

INTRODUCTION

1.1 PURPOSE AND SCOPE OF THE PLAN

Purpose of This Plan. The purposes of this multi-hazard mitigation plan are twofold: 1) to protect people and structures from harm and destruction; and 2) to minimize the costs and disruption of disaster response and recovery. Hazard mitigation planning is the process that analyzes a community's risk from natural hazards, coordinates available resources, and implements actions to reduce risks. There are many benefits in developing a hazard mitigation plan: a well-thought-out blueprint provides more direct access to a wide range of technical and financial resources; the planning process promotes the development of a well-informed citizenry knowledgeable about hazards; mitigation strategies are more integrated with other community needs and goals; and the plan would improve the County's ability to recover after a disaster. A hazard mitigation plan is a pre-requisite to receive federal disaster assistance funding. In the past, the Federal Emergency Management Agency (FEMA) placed primary emphasis on response and recovery. Recent changes in federal law marked a fundamental shift in policy to focus on mitigation as the foundation of emergency management.¹ For disasters declared after November 1, 2004, state and local governments must have a mitigation plan approved by FEMA to receive pre- and post-disaster Hazard Mitigation Grants.

What is a Hazard? A hazard is a natural- or human-caused event that has the potential to cause significant injury, loss of life or property damage. "Disasters" are distinguished from "emergencies" by the degree of response required. An emergency is where local resources are adequate to respond. A disaster is when the marshaling of broader resources such as State and/or national resources are necessary to assist with recovery.² Since 1977, Hawaii County

1. Disaster Mitigation Act of 2000 (P.L. 106-390), which amended the Stafford Disaster Relief and Emergency Assistance Act (P.L. 100-707) which in turn amended the Disaster Relief Act of 1974, P.L. 93-288.

2. "'Disaster' means any situation, usually catastrophic in nature, where numbers of persons are plunged into helplessness and suffering and as a result may be in the need of food, clothing, shelter, medical care, or other necessities of life, and the governor of the State or the mayor of the County have declared a state of disaster or emergency." (Hawaii County Code section 7-6).

has experienced four events (two floods, a lava flow, and an earthquake) that have met criteria for Presidential declaration as a disaster area (see Table 1-1).

Table 1-1. Hawaii County Major Natural Hazard Events Since 1977

Event	Date	Areas Affected	Disaster Declaration
Tsunamis	(Most recent tsunamis in 1960 and 1946)	Hilo, Hamakua	
Floods			
Flooding	<i>November 1& 2, 2000</i>	<i>Ka'u, Pahala, Waiakea Uka, Komohana</i>	<i>Mayor, Governor, President</i>
<i>Flooding, high surf</i>	<i>November 17, 1996</i>	<i>Countywide</i>	<i>Governor</i>
Flooding	September 19, 1994	Hilo, Puna, Ka'u	Mayor
Flooding	August 12, 1994	Hilo, Hamakua, Puna, Ka'u	Mayor, Governor, President
Flooding, high winds	April 7, 1989	N&S Kohala, Hamakua	Mayor
Flooding, high winds	February 11, 1982	N&S Kona	Mayor
<i>Flooding</i>	<i>March 14-26, 1980</i>	<i>Puna, Ka'u, N&S Hilo, Hamakua, N&S Kohala</i>	<i>Mayor, Governor</i>
<i>Flooding, high surf, high winds</i>	<i>January 8-14, 1980</i>	<i>Countywide</i>	<i>Mayor, Governor</i>
<i>Flooding</i>	<i>November 15-17, 1979</i>	<i>Puna, K'u, N & S Hilo, Hamakua, N&S Kohala</i>	<i>Mayor, Governor</i>
Flooding	October 9, 1979	Ka'u	Mayor
<i>Flooding</i>	<i>February 17-22, 1979</i>	<i>Puna, Ka'u, N&S Hilo</i>	<i>Mayor, Governor</i>
Flooding, high winds	January 12, 1979	Waipio Valley, N & S Hilo, Hamakua	Mayor
Lava Flow			
Kilauea eruption	April 23 1990	Puna	Mayor
Kilauea eruption	May 18, 1990	Puna	Mayor, Governor, President
<i>Kilauea eruption</i>	<i>February 4, 1987</i>	<i>Puna</i>	<i>Governor</i>
Kilauea eruption	December 9, 1986	Puna	Mayor
Mauna Loa eruption	March 29, 1984	E & SE portions of County	Mayor
Kilauea eruption	September 30, 1977	Kalapana	Mayor
Earthquake	November 16, 1983	Countywide	Mayor, Governor, President
Hurricane and High Winds			
Hurricane Fernanda	August 16, 1993	Countywide	Mayor
Hurricane Iniki	September 28, 1992	Countywide	Mayor
High Winds	February 16, 1986	Hamakua, N&S Hilo, Puna	Mayor
High Winds	December 12, 1978	Waimea, Kawaihae, Waikoloa, Kiholo	Mayor
Hurricane Fico	July 19, 1978	Kapoho, Kaimu, Honuapo	Mayor
Drought	July 22, 1999	Ka'u, N & S Kona, N & S Kohala, Hamakua	Mayor
	January 30, 1998	Countywide	Mayor
	November 8, 1996	N&S Kohala, Hamakua	Mayor

