

# AGRICULTURAL & RESOURCE ECONOMIST

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## Dynamic Forces Within Hawaiian Agriculture

**Shelley M. Mark**

Agriculture is often regarded as a declining sector of Hawaii's economy, mainly because of three factors: the long-term drop in its contribution to total income and employment in the state (less than 3% today), the more recent growth of tourism and other urban-oriented sectors of the economy, and the uncontrollability of various forces affecting markets for agricultural products. Many people believe that resources previously devoted to this sector might better be spent on other, presumably more profitable activities.

However, this attitude overlooks some positive aspects of Hawaii's agricultural development. First, the statistical decline has been in relative rather than absolute terms, meaning that agricultural output has increased even as agriculture's share of Hawaii's total income has decreased. Also, as Hawaii's population and economy continue to grow, agricultural activities which provide the state's necessary food supply, either directly by cultivation or indirectly through income received from exports, will have to expand.

Second, the relative decline of agriculture is a result of the growth it has stimulated in the overall economy rather than a reduction in its resourcefulness and economic vitality. The recent accelerated growth of other sectors of Hawaii's economy is in large part a result of dynamic economic influences exerted by agriculture during its earlier development. These influences included technological improvements, enhancing and increasing the availability of labor skills, financing the construction of supportive infrastructure (e.g. ports and roads), speeding the transition from

labor to capital-intensive production, and shaping an economic environment in which legislation, agricultural policy and social opinion combined to facilitate orderly and efficient transitions in resource use.

Third, planning and development initiatives prompted by these dynamic influences remain viable today and provide a basis for further growth. Research programs sponsored by the College of Tropical Agriculture and Human Resources, the Hawaiian Sugar Planters' Association, the U.S. Department of Agriculture and various public-private commodity analysis groups represent the single most potent R & D establishment in Hawaii today. Coordinated efforts by these groups will undoubtedly continue to stimulate agricultural development, as well as growth in the rest of Hawaii's economy.

Indeed, there is ample evidence that continuing research, technological innovation and new capital investment have resulted in more viable and competitive sugar and pineapple production, and more growth in fruit and tree crops and other products of an expanded and more diversified Hawaiian agricultural industry.

The spread of drip irrigation in the cultivation of sugar and more recently pineapple has sustained the competitiveness of these crops. Continued research and experimentation have resulted in higher yielding plant varieties and use of more cost-effective combinations of seed, water, fertilizers and pesticides. Increased development and marketing of agricultural byproducts such as molasses, bagasse, feed and fuel, have augmented industry revenues. And, as in other regions of the country, the impact of developments in biotechnology (in terms of new products, new procedures, and more

# Agricultural Development and Change in Hawaii Agricultural Product Cycles

Hiroshi Yamauchi

Over the past 200 years agriculture in Hawaii has grown from a basic subsistence economy which supported the native Hawaiians into a profit-oriented, mixed-market sector supporting more than one million consumers and playing a vital role in this state's contemporary economy. The development of agriculture in Hawaii has involved much innovation and adaptation, and has been characterized by the rise and fall of several crops and export markets.

The history of foreign trade in Hawaii began in the 1780's with such products as skins, wool and sandalwood. Between 1815 and 1830 the export of sandalwood to China provided the Hawaiian Kingdom with its most important source of income under Kamehameha I and his son Liholiho, who supervised the royal monopoly on sandalwood. This income source ended suddenly, however, with the exhaustion of the sandalwood forests between 1830 and 1835.

Few agricultural products come to such an abrupt end as sandalwood, but all products progress through distinct stages of development after they are first cultivated or produced. This staged progression is known as a product cycle, and product cycles are characterized by three phases.

In the introductory phase a new product is successfully brought onto the market; in the expansion phase growth in the product's sales rate increases sharply and then gradually slows down; in the mature phase the sales curve levels off and may either continue on a plateau or decline.

In Hawaii, the rice crop had reached its mature phase by 1900 and peaked around 1910, after which it rapidly gave way to sugarcane and pineapple.

Sugarcane's product cycle began in 1837 with the opening of Hawaii's first sugar mill. Its introductory phase was characterized by the systematic establishment of plantations and included a number of minor booms. Sugar production and export were accelerated by the Land Reform Act of 1848 and the Reciprocity Treaty of 1876, and by 1885 sugar accounted for 93% of Hawaii's total exports. Sheepskins and wool products followed in importance as principal export items. At the turn of the century sugar was already in its expansion phase and over the next seven decades rapid increases in production were interrupted only by events such as labor strikes and WWII.

