POPULATION, AGRICULTURE AND URBANIZATION IN THE KINGDOM OF TONGA

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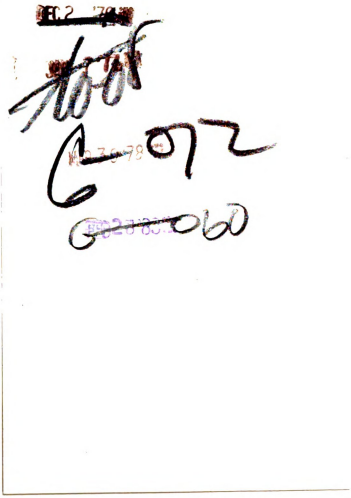

ABSTRACT

POPULATION, AGRICULTURE AND URBANIZATION IN THE KINGDOM OF TONGA

By

William Fenton Clark

Prior to this investigation it was believed that alterations in the population profile and agricultural economy of Tonga have resulted in a growing social, economic and nutritional instability throughout the Kingdom. Natural population increase and internal migration have contributed to the urbanization of approximately fifty percent of the nation's total population. Increases in population are also noted to be accompanied by subsequent increases in pressure upon available agricultural acreage, resulting in a growing number of a landless agrarian populace. In addition, increases in the cash income of those Tongan farmers who enjoy secure land tenure have been accompanied by increases in migration to urban areas and absentee landholding. It was hypothesized that these demographic and economic shifts result in a continuation of rapid urbanization and a subsequent growing malnutrition among the urban population. In addition, it was proposed that the increase of cash cropping replacing traditional subsistence agriculture has resulted in a reduction of domestic foodstuff production in ratio to total population requirements and a subsequent dependency upon imported

foodstuffs. Demographically, continued urbanization was perceived to be strongly correlated with undernourishment and malnutrition.

Field investigations supported the above contentions. Increases in the absolute total of agricultural production have been nullified by population growth. In addition, growing landlessness (due to population growth and the mismanagement of the national land system), absentee landholding and the status ascribed to food imports have hastened a reduction in domestic food production. Examination of preschool children conclusively showed that alterations in dietary quality correlated with urbanization have resulted in retarded physical development. Continued alterations in the demographic and economic structure of Tonga are perceived to be a critical factor in all future private and governmental planning.

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by

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Thank God . . .

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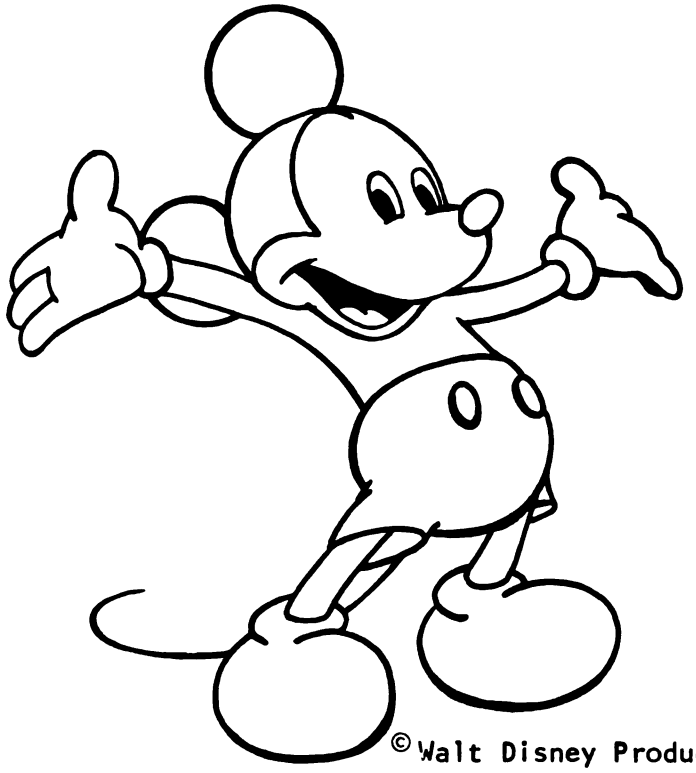

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CHAPTER I

INTRODUCTION

For centuries, mankind has been aware of the consequences of population expanding in numbers more rapidly than agricultural production. Ancient history records the efforts of governments in storing foodstuffs during periods of plenty, in preparation for periods when agriculture could not support the populace (Genesis 41:25-36). In the past, a natural catastrophe was often the cause for food shortage. However, in the current century, in addition to flood, drought and disease, mankind must contend with the consequences of his own multiplicative nature influencing the production and availability of food. As the 1970s progress, one is struck with the realization that there are developing all the conditions necessary for a global food shortage and regional famine. In this decade, nations, including India and Brazil, have been the scene of riots by those demanding food necessary for survival. These demandings may, in fact, be only the prelude of a time when traditional agriculture will have exhausted its potential and securing food for survival will be foremost in the activities of man.

A full accounting of the causes and consequences of the world's population-agricultural production imbalance on a global scale would be an enormous undertaking. However, a microcosm of

these conditions may be found in many parts of the world such as the islands which dot the oceans. One such microcosmic situation may be observed in the Kingdom of Tonga, which is located as an island chain in the Southwest Pacific Ocean. (Note general mapping of Tonga, Figure 4, Appendix A.) Population growth and diminishing agricultural food production, per capita, as a ratio to total population, are as serious a threat to national stability in Tonga, as in the more publicized nations of the world. (The reader, if not familiar with the more basic geographic considerations regarding Tonga, may, at this point, wish to review Appendix A.)

Even though these conditions exist in Tonga, as well as in other populated island groups, it must be understood that while many of the Pacific islands are now facing a land-population growth crisis, only recently have these conditions arisen. Anthropological data indicate that historically the Pacific Basin is a region of relatively recent human settlement (Harris 1966, p. 13). In the case of Polynesia, Tonga, Samoa and the Society Islands formed the core from which the population of other island groups originated (Emory 1974, pp. 732-745). The Tongas were settled probably no earlier than 1100 B.C. The significance of this situation is that when religious quarrels, conditions of war, or overpopulation arose, groups of island people migrated to other islands in, seemingly, an ocean of innumerable islands (Harris 1966, p. 14). However, in the twentieth century, uninhabited island groups are no longer to be found and since 1945, overpopulation has become a growing force,

with little probability of relief. Such is the case in Tonga at the present.

With a population exceeding 95,000 scattered over 288 square miles, Tonga contains areas of rural population density in excess of 600 per square mile. Coupled with a resource base inadequate for significant industrial development, and an economy which is at present entirely dependent upon agriculture, Tonga often resembles many nations of the "underdeveloped world." However, because of a growing relationship with the British Commonwealth, a Western form of government, and a 95 percent literate population, Tonga resembles many nations of the "developed world." Characteristics of both "worlds" are found scattered over the 150 islands that comprise the nation. Therefore, here is a laboratory situation in which to study the critical issue of population growth and urbanization versus food production.

The Tongan population-agricultural imbalance may be reduced to a simple statement of conditions. Tongan population growth has in recent years stood at over 3.5 percent per year and is today among the highest of the Pacific islands. (Other island groups of the region having had high growth rates include Fiji with 3.5 percent, Samoa with 3.8 percent, and Tahiti with 3.6 percent.) Conditions in Tonga, as evidenced by the present population growth rate, indicate that the present population of 95,000 will more than double by 1990. News items from Tonga predict that this number will overwhelm the food production capacity of the land ("There's Not Enough Land . . .," 1967, p. 37). Such conditions are not yet so

critical in other Polynesian island groups. In the case of Fiji, the issue is not one of overpopulation as much as land distribution among racial elements of the population (Mohan 1961). In Western Samoa and the Cook Islands, population expansion is drawn off by migration to New Zealand (Curson 1973). In American Samoa, population expansion is released to the American West Coast and Hawaii.

Tonga, having had a long history of political independence, has no such outlet for her growing population. Migration has not played a significant role in the population characteristics of Tonga in the past several decades. (This refers only to movements of population out of the national limits of Tonga in a permanent sense. Internal migration, i.e., rural to urban, is a significant consideration and will be treated in some depth within this research.) Presently, the only notable migratory trend is in temporary Tongan labor movements to Australia, New Zealand and nearby islands, in search of employment. The majority of these laborers return to Tonga within a year and, therefore, do not provide an effective or permanent outlet for Tongan population (Clark 1974). However, of significance is the additional capital and purchasing power enjoyed by this labor group, upon their return to Tonga.

Eliminating the probability of large scale migration, Tonga is faced with three basic alternatives in the foreseeable future: (1) establish and maintain a population control program which will stabilize the expanding population at a level capable of being sustained by Tongan agriculture and the limited national resource base; (2) support the growing national population through an

expanded agricultural base and a program of commodity imports from nations still producing a food surplus; or (3) approach a level of population at which point natural controls (i.e., malnutrition and/or starvation) set in to bring the population into balance with the supporting capacity of the land.

In addition to the basic difficulty of population-food imbalance, Tonga must also contend with the physical shifting of its population from rural to urban settings, and the economic shift of elements of the population from a traditional subsistence agriculture to a cash economy. Both of these changes in the character of Tongan population tend to aggravate the overall population-food and agricultural imbalance.

Rates of urbanization in the entire South Pacific region are among the highest in the world, when considered as a percentage of total population. If one includes the nations of Australia and New Zealand, the peoples of the South Pacific are the most urbanized in the world on a proportional basis (Urban Problems in the South Pacific, 1967, p. 2; Urbanization in the South Pacific, 1962, p. 1). Tonga, since the end of World War II, has seen rapid growth in its capital city, which has nearly tripled in size.

This changing characteristic of the population has in itself had a significant impact on the natural environment of Tonga. In addition, as urbanization continues to expand, social issues including housing, public health, and sanitation grow proportionally. As in most other island environments in the South Pacific, water for

drinking and sanitation remains, at best, in a precarious balance with growing urban population.

The process of urbanization has several causes which are significant in the framework of this research. Since the mid-1960s, the development of tourism, and its associated activities, have been stressed in the developmental plans of all island governments in the Southwest Pacific. This has had two immediate results in Tonga. First, many individuals within the agricultural sector of the population have given up their subsistence agricultural activities and moved into urban centers hoping to secure cash employment in handicraft or tourist related activities. This is particularly the case in Nuku'alofa, Tongatapu and Neiafu, Vava'u. This movement has not only rapidly increased the urban population but has also decreased the total acreage in agricultural production, or changed production from food crops to cash crops. Others of the rural population, who remain on their farms, often devote increasing amounts of time to the production of craft items. However, because of the rate of expansion in Tongan population, total rural population has continued to increase. Therefore, as rural population continues to grow, agricultural food production is decreasing and urban population is rapidly expanding.

The second important result of urbanization, without considering the social and cultural impact, is the growing reliance upon imported foods and urban oriented materials (Horine 1967, p. 43). As urban population increases and agricultural production of foodstuffs proportionally decreases, food imports become necessary.

Many, though not all, of these imports are of little nutritive value and may be actually detrimental to the health of the people. In Tonga, for example, a recent French survey of the capital city revealed a dramatic increase in the consumption of high energy foods, such as sugar, alcohol, and highly processed foods. As a result, the French study concluded, there was a rapid rise in the incidence of dental caries within the Tongan population, accompanied by a general decrease in the overall nutritional status, especially among preschool children (Hansell 1962).

This is not to imply that all food imports are of little nutritive value or that Tonga should strive to achieve self-sufficiency in food production. However, it is clear that some form of control, governing the quantity and quality of certain foods, should be considered. Such action should be aimed at improving the quality of imports, including flour, meats, and grains. Consideration of the nutritional status of urban populations is advisable in view of the rapid expansion of this population segment and the increasing utilization of imported foodstuffs.

The economic shift of the populace is another major cause of urbanization. This shift has been most notable in the agricultural sector of Tonga's national economic structure. The effects upon agriculture are felt in two significant areas. As alternatives to agriculture are found in cash employment in urban areas, the cash income of the people involved increases and imported foods, often seen as status symbols, are sought as such. Therefore, the per capita urban demand for indigenous foodstuffs tends to decline,

if imported foods are available and cash is on hand with which to purchase them (Horine 1967, pp. 43-46). In addition, as the possibilities of cash employment in urban areas increases, the population is less inclined to work their traditional urban gardens. Rather, they prefer to raise their visible socioeconomic status through the use of imports. This subsequently reduces further the amount of foodstuffs produced in the nation.

In rural areas of Tonga, major portions of the remaining agricultural sector are changing to a cash orientation. The government requires a substantial portion of a farm holding to produce export products (or at least be planted in such), principally coconuts or bananas. However, many farm plots are totally devoted to the production of crops for export (Kennedy 1961, p. 61). Major cash crops include copra and sweet banana, which together account for 80 percent of Tonga's exports. As is the case in urban areas, as the cash income of farmers increases, the incentive for producing agricultural food staples decreases. This situation will probably continue as long as market prices for Tongan exports remain high and the status associated with material products, including imported foodstuffs, exists.

Therefore, one may hypothesize that as Tonga's population continues to increase, urbanization will increase, agricultural production of foodstuffs per person will decrease, the dependency being placed upon food imports will continue to grow, and the nutritional status of particularly urban populations will probably decline.

CHAPTER II

LITERATURE REVIEW AND RESEARCH METHODOLOGY

Literature Review

Few research projects of this type, on a regional scale or limited to Tonga, have been initiated in the Pacific islands. A search through numerous texts and bibliographic materials, among other possible sources of information, supports this conclusion. Organizational work with regard to population and agricultural development in the Pacific islands has been conducted by several international groups. Most notable among these are (1) the World Health Organization, (2) the Food and Agricultural Organization, (3) the Offices of the United Nations, including the United Nations' Children's Fund, and (4) the South Pacific Commission.

The South Pacific Commission and the World Health Organization have been the most active, producing at least 16 technical reports dealing with agriculture, population distribution, and nutritional difficulties through 1970. However, only three of these treat Pacific island populations and their food production agriculture, and none treat Tonga specifically. These papers are Chemical Composition of South Pacific Foods (Peters 1957), Dietary and Nutritional Problems in the Pacific (Massal 1954), and Some Food Problems in the Pacific Islands (McKee 1957).

In addition to international work, several nations have conducted work in the South Pacific. French research has been confined primarily to French Polynesia, New Caledonia and the New Hebrides. However, a brief nutritional survey prepared in Tonga is one of few such reports stressing the dangers of a growing dependency upon imported foodstuffs (Hansell 1962).

In the United States, the National Research Council has conducted some research in Micronesia, Samoa, and Hawaii but none of significance in Tonga. More significant has been the work carried out through the University of Hawaii, the Hawaii Agricultural Experimental Station and the East-West Study Center in Honolulu. Notable research by these groups include the determination of food values in native diets, determination of nitrogen and protein balances in native groups, and the utilization of macro and micro nutrients in island populations (Peters 1957; Murai et al. 1958). In addition, extensive research has been conducted with regard to crop production, crop disease, and pest control (McKee 1957; Paine 1964; Watson 1956). Urbanization has also received increased attention in the past decade due to the continued development of this phenomenon among Pacific island populations (Urban Problems . . ., 1967; Urbanization . . ., 1962; Harr'e 1973; Horine 1967).

Individual research efforts in Tonga are also limited. The most notable example is a doctoral thesis, "Population, Land and Livelihood in Tonga" (Maude 1965). Another example is an economic analysis of Tonga by T. F. Kennedy (1961). In both cases, population expansion and pressure upon a limited amount of available

agricultural land was found to be one of the more serious issues facing Tonga's future.

With regard to population expansion and the pressure of numbers upon agricultural land within the South Pacific, work has been published since the period of European exploration. Most notable among these are the narratives of James Cook. However, until recently, such research treated only two general themes. First, the process of depopulation brought about through European contact and the spread of common European diseases, such as measles and the flu, was examined (Friis 1967; Roberts 1927; Pacific Islands . . ., 1944). This subject has been treated not only with regard to the Pacific island populations, but other cultures as well. One such reference work is the series by J. M. May: The Ecology of Malnutrition and Studies in Disease Ecology (May 1961a, 1961b).

Second, research has examined the recovery Pacific populations have made during the post-World War II period (Great Britain Colonial Office 1956-64; Roberts 1927). Therefore, little attention has been paid to intra-regional population characteristics, including migration and the chaos wrought by combatants of World War II upon native cultures. In the postwar period, more interest has been directed toward the Pacific peoples in terms of population outstripping sustaining capacities of agriculture and natural resources, on isolated islands or groups of islands. However, as mentioned, little work has been conducted on a regional basis, considering the agricultural and nutritional consequences of continued development in the Pacific. This has been particularly true in terms of population

growth and movement, food production and the rise of tertiary industries.

Research Methods

Based upon the hypothesis of this study, three major divisions of research were discerned. First, the degree of population increase and the growth of urbanization was measured. This involved analysis of Tongan population data from the last thirty years (post-World War II).

Second, the changes in the agricultural profile of the nation were investigated. This involved a brief sequence occupancy survey in which the historical expansion of population onto agricultural land and the development of the traditional Tongan farm system ('api) was traced. In addition, a determination of the growth of cash cropping and the changing agricultural profile of rural Tonga was necessary. From these data, a pattern of population pressure upon agricultural resources was developed. Furthermore, any change in the purchasing power of rural Tongans was noted. This change proved to be (1) a decline in the support capacity of the land because of increasing population, resulting in land abandonment and poverty migration to the urban area, or (2) an increase in purchasing power and subsequent moves to the more attractive urban environment.

Third, once the pattern of urbanization was established, it was necessary to examine the food intake and basic nutritional status of the urban population, especially children. Two methods developed included a survey of available foods within the urban area,

and a calculation of their basic nutritional content. (While protein was of prime importance, the effect of other macro nutrients, fat, and carbohydrates were also considered as were dietary minerals including zinc, iron and copper.) A second method involved a brief physical examination of a sample of Tongan children. This included such observations as teeth (caries), hair, general body tone and structure, plus a tricep skinfold measurement taken in conjunction with upper arm circumference.

With regard to population increases, a mathematical comparison of migration from Tonga, to immigration into the nation, provided an accurate estimate of population totals. Combining this estimate with data concerning growth in urban population and rural density, collected from census material, resulted in an indication of the distribution of population growth and migration potential.

Using agricultural data gathered from census materials and ministerial reports, a brief historical outline (i.e., post-World War II) of land usage patterns was developed. (The postwar period evidenced the most rapid population growth.) This indicated developmental trends in specific aspects of agriculture, such as cash cropping, the spread of plant diseases, etc., which altered agricultural patterns. Trends in land utilization and land abandonment were established, such as tenancy, absentee landholding, etc.

Assessing the nutritional status of urban population and geographically comparing these findings with rural inhabitants became a major undertaking in itself. However, because alteration in nutritional status was to be related to urbanization only in

cause and effect, extensive scientific investigation, such as blood assay of amino acids, was not necessary.

There are three reasonable approaches which can be followed in collecting data for this comparison. First, food consumption surveys, using selected families, were employed. In this approach a record of food and approximate amounts used was made. This technique also supplied data pertaining to food availability, by type, for both rural and urban areas. The disadvantages of using household food consumption surveys were (1) the survey would have been necessarily limited due to the time involved, and (2) the difficulty an outsider encounters communicating in a traditional society concerning a personal topic. Secondly, the determination of nutritional status employed anthropometric measuring of subjects (head, upper arm, chest circumference plotted against established standards by age). Third, a clinical analysis utilizing hair root diameters as a precise measurement of nutritional status was undertaken. (Studies have shown strong correlation between hair root examination and serum amino acids and anthropometric measurements [Bradfield, 1972 and 1971; Nommacher 1972].) It was felt that this technique, when used in conjunction with the above anthropometric measures, would provide an almost foolproof comparison of rural and urban children with respect to nutritional status and physical growth and development.

In data collecting, every effort was made to avoid environmental, physical, or nutritional influences which would have resulted in skewed or distorted conclusions. All children of the

survey sample were examined within a 4-week period. Standards for physical measurements and hair sampling were observed in that each child was measured on the same anatomical site and hair samples were taken from the same scalp location[1] (note procedures in Appendix C). Efforts were also made to insure the sample was a cross-section of Tongan population which involved no particular religious or economic group in excess.[2] Therefore, it was fully recognized from the onset of this research that in surveys of an entire population, as well as specific groups within the population, one should make every possible effort to gain results which are representative and unbiased. The sampling took into account specific cultural and occupational characteristics of the area and the population.

After the individual sample subject was selected, every effort was made to gain complete information for that subject. Of the total sample, a research sampling of 265 Tongan preschoolers were selected from rural and urban areas throughout Tonga. In the selection of each subject, care was taken that only one per family was included in the sample. Upon initial inspection, if the child was

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[1]The possibility of such dietary variations as mineral consumption between rural and urban children was recognized as a factor which could result in differences in the growth profile between the two groups. Research pertaining to such cause and effect was not undertaken within the scope of the present endeavor. However, one possibility for future research is seen in the role of zinc in relation to the large consumption of wheat bread in urban areas.

[2]The most obvious case was that of Mormon (Latter Day Saints) families. Without exception, children in these households appeared better cared for in terms of physical development and general conditioning. This distinction was noted early in the sampling process and was compensated for.

determined to be abnormal in his physical development, i.e., unusually large or small for his particular age group, his survey form was not included in the research survey.

CHAPTER III

POPULATION AND SETTLEMENT

Historical Development

The initial settlement of the Tonga Islands resulted from southward migrations of Polynesians from Samoa, approximately 3,000 years ago (Green and Kelly 1931, p. 64). Pottery fragments and ancient fortifications indicate that settlement was widespread and that a prehistoric population of approximately 30,000 persons developed within the islands (Green and Kelly 1931, p. 64; Maude 1965, p. 27). Between this prehistoric period and European contact in the seventeenth and eighteenth centuries, there elapsed sufficient time for the population to have expanded beyond this level, even with only a modest growth rate. This suggests that at some time during this pre-European period, Tongan population stabilized at a level reasonably in balance with the carrying capacity of the land. This assumption is, in part, confirmed by the writings of Tasman in 1643, and Cook in 1773, each of whom observed widespread settlement throughout the islands. Concerning the island of Tongatapu, maps and descriptions from the seventeenth and eighteen centuries indicate only small scattered areas not included within a system of native food producing plantations (Green 1973, p. 64).

It appears that the concept of village settlement did not exist in Tonga during this early period of European contact. Tasman

reported that individuals resided within private gardens, separated from each other by fences, or such common boundaries as roads and trails. Cook, more than a century later, reported a similar pattern of settlement. Such accounts suggest that the island population was relatively evenly distributed over most of the island acreage. Towns, as defined today, were unfamiliar, the population groupings being loosely clustered on land holdings of respective chiefs (Kennedy 1958, p. 162).

During the eighteenth century, newer types of weapons were introduced (i.e., the bow and arrow, and a modified throwing spear, from Fiji) and tribal fighting began within Tonga. What began as small scale conflicts gradually evolved into civil war which involved all the Tongan islands. This period of warfare, which lasted until the 1850s, effectively terminated the widespread house and garden type of settlement (Kennedy 1958, p. 164). Replacing this traditional system for a limited time was a settlement pattern in which most people resided within fortified structures. The war also disrupted the garden agricultural system, owing to frequent raids from neighboring tribes. As a result, treaties were formulated between two or more fortified groups, whereby land was guarded, planted, and harvested in common (Kennedy 1958, p. 64).

With the close of the civil war period (1799-1852), which lasted for more than a half century, the three principal island groups comprising the Tongas were unified under the rule of Taufau'ahau (Tupou I). However, the end of hostilities did not signal a return to the traditional house and garden settlement

pattern. Villages, resembling the modern concept of population grouping, replaced the fortified structures, often being constructed on the original fortress site (i.e., Feletoa and Neiafu).

It was during this post-civil war period that the present agricultural system, based upon land tenure, was initiated. Under a decree issued by Tupou I, farmland was divided into allotments of approximately eight and one-quarter acres, or 100 fathoms square. This 'api tukuhau, or rural allocation system, was available to all males over 16 years of age. In addition, the 'api kola, or urban allocation system, provided each family with two-fifths of an acre within a village, for housing. An alternative to the above permitted an individual to waive his rural and urban allotments, in exchange for a larger rural allotment of 12 3/8 acres.

The bonds of communal living insured the survival of this nuclear village pattern, despite the fact that some individuals resided a substantial distance from their farm holdings. Within modern Tonga, this pattern still exists as a strongly bound unit, even though this often necessitates as much as 20 miles of travel from village to farm acreage (Kennedy 1958, p. 165).

Twentieth Century Population Settlement

The population of twentieth century Tonga can be divided into three groups, by pattern of settlement: (1) villages, (2) towns, and (3) miscellaneous groupings, such as school and church facilities.

Although the village concept is relatively new to Tongan culture, it serves today as the center of most social and economic

activity, being second only to the family in social unity. Even within larger urban areas, village characteristics remain. The capital, Nuku'alofa, still retains social divisions based on older village distinctions. For example, sections of the capital, such as Kolomotu'a, exhibit aspects of the former village social structure.

The 1966 census of population lists 152 villages within the Tongan Kingdom (Fiefia 1968, p. 39). The location of the majority of these villages is within a half mile of the sea, with relatively few being found within interior areas. The explanation for this distribution involves consideration of the insular nature of the nation, as well as the significant role the reefs and sea play in supplying the Tongan diet with protein. During the civil war period, the fortified structures were built on hills to facilitate strategic defense. For this reason occasional villages, built upon old fortress sites, are today located on inland elevations. This is most often the case in Vava'u (i.e., Feletoa, Mataika, and Leimatu'a).

All Tongan villages are similar in social character, with differences stemming only from size. Larger villages are more urban oriented, and exhibit such recreational facilities as motion pictures, pool halls, and social halls. However, most Tongan villages number fewer than 400 total inhabitants, and have few distinguishing characteristics.

Some of the larger villages represent an amalgamation of two or more settlements which, following a period of expansion, joined together forming a cluster or elongated configuration. Nuku'alofa

represents such an occurrence. Historically, the formation of this city resulted from the merger of three villages, Ma'ufanga, Kalamotu'a and Kolomofu'ou, during the reign of Tapou I. Following rapid urban population growth and expansion of settlement along the major transportation routes of the city, Nuku'alofa has recently incorporated other nearby villages such as Longalonga, Fasi, Fanga, and Maile'taha.

The Tongan Minister of Lands has classified only four Tongan towns as being urban areas: Mu'a, Nuku'alofa, Pangai, and Neiafu. The latter three are the capital cities of Tongatapu, Ha'apai, and Vava'u, respectively. Mu'a, which is located on Tongatapu and is Tonga's third largest city, historically represents the seat of Tongan power. (It was also the site of Cook's landing in the eighteenth century.) Mu'a today, however, is economically and socially overshadowed by Nuku'alofa, which is 11 miles away, and therefore has retained the function and appearance of a large agricultural village. In other words, it exhibits few of the economic and political functions which characterize Nuku'alofa, Pangai, and Neiafu.

While there is no uniform definition of an urban area nor a standard of measurement, within the Pacific Islands, the Urbanization Advisory Committee of the South Pacific Commission has established several applicable characteristics:

1. a noticeably heavy concentration of population in comparison to the surrounding areas;
2. an occupational distribution differing from the surrounding area, with a larger proportion engaged in non-farming pursuits,

3. a form of local government different from that of rural areas, as being more suited to the provision of necessary urban services, made possible by greater population concentrations and financial potential (Urbanization . . ., 1962, p. v).

Nuku'alofa is Tonga's center of economic and social activity. The urban area houses a rapidly expanding population in excess of 20,000, and has spread along the major transportation routes to the point where it has overtaken surrounding villages and formed a 1.5 mile arc, radiating from the waterfront. The population density is greatest along the peripheral edge of the city's central business district, and along the major transportation routes leading into the city. As the nation's capital, Nuku'alofa contains the majority of governmental divisions, including the royal family and all major ministerial departments. Although Pangai and Neiafu are also capitals, of Ha'apai and Vava'u respectively, they are greatly overshadowed by Nuku'alofa.

Pangai, the capital of Ha'apai, exhibits fewer of the urban characteristics found within Nuku'alofa. Smallest of the four Tongan cities, Pangai evidenced a decreasing population during the intercensal period of 1956 to 1966. However, within the Ha'apai island group, Pangai remains the focal point of governmental, social and economic activity. The recent construction of the Ha'apai airfield, and the development of tourism, is expected to forestall further declines in Pangai's population.

Neiafu, capital of Vava'u, is second only to Nuku'alofa in terms of commerce and economic development. Neiafu not only serves as the administrative center of Vava'u, but is rapidly becoming the most important tourist center in the Kingdom.

Considering the urban characteristics set forth by the South Pacific Commission as being applicable to the Pacific islands, it becomes apparent that the cities of Pangai, Neiafu, and Nuku'alofa can be defined as being urban centers. In the case of Mu'a, though larger than Pangai in terms of population, the lack of such urban characteristics as government, commerce, and economics eliminates it from urban classification, under the South Pacific Commission's definition.

Other population groupings of significance include church training facilities and schools. The most important of these are Salote College and Toloa Methodist Training College, sponsored by the Wesleyan Methodist organization, and Liahona High School, sponsored by the Church of Jesus Christ of Latter Day Saints. Each of these include several hundred students and staff, many of whom live in housing provided by the respective schools.

Other groupings to be considered within this classification are the training camp for the Tongan defense force and the police training facility, both on Tongatupa. The population of these two facilities, though largely transient, must be recognized.

The historical growth of Tongan population can only be estimated through calculation of approximate numbers supported by approximate tillable acreage. Therefore, figures representing the population prior to the first census (1921) reflect educated guesses supported at times by missionary estimates and head counts (Walsh 1970, p. 31). In addition, none of the censuses prior to 1956 can be considered to be entirely reliable. McArthur stated that

fluctuations of the population of individual islands "are such as to arouse considerable doubts of the accuracy of either the recording or summarizing of the data" (McArthur 1968, p. 81).

It is generally assumed that an estimated pre-European population of 29,700 represents a reasonable figure. This estimate, by Maude (1965), takes into account the entire Tongan group and will suffice as a starting point from which a discussion of modern Tongan population can begin. Table 1 represents a summation of available population data, beginning with the pre-European period. Although it is recognized that the historical statistics prior to the 1956 census are primarily estimations, several broad conclusions can be drawn from this table. An overall pattern of population decline and recovery, common to most of the Pacific island groups, is evident throughout Tongan history. In addition, three contact phases, following Tasman's initial landing on Tongatupa, are suggested and supported within the historical population data of Table 1 (Tupouniua 1957, p. 17).

