctuated downward throughout the 1990s while imports continued to grow until 1993, before moderately declining after that (Figure 1). Sharp drops in Hawaii's fruit production in 1979, 1982 and 1985 were all attributed to papayas. For the 1991 drop, papayas and guavas were the contributing factors. Production recovered in 2000 but reversed its course and renewed its contraction trend the next year with steep falls in 2002 and 2004, due mainly to papayas, bananas and guavas. Imports strongly rose from 2002, to cover for the local supply shortfall. By 2005, production shrank 37.9% to 75.47 million pounds from its 1988 record high level, while imported fruits grew 18.9% to 107.96 million pounds over the same time period. Nonetheless, over the entire 45-year period, Hawaii's fruit production grew nearly threefold to 75.47 million pounds, and imports grew more than fourfold to 107.96 million pounds.

Vegetable imports rapidly grew until 1989, especially from 1975, then remained relatively flat until 2000 (Figure 2). In the following year, vegetable imports declined 5%, due to the 9/11 crisis, and continued to decline in the successive years until 2003.² Vegetable imports surged in the next two consecutive years, reaching 168.69 million pounds in 2005. Local vegetable production also expanded, but less dramatically than fruit production. Hawaii's vegetable production grew relatively rapidly between 1972 and 1983, but declined after that until 1994. Then, production expanded again for the next five years. Hawaii's vegetable production volume has been in a decline since 2000. By 2005, vegetable output decreased to 88.96 million pounds, but remained 60.5% more than its 1960 level. Figure 2 clearly shows that vegetable production is lagging behind imports while fruit production, in Figure 1, was roughly growing about the same pace as imports over the entire 45-year stretch. In fact, between 1974 and 1988, Hawaii's fruit production grew (128.8%) much faster than imports (70.1%).

¹ Pineapples are excluded to isolate it from all other fruit varieties in the “diversified agriculture” category, because it is considered a traditional crop characterized by large plantations.

² In 2001 total visitor days declined 6.4% from 61.7 million in 2000. By 2003 total visitor days was still 4.8% less than in 2000. The visitor industry did not fully recover from the 9/11 effect until 2004, when total visitor days exceeded the 2000 level by 1.8%.

Figure 1.

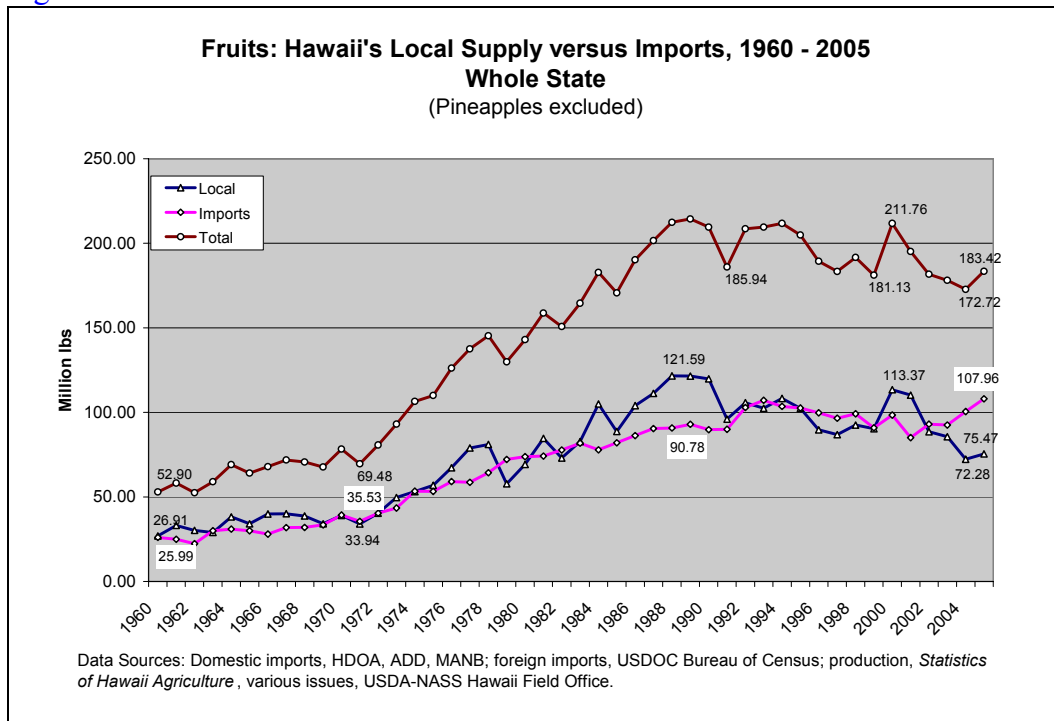
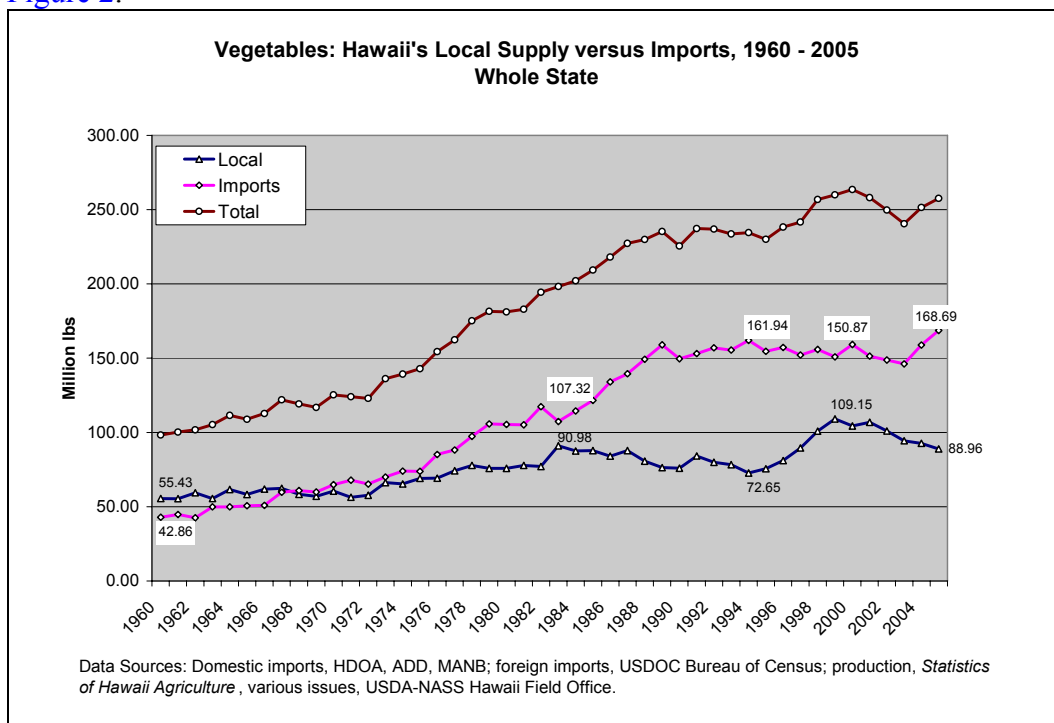


Figure 2.