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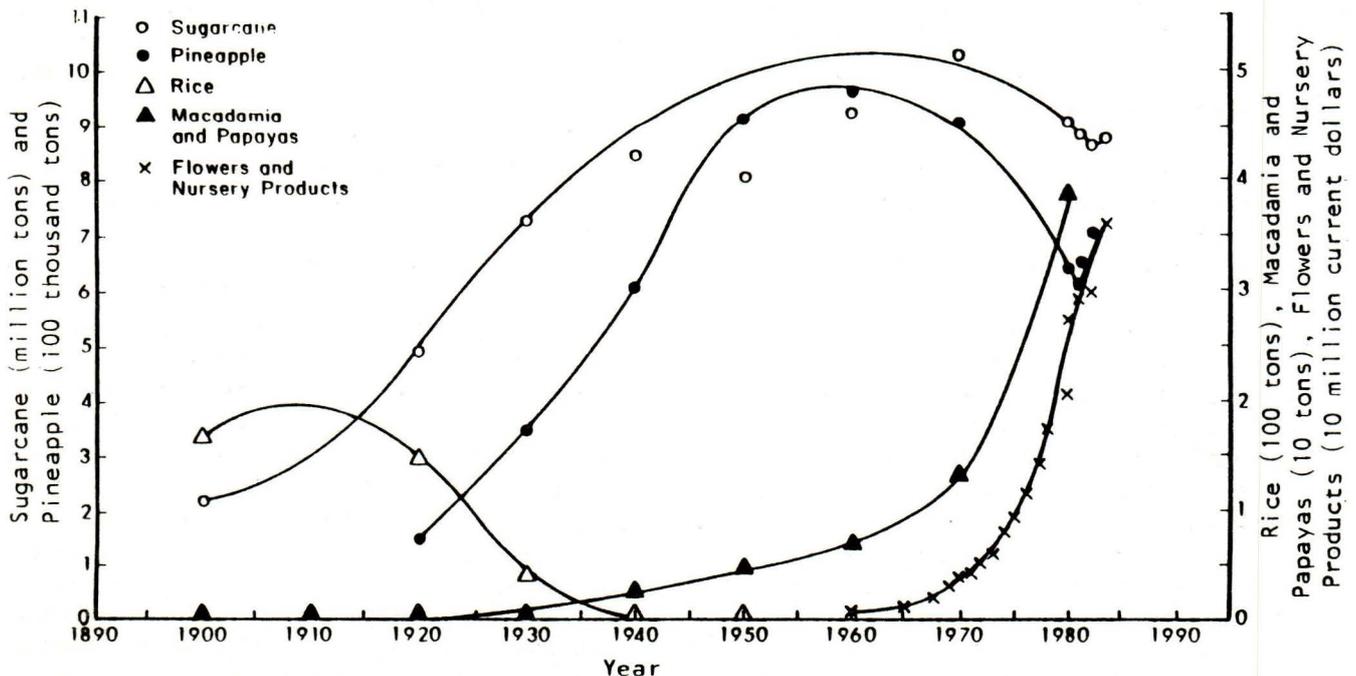


Figure 1. Product Cycles in Hawaii Agriculture.

## AGRICULTURAL DEVELOPMENT, continued

efficient production of goods) has yet to be felt.

Thus the production end of agriculture in Hawaii appears to be building upon its dynamic qualities although serious unresolved questions remain on the consumption end, including the current hesitation in worldwide economic growth, the instability of agricultural markets, the availability of substitute products, an increase in international competitiveness, the difficulty of transportation and storage in island economies, and unpredictable changes in consumer preferences and government policies. These difficulties should not be underestimated, but there is reason for optimism given the following positive influences.

Despite great advances in agricultural productivity in recent decades, world food requirements have not been fully or equitably met. If market expansion resumes in the more advanced industrial nations, income levels of developing and less-developed countries can be expected to rise. Increased incomes can eventually lead to changes in consumer preferences and purchase of more specialty food items which have been typical of Hawaii's export sector.

Satisfactory preparation for this possibility, however, will require better market research and more crop variety in areas where Hawaii's competitors hold a comparative advantage. Such effort has tended to lag behind agricultural research and technological progress in Hawaii.