Phase one, from 1643 to 1799, represents the period of Tongan history for which there are no records "of any large scale destruction through disease, and internal wars were totally unknown" (Tupouniua 1957, p. 17). This period began with Tasman's visit and continued until Cook's last contact with the islands. Due to the absence of wars and disease, a balanced population with a steady, if somewhat slow, growth rate can be assumed.

Phase two represents the civil war period, from 1800 to 1852, a period of "bewilderment and social disintegration marked by

TABLE 1.--Distribution of Population by Island Groups (Percentages).

	Pre-Contact[1]	1840[1]	1891[2]	1921[3]	1939[4]	1956[5]	1966[6]
Tongatapu	43.9	43.2	--	--	--	55.0	61.9
'Eua	2.0	0.8	--	--	--	3.4	4.4
Tongatapu and 'Eua	45.9	44.0	36.6	42.6	46.2	58.4	66.3
Ha'apai	21.9	21.6	28.2	25.2	21.9	17.5	13.7
Vava'u	21.9	21.6	26.5	24.4	24.0	22.0	17.5
Other[7]	10.4	12.4	8.7	7.8	7.9	2.2	2.6
Total Population	29,700	18,500	19,968	24,935	34,130	56,838	77,429

[1]Estimated by A. Maude in Population, Land and Livelihood: The Kingdom of Tonga (Ph.D. dissertation, Australian National University, 1965), p. 27.

[2]Missionary account. Census 1956: 17.

[3]A. H. Wood, History and Geography of Tonga (Nuku'alofa: Government Printer, 1932), Appendix 6.

[4]Census 1956: 41.

[5]Ibid.

[6]Census 1966: 36.

[7]Niuafo'ou and Niuatoputapu. Niuafo'ou had no population in 1956.

a sense of insecurity" (Tupouniua 1957, p. 18). During this phase, internal armed conflict often resulted in large scale loss of life, destruction of crops, and subsequent famine conditions. It is estimated that at least one-fourth of the Tongan population perished during the first half of this period, victims of either war or famine (Wood 1932, p. 33). In addition, diseases contracted from Europeans, whose contacts with the islands were increasing in frequency, produced several severe epidemics. In combination, the war and disease resulted in a large and widespread reduction of population.

Phase three represents a period of "adjustment and recovery," dating from 1852 to the end of the century. Recovery, in terms of population numbers, did not immediately occur. Secondary effects of the civil war period lasted until approximately 1890 to 1895, or until large numbers of individuals born after 1852 entered the reproductive ages.

Following the 1890s, the population evidenced a numerical recovery, though periodic outbreaks of disease resulted in an irregular pattern of increase. For example, an epidemic of measles in 1893 reportedly killed a "twentieth of the population," while an influenza epidemic in 1918 claimed as much as a tenth of the population, on some islands (McArthur 1968, p. 96). Nonetheless, the number of individuals increased from approximately 20,000 in 1891, to 24,000 in 1918. Following the 1918 epidemic, the Tongan population exhibited a period of accelerating growth. Between 1891 and 1931, the annual rate of increase was 1.1 percent. This rate

increased to 3.1 percent between 1931 and 1956, with the population growing from 28,839 to 56,838 (Kingdom of Tonga: Statistical Abstract 1972, p. 1). This rate of expansion accelerated further during the intercensal period, 1956 to 1966, to reach 3.6 percent. By the time of the 1966 census, the Tongan Kingdom contained 77,429 individuals. This represents a tripling of the 1918 population figure, in less than 40 years. Since 1966, the population has increased by approximately 20,000, and now stands in excess of 95,000.

Data available from the Tongan Department of Justice, and published after 1966, indicates a decelerating population growth rate (Table 2). While there exists some speculation as to the accuracy of this data, it appears that the annual growth rate has decreased from the intercensal 3.6 percent, to a 1973 level of 2.5 percent (Report of the Department of Justice 1973, p. 9). However, despite the declining growth rate, a proportional decrease in the yearly numerical increase of the population is not evident. Statistical evidence indicates that greater numbers of the population are entering the fertile years, thereby offsetting the decreasing rate of growth by maintaining a nearly constant or increasing number of births. Furthermore, due to the age structuring of the population, which is decidedly young, more individuals will be entering the reproductive years in the near future, than will be leaving it (Table 3).

Projection for the future population of the islands differs greatly, depending upon the sources consulted. Therefore, Table 4 (page 29) projects the population for five different growth rates,

TABLE 2.--Crude Birth and Death Rates.

Year	Registered Births	Registered Deaths	Natural Increase	Per Thousand		Yearly Growth
				Births	Deaths	
1966	2,870	228	2,672	38	3	3.46
1967	2,652	278	2,374	34	4	3.06
1968	2,648	209	2,439	33	3	3.05
1969	2,844	236	2,608	34	3	3.16
1970	2,652	227	2,425	31	3	2.85
1971	2,505	285	2,220	29	3	2.54
1972			2,486			2.74
1973			2,395			2.58

SOURCES: Population Census Reports, 1956 and 1966.
Report of the Department of Justice, 1966-1971 (Nuku'alofa: Government Printer).
Kingdom of Tonga: Statistical Abstract 1972 (Nuku'alofa: Government Printer, 1972), p. 4.

TABLE 3.--Population by Broad Age Groups.

Age Groups	1956 Census		1966 Census	
	Total	%	Total	%
Under 5	10,031	17.7	14,326	18.5
05 - 09	8,090	14.2	11,546	14.9
10 - 14	6,843	12.0	9,873	12.7
15 - 19	6,045	10.6	7,825	10.1
20 - 24	4,968	8.8	6,219	8.0
25 - 29	4,416	7.8	5,441	7.0
30 - 34	3,537	6.2	4,542	5.9
35 - 39	2,896	5.1	4,154	5.4
40 - 44	2,256	4.0	3,321	4.3
45 - 49	1,782	3.1	2,711	3.5
50 - 54	1,606	2.8	2,064	2.7
55 - 59	1,279	2.3	1,484	1.9
Over 60	3,089	5.4	3,923	5.1
Total	56,838	100.0	77,429	100.0

SOURCE: Kingdom of Tonga, Statistical Abstract 1972 (Nuku'alofa: Government Printer, 1972), p. 4.

TABLE 4.--Projected Population Size of Tonga.

Year	Growth Rate, Percent Per Year				
	1.5	2	2.5	3	3.5
1980	104,000	107,500	112,000	117,500	121,000
1990	120,500	131,500	143,500	156,500	170,500
2000	141,500	161,500	183,000	210,000	240,000
2010	162,500	198,000	234,000	281,000	338,000

for the forthcoming 30-year period (1980 to 2010). A growth of 2.5 percent, though not currently met, probably provides the most realistic estimate, though possibly conservative, for long range projections.

Regardless of the estimated growth rate used, one overriding feature becomes apparent when considering Tonga's population history and its projected future. It took approximately 100 years to double the 1840 population figure of 18,500. The 1940 population figure, approximately 35,000, required less than 25 years to double, resulting in 70,000 individuals. Projected growth rates (Table 4) indicate that the population will double again between 1966 and 1990, a period of 24 years.

The population composition of modern Tonga is homogenous. As indicated within Table 5, 98 percent of the population is Tongan, while less than 2 percent is composed of other racial elements. Throughout history, Tongan law has consistently forbade the sale of land to non-Tongans, Therefore, this non-native element is primarily

TABLE 5.--Component Populations of the Kingdom Showing Respective Percentages to Total Population: 1939, 1956, and 1966.

Component Population	1939 Census	1956 Census	1966 Census
Tongans	96.28%	97.04%	98.31%
Europeans	1.17	0.40	0.42
Part-Europeans	1.29	1.06	0.66
All Others	1.26	1.41	0.51
	100.00	100.00	100.00

SOURCE: S. N. Fiefia, Report of the Results of the 1966 Census (Nuku'alofa: Government Printer, 1968), p. 17.

concentrated within the urban areas. Of this 2 percent non-Tongan population, nearly 30 percent are of mixed racial composition, the majority of whom are of Tongan and European descent. The significance of this absence of alien racial elements is the subsequent absence of conflicts of interest between these elements, often evident in other Pacific island groups (i.e., in Fiji between Fijians and Indians, and in Tahiti between the Chinese and native Tahitians).

The basis for this homogenic feature may, in part, be traced to the civil war period of Tongan history. During this period, evidence indicates an increasing Tongan hostility toward the resident Europeans. The popularized name, "The Friendly Islands," given to Tonga by Cook, became a misnomer as ships and missionaries were attacked. Tales of murder and cannibalism emanated from the voyages of the ships "Duke of Portland" (1802), "Union" (1804),

"Supply" (1822), and "Rambler" (1824) (Wood 1932, p. 34). Although the authenticity of these stories may be questioned, they effectively portrayed Tonga as an extremely inhospitable landing for European ships.

Following the civil war period, the newly formed Tongan nation successfully maintained its independent status, despite the fact that other Pacific territories became European colonies or possessions. Prior to 1900, various treaties were signed with France, Germany, the United States, and Britain. The British treaty of 1900 designated Britain as the Protecting Power of Tonga, and reconfirmed Tongan independence. This treaty, in effect from 1900 to 1970, insured Tongan independence and shielded the islands from any substantial alien influences.

At no time has Tonga experienced large scale influxes of alien population, such as the introduction of alien labor into Fiji, or the Anglo annexation of Eastern Samoa. This has allowed the maintenance of a nearly pure racial complexion in Tonga, with only a very minimum alien entry.

A second significant feature of the Tongan population composition is the age structure. This factor is particularly important in terms of projected population growth rate, as well as to future agricultural, urban, and economic planning. An examination of the 1956 and 1966 censuses reveals a significant expansion of the population percentages within the young age groups (Table 3). For example, the pre-fertility age group, ages 0 to 14, increased from 43.9 percent of the total population in 1956, to 46.1 percent in

1966, On the other hand, the reproductive age groups, ages 15 to 44, evidenced a decline within each age group, with the exceptions of ages 35 to 39 and 40 to 44. Further examination of these reproductive age groups indicates, however, that while an overall percentage decrease was realized between 1956 and 1966, the absolute numbers within each group increased substantially. This explains why, while the percentage of post-1966 births has decreased, the total number of births has remained nearly static (Table 2).

While stable populations develop stable age distributions, rapidly increasing populations evidence a greater proportion of younger age groups. The younger groups provide a broad base from which a large reproductive age group may eventually emerge, with the potential of even further increasing the birth rate. Tongan census statistics report a 1966 growth rate of 3.46 percent which represents one of the largest yearly growth rates in Tongan history. Since 1966, yearly percentage growth rates have decreased. However, as the younger age groups reach reproductive ages, Tonga may experience a resurging population expansion.

In order to forestall this continually increasing birth rate, and to establish a more stable demographic profile, the Tongan government has, since 1955, supported a family planning program. The medical department of the Tongan Ministry of Health began the present program of family planning in 1958, with aid from the South Pacific Commission. Since its initiation, the program has been extended to all parts of the Kingdom, with varying degrees of success.

Tongan traditions are contrary to the concept of reduced family size. Prior to 1950, high infant mortality motivated production of large numbers of offspring. In addition, a large family represented security for elderly parents. However, with the introduction of public health facilities, such as water purification, infant mortality declined, but without a corresponding decline in the birth rate. Thus, family size has increased slightly. The average number of persons per household in 1956 was 6.6, while in 1966 this figure was 6.7.

Several of the active religions within the Tongan Kingdom are a second major obstacle to effective family planning. These church groups (Mormon, Free Church of Tonga and Catholic) are outspoken in their opposition to family planning and birth control. Estimates of lay agreement to this opposition vary. The Office of Family Planning in Tonga claims that 18 percent of the Catholic population participates in the program. However, interviews conducted in a cross sampling of the Tongan population indicated a much lower percentage of Catholic supporters. Interviews with Mormon and Free Church members indicated consistent rejection of the family planning project. Despite the fact that the majority of the Tongan population is of Methodist affiliation, the influence of smaller church groups should not be underestimated. The Mormon church mission, for example, has experienced a rapid expansion in all areas of the Kingdom. The potential for a religious-based block to governmental birth control programs is not insignificant (Clark 1974).

A lack of consistent governmental support has produced a final obstacle to an effective family planning program. While a few members of the government outwardly support the program, others have, for various reasons, withheld their endorsement. This inconsistency is prevalent at all levels of the government.

The combined result of these three negative factors is a program far less effective than its earlier reported potential. Interviews with Tongan family planning administrators indicated that while these are important considerations, family planning is making progress and stabilizing population growth. However, interview questions designed to determine the opinions of average village inhabitants toward Tongan population issues revealed several interesting factors.

Among those Tongan citizens questioned, there was almost unanimous agreement that overcrowding is a problem within Tonga, in the 1970s. This overcrowding was recognized at four societal levels: family, village, island, and nation. However, very few of those interviewed could supply an accurate national population estimate (within 15,000).

Similarly, of those interviewed, most believed that overpopulation would remain a major problem in Tonga's future. On the other hand, few individuals considered family planning to be an important feature of household management.

Density of population was also found to be of minor importance in the acceptance or rejection of family planning. In a comparison of the high density areas of Ha'apai with low density

areas, suah as 'Eua, no significant difference in the proportion of acceptance was evidenced. Nor were significant variations of acceptance noted between rural and urban areas.

Examination of interview responses tends to indicate that the major factor determining acceptance or rejection of a family planning program is based in economics. It was found that the average Tongan, even when knowledgeable of the population issue, was more concerned with his own cost of living, school fees, and social expenses, than with overcrowding in his village or nation. Recognition of the possibility of improving family living standards by the reduction of offspring was the major motivation for acceptance of family planning. It is argued that with current trends toward increased tourism, the economic incentive for family planning may be removed. However, fewer than one percent of the total population would benefit monetarily from these changes. Therefore, it apears that the major incentive to acceptance of planning, the possibility of improving economic status, will continue to be influential.

The possibility of improved economic status also is the driving force behind population migrations in modern Tonga. This possibility, coupled with related social aspects (i.e., educational facilities, urban amenities) of certain areas over others, provides the major stimulus for movement within the nation.

Tongans have, for centuries, been known as a regionally mobile population. However, while movements of population out of the islands were frequent, seldom were they permanent. For example,

Tongan sovereignty was, at one time, established in Samoa, Futuna, Rotuma and Uvea to facilitate collection of tribute (Gifford 1929, p. 15). Control was also extended to Fiji, the Gilbert and Ellis Islands, Niue, and the Cook Islands, as a result of war. None of these cases represents part of a permanent migratory pattern.

Migration in modern Tongan history has also been largely restricted to movement within the nation. In other words, the Tongans have never had a period of large scale permanent movement out of the nation. Those individuals now leaving for New Zealand, Australia, Samoa or the United States usually do so for higher wages in industry or service activities. These people, however, usually return to Tonga within a year. (These external migration figures are not yet significant, although they are increasing.) Therefore, a consideration of migration in modern Tonga is most often concerned with rural to village or city movements, or inter-island movements.

The movement of people between the islands, particularly to Tongatapu, is reaching such a significant level that government regulation has been suggested (Fiefia 1968, p. 11). The increase in the proportion of the population living in Tongatapu, and the corresponding decrease in proportions living in other islands, has become the most noticeable trend in the population distribution of the Kingdom. This movement can be explained by better educational facilities, the availability of cash wages, and a force vaguely described as the centripetal pull of urban areas.

During interviews with individuals who had migrated to Tongatapu, the most frequently offered explanation for this migration was the desire for the best education for the children, and a subsequent qualification for careers in government service. Until recently, Tonga's secondary schools were all located on Tongatapu. Even though secondary schools have now been built on the other islands, most informants believed that the Tongatapu schools are superior. All such individuals expressed a willingness to temporarily lower their standard of living, undergo long periods of family separation or relocate the entire family, in order to achieve a long range goal of better education.

A smaller number of informants migrated to Tongatapu, due to a desire for cash employment in or near the capital. However, in many cases both motives, education and employment, were influential.

The centripetal force of urbanization, as described by Fiefia in the 1966 census report, is noted particularly with regard to younger age groups. "The drift of young people from the atolls of Ha'apai, especially, and rural areas of Tongatapu to Nuku'alofa is probably indicative of this trend" (Fiefia 1968, p. 11).

Most of the internal migration is from rural to urban areas, and Nuku'alofa is by no means the only urban area affected. The 1956 census listed six settlements, including the capital, with populations in excess of 1,000. With the 1966 report this statistic had risen to 13. (Table 6 lists these settlements with the respective intercensal increases.) These 13 evidenced a combined

TABLE 6.--Towns With 1,000 Population and Over Showing the Percentage Increase Since 1956.

District and Town	1956 Population	1966 Population	Percentage Increase or Decrease	
Tongatapu				
Nuku'Alofa including Siesia-Patangata	9,202	15,685	+	70.04
Mu'a	2,560	3,502	+	36.8
Vaini including the Government Experimental Farm	1,064	1,741	+	63.6
Ha'ateiho including Tonga College and Lotoha'apai	1,093	1,473	+	34.6
Fua'amotu including Camp Taliai of the Tonga Defense Force	827	1,343	+	62.4
Haveluloto (Havelu)	292	1,334	+	356.8
Kolonga	866	1,311	+	34.9
Houma	833	1,259	+	51.1
Nukunuku	799	1,078	+	34.9
Ha'apai				
Pangai	1,838	1,670	-	9.1
Hihifo	965	1,005	+	4.1
Vava'u				
Neiafu	2,873	3,593	+	25.0
Leimatu'a	1,004	1,068	+	6.3
Total	24,216	35,922	+	48.3

SOURCE: S. N. Fiefia, Report of the Results of the 1966 Census (Nuku'alofa: Government Printer, 1968), p. 10.

percentage increase of 48.3 percent of the total "urban" population and represented in excess of 46 percent of the Kingdom's population. Nuku'alofa alone accounted for nearly 21 percent of the national population total.

It is important to note that 9 of the 13 settlements (Table 6) are in the middle and eastern sections of the Tongatapu district, the areas where economic and educational activities are concentrated. These 9 villages represent nearly 60 percent of the island's population, with Nuku'alofa, alone, accounting for 32.4 percent of the total (Fiefia 1968, p. 10). An example of extremely rapid village growth is the case of Haveluloto (Havelu). This rapid growth is the result of three factors:

1. The proximity of Havelu to Nuku'alofa attracts many people who could not find land within the capital.

2. The relocation of the Tonga Copra Board and the Tonga Construction Company, from Nuku'alofa to Havelu, was accompanied by a subsequent relocation of employees.

3. The construction of a new island hospital within Havelu has attracted many residents.

The major road between Havelu's hospital and Nuku'alofa is solidly lined with dwellings.

The four remaining villages of over 1,000 population, not found on Tongatapu, are divided evenly between Ha'apai and Vava'u. Of these, Pangai declined in population during the intercensal period, while the other three registered the lowest percentage increases of the 13 settlements. This statistic indicates that movement from rural to urban areas was not as influential within

Ha'apai or Vava'u, as in Tongatapu. This conclusion is supported by the outmovement of population, both rural and urban, from these islands to Tongatapu. In Ha'apai, four villages lost population, while others increased at rates lower than the national average. In Vava'u, one-third of the villages lost population, while only two increased at a rate equal to the national average (Walsh 1970, p. 36).

Areas of Tonga most affected by in-migration are portions of 'Eua, owing to the available land, and Tongatapu. In addition to Nuku'alofa and its environs, the east central districts of Tongatapu have been most affected. The Nuku'alofa in-migration is of particular interest. Prior to 1956, the majority of migration to Tongatapu was directed to rural areas. Growth rate of Nuku'alofa during the intercensal period of 1931 to 1956 averaged 5.2 percent, while rural Tongatapu grew at a rate of 6.3 percent. However, the trend altered during the intercensal period of 1956 to 1966. Nuku'alofa, during this period, grew at a rate of 7.4 percent, while rural Tongatapu maintained the rate of 6.3 percent. This, and the preceding statistics, demonstrate the increasing importance of Nuku'alofa and the other major villages, both in terms of population (nearly 50 percent of the nation's total) and the tendency for current migration to Tongatapu to be urban oriented (Walsh 1970, p. 38).

Movements to Nuku'alofa and its environs from other areas of Tongatapu were more numerous than in-migration from other islands. This suggests a two-step migratory pattern. Frequently, a migrant from the other islands will settle initially in a Tongatapu village,

rather than move directly into the capital. Movement from these areas into Nuku'alofa primarily involves young age groups, such as school girls attending Queen Salote College.

Two factors stimulate movement from the outer islands. Centrifugal forces push people out of Ha'apai and Vava'u, while centripetal forces pull these people to Tongatapu. The most notable examples of these forces are greater opportunities for social mobility through education, improved transportation facilities between the islands, recent hurricanes in Ha'apai and Vava'u, an outbreak of black leaf streak in Vava'u, and the urban attractions of Nuku'alofa. Each of these forces can be related to economics. Simply, the average Tongan is seeking to improve his economic status to moving himself, if not his entire family, to Tongatapu.

These movements to Tongatapu are complicating the already serious problem of land and housing shortages on that island. As a result, migrants often live with relatives, or within the crowded substandard dwellings near Nuku'alofa. Examples are especially prevalent along the major roads between Nuku'alofa and Pea.

Interviews with individuals residing under these conditions revealed two important facts. If employment is secured and a permanent home established, the individual can expect additional family members and relatives to also migrate and move in with him, resulting in a cyclical process. In addition, it was found that as families leave Ha'apai and Vava'u, farmlands are not properly maintained, due to the absence of male family members, who are usually the first to migrate. Therefore, the the Kingdom is experiencing a severe

maldistribution of resident population, with over 50 percent now living on Tongatapu. This situation is compounded by the decreasing use of arable farmland and a subsequent reduction in the production of indigenous foodstuffs (Fox 1972, p. 5).

Several Tongan geographic features are influential in the distribution of the Tongan population. The western chain of islands in the Tongan group are volcanic and therefore have been settled only intermittently. These islands, usually smaller in size, are less densely settled than the eastern coral islands. Factors, such as the lack of permanent fresh water, and land too steep for anything beyond scattered cultivation, severely limit their settlement potential. In addition, occasional volcanic eruptions further deter settlement. During the civil war period of Tongan history, most of the western chain islands supported sizable populations. However, only Niuafo'ou and Niuatoputapu continued to support communities into the twentieth century (Walsh 1970, p. 30). A volcanic eruption on Niuafo'ou in 1946 forced its evacuation and most of the village population from this island resettled on 'Eua. (Niuafo'ou was resettled in 1958.) Recent attempts to settle Kao and Tofua in Ha'apai have met with varied success. Only Tofua appears, at present, able to sustain a reasonable population. However, plans and proposals are occasionally presented for the permanent settlement of Late and Koa, also in Ha'apai.

The concentration of Tongan population within towns and villages is expected to continue to be a significant feature of Tongan population distribution. Similarly, a growth in the number

of village communities with populations in excess of 1,000 is anticipated, particularly on Tongatapu and 'Eua. The attraction of 'Eua appears to be the availability of land, which motivates the migration of Tongatapu's landless males. Table 7, which includes the distribution of population from the 1921 census, illustrates the population growth on 'Eua, from 1.4 percent of the total population in 1939 to 4.3 percent in 1966.

Another significant factor determining population distribution is proximity to food source. In most cases, this results in location either near the sea or near cultivated land. Maude, in his examination of Tongan areas of low and high density, has

TABLE 7.--Population Distribution.

District	Population 1921	Population 1939	Population 1956	Population 1966
Tongatapu	10,127	15,754	31,264	47,920
Ha'apai	5,976	7,483	9,918	10,591
Vava'u	5,787	8,199	12,477	13,533
Niuatoputapu	791	836	1,254	1,395
Niuafo'ou	1,108	1,378	---	599
'Eua	---[1]	480	1,925	3,391
Total	23,759	34,130	56,838	77,429

[1] Included in the Tongatapu figures.

SOURCE: S. N. Fiefia, Report of the Results of the 1966 Census (Nuku'alofa: Government Printer, 1968), p. 9.

suggested that a balance between land and sea resources is generally the determining factor (Maude 1965, p. 63).

Although it is in close proximity to Tongatapu, in-migration to 'Eua has only recently been of significance. Interviews with residents of 'Eua suggested two reasons for this relative neglect. Passage to 'Eua is often dangerous, owing to the reef which surrounds the island. In addition, there is a marked lack of seafood available to the settlers on 'Eua. However, with the lack of land and the increasing population pressure on Tongatapu, coupled with the availability of land on 'Eua, in-migration is expected to steadily increase.

Population density, in relation to tillable land, is often determined by the degree of willingness on the part of Tongan nobles, to lease their holdings. In eastern and southeastern Tongatapu, large tracts of land lie idle or are used only minimally. However, in other portions of the nation, where landowners have been willing to lease, distribution is concentrated and densities are much higher.

Table 8 includes population density statistics for the major districts of the nation. For purposes of discussion, population density can be considered at three levels: (1) uninhabited land, (2) areas of low density, and (3) areas of high density.

Uninhabited areas of the Kingdom are usually those lands which are either unsuitable for cultivation or restricted from cultivation by members of the nobility. The majority of the volcanic formations in the western Tonga chain are included within

TABLE 8.--Population Density of Each Principal District: 1956 and 1966.

District	1956	1966
Tongatapu	313	480
Ha'apai	490	523
Vava'u	281	304
Niuatoputapu and Tafahi	172	191
'Eua	57	100

SOURCE: S. N. Fiefia, Report of the Results of the 1966 Census (Nuku'alofa: Government Printer, 1968), p. 9.

the former category. As mentioned previously, the lack of suitable water sources, coupled with the steep and rocky landscape, pose an effective deterrent to agricultural settlement.

Several important examples of uninhabited coral formations are located within the eastern island chain. Walsh described Uoleva as having never been inhabited and explained that the soil of the island is unsuitable for yam cultivation and "although visited and farmed to some extent, there is no record of permanent settlement" (Walsh 1970, p. 30). Interviews within Ha'apai settlements supported this conclusion in relation to several smaller uninhabited islands of this same island group.

The uninhabited areas of Vava'u are usually small islands which are steep and provide little acreage for productive farming. Also, in Vava'u, which has not experienced significant overcrowding, there has been little need for additional land. Many farmers

recognize that the uninhabited land is available, but continue by stating, "We have enough land."

Although Ha'apai and Vava'u include areas of low density population, the majority of this land is located on Tongatapu, also the scene of in-migration, population maldistribution and crowding. While totally uninhabited areas on Tongatapu are few, there are several areas of extremely low density, most often held by the nobility and located within the eastern and southeastern districts. The total amount of land held or controlled by Tongan nobility and/or royalty is unpublished (Rogers 1969, p. 217), and estimates vary from less than 50 percent to 70 percent. However, it is anticipated that population pressure, building throughout the Kingdom and particularly on Tongatapu, will necessitate the end of such land hoarding.

Natural factors may also contribute to the low density of a particular area. Maude's assumption of a balance of "land and sea resources" would seem to be the major cause. Though growing population pressure may necessitate a reordering of this concept, at present it appears that a scarcity of seafood correlates highly with low population density on adjacent land areas. This is particularly noticeable in the smaller islands of Eastern Ha'apai, and in areas of Vava'u. However, the situation in Vava'u is compounded by the inaccessibility of existing resources, owing to reefs and rocky shorelines.

On the other hand, densities which are highest, excluding urban areas, are located within areas where reefs provide an

accessible and abundant sea resource. This is true of western Tongatapu and the western sides of the Ha'apai islands, with the reefs of inner Ha'apai being the most productive.

Urban areas are by definition high density zones, and therefore need not be defended as such. However, urban density can be examined in relation to size of housing units within the islands. The average size of the Tongan household, as reported in 1966, included 6.7 persons. Recently collected data indicated no significant change in this level. However, the census reported nine villages with households averaging eight persons, and four villages which averaged over nine persons per household. Most of these were located on Tongatapu. Similarly, recent study indicated the average household size in Nuku'alofa to be 7.96; Pangai, 7.55; and Neiafu, 7.42. In addition, more than 63 percent of those households containing three or more nuclear family units were located on Tongatapu.

High density rural areas may number more than 2,000 persons per square mile, as in some parts of Ha'apai, while urban densities may be much higher. The average density of the population on inhabited islands, in 1966, was approximately 375 persons per square mile. This represented an increase in overall density per square mile of nearly 100 persons, from 1956 to 1966. However, these statistics are of little significance, unless considered in relation to the Kingdom's available human, natural, and agricultural resources. The following sections, which treat land tenure and agricultural exchange, will rely heavily upon an analysis of these resources, and their critical interrelations within Tonga.

CHAPTER IV

LAND TENURE

The Tongan land tenure system originated in 1852, following the conclusion of the civil war period of 1799 to 1852. It was at this time that Tupou I proclaimed himself to be ruler of all Tonga, and issued the two proclamations which laid the foundation for land tenure. Maude summarized these two proclamations as: (1) "No person has any title to lands in the islands except by grant from the government," and (2) "It shall not be lawful for any chief or people in Tonga (Tongatapu), Haabai (Ha'apai), or Vava'u to sell a portion of land to strangers" (Maude 1965, p. 62). Although the sale of land to foreigners was thus prohibited, leasing was permitted under government supervision, thereby satisfying the requests for land by Europeans (i.e., missions, traders, and refueling facilities).

The Tongan nobility received the first land divisions, from Tupou I, in the form of estates. This land was to be leased, in turn, to people residing in the vicinity of each noble. Thus, the leasing system probably began shortly after these estates were granted, in the 1850s, and has remained intact to this day.

The first significant step toward formal clarification of the land tenure system appeared in the code of 1862, with the

requirement that all foreign leaseholders pay rent to the Crown. In addition, non-ownership of land was extended to Tongans, as well as foreign residents. The code also borrowed from the earlier Vava'u Code of 1839 the concept that people are entitled to farmland, and that so long as tribute is paid, they cannot be dispossessed.

The legal basis for this system was supplied by the Constitution of 1875. Though revisions to the system have been made, most notably in the Land Act of 1927, the fundamental provisions of the 1875 Constitution, pertaining to land, have remained virtually unchanged. All land remains the possession of the King, who can grant estates to nobles. Nobles, in turn, lease parcels of land to individuals residing within the respective districts, as is needed. Land cannot be sold to Europeans or Tongans, and only leases approved by the government are recognized (Pacific Islands, Vol. III, 1944, p. 58).

This system was further developed between 1875 and 1900, the most notable modification being the regulation by the Crown of all land rents (i.e., taxes), allotments, and evictions, initiated in 1890. This legally limited the traditional power of the Tongan chiefs and nobles. In addition, the nobles could not refuse land to any person in their district. In other words, the government had successfully solidified and reserved for itself, ultimate control over all land.