Table 1-1. Hawaii County Major Natural Hazard Events Since 1977 (Continued)

Event	Date	Areas Affected	Disaster Declaration
	November 22, 1995	Hamakua, Hilo, Puna	Mayor
	January 10, 1994, February 22, 1995 (amended), March 2, 1995 (amended)	Initially N & S Kohala, Ka'u, Kona; amended to include all districts	Mayor
	May 11, 1993	Kohala, Ka'u, Kona	Mayor
	February 28, 1992	Countywide	Mayor
	February 10, 1986	Countywide	Mayor
	December 16, 1983	Countywide	Mayor
	<i>March 14, 1983</i>	<i>Countywide</i>	<i>Governor</i>
	February 15, 1983	Countywide	Mayor
	July 15, 1981	S. Kohala, Hamakua	<i>Governor</i>
	June 29, 1981	Countywide	Mayor
	January 30, 1981	Hamakua, S. Kohala	Mayor
	<i>January 5, 1981</i>	<i>Waiakea Uka, Puna</i>	<i>Governor</i>
Wildfire	July 1, 1987	S. Kohala	Mayor

Bold=Presidential Declaration

Scope of this Multi-Hazard Plan. This plan focuses on natural hazards, with a priority on disaster-potential hazards. Other plans in the future will focus on human-caused hazards such as terrorism and hazardous wastes. Rather than create separate plans for each type of natural hazard, this plan is a multi-hazard plan. A multi-hazard plan has several advantages: 1) certain hazards cause cascading hazard effects (e.g., earthquakes may cause landsliding, local tsunamis, or dam break flooding; hurricanes cause wind damage and flooding); 2) priorities can be established to allocate limited resources to areas susceptible to the most severe or frequent hazards; 3) areas identified as susceptible to multiple types of risks may require special attention; 4) common responses often apply to different hazards; 5) resources or mitigation measures can be leveraged where they could benefit multiple hazards; for example proposed changes to building design standards could consider both wind-loading (hurricane) and ground-shaking (earthquake).

Why focus on Mitigation? Emergency management includes preparedness, response, recovery, and mitigation. Although this plan will address all phases of emergency management, it will focus on mitigation-- i.e., strategies to reduce risks. For example, retrofitting bridges can keep them from washing out; installing hurricane clips can reduce personal and property losses thereby reducing the need for public assistance. The money spent today on preventive measures can significantly reduce the impact of disasters in the future. Reducing overall economic losses and social disruption will enable the community to recover to pre-disaster conditions as quickly and efficiently as possible, not to mention the costs saved. The goal is to become a “disaster-resilient” county where our lifeline systems of roads, utilities, infrastructure, and other support facilities are designed to continue operating in the midst of high winds, rising water, or shaking ground. Critical facilities such as hospitals, schools, and fire stations would be located in safe areas, rather than areas prone to high hazards. Resilient structures would be built or retrofitted to meet the safest building code standards available. Natural areas that provide buffers to flooding or other hazards would be conserved.