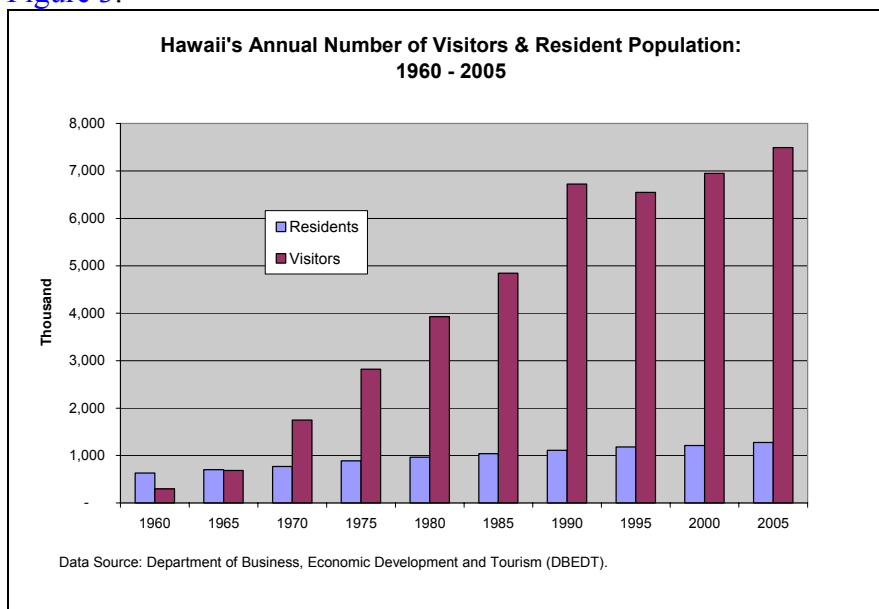


Population increase, both resident and visitor, was the main determining factor for rapid growth of Hawaii's fruit and vegetable production and imports, especially in the 1970s through the late 1980s. From 1960 to 2005, Hawaii's resident population doubled, growing from 632,772 to

1,275,194. Visitor population expanded most rapidly, adding to the rapid increase in demand for fresh produce. In 1960, Hawaii had 296,249 visitors. By 1970, there were 1.75 million. This increased to 3.93 million by 1980 and to 6.72 million by 1990. In 2005, there were in total 7.49 million visitors to Hawaii (Figure 3).

Although the number of visitors in 2005 was nearly six times larger than the resident population, the visitors' total demand for food was much less than that of Hawaii residents' because the visitors' average length of stay was very short compared to Hawaii residents.³ Figure 4 provides a visual aid comparing resident days with visitor days. Between 1990 and 2005, visitor days accounted for approximately 12% of total consumer days on average.⁴ However, the visitors' share in the state's total food demand volume was larger than what the visitor days share (in Hawaii's total consumer days) suggested. This was because eateries are an important part of tourism.⁵ In 2003, based on DBEDT's estimate, the visitors' total expenditure on food accounted for approximately 31% of the state's total expenditure on food.⁶ Since a meal normally costs an average visitor more than what it would for an average local resident, visitors' share in the state's total food demand volume would be less than that of the spending share. Thus, visitors' share in the state's total food demand volume would lie between 12% and 31%.⁷

Figure 3.



³ From 2000 through 2005, average length of stay exceeded 9 days in each year; average length of stay over 1990-2005 was 8.8 days on average (with a minimum of 8.2 and maximum of 9.2).

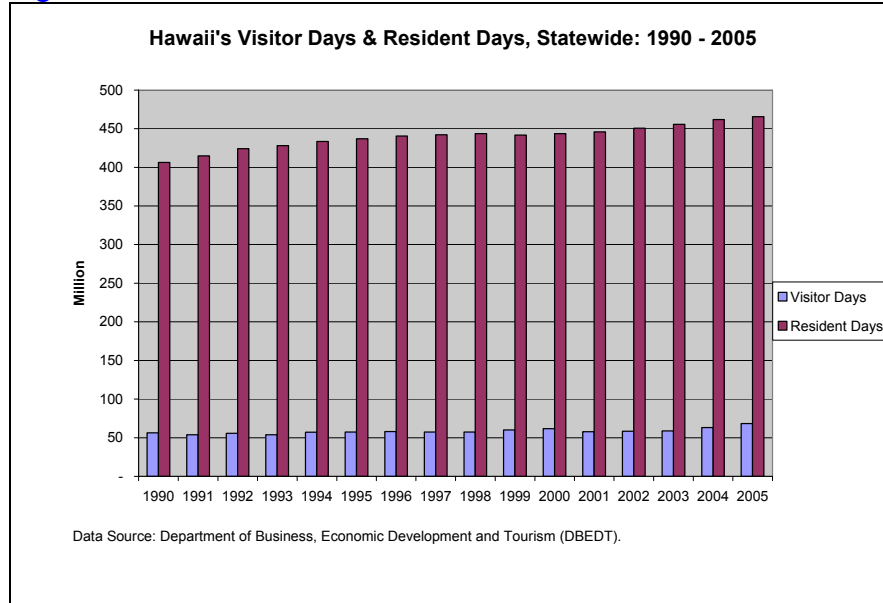
⁴ Total consumer day is the sum of visitor days and resident days, where resident days are the product of resident population and the total number of days in a given year. The furthest back visitor day data available is 1990. The minimum and maximum are 11.5 and 12.8, respectively, and the standard deviation is 0.004.

⁵ Although an average individual visitor may not eat much more than an average local resident, food allocation for each visitor per day tended to be larger than what an average local resident would utilize per day.

⁶ Based on 2003 Annual Visitor Research Report, DBEDT.

⁷ If an average visitor's spending on a meal was approximately 1.5 times that of an average local resident's, visitors' share in total demand volume would be in the neighborhood of 20%. Visitors mostly dined at commercially prepared and serviced eateries, where a meal costs more per pound than a meal prepared at home which is more common for local residents.

Figure 4.



5. What caused local supply shrinkages in recent years?

Hawaii's major fruits and vegetables that experienced a decline in recent years are respectively shown with some details in [Tables 1 and 2](#). The shrinkage in aggregate production of fresh fruits and vegetables in Hawaii in recent years has several explanations including pests, severe weather conditions, and market forces. New market conditions emerged as a result of U.S. free trade agreements with North American countries (Canada and Mexico) and others. This allowed greater inflows of relatively low-cost foreign agricultural products into Hawaii to compete with local-grown products.

The dramatic decline in Hawaii's ginger production was mainly a result of increased imports of low-cost ginger from China and elsewhere. The decline in guava output after 2000 was due to the industry's adjustment to market conditions. The decline in pineapple (not included in any fruit figures and Table 2 for being a traditional crop) was also a result of fundamental change in the market which made Hawaii-grown pineapples less competitive. Although fundamental changes caused by expanded free trade policies of the United States have eroded Hawaii-grown products' competitiveness across the board, not all commodities that experienced shrinkages suffered from this new environment. The decline in Hawaii's tomatoes in 2004 and 2005 was due mainly to sustained rainfalls.⁸ Bananas, papayas, and cabbages were severely affected by pests and diseases.⁹ The decline in watercress output (not shown in Table 1) was due to productivity erosion and pest problems, not to import competition.¹⁰

⁸ While tomato output went down after 2003, acreage harvested went up (Table 1).

⁹ Although banana production in aggregate has been declining, apple banana production, which made up approximately 25% of all banana production in Hawaii, has been expanding.