Another positive force in Hawaii is strong social support for maintenance of a vigorous agricultural sector. This support is evidenced by constitutional provisions and state laws reserving Hawaii's most productive lands for agricultural use, by strict zoning regulations regarding the use of such lands, by favorable though not fully adequate appropriations for agricultural research, by product development and promotion, and by a sizable supportive infrastructure.

Finally, the current status and future role of agriculture in Hawaii's economic development should be examined in a more comprehensive context. As suggested in this issue's lead article, the agricultural sector can be regarded as an agro-food industry, including production, processing, and related services.

An analysis of interindustry linkages reveals extensive connections, both direct and indirect, between the various agricultural sectors and between agriculture and other sectors of the economy. Hawaii's 1980 input-output table identifies production in sugarcane, pineapple and diversified agriculture as primary sector activities; pineapple canning and processing of sugar and other food items as secondary activities, and operations such as transportation, warehousing and wholesale and retail food sales as tertiary activities.

Not surprisingly, total revenue generated in interindustry transactions was found to far exceed the

value of direct agricultural sales or purchases. In 1980 about 10% of the total value of transactions in Hawaiian industry was attributable to the agro-food industry. This contrasts with its three percent share of direct employment and income.

The suggestion here is that a more comprehensive outlook can highlight the dynamic influences and interactions which have resulted in agriculture's past contributions and which remain the basis for its future growth.

## DYNAMIC FORCES, continued

Pineapple was introduced and emerged as an important export commodity around 1900. All three phases of its product cycle have occurred within the past seven decades. Following a relatively short introductory phase the pineapple crop grew faster during its expansion phase than sugarcane, and by 1940 its export sales accounted for 44% of Hawaii's total exports. It also recovered more strongly than sugarcane after the interruption of WWII.

Sugar and pineapple accounted for almost 95% of total export sales in 1950 but declined to 87% by 1970. Both crops faced stiff international competition in recent years, but their relative decline is also due in part to expanding exports of diversified agricultural crops such as flowers and nursery products, macadamia nuts, and papayas and a sharp increase in Hawaii's volume of re-exported petroleum products (e.g. crude oil, classed as an export because it passes through Hawaii en route to other markets).

Competition for resources and market shares forced both plantation industries into post-war modernizations and their present mature phases. Modernization of the pineapple industry was necessary to continue the increase in yields as it approached its mature phase. Although export shares of the two commodities have continued to decline in recent years, they remain the two most important agricultural crops in Hawaii.

Prominent crops in diversified agriculture today are flowers and nursery products, macadamia nuts, and papayas. Following relatively long introductory phases, cultivation of these crops emerged as promising industries after WWII. Their growth rates picked up in the 1960's after statehood and the boom in the visitor industry. These crops are still in their expansion phases.

The development of livestock products presents a mixed picture. Milk, eggs, broilers and chickens have grown steadily, while beef and pork have undergone considerable fluctuation. Honey has recovered in the last decade after two decades of poor performance, but remains minor in the overall picture.

# Structural Changes in Employment, Income and Natural Resource Use

Hiroshi Yamauchi

A structural change can be defined in three ways: as a change in an industry's inputs (e.g. land, labor and capital) which causes a change in that industry's output; as a change in an industry's relative share of gross state product or total employment; or as a change in an industry subsector's share of output, employment and income within the overall industry.

In Hawaii, structural changes in the agricultural industry included the development of new crops and markets and adjustments in agriculture's utilization of natural resources, and relative structural changes included shifts in agriculture's share of Hawaii's total employment, income distribution and trade activity.

These structural changes were spurred by activities such as the sandalwood trade and whaling in the early 19th century, exports of sugar and pineapple in the 19th and 20th centuries, and emergence of the defense and visitor industries since WWII.

## \*\*EMPLOYMENT\*\*

In 1900 Hawaii was still predominantly an agrarian society; over 62% of the labor force was engaged in primary industries (i.e. agricultural production), of which sugarcane was by far the most important. Significant portions of non-primary industries such as sugar processing and the marketing of other farm products were also tied closely to agricultural production.

During the early expansion period of sugarcane, increasing requirements for plantation labor were met by successive importations of immigrant labor, mostly from Asian countries. Cheap immigrant labor was an important factor in keeping agricultural wages at a low level. This was prior to the 1920's when immigration laws were relatively liberal and labor unions were not yet formally organized to bargain with management.