Coordinated Approach. Effective planning and response to hazard events involves local, State, and federal agencies. This plan has been coordinated and is consistent with the State of

Hawaii Natural Hazards Mitigation Plan and guidelines of the Federal Emergency Management Agency (FEMA)³.

1.2 ORGANIZATION OF THE PLAN

The plan is organized into the following subject areas:

- **Hazards Identification** (Chapter 2). All natural hazards that pose a potential threat to the County of Hawaii were analyzed to determine the degree of threat posed by each. The analysis examined the frequency of occurrence, magnitude and potential intensity, location, spatial extent, duration, seasonal patterns, speed of onset and availability of warning.
- **Risk and Vulnerability Analysis** (Chapter 3). Those hazards determined to be of sufficient threat to the County of Hawaii were further examined to determine the degree to which the population, structures and land areas are vulnerable to the hazards. The analysis examined location of population concentrations, critical facilities, community resources, major transportation routes and infrastructure lines.
- **Mitigation Actions** (Chapter 4). By overlaying the hazard areas and community assets, problems and issues were identified. The strategy to address these problems and issues consisted of clarifying mitigation goals and objectives, identifying alternative mitigation actions, selecting and prioritizing the actions to be implemented, and developing an action plan. Mitigation actions include improving warning systems and evacuation plans; “hardening” critical facilities to withstand hurricane and earthquake forces; structural and land treatment measures that contain or redirect natural hazards; planning and regulatory measures to guide development away from hazards and establishing standards for managing exposure to hazards; and incentive and educational measures to encourage practices which are consistent with the disaster resistant community goals.
- **Planning Process** (Chapter 5). The last chapter documents the extent of public participation and methodology used to develop the plan, as well as the methods and frequency to keep the plan updated.