¹⁰ Although output in the past several years was much lower than in the mid-1980s, watercress acreage harvested remained stable. In 1985, 35 acres produced 1.53 million pounds; in 2005, the same amount of harvested acreage produced 700,000 pounds in total.

Table 1. Major Vegetables Experiencing Contraction in Recent Years

	1997	1998	1999	2000	2001	2002	2003	2004	2005	Diff. from Yr Highlighted
<i>1,000 pounds</i>										
Beans (snap)	700	900	1,000	1,200	1,100	900	1,000	900	700	(500)
Cabbage										
(Chinese)	7,700	7,900	7,500	7,200	7,000	6,800	6,700	5,300	5,700	(2,200)
Cabbage (head)	13,000	15,300	14,300	14,600	12,500	13,000	12,600	9,000	9,800	(5,500)
Celery	1,250	1,300	1,300	1,100	1,150	1,100	1,200	900	830	(470)
Corn (sweet)	1,300	1,100	1,700	2,400	1,900	2,400	2,500	1,800	1,700	(800)
Daikon	3,300	3,000	2,700	3,100	3,200	2,500	2,300	1,700	NA	(1,600)
Onions (round)	1,700	3,500	3,400	4,300	5,400	2,100	3,300	1,600	2,300	(3,100)
Romaine	1,900	3,300	2,700	2,000	2,000	1,800	1,900	1,500	1,700	(1,600)
Squash (Italian)	1,400	1,500	1,900	2,200	1,800	1,400	1,800	1,700	1,500	(700)
Taro	5,500	6,000	6,800	7,000	6,400	6,100	5,000	5,200	4,000	(3,000)
Tomatoes	10,200	10,200	16,800	16,500	17,500	17,500	17,500	16,800	14,200	(3,300)
Ginger root	12,100	18,000	16,100	13,500	18,000	14,400	6,000	6,000	5,100	(12,900)
All Other										
Vegetables	29,500	28,926	32,950	29,270	28,860	31,000	32,620	40,250	41,430	11,930
Total	89,550	100,926	109,150	104,370	106,810	101,000	94,420	92,650	88,960	(20,190)
<i>1,000 acres harvested</i>										
Beans (snap)	0.130	0.200	0.200	0.210	0.210	0.180	0.200	0.170	0.130	(0.080)
Cabbage										
(Chinese)	0.390	0.380	0.330	0.320	0.320	0.340	0.310	0.260	0.260	(0.120)
Cabbage (head)	0.650	0.600	0.550	0.540	0.500	0.540	0.500	0.360	0.430	(0.170)
Celery	0.050	0.050	0.050	0.050	0.050	0.050	0.045	0.030	0.025	(0.025)
Corn (sweet)	0.420	0.400	0.450	0.440	0.440	0.610	0.830	0.540	0.410	(0.420)
Daikon	0.290	0.300	0.300	0.350	0.330	0.250	0.220	0.200	NA	(0.090)
Onions (round)	0.185	0.270	0.310	0.340	0.300	0.200	0.330	0.180	0.220	(0.080)
Romaine	0.165	0.220	0.240	0.190	0.190	0.150	0.160	0.140	0.140	(0.080)
Squash (Italian)	0.200	0.170	0.180	0.180	0.160	0.175	0.150	0.230	0.200	0.020
Taro	0.450	0.490	0.500	0.470	0.440	0.430	0.420	0.370	0.360	(0.110)
Tomatoes	0.340	0.300	0.420	0.500	0.580	0.580	0.560	0.600	0.660	0.100
Ginger root	0.275	0.360	0.350	0.270	0.360	0.320	0.160	0.150	0.120	(0.240)
All Other										
Vegetables	2.115	2.070	3.750	1.980	2.100	2.425	2.065	2.960	2.895	0.780
Total	5.660	5.810	7.630	5.840	5.980	6.250	5.950	6.190	5.850	(1.780)

Data Source: *Statistics of Hawaii Agriculture*, various issues, USDA-NASS Hawaii Field Office.

Table 2. Major Fruits Experienced Contraction in Recent Years
(Excluding Pineapples)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	
<i>1,000 pounds</i>										
Bananas:	13,700	21,000	24,500	29,000	28,000	20,000	22,500	16,500	20,900	(8,100)
Papayas:	38,800	39,900	42,400	54,500	55,000	45,900	42,600	35,800	32,900	(22,100)
Guavas:	15,900	14,600	10,700	15,900	15,300	9,700	6,700	8,100	8,100	(7,800)
Watermelons	16,800	15,800	11,400	12,600	10,500	11,300	11,900	10,100	11,300	(5,500)
All Other Fruits	1,650	1,210	1,246	1,367	1,341	1,662	1,914	1,781	2,265	616
Total Fruits	86,850	92,510	90,246	113,367	110,141	88,562	85,614	72,281	75,465	(37,902)
<i>1,000 acres in crop</i>										
Bananas:	1.590	1.600	1.760	1.710	1.660	1.510	1.560	1.360	1.145	(0.565)
Papayas:	4.055	3.555	3.500	2.845	2.860	2.320	2.240	2.105	2.395	(0.465)
Guavas:	0.900	0.890	0.870	0.800	0.710	0.640	0.610	0.610	0.670	(0.130)
Watermelons	0.840	0.790	0.570	0.560	0.520	0.550	0.450	0.510	0.450	(0.390)
All Other Fruits	1.455	1.555	1.870	1.745	1.870	2.130	1.990	1.925	1.990	0.535
Total Fruits	8.840	8.390	8.570	7.660	7.620	7.150	6.850	6.510	6.650	(1.010)

Data Source: *Statistics of Hawaii Agriculture*, various issues, USDA-NASS Hawaii Field Office.

Hawaii has continually been a net importer of food and the majority of other consumer goods. It is not only because Hawaii's climate and land is not suitable for growing the many types of crops consumers on the islands demand, but Hawaii is one of the most expensive places in the world to farm. Being located in the center of the Pacific Ocean, Hawaii farmers must pay additional costs associated with transporting into the islands materials, tools, and equipment needed for farm operations. Land and water costs for agriculture are also relatively high in Hawaii. Thus, Hawaii's farmers are in general high-cost producers. Typically, island economies worldwide tend to have higher costs than economies on continents. Recent energy price hikes, which resulted in rising transportation cost of imports, did not raise Hawaii-grown products' competitiveness in local markets because costs of inputs that Hawaii's producers must import have also risen. Other than cost increases, Hawaii's farmers also have more difficulty finding skilled farm workers than do farmers in the Mainland.

As part of the United States and as an open economy, Hawaii's farmers must compete against relatively low-cost Mainland farmers and, especially, foreign farmers. The North American Free Trade Agreement (NAFTA), which entered into force in January 1994, had changed the competitive environment in the fresh produce industry. Competitive pressures are likely to increase as U.S. free trade agreements are expected to continue to expand with more countries around the world. Recent gradual surges of fruit and vegetable imports are visible in the supermarkets and mega markets (Costco and Sam's Club). While relatively low-cost imports are benefiting consumers in general, they increased competitive pressures for Hawaii's producers, especially those growing crops identical to imports.