Under the 1890 provisions, Tongan males, upon reaching the age of 16, were recognized as being entitled to apply for a land

allotment. Two types of allotments were granted. The 'api tukuhau, or rural allotment, was 100 fathoms square or approximately eight and one-quarter acres. The 'api kolo, or town allotment, measured 22 fathoms square (132 yards square) and was designed for use as a dwelling and garden site. Portions of Tongatapu and Ha'apai were subdivided into units 50 fathoms square, to allow for greater population density in select areas. In addition, the 1890 provisions made land liable to forfeiture if rents or taxes were not paid for three successive years. Annual rates of tax equaled eight shillings per 'api tukuhau. Smaller allotments were assessed a proportionate rent, while no rent was paid for the 'api kolo.

In 1915, a minor regulation was added to the 1890 provisions, whereby the government was required to notify the nobility prior to making allotments from their estates.

The 1927 Land Act consolidated the existing laws and is the legal instrument currently consulted for clarification of land policies. This act also included provisions for granting a rural allotment of 12 3/8 acres to any applicant willing to forfeit his town site. This modification was probably designed to encourage more even distribution of population, plus increase agricultural production. In 1934, the size of this allotment was increased to 15 acres, due to the lack of interest in the 12 3/8 acres. The 15 acres were comprised of a standard 8.25 acre rural allotment and a town site of 1.75 acres. In addition, an optional five more acres could be leased for 50 years, at a minimal rate. Employees of the Tongan Ministry of Lands, as well as village residents, indicate that

neither allotment size has been popular to the point of significantly altering population distribution. While several estates were initially surveyed into 15 acre allotments, most have since been resurveyed to the stand eight and one-quarter acre size (Wood 1932, p. 74).

The estimated total land area of the Tongan Kingdom is 184,674 acres, or approximately 288 square miles (Report of the Ministry of Lands and Survey, 1973, p. 14). Approximately 40 percent of this total represents the Tongatapu island group. Vava'u and Ha'apai represent 22 percent and 18 percent, respectively, with the remaining 20 percent being volcanic and largely uninhabitable. Population estimates of 101,608 for 1975, projected in the 1970 economic survey, allow 1.8 acres per person or an overall density of 352 persons per square mile (An Economic Survey of Tonga: 1970, p. 10). However, a breakdown of Tongan districts illustrates the maldistribution of population and land resources. Tongatapu, with over 60 percent of the total population, currently has a ratio of approximately 1 to 1.02 acres per person, and an estimated 1975 population density of 628.8 persons per square mile. Ha'apai, not including Tofua and Koa, shows 0.94 acres per person and a density of 685.6 persons per square mile. 'Eua, on the opposite extreme, contains 4.3 percent of the population, or approximately 4,370 persons. 'Eua is an estimated 33 square miles in size, resulting in a population density of approximately 129 persons per square mile, or 5.0 acres per person (see Table 9).

TABLE 9.--Population Density, and Acres Per Capita.

	Population 1975 est.	Area Sq. Mi.	Density Per Sq. Mi.	Acres Per Capita
Tongatapu	62,794	99.85	628.8	1.02
Ha'apai	13,890	20.26	685.6	0.94
Vava'u	17,679	44.44	397.8	1.61
'Eua	4,370	33.76	129.44	4.97

SOURCES: Kingdom of Tonga: Statistical Abstract 1972 (Nuku'alofa: Government Printer, 1972), p. 2.
S. N. Fiefia, Report of the Results of the 1966 Census (Nuku'alofa: Government Printer, 1968), p. 8.
An Economic Survey of Tonga: 1970 (Nuku'alofa: Government Printer, 1970), p. 8.

As indicated by these statistics, land is often at a premium within Tonga. While the laws provide for an equitable system of land distribution, differences between actual practice and theory in land distribution, in view of population pressure, must be recognized. Of 265 sample household interviews within the Kingdom, 51 percent of the respondents reported to be landless. These individuals indicated that the willingness of the estate holder to lease land, as well as Tongan tradition, is frequently a more decisive factor than the 1927 Land Act, with regard to land distribution. Many interviewees suggested that land is rarely acquired in the manner stated by law, but rather through a complex, and apparently corrupt, system of barter and favor buying. This accounts for the fact that a large number of Tongans are landless, while as much as 50 percent of available acreage remains intact within royal and noble estates.

The same reasoning applies to historically prevalent variations in size of holdings.[1] Though an exposé of these issues is not the intent of this research, they are, nonetheless, considerations with regard to population and land distribution. The following paragraphs describe the land tenure system in practice, in contrast to that outlined by Tongan law and theory.

Within the Tongan tenure system, there are two principal types of land holdings--the estates of the royalty and nobility, and the land allotments of the average citizens. The 1927 Land Act listed three types of estates: those belonging to the King, those belonging to the royal family, and the hereditary estates of the Tongan nobility. At present, 39 nobles retain control, beneath the Crown, of 31.1 percent of the total land area (see Table 10). About 60 percent of the Tongan population resides upon hereditary estates. A few of the nobility retain possession of two estates or one estate and other small holdings. In addition, some holdings may be on more than one island, or fragmented on a single island. These features complicate the assessment of these holdings, in terms of land area involved, usage, and amount of leasing. Discussions with employees of the Tongan Ministry of Lands revealed that although the Land Act of 1927 requires the registration of estates and their boundaries, approximately one-half of the existing estates have not been listed.

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[1]The 'api tukuhau, or rural allotment, is most frequently 8.25 acres in size. However, sizes do vary considerably owing to a variety of circumstances, which need not be discussed, with regard to the tenure system. The average rural allotment ascertained through interviews amounted to 9.63 acres, with extremes of two acres and 48 acres being encountered.

TABLE 10.--Distribution of Land Ownership.

	Number of Allottees			Area Allotted (Acres)			% of Total Area		
	1969	1970	1971	1969	1970	1971	1969	1970	1971
1. Land granted as tax and town allotments to Tongans	21,259	21,721	22,186	66,906	67,024	70,573	41.5	41.5	42.7
2. Land leased by Native Tongans	712	879	954	2,159	2,171	2,771	1.3	1.3	1.7
3. Land under Crown hands	--	--	--	34,380	34,500	34,084	21.3	21.4	20.7
4. Hereditary Noble Estates	--	--	--	52,176	51,344	51,448	32.3	31.8	31.1
5. Foreign leases	--	--	--	2,088	2,378	2,222	1.3	1.5	1.3
6. Charity leases	--	--	--	3,721	4,031	4,104	2.3	2.5	2.5
7. Total land distributed	21,971	22,606	23,140	161,430	161,430	165,202	100.0	100.0	100.0

SOURCES: Report of the Ministry of Lands and Survey, 1969-1971 (Nuku'alofa: Government Printer).
K. B. Cumberland, Southwest Pacific (New York: F. A. Praeger, 1968), p. 95.
Kingdom of Tonga: Statistical Abstract 1972 (Nuku'alofa: Government Printer, 1972), p. 95.

Note: Breakdown of tax and town allotments by acres unavailable readily.

This lack of compliance results from inadequate surveying, disputed boundaries, and/or apathy.

In addition to the 31.1 percent of total acreage being held by nobility, Crown lands account for another 20.7 percent. This land, much of which is totally unused, includes the holdings of the King and the royal family.

Another type of estate, of recent origin, is that designated as government estates, under the control of the Tongan Ministry of Lands. These consist of land which has not been granted by the Crown to the nobility.

Thus, the estate is the primary unit in the division of land by the Crown. However, beyond the breakdown of land ownership within Table 10, an accurate accounting of land availability and distribution is difficult. It may be reasonably assumed that over one-half of the Kingdom's total acreage is held in estate form, with much being left unused or used below capacity. The uneven distribution of population further complicates an analysis of the Tongan estate system. For example, while estates in Vava'u and 'Eua may show a capita per acre ration of 1:5, more densely settled Ha'apai and western Tongatapu show ratios of 1:0.9. This fact leads to an expectation of internal migration, resulting in more favorable distribution patterns. However, landless householders indicate that it is extremely difficult to obtain land in distant areas. This is in direct conflict with the principles of the 1927 Land Act, and emphasizes the influence of tradition and the unwillingness of nobility to lease land to those from outside their districts.

The 'api, or land allotment, represents the second type of land holding in the Kingdom, being a subdivision of the estate. In theory, the estates are to be divided into allotments as needed. However, according to the Tongan Ministry of Lands, only the nation's major geographic features, such as roads and shorelines, had been surveyed prior to the national survey of 1958. Subsequently, few of the estate lands had been subdivided into the standard eight and one-quarter allotments prescribed by law and the presence of customary farm holdings, which were of a wide range in size and spacing, made implementation of the 1927 Land Act, in terms of land distribution, impossible. The national survey in 1958 greatly increased the number of available land allotments. Maude (1965) reported that in 1957, only 2,564 allotments, of eight and one-quarter acres, were available to 12,000 Tongan taxpayers. Table 11 indicates that by 1973, this figure had increased to over 15,000 allotment holders (Report of the Ministry of Lands and Survey, 1973, p. 15). Though the increase of surveyed and allotted land is impressive, over 50 percent of Tonga's acreage is retained by royal and hereditary estates, and the growing number of landless households persists. A recent royal address indicated that as many as 39,837 individuals had applied for only 13,017 available allotments. Based upon this data, there are twice as many men entitled to land as there are allotments available. This trend may reasonably be expected to increase, as younger population groups reach maturity.

Land is most easily acquired through inheritance of a lease. (The most frequent explanation for landlessness, as reported by

TABLE 11.--Distribution of Land Holdings by Type.

Year	Tax Allotment Holders 'api tukuhau	Town Allotment Holders 'api kolo	Total
1967	13,041	7,186	20,221
1968	13,614	7,116	20,730
1969	14,065	7,194	21,259
1970	14,329	7,392	21,721
1971	14,615	7,571	22,186
1972	14,965	7,594	22,559
1973	15,152	7,828	22,980

SOURCE: Kingdom of Tonga: Statistical Abstract 1972 (Nuku'alofa: Government Printer, 1972), p. 95.

Tongan interviewees, was the lack of an inheritance.) On death of the landholder, his widow is entitled to life interest in his land holding. This right is lost only upon remarriage or conviction of adultery and/or fornication. If there is no widow, the land passes to the eldest son, and in the case of his death, to his eldest son. If there are no sons, an unmarried daughter may hold the land for life.

With the average Tongan household consisting of 6.7 persons, it is apparent that many males will not inherit land. Therefore, the only subsequent way to acquire land is through an allotment which is vacant, or an arrangement for land usage with a noble, relative or friend. Many interview respondents indicated that vacant land is scarce in densely settled areas, in that no

allotments are unclaimed, or the surveying for allotments has not kept pace with demand.

Acquiring a vacant parcel of land is also complicated by tradition and the power of the estate holder, as was mentioned previously. A noble may delay the registration of the leased allotment with the Ministry of Lands, thereby enabling him to extract favors and gifts from those using his estate. Several farmers in Vava'u, responding to interview questions, reported having agreed to lease land from a particular noble, and after paying the customary favor, discovered that the land was already leased. Many estate holders are reluctant to relinquish their powerful position. Subsequently, the allotments which were listed in the 1958 national survey as being available have been only slowly distributed.

The Tongan law requires a yearly payment of 80 cents to the government or estate holder, by each farmer (Report of the Ministry of Lands and Survey 1973, p. 3). However, investigation indicated that many rents are far in excess of this requirement. Frequently, farmers estimated their yearly rent to be more than ten dollars. In many cases, rents are paid with gifts of food, such as pigs or yams, or other material items, which are valued at more than 80 cents, and make an accurate estimate of an average tax rate difficult to determine (Clark 1974).

This situation may, in part, explain the widespread failure by farmers to pay rent as required. Table 12 lists 1,241 allotment holders, throughout the Kingdom, who have failed to pay rent, and this delinquency continues to grow. Note that in 1971, only 1,034

TABLE 12.--Nonpayment of Rents by Lease Holders: 1971 and 1972.

	1971	1972	Increase or Decrease in Numbers
Tongatapu and 'Eua	216	386	+ 170
Ha'apai	65	539	+ 474
Vava'u	691	225	- 466
Niuatoputapu	62	91	+ 29

SOURCE: Report of the Ministry of Lands and Survey 1973 (Nuku'alofa: Government Printer), p. 3.

allotment holders were listed as delinquent in rents (Report of the Ministry of Lands and Survey 1973, p. 3). Several interviewees indicated that they had no intention of paying rent under the present system of collection. Since the regulation permitting eviction after three years of delinquent rent is not strictly enforced, the number of delinquent landholders is expected to increase.

The 1966 census reported that only 42 percent of Tongan taxpayers had a tax allotment, the distribution of this percentage being 39 percent among the larger Tongatapu population, 46 percent on Vava'u and 48 percent on Ha'apai (Fiefia 1968, p. 30). This variation in distribution appears to be related to the uneven distribution of population, the resulting uneven demand for allotments, and the fact that each year there are more taxpayers than available allotments. A temporary solution, as indicated by interview responses, involves subleasing from friends or relatives. This

subleasing is common throughout the islands, and most frequently, payment is in a traditional means, such as an occasional basket of taro or yams, or on a special occasion, a small pig.

Upon initial inspection, the information presented thus far suggests a land shortage in the Kingdom. However, this interpretation is not necessarily valid. When confronted by statistics showing less than one-half of the Tongan taxpayers possessing allotments, several qualifications must be recognized. Misallocation and maldistribution of land certainly exists. However, none of the interviewed population, even in the squatters section of the capital, appeared to be critically short of food. In cases where land is totally unavailable for household cultivation of vegetables, it is traditional to borrow or receive subsistence foodstuffs from neighbors, friends, or relatives. In this way even the totally landless Tongans benefit from garden produce. (Food quality does vary within the Tongan popualtion, and this will be discussed further within a later chapter.)

Borrowing land for cash cropping or purposes other than subsistence food production is rare. In very few interviews with landless Tongans did the sale of cash crops contribute to the income of the household, and this fact was often reflected significantly in the income of the landless family. However, landlessness should not be considered synonymous with poverty in Tonga. Landless households, though enjoying less agricultural cash income, often receive income from more fortunate relatives, in the form of gifts. (While the most frequent extra-subsidiary expense

encountered in survey responses was church contribution, the second most frequent expense was cash gifts to relatives.) In addition, landless households may receive cash from relatives working overseas, most frequently in New Zealand, though also in Australia, Samoa and Hawaii. In a few cases, landless households receive as much or more income from overseas sources than the total income of a landholding Tongan.

Additional alternatives open to landless Tongans include a variety of sharecropping arrangements, the most common being an agreement to harvest a prearranged quantity of produce, for which no return to the landowner is made. A modification of this is the harvesting of the entire crop by the landless family, and sharing the profits, half and half, with the landowner.

Still another alternative enabling landless households to obtain land is the paying for such through an unofficial rent system. The renting or leasing of land under this arrangement is, strictly speaking, illegal. However, use of land is often granted in exchange for gifts of vegetables, pigs, labor or even small amounts of cash paid to the landowner.

The landless element in Tonga is rapidly growing, and undoubtedly will become a major social and economic issue in the Kingdom's future. However, at present, significant or widespread social unrest related to the issue of land tenure is not evident. Of those interviewed, 21 percent believed the present land tenure system to be unsatisfactory, due to the lack of sufficient land. This opinion was not restricted to landless households, but was

expressed by landowners, as well. However, only 0.3 percent of the sample expressed the opinion that the tenure system should be reorganized. Though this appears to be contradictory, most informants, when pressed on the issue, implied that the land tenure system was based on tradition, and would not change.

Considering these features of the system, the following conclusions may be formulated. Although landlessness exists on a large scale throughout Tonga, few landless households suffer critical hardships resulting from land shortage. Most landless individuals consider their income sufficient for household needs. An occasional landless family enjoying remittances from abroad or who derive income from fishing or labor may even achieve an income level above that of the average allotment holder.

Land tenure must also be considered in terms of its role in the nation's agricultural economy. Although an in-depth analysis of Tongan agriculture is contained within the following chapter, its relation to land tenure can be considered within the framework of the present section. The major issue which arises is that concerning the basis for the development of cash cropping, which is vital to Tonga's balance of payments.

Cash cropping has been largely confined to the production of bananas and cocnut products. This does not mean that other cash crops are being rejected, owning to land tenure. At the present, several attempts are being made to develop the cultivation of vanilla and citrus as cash crops. Nonetheless, the great majority of export

capital earned by cash cropping is the result of banana and coconut product sales.

Prior to 1965, the slowness with which allotments were registered and the incomplete subdivisions of larger landholdings hindered the expansion of both the banana and coconut crops. Many informants expressed a reluctance to plant their land with such long-term crops as coconuts, until their allotments were registered with the Ministry of Lands, and their tenures secure. Large scale banana production was postponed for the same reasons. Under these circumstances, the cultivation of short-term food crops has been conducted on land often sparsely planted or devoid of coconuts. Since 1965, and the initiation of the Coconut Replanting Scheme, a major effort supported by the government, a marked increase in the area planted in coconut palms has resulted. This, in turn, has encouraged some farmers to cultivate bananas also. Therefore, it appears that the basis for developing cash crop agriculture, within the present land tenure system, is sound. However, expansion will likely fail to meet its potential unless the tenure system is strictly applied and implemented, as stated in Tongan law and theory.

According to survey respondents, the single major limiting factor to increasing agricultural production is the lack of land. Many farmers expressed a willingness to increase production, if land was made available and secure to them. Assuming this willingness to be reliable, the tenure system limits the average farmer to eight and

one-quarter acres, except for the above mentioned modifications, and thus significantly limits the future expansion of cash cropping. In some cases, this has led to the borrowing of land, whereby the borrowed land is used for family food production, while intensive cash cropping is carried out on the borrower's individual allotment.

Despite the above deterrents, agriculture remains the fundamental basis of the Tongan economy. The following chapter contains an indepth analysis of this agricultural activity.

CHAPTER V

AGRICULTURAL PATTERNS

The Traditional System

Economically, Tonga is supported primarily by agriculture. Production of primary agricultural products accounts for approximately 65 percent of the nation's employment and the majority of all export earnings (96 percent in 1969). In addition to subsistence cropping, bananas and coconut are most frequently raised as cash crops. Copra is currently Tonga's major agricultural export, seconded by bananas. While the export value of bananas was greater than copra in 1967 and 1968, the occurrence of diseases, which affect the banana plant, permitted copra to regain its dominance. Copra is expected to remain the major agricultural cash crop in Tonga, during the near future.

Most Tongan men earn their livelihood as farmers, having three basic production activities. Production of subsistence crops for family consumption is the major concern of the majority of these men. Additional production activity concerns crops for local sale and crops for exportation to international markets.

Table 13 presents the major labor divisions within the Tongan Kingdom. While only 66.5 percent of the male population is engaged in agricultural employment, recent surveys indicated that a majority of the remaining work force are also part-time farmers, producing

TABLE 13.--Economically Active Males Over Age 15 Classified According to Industry in Which Engaged: 1966.

Industry	Total Number	Percent
Agriculture	13,827	66.58
Commerce	180	.86
Transportation and Communication	334	1.60
Services	1,715	8.25
Manufacturing and Processing	579	2.78
Government and Administration	124	.59
Domestic	33	.15
Unclassified	3,974	19.19
Total	20,766	100.00

SOURCE: S. N. Fiefia, Report of the Results of the 1966 Census (Nuku'alofa: Government Printer, 1968), p. 72.

food crops for home consumption, plus some meat, such as pork and goat. As outlined in the previous chapter, virtually all Tongans are tied to the land and only rarely is a household encountered where the production of at least garden crops does not exist. However, the use of imported food commodities is increasing, particularly in the urban areas. This will be discussed in greather depth within the following chapters.

Agriculture is usually the work of men, although it was frequently observed that an entire family may travel to its rural 'api and spend several days working together. Men usually do the heavier labor, such as clearing and preparing the land for planting. While

the primary duties of women are cooking, cleaning and looking after the children, they may also assist in the planting and tending of crops. A rigid social division of domestic duties was not observed in Tongan culture, and often men or older children were seen cooking or tending the children while women labored in the household garden.

Tongan agriculture is based upon a bush fallow system. The terminology "bush fallow," in this investigation, is used to denote the Tongan form of shifting cultivation, in which a fallow period is included between cycles of cropping. This system is used primarily in the production of tubers for home use or local market sale.

The bush fallow cycle begins with the selection of a portion of the 'api for clearing, burning-over, and planting. The selection is based upon the requirements of the crop to be grown, in relation to the characteristics of the available land. For example, low swampy land is usually planted in taro, while yams require better drained, loose soil. Following selection, the land is cleared, a procedure which often involves little more than cutting small undergrowth, using a bush knife (Plate 1, p. 73).

Most Tongan soils are the result of weathered volcanic ash and are 60 to 90 percent clay. The soil structure is strong, as indicated by its formation and friability, very permeable, and generally exhibits characteristics of favorable tilth. Most Tongan soils are also high in calcium, magnesium and potassium. Phosphorus, generally fixed and immobile, is therefore unavailable in large quantities, although enough is released at a constant rate to

provide for crop needs.[1] The practice of burning-over land, which follows clearing, represents a significant factor to soil composition. This constant burning severely limits the amount of humus in the soil and acts to reduce the amount of available nitrogen (Hougland 1974). A further negative effect of burning is evident in cash crop production. Improper timing of the burning process often results in damage to coconut palms, thereby reducing the number of nuts produced. Several 'apis were observed where burning had totally destroyed the immature nuts of producing palms.

Following burning, very little ordering of the land is done. Occasionally, a farmer may rent a small tractor to plow his land, but usually the cost is prohibitive or the procedure is considered unnecessary. The planting of crops in Tonga involves little more than digging a hole in the soil, planting, and leaving the crop largely untended until maturity. Few farmers effectively weed more than the immediate planting site, and planting often follows no pattern of rows or other orderly arrangement.

Tongans evaluate land fertility by the presence of such wild vegetation as weeds and grasses, plus previous experience with the given land. However, land shortages in the more densely populated areas often limit the choice of planting sites, and even in cases where land is borrowed, usually only the poorer land is lent, and thus secured for planting.

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[1]This information was obtained from an examination of Tongan soil, in conjunction with interviews conducted at the Tongan Government Experimental Farm.

Yams are the first crop produced during the cultivation cycle, given sufficiently fertile soil. Most farmers interviewed stated that they grew two crops of yams on a given planting site, before proceeding to the next cultivation stage. Interplanted with the yams are a variety of other miscellaneous vegetables, bananas, kape (i.e., giant taro), or plantains. In densely populated areas, such as western Tongatapu, taro is occasionally interplanted also. In regions in which sandy soils prevail, sweet potato instead of yam often starts the planting cycle. This is usually followed by bananas, plantains or cassava.

Following the yam harvest, taro, cassava or sweet potato is planted. While surveys indicate that there is no established pattern or sequence of cropping following the yams, taro was found to be the usual second crop. Most farmers produce two plantings of the second crop prior to the third cultivation stage, which most often involves the production of cassava. Up to six croppings of cassava are produced, although this figure is not the norm. Cassava is occasionally found sparsely planted on fallow land, or growing wild, especially in the densely settled areas of Ha'apai, where the fallow period is much shorter, owing to less available land. An almost endless number of variations of planting and intercropping was reported by individual farmers. However, as the first planting was usually yams, the last planting was usually cassava, for reasons of soil depletion and the ease of cassava production (i.e., the lack of tilling, weeding, and grass control). Only occasionally did the sequence end with bananas, rather than a tuber.

Two features of the bush fallow system of particular interest are crop interplanting and crop succession. Interplanting was found to be practiced by over 90 percent of all landowning farmers engaged in cultivation. When questioned as to the reasons for this practice, the most frequent response concerned a desire for increased production on limited land. However, several additional advantages were observed. Interplanting reduces farm labor requirements, in terms of weeding, to only minor maintenance activities. Interplanting also retards soil erosion, such as on the steep slopes of Vava'u and the more sandy soils of Ha'apai. In addition, it is believed that the soil nutrient requirements of interplanted crops are frequently complimentary, although this was not tested.

The cycle of crop succession in Tonga is primarily based upon a farmer's knowledge of his land's condition and fertility, plus the fertility requirements of individual crops. Yams are planted first because they require a loose soil, such as is found following the clearing process, and a higher soil fertility.

Taro and cassava, the most frequently planted second and third crops, are less demanding on soil fertility. Cassava is particularly notable in this respect. Thus, in the more densely settled portions of Tongatapu and Ha'apai, where the fallowing periods are much shorter and, consequently, soil fertility is lower, cassava is more frequently cultivated.

Tuber cultivation, such as for yam, taro and cassava, represents the principal farming activity in the Kingdom's food production. However, several supplementary crops are noteworthy, the

most important being coconut. The coconut, though representing the majority of cash-earning export production, is also an important domestic food source. Coconut flesh and cream are integral parts of practically every Tongan meal. In addition, products of the coconut palm are also important to other aspects of Tongan life, from house construction to production of a shopping basket for marketing.

A second important supplementary agricultural crop is kava. The roots of this plant are dried, pulverized, and mixed with water to produce what could be called the Tongan national beverage. Although the taste is somewhat alien to a non-Tongan palate, the only observed immediate physical effect of this drink was a slight narcotic quality.[1] Prolonged consumption, however, was noted to cause a darkening and scaling of the skin, evidenced in some older Tongans.

A third supplementary plant is the papaya, which is only infrequently cultivated for its fruit, and usually grows totally unaided. While foreigners find the papaya to be a welcome addition to the principally tuber diet of the Tongan, it is, strangely, a native food viewed with low status. Few interviewees admitted to consuming papaya regularly, and frequently described the fruit as being pig food.

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[1]On several occasions young Tongan men, having consumed a large quantity of the kava drink, or "Tongan beer" as it is commonly referred to, were observed to be thoroughly intoxicated. However, experience indicated that enormous quantities of the drink are necessary to produce anything more serious than a mild headache. From all indications, the intoxicating effect is quite simply psychological, rather than physiological, although all Tongans questioned will attest to the contrary.

Cash cropping (to be discussed in greater depth later in this chapter) in the bush fallow system can be divided into long- and short-term crops. The principal short-term crops include bananas and a variety of melons, plus miscellaneous plants. Bananas, as described above, may be interplanted in the normal planting cycle. Usually, banana cropping is continued for several years before a plot is returned to fallow. Production from this crop is allocated to household consumption, or sold in local markets. Surveys encountered only an occasional farmer producing bananas for the international export market. Subsequent interviews indicated several limitations on this type of production, such as plant disease and inadequate shipping facilities.

The most severe diseases affecting banana production are black leaf streak, bunchy top, and banana scab moth, the most serious being black leaf streak. Decreases in the production of exportable bananas since 1967, equaling 83 percent of the 1967 crop, have been attributed largely to this particular disease. Leaf streak is a fungal disease, characterized by a dark streaked appearance on the plant leaf (Plate 2). The disease, by decreasing the total leaf area of the plant, thereby reduces the plant's photosynthetic capacity. The results are smaller fruit, smaller numbers of fruit per bunch, or frequently the complete absence of fruit.

Banana bunchy top is a viral disease, also reducing the photosynthetic area of the plant. It is characterized in the field by the insequential order in which the plant leaves die and the bunched appearance of remaining leaves (Plate 3, p. 74). Bunchy top

Plate 1.

A Bush or Rural 'Api in Cultivation.

Plate 2.

Characteristic Appearance of Black Leaf Streak.

Plate 3.

Characteristic Appearance of Bunchy Top.

Plate 4.

Characteristic Appearance of Banana Scab Moth Damage.

retards the growth and development of the plant, and terminates fruit production.

Banana scab moth, most destructive during its larval stage, may cause damage ranging from simple fruit discoloration to total destruction (Plate 4, p. 74). DDT, which is frequently used to combat scab moth, has been ineffective in annihilating the pest.

The combined effect of these three diseases have reduced internationally marketable banana production by nearly 1.5 million dollars, representing approximately 30 percent of total agricultural export production since 1967. Farmers are increasingly hesitant to initiate large scale banana production, unless guaranteed assistance in combating disease and plant destruction.

Survey interviews also attributed decreasing banana production to inadequate shipping facilities. Frequently, harvested bananas are placed on a dock to await the arrival of transport vessels destined for overseas markets. During this time, the fruit becomes over-ripe, falling below export quality. As a consequence, fruit originally priced up to $1.90 per case may be sold for as little as 40 cents. Because of this potential low cash return, many interviewed farmers stated that large scale banana production was an unwise economic risk.

Commercial production of melons, especially watermelons, is also hindered by the inadequate scheduling of transport facilities to overseas markets. Melons are also produced for Tongan markets, but frequently earn only low prices, even when out of season.

Of the miscellaneous crops produced, two are particularly noteworthy--sugar cane and peanuts. Sugar cane is frequently produced on the farms of Vava'u, although limited cultivation may be found throughout the nation. Sugar for domestic consumption is not produced in the Kingdom, and mature cane is sold in small unprocessed sticks, much like candy.

Peanuts have a great potential for expanded production in Tonga. The presence of a domestic market for peanuts is apparent throughout the Kingdom, and the potential dietary value of this product should be recognized. Employees within the Tongan Ministry of Agriculture blame the lack of extensive peanut production on the laziness of individual farmers. On the other hand, farmers refuse to plant peanuts without guaranteed aid for the necessary machinery and fertilizers.

Coconut is the best example of long-term cash cropping. Products of the palm, principally copra, equal approximately 85 percent of Tonga's total international export. Cultivation of palms is conducted independently of the food crop planting cycle. If well cared for, young palms will reach initial production four to six years after planting, although seven to nine years was frequently reported in interviews as being the time required prior to production. The coconut palm will produce for up to 70 years, with 50 to 60 years being the norm. However, rats and beetle damage claim up to 25 percent of all potential produce.

Palms are often not planted in an orderly fashion on a typical 'api, being planted in a seemingly random distribution. An

aerial analysis of Tongatapu, and a subsequent comparison with Western Samoa, revealed a marked difference in planting and cultivation. Portions of Samoa reveal an orderly planting configuration, suggesting more devoted commercial production of coconuts. Tongan farmers, when questioned about the uneven planting, noted that they can produce much larger tuber crop yields if sunlight is not blocked by closely planted palms. However, loosely defined and enforced Tongan laws requiring palm cultivation, plus the desire for a cash income, have motivated an increasing number of Tongans to plant their entire landholding with coconuts.

