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沖縄における「亜熱帯農業」の展開方向

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	作成者: 福仲, 憲, Fukunaka, Ken
	メールアドレス:
	所属:
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The direction of Development in Subtropical Agriculture in Okinawa*

Ken FUKUNAKA**

Key Words : Okinawan Agriculture, Subtropical Agriculture, Ancient Ryukyu Agricultural Papers.
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Summary

1. There is strong tendency to make the agriculture of mainland Japan a standard and to judge Okinawa's agriculture by how far it veered from that of the mainland. This kind of thinking, which views Okinawan agriculture as a 'deviation' from temperate agriculture, could be described as looking at the situation from one side only. However, if we consider the establishment of subtropical agriculture in Okinawa based on the principles of both northern temperate agriculture and those of southern tropical agriculture, we can achieve an all round view. This overall view is necessary to gain an accurate understanding of Okinawan agriculture. This means we should approach the cultures and characteristics of the people of the Ryukyu Cresent from a 'wide field viewpoint', as is the basic principle used in Okinawan Research. We should not look at Okinawa only from its relationship with Japan. We should try to see a borderless view that includes Southeast Asia, continental China, and the islands of the South Pacific as well.

2. The old Ryukyu Agricultural Papers (Kinsei-Noushou) describe farming technology which matches the natural conditions of the region, based on family run multi-crop farms. As we look to the future of Okinawan agriculture, we should take a step back to the principle of multi-crop farming. I think our best approach is to take the modern technologies we have developed already and create a new vision of how agriculture should be, based on the relationship of human beings to nature. I think this should be the starting point for the creation of 'Subtropical Agriculture' in Okinawa.

Introduction

The transformation of Okinawa's agriculture in recent years has been far and away

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** Department of Bioproduction, Faculty of Agriculture, University of the Ryukyus.

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the most radical in its history. It hasn't stopped at shifts in principal crops or at technological innovations such as the mechanization of production processes or capital investment in facilities, but has gone so far as to change the very structure of the farming industry. Even basic production organization patterns and farm management methods have changed. However, because not enough has been done to cope with these changes, farmers and farming communities are now facing critical and difficult problems.

For example, issues which agriculture and farming communities, the shift towards running farms as a side business, the aging of farmers, the difficulty in finding successors to take over farms, and the shortage of women who are willing to marry into farming families are more socio-economic than technological in nature. Not only in agriculture and forestry administration, but even in production techniques are hounded by economization (i. e. efficiency). As it is prioritized, the link with nature progressively breaks down. Of course, these problems are quite typical of what has been experienced by farming industry throughout Japan.

Recently, however, there has been a growing awareness of the need to revisit "regional agriculture" in Okinawa. This has been accompanied by a call for the establishment of "subtropical agriculture." The idea of "regional agriculture" was initially proposed as a policy in the "First Okinawan Development and Promotion Plan," created in December 1942, but to date it has been discussed only as a theoretical concept.

There are three basic ways one can try to understand the concept of regional agriculture. The first is to approach a given "regional agriculture" from an historical point of view (i.e. look at things from the flow of time). The second is to approach it from a geographical point of view by clarifying the characteristics of the "place" where it developed. The third is to approach it by using both "time" and "place" as variables, setting both historical and locational factors as intersecting axes of a graph[1]. In this study, I will focus first on the "place" of regional agriculture, and will investigate agricultural management and the direction Okinawa's agriculture should take based on the prefecture's geographic conditions.

1. Preconditions for Establishing "Subtropical Agriculture" in Okinawa

The Nansei Islands are comprised mostly of the Ryukyu Island chain of Okinawa, covering a broad expanse of ocean together with other smaller island chains such as the Daito Islands and the Sensaku Islands (Fig. 1)[2]. The Ryukyu Islands are a chain which stretches from Kyushu to Taiwan and is also known as the Ryukyu Cresent. Although the combined surface area of the islands is very small, they cover a broad geographical region and have their own unique natural environment. To make a comparison to the Japanese mainland, which fall within the temperate zone, "the Ryukyu Archipelago is a bow-shaped island chain which stretches 1,100 kilometers from Tanega Island in the north to Yonaguni Island in the southwest. The length of this string of islands is roughly equal to the distance between Aomori and Shimonoseki"[3] (the north and south tips of Honshu Island, the central of the four main islands which make up Japan). In this report, I will investigate the fundamental conditions which would be required to establish "subtropical agriculture" in the broad area of the Ryukyu Cresent.

What Is The Ryukyu Archipelago?

The Ryukyu Archipelago is the name used for a bow-shaped chain of islands that stretch over a total distance of approximately 1300 kilometers in the ocean between Kyushu and Taiwan. Strictly speaking, the Ryukyu Archipelago does not include the Daito Islands and the Senkaku Islands which are part of Okinawa prefecture today, because the name refers to the crescent shaped archipelago between the Ryukyu Trench and the Okinawa Channel. The name has the same basic meaning as the Ryukyu Crescent. The Ryukyu Crescent contains a total of 188 islands with a surface area of 0.01 sq. km. or greater, of which 68 are populated.