Nonetheless, locally grown fruits and vegetables that are highly perishable or have unique characteristics and qualities, albeit high production cost, are not being directly threatened by imports. For instance, Hawaii-grown papayas are unique in quality and characteristics. Although

Hawaii's papaya production experienced a substantial and lasting decline after 2001 (Table 2), only a negligible amount of papayas were imported via California in recent years—11,400 pounds in 2005 and less than 6,000 pounds in 2006. The decline in papaya production was due to disease and pest, compounded by sustained rainfalls in some years, and affected the exported market, rather than the local market. While the aggregate production has been in a decline in the past five to six years, the production of certain fruits and vegetables remained relatively stable, and some even expanded. The production of cucumbers, eggplants, lettuces, green onions, and green peppers has been relatively stable. Sweet potatoes, fresh herbs, other minor crops, and certain tropical specialty fruits were experiencing growth.¹¹

6. Implications on Hawaii's food security

Three elements indicating Hawaii's food security status in this paper's context are (1) changes in import shares in total fruit and vegetable supplies over time, (2) changes in per capita local production and imports over time, and (3) changes in farmland acreage over time.¹² An increase in import share means that, in an emergency, Hawaii's food supply vulnerability (or food security status) is worsened and more stockpiling of food supplies is required. A decrease in import share has the opposite implication. An increase in per capita local production implies that food security status improves in both meeting current demand and ability to be self sufficient if the situation warrants, and a decrease in per capita local production has the opposite implication. The implication of an increase or decrease in farmland on production capacity is straightforward.

Import shares in Hawaii's total vegetable supply, as appears in Figure 5, has clearly increased over the past four decades. Hawaii's fruit production performed much better than vegetables, with import share hovering mostly under the 50% line until the latest series of sharp growth in imports which began in 2002.¹³ There were 24 years over a 45-year period when import share in Hawaii's total fruit supply was lower than the 1960 level. For vegetables, 1962 was the only year that import share in Hawaii's total supply went below the 1960 level.

In per capita terms, Hawaii's imports of combined fruits and vegetables grew more than 99% over 1960 and 2005, while local production declined 0.9% over the same period (Figure 6). Imports grew most rapidly over the 1965 to 1990 interval, when both resident and visitor population grew most rapidly, accounting for nearly 94% of all growth over the entire 45-year period of analysis. Hawaii's combined fruit and vegetable production expanded considerably between 1970 and 1990, causing per capita output to increase nearly 37% over this period. However, Hawaii's per capita production slipped in the next five-year interval after 1990, but resurged between 1995 and 2000. It again plunged considerably after 2000. Land utilized for fruits and vegetables have also declined since 1999 (Figure 9).

¹¹ Fruits expanding include longan, mango, rambutan, persimmon, in the "All Other Fruits" category.

¹² The more desirable measure than the per capita measure is the per consumer day measure (resident day plus visitor day). Unfortunately, visitor day data for back years are not available beyond 1990. Data of the number of visitors is not comparable with residential population data because visitors stayed on the islands only briefly.

¹³ If fresh market pineapples are included, import share will drop a little, but the fluctuation and trend would remain close in resemblance to what appears in Figure 5. However, if processed pineapples were included, import share is expected to decline further by an undetermined amount because of a lack of data on processed fruit imports.

Figure 5.

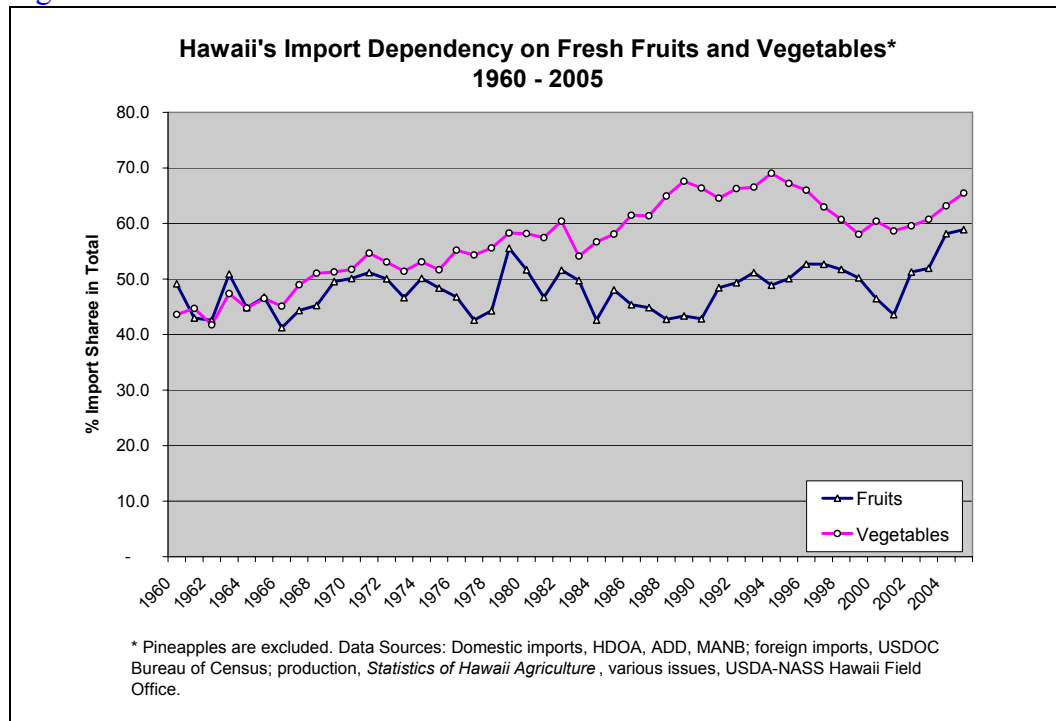
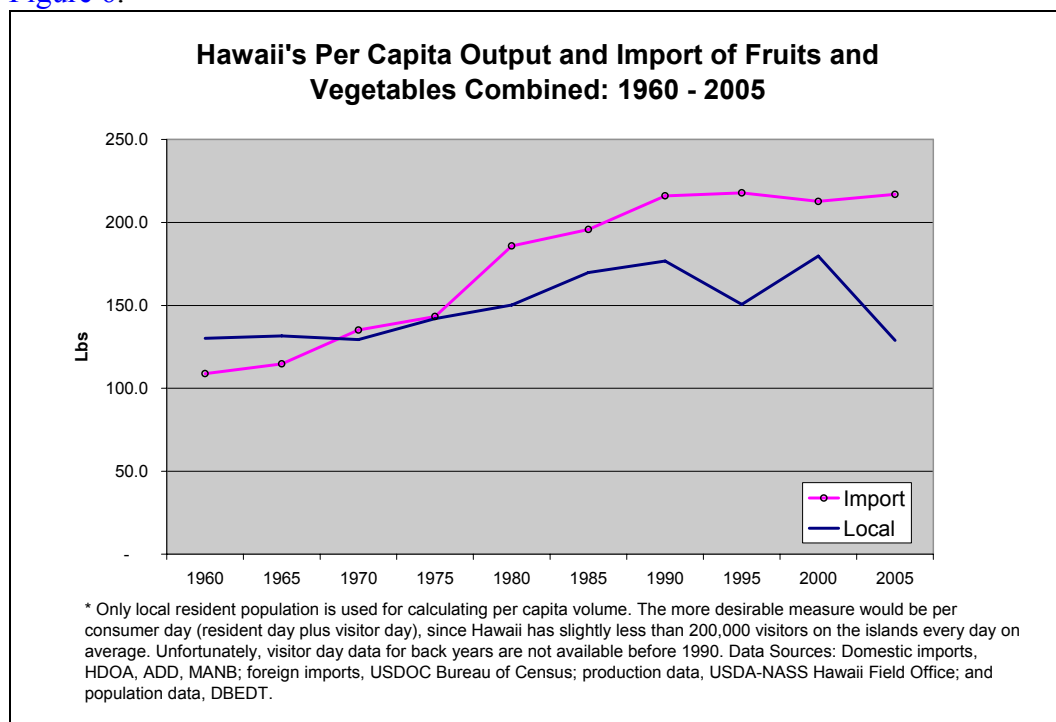


Figure 6.