It was noted in such cases that extensive coconut production is accompanied by smaller gardens and less rotation of crops. This subsequent reduction of tuber food crop yields is compensated by the purchase of foodstuffs in neighboring village or urban areas. In Ha'apai and the more densely settled portions of Tongatapu, an occasional interviewee reported the necessity of planting entire land holdings in coconuts to insure a cash income. Increasingly, incomes from cash crops are providing households with diets of imported foodstuffs, replacing those of traditional crops.

The possibility of subsistence crop production in conjunction with coconut planting is largely dismissed by Maude (1970). While coconut yields can be temporarily improved by the occasional clearing of bush for gardens, the burning of the cut vegetation scars the palm and severely reduces production. In addition, once the planting cycle is complete and fallowing begun, vegetation is allowed to grow around the palms unhindered. This growth not only competes

for plant nutrients and soil moisture, but also hinders collection of nuts (Maude 1970, p. 60). Similarly, planted food crops also compete for soil nutrients, and none of the interviewed farmers reported using significant amounts of fertilizer, owing to rapid price increases. Only when coconut production is profitable enough to pay for increased fertilization is interplanting of significant value.

In addition, when interplanting is practiced, the potential for the reduction of both coconut and subsistence crop yields exists, due to competition for moisture, shading, and damage to the root system of the coconut. Maude concluded that there is, as yet, no satisfactory integration between the bush fallow food cropping system and the coconut plantation (Maude 1970, p. 60). Therefore, as the development of cash cropping continues, through enforcement of palm cultivation laws or simply the farmer's desire to insure a larger cash income, a significant alteration of Tongan agricultural society will emerge.

The increased planting of palms since 1965, initiation by the Coconut Replanting Scheme, has brought about an increase in the cash income of Tongan landholders. However, owing to the incompatibility of bush fallow and plantation cultivation, the landowners' production of foodstuff for home use is increasingly curtailed. As a result, the increase in cash income is frequently used entirely in the purchase of food from village or urban markets. The dietary and nutritional implications of this alteration will be discussed in the following chapters.

As coconut palm cultivation increases toward the point of monoculture, the potential for destruction of croppings by pests also increases. Two such pests are of particular significance in Tonga--rats and the rhinoceros beetle. Rats, alone, account for a loss of approximately 20 percent of the total coconut crop, annually. Fallow vegetation, which is left growing around planted palms, provides an excellent habitat for rats, and is conducive to rat breeding. Despite efforts by the Ministry of Agriculture to encourage farmers to reduce this cover, Tongan farmers continue to be uncooperative. Damage to young nuts is mot frequent, and occasionally a palm will lose its entire crop to this type of destruction. Plate 5 (p. 81) illustrates coconuts which have been destroyed by rats. The most reliable identification of rat damage is a hole gnawed through the coconut husk.

There are two procedures which have been proven to be effective in preventing, or at least curtailing, rat destruction. The removal of cover vegetation effectively discourages large numbers of rats from living in close proximity to the palms. Secondly, fastening metal or plastic strips around the trunk of a palm prevents rats from climbing to the nuts. (This technique is most effective on palm trunks perpendicular to the ground, as opposed to those which lean to any excess.) Agricultural specialists in Tonga reported the use of metal strips to be the most effective method of combating rat damage (Hougland 1974). However, of the farmers interviewed, less than one percent used this technique. Although the strips are cheap (8 to 15 cents apiece) and some varieties are guaranteed to last the

life of the palm, the initial cash outlay deters increased usage. Farmers believe that the initial outlay of 8 to 15 dollars per hundred palms is excessive, and do not understand the concept of long-term investment. Agricultural extension workers claim that a more realistic reason for insufficient use of the strips is laziness of the Tongan farmer. Only the Mormon plantation and two 'apis were observed to be using the preventive strips. Plate 6 illustrates the simplicity of the procedure.

Another pest destructive to coconut production in Tonga is the rhinoceros beetle. This beetle has only recently become a major threat, and was largely unknown in the islands, until the 1950s and 1960s. Plate 7 illustrates the characteristic angular leaf damage inflicted on the palm by this insect, which reduces the photosynthetic area of the plant, and subsequently the production potential of the palm. The most frequently noted method of control consists of a mound of sawdust into which are placed the eggs or larva of one of several predator insects, usually mites or click beetle (Plate 8). Sawdust is a favorable breeding ground for the predator insects, as well as for the rhinoceros beetle, which is attracted to the sawdust pile. Subsequently, the larva of the mite or click beetle destroys the rhinoceros larva, with up to 100 percent efficiency. Despite the effectiveness of this technique, it is not extensively used within the Kingdom. The procedure was observed being used most frequently in Vava'u, only occasionally in Ha'apai, and not at all in Tongatapu.

Plate 5.

Rat Damaged Coconuts

Plate 6.

Tin Strips Used as a Protective Measure Against Rats.

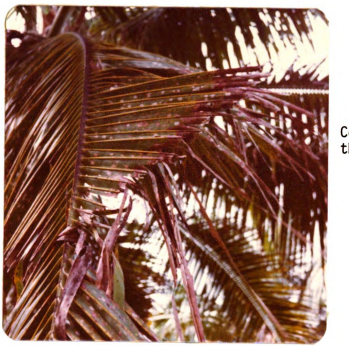


Plate 7.

Coconut Palm Damage from the Rhinoceros Beetle.

Plate 8.

Rhinoceros Beetle Control.

Survey information covering the 1973-74 cropping year indicated only scattered and infrequent use of any type of pest control by Tongan farmers. Only 25 percent of those farmers surveyed used spray or dust pesticide of some type. Most often this was DDT, supplied by the Tongan Department of Agriculture. Application of this was usually concerned with combating the scab moth for banana production. The expansion of cash cropping, whether in plantation or bush fallow production, is significantly limited by this lack of pest control.

Food cropping for home use, mainly tuber production, does not notably suffer from pest destruction, with soil fertility depletion being the major cause of reduced yields. Fertilizer is beyond the economic means of the typical Tongan farmer. The cost of basic fertilizer, such as urea, increased from $120 to $220 per ton in 1973-74 (Hougland 1974). Of the total survey sample of farmers cultivating land, only two percent used any kind of fertilizer, and it usually was supplied by the Tongan Agricultural Department. More readily available sources of fertilizer, such as green manuring or the spreading of animal manure, are untraditional in Tongan farming and, therefore, unfamiliar and unused. The bush fallow system remains the major technique employed in Tonga to increase soil fertility.

In the bush fallow system, a given plot undergoes a cropping cycle of up to seven years. Declining yields during this period make continued cultivation unprofitable, and the garden area is shifted to another portion of the 'api. Nitrogen depletion appears to be the major cause for crop yield reduction. Maude (1965) reported no

significant difference in nitrogen concentration between plots which had been cropped for long periods and those in fallow. In conclusion, Maude finds no specific reasons for declining yields or the effects of cropping on soils, which might necessitate rotation (Maude 1965, pp. 135-136). However, several points must be considered. Phosphorus in Tongan soil is primarily fixed and immobile, and therefore is a direct influence upon the amount of available nitrogen, as opposed to total nitrogen, used in plant growth. Interview information indicated that phosphorus is released very slowly and, therefore, in fallow periods with less demand, may build in-soil concentrations, or be contained in fallow vegetation. This concentration of phosphorus creates a subsequent increase in available nitrogen, rather than total nitrogen, used by plants in fallow or to be cropped.

The principle behind the bush fallow system (i.e., the increase of available nitrogen) is negated by excessive weed and grass growth during the fallow period, which extends from three to six years. Wild grasses, which grow during the fallow period, are the most demanding on soil nutrients. The most common of these grasses are nut grass (nut sledge), guinea grass, and Johnson grass. Nut grass presents the greatest concern, owing to its difficulty of control and its competitiveness for available nitrogen. It is believed that unless some control of weed and grass growth is carried out during the fallow period, the peak of nitrogen fertility being returned to the soil by fallowing is reached in approximately three years. Beyond this time, fallowing seemingly enters a period of

diminishing return, during which nutrient demands upon the soil by weeds and grasses are equal to or greater than that being restored.

As stated previously, a further complication to soil fertility results from the traditional practice of burning-over the land, prior to initiating the planting cycle. The burned vegetable residue represents a return of a thin layer of mineral ash to the soil, consisting primarily of calcium, magnesium, phosphorus, and potassium. With the addition of rain and new plant growth, these mineral components become mobile within the soil. However, the nitrogen contained in the fallow vegetation is lost in the burning process, and therefore not returned to the soil. Thus, available nitrogen for crop production may actually be reduced.

The fallowing period may last from one year to as long as ten years. Examples of these longer fallowing periods were encountered in interviews, as well as occasional plots which had never been fallowed. The average time schedule consists of three to six years in fallowing and two to four years in cropping. However, no farmer reported following a predetermined schedule, basing decisions upon crop yields.

Variations in the length of time allotted to cropping and fallowing were noted in relation to population density. In Ha'apai and western Tongatapu, where land shortage is related to population density, relatively short periods of fallowing are followed by longer periods of cropping. In addition, the practice of retaining cassava growth, and occasionally taro, on fallow acreage was noted in these regions. Explanations for this, presented during interviews,

ranged from spontaneous growth to a safeguard against periods of food shortage.

Entering land into fallow was found to be a gradual process. Tubers, and occasionally bananas and plantain, may continue to be harvested from the plot for several years after the cessation of active cultivation. Coconuts are also produced in fallowing plots, independent of the bush fallow system.

Increasingly, in more densely populated areas of the Kingdom, this combination of fallow and cropping is being practiced, whereby a farmer plants cassava on the fallow plot and allows grasses and weeds to grow unhindered. The only incidence of weeding is at the time of planting and then in only the immediate planting site. This activity may last for several years, or occasionally for the entire fallow period, followed by the planting of yams or taro. Only in western Tongatapu was the addition of any fertilizer (an occasional application of small quantities of pig manure) noted.

Fallowing is traditional to Tongan agriculture. However, due to population growth in many areas of the Kingdom, increasing demand for land is modifying the fallow system. Surveys indicated an average fallow time of three to six years. It was the opinion of over 81 percent of those farmers interviewed, and who had land in fallow, that the average fallowing time is evidencing a slow but steady decrease. Farmers are finding it necessary to devote more of their acreage to some form of semi-permenant cultivation, in order to meet subsistence requirements, or to secure an adequate

level of cash income through local sale of produce. Many of the above farmers were those who expressed dissatisfaction with the land tenure system. Tracts of long-term idle land adjacent to leased intensively cultivated plots is a growing source of embitterment.

The typical 'api allotment is subdivided into several plots, at various stages of the bush fallow system. For example, the average farmer cultivates two or three plots, which usually differ in the age and crops being grown, while several plots are simultaneously in various stages of fallow. Thus, land at all stages of the agricultural cycle may be found in the typical allotment. Figure 1A illustrates a bush allotment of eight and one-quarter acres, indicating the variety of plantings and fallow. Figure 1B is typical of the smaller holdings in Ha'apai and western Tongatapu. The smaller fallow area and shorter fallow time are indicative of increased population pressure and the subsequent increased land use.

Labor requirements of an 'api vary greatly as to the amount of cultivation and the crops being produced. Interview responses indicated extremes from five 8-hour work days per week, to as little as three hours per weekend. The average for cultivating farmers, however, is 3.75 hours per day, or less than one-half day. No particular routine was noted, the Tongan farmer usually laboring only upon impulse.

Although lack of land was a frequent explanation for the difficulty in increasing agricultural production, another prevalent

Figure 1.--Planting of the Tongan 'Api.

1A. 8.25 acres

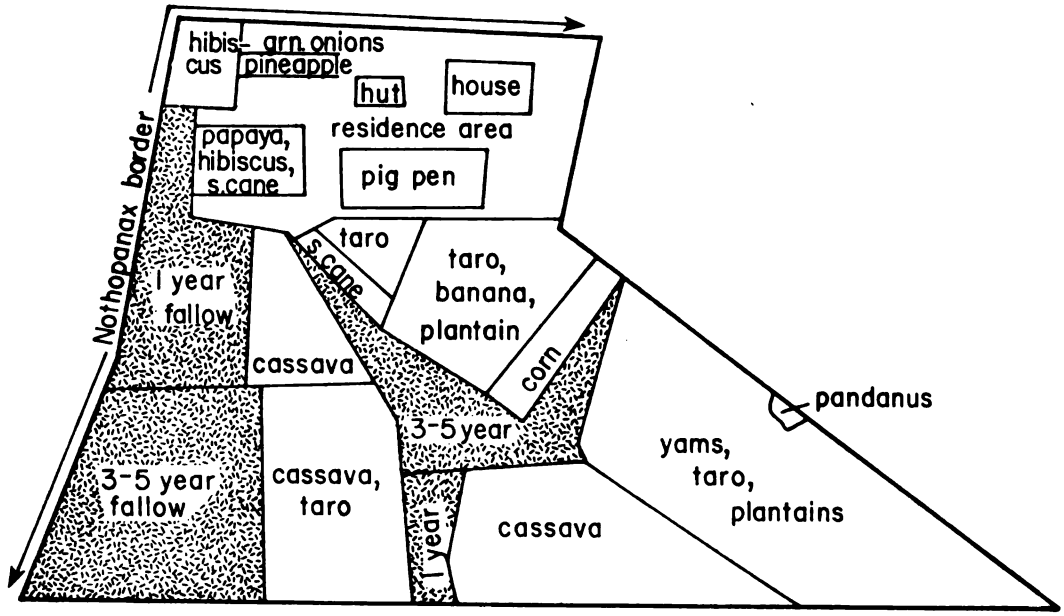
1B. 4.76 acres

SOURCE: R. R. Thaman, "The Role of the Tongan Agricultural System in Fulfilling the Subsistence Needs of the Tongan Society," R. W. Parkinson Memorial Lecture, School of Social and Economic Development, University of the South Pacific, September 26, 1974.

DISTRIBUTION OF MAJOR CROPS AND FALLOW

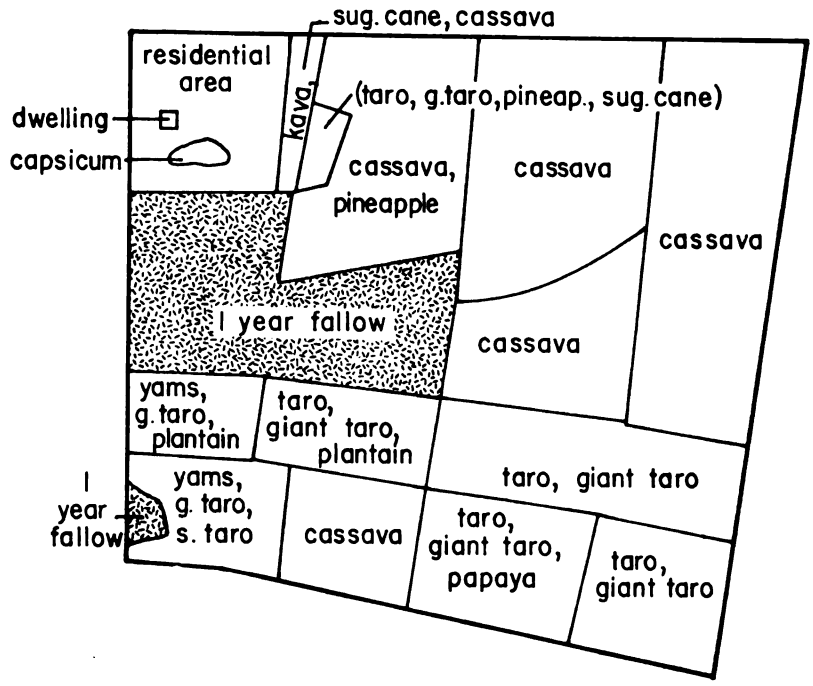
Sample Bush Allotment

Area: 8.25 acres



Sample Bush Allotment

Area: 4.76 acres



factor in Tongan society reduces the incentive for increased production. Individuals who manage to significantly increase their production of crops or agricultural profits are under social pressure to supply loans and miscellaneous obligations to close relatives and friends. This practice severely reduces the independence of the farmer. Several informants stated that they would not increase crop production because neighbors and relatives subsequently "borrow" all extra produce. Although lending is a tradition which increases the social status of the lender, resentment toward this social obligation is increasingly expressed among younger landholders, who place higher esteem on cash than tradition.

At present, the typical farmer appears to work his 'api an average of 18 to 20 hours per week. The remaining time is occupied by a variety of additional activities. Although statistical evidence of the duration of each activity was not collected, three activities appeared to be dominant. Owing to the distribution of population and the subsequent pattern of settlement, a farmer often spends several hours per day traveling to and from his 'api. Travel extremes from zero to 21 miles were reported by interviewees. Occasionally, informants reported leasing land on nearby islands, which necessitated travel overland, as well as by boat. However, an average of 6.75 miles was determined to be the distance necessary for the typical farmer to travel to his 'api. Although the principal islands of the Kingdom have bus transportation, the busses average no more than 15 miles per hour, thereby consuming at least an hour of travel per day for the average farmer. Frequently, walking for

another hour follows the bus ride. Transport of crops from the 'api usually involves greater lengths of time as the common method consists of a horse-drawn cart (Plate 9, p. 93).

Fishing is a second significant activity conducted away from the 'api, although of less concern within the interior of Tongatapu and along those shores with poor sources or access. In Vava'u and Ha'apai, fishing often consumes several hours per day, and supplies not only family food needs, but also enough for sale in local markets.

A third major activity concerns church and social functions within the local village or the nearest urban area. Many of these activities are concentrated during the weekends, such as marketing and major church functions. However, social activities during the week require participation of several hours per week.

In addition to the above, an entire range of miscellaneous labor must be considered, due to the low level of specialization of labor in Tonga. Thus, to summarize, it is evident that potential expansion of agricultural production in Tonga involves not only issues of land tenure and management, but also individual incentive, tradition and the amount of time devoted to agricultural activities.

During interviews conducted on all of the major Tongan islands, lack of land was most frequently denoted to be the major limitation upon agricultural expansion, while laziness of Tongan farmers was the second most frequent response. The third most frequent explanation concerned the lack of adequate agricultural tools and machinery. An examination of farm equipment, either owned or rented by the interviewees, indicated that most farmers possess

only basic agricultural tools, such as a bush knife, hoe, planting stick, and spade (Plate 10). Beyond these, little else is used for cultivation. Of all landholding Tongans surveyed, only 16 percent used a plow or tractor and, in each case, the implement was either rented or borrowed.

The maintenance of agricultural machinery, in terms of efficiency and materials (i.e., fuel, parts, and lubricants), severely limits the possibility of increased use within Tonga. Interviews within the Tongan Department of Agriculture indicated that this problem reaches every level of agricultural operation, from trucks to garden tilling machinery. For example, a large truck was cited as having not been used for over 18 months, because of a broken transmission gear. The required part, ordered from Japan, had not yet arrived and no one knew if it ever would. In the interim, no attempt to make the part, in one of the local blacksmith shops, had been made. It was confidentially learned that, should the part arrive, the truck would remain largely inoperative because of another damaged gear which was not totally broken and, therefore, not replaced. Other examples of this situation were noted, emphasizing the serious lack of basic mechanical service.

When workable machinery is available for rent, the cost is often prohibitive to the average farmer. Informants also complained that rental machinery is allocated on the basis of social standing and status, rather than need. Thus, the majority of planting, cultivation, and harvesting on Tonga remains the work of hands, and is expected to remain so.

Plate 9.

Movement of Rural Agricultural Produce to Market.

Plate 10.

Basic Agricultural Tools of the Tongan Farmer.

(From left: Bush knife,
spade,
stick spade,
hoe,
bush knife.)

In addition to traditional cropping, livestock also plays a significant role in the agricultural system of Tonga. The most frequently observed stock, owned by Tongans, included horses, cattle, goats, pigs, chickens and a variety of other fowl, such as guineas, geese, ducks and turkeys. Table 14 provides a breakdown of these groups for the entire Kingdom, for the year 1973. Additional information, acquired during village surveys, is summarized in Table 15. Survey results indicated that horses and cattle are raised most frequently by rural residents. On the other hand, goats, pigs and fowl are kept in approximately equal quantities in both rural and urban areas, except in regions of high population density in Ha'apai and Tongatapu, where a larger proportion of scavenger stock was noted.

TABLE 14.--Livestock Census: 1973.

	Cattle	Pigs	Horses	Poultry
Tongatapu	1,836	13,962	2,306	31,377
Ha'apai	216	9,443	1,289	11,097[b]
Vava'u	637	9,443	1,467	16,148
'Eua	724[a]	2,115[a]	530[a]	2,714[a]
Niuatoputapu	--	1,643	218	1,843
Niuafo'ou	--	1,007[b]	117[b]	1,623[b]
Total	3,413	37,613	5,927	64,802

[a]1971.
[b]1972.

SOURCE: Report of the Minister of Agriculture 1973 (Nuku'alofa: Government Printer).

TABLE 15.--Livestock Owned by Tongan Households: Sample of 265.

	Households Owning (%)	Mean Owned per Household	Range of Ownership	Total No. of Livestock Owned By Entire Sample
Horse	38	1.0	1-6	98
Cattle	12	4.0	1-12	124
Pigs	55	4.9	1-48	700
Goats	27.5	2.5	1-8	179
Total fowl	70	20.2	1-50	3,676

SOURCE: William F. Clark, data collected through personal survey, Kingdon of Tonga, August-October, 1974.

Livestock, as a food source or a cash product, is raised almost exclusively for the domestic market. Very little of this produce is exported to neighboring nations. In addition, the domestic role of livestock is complex and complicated by tradition. Pork is consumed more frequently than any other meat source, excluding fish, and with the possible exception of poultry. Fresh milk, for feeding small children, is usually in short supply, although the large number of goats on the islands represents a potential source of milk protein. Tradition, however, undermines the widespread use of goat's milk. Food production and consumption patterns in traditional Tongan society are more often influenced by social custom than by need.

Survey results indicated that horses are owned by 38 percent of Tongan households, and are used as a means of transportation.

Horses are most frequently used for transporting agricultural produce from farm to village markets, either as pack animals or in conjunction with a cart (Plate 9). Despite their obvious usefulness, horses are largely uncared for in the Kingdom, being frequently overworked and then tied in the bush or village with insufficient food and water. As a result, many of the animals evidence gross nutritional deficiencies and, subsequently, operate far below their potential.[1]

Cattle were reported as being owned by 12 percent of the surveyed households. Generally speaking, these households had access to more land than the average, and therefore could allot land for pasture in addition to agricultural cultivation. Cattle are not an integral part of Tongan agriculture, and at present provide only limited quantities of meat and milk. Although past attempts to establish herds on Tongatapu and 'Eua have met with varied success, cattle are not expected to become a significant factor in Tongan agriculture. Occasionally, cattle are grazed on cash crop plantations (i.e., coconut), in an attempt to reduce the grass and weed

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[1]The plight of the horse is similar to that of the dog, a frequent food source in Tongan society, in respect to general care. Both have a marked dependency upon man for food and care. In the case of cattle, status insures the well-being of the animal, while pigs, goats, and fowl are able to sustain themselves as efficient scavengers. However, the domestic dog evidences neither characteristic, and is often in a state of starvation, due to his dependency. The same is true of the horse. Therefore, a seemingly contradictory image of livestock is found. Poorly maintained horses, which are essential to agricultural transportation, and dogs, which provide a food source, exist in conjunction with healthy pigs, goats and fowl, the scavengers of Tongan agriculture.

cover, which is attractive to rats. However, the initial expense of cattle, plus continued capital outlay for maintenance, substantially reduces the profitability of this scheme.

Goats were owned by 27.5 percent of the total survey sample. Although a potentially valuable source of meat and milk, roaming goats cause considerable crop damage in Tonga. The goat is one of three scavengers, competing with pigs and fowl for household refuse and other edible items. While goats are occasionally used for meat on special occasions, the pig is considered to be a much more prestigious food or gift. In addition, because of the low status ascribed to goats, use of goat's milk is avoided. Thus, the role of the goat in Tongan agriculture is expected to remain one of little significance.

Pigs are the most prestigious livestock raised in Tonga, and were owned by 55 percent of the survey sample. As mentioned previously, the pig is a meat source used for important social functions and traditional gifts. Being the most common of Tongan livestock, the pig plays an indispensable role in the control of garbage and refuse, plus provision of meat protein. Most households own several pigs, raising them as a food source or as a means to fulfill a variety of social obligations. It is not uncommon for taxes, debts and other financial obligations, especially to the nobility, to be paid with one or more pigs. Pork is not included in the average Tongan weekday diet, being consumed primarily during main Sunday meals or at feasts.

Being a scavenger, the pig is generally allowed to roam unrestrained, although laws prohibit the animal from being untended in major urban areas of each island group. However, enforcement of these laws appeared to be quite lax. Roaming animals were frequently noted on the periphery of the main business sections of Nuku'alofa and Neiafu, as well as entering and leaving the royal grounds in Nuku'alofa. In villages, pigs are occasionally confined to prevent crop destruction. However, it was observed that confined pigs appear less healthy than those left unrestrained. This is probably the result of poor environmental management, plus the disruption of scavenging.

Seventy percent of those surveyed owned some variety of fowl, with chickens being the most frequent. Fowl, which represent the third scavenger in Tongan agriculture, are seldom confined. Their major food function is the provision of meat, since eggs are seldom collected. The sale of eggs was noted only infrequently, and at a price prohibitive to the typical Tongan. A single egg may sell for as much as 13 cents. Most eggs are left undisturbed to hatch, although more than half of any given brood dies from dampness or destruction by other animals. Thus, lack of management successfully eliminates the utilization of eggs as a food source, plus severely reduces the number of fowl available for consumption.

To summarize, livestock ownership remains largely a matter of status, often exemplifying more value as a product of social exchange than as a source of food. The maintenance of stock is

frequently nonexistent and the well-being of large numbers of pigs, goats and fowl throughout the Kingdom depends greatly upon scavenging.

An advantage of livestock production almost totally neglected in Tongan agriculture is the production of manure. The process of applying manure to soil is not traditional in the Tongan agricultural cycle, and the basic concept is, for the most part, not understood (Hougland 1974). Annual manure production per animal varies as to diet and amount of feeding. Table 16 indicates the amount of potential fertilizer (i.e., animal manure) which can be returned to the soil. Table 17 provides additional data, including the amounts of the three macro-nutrients available per ton of animal manure, essential for maintaining soil fertility.[1] Collection of manure would require containment of stock, or at least confinement to the boundaries of the 'api, thereby bringing about direct return. Only a small minority of Tongan allotments are fenced, the required cost and labor being considered excessive.

Livestock is expected to retain its traditional role in the agricultural system of Tonga. The potential upgrading of stock, as well as the full utilization of this agricultural component, is directly determined by Tongan farming traditions. Thus, while fulfilling an unintentional role as scavengers, livestock will probably

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[1]The average stock-owning household may claim ownership of twenty fowl, two goats, five pigs, four cattle and one horse (Table 15). No individual household in the survey completely owned this number of animals, due to combination ownership. However, only five percent of the surveyed households owned no stock of any type.

TABLE 16.--Livestock Production of Manure Per Annum.

	% of Total Sampling Owning	Mean Per Owning Household	Manure Production Per Year, Per 1,000 Pound Live Weight (ton)	Estimated Average Weight Per Mature Animal (lb.)	Total Manure Production Per Year (ton)
Horse	38	1.0	12.00	900	10.8
Cattle (cow)	12	4.0	15.00	1,100	66.0
Pig	55	4.9	18.25	200	17.9
Goat (sheep)[1]	27.5	2.5	9.75	70	1.70
Fowl (all types)	70	20.2	4.50	3	0.27

[1]Data for goats was not available.

SOURCE: D. Acker, Animal Science and Industry (Englewood Cliffs, N.J.: Prentice-Hall, 1971, p. 169.

TABLE 17.--Approximate Soil Nutrients Per Ton of Manure.

	Nitrogen (N) lb.	Phosphoric Acid ($P_2 O_5$) lb.	Potash (K_2O) lb.
Horse	13.2	5.1	12.1
Cow	11.4	3.1	9.9
Pig	9.9	6.7	9.3
Sheep	115.8	6.7	18.0
Hen	21.0	16.4	10.2

SOURCE: D. Acker, Animal Science and Industry (Englewood Cliffs, New Jersey: Prentice-Hall, 1971.

remain most important as an instrument within the Tongan social structure.

Cash Cropping

The crops grown primarily for the international export market are coconuts and bananas, although vanilla, melons, fruits and vegetables are also produced in less significant quantities. Survey results, substantiated by personal observations, indicated that most landholdings are at least partially planted with coconut palms, while many 'apis of Ha'apai and Vava'u are totally planted in palms. As the desire or necessity for cash income increases, a greater proportion of the typical 'api will be planted in some type of cash crop.

Coconut surpluses, beyond the needs of the family, are usually sold as copra to the Tonga Copra Board. Bananas in surplus are sold

to the Tonga Produce Board. The Produce Board also handles the export of vegetables, melons and miscellaneous fruit and agricultural production directed to the international market.

Cash cropping, as mentioned previously, consists mainly of two broad categories: long- and short-term production. In addition, each may further be classified as either for domestic or international sale, although short-term croppings (i.e., vegetables, fruit, and melons) are usually domestically sold and long-term (i.e., coconut products and bananas) are international export items.

Cash cropping remains largely in the hands of Tongan officials, with only a few exceptions, including church plantations. The European contribution to this agricultural component is decreasing as leases expire and are not renewed.

Coconuts, copra, and other coconut products are the major cash crop of the Kingdom, representing as much as 85 percent of total agricultural exports (Table 18). Survey responses indicated that all landholders rely upon the sale of copra for at least a portion of the household cash income. While statistics from the Department of Agriculture evidenced that the majority of coconut sales originate on Tongatapu, survey data revealed that the proportion of total household income, earned from coconut production, is greatest in Ha'apai. The fact that Ha'apai soils are often not ideally suitable for large scale production of other cash crops, such as bananas, may represent an explanation for this apparent contradiction. Also, in areas of high population density, such as Ha'apai, a smaller proportion of land can be allocated to

TABLE 18.--Produce Exported Through the Tonga Produce Board and Copra Board, 1972-1973.