Gains in labor productivity during this expansion phase became the main source of managements' capital reinvestments into agriculture and new investments into non-agricultural sectors. These investments brought the industry into a capital accumulation spiral of more profits and more reinvestment. Production and employment in the sugar industry steadily expanded.

Between 1900 and 1930 Hawaii's primary economic sector, agriculture combined with forestry and fisheries, maintained its employment level within the state's

growing labor force and even increased it significantly around 1930.

Agricultural expansion could have continued so long as labor was available at the existing low wage rates and favorable market conditions prevailed for sugar. But real wages took a strong turn upward sometime before the 1930's and agricultural expansion in Hawaii was restricted by several external factors.

The 1924 U.S. Immigration Act prohibited continued immigration from Japan. Subsequently, the reduced growth rate of agriculture's labor supply coupled with increased rates of federal defense and visitor expenditures pushed up general wage rates for all workers and created relative labor shortages for agriculture. Furthermore, active unionization of agricultural workers under the 1945 Hawaii Employment Relations Act pushed wages even higher.

With investment-induced, rapid expansion in the rest of the economy, the great depression of the 1930's and preoccupation with WWII and recovery in the 1940's and 1950's, the primary sector's share of total employment declined from its initial high of over 62% to less than 8% in 1960.

Paralleling this trend, the manufacturing sector's share of total employment also decreased steadily after 1950, due in part to its close relationship with agriculture. On the other hand, employment in trade, services and government all increased sharply during this period.

The primary sector's share of total employment fell even further to around 3% in the 1970's and 1980's. This continued, dramatic decline resulted from a combination of influences, including reductions in immigrant labor, expansion of the visitor industry and federal expenditures, and stiffer international competition in sugar and pineapple markets.

These influences helped modernize plantation agriculture in Hawaii, leading it away from labor-intensive into highly mechanized, capital-intensive production systems. And while government, trade and services have been the major sources of new jobs in Hawaii, it should be noted that the rate of decrease in agricultural employment has diminished with time. In fact, from 1980 to 1982 an increase in jobs in diversified agriculture more than offset the combined decrease in jobs in the sugar and pineapple plantations.

## STRUCTURAL CHANGES, continued

Presently the long-term decline in the number of agricultural workers seems to be finally stabilizing, and prospects for a positive turnaround led by growth in diversified agriculture appear brighter than at any other time in Hawaii's postwar history.

### \*\*INCOME\*\*

Between 1940 and 1952 agriculture's share of all wage and salary income in Hawaii dropped from 20.5% to 11.2%. At the same time it nearly doubled within the industry (after a severe decrease from \$96.8 million in 1940) from \$37.4 million in 1942 to \$73.4 million in 1952.

Similarly, between 1958 and 1980 farm income more than tripled, from \$63 million to \$213 million, while agriculture's share of Hawaii's total personal income declined from 5.5% to 2.2%. Income growth in government and tourism during this period far overshadowed income growth in agriculture.

From 1940 to 1952 average income per farm worker grew by 284%, the highest of all industries in Hawaii. This was due to a great increase in the productivity of agricultural labor, brought about by a reduction in the number of workers and introduction of new labor-saving technology. As a result, the average income of agricultural workers improved from 70% of the average income of workers in all industries in 1939 to 83% in 1952.

From 1958 to 1980 the increase in the growth rate of total agricultural income was less than half that in the nonagricultural sector. However, because of the steady decrease in the number of farm workers coupled with the substantial increase in agricultural productivity, income per farm worker increased at about the same rate as that of nonagricultural workers.

### \*\*NATURAL RESOURCES\*\*

The natural resource base that sustains agriculture consists mainly of renewable soil, water and energy resources. Primary energy from the sun is nondepletable, but Hawaii's soil and water are subject to economic scarcity and governmental regulation.

From 1958 to 1967 irrigation shifted strongly onto the highest quality (class I) lands and to a lesser extent onto the next quality (class II) lands. However, from 1967 to 1982 as the availability of class I and II lands for irrigation decreased, irrigation of lower quality land increased. Hardly any class I lands now remain to be converted to irrigation and the availability of class II lands is diminishing rapidly.

According to estimates by the U.S. Soil Conservation Service, the proportion of irrigated croplands in Hawaii increased from about 42% in 1958 to 65% in 1982

during a period when agriculture's share of total income and employment in Hawaii was on a general decline.

Sugarcane now occupies 70% to 75% of all irrigated croplands in Hawaii. In 1978, about 63% of the total value of agricultural products in the state came from irrigated agriculture.