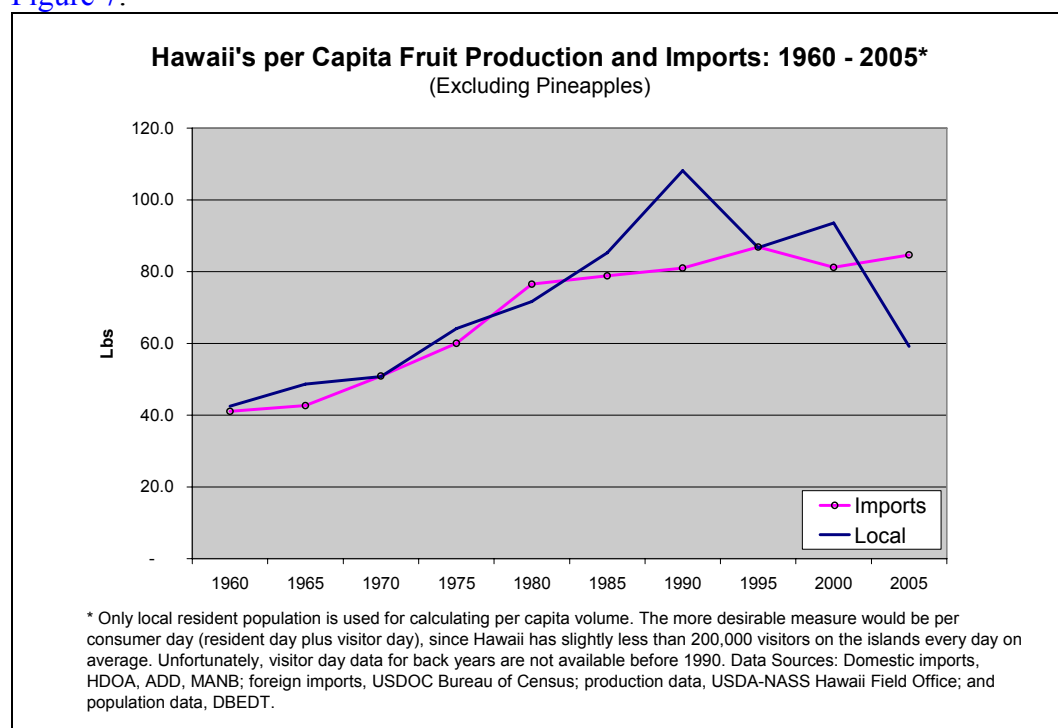


Over the 1960-2005 period, although the total volume of combined fruit and vegetable production and land under fruit and vegetable crops expanded considerably, Hawaii is not more food secure today than in 1960. It is because Hawaii's production, calculated in per capita terms,

has declined. Growth in demand has outstripped local production over this period. The local production trend set in the past five years is especially a concern. As shown in [Figure 6](#), Hawaii's per capita output of combined fruits and vegetables in 2005 (128.9 pounds) was 28.3% lower than in 2000 (179.7 pounds).

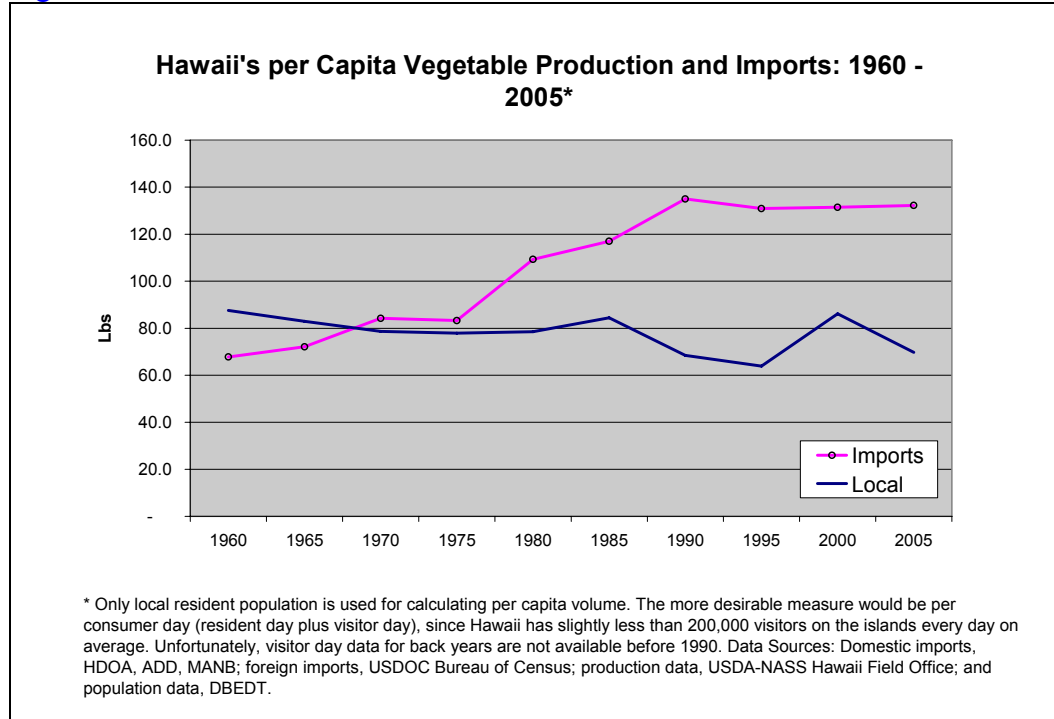
When fruit and vegetable are disaggregated, respectively illustrated in [Figures 7 and 8](#), it reveals that fruit was the strong performer and vegetable the weak performer. Per capita fruit production grew more than doubling between 1960 and 1990, from 42.5 pounds to 108.1 pounds. Over the same period, per capita fruit imports also grew rapidly, from 41.1 pounds to 81 pounds. However, after 1990, per capita fruit production declined substantially while per capita imports continued to rise. The per capita fruit production dropped further after a brief rebound between 1996 and 2000. Between the 1990 and 2005, per capita fruit production dropped 45% from a record-high of 108.1 pounds to 59.2 pounds. Land in crop for fruit also dropped significantly from its highest level of 8,000 acres in 1999 to 6,200 acres in 2005. Nonetheless, over a 45-year period, per capita fruit production increased 39% in total and land in crop ([Figure 9](#)) expanded 177% from 2,240 acres, while per capita fruit imports expanded 106% from 41.1 pounds.

[Figure 7.](#)



For vegetables ([Figure 8](#)), per capita production has been weak compared to that of fruit. It has never risen above the 1960 level of 87.6 pounds. The decline in the per capita vegetable production was gradual and mild, with a slight growth in the early eighties before it dropped sharply in the later half of the eighties. Nonetheless, per capita vegetable output grew substantially between 1995 and 2000, but it dropped further thereafter. By 2005, per capita output reduced to 69.8 pounds, a decline of 20.3% from its 1960 level. The per capita vegetable imports nearly doubled between 1960 and 1990, growing from 67.7 pounds to 135 pounds, but declined slightly after that. In 2005 Hawaii imported 132.3 pounds per capita of vegetables.