Commodity	Unit	Quantity		Value T$	
		1972	1973	1972	1973
Bananas	56 lb. case	119,186	112,628	321,946	304,099
Watermelons	Loose	34,968	91,070	67,219	88,934
Pineapples	18 per case	3,003	1,426	4,205	1,997
Plaintains	56 lb. case	1,977	523	4,522	1,361
Swamp taro	56 lb. case	3,534	1,770	10,876	5,548
Taro Tarua	Bags	419	110	586	849
Yams	43 lb. case	731	82	2,118	402
Avocadoes	15 lb. case	1,507	936	1,507	1,145
Capsicums	15 lb. case	13,080	10,801	16,309	14,534
Tomatoes	14 lb. case	3,720	4,761	3,102	4,133
Vanilla	60 lb. crate	20	31	5,198	8,693
Egg plants	---	141	96	190	147
Cabbage	cartons	---	2	Samples only	
Lettuce	cartons	---	3	Samples only	
Copra	ton	---	12,362	---	2,175,461

SOURCE: Report of the Minister of Agriculture (Nuku'alofa: Government Printer, various dates).

the cultivation of cash crops. Coconut palms, being relatively independent of the agricultural planting cycle, are a logical choice for farmers engaged in cash cropping in densely populated areas.

In addition to being the major cash crop export, the coconut palm is also invaluable to the Tongan as a building material and a source of food and drink. However, until land tenure is secure, many farmers are reluctant to enter large scale copra production. Interviewed farmers also expressed reluctance to mix the cultivation of food crops and large scale palm growth, because the shade from palms supposedly reduces the yield from food plants. Frequently, farmers eliminate all palm growth from small, scattered portions of their allotments, reserving these areas entirely for food crop production.

The frequency with which households collect coconuts and produce copra varies considerably. Survey informants indicated collections every week, to once per month. In copra production, the coconuts are collected and usually transported to a central location, frequently the area of residency on an allotment. Here the nuts are split and placed in the sun to partially dry (Plate 11). Later, the flesh is scooped out, dried thoroughly in the sun, and bagged for sale. Occasionally a crude kiln drying shed is used to dry the flesh, in which the heat is supplied by a fire beneath the shed, fed by discarded coconut husks and shells (Plate 12). The production of copra usually involves the entire family, with men collecting and splitting the nuts, women extracting the flesh, and small children guarding the sun-drying copra from dogs and pigs. The

Plate 11.

Sun Drying Split Coconuts.

Plate 12.

Kiln Copra Drying Shed.

kiln drying shed, introduced in 1938, is replacing the more traditional sun-drying method, being recognized by most Tongan producers as more efficient.

Historically, Tongan copra had the reputation of being poor quality. However, in 1926, government legislation made it a statutory offense for a trader to be in possession of damaged copra. Since the introduction of such laws, the quality of Tongan produce has steadily improved and today ranks among the world's best.

Coconuts and copra are marketed through the Tongan Copra Board, which is a government monopoly established in 1942. Collection points are located throughout the islands, while the principal grading and storage facilities are in Neiafu, Pangai, and Nuku'alofa. The Tonga Copra Board purchases copra from local producers, and then resells it in the international market. Maude (1965) noted the variance in the international market price (FOB) of copra, as compared to the price paid local producers. After all payment to producers has been made, 36 percent of the FOB price remains with the Copra Board to cover management, handling, export charges and miscellaneous expenses. A survey of local producers throughout the Kingdom indicated their concern and dissatisfaction with the government's arrangement. Some farmers expressed the opinion that internal corruption caused the cash variance. It is clear that while the average Tongan farmer does not understand the management and market economy of copra, a growing resentment of the pricing policy of the Copra Board is evident.

Bananas are Tonga's second most important cash crop for the international market, although exports and capital earned by this crop have decreased significantly since 1967 (Table 18, p. 103, and Table 19, below). Tongatapu is the principal producer, with Vava'u being second. Banana exports represented 45 percent of the value of total exports in 1967, but by 1973, equaled less than 15 percent. While this percentage has continued to decline, the market price for banana produce has generally risen. Owing to this rise in price, many farmers expressed a willingness to produce bananas, providing governmental assistance was received in combating crop disease. (As mentioned previously, the principal reason for

TABLE 19.--Tongan Banana Exports and Their FOB Values.

Export Year	Total Quantity of Export (thousands of lbs.)	Total Revenue Earned by Banana Exports
1965	22,708 lb. at 4.1¢ a lb.	$ 941,222
1966	31,883 lb. at 4.2¢ a lb.	1,337,554
1967	43,949 lb. at 4.1¢ a lb.	1,794,000
1968	37,674 lb. at 4.6¢ a lb.	1,738,679
1969	15,147 lb. at 4.5¢ a lb.	683,440
1970	10,268 lb. at 4.5¢ a lb.	465,950
1971	7,706 lb. at 4.8¢ a lb.	368,970
1972	6,743 lb. at 4.8¢ a lb.	327,914
1973	6,272 lb. at 4.8¢ a lb.	302,400

SOURCE: "Banana Exports Have Declined Sharply," Tonga Chronicle, August 8, 1974.

decreasing production of bananas is the spread of black leaf streak, bunchy top and scab moth.)

Marketing of banana produce, through the Tonga Produce Board, is often difficult because of improper scheduling of shiping facilities and the subsequent sale of under or overripe fruit. In one example, 9,000 cases of produce became overripe while in wharfage awaiting shipment, resulting in the fruit being sold for 40 cents per case (Report of the Minister of Agriculture 1973, p. 5). The bulk of banana produce is shippped to New Zealand, although the shipping difficulties and quality control remain obstacles to full entry into this market. These same problems with marketing, shipping and quality have been effective in removing many Tongan farmers from banana production. At present, the Produce Board reports that export levels are so low that levies are not sufficient to provide a comprehensive service to growers in such areas as disease control ("Banana Exports . . ." 1974, p. 5).

In addition to the exportation of bananas, coconut, and miscellaneous melons, fruits and vegetables to international markets, small quantities of produce are also traded among the islands, the most important of these transfers being from 'Eua to Nuku'alofa on Tongatapu, and from Nuku'alofa to Pangai and Neiafu. This movement involves not only domestic produce, but also food imports such as tinned meats, sugar, flour and a wide range of foodstuffs sold through the local stores (fale koloa).

Large quantities of produce are also marketed domestically. Although some produce is sold in several smaller settlements, the

largest markets are Nuku'alofa in Tongatapu, Pangai in Ha'apai, and Neiafu in Vava'u. Such markets cater to two principal groups, although many people travel to market to buy, sell, or socialize. Those members of the non-Tongan population who do not lease land, such as church facilities, and must purchase market food, represent one group. Though not large in comparison to the Tongan population, this group does contribute a significant cash input to the local economy. The second group consists of landless Tongans and those Tongans who do not farm or garden intensively and derive cash income from other means.

Producers, or members of their families, most frequently sell directly to the consumer. Saturday is market day (although the major markets carry some business throughout the week, except Sunday) and the market area becomes the center of urban activity. Individuals having produce to sell may rent one of several types of stalls or floor space, upon which to display their produce. The staple foods (i.e., tubers, coconuts, and bananas) are the major items sold, although other types of food produce and miscellaneous items, such as shells, carvings, and handicrafts, are also available. Marketing hours generally are from 8:00 A.M. to 5:00 P.M., with the busiest time being in the forenoon and early afternoon.

Personal observations, plus discussions with sellers, revealed several marketing patterns. A few farmers or craftsmen sell each day or week on a regular basis, and generally have rented stalls which can be locked at the end of each day. Rental for these is on a monthly basis, and costs the producer eight dollars per

month. On the other hand, some farmers market their produce only monthly or occasionally during the year, depending upon when a cash need arises. A third type of seller is the craftsman who produces items of quality specifically for the tourist trade (i.e., handicrafts of wood, shell or tortoise shell) and markets these goods only when a tourist ship or plane has brought passengers from Fiji or Samoa. Thus, the craftsman's sales are largely independent of the needs of native Tongans. The prevalence of this type of producer is expected to increase, as tourism develops within Tonga.

A variety of baked goods may also be found in the market on Saturday. Though largely devoid of flavor and extremely heavy in texture, Tongan "cakes" are popular and sell rapidly. An excellent market also exists for peanuts. Supply rarely is adequate to meet demand. The sale of kava (from which "Tongan beer" is made) is also brisk. Kava is lightweight and easily transportable. Producers on Ha'apai, Vava'u and many of the isolated islands often send kava to Nuku'alofa for sale.

The major competitor to the open-air market is the Vuna Government Market, which handles the majority of fish and meat sales to Nuku'alofa and surrounding Tongatapu. Many of the local stores are also beginning to sell fresh meat products. Consequently, the amount of meat sold in the market fell from 160,771 pounds in 1971, to 94,684 pounds in 1973. The sale of fresh fish in the market rose during the same period, mainly due to the operation of a government fishing vessel which had a total catch of 203,243 pounds in 1973 (Report of the Minister of Agriculture 1973, p. 24).

Fishing activity is often not considered part of the agricultural sector of an economy. However, in Tonga fishing represents a significant cash input to the local agricultural base. Of the total survey sample, over 15 percent of those questioned indicated that they derived some part of the household cash income from fishing. The Tongan government obviously considers fishing to be of significant value to the national economy, in that it includes evaluations of fishing catch and sale within the annual reports, and operates one major fishing vessel, the Ekiaki. This ship is of modern construction and contains some refrigeration and pre-processing facilities. In 1973, the Ekiaki landed a total of 203,243 pounds of fish, representing a catch percentage (catch per 100 hooks) slightly better than Korean and Chinese operations in the region. This total catch was smaller than anticipated, due to mechanical breakdowns and the lack of trained operation personnel.

Tongan waters are a largely untapped source of food, including such fish species as tuna, bill-fish, and shark (Report of the Minister of Agriculture 1973, p. 30). In 1973, sale of fish through the Vuna market equaled over $15,000, or 120,000 pounds. However, demand for fish in Nuku'alofa far excelled this amount. Personal observations evidenced that on those days when fish is to be sold, crowds of consumers wait hours before the market opens.

Despite the fact that domestic demand for fish is unsaturated, 40 percent of the Ekiaki's total catch, for the year 1973, was

sent to canneries in Pago-Pago.[1] A recent Japanese survey, which mapped the most productive Tongan fishing grounds, suggested that up to 90 percent of the potential catch could be exported to Japan (Kyokuyo, Hogai Co. Ltd. 1965, p. 2). In view of the domestic demand for fish products, plus the nutritional status of many urban Tongan inhabitants (to be discussed in the following chapters), such exportation would be totally irresponsible to the needs of the Tongan people.

Small scale, private household fishing activity has done little to meet domestic demand. Survey responses indicated that the lack of investment capital for necessary fishing equipment is the major obstacle to expansion of private fishing enterprises. Discussion of this problem with part-time and full-time fishermen revealed that not only is the basic cost of equipment prohibitive, but a 33 percent import tax, charged by the government for such items (i.e., nets, lines and hooks) makes purchase impossible for the average Tongan. While this situation insures the governmental monopoly on commercial fishing, it hinders the expansion of fishing activities necessary for meeting the domestic demand for fish products.

Another major obstacle to the expansion of fishing activities in Tonga is the general lack of preservation and holding facilities throughout the islands. Again, the only adequate

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[1] Ironically, much of this same catch is processed in canneries and resold as tinned fish products to Tonga at a sizable increase in price.

facilities are governmentally controlled. Thus, most fishermen catch only that which will satisfy family needs, plus a small quantity for immediate sale.

Data determining income levels from all types of cash food production (including fishing) was collected during household surveys.[1] Range of income was from zero to $1,200 per year, with a mean of $480 per year for those farmers selling produce. Sale of copra results in the largest cash income, with vegetables (all types) second and bananas third.[2]

During survey discussions concerning income, it became apparent that cash incomes have increased substantially over the past several years. As a result, Tongan farmers are enjoying an increase in purchasing power, reflected in the purchase of non-traditional items, such as imported foodstuffs or the purchase of food items from local producers. However, while few farmers are totally dependent upon this new cash-based living, the significant increase in the use of canned goods, sugar, bread and assorted imports is an obvious indication of the direction of this trend.

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[1]The average Tongan farmer keeps no record of his yearly or monthly earnings and survey information probably reflects mere estimations. In addition, in several instances, it was apparent that income levels were being exaggerated or minimized for one or more reasons. Although obviously skewed data was excluded from survey data compilation, it is reasonable to assume a margin of error still exists. For this reason, only range and mean of income are used, in an attempt to minimize the effects of misleading data.

[2]The other major contributors to the household cash income include the sale of handicrafts, plus income derived from relatives or overseas sources.

(This concept, which is becoming more notable in all segments of Tongan population, is analyzed within the following chapters.)

In summary, while many aspects of Tongan agriculture have remained basically unchanged through history, there have been several significant alterations with respect to population growth, land distribution and cropping practices. The most significant of these changes has been the development of cash cropping and the subsequent rise in purchasing power of the average Tongan farmer. An indication of these alterations is the increased incidence of material items within the household, plus reliance upon imported food products, such as tinned meat, fish, bread and sugar.

The continually good market for copra and coconut products has resulted in many 'apis being planted almost entirely with palms, and less production of traditional foodstuffs. In addition, in densely populated areas where food crops are interplanted with palms, the competition for sunlight, soil nutrients, and moisture insures significantly lower yields from food plants.

Low production yields associated with decreases in soil fertility are frequently the result of the shift to a more continuous exploitative cropping system. This change is stimulated by the Tongan farmer's desire for increased cash income, and by increasing population pressure on land available for cultivation. This population pressure is intensified by the migration of individuals to Tongatapu from the other island groups, especially Ha'apai. The Tongan situation is becoming increasingly intensive, with often a crop/fallow period ratio of one to one, and a supported population

density in excess of 600 persons per square mile, in some regions. Surveys determining fallow periods evidenced a marked decrease in fallow time in Ha'apai and densely settled portions of Tongatapu, and a subsequent lengthening of the cropping cycle. In many cases, cropping is continuous, considering the frequent practice of sparsely planting fallow acreage with tubers.

The use of fertilizers necessary in offsetting the nutrient depleting effect of intensive cropping is not financially feasible nor understood by the typical Tongan farmer. The issue of maintaining soil fertility is of critical concern to the few agricultural and soil technicians in Tonga. However, owing to prohibitive cost, scarcity, and lack of knowledge, it is expected that most Tongan farmers will continue to rely upon the fallow system for replenishing soil nutrients.

The problems of soil fertility and land availability in Tonga have resulted in the increased cultivation and household reliance upon taro and cassava as major food staples.[1] Cassava represents the best example of the variation in food cropping brought about by increasing pressure upon the land. In a status ranking of tubers grown in Tonga, cassava is found at or near the bottom. However, even though the least desirable, cassava is the

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[1]Both tubers were introduced into Tonga in the nineteenth century, although a variety of taro was cultivated in Tonga prior to that period. The introduced taro varieties are more tolerant of dry, upland conditions, as opposed to the marsh requirements of the earlier species. Today most taro is cultivated without a marsh environment. Cassava is an introduced food crop. Of the cultivated tubers, cassava is lowest in status and its increasing cultivation is due to necessity, rather than any growth in popularity.

easiest to cultivate, plant or harvest, requiring very little care for a high yield. In addition, of the tubers grown in Tonga, cassava is the least demanding upon soil fertility and is the most tolerant of drought. Survey data indicated that cassava is cultivated the most in the densely populated portions of the islands or in those areas where land availability is limited.

The increasing reliance upon cassava presents a potential nutritionally detrimental situation. Cassava as food is nutritionally unbalanced in several ways, particularly in protein content. Protein derived from cassava is deficient in the sulfur essential amino acids. Therefore, most cassava protein, low in total value to begin with, is unavailable for use by the human body. The consumption of cassava, in lieu of more nutritionally balanced foods, could result in protein deficiency in several segments of Tongan population, including pregnant women and preschool children.

The increase in cassava cultivation has seemingly brought about a corresponding decrease in the cultivation of yams. Though the yam is the most prestigious of the major tubers, yams are a much more labor intensive crop than cassava, requiring intensive soil preparation, careful planting, weeding and harvesting. In addition, yams are more demanding on soil fertility, and with increasing cash cropping and decreasing land availability, less land is suitable for yam cultivation. The trend toward decreasing fallow periods does not permit sufficient soil nutrient accumulation for favorable yam growing conditions.

Land tenure is also related to changes in the Tongan agricultural system. The land tenure system in Tonga is the cause of considerable social dissatisfaction and economic inefficiency. Farmers are reluctant to invest significant quantities of labor or capital in land, until secure tenure has been established, thereby reducing productivity levels. Since more than 50 percent of Tonga's tillable acreage is owned by royalty or nobility, the land available for crop production is severely limited. It is a general opinion in Tonga that land shortage is the major restraint upon improving agricultural productivity. However, land shortage in absolute terms is not the case. The shortage of acreage is in that which is made available to Tongan farmers by the nobility and royalty.

Tongan social and cultural traditions are also an influential force upon agriculture. For example, many surveyed farmers expressed a reluctance to increase production because of the corresponding increase in social obligations which would offset the effort. This custom of "borrowing" cash or crops, with infrequent repayment, has caused many farmers to purposely curtail production. In addition, growing urbanization has had an enormous impact upon Tongan agriculture.

Despite the above, Tongan economy remains tied to agriculture. This fact is unlikely to change in the foreseeable future, despite continuing population pressure, alterations in cropping patterns, and the increasing consumption of imported foodstuffs.

Personal observations, survey data and research indicate that the agricultural future of Tonga will be one of continued drain upon soil fertility, decreasing production rates per man hour in food crop cultivation, and increasing reliance upon cash cropping to satisfy the needs of an agrarian population.

CHAPTER VI

AGRICULTURE TO URBANIZATION

Urbanization and its effects are issues confronting all the governments in the Pacific islands. Of the principal Polynesian cities, only Pago-Pago in Eastern Samoa evidenced a decrease in urban population between the mid-1960s to 1975, a result of migrations to Honolulu and San Francisco. The remaining cities of the region are coping with the increasing numbers of individuals migrating from villages and rural areas. Thus, urbanization, as defined by the South Pacific Commission and applied to Tonga (see pages 21-22) must be examined in relation to those factors motivating population movement from rural to urban centers. A fallacious assumption examines urban growth as a product of the city when, in fact, "it must be viewed as stemming from forces working on the whole of society" (Harr'e 1973, p. 11). Urbanization in Tonga results from both urban and agricultural societal forces. Although three urban centers in Tonga are recognized, Nuku'alofa exemplifies the process of urbanization in Tonga and will be used as a model in the following discussion.

The steady and accelerating growth of Nuku'alofa, particularly notable in the past 40 years, has been generally an uninterrupted process. In 1937, the capital contained 4,000 inhabitants.

By 1956, this figure had increased to 9,200, and by 1966, to nearly 16,000 not including surrounding areas. Today, Nuku'alofa, including the adjoining settlements, contains between 25 and 30 thousand persons. This number represents approximately half of the population of Tongatapu and a quarter of the nation's total population.

Nuku'alofa is not unique in these respects as many of the same features of growth are common throughout Polynesia. However, unlike other Pacific cities, Nuku'alofa is almost totally unprepared to absorb the continuing flow of 600-1,000 new inhabitants per year. The city lacks strong local government and laws, contains inadequate water and drainage facilities, refuse collection, and sewage systems, all necessary for coping with a sizable population. In addition, there are few opportunities for steady urban employment and, therefore, many persons are underemployed semi-subsistence agricultural workers dependent upon the production of others.

In these respects, one could justifiably argue that Nuku'alofa is not an urban settlement, in the true sense, but merely an agglomeration of three agricultural villages (Kolomofo'ou, Ma'ufanga and Kolomotu'a). The merging of these three villages into one urban area resulted from the establishment of the royal seat of power and the Wesleyan church headquarters at this location, plus the fact that Nuku'alofa was Tonga's first international port. The urban center of Nuku'alofa remains highly agricultural in nature. The city has acquired few new facilities other than those usually associated with administration and trade. Three

factors have been major forces motivating the migration of rural residents into Nuku'alofa. Employment opportunities are available to some individuals who have friends or close relatives already employed, an attraction to potential migrants. However, surveys of migrated urban residents indicated that only two percent had moved as a result of acquiring urban employment. In addition, cash income earned by this same group from urban employment was only a small proportion of total earnings. However, most agreed the possibilities of increasing their cash income were greater in Nuku'alofa than in rural agriculture, and that infrequent part-time employment was preferable. Government-owned services and operations represent the greatest source of urban employment, although church and privately sponsored work (i.e., teaching, housekeeping, and miscellaneous part-time labor) also exists.

A more significant factor, motivating migration to urban areas, is rather vaguely defined as "urban attractiveness." In the case of Nuku'alofa, the excitement and variety of town life is especially attractive to younger age groups. Social clubs, dances, sporting events and other amusements, including the seemingly endless opportunities for kava, make village life appear to be comparatively dull to individuals confronted with daily agricultural and domestic chores. In addition, urban living is a symbol of prestige, indicative of a higher living standard. Young men most frequently migrate for these reasons although women are not to be excluded. This has resulted in a large number of unemployed and underemployed urban youth, characterized by young people loitering in the market

areas and in amusement facilities. This situation is often blamed for the rapid rise in crime in Nuku'alofa. Burglary is the most frequent offense, although the incidence of fighting, prostitution, and petty theft have recently evidenced significant increases. Subsequently, this continuous migration of young Tongans has become a concern at all levels of government in the Kingdom (Report of the Department of Justice 1973).

The most influential urban factor attracting rural individuals to Nuku'alofa is the opportunity of improved education. Nearly all of the secondary schools are on Tongatapu and most of these are in Nuku'alofa. The fact that substantial education is usually unnecessary for village life, and that there are few opportunities for gaining urban employment, is of little consequence in deterring this desire. As mentioned previously, families often entirely abandon their village residence in order to move into the city and acquire a better education for the children. Frequently, this migration is intended to be temporary. However, as the older children finish their education, the younger children begin. In addition, the older children often marry and, as a result, permanent residency is established. Tongans perceive education to be symbolic of prestige, even though the knowledge gained will be put to little use. Educational attainment is considered to be the simplest and most direct means to upward social movement.

The rural factors contributing to expanded urbanization are almost entirely related to the system of land tenure and agriculture. Pressure of population upon land resources has been shown to exist

in varying degrees throughout the Kingdom, though it is greatest in Ha'apai and portions of western Tongatapu. As population pressure increases and maintaining a living through agriculture means becomes more difficult, migration from these regions can be anticipated. Related to this issue are the decreasing agricultural yields resulting from lower fertility levels, shorter fallowing periods and the expansion of cash cropping. When cash cropping profits become substantial enough to support a given household, independent of large scale home food production, the motivation for migrating to an urban area is high. Such migration results in absentee landholding and the utilization of friends or relatives to harvest the cash crop. Thus, agricultural acreage is removed from domestic food production, and allocated to cash crop production. The cash earnings are used to maintain the household in the urban environment. Consequently, the family experiences an increased dependency upon a greater proportion of foreign imports in order to satisfy its food and material needs. The effects of this are currently being felt in Nuku'alofa, a direct result of too many urban consumers being served by too few rural producers. The Kingdom is operating under an increasing trade deficit in order to supplement native food production with imports (Table 20). Eventually, this will necessitate major adjustments in the national economic profile.

Migrating to an urban area such as Nuku'alofa often increases the social position of the household. Urban living is perceived as being synonymous with an improved standard of living, while agricultural employment is considered to be a lower prestige occupation.

TABLE 20.--Tongan Balance of Trade: 1950-1972 (T$,000).

Year	Imports	Exports	Trade Surplus (+) Deficit (-)	% of Imports Represented by Foodstuffs
1950	1,778	2,776	+ .998	8.30
1952	2,322	2,802	+ .480	7.60
1954	2,220	2,786	+ .566	9.38
1956	3,028	3,248	+ .220	12.38
1958	3,236	2,420	- .816	14.71
1960	3,300	3,393	+ .093	16.58
1962	2,460	1,667	- .793	17.68
1964	3,854	2,328	-1.526	16.11
1966	4,141	3,617	- .524	23.97
1968	5,150	3,846	-1.304	22.87
1970	5,539	2,676	-2.863	23.50
1971	6,305	2,200	-4.104	28.30
1972	7,456	2,050	-5.406	30.11

SOURCES: 1954-1961--An Economic Survey of Tonga: 1970 (Nuku'alofa: Government Printer, 1970); Kingdom of Tonga: Statistical Abstract 1972 (Nuku'alofa: Government Printer, 1972); Great Britain Colonial Office, Report: Tonga (1954-1963)(London: Her Majesty's Stationery Office, 1956-64).

1970, 1973--Report for the Ministry of Finance (various dates) (Nuku'alofa: Government Printer); "Statement of Trade and Navigation: 1973" (Nuku'alofa: Government Printer, 1974).

A survey of employment preferences indicated that 83 percent of the respondents preferred to remain in agriculture. However, this response was given for one or both of the following reasons: (1) agricultural employment was preferred to unemployment, and/or (2) agriculture was perceived to be the only employment opportunity available to the interviewee. Several respondents stated that if they were given urban employment, they would abandon farm work, even if it meant a minor reduction in cash income.

It is not the purpose of this research to present an indepth analysis of Tongan urban environments. However, mention of the more fundamental issues is appropriate. In the future, in addition to limited opportunities for employment and a steadily increasing crime rate, the urban officials will have to contend with inadequate housing, expanding squatter sections and increasing public health problems resulting from the lack of adequate sewage and refuse disposal.

More significantly, the entire migratory process evidences a weakening of traditional Tongan social and cultural norms. Frequently, the movement of households to the urban area disrupts the traditional extended family system. Although family ties are never severed entirely, there is a distinct transition from the system of extended families evident in small rural villages, to the nuclear families found in larger villages and urban areas. However, in instances in which extended family ties are maintained, an urban family may anticipate the eventual arrival of rural relatives. The new arrivals reside with the established urban household until

employment is found or a means of establishing a new urban household is secured. At this point division is accomplished and the newly urbanized family becomes another potential host to migrating relatives. This system with its chain nature of migratory urbanization was observed in many of the surveyed urban households.

Thus, migration to urban areas has been in response to economic and social pressures for education, employment and the prestige of urban living, plus a lessening attachment to the traditional village life style. Therefore, migratory trends are indicative of cultural and economic changes in Tonga, which are expected to continue.

With the development of cash cropping and a greater dependency being placed upon a cash economy, money has become an essential to the average Tongan. Not only is it needed to meet social obligations (i.e., education, taxes and church contributions) but it is also increasingly important in satisfying the basic subsistence needs of both rural and urban residents. The desire to increase cash income has altered the agricultural pattern of the nation from traditional to cash cropping, thus eliminating a dependency upon the land for production of food and material necessities. These changes have been facilitated by fluctuations in post-World War II copra prices, and such natural disasters as drought and hurricanes.

While Nuku'alofa does not offer full-time employment to most migrants, there remains the possibility for part-time labor, sufficient to meet the minimum cash requirements. Thus, urban

migration in Tonga is not only closely tied to a desire for social mobilization, but also to fundamental economic changes. The urbanization process has, therefore, been encouraged by conditions in both the urban and rural environments of Tonga. A variety of factors have been influential, with each part acting to accelerate the whole. The role of social status and prestige in everyday Tongan life motivates the continuation of these transitions resulting in the potential social and economic disruption of the Kingdom.

CHAPTER VII

NUTRITIONAL IMPLICATIONS OF CHANGE

Investigations in Tonga, presented in the previous chapters, indicated that agriculture, land and population are major contributors to the urbanization process. There remains to be discussed the fundamental subsistence of those residing within the urban environment. Public health, housing, water supply, waste disposal and disease vectors are only a few of the problems encountered in massive urbanization. However, of particular interest to this research are those factors altering the nutritional patterns of the urbanite. Specifically, the degree of nutritional gradient between rural and urban populations is perceived to be important and an issue largely neglected in considerations of Pacific island urbanization.

At present, the Tonga Islands are relatively devoid of recorded malnutrition, when compared to selected nations of Africa, Asia and South America. However, a pattern of development in Nuku'alofa, similar to the urban centers of other regions, is becoming more apparent. The continued urbanization of Tonga's population, approaching 50 percent of the nation's total, frequently is accomplished at considerable cost to family health and welfare.

The traditional food patterns of the Tongan are nutritionally balanced. Fruits and root vegetables provide sources of

calories, vitamins and minerals, as do nuts and shellfish. However, this balance in the average Tongan diet has recently undergone significant change. Particularly since World War II, imported cereal products are replacing the traditional vegetables, while tinned varieties of meat and fish are replacing fresh sources. However, survey results indicated that this dependency upon imported food products is more pronounced in urban areas, especially Nuku'alofa.

The history of Tonga, as well as the generalized South Pacific, shows the classical forms of malnutrition to be very uncommon. Accounts of folk medicine reveal very few treatments for the symptoms of malnutrition (Harr'e 1973, p. 86). Similarly, more recent health and nutritional surveys, conducted by the South Pacific Health Service during the 1950s and including those by Langley (1952), and Whiteman (1956), did not note significant nutritional variations between rural and urban populations. However, rapid population expansion in conjunction with the developing of urbanizaton, during the 1960s and 1970s, necessitated a reexamination of Tonga in terms of undernourishment and classic malnutrition. Investigations by Hansell (1962) reported that up to 15 percent of households contacted by the Tongan Service for the Protection of Mothers and Children evidenced some signs of protein-calorie malnutrition (Hansell 1962, p. 288). More recently, Jansen (1973) reported that protein-calorie malnutrition is becoming a more frequent occurrence within Tonga, with 55 cases reported in 1971. Malnutrition was

further reported to be the fifth leading cause of death among young in-patients at Vaiola hospital on Tongatapu in 1971 (Jansen 1973, p. 3).

It is probable that borderline malnutrition, or at least undernourishment, has existed in the South Pacific to some degree since the influenza epidemic of 1918. Rapid population growth has been prevalent and unabated since that time. The situation in such urban environments as Nuku'alofa is becoming serious with regard to nutrition and general well-being. The high cost of living and underemployment, aggravated by the overflow of unskilled or semi-skilled laborers, has resulted in a subsequent increase in the number of malnourished children. Foods such as yam, fresh fish and fruits which traditionally were eaten by all Tongans are now, for many families in Nuku'alofa, a luxury beyond their economic means. Money secured through cash cropping, relatives or overseas remittances often is insufficient to support a large urban family and migrating relatives. Jansen (1973) concluded that under prevailing conditions,

> two points must be kept in mind: a. in spite of socio-economic progress, technology, better education, etc., many children in the Pacific Islands actually die because they lack proper food; b. the survivors may be permanently stunted in physical, and possibly mental, development (Jansen 1973, p. 43).

In the present investigation, the incidence of protein malnutrition or undernourishment was of prime interest. Throughout the sample survey, children of preschool age groupings (here defined as 2 years 0 months to 5 years 0 months) were examined. Data presented

in previous chapters indicated the economic and environmental factors conducive to the development of nutritional disorders. Preschool children were chosen as subjects, in that they are the most dependent on household food supplies. The selection of the sample was conducted randomly, within such cross sections of Tongan society as religion, economic and social standing. Collected data from 265 preschool children (114 female and 151 male) was then examined in light of possible rural/urban variations in nutritional well-being. For a more complete description of data collection procedures, see Appendices B and C.