Underlying these shifts is a recent trend toward drip irrigation. Experimentation with drip irrigation began on sugarcane in the mid-1960's, and this highly efficient method has since been used on pineapple, macadamia and papaya orchards, protea, and a variety of diversified vegetable and nursery crops.

Use of drip irrigation leads to more capital-intensive farming practices, which favor high-yielding crop varieties and increased use of chemical fertilizers and pesticides. Management and labor must also adjust their skills to operate this modern capital-intensive farming system.

### COMPUTERS IN AGRICULTURE TRADE SHOW

The Department of Agricultural and Resource Economics will be cooperating with the Hawaii Farm Bureau in presenting Seminar IV: Agricultural Computer Use and Trade Show. The seminar will be held on April 26, 1986 in Jefferson Hall at the East-West Center from 1:00 p.m. to 5:00 p.m. Featured in the program will be speakers on computer use in agriculture, a panel of farm/ranch computer users, and a trade show which will exhibit current hardware and software. Registration is \$15.00 per person. For more information, call the Department (948-7039) or the Hawaii Farm Bureau (848-2074).

### NEW FINANCIAL SOFTWARE PACKAGE ANNOUNCED

Members of the Western Extension Farm Management Committee were introduced to FINPACK at its annual meeting in January. FINPACK is a financial software package developed by the University of Minnesota Agricultural Extension Service. It is designed to be used as tools by farm managers for financial planning and analysis. This program is widely used in Minnesota by banks and other financial institutions and is being introduced to other states as well. More information on this program will be disseminated as it becomes available.

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**Address Correspondence to: Editor, Economist  
Dept. of Agricultural and Resource Economics  
2545 The Mall  
University of Hawaii  
Honolulu, HI 96822**

# Faculty Profile: Department of Agricultural and Resource Economics

The Department of Agricultural and Resource Economics is one of twelve individual departments which together form the College of Tropical Agriculture and Human Resources at the University of Hawaii-Manoa. The offices of the faculty members in the department are located on the second and third floors of Bilger Hall, and the phone number of the department office is 948-7039.

Agricultural and resource economics involves the application of economic concepts and analytical methods to all aspects of agriculture, including production, management, marketing, agricultural development and agricultural policy. Agricultural economists study forestry and fisheries as well as traditional farming, and are also involved in evaluation of natural resource use and management, which includes human resources and natural resources such as land, water, energy.

The following are faculty members within the department and are involved in teaching, research and extension activities:

Richard L. Bowen Ph.D., Colorado State University; community resource development and public policy.

Chauncy T.K. Ching Ph.D., University of California at Davis; production economics; presently Director, Hawaii Institute of Tropical Agriculture and Human Resources.

Salvatore Comitini Ph.D., University of Washington; marine economics.

Linda J. Cox Ph.D., Texas A&M University, finance and management.

Jack R. Davidson Ph.D., University of California at Berkeley, production and marine economics; presently Director, Hawaii Seagrass College Program.

Peter V. Garrod Ph.D., University of California at Berkeley, production economics and marketing.

Chennat Gopalakrishnan Ph.D., Montana State University; resource and energy economics.

John M. Halloran Ph.D., Michigan State University; marketing and policy

PingSun Leung Ph.D., University of Hawaii; agricultural systems analysis.

Shelley M. Mark Ph.D., University of Washington; international development and policy.

Walter Miklius Ph.D., University of California at Los Angeles; marketing and transportation.

Herbert K. Marutani Ph.D., University of Hawaii; production economics.

Karl C. Samples Ph.D., University of Wisconsin; marine economics.

Frank S. Scott Jr. Ph.D., University of Illinois; market potentials and market development.

Yung C. Shang Ph.D., University of Hawaii; resource and marine economics.

Gary R. Vieth Ph.D., Oregon State University; resource economics, production economics and quantitative methods.

Hiroshi Yamauchi Ph.D., University of California at Berkeley; resource economics.

## AFFILIATE GRADUATE FACULTY

John Dixon Ph.D., Harvard University; economic development and food policy analysis.

Maynard M. Hufschmidt Ph.D., Harvard University; environmental economics.

## RESEARCH ASSOCIATES

John Roecklein M.S., University of Hawaii; marketing and transportation.

John Sisson M.I.M., American Graduate School of International Management; marketing and production economics.



Richard L. Bowen  
Extension Specialist in Community  
Resource Development