1.3 OVERVIEW OF HAWAII COUNTY

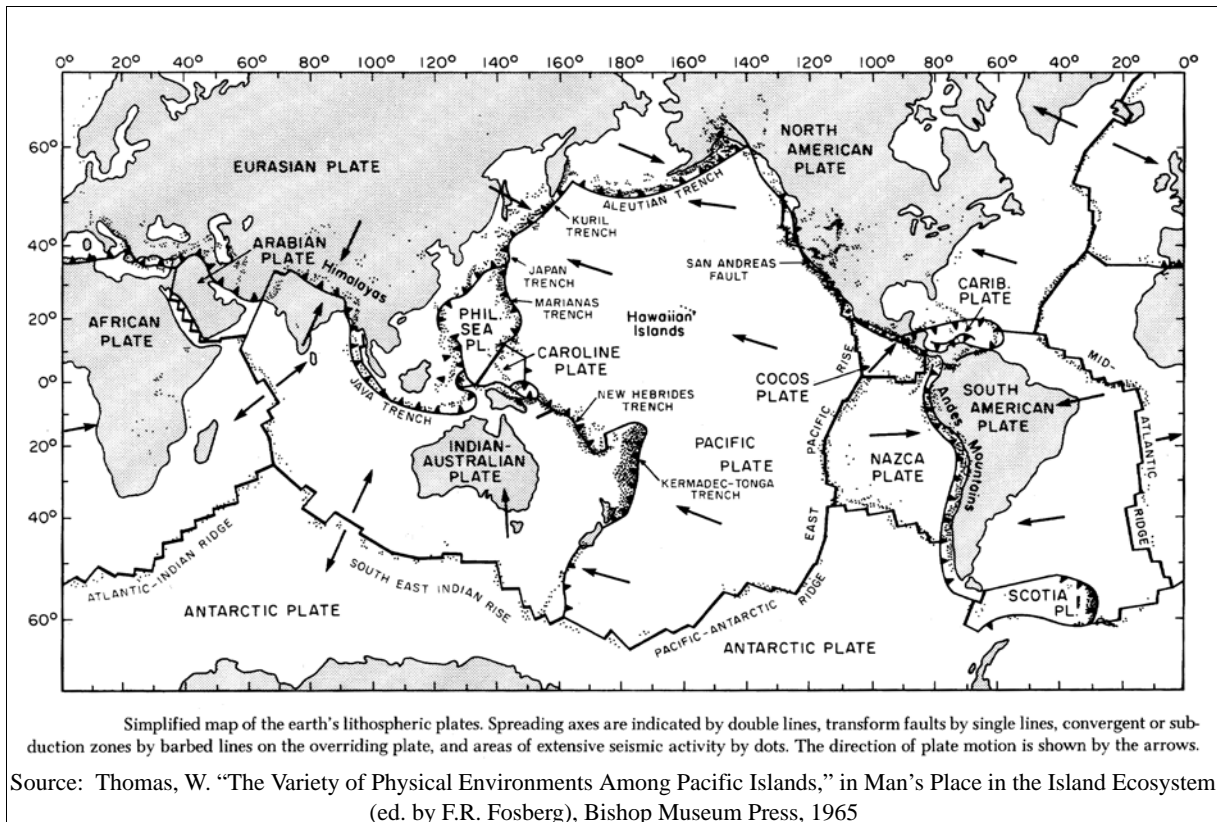
1.3.1 Geography

The State of Hawaii consists of eight major islands (Kauai, Niihau, Oahu, Maui, Molokai, Lanai, Kahoolawe, Hawaii) and 124 small islands, reef, and shoals (referred to as the North-west Hawaiian Islands). Located in the middle of the Pacific Ocean, it is one of the most isolated places on Earth-- 2,400 miles to the West Coast, 3,800 miles to Japan, 6 time zones separating Hawaii from the eastern United States. The Pacific Ocean is rimmed by active faults where tectonic earthquakes occur that can generate tsunamis (see Figure 1-1).⁴

Hawaii Island is the southeasternmost island in the Hawaiian archipelago. The islands are divided into four counties-- Kauai, City & County of Honolulu (Oahu), Maui, and Hawaii. Hawaii County encompasses the entire island of Hawaii.

3. The federal Disaster Mitigation Act of 2000 (P.L. 106-390) encouraged states and local governments to develop integrated natural hazard mitigation plans. States and local governments with plans in place would be eligible for faster funding and more effective risk reduction projects. A useful resource consulted to prepare the plan was FEMA, *Understanding Your Risks: Identifying Hazards and Estimating Losses. State and Local Mitigation Planning How-to Guide, Version 1.0, August 2001.*