Figure 8.



Total fruit and vegetable acreage nearly tripled between 1960 and 1999 before it reversed sharply after that, but by 2005 it was still more than double its 1960 level (Figure 9). Regardless of the expansion in fruit and vegetable farm acreage, the per capita production over the past 45 years clearly indicates that Hawaii today is less capable of self sufficiency than in 1960, due to the sluggish vegetable production that did not catch up with the growing resident and visitor population.

In addition to Hawaii being considerably and increasingly dependent on external food supply, the dramatic and continual shrinkage in the total farmland acreage since 1960 is also raising concerns over Hawaii's long term strategic food security. Figure 10 shows that Hawaii's farm acreage shrank 50% between 1960 and 2005, decreasing from 2.6 million acres in 1960 to 1.3 million acres in 2005. A loss of farm acreage with ready infrastructure (irrigation) means a loss of production capacity, unless a new and more productive technology that requires much less land is available.

How significant is this loss of agricultural land to food security? The continual decline in Hawaii's farm acreage is due overwhelmingly to the closures of the export-oriented sugarcane plantations and pineapple industry as illustrated in Figure 11. Part of the former sugarcane fields were then converted into non-agricultural land, thus reducing farmland acreage. The remaining 1.3 million acres of farmland comprises of 3.1% in the remaining sugarcane, 1.1% pineapples, 1% vegetables and fruits, 0.6% coffee, 1.4% macadamia nuts, 0.7% other crops, and 92.2% pasture and others not in crop.¹⁴

¹⁴ Agricultural land not in crop includes farmhouse lots, roads, woodlots, etc.

Figure 9.

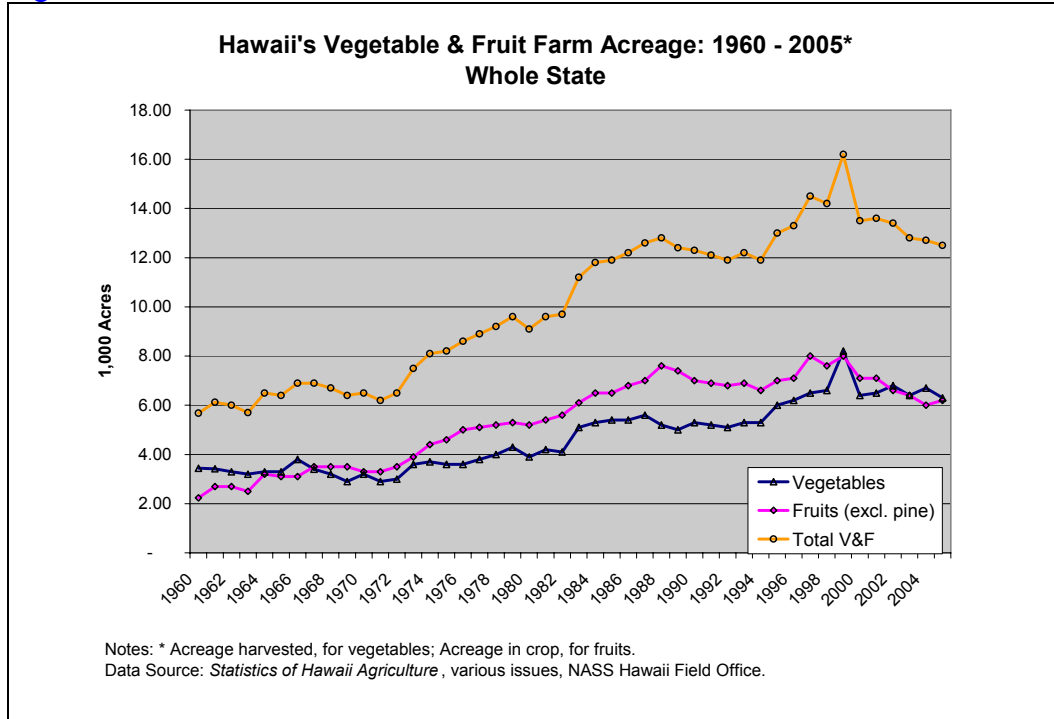


Figure 10.

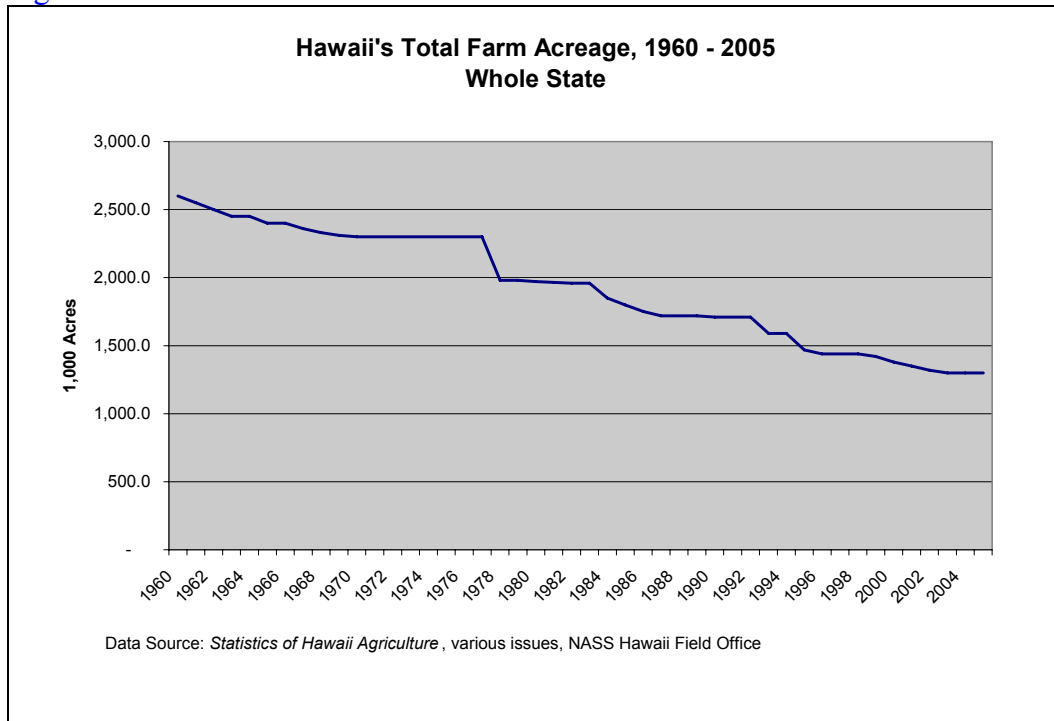
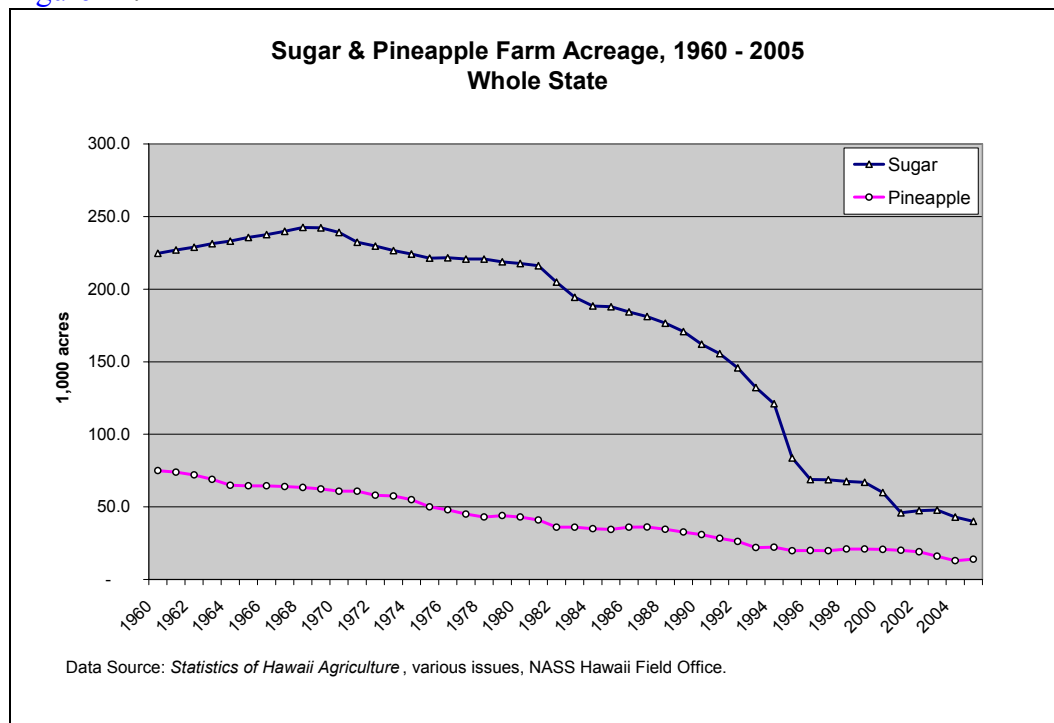