The prevalence of protein malnutrition represents a serious risk in Tonga, for several reasons. A correlation between urbanization and the incidence of protein malnutrition, as well as additional nutritional factors, adds a new dimension to any consideration of the urban process in Tonga or the South Pacific in general. With regard to the individual, lesser degrees of protein malnutrition may cause retarded physical growth (most obvious in height and weight). In addition, a malnourished individual suffers more from a variety of common infectious diseases than does a well nourished person.

In any consideration of food production, distribution, consumption and value patterns, a variety of cultural factors must be recognized. In Tonga, several such factors have a profound influence upon the quantity and quality of food consumed by the preschool child. Aside from purely economic factors, which frequently dictate quantity and quality of food consumed, the family size and age spacing are also important. Cultural patterns, which determine the

rank order of food consumption during family meals, also often limit the preschooler's diet.[1]

Diet is also influenced by the prestige value of foods as was discussed in relation to papaya, pork and goat. Tubers are generally ascribed a high prestige value in Tonga. This is particularly true of the yam and white potato. However, leafy vegetables which are potential sources of vitamins lack this status

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[1]Tongan government officials and members of the World Health Association publicly deny the existence of a feeding order within Tongan households. However, it was confidentially learned from field officers of W.H.O. and medical personnel in Tonga that such a situation does exist and is a significant influence upon the nutritional well-being of the preschooler. Personal observations substantiated the prevalence of a traditional feeding order, in which the meal is consumed in shifts, with adult men (joined occasionally by women) eating first, women and children eating in an order following. It was noted in many cases that preschoolers are unable to compete with older children for those food items not consumed by adult family members. Occasionally older children are given charge of feeding younger brothers or sisters, and subsequently neglect their responsibility. Thus, another significant factor which influences the nutritional well-being of the preschooler is his age and ability to fend for himself. A category of foods nearly universally neglected in nutritional survey work is that generally known as "bush food," or those wild or domesticated fruits, nuts, etc. which an individual collects and consumes away from the household. A preschooler is not physically developed enough to take advantage of this food source. A three-year-old was never observed scaling a coconut palm in search of a snack. However, a 40 foot palm proved no obstacle to a 6- or 7-year-old. Similarly, preschoolers were never observed on the reefs searching for edible raw shellfish. However, older children, as well as numerous adults, were able to take advantage of this valuable protein source. The preschooler is at a developmental stage in which he is totally dependent upon the household for food. However, within the household, he usually consumes only the leftovers and is often left out entirely. This cultural pattern is totally contradictory to the nutritional needs of the growing child.

and are often excluded from the diet.[1] On the other hand, imported foods are perceived as being prestigious items. Some imports have limited nutritional value, although often below that of domestic products, while others such as refined flour, cereal products and sugar may cause or aggravate conditions of ill health, sugar being an obvious offender. Hansell (1962, p. 288) listed increased sugar consumption as being the principal cause of the rapid rise in the incidence of dental caries in Tonga. Personal observations verified this situation, with a marked predominance of cases noted in Nuku'alofa.

During the data collection process, a 24-hour dietary recall was conducted for each preschool subject, to determine any obvious dietary variations between rural and urban children. In addition, a frequency of consumption record was taken for the entire family, listing the frequency during an average week with which selected foodstuffs were consumed (i.e., fresh or canned meats and milk, tubers, cereal products, soft drinks, alcoholic products and sugar). In collecting this data care was taken to avoid the inclusion of weekend food consumption, especially that of Sunday. Because Sunday is a traditional day of feasting and heavy eating, a 24-hour dietary recall of this day would give a skewed and unrealistic picture of the preschooler's food consumption pattern.

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[1]The best example of this is the leaf of the taro plant. The leaf is used in the preparation of many dishes called "Lū" (i.e., lū pulu or beef, lū ika or fish) in which the meat is, in combination with coconut cream, etc., wrapped in taro leaves and cooked. However, the prepared dish is usually eaten without the leaf wrapping. In addition, raw vegetables, such as cabbage or greens, are not eaten.

The information acquired for the household frequency of consumption record usually consisted of rough approximations. However, several important aspects became evident during the rural to urban comparison. For example, household usage of sugar was found to be as high as 3.31 pounds per person per week in Nuku'alofa, although the average for the entire urban sample was 1.18. On the other hand, rural consumption of sugar averaged only .57 pounds per week. Cereal products, including bread and flour, are also used in greater quantities in Nuku'alofa than in rural areas.[1]

The consumption of soft drinks, alcoholic products, and cassava significantly increased in the urban areas, while the consumption of yams decreased. In the case of tubers, this fact most probably reflects economic forces which dictate that a basket of cassava cost T$.80, while a basket of yams sells of T$10-12.[2]

A higher rate of consumption of canned meat products was also observed in the urban area, although this product is widely used throughout Tonga--a probable reflection of its ease of distribution, storage and social status. A purchase of two samples of the most commonly used canned meat, and a subsequent proximal

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[1]This data may have been influenced by the distribution of such products over the islands. Surveys of stores in rural villages indicated that often sugar, flour and bread were not in stock. At times, the entire Kingdom is devoid of such basic commodities as sugar or flour. In one such incidence, over two weeks elapsed before a new shipment arrived from overseas sources, during which the entire nation lacked sugar. However, even with consideration being given to these influences, a significant variation between rural and urban consumption is evident.

[2]Prices acquired in the Nuku'alofa market, October, 1974.

analysis of these samples revealed that in each case, quality was below suggested standards in content of protein, fat, carbohydrate and moisture (Table 21). This was especially true of the sample of K. & R. Corned Meat Loaf. This product is frequently consumed in Tonga, a probable reflection of its lower cost. Price surveys indicated that this meat loaf sold for approximately T$.30-.35, while the other canned meat sample analyzed sold for T$.75-.85.[1]

Fresh beef from Australia and mutton from New Zealand are also consumed in greater quantities in urban Tonga. Analysis of random samples purchased in Nuku'alofa showed the surface fat of beef imports to be in excess of 73 percent of total product weight. Similarly, mutton samples not only evidenced a high fat content but were also greatly weighted by bone.[2]

On the other hand, individuals residing in rural areas consume more fresh meats such as pork, poultry, and fish (although fresh and canned fish are popular throughout the Kingdom), plus a greater variety of tubers. Yams, sweet potatoes, and taro retain their important traditional role in the Tongan diet within the rural

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[1]The results of the analysis of both products, which are imported from Australia, emphasize the fact that the Tongan government, despite recommendations by members of medical professions and church groups, refrains from monitoring the quality of products imported into Tonga. This neglect is exploited by foreign commercial organizations as evidenced by the analysis of the above canned meats, in addition to imported fresh meat samples (Appendix C).

[2]The Tongan government recently announced plans for a refrigerated vehicle to transport fresh meat to rural Tongatapu. The value of such a scheme is questionable, considering the low quality of the products to be transported.

TABLE 21.--Proximal Evaluation of Canned Meat Typically Available to Tongan Consumers.

Content (%)	Globe Corned Beef	K & R Corned Meat Loaf	Suggested[1] Value
Protein	21.93	7.68	26
Fat	10.82	13.63	8
Carbohydrate	.95	13.39	--
Ash	2.50	2.40	4
Moisture	63.80	62.90	62
Total	100.00	100.00	100

[1]Value for corned beef as given in H. S. Mitchell, et al., Cooper's Nutrition in Health and Disease, 15th ed. (Philadelphia: J. B. Lippincott Co., 1968), p. 553.

environment. Cassava, though consumed throughout the Kingdom, is proportionally less important in rural areas. However, as emphasized in preceding chapters, this fact is changing, with increasing consumption of cassava in such densely settled areas as western Tongatapu and Ha'apai.

The 24-hour dietary recall for each preschool subject substantiated the trends indicated by the frequency of consumption records. In urban Nuku'alofa, children often eat only one or two meals per day. Of particular interest is the urban child's reliance upon bread and butter for an entire meal. Tea is also

a popular drink at mealtimes. It is actually little more than hot sugar water and remains a poor substitute for milk or broth.[1]

Snack foods consumed by urban preschoolers also are of poor nutritional quality such as imported cookies (called biscuits), soft drinks, and miscellaneous items (cheese puffs were observed to be favorites). In rural areas a child is most often given coconut, taro or a fruit, such as papaya or mango, when in season. Rural children also enjoy a greater variety of foods per meal, with several tubers being supplemented by fruit and frequently meat or fish.

To summarize, the preceding data indicated that individuals residing in urban Tonga consume less nutritionally balanced diets. This was substantiated by interviews with the medical staff of Vaiola hospital on Tongatapu. The urban group most frequently having substandard diets was found to be migrants from other islands or

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[1]The low consumption of milk in all regions of Tonga, but especially Nuku'alofa, is a nutritional shortcoming in the Tongan diet. Imported milk sources such as powdered, sweetened condensed or evaporated products are available and, if used properly, could be influential in improving the preschool dietary condition. However, the most frequent way of serving milk is to substantially dilute the mixture with water (often unclean) and thereby reducing the nutritional value. Domestic sources of cow's milk are scarce and expensive, while the large milk goat population in Tonga represents a largely unused potential milk source. A nutritive comparison of goat's milk and cow's milk indicates that goat's milk is quantitatively higher in most vitamins and minerals, contains more fat, a higher total caloric value in addition to a reasonably equal protein value. Widespread use of goat's milk, as suggested in previous chapters, would improve the nutritional conditions of many currently malnourished Tongan children. However, the consumption of goat's milk is believed to be indicative of low social prestige and government officials are unreceptive to information concerning its potential value.

rural Tongatapu. These people, displaced by overpopulation, the lack of land or through the development of cash cropping, represent a critical potential risk for the development of classical malnutrition.[1] A situation cited as being conducive to the development of malnutrition involves a child with diarrhea (as is common in weaning infants) being fed only warm sugar water, a folk medicine remedy. This treatment tends to aggravate the initial condition and the cycle develops and intensifies (Tu'itavaka 1974). Subsequent manifestations of malnutrition are a lessening of the child's activity level, an increase of irritability and a retardation in the physical growth and development of the child.

During the investigation designed to determine the physical conditions of Tongan preschool children, height, weight, arm circumference and skinfold measures were recorded, as anthropometric indicators of a child's growth and development. Data from each indicator was grouped as to rural or urban and compared to suggested standards (The Health Aspects of Food and Nutrition 1972, pp. 278-283). Percents of variation from standards were then taken and

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[1]The development of the symptoms of malnutrition (i.e., retarded growth and development in preschool subjects) was not strongly correlated to densely populated rural areas such as rural Ha'apai and western Tongatapu. Interview responses indicated no cases of malnutrition in these areas, which may be attributed to the greater availability of protein. The Nuku'alofa environs produced the greatest number of cases of malnutrition with Neiafu containing the second largest number. Only one case of malnutrition from the outer islands was reported. The staff of Vaiola hospital on Tongatapu believe malnutrition in Tonga is strongly linked to continued urbanization. (Interview with S. U. Tu'itavaka, Vaiola Hospital, Nuku'alofa, Tongatapu, September 24, 1974.)

averaged, giving a finalized comparative indication of the variation in the physical growth and development of rural and urban preschool children.

Height measurements are summarized in Table 22. These data for age groups 2 years, 1 month, to 5 years, 0 months, clearly show the superior physical growth of the rural child. Although neither variation from the standard suggested by the World Health Organization is substantial, the significance of the data is the rural/urban comparison. In all but 6 of the 35 sample age groups, the rural preschooler was observed to be taller. A comparison of the average height of all subjects with suggested standards showed the rural subjects to be .51 percent above the norm while urban preschoolers fell 2.35 percent below the suggested values. While a total variation of 2.86 percent between rural and urban preschoolers may not be alarming, it is nonetheless reflective of dietary variation among the two groups.

Measurements of weight, summarized in Table 23, are congruent with the data in Table 22, except that the weight measurements show a greater deviation from W.H.O. suggested norms. Rural preschoolers averaged 1.93 percent above suggested standards while uban children of the same age groups averaged 4.11 percent below suggested values. Considering a total difference of 5.04 percent between the weights of rural and urban preschool children, a clearer indication of the consequences of those dietary variations noted above begins to become evident. The urban preschooler is generally smaller in height and weight than his rural counterpart.

TABLE 22.--Height Measurements of Tongan Preschool Children (N=265).

Age Year-Mo.	Avg. of Rural Subjects (cm)	Avg. of Urban Subjects (cm)	Standard[1] (cm)	% of Std. (Rural)	% of Std. (Urban)
2- 1	88.64	85.36	88.00	100.72	97.00
2- 2	89.43	86.87	88.80	100.70	97.82
2- 3	90.38	90.96	89.70	100.75	101.40
2- 4	85.46	87.03	90.40	94.53	96.27
2- 5	93.70	86.55	91.30	102.63	94.79
2- 6	92.14	90.78	91.80	100.37	98.88
2- 7	91.50	88.15	92.60	98.81	95.19
2- 8	91.36	90.88	93.30	97.92	97.40
2- 9	95.20	93.80	94.00	101.28	99.78
2-10	95.73	95.66	94.70	101.08	101.01
2-11	97.12	94.02	95.30	101.91	98.65
3- 0	99.36	94.30	96.00	103.50	98.22
3- 1	100.43	93.47	96.60	103.96	96.75
3- 2	98.00	94.96	97.30	100.72	97.59
3- 3	91.23	96.62	97.90	93.19	98.69
3- 4	96.15	95.12	98.40	97.71	96.66
3- 5	101.70	93.42	99.10	101.92	94.26
3- 6	100.25	99.80	99.70	100.55	100.10
3- 7	101.40	100.26	100.30	101.10	99.96
3- 8	102.05	97.47	101.50	100.99	96.02
3- 9	99.63	95.86	101.60	98.06	94.35
3-10	105.93	100.26	102.10	103.75	98.19
3-11	103.35	100.77	102.70	101.22	98.12
4- 0	105.68	98.95	103.30	102.30	95.78
4- 1	102.12	98.68	103.80	98.38	95.06
4- 2	103.63	107.00	104.50	99.17	102.39
4- 3	105.83	102.00	105.20	100.60	96.95
4- 4	105.27	102.82	105.70	99.59	97.27
4- 5	104.68	106.46	106.20	98.57	100.24
4- 6	107.96	106.93	106.80	101.09	100.12
4- 7	106.40	100.60	107.30	99.16	96.55
4- 8	106.34	102.40	107.90	98.55	94.90
4- 9	109.46	107.22	108.20	101.16	99.09
4-10	115.70	103.37	108.50	106.64	95.27
4-11	114.47	105.62	108.70	105.31	97.16

Average variation of measured subjects from suggested standards (%): Rural +.51, Urban -2.35.

[1]The Health Aspects of Food and Nutrition, 2d ed. (Manila: Regional Office for the Western Pacific of the World Health Organization, 1972), pp. 278-283.

TABLE 23.--Weight Measurements of Tongan Preschool Children (N=265).

Age Year-Mo.	Avg. of Rural Subjects (Kg)	Avg. of Urban Subjects (Kg)	Standard[1] (Kg)	% of Std. (Rural)	% of Std. (Urban)
2- 1	12.58	11.28	12.6	99.84	89.53
2- 2	11.73	13.53	12.7	92.35	106.54
2- 3	12.54	11.11	12.9	97.26	86.14
2- 4	13.30	11.94	13.1	101.55	91.17
2- 5	14.11	13.60	13.3	106.57	102.31
2- 6	13.98	14.09	13.5	103.59	104.39
2- 7	13.53	14.28	13.7	98.76	104.29
2- 8	13.74	13.06	13.8	99.59	94.66
2- 9	14.18	14.62	14.0	101.25	104.49
2-10	15.71	13.75	14.2	110.62	96.88
2-11	13.53	13.75	14.4	93.96	95.53
3- 0	15.56	13.68	14.5	107.30	94.38
3- 1	16.33	15.04	14.7	111.09	102.32
3- 2	16.56	14.69	14.8	111.87	99.30
3- 3	15.31	13.24	15.0	102.06	88.30
3- 4	15.76	14.96	15.2	103.70	98.47
3- 5	15.59	13.68	15.3	101.93	89.41
3- 6	14.52	13.22	15.5	93.65	85.33
3- 7	14.97	15.64	15.7	95.34	99.67
3- 8	15.03	14.06	15.8	95.11	88.99
3- 9	17.46	15.14	16.0	109.15	94.63
3-10	17.08	14.78	16.2	105.45	91.28
3-11	17.24	15.45	16.3	105.75	94.83
4- 0	19.20	14.40	16.5	116.37	87.28
4- 1	17.01	17.32	16.6	102.47	104.38
4- 2	16.73	18.89	16.8	99.58	112.48
4- 3	16.67	17.91	16.9	98.64	106.01
4- 4	16.73	16.29	17.1	97.83	95.30
4- 5	16.39	17.55	17.2	95.28	102.08
4- 6	18.26	15.64	17.4	104.93	89.93
4- 7	15.88	17.69	17.6	90.20	100.51
4- 8	16.10	15.49	17.7	90.98	87.54
4- 9	18.32	16.00	17.9	102.33	89.41
4-10	20.11	15.30	18.0	111.71	85.05
4-11	19.96	17.01	18.2	109.66	93.46

Average variation of measured subjects from suggested standards (%): Rural +1.93, Urban -4.11.

[1]The Health Aspects of Food and Nutrition, 2d ed. (Manila: Regional Office for the Western Pacific of the World Health Organization, 1972), pp. 278-283.

Skinfold and circumference measures substantiated this trend. In each case the urban child was found to be smaller and less developed. Skinfold data, summarized in Table 24, evidenced the greatest variations between urban and rural children. Skinfold measurements of rural preschool children of both sexes were significantly higher than their urban counterparts, resulting in variation between the two sample groups of 24.38 percent for male subjects and 26.55 percent for female subjects. Circumference data (Table 25) also showed a variation in the development of rural and urban subjects. When compared to suggested norms, rural preschoolers had greater upper arm circumference measurements than urban children by 3.29 percent for male children and 2.80 percent for female children.

Considering the above four physical parameters measured on each preschool subject, it is conclusively evident that the rural child is physically larger and more developed than his urban counterpart. A final nutritional evaluation technique was conducted in which a sample of each child's hair was collected using the procedure outlined in Appendix C. Later, each hair specimen was examined and classified as to growing phase (i.e., growing or anagen, and resting or telogen), and bulb and shaft morphological changes. A hair in the growing or anagen phase is characterized by a bell-shaped bulb structure and solid dark pigmentation. The telogen bulb is shaped like a teardrop and shows a distinct lack of pigment (Bradfield 1972, p. 721). Protein malnutrition, in particular, causes hair to shift to the telogen phase. Rural hair samples

TABLE 24.--Tricep Skinfold Measurements of Tongan Preschool Children (N=265).

Age Year	Avg. of Rural Subjects (mm)	Avg. of Urban Subjects (mm)	Standard[1] (mm)	% of Std. (Rural)	% of Std. (Urban)
Male					
2	12.00	9.70	10.00	120.00	97.00
3	12.55	9.63	9.30	134.95	103.54
4	11.22	9.48	9.30	120.64	101.93
Average variation of measured subjects from suggested standards (%): Rural +25.20, Urban +.82.					
Female					
2	12.64	10.31	10.10	125.15	102.07
3	13.07	10.00	9.70	134.74	103.09
4	12.61	10.07	10.20	123.62	98.72
Average variation of measured subjects from suggested standards (%): Rural +27.84, Urban +1.29.					

[1]The Health Aspects of Food and Nutrition, 2d ed. (Manila: Regional Office for the Western Pacific of the World Health Organization, 1972), pp. 278-283.

TABLE 25.--Upper Arm Circumference Measurement of Tongan Preschool Children (N=265).

Age Year-Mo.	Avg. of Rural Subjects (cm)	Avg. of Urban Subjects (cm)	Standard[1] (cm)	% of Std. (Rural)	% of Std. (Urban)
Male					
2-3	17.08	16.30	16.6	102.89	98.19
2-6	16.90	16.13	16.4	103.05	98.35
2-9	17.29	16.88	16.4	105.43	102.92
3-0	16.07	16.28	16.2	99.19	100.49
3-3	17.36	17.16	16.9	102.72	101.53
3-6	17.52	17.25	16.5	106.18	104.54
3-9	17.46	17.05	16.7	104.55	102.09
4-0	17.54	16.81	16.9	103.78	99.46
4-3	17.68	17.78	17.2	102.79	103.37
4-6	17.77	16.99	17.5	101.54	97.08
4-9	17.55	17.12	17.2	102.03	99.53
5-0	18.78	16.60	17.0	110.47	97.64
Average variation of measured subjects from suggested standards (%): Rural +3.72, Urban +.43.					
Female					
2-3	16.90	15.66	16.4	103.05	95.48
2-6	16.97	16.47	16.4	103.47	100.42
2-9	16.91	16.13	16.1	105.03	100.18
3-0	17.01	16.34	15.9	106.98	102.76
3-3	17.21	17.10	17.4	98.90	98.27
3-6	17.25	17.43	16.3	105.82	106.93
3-9	16.99	17.85	16.8	101.13	106.25
4-0	17.51	17.22	16.9	103.61	101.89
4-3	17.41	17.65	16.8	103.63	105.05
4-6	17.31	16.85	16.6	104.27	101.56
4-9	17.51	16.16	16.8	104.22	96.19
5-0	17.87	16.42	16.9	105.73	97.15
Average variation of measured subjects from suggested standards (%): Rural +3.81, Urban +1.01.					

[1] The Health Aspects of Food and Nutrition, 2d ed. (Manila: Regional Office for the Western Pacific of the World Health Organization, 1972), pp. 278-283.

were found to be 79 percent anagen and only 5 percent telogen. Suggested standards call for between 80 and 90 percent anagen, though the exact percent may vary from subject to subject and a percentage greater than 50 may be considered normal (Bradfield 1972, pp. 721-725). (See Table 26 for suggested hair evaluation standards.) Urban samples showed a marked increase in the percent of telogen hair samples. Of the urban sample taken from Nuku'alofa, only 44 percent were classified as anagen while 13 percent were telogen. While this 13 percent incidence of telogen hair falls below the suggested 20 percent indicative of moderate protein malnutrition, it nonetheless shows a significant variation from the rural values. This percentage increase is, therefore, interpreted to be indicative of increasing moderate protein malnutrition in the urban child. The urban incidence of anagen hairs, however, falls well within the values indicative of moderate protein malnutrition and is seen as a positive indication of the lower level of nutritional status in the urban preschooler.

Hair samples were also examined to determine the incidence of atrophied bulbs. An atrophied bulb is shrunken, often has a shriveled appearance, and shows a considerable decrease in diameter to the point of being less than the hair shaft itself (Bradfield 1972, p. 722). An increase in the incidence of atrophied samples is an indication of severe or chronic protein-calorie malnutrition, and is associated with depletions of tissue reserves. In addition, increases in root atrophy frequently occur simultaneously with depressed weight and height values (Nommacher et al. 1972, p. 874).

TABLE 26.--Suggested Standards for Hair Sample Evaluation.

Maximum mean bulb diameter, mm x 10^{-2}	>11	Normal
	6-11	Moderate Protein Malnutrition
	< 6	Severe Protein Malnutrition
Atrophy, % of anagen	0-25	Normal
	26-50	Moderate Protein Malnutrition
	>50	Severe Protein Malnutrition
Anagens (%)	>50	Normal
	30-50	Moderate Protein Malnutrition
	<30	Severe Protein Malnutrition
Telogens (%)	<20	Normal
	20-45	Moderate Protein Malnutrition
	>45	Severe Protein Malnutrition

SOURCE: R. B. Bradfield, "Protein Deprivation: Comparative Response of Hair Roots, Serum Protein and Urinary Nitrogen," American Journal of Clinical Nutrition 25 (February 1972): 186-205.

Of the hair samples taken from rural preschool children, 16 percent were classified as being atrophied, a value within the range of normality. However, total urban hair samples showed a 42 percent incidence of root atrophy which is a value near that associated with severe protein malnutrition. The 26 percent variation in the rate of atrophy incidence between rural and urban children is a clear indication of the comparatively poor nutrition and general state of health of the urban child. The high percentage level of telogen and atrophied root samples among the urban preschool children together substantiate the lower level of growth and development indicated by anthropometric measures, as well as a tendency toward severe protein malnutrition. The rural child, on the other hand, was not found to exemplify, to any great extent, these abnormalities.

With the onset of protein deprivation or a malnourished period which may lead to protein malnutrition, the earliest consistent change notable is a reduction in maximum bulb diameter (Bradfield 1972, p. 722). Hair root bulb diameter measures from both rural and urban samples fell below suggested standards. However, the average for rural samples amounted to 9.65 mm x 10^{-2}, while urban samples averaged 8.25 mm x 10^{-2}. Though both are below the suggested standard of 11 mm x 10^{-2} (Table 26), the more pronounced deviation is seen in the urban sample. This also lends support to the contention that the urban preschooler is nutritionally less sound than his rural counterpart.

In conclusion, two additional factors of Tongan society must be emphasized. Cases of classical malnutrition, particularly severe protein malnutrition, were not found to be currently prevalent throughout the islands. Occasionally, children were observed exhibiting illness which could be directly correlated with the lack of sufficient food or adequate nutrition. Infections and eye disorders were relatively common. A more significant factor is the potential risk for the future development of malnutrition, especially in urban areas, where the diet was found frequently to be deficient in both quantity and quality. Indicative of this condition is the urban preschool child who is smaller and less developed than his rural counterpart, by every parameter examined. These data support the conclusion that the occurrence of moderate and severe protein-calorie malnutrition in Tonga is greatest among urban children.

Attributing this condition to the effects of urbanization and continued in-migration from rural areas of Tonga, the prevalent factors of overpopulation, pressure upon domestic agriculture and the continued development of a cash crop economy assume a new significance. Tongan society, already approaching 50 percent urbanization, has reached a critical stage during which the future health and well-being of the population will be determined.

CHAPTER VIII

CONCLUSION

Summary

The objectives of this research were threefold:

1. To assess alterations in the population profile of Tonga (i.e., natural increase, internal migration and urbanization).

2. To determine the influence of population growth, land tenure and the development of cash cropping upon the agricultural economy of Tonga.

3. To determine the degree to which urbanization has altered the nutrition status of the Tongan people.

Prior to fulfilling the above objectives, it was hypothesized that:

1. Increases in population are accompanied by subsequent increases in (a) pressure upon agricultural lands, (b) population migration, and (c) urbanization.

2. Increases in cash income among agricultural producers are accompanied by subsequent increases in migration to urban areas, and decreases in agricultural production of food crops in ratio to total national population.

3. Increases in urbanization are accompanied by subsequent increases in reliance upon imported foodstuffs, and decreases in domestic food production and nutritional status.

Data acquired during field investigations supported the above hypotheses. A condition of increasing urbanization in Tonga was found to be the result of (1) natural population growth within

urban areas, (2) displaced individuals migrating due to increased population pressure on agricultural land, and (3) migration of those rural individuals with sufficient income from cash cropping enterprises. (The above is summarized within Figure 2).

Despite increases in the absolute quantity of domestic food production, research results indicated that population growth more than nullifies these gains. This situation is aggravated by the withdrawal of acreage from domestic food production resultant from (1) expanded cash cropping, and (2) increasing absentee landholding. The ensuing gap between population and domestic food needs requires that Tonga import large quantities of foodstuffs (Table 20).

Further investigation revealed that the consequences of urbanization in Tonga are (1) decreased domestic food production per capita, and (2) retarded physical development of preschool children most likely due to inadequate dietary quality, as shown in Table 21, and Table 28 (p.188). However, in order to strengthen the reliability of the preceding hypotheses, it is recommended that they be tested in relation to alternative societies.

Implications

The Tongan social structure and systems of land tenure and agriculture, in combination with expanding urbanization, require that Tongan governmental officials realize the vital role of agriculture in the Tongan economy. To date, the Kingdom lacks any other alternative resources. Thus, care must be taken to stabilize and revitalize agriculture and domestic food production.

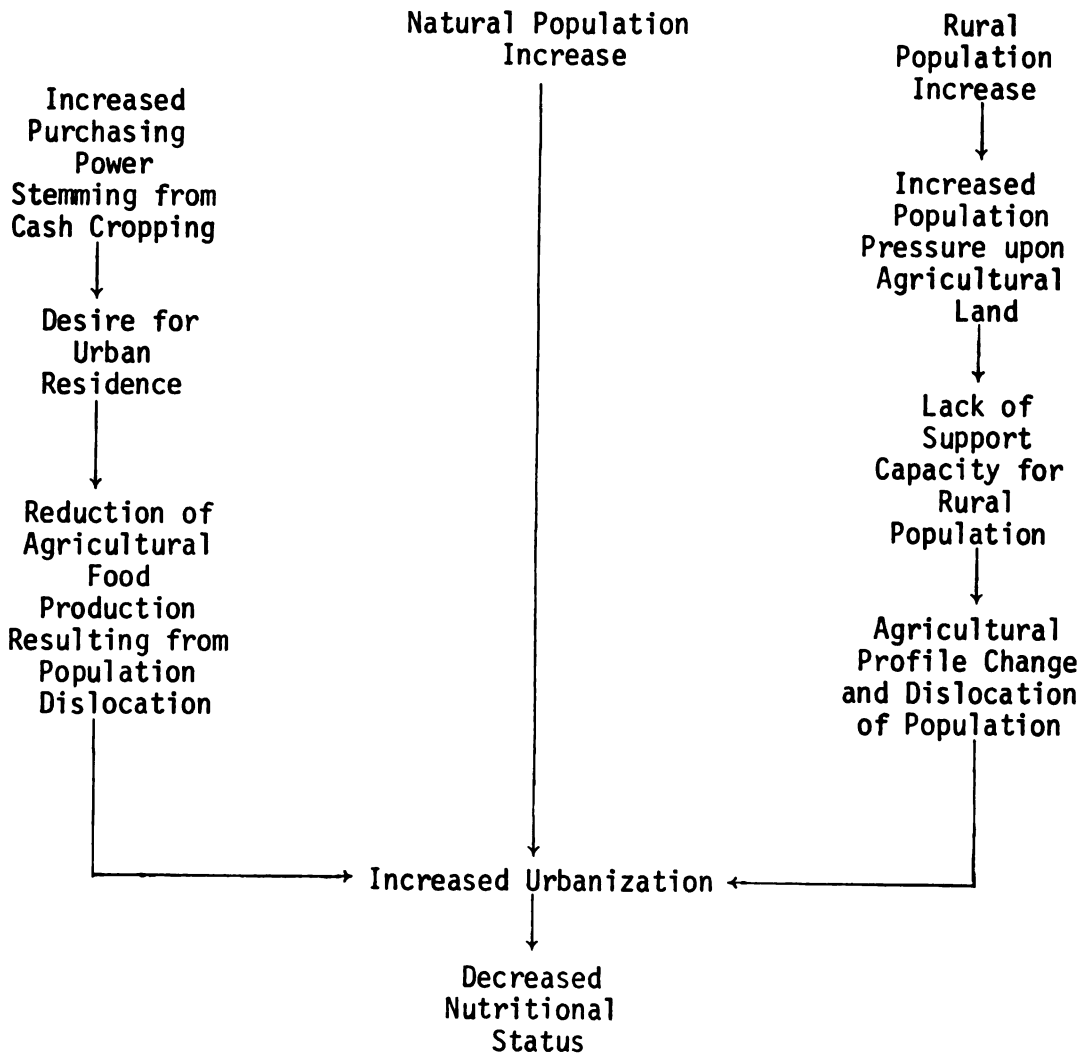


Figure 2.--Urbanization: Kingdom of Tonga

Recommendations

Recommendations following this research might take several forms. The most immediate need involves the complete redistribution of land now being held by the nobility or royal family. Further, allotment sizes of four acres appear able to provide the needs of the average family. Therefore, division of existing eight and one-quarter acre or larger holdings into four-acre units seems advisable. It is fully recognized that the existing political and social structure of the Kingdom make implementation of such recommendations difficult. More realistically, the following may be offered with some expectation for immediate or future implementation.