Figure 1-1. Pacific Rim of Ocean Trenches

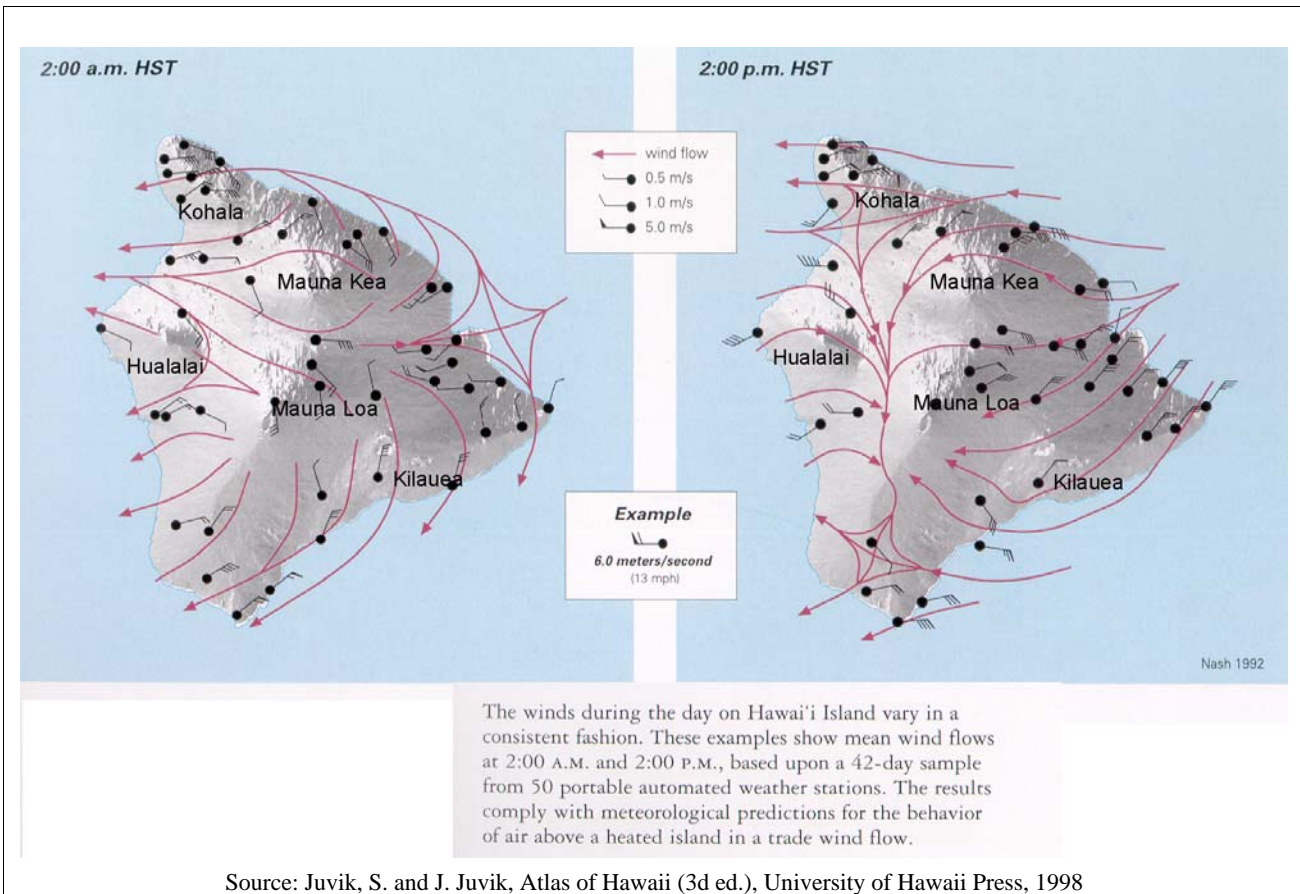


Although the Hawaiian islands were all formed by volcanic eruptions, only Hawaii Island still has active volcanoes. Related to volcanic activity are earthquakes. The size of Hawaii Island continues to grow as a result of the ongoing eruptions. At approximately 4,028 square miles, Hawaii Island, also known as the Big Island, is larger than all the other islands combined. Hawaii Island was formed from the coalescence of five volcanoes-- Kohala, Mauna Kea, Hualalai, Mauna Loa, and Kilauea. These five dominant mountains create complex wind patterns (see Figure 1-2).

As the geologically youngest island, Hawaii Island's landforms have not been weathered to the extent of the other islands. Thus rainfall runoff flows in narrow V-shaped stream valleys without broad floodplains or sheetflows in relatively undefined drainageways especially in the

- The geological theory called plate tectonics attempts to explain geological phenomena such as the location of volcanoes and earthquakes. According to this theory, the lithosphere (the rigid outermost part of the mantle approximately 70 to 100 km thick capped by both continental and oceanic crust) is broken into a number of rigid plates that slide in various directions and velocities relative to each other. The boundaries of plates are the origin of extensive geologic and tectonic activity (e.g., earthquakes, volcanism, metamorphism, mountain building). At the plate boundaries, the plates either: 1) diverge or move apart (usually at mid-ocean ridges) and molten lava moves up to fill the cracks by active basaltic volcanism and create new crust; 2) slide laterally where earthquakes occur along the transform fault, the most famous being the San Andreas Fault, or 3) collide where one plate is pushed beneath another usually at ocean trenches. Most of the tsunamis that have affected the Hawaiian Islands originated in the major earthquake belts, or ocean trenches, that surround the Pacific Ocean. These massive earthquakes along faults are called tectonic earthquakes. The devastating tsunamis of 1946 and 1960 were both generated by this type of tectonic earthquake, the former originating in the trench along the Aleutian Islands and the latter along a fault near Chile.

Figure 1-2. Complex Diurnal Wind Patterns on Hawaii Island



drier leeward areas. The relatively immature reef development and related lack of white sandy beaches is also characteristic of the youthful geologic age of this island.