Figure 11.



Is the remaining farmland adequate for food self-sufficiency should the situation (as discussed earlier) call for? In 2005, while local vegetables and fruits (excluding pineapples) together covered only 1% of state's total farmland they respectively made up 34.5% and 41.1% of Hawaii's total supply (imports plus local production).¹⁵ In addition to fresh vegetables and fruits, Hawaii also imported large amounts of processed fruits and vegetables.¹⁶ Including this component would account for Hawaii's total demand for fruits and vegetables. However, data for processed fruit and vegetable imports are not available. For the purpose at hand, it is assumed that the fresh-equivalent volumes of processed fruits and vegetables imported into Hawaii, excluding the volumes of packaging materials and water used in canning and bottling, was at most twice the fresh import volumes. If these assumed volumes are included, the fresh-equivalent import volumes (fresh plus processed) would be triple that of the fresh import volumes alone. Based on this assumption and fixed technology, to produce enough fruits and vegetables to feed Hawaii's residents and visitors in 2005, land for fruits must increase fourfold and for vegetables, sixfold.¹⁷ In other words, Hawaii would need roughly 25,000 acres for fruits and 38,000 acres for vegetables. Together, they would account for only about 5% of Hawaii's total agricultural land in 2005. With 95% of the remaining farmland available for other crops and livestock, judging based on the remaining farmland alone, Hawaii's food security is not threatened yet. However, the continual decline of farm acreage is a warning sign for Hawaii's future food security.

¹⁵ Local share for combined vegetables and fruits in 2005 was 37.3%.

¹⁶ Processed vegetables and fruits include frozen, canned, dried, cooked, fresh cut or chopped and packed ready for consumption out of the package.

¹⁷ It is assumed that only the varieties that are suitable to be grown in Hawaii will be available to consumers and that consumers will maintain the same consumption volume of fruits and vegetables as in the pre-crisis period.

Although Hawaii still has more than enough agricultural land with ready infrastructure for self-sufficiency and state's diversified agriculture—everything except for sugarcane and pineapple—has expanded substantially since 1960, Hawaii is less food-secure today than in 1960. The expansion in diversified agriculture in recent decades has been mainly in its economic value. Over the 1960 to 2005 period the per capita value of Hawaii's diversified agriculture as a whole and as combined fruits and vegetables (excluding pineapples) increased more than 204% and more than 154%, respectively.¹⁸ Growth in economic value is an advantage in a normal world with open trade, but it is not necessarily so in an anomaly that isolates Hawaii from the rest of the world. Over this same period, the per capita output of combined fruits and vegetables shrank slightly, by 0.9%, and the per capita production of vegetables alone contracted by 20.3%. These figures are derived based on resident population only, and they reveal that vegetable production is lagging behind demand.¹⁹ Hawaii also has a considerably large number of visitors on the islands everyday. Based on 2005 data, each day there were roughly 200,000 visitors on the islands, approximately 16% of the resident population, who would remain on the islands should a crisis occur. Presently, with a considerably larger visitor population on the islands each day than in 1960, it is clear that Hawaii is less food-secure today than in 1960. With the visitor population included, the per capita vegetable and fruit production in 2005 would be reduced by 13.4%.

The recent decline of fruit production in Hawaii was due mainly to pests and diseases. The decline in Hawaii's guava and watermelon production, however, was a result of market competition with imports. Production of other varieties of tropical fruits (e.g., tropical specialty fruits, avocados) has also grown over the same period, partially offsetting the loss in the production volume of guavas, papayas, bananas and watermelon. The decline in production volume of vegetables was also the combined result of pests and market changes that encouraged Hawaii's farmers to focus more on lightweight, high-monetary yield crops such as herbs.²⁰ With regard to food security under a crisis that would halt all transportation between Hawaii and the rest of the world, the volume of a variety of essential food crops would be more critical than their monetary values. While a growing value of crop production is economically desirable during normal times, it would be useless in a time of crisis if it were at the expense of crops that have low monetary value but high in food security value.

7. Conclusion and policy recommendations

Between 1960 and 2005, imports of fruits and vegetables grew substantially, especially between the mid-1960s and 1990, when population and the tourism industry expanded most rapidly. Over this 45-year period, import share for fruits grew from 49.1% to 58.9% and for vegetables, from 43.6% to 65.5%. The per capita imported fruits grew from 41.1 pounds in 1960 to 84.7 pounds in 2005 and imported vegetables from 67.7 pounds in 1960 to 132.3 pounds in 2005. Hawaii's per capita fruit production grew from 42.5 pounds in 1960 to 108.1 pounds in 1990, but it plunged considerably after that to 59.2 pounds by 2005. Hawaii's per capita vegetable production shrank

¹⁸ Hawaii's aggregate value of diversified agriculture production grew from \$46.56 million (\$73.58 per capita) in 1960 to \$438.09 million (\$343.54 per capita) in 2005. Over the same time period, the production value of combined fruits and vegetables grew from \$6.01 million (\$9.50 per capita) to \$93.45 million (\$73.29 per capita).

¹⁹ Demand by visitor population is excluded due to data inconsistency, as explained in footnote 12.

²⁰ Hawaii's herb production grew rapidly from \$1.8 million in 1990 to \$8.6 million by 2005

from 87.6 pounds in 1960 to 69.8 pounds in 2005. When vegetables and fruits are combined, the per capita production declined 0.9%.