1. Inasmuch as pest damage to Tongan agricultural production amounts to 20 percent of exportable cropping, newer forms of effective pest control are appropriate. The rat, as the most destructive, should receive first priority. Reducing foliage cover and using protective measures for crops has been shown ineffective in the Tongan situation. Therefore, newer approaches of research are advisable, including disruption of the rodent's feeding base and the possible introduction of predators, i.e., viral or mammalian. Such control measures, if successful, would benefit not only the Tongan situation, but other Pacific islands as well.

2. Owing to the already serious population maldistribution, it is advisable that immediate action be taken by the Tongan government leading to the strengthening of rural activities, resettlement or planned settlement of migrating Tongans, and the discouragement of

the continued movement of people into the urban areas, principally Nuku'alofa.

3. A third recommendation for immediate implementation calls for quality inspection of food imports. The quality of most fresh meat and canned beef products is indicative of this necessity. As food products assume a greater proportion of total Tongan imports, the continued lack of efficient quality inspection is seen as detrimental to the health and nutrition well-being of urban Tongans.

In addition to recommendations for immediate action, it is advisable that long-term planning and implementation of the following be undertaken.

1. Agricultural education of extension services for use in all rural settlements is advisable. Such an undertaking is feasible considering the existence of the government farm on Tongatapu and the agricultural training facility on 'Eua.

2. Basic family hygiene and nutritional education is also advisable. The formulation and instruction of fundamental home economics or family ecology could easily be incorporated in the nation's secondary schools. In view of the fact that continuing education is viewed as a status in Tongan society and literacy is almost universal, it is reasonable to suggest such an introduction in the Tongan educational system would reach a large segment of the population.

3. A reorientation of the subject areas of emphasis in the educational system might also be a long-term goal. Development of technical skills, including construction and fundamental

manufacturing techniques, crop and soil science, as well as animal husbandry seem appropriate areas of emphasis given Tonga's economic profile.

It is recognized any change in policy or the implementation of the above recommendations require capital outlays involving land, population and urban conditions making it imperative that the government reorder its current development priorities. This investigation concludes that a pessimistic aura regarding the future of Tonga remains. Given the social structuring and system of land tenure and agriculture, coupled with a numerically increasing and urbanizing population, Tongan government officials must face several hard realities. The nation lacks to date any economically exploitable resources save its agricultural acreage or possibly the fishing resources in surrounding ocean waters outside the reef areas. Talk of economic schemes and wealth from underseas deposits of petroleum or minerals has largely proven to be rhetoric. Tonga must quickly come to grips with the economic and population crises which are already the cause of discontent in several significant sectors of the population. Yesterday's factors of risk concerning overpopulation, malnourishment and economic instability are rapidly becoming realities of today.

APPENDICES

APPENDIX A

GEOGRAPHICAL SURVEY OF TONGA

APPENDIX A

GEOGRAPHICAL SURVEY OF TONGA

The islands comprising the Kingdom of Tonga are scattered through 8°30' of latitude, from 15° South to 23°30' South, and 4° of longitude, from 173° West to 177° West. Directionally, the Kingdom is located East of Fiji and South of Samoa (Harris 1966, p. 124). The total area encompassed by the Kingdom is over 20,000 square miles. However, of this area only 288 square miles are land and this amount is scattered over 150 islets of which only 45 are inhabited (Kennedy 1968, p. 22). The largest and most populated island of the Kingdom is Tongatapu which accounts for 99 square miles and holds a population in excess of 50,000. Estimates of Tonga's total population vary from 80,000 to 100,000. However, sources within the nation give the total as of January 1, 1975, as 95,000 (Report of the Ministry of Health 1973, p. 26).

The islands of Tonga lie in two fairly parallel lines and are actually the tops of two undersea mountain ridges. The basic orientation is Northeast to Southwest with several notable outliers in the Northwest of the Kingdom's territorial limits. These outliers include the islands of Niuatoputapu and Niuafo'ou (Kennedy 1968, p. 22).

Physically, the geography of the islands is not uniform. There are three divisions of islands by geologic type (Figure 3).

Figure 3.--The Islands of Tonga by Geologic Type.

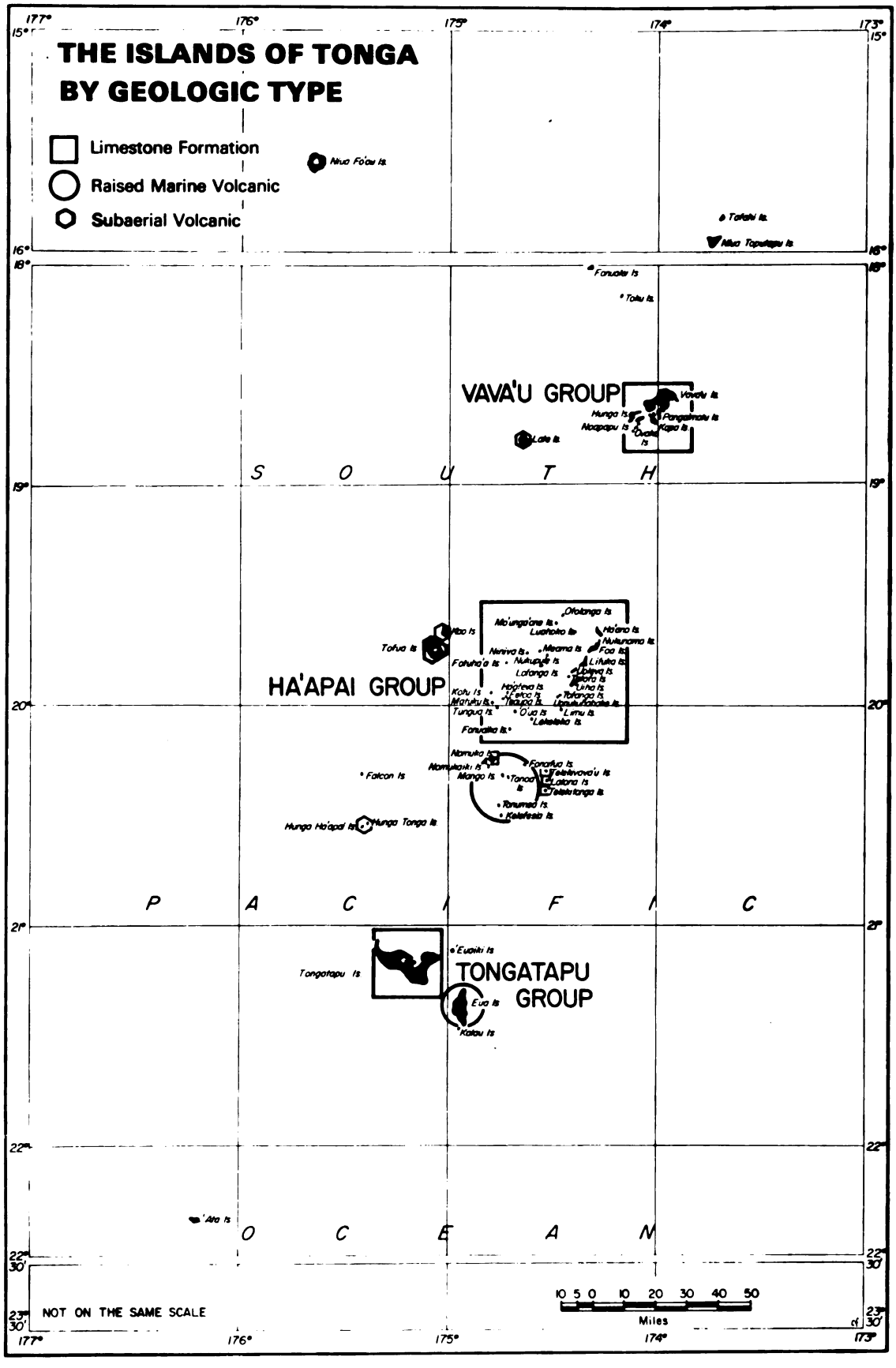

THE ISLANDS OF TONGA
BY GEOLOGIC TYPE
Limestone Formation
Raised Marine Volcanic
Subaerial Volcanic
VAVA'U GROUP
HA'APAI GROUP
TONGATAPU
GROUP
SOUTH
PACIFIC
OCEAN
NOT ON THE SAME SCALE
10 5 0 10 20 30 40 50
Miles
177°
176°
175°
174°
173°
15°
16°
18°
19°
20°
21°
22°
22° 30'
23° 30'

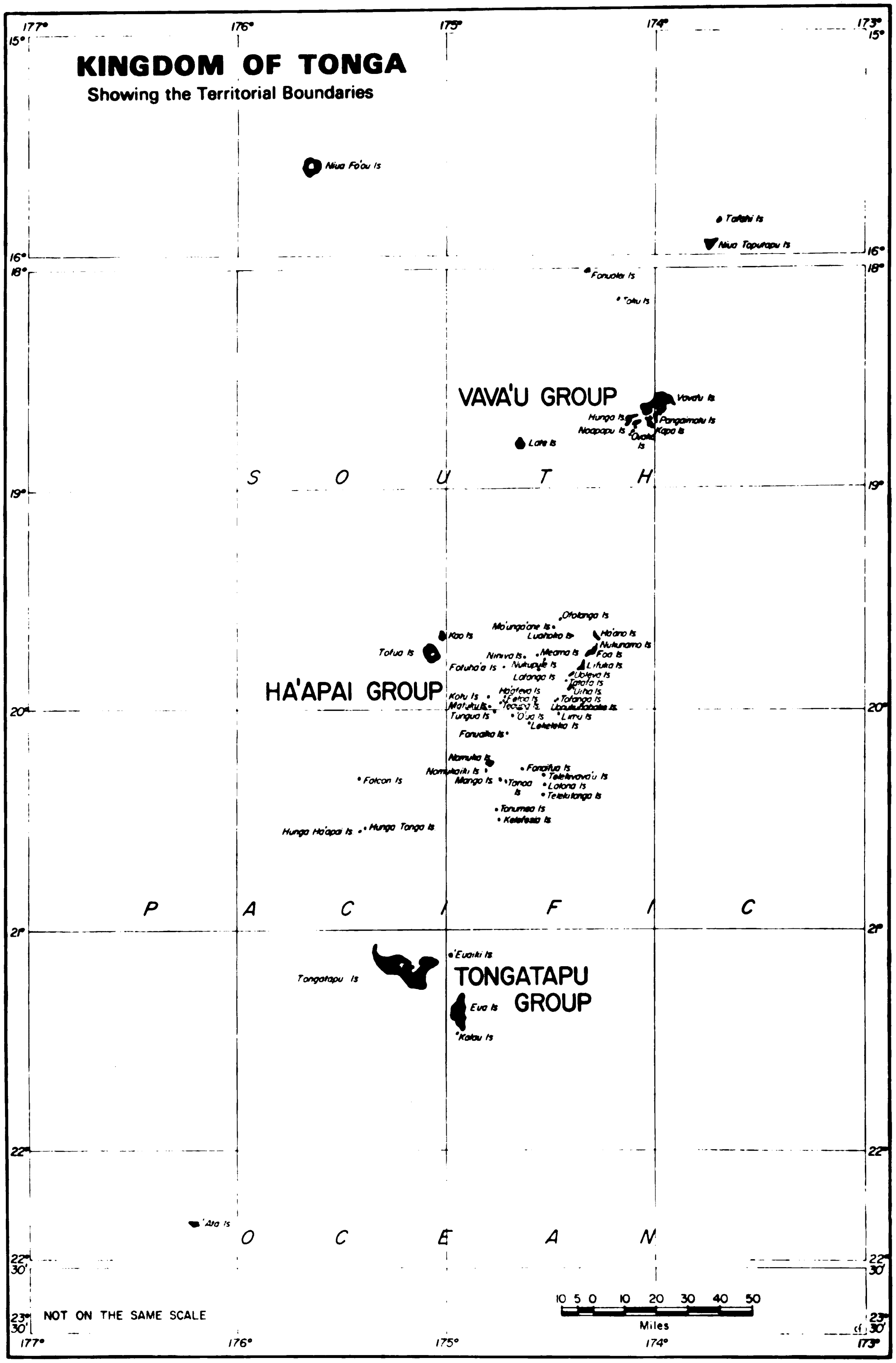
Figure 4.--The Kingdom of Tonga.

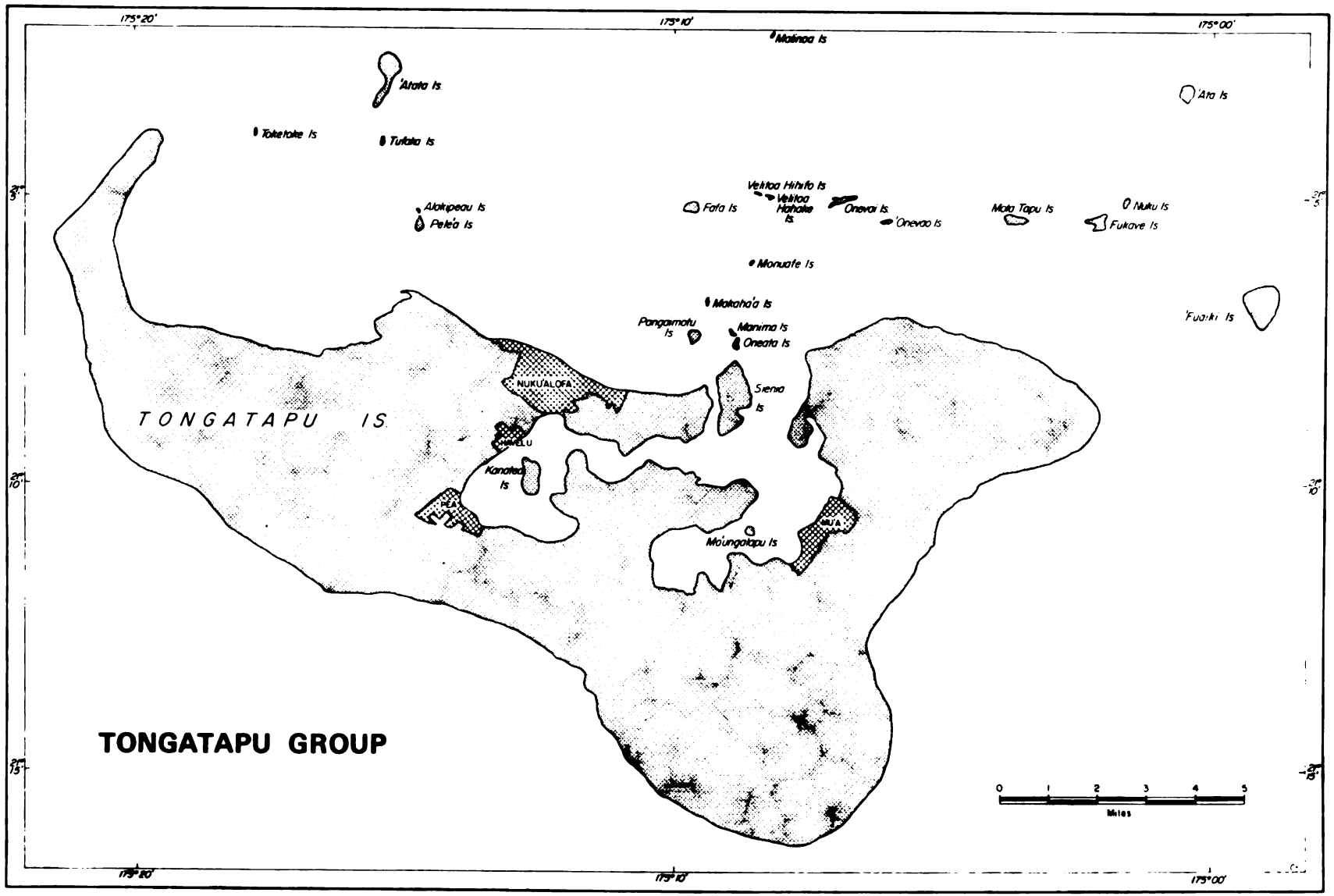
4A. Principal island groups and outliers.

4B. Tongatapu group with principal outliers (excluding 'Eua).

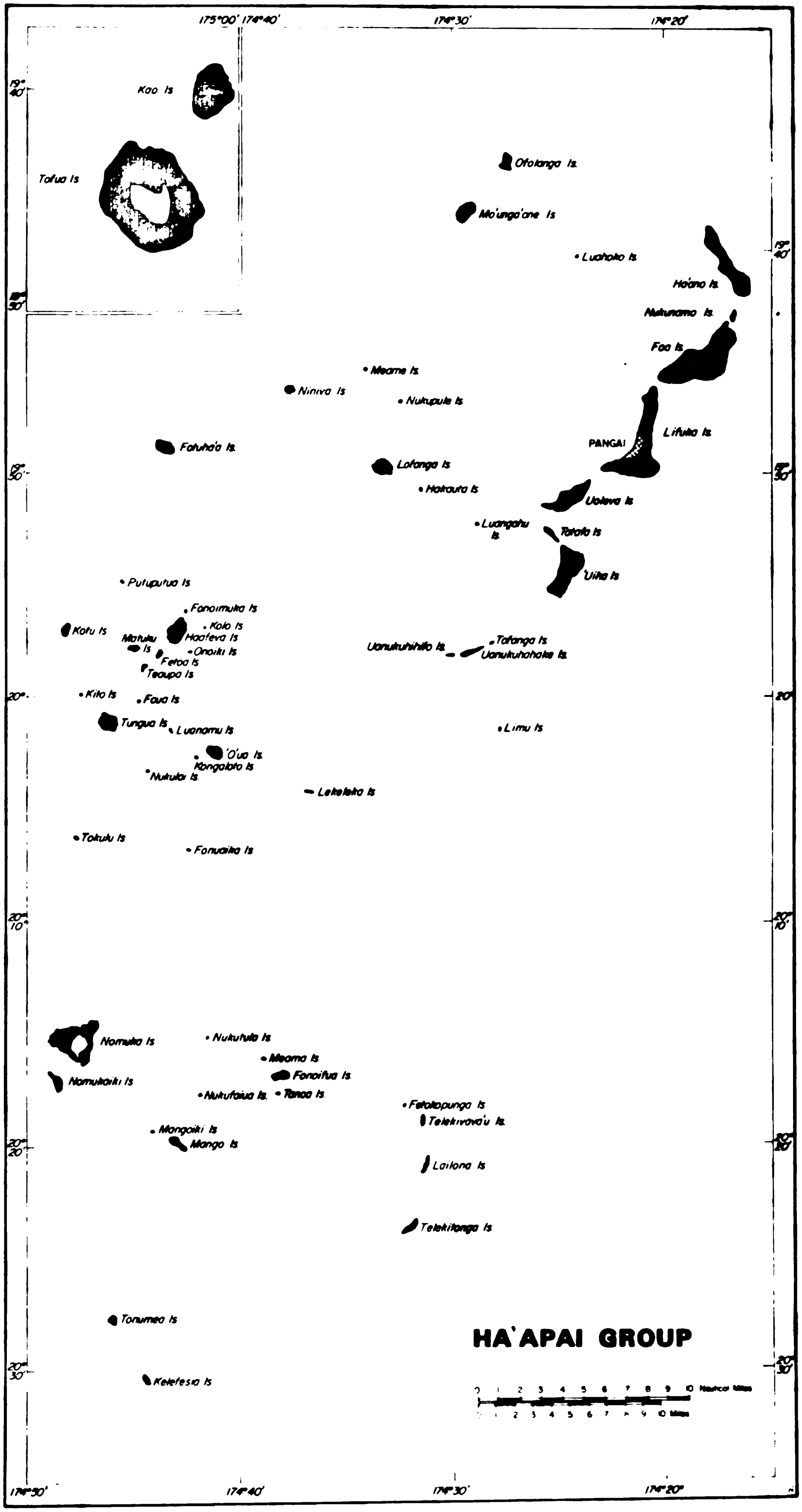
4C. Ha'apai group.

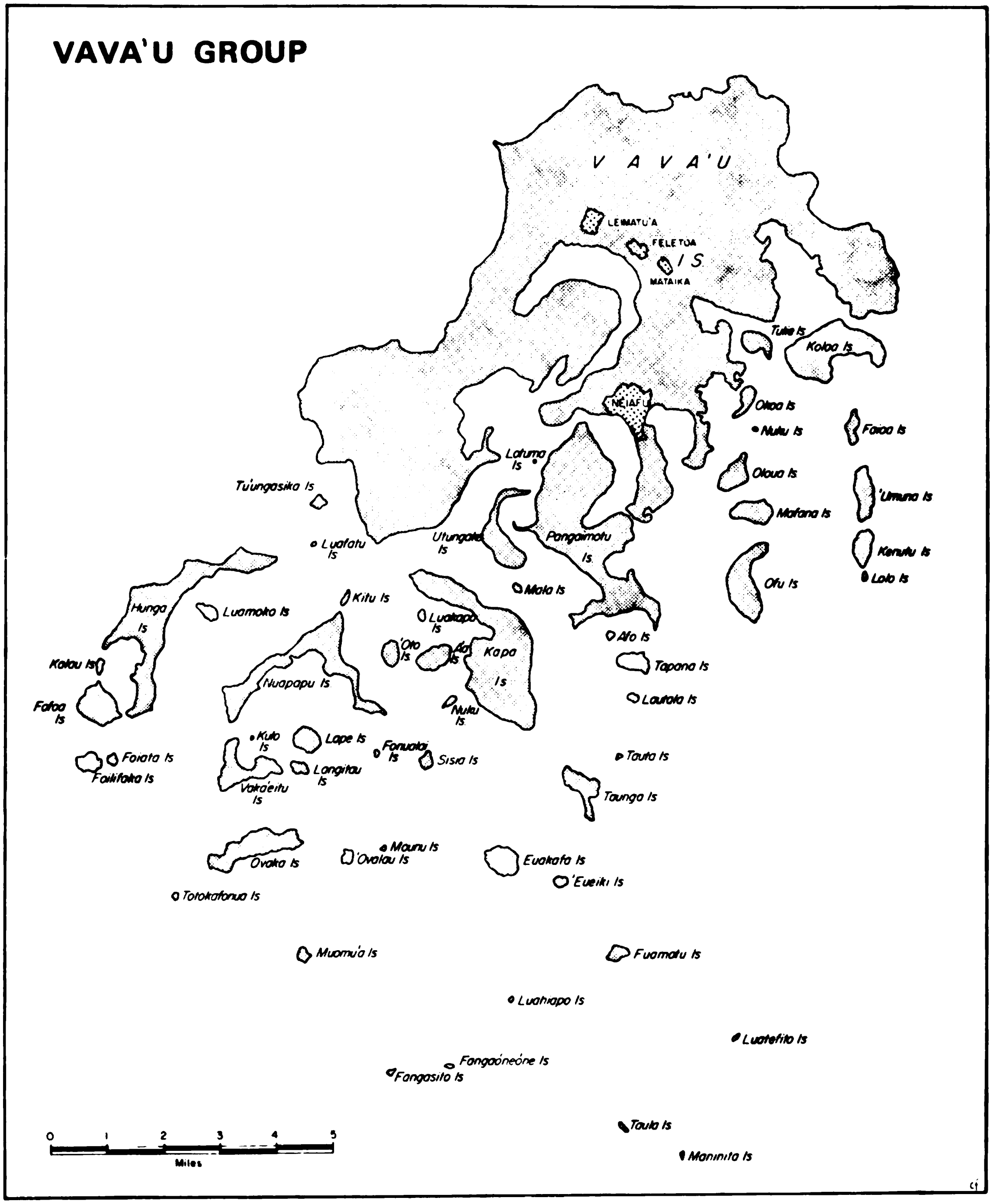
4D. Vava'u group.


KINGDOM OF TONGA
Showing the Territorial Boundaries
Niua Fo'ou Is
Tafahi Is
Niua Toputapu Is
Fonuolei Is
VAVA'U GROUP
Vava'u Is
Hunga Is
Pangaimotu Is
Kapa Is
Late Is
S O U T H
Kao Is
Tofua Is
HA'APAI GROUP
Falcon Is
Hunga Ha'apai Is
Hunga Tonga Is
P A C I F I C
Eua'iki Is
Tongatapu Is
TONGATAPU GROUP
Eua Is
Kalau Is
Ata Is
O C E A N
NOT ON THE SAME SCALE
Miles
177°
176°
175°
174°
173°
15°
16°
18°
19°
20°
21°
22°
22° 30'
23° 30'



TONGATAPU GROUP


Kao Is
Tofua Is
Ofolanga Is
Mo'unga'one Is
Luahoko Is
Ha'ano Is
Foa Is
Meama Is
Niniva Is
Nukupule Is
Fotuha'a Is
Lofanga Is
PANGAI
Lifuka Is
Haafeva Is
Uoleva Is
Luangahu Is
Tatafa Is
Uiha Is
Putuputua Is
Fonoimuka Is
Kolo Is
Kotu Is
Matuku Is
Onoiki Is
Fetoa Is
Teaupa Is
Tofanga Is
Uanukuhahake Is
Kito Is
Faua Is
Tungua Is
Luanamu Is
Limu Is
'O'ua Is
Kongaloto Is
Nukulei Is
Lekeleka Is
Tokulu Is
Fonuaika Is
Nomuka Is
Nukutula Is
Meama Is
Fonoifua Is
Nomukaiki Is
Nukufaiua Is
Tonoa Is
Fetokopunga Is
Telekivava'u Is
Mangoiki Is
Mango Is
Lalona Is
Telekitonga Is
Tonumea Is
Kelefesia Is
HA'APAI GROUP
Nautical Miles
Miles
175°00'
174°40'
174°30'
174°20'
174°50'


VAVA'U GROUP
V A V A ' U
I S.
LEIMATU'A
FELETOA
MATAIKA
NEIAFU
Tuie Is
Koloa Is
Okoa Is
Nuku Is
Faioa Is
Oloua Is
'Umuna Is
Mafana Is
Kenutu Is
Lolo Is
Ofu Is
Lotuma Is
Tu'ungasika Is
Luafatu Is
Utungake Is
Pangaimotu Is
Mala Is
Kitu Is
Hunga Is
Luamoko Is
Luakapa Is
Kapa Is
'Oto Is
Afo Is
Tapana Is
Kalau Is
Nuapapu Is
Nuku Is
Lautala Is
Fofoa Is
Kulo Is
Lape Is
Fonualei Is
Sisia Is
Tauta Is
Foiata Is
Foiifoko Is
Langitau Is
Vaka'eitu Is
Taunga Is
Maunu Is
Ovaka Is
'Ovalau Is
Euakafa Is
'Eueiki Is
Totokafonua Is
Muomu'a Is
Fuamotu Is
Luahiapo Is
Luatafito Is
Fangaoneone Is
Fangasito Is
Taula Is
Maninita Is
0 1 2 3 4 5
Miles

1. Subaerial volcanic islands, formed above the sea by volcanic action.

2. Raised marine volcanic islands formed beneath the sea and elevated, composed of both volcanic material and limestone.

3. Islands formed entirely from limestone.

The volcanic islands to the west form a line extending Northeast to Southwest, approximately parallel to the long axis of the group. Raised marine volcanic islands are found in the Southern Ha'apai group and the island of 'Eua. Limestone islands comprise Tongatapu, the Vava'u group and the Northern Ha'apai islands. The material of this latter group is entirely of coral origin which seems to have been formed by the elevation of the various atolls through geologic history (Pacific Islands, Vol. III, 1944, pp. 15-21).

The islands have experienced volcanic activities in historic time which, while not always severely damaging, have caused evacuation of some islands. It is also significant to note this activity has contributed to the soil fertility of the islands adjacent to an eruption through the spreading of volcanic ash over the area. The majority of this activity is found in the western chain of islands away from the mainstream of Tongan life located on the coral limestone islands to the east (Pacific Islands, Vol. III, 1944, pp. 15-21).

Geographically, the islands of Tonga are found in three distinct groups spread along a 500 mile North-to-South axis (Figure 4A). These groups are: Vava'u to the Northeast, the central islands of Ha'apai, and Tongatapu to the Southwest. The

majority of population, social, political and economic activity is found on Tongatapu centering on the capital, Nuku'alofa.

The distance over which the islands are spread allows some variety in climate. Temperature is, on the whole, equable. The absolute maximum seldom rises above 90°F or falls below 80°F. The temperature minimum seldom reaches above 70° or falls below 50°F. For most of the year the mean temperature is between 70° and 80°F. As is often the case in tropical locals, seasonality is measured in terms of wet and dry periods. Rainfall in Tonga occurs on the average of 170 days during the year in progressively heavier amounts northward (Table 27). The wet season spans the months from December to April. Dryer periods and occasionally droughts occur from May through November. Overall averages for rainfall vary from 67" in the South, to 117" in the North.

Coupled with the advantages of a warm temperature range and an adequately distributed rainfall, Tonga possesses a third basic

TABLE 27.--Mean Annual Rainfall: 1932-1940.