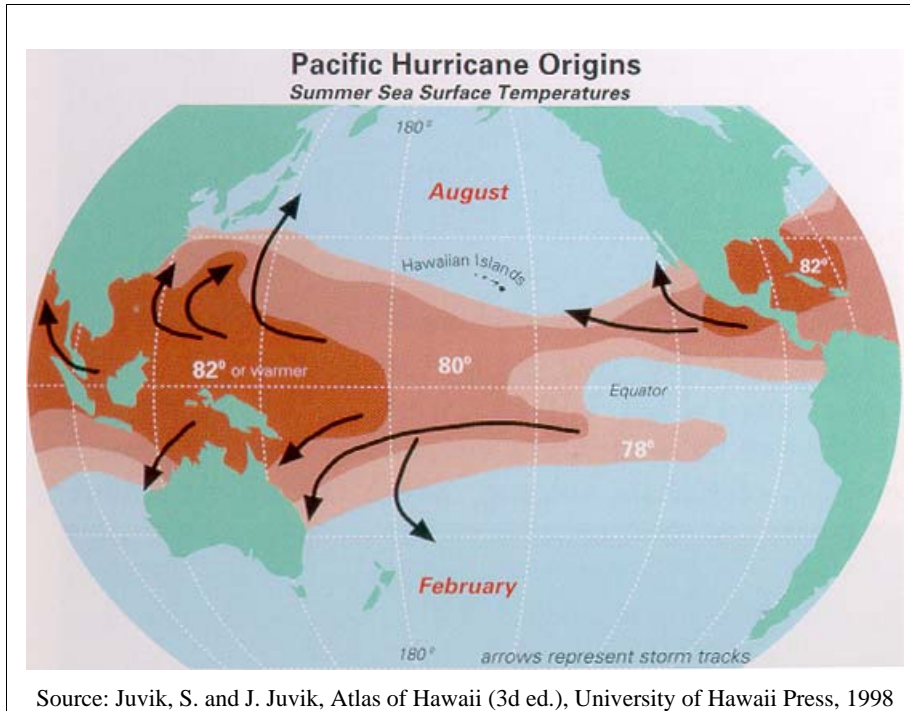
Located between 19 and 22 degrees north latitude at the northern edge of the tropical zone, Hawaii's mild salubrious climate is due in part to location within the tradewind zone. Hawaii's climate is notable for its low day-to-day and month-to-month variability. The annual variation in mean monthly temperatures is only about 9 degrees F for areas at sea level. While the climate is equable, the mountainous topography makes Hawaii Island one of the most spatially diverse anywhere. From 20 inches in leeward areas to 300 inches in the upper windward areas, this island experiences a range of moisture and temperature regimes exceeding that found across the breadth of a continent.

The tropical conditions of the eastern Pacific are ideal for hurricane formation-- i.e., the warm ocean water near the equator combined with the cyclonic spin within 5 degrees of the equator (see Figure 1-3). As the easternmost island in the State, Hawaii Island has a higher probability of landfall but has been lucky so far.

1.3.2 Population

Hawaii Island's resident population according to the 2000 census totaled approximately 148,700, supplemented with approximately 18,400 visitors for a de facto population of approximately 167,100 persons. Among the four counties, Hawaii County's resident population is second to City & County of Honolulu, while Maui County's larger visitor count pushes Hawaii County to third in terms of de facto population. However, in terms of percent change

Figure 1-3. Sea Temperatures and Hurricane Origins



from 1990, Hawaii County’s de facto population grew the most among the four counties, and its resident population grew at a rate second to Maui County. The change in the resident population represented the highest net in-migration among the four counties, in contrast to the 46,800 residents who moved out of the City & County of Honolulu between 1990 and 2000.

The age distribution in this County is comparable to the other counties, with minors (under 18 years) comprising approximately one-fourth of the resident population, the working age (18 to 64 years) comprising approximately 60%, and the elderly residents (65 years and older) comprising roughly 14%. Hawaii County’s residents have the lowest per capita income among the four counties at \$20,343 in 2000. A significant proportion of the residents over age 5 do not speak English “very well” (8%). More than 18% of the residents speak a second language at home. According to the U.S. Census Bureau, Hawaii County is the most ethnically-diverse county in the United States, with more than 28% of the population claiming two or more races.