The rising import shares in Hawaii's total fruit and vegetable supplies, with increasing per capita import volumes and declining per capita local production together, suggests that Hawaii's food security status in 2005 was worse than that in 1960. With visitor population included, the per capita vegetable and fruit production in 2005 is reduced by 13.4%, worsening Hawaii's food security status. Less local production means a higher probability of a food shortage incidence. Therefore, more stockpiling of essential food items and crop seeds is needed to prevent food shortages in an emergency situation.

Between 1960 and 2005, farm land in Hawaii shrank from 2.6 to 1.3 million acres, due almost entirely to the decline in the export-oriented sugarcane and pineapple industries. Of the remaining 1.3 million acres of farmland, Hawaii needs roughly 5% to produce enough vegetables and fruits for both residents and visitors, leaving 95% of farmland for other crops and livestock, more than enough for self-sufficiency during a crisis. Although the decline in farm acreage to present has not yet reached the "*critical point*" where Hawaii's food security would be threatened, the trend is a warning sign for Hawaii's future food security.

What is more critical for food security than the declining farm land is that Hawaii does not commercially produce essential food crops for everyday dietary needs such as grains, potatoes, among others. Currently, only sweet potatoes are grown commercially in Hawaii. Land-scarce Hawaii is not suitable for rice production, which requires an extended track of land. Potatoes are not grown commercially in Hawaii because of the availability of inexpensive imports. Vegetables, including potatoes, and fruits are only part of the daily dietary needs that local production has not been keeping up with. Also, Hawaii's production of protein food sources (cattle, hogs, milk, eggs) has not only been lagging behind population growth, but has been declining since the late 1980s/early 1990s (not discussed in the main text).

Policy recommendations:

Presumptions upon which policy recommendations are made in this paper include: (1) Food imports lower household food bills, allowing residents to attain a higher living standard than if Hawaii were to be completely self-sufficient in food. (2) Thus, Hawaii must import food and most other items needed to maintain a high living standard. (3) Consequently, Hawaii's farmers must compete with relatively low-cost foreign producers for many essential food items. (4) Hawaii is an expensive place to farm. (5) There is a possibility for a crisis to occur involving an H5N1 flu pandemic or chemical/biological terrorism, causing the shipment of food into Hawaii from elsewhere an extremely difficult task for an extended period of time.

There are several basic levels of food security with regard to assuring sufficient supplies to meet the population's demand during a crisis. First, and foremost, is the ability to meet immediate demand during a crisis, when short-term survival is the issue.²¹ The next level comes into play if the crisis makes the shipment of food into the state an extremely difficult task for an extended

²¹ In a crisis, distribution can easily become dysfunctional. Even with supply available, the market tends to fail in its distributive role. This issue is beyond the scope of this paper.

period of time. In complete isolation, local production would be the only option available for the survival of the population. To enhance the state's food security status, not only does Hawaii need to preserve agricultural land, but also the production of essential food crops and the means of proliferation when situations demand them. In fact, keeping agricultural land active is the most effective way to preserve agricultural land and strengthen Hawaii's food security status. To improve Hawaii's food security status, this paper suggests the following actions:

- **Continue to promote the existing crops that are market-driven through marketing support, pest control and research:** Although Hawaii is a high-cost location for agricultural production, the state has a number of food crops that are competitive in local and/or out-of-state markets. These crops tend to have unique qualities or are able to compete against imports due to their limited shelf life. Vegetables with short shelf lives tend to do better in local markets than those with longer shelf lives. Competitive fruit and vegetable crops include cucumbers, green peppers, sweet potatoes, tomatoes (except for the decline in the past couple of years caused by unfavorable weather), apple bananas, papayas, watermelons, avocados, specialty fruits and vegetables. Hawaii's fresh pineapples (excluded from the earlier quantitative analysis) are also doing well as opposed to the canned industry.
- **Promote food crop diversification by encouraging laboratory research and field experimentation in both production and marketing through a public-private partnership program:** Because Hawaii is a high-cost location for agriculture, a profitable crop today could lose its competitiveness and become unprofitable tomorrow as soon as low-cost foreign producers are able to develop or raise the quality of their competing crops. In order to maintain agricultural production in Hawaii, a continual search for new products with market potential is a must. The search for new agricultural crops with market potential has not only economic importance, it is also critical for food security. The most assured way to improve food security is to promote and sustain active farmland with varieties of food crops at least sufficient for local demand. Some of this diversified food crop production may not necessarily replace imports. It may be grown mainly to supply the out-of-state markets. Should exporting or importing food become impossible for the reasons discussed, these export-oriented crops could serve, or adapt to serve, local markets.

Private-public cooperation in laboratory research and field experimentation is necessary for efficiency and minimizing public financial burden. Field experimentation and marketing trials should be carried out by independent private investors driven by an entrepreneurial rationale as opposed to the scientific or administrative rationale of university researchers. This does not mean that the university research program should be replaced by the private, market driven program. Both are crucial, but private sector's initiative and finance are critical for success. Field experimentation must be closely monitored by the appropriate government agency in order to control the potential harmful effects on existing commercial crops and local vegetation.

- **Promote and sustain the production of *essential crops* through joint private-public marketing campaigns, tax incentives, and land subsidies:** Crops that are deemed

critical to the daily human diet such as potatoes, soy and various other beans, among others, must be produced in order to attain some supply-readiness and production infrastructure, and to maintain farming knowledge of these crops. Currently, Hawaii does not produce essential crops such as grains, except for sweet potatoes, sweet corn and soy. It is unprofitable to produce these crops in Hawaii. One of a number of ways to preserve the production of essential crops is, in addition to the existing “Buy Local” campaign to the general consumers, to actively promote linkage between fine dining restaurants and local-grown produce classified as “essential crops.” A marketing campaign alone may be an effective tool to promote such linkage. If not, a tax incentive may be needed to encourage the consumption of local-grown essential crops. Incentives could either all go to farmers through a price support program or be split between farmers and users, depending on which would yield the most desirable outcome. The classification of essential crops and tax incentive program possibilities would require detailed research under two separate studies.

- **Promote saltwater aquaculture:** Hawaii is surrounded by a giant body of ocean and rich with aqua resources that could be directly utilized or farmed to provide protein and other nutrients for human consumption. This area should be explored extensively.
- **Stockpile food supplies and seeds of essential crops:** Many households in Hawaii have about a week-long supply of dried and canned food in case of emergency. However, to prepare for a situation in which sea and air transportations are completely halted or extremely limited, the food supply chain is contaminated, or food production and distribution at out-of-state sources halted, a large scale government-controlled program is required. Stockpiling food supplies for an emergency situation is an expensive project, but if it is not done, a food shortage crisis could occur. The right amount of food to stockpile is one that minimizes public burden while ensuring an adequate essential food supply until local production can catch up with demand. Thus, determining how much food supplies to stockpile and distribute requires a careful and detailed study.

The conclusion made in this paper is considered a preliminary finding. A more detailed and in-depth study is required for drawing a more precise conclusion about Hawaii's food security status and its future. A formal *Food Security Index* measuring food security status and trend needs to be developed in order to attain a more concrete interpretation of Hawaii's food security status at any given point in time. Food security is a function of multiple factors, not just local supply and not simply the aggregate volume of output. These factors include the likelihood that transportation will be severely disrupted for a long time; that the majority of Hawaii's existing suppliers of imported foods will be severely handicapped; and that Hawaii would not be able to find alternative suppliers should such a severe crisis occur.

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