Tongatapu	65 inches
Ha'apai	67 inches
Vava'u	75 inches
Niua Toputapu	95 inches
Niua Foou	121 inches

SOURCE: Pacific Islands, Vol. III: Western Pacific (Tonga to Solomon Islands) (Washington: Naval Intelligence Division, 1944).

agricultural necessity, rich soil. Except on the volcanic islands, the soils are predominantly clay loams derived from coral limestones and weathered volcanic ash material. The eastern islands, which contain the bulk of population and production activity, are close enough to the volcanic chain to the West to have received numerous coatings of volcanic ash through geologic history. The result is the presence of a much more fertile soil than is normally found in a coral island environment (Kennedy 1961, p. 66).

The soils of the islands may be seen as two general layers (Plate 13). The lower layer is comprised of older volcanic ash material which has undergone little weathering but shows evidence of water action, i.e., percolation and some leaching. The clay content, though as high as 90 percent, does not prevent water passage or pose any significant potential for hardpan or claypan development. The upper level (actually a topsoil layer of up to three feet in depth) consists of approximately 60 percent clay, and is also weathered volcanic ash material. An examination showed the soil to have an excellent structure with particle size generally in the 1-2 cm. range. The structure is also strong as evidenced by its friable character. However, owing to the average particle size and generally young appearance of the soils in profiles examined, it remains very permeable and possesses few water retention qualities (Hougland 1974).

Soil mineral characteristics are also generally favorable. Those examined where high in calcium, magnesium, and potassium. However, nitrogen deficiency in some areas may be noted. This is

Plate 13.

Profile of Tongan Soil: Tongatapu.

Plate 14.

Severe Soil Erosion: Vava'u.

likely owing to the combination of a number of factors, both physical and cultural, not the least of which are rainfall, general weed and grass growth and the custom of burning acreage prior to planting.

The key to the maintenance of soil fertility in the islands under the present pattern of cultivation is the system of "bush fallowing" and close planting of crops which results in the retention of some humus in the soil (Great Britain Colonial Office 1956-64, p. 20). This, along with the soil characteristics described, make some minor leaching and nitrogen depletion the major problems regarding the soil's physical properties.

Vegetation is luxuriant and includes most typical tropical types with a number of superimposed imported varieties, particularly food producing plants. In addition to introduced food crops, an undesirable feature of plant life which has been introduced is weeds which pose problems for agriculture as well as being a bother to the human element (Pacific Islands, Vol. III, 1944, p. 37). The most significant of these are the grasses, including Nut, Guinea and Johnson varieties (Jansen 1973).

Forestry potential presents perhaps the most valuable aspect of natural vegetation aside from food production. The total area of all forest lands comprises approximately 26,000 acres which are confined to the islands of 'Eua and Vava'u. This resource is owned and managed by the government. However, it is presently of little commercial value due to the problems of resource inaccessibility and transportation of the milled production. Most activity in this

sector is directed to the construction of banana cases and local housing construction. It should be noted, however, that since 1954, the Tongan Department of Agriculture has begun a small scale reforestation program designed to determine the feasibility of developing this as an exportable economic resource (Great Britain Colonial Office 1956-64, p. 22).

Other species of vegetation which are culturally important to Tongans are those which produce the majority of the nation's food. These include the breadfruit, coconut, banana and various root crops.

Until recently, Tonga has had the distinction of being one of the few Pacific territories which could be called a self-supporting community (Harris 1966, p. 127). Economically, Tonga is essentially an agricultural country. There are no notable developed mineral resources and the only industry consists of minor processing facilities for agricultural products. Economic necessities from outside the islands are paid for by exports of bananas and coconut products in most cases. Until recently, Tonga enjoyed a favorable balance of trade. However, this balance has tended to reverse in the past few years with the tendency toward larger and larger deficits as shown in Table 20.

The population in the past has been in the position to plant a large portion of their food requirements. Any cash requirements were usually provided through the sale of bananas and coconuts to regional collection points (Great Britain Colonial Office 1956-64, p. 11). This subsistence system is rapidly altering due to increasing

pressures of population upon the land. The result of this pressure is seen in part in a growing dependency on imported foodstuffs.

Exports have been the only significant source of income for the Kingdom, though earnings from tourism and overseas remittances are becoming increasingly important. Of this trade, copra, bananas, and pineapples represent the only items traded in quantity internationally. Copra currently accounts for more than 70 percent of the total exports and, therefore, the export income of Tonga is largely at the mercy of fluctuations in world copra prices (Kennedy 1968, p. 20; Britten 1968, p. 53).

A diversification of export crops is possible under existing environmental conditions. However, the isolation of Tonga from international trade routes coupled with distance from markets make large scale diversification unlikely in the near future.

Fundamental in the economy of any agricultural nation is the policy formation regulating land use by the native element. In Tonga, ultimate title to all land rests with the King. However, every individual is entitled to an eight and one-qaurter acre farm lot and a two-fifths acre town lot. Obviously, in light of the growing population situation, the plan cannot work as the policy intends. However, in the past the policy had the effect of allowing most people the opportunity to plant and earn a subsistence living from the earth. The law, at present, states that males upon reaching 16 years of age are required to register with the government for tax purposes. At the same time, all are invited to

register for their land allotment called an "'api." However, with the upsurge in populaton, there simply is not enough land to go around. The King of Tonga, in a report to the nation's Legislative Assembly (October, 1967) told of "39,837 males in the Kingdom who are, or will be, entitled to tax allotments, there are currently only 13,017 allotments to distribute to them" ("There's Not Enough Land . . ." 1967, p. 37).

APPENDIX B

RESEARCH SURVEY

APPENDIX B

RESEARCH SURVEY

(Demographic)

1. Location _____ Urban_____

   _____ Rural_____

2. Type of Household

   Single family _____ Multiple family _____

   Family and relatives_____ Mult. family and rel. _____

   Family and friends _____ Mult. family and friends____

3. Age-Sex Structure

   0-2_____ 10-14_____ 25-29_____ 50-59_____

   3-5_____ 15-19_____ 30-39_____ 60-69_____

   6-9_____ 20-24_____ 40-49_____ 70+ _____

4. Occupational and Educational (Household Head)

   Educ: Primary_____ Univ._____

   Secondary_____ Tech. Sch._____ Type of Train._____

   Occup.: Agri._____ Skilled_____ Share_____

   Fish_____ Wt. Collar_____ Unemp._____

   Unskilled___ Self Employ.____ Location of Emp.___

(Migration)

5. Time household lived in present location

   0-1_____ 5-9_____ Life_____

   2-5_____ 10+_____

6. If less than life in same village

   Other places lived and how long prior, or between moving to

   T._____ _____

   H._____ _____

   V._____ _____

7. Does this household intend to remain permanently in this village?

   Yes_____ No_____

   Why?_____

8. Why moved to this village

   Employment_____ Health Care_____ Relatives_____

   Land _____ Food Avail._____ Friends _____

   Educ. _____ Religion _____

   Other_____

9. Household members who have left or entered in past year

   Sex_____ Age_____ Loss or gain_____

   Perm. or temp._____ Where_____

   Reason for move_____

(Land)

10. Size and location Town_____ Ac._____

    Tax_____ Ac._____

    Distance from dwelling _____ mi.

    Landless_____ Reason_____

11. Considering existing land tenure system satisfactory.

    Yes_____ No_____

    Reason_____

12. Do any other people use the same land for any type of Agri. production?

    No_____ Yes_____

    How long_____ Type of use_____

    Reason for use_____

13. Number of people supported from land_____

14. What is the best size for a Tongan 'api_____ac.

(Agriculture Production)

15. Who operates farm: Head_____ Family_____ Others_____

16. Main crops grown by household during 1973-74.

    Main Crops Amt. Grown

    _____ _____ ac. yield_____ Single Crop_____

    _____ _____ ac. yield_____ Double Crop_____

    _____ _____ ac. yield_____ Triple Crop_____

    Fallow land_____ac.

17. Fallow usage (ex. coconuts)_____

    Time in fallow_____ Hist. increase_____ Decrease_____

18. Livestock, 1973-74

	Head	Slaughtered		Given Away		Sold	
Horse	_____	_____	_____%	_____	_____%	_____	
Cattle	_____	_____	_____	_____	_____	_____	
Goat	_____	_____	_____	_____	_____	_____	
Pig	_____	_____	_____	_____	_____	_____	
Fowl	_____	_____	_____	_____	_____	_____	
Other	_____	_____	_____	_____	_____	_____	

19. Length of time (day) spend working farm lot_____ hr.

Work for others: No_____ Yes_____ Payment_____

20. Use of farm equipment, and farm fertilizer

knife _____ spade_____ tractor_____

hoe _____ ax _____ own equip.: No_____ Yes_____

stick _____ plow _____ equip. not owned____

Use animal manure: No_____ Yes_____

Human manure: No_____ Yes_____

Commercial fert.: No_____ Yes_____

Frequency of usage of fert._____yr.

21. Use of fertilizer, seed, spray, dust, 1973-74

	Frequency	Amount	Where Obtained	Cost
Fert.	_____	_____	_____	_____
Seed	_____	_____	_____	_____
Spray	_____	_____	_____	_____
Dust	_____	_____	_____	_____
Tin prot. strips	_____	_____	_____	_____
Pest Control	_____	_____	_____	_____

22. Major limiting factor to increased prod. on farm in order of importance.

Lack of land_____

Disease of crops_____

Pest destruction_____

Use of produce by others_____

23. Is Agriculture important to this household as a means of livelihood?

Very _____ Not important_____

Important_____ Don't know_____

24. Occupational rating and reasons for preference

Agri._____ Prof._____ Self. employed_____

Fish_____ Skilled_____ Wage-earning labor_____

Other_____

Reason_____

(Income)

25. What income was earned by household members in nonagricultural employment:

Member	Occupation	Where	Earning	wk.	mo.

26. Livestock and crop sold during year:

Commodity	Quantity	Value	Where sold

27. Fishing produce sold:

Commodity	Quantity	Value	Where sold

28. Other sources of income (handicrafts, etc.):

Source	Type of income	Amount	Where sold

(Expenditure)

29. Food per week bought:

Item	Quant.	Cost (Unit)	Where bought	Meth.of Pay

Total food value per week_____

30. Farm needs during year:

Item	Quant.	Cost	Where bought	Meth.of Pay

31. Other spending during year (approx.):

Clothing_____ Church_____

School_____ Other_____ Value_____

_____ _____

_____ _____

(Household Possessions)

32. Does this household possess:

Radio	_____	Food cabinet	_____	Community H_2O	_____
Telephone	_____	Electricity	_____	Indoor toilet	_____
Refrig.	_____	Indoor H_2O	_____	Indoor washing	_____

(Attitude to Population Size)

33. Is this household overcrowded: No_____ Yes_____

If No____, will you have any more children? No_____ Yes_____

34. Is this village overcrowded? No_____ Yes_____

Is this island overcrowded? No_____ Yes_____

Is Tonga overcrowded? No_____ Yes_____

Will Tonga be overcrowded in the future? No_____ Yes_____

When?_____

What is the best number of population for Tonga?_____

Religion_____

35. How many children is best for a Tongan family?_____

36. Does any member of this household use or subscribe to any form of birth control?

Member	Type of BC	How long
_____	_____	_____
_____	_____	_____

37. Is family planning important for this household? No___ Yes___

Is family planning important for Tonga? No___ Yes___

38. Is the present family planning program adequate for Tonga?

No_____ Yes_____

39. Do you consider Tonga's growing population associated with problems of

Unemployment _____ Lack of available land _____

Lack of education _____ Difficulty of food prod._____

(Child Survey)

40. Sex_____ Age, Yr._____ Mo._____ Date of Birth_____

Height _____ cm. Weight_____ kg. Breastfed_____ Time_____

41. Left arm circum. _____cm.

Left arm tricep Sf. _____mm.

42. Hair sample taken? No_____ Yes_____

43. General appearance

Skin_____ Eyes_____ Hair_____

Teeth_____ Frank Nutr. disorder_____

44. How often does this household have: (week days) Meat:

Mutton_____ Tinned____ Fresh____ Bread_____

Beef_____ Tinned____ Fresh____ Biscuit_____

Pork_____ Tinned____ Fresh____ Rice_____

Fish_____ Tinned____ Fresh____ Butter_____

Poultry_____ Tinned____ Fresh____ Coconut milk_____

Milk_____ Coconut flesh_____

Tinned sweetened_____ Yam_____ Soft drinks_____

Powdered_____ Potato_____ Canned jam_____

Fresh_____ Taro_____ Alcoholic_____

Cassava_____ Flour (pd.)_____

Sugar (pd.)_____

45. Dietary Recall (24 hr. for _____)

Breakfast Lunch Dinner Other

APPENDIX C

DATA COLLECTION CRITERIA

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DATA COLLECTION CRITERIA

Physical Examination

In conjunction with the population survey a brief physical examination of each preschool child residing in the sample households was conducted. The following indicators of nutritional and general well being were noted:

1. Skin changes. Careful observation was especially given for flake-paint dermatosis, which may characterize severe protein malnutrition. However, only one such case was noted and that child was a weaning infant and too young for inclusion in the survey sample. Skin areas with open wounds resembling burns or infection were examined also. Though the incidence of infection was quite common within the urban sample, it was impossible to directly attribute any to nutritional disorders alone, and probably reflect the effects of the total urban environment.

2. Edema. Each child's feet, ankles, hands and wrists were examined for this characteristic of severe protein malnutrition. Several cases of this, in generalized form, were observed in the urban sample, although absent in rural areas. Several infants, not included in the sample, were also noted as having this condition.

3. Eyes. Vitamin A deficiency symptoms were noted to be common throughout Tonga. Parents frequently indicated that their

children showed symptoms of night blindness. Bitot spots, xerosis, xerophthalmia and keratomalacia were also noted.

4. Hair changes. Principally, dyspigmentation of hair color from the characteristic black to a reddish brown was noted. However, the possible use of domestic or imported dye (frequently perceived as a status item) lessened the reliability of these observations. None the less, microscopic examination of hair samples verified that changes in pigmentation were greater within the urban sample.

5. Muscle wasting. This condition was noted in only one case in the total sample. Given the high caloric and starch diet of the Tongan, it is reasonable that such cases are rare.

6. Anthropometric indicators. Each child's height, weight, left arm circumference and tricep skinfold measurements were recorded. Height was taken using a vinyl tape, in conjunction with a back and head rest. The circumference measurement was acquired following the standard procedure of measuring halfway between the acromial process of the scapula and the point of the elbow. Weight was taken using a bathroom scale, adjusting the reading to zero prior to each weighing. Skinfold measures were taken three times and the average was recorded.

7. Hair. Hair specimens were also obtained from each preschool child examined. Care was taken to obtain specimens having the hair root intact. The procedure followed that outlined by Bradfield (1972), and varied only in the number extracted from each

child.[1] Samples were stored in numbered postage envelopes for transit from Tonga, the numbers corresponding with those of the appropriate survey forms.

Examination and analysis of collected specimens also followed the procedure outlined by Bradfield. Samples were first separated by growth phase (i.e., anagen [growing], telogen [resting]) followed by a classification of morphological changes in each phase. Bulb diameter was determined, using a standard disecting microscope equipped with a micrometer eyepiece. Two measurements for each sample were taken and the average determined. The percent of atrophy (an atrophied bulb is shrunken, having a shriveled appearance and a considerable decrease in bulb diameter) was also determined.

Alterations in bulb, sheath and hair shaft were also noted and classified, although growth phase, root bulb diameter and percent of atrophy were of prime importance to the research. Results of the above were then compared with the figures in Table 26, which suggests standards for preschool children. The standards formulated by Bradfield were developed from studies of children with Asian and Negroid hair types.

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[1]Because root presence was determined at the time of collection, fewer hairs were necessary than that suggested by Bradfield (1971, p. 70).

Tinned Mean Samples

Two samples of tinned meat were purchased in Tonga and subsequently analyzed upon completion of the data collection process. The selection of the meat samples was based upon the criteria which influence their consumption by the Tongan people: (1) availability throughout the islands, determined during price surveys in village and urban shops; and (2) price, K. & R. brand Corned Meat Loaf being usually the cheapest of the tinned meat products of comparable variety. It appeared that the large-scale consumption of the meat loaf was based solely upon price as it was perceived to have the lowest prestige value of all tinned meats. Globe Corned Beef, the other tinned meat sample selected, enjoyed a much higher status ranking but had a medium price, making it more acceptable than products advertised to be better quality tinned beef products.

Each product was analyzed by proximal determination, which supplied values for protein, fat, moisture and ash. Carbohydrate values were determined by the subtraction of the total values for protein, fat, ash and moisture from 100 percent. The Kjedahl-Total Nitrogen method as described by McKenzie was used to determine the protein content while fat content was discovered using the Soxhlet method (McKenzie and Murtphy 1970, p. 158). Moisture was determined by weighing a sample of the product, vacuum drying it at 100°F for 5 hours, and then reweighing it. Ash content determination called for charred samples being placed in a Muffle oven at 500°C for not less than 6 hours.

Two samples of each product were analyzed, as explained above, and the averages were calculated. The results were presented in Table 21.[1]

Fresh Meat Samples

Fresh meat samples imported from Australia and representative of available supplies found in Nuku'alofa were also purchased in four stores. Prices of the product varied from T.50 to .70 per pound. (At the time of purchase, October, 1974, U.S. $1.00 equaled T.63.) Small samples of the meat were weighed on a standard Welch balance. Surface fat was removed from each using an ordinary paring knife, followed by weighing. Next, samples were placed in boiling water for four minutes. Recognizing that much of the weight of the melted fat was replaced by water, attempts were made to thoroughly dry each sample over slow heat, prior to reweighing. Although this procedure is not the recommended methodology for fat determination of fresh meat samples, the results nonetheless provide a crude approximation of value. The results of this procedure are presented in Table 28.

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[1] A complete explanation of the procedures used in this analysis may be found by consulting the Official Methods of Analysis of the Association of Official Analytical Chemists 1970.

TABLE 28.--Determination of Fat and Lean Content in Fresh Meat (Beef) Samples Available in Nuku'alofa.

	Purchased Weight (Gm)	Weight Following Surface Fat Removal (Gm)	Weight Following Boiling and Drying (Gm)	Tissue (%)	
				Fat	Lean
Sample #1	148.4	65.0	45.1	69.61	30.39
Sample #2	263.4	111.1	87.8	66.67	33.33
Sample #3	168.2	38.1	28.4	83.12	16.88
Sample #4	225.5	75.3	57.7	74.42	25.58
Average	201.4	72.4	54.8	73.46	26.37

SELECTED REFERENCES

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Acker, D. Animal Science and Industry. Englewood Cliffs, New Jersey: Prentice-Hall, 1971.

An Economic Survey of Tonga: 1970. Nuku'alofa: Government Printer, 1970.

"Banana Exports Have Declined Sharply." Tonga Chronicle, August 8, 1974.

Berg, A., and Muscat, R. "Nutrition and Development: The View of the Planner." American Journal of Clinical Nutrition 25 (February 1972): 186-205.

"Big Increase in Tonga's Population." Pacific Islands Monthly, September, 1967, p. 26.

Bradfield, R. B. "A Rapid Tissue Technique for the Field Assessment of Protein-Calorie Malnutrition." American Journal of Clinical Nutrition 25 (July 1972): 720-729.

_____. "Protein Deprivation: Comparative Response of Hair Roots, Serum Protein and Urinary Nitrogen." American Journal of Clinical Nutrition 24 (April 1971): 405-410.

Britten, E. J. "The Problems of Agricultural Education in the South Pacific." South Pacific Bulletin (Second Quarter, 1968): 21-24.

Brozek, Josef. Body Measurements and Human Nutrition. Detroit: Wayne University Press, 1956.

Catley, A. "Rhinoceros Beetle Project." South Pacific Bulletin (Second Quarter, 1969): 15-17.

Chan, George L. "Health Problems of Coral Atoll Populations." South Pacific Bulletin (Third Quarter, 1967): 24-26.

Clark, William F. Data Collected Through Personal Survey. Kingdom of Tonga, August-October, 1974.

"Crime: Tonga's Growing Problem." Pacific Islands Monthly, January, 1970, p. 20.

Crocombe, R. G. Improving Land Tenure. Noumea, New Caledonia: South Pacific Commission, 1968.

_____, ed. Land Tenure in the Pacific. Melbourne: Oxford University Press, 1971.

Cumberland, K. B. Southwest Pacific. New York: F. A. Praeger, 1968.

Curson, P. M. "The Migration of Cook Islanders to New Zealand." South Pacific Bulletin (Second Quarter, 1973): 15-25.

"Don't Lose Touch with the Land." Pacific Islands Monthly, November, 1969, p. 47.

Emory, K. P. "The Coming of the Polynesians." National Geographic, December, 1974, pp. 732-745.

Eva, Alo. Vaiola Hospital, Nuku'alofa, Tongatapu. Interview, September 24, 1974.

Fanamanu, J. "Training in Family Planning in Tonga." South Pacific Bulletin (Second Quarter, 1969): 18-19.

Fiefia, S. N. Report of the Results of the 1966 Census. Nuku'alofa: Government Printer, 1968.

"Five Year Plan to Pull Tonga's Finances Together." Pacific Islands Monthly, August, 1966, pp. 11-12.

Fox, Morris G. An Exploratory Visit to the Kingdom of Tonga. Noumea, New Caledonia: South Pacific Commission, 1972.

Friis, H. R., ed. The Pacific Basin. New York: The American Geographical Society, 1967.

"Genesis, Chapter 41, Verses 25-36." The New English Bible: The Old Testament. New York: Oxford University Press and Cambridge University Press, 1970.

Gifford, Edward W. Tongan Society. Honolulu: B. P. Bishop Museum, Bulletin #64, 1929.

Grathan, C. H. The Southwest Pacific Since 1900. Ann Arbor: University of Michigan Press, 1963.

Great Britain Colonial Office, Report: Tonga (1954-1963). London: Her Majesty's Stationery Office, 1956-64.

Green, R. C. "Tonga's Prehistoric Population." Pacific Viewpoint 14 (May 1973): 61-74.

Green, R. C., and Kelly, M., ed. Studies in Oceanic Cultural History. Vol. I. Honolulu: B. P. Bishop Museum, 1931.

Hansell, F. M. S. "Tonga." Unpublished South Pacific Commission Study, Noumea, New Caledonia, 1962.

Harr'e, John, ed. Living in Town: Problems and Priorities in Urban Planning in the South Pacific. Suva: Mayfair Printers Ltd., 1973.

Harris, N. V. The Tropical Pacific. London: University of London Press, 1966.

Henderson, John W. Area Handbook for Oceania. Washington: U.S. Government Printing Office, 1970.

Horine, E. F. "Food and Nutrition in Urbanization: An Unmet Challenge." South Pacific Bulletin (Third Quarter, 1967): 43-46.

Hougland, Geoffrey. Government Experimental Farm, Tongatapu. Interview, October 7, 1974.

Jansen, A. A. J. Report on a Nutritional Survey in the Kingdom of Tonga (November 6-December 7, 1972). Report to the World Health Organization, Manila, April 17, 1973. Manila: W.H.O., 1973.

_____. "Nutrition of the Pre-School and School Child." South Pacific Bulletin (First Quarter, 1973): 37-43.

Jelliffe, D. B. The Assessment of the Nutritional Status of the Community. Geneva: World Health Organization, 1966.

Jelliffe, E. F., and Jelliffe, D. B. "The Arm Circumference as a Public Health Index of Protein-Calorie Malnutrition of Early Childhood." The Journal of Tropical Pediatrics 15 (December 1969): 177-188.

Kennedy, T. F. "Land, Food and Population in the Kingdom of Tonga." Economic Geography 37 (January 1961): 61-72.

_____. A Descriptive Atlas of the Pacific Islands. New York: F. A. Praeger, 1968.

_____. "Village Settlement in Tonga." New Zealand Geographer 14 (1958): 161-172.

"Kingdom of Tonga." Department of State Publication 8594. Washington: Office of Media Services, June, 1971.

Kingdom of Tonga: Statistical Abstract 1972. Nuku'alofa: Government Printer, 1972.

Krehl, W. A., and Hodges, R. E. "The Interpretation of Nutritional Survey Data." American Journal of Clinical Nutrition 17 (October 1965): 191-199.

Krumdick, C. L. "The Rural to Urban Malnutrition Gradient." Journal of the American Medical Association 215 (March 8, 1971): 1652-1654.

Kyokuyo, Hogai Co. Ltd. The Report on the Fishing Investigation in the Kingdom of Tonga. Tokyo: 1965.

Langi, Viliami. Ministry of Lands and Survey, Nuku'alofa, Tongatapu. Interview, September 24, 1974.

Malcolm, Sheila. Diet and Nutrition in American Samoa. Noumea, New Caledonia: South Pacific Commission, 1954.

_____. Nutrition Investigations in New Caledonia. Noumea, New Caledonia: South Pacific Commission, 1953.

"Man Behind Tonga's Family Planning." Pacific Islands Monthly, July, 1970, pp. 69-70.

"Map of the Kingdom of Tonga." Nuku'alofa: Ministry of Lands and Survey, 1969.

Massal, E. Dietary and Nutritional Problems of the Pacific. Noumea, New Caledonia: South Pacific Commission, April, 1954.

Maude, A. "Population, Land and Livelihood: The Kingdom of Tonga." Ph.D. dissertation, Australian National University, 1965.

_____. "Shifting Cultivation and Population Growth in Tonga." Journal of Tropical Geography 31 (December 1970): 57-64.

May, J. M. The Ecology of Malnutrition in the Far and Near East. New York: Harper Publishing Co., Inc., 1961a.

_____. Studies in Disease Ecology. New York: Harper Publishing Co., Inc., 1961b.

McArthur, N. Island Populations of the Pacific. Canberra: Australian National University Press, 1968.

McKee, H. S. Some Food Problems in the Pacific Islands. Noumea, New Caledonia: South Pacific Commission, 1957.

McKenzie, H. A., and Murphy, W. H. Milk Proteins; Chemistry and Molecular Biology. New York: Academic Press, 1970.

Mitchell, H. S.; Rynbergen, H. J.; Anderson, L.; and Dibble, M. V. Nutrition in Health and Disease. Philadelphia: J. B. Lippincott Co., 1968.

Mohan, M. "Population Problems in Fiji." Race 2 (May 1961): 70-77.

Murai, M.; Pen, F.; Miller, C. D. Some Tropical South Pacific Island Foods. Honolulu: University of Hawaii Press, 1958.

Nommacher, M. A.; Bradfield, R. B.; and Arrogave, G. "Comparing Nutritional Status Methods in a Guatemalan Survey." American Journal of Clinical Nutrition 25 (September 1972): 871-874.

"Now It's Valuable." Pacific Islands Monthly, February, 1967, p. 33.

Official Methods of Analysis of the Association of Official Analytical Chemists. 11th ed. Washington: Association of Official Analytical Chemists, 1970.

Olivier, Georges. Practical Anthropology. Springfield, Illinois: Charles C. Thomas, 1969.

Osborne, Charles. Australia, New Zealand and the South Pacific. London: W. and G. Baird Belfast, 1970.

"Outside Investment Invited for Tonga's New Five Year Plan." Pacific Islands Monthly, July, 1970, pp. 112-115.

Pacific Islands, Vol. III: Western Pacific (Tonga to Solomon Islands). Washington: Naval Intelligence Division, 1944.

Paine. R. W. The Banana Scab Moth: Its Distribution, Ecology and Control. Noumea, New Caledonia: South Pacific Commission, 1964.

Peters, F. E. Chemical Composition of South Pacific Foods. Noumea, New Caledonia: South Pacific Commission, 1957.

Rajalakshmi, R. Applied Nutrition. Baroda, India: By the Author, 1969.

Report of the Minister of Agriculture. Nuku 'alofa: Government Printer (various dates).

Report for the Ministry of Finance. Nuku'alofa: Government Printer (various dates).

Report of the Ministry of Health. Nuku'alofa: Government Printer (various dates).

Report of the Department of Justice. Nuku'alofa: Government Printer (various dates).

Report of the Ministry of Lands and Survey. Nuku'alofa: Government Printer (various dates).

Roberts, S. H. Population Problems of the Pacific. London: Routledge and Sons, 1927.

Rogers, Garth. "Some comments on the 'Report on the Results of the 1966 Census' Kingdom of Tonga, 1968." Journal of the Polynesian Society 78 (1969): 212-222.

Singh, I. P., and Bhasin, M. K. Anthropometry. Delhi: Bharti Bhawan, 1968.

"Statement of Trade and Navigation: 1973." Nuku'alofa: Government Printer, 1974.

Thaman, R. R. "The Role of the Tongan Agricultural System in Fulfilling the Subsistence Needs of the Tongan Society." R. W. Parkinson Memorial Lecture. School of Social and Economic Development, University of the South Pacific, September 26, 1974.

"The Community Water Supply and School Sanitation Programs in the Island Kingdom of Tonga." New York: U.N. Economic and Social Council, April 15, 1966, p. 2.

The Health Aspects of Food and Nutrition. 2nd ed. Manila: Regional Office for the Western Pacific of the World Health Organization, 1972.

"There's Not Enough Land to Go Round, Tonga's King Says." Pacific Islands Monthly, November, 1967, p. 37.

Tonga Chronicle. March 14, 1974, p. 5.

"Tonga's First Agricultural College Opens on Fertile 'Eua." Pacific Islands Monthly, November, 1969, p. 45.

Tudor, Judy, ed. Pacific Islands Yearbook and Who's Who. 9th ed. Sydney: Pacific Publications Ltd., 1963.

Tu'itavaka, S. U. Vaiola Hospital, Nuku'alofa, Tongatapu. Interview, September 24, 1974.

Tupouniua, 'Uli 'Uli. Report on the Results of the 1956 Census. Nuku'alofa: Government Printing Office, 1957.

U.S. Department of Health, Education and Welfare. Height and Weight of Children: Socioeconomic Status. Rockville, Maryland: Health Services and Mental Health Administration, 1972.

_____. Skinfold Thickness of Children, 6 to 11 Years. Rockville, Maryland: Health Services and Mental Health Administration, 1972.

Urban Problems in the South Pacific. Noumea, New Caledonia: South Pacific Commission, April, 1967.

Urbanization in the South Pacific. Noumea, New Caledonia: South Pacific Commission, 1962.

Walsh, A. C. "Population Changes in Tonga." Pacific Viewpoint 11 (May 1970): 27-46.

Watson, R. Rice Production in the South Pacific Region. Noumea, New Caledonia: South Pacific Commission, 1956.

"We Need Advice Say Growers." Pacific Islands Monthly, May, 1970, p. 141.

Wood, A. H. History and Geography of Tonga. Nuku'alofa: Government Printer, 1932.