Table 1-2. Hawaii County Demographic Profile

Characteristic	Hawaii County	State	Rank Among Counties
Resident population ¹	148,677	1,211,537	2
% change, April 1, 1990 to April 1, 2000	23.6	9.3	2
De facto population	167,073	1,337,991	3
% change, April 1, 1990 to April 1, 2000	23.7	7.2	1
Resident population per sq mile, 2000 ²	36.9	188.6	4
Residents <18 years old, % ³	24.4	26.1	2
Residents 18 to 64 years old, %	60.3	62.3	3

Table 1-2. Hawaii County Demographic Profile

Characteristic	Hawaii County	State	Rank Among Counties
Residents 65 years and older, %	13.5	13.3	2
Persons >5 years old who do not speak English “very well” ⁴	10,840	80,000	
Population per household, 1980/1990/2000 ⁵	3.09/2.86/2.75		
Net migration ⁶	17,883	(9,804)	1
Personal income per capita, 1999	20,343	27,533	4

1. Resident and de facto population from Hawaii County Data Book 2000, Table 1.4
2. Hawaii County Data Book 2000, Table 1.3
3. Age characteristics from Hawaii County Data Book 2000, Table 1.11a
4. Hawaii County Data Book 2000, Table 1.17
5. Hawaii County Data Book 2000, Table 1.18
6. Hawaii County Data Book 2000, Table 1.23

1.3.3 Economy

Sugarcane was the dominant industry of this island for more than 120 years. As late as 1969, plantations located in Hamakua, Kohala, and Ka’u Districts contributed more than 37% of the State’s sugar production. The process of downsizing and closing plantations began in the 1970s and culminated in the abandonment of sugarcane production on the island in 1996. Throughout the years of sugar’s decline, there has been growth in the island’s tourism sector that is based largely in the Kona and South Kohala Districts. Diversified agriculture has experienced a generally upward trend as it strives to replace the abandoned sugarcane fields. Diversified agriculture is dominated by macadamia nuts, papaya, flowers, tropical and temperate vegetables, and specialty coffee grown in the unique summer rainfall below on the middle slopes of the Kona District. Cattle ranching makes use of extensive areas.

Employment, according to the 2000 census, ranked as follows: education, health or social services (19%); hotel, restaurant, recreation, entertainment and arts (17.6%); retail (12%); professional, scientific, management, administrative (8.6%); construction (7.8%); agriculture, forestry, fishing, hunting (7.1%); public administration (5.7%); transportation, warehousing, utilities (5.5%); finance, real estate, insurance, rental and leasing (5.1%); miscellaneous (4.5%); wholesale trade (2.7%); manufacturing (2.6%); and information-related (1.8%).

1.3.4 Land Use

The passage of the Land Use Law in 1961 established the State Land Use Commission. It called for the classification of all lands in the State and authorized the adoption of rules of practice and procedures and regulations for land use within the various State land use districts. The four land use districts created by the State Land Use Commission provide the basic legal framework for land uses in the State of Hawaii. The Urban District is generally defined as lands in urban use with sufficient reserve to accommodate foreseeable growth. In the County of Hawaii this district is comprised of approximately 54,267 acres, or two per cent of the island's total land area. Rural Districts are defined as lands primarily comprised of small farms mixed with low density residential lots that have a minimum lot size of one-half acre under the State Land Use Law. Of the four districts, this is the smallest, with approximately 807 acres of the island's total land area. The Agricultural District includes lands with a high ca-

capacity for intensive cultivation as well as those with low capacity. The minimum lot size in this district under the State Land Use Law is one acre. The Agricultural District has the second greatest land area with approximately 1,184,599 acres or slightly over 46 per cent of the total land area of the island. Conservation Districts are primarily those lands in the existing forest and water reserve zones. This district has the largest land area with approximately 1,338,135 acres or 52 per cent of the total land area of the island.