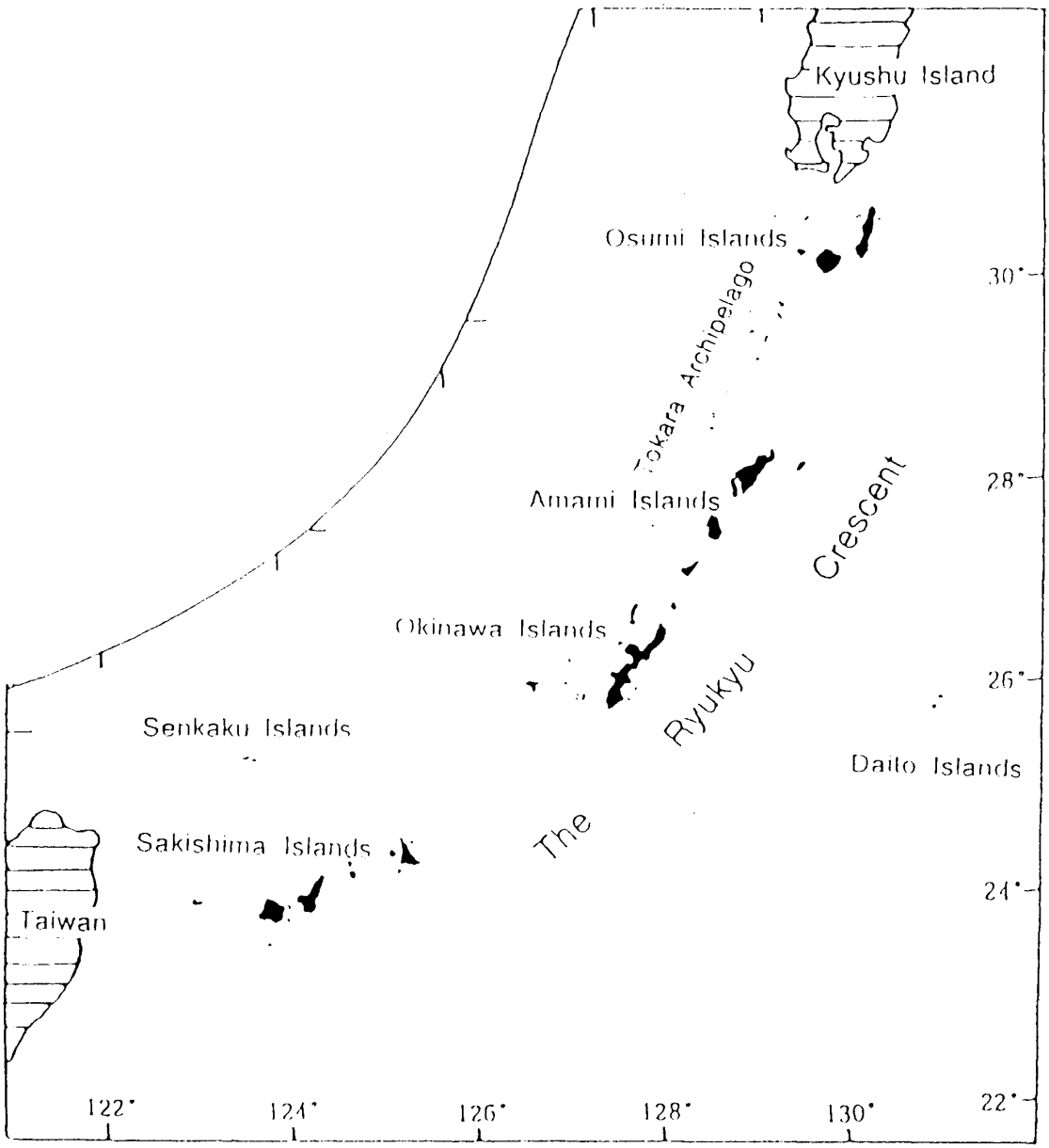

Figure 1: Rough Map of the Ryukyu Crescent

Note: Borrowed from Shigekazu Mezaki's, 'Throughout the Ryukyu Crescent' [2)]

1) Okinawa's Natural and Geographic Conditions

In viewing agriculture from a geographical point of view, there are two primary classes: temperate and tropical agriculture. The specific geographic conditions or concrete guidelines for third class, subtropical agriculture, which fall somewhere between temperate and tropical agriculture, have never been well-defined or agreed upon. However, Shiroma has stated, "Okinawa Prefecture is subtropical whether one judges from its latitude or temperature."[4] Nose, based his analysis directly on temperature:

> "Okinawa's average temperature, 22.1℃ for Naha and 23.6℃ for Ishigaki, would categorize it as subtropical. Its average annual precipitation, 2,178mm for Naha and 2,195 mm for Ishigaki, would be considered heavy. Therefore, if we follow T. Kira's method of classification, Okinawa's climate would be defined as wet subtropical."[5]

He later adds, "Okinawa weather, its higher summer temperatures and extended sunlight hours and warm, short winter days, occupies a unique weather niche." Furthermore, while Mezaki insists, "It is rather difficult to get a meteorological explanation that Okinawa's (climate) is subtropical and different from the mainland," based on the various natural features such as the existence of mangrove forests, organic red clay soil, coral reefs, and tropical karst. He has also said that:

> "even if one goes so far as to say that is this point in time it is not appropriate to assign Okinawa to the meteorological classification of 'subtropical