Land uses within the Urban Districts are administered exclusively by the counties. In the Agricultural and Rural Districts, the State Land Use Commission establishes use regulations and the counties are responsible for their administration. The counties, however, may adopt more stringent controls than those imposed by the State within these two districts. Land use in the Conservation District is regulated by the State Board of Land and Natural Resources, except that the counties have concurrent permitting power within the Special Management Area near the coast. The counties have no land use control over Federal property, and the Hawaiian Homes Commission has the ultimate control over uses of the Hawaiian home lands leased to native Hawaiians.

Within the County of Hawaii, the desirable future land use pattern is set forth by the General Plan Land Use Pattern Allocation Guide Map (LUPAG). The more detailed zoning must be consistent with the LUPAG. Lands designated Residential-Agriculture (RA) saw the largest percentage increase in acreage between the years 1989 and 2000 at 60 per cent, although the total acreage of RA zoned lands accounted for less than one-tenth of 1 per cent of the total land area within the County. During the same period, Commercial zoned lands increased by 49 per cent, Multiple Family Residential zoned lands increased by 15 per cent and Industrial zoned lands increased by 14 per cent. Acreages of Open zoned lands fell by 0.6 per cent. Lands designated as Agricultural, excluding lands zoned Unplanned prior to the comprehensive revision to the Zoning Code in 1996, account for 77 per cent of all zoned lands within the County.

1.3.5 General Plan Projections

The following assumptions were the basis by which the County's General Plan was developed:

- **Agriculture**

Agricultural employment will increase significantly as former sugarcane lands are brought into production with import replacement, export and value added crops and products. Additional employment will be derived from expanding agrotourism enterprises. The expansion of the industry will be facilitated by the establishment of a new air cargo distribution center and post-harvest processing facilities that will allow for significant increases in the volume and types of products exported to the continental United States and foreign countries. Agricultural research and education will be greatly enhanced.

- **Tourism**

The County will continue to pursue the development of a strong multi-market base for the visitor industry that includes direct oversea flights to Kona, growth of the cruise ship industry, strong resort-based employment centers and integrated product development for local products that can generate a healthy small business economic base. The County's visitor industry will continue to successfully grow and expand. Likewise, employment in the visitor industry and its related industries will continue to grow.

- Other Basic Industries

There is tremendous potential for expansion in other industries such as aquaculture, astronomy, renewable energy, research and development, and special events such as cultural festivals and athletic events.

Employment and population projections for the County of Hawaii were developed through the analysis of relationships between economic activity, employment, and population. The analytical approach used entails the forecasting of employment in basic industries and the relationship that changes in employment have upon population. Primary Income Generators are those industries that generate income from outside the County. They are assumed to be the foundation of the local economy and the key to the development of the island. Primary Income Generators include agriculture, tourism, the manufacturing of export products, and research and development. These Primary Income Generators, in turn, “drive” the secondary industries, or those enterprises that service the Primary Income Generators or the local population and includes wholesaling, retailing and services. The Primary Income Generators determine the long-run pattern of population and income growth for the County.

Three sets of projections were developed for the General Plan, Series A, B, and C. The major variables in each of these projections were the rate of growth of the visitor industry, the construction of the proposed State prison, the expansion of the University of Hawaii at Hilo, and the utilization of a post-harvest treatment facility for export agricultural products. The population projections, and the strength of the correlation between primary economic generators and population growth, must be viewed with caution. The 1989 General Plan contained a similar set of economic and population projections. Visitor arrivals from 1990-2000, a primary economic generator, grew far less than projected. The 1989 “Series A” projected a 35 per cent growth in westbound visitor arrivals in the 1990-2000 period; the actual number barely increased. Agriculture, the other major primary economic sector, lost jobs because of the loss of the sugar industry. During the same time period, the county's population grew about 24 per cent, just slightly less than the 1989 Series A projection of 27 per cent. It appears that there has been substantial population growth not driven by economic opportunities in the primary industries. This may be due to in-migration of people seeking other amenities such as a clean environment and rural lifestyle.

Population projections developed for the General Plan assume that the visitor industry will grow at an annual rate of 1% (Series A) to 3% (Series C), compared to a historical growth rate of 1.45% between the years 1977 and 1998. The resulting resident population projection for the year 2020 ranges from 213,000 to 237,000, compared to 148,700 residents according to the 2000 census, an increase of 43% to 59% over 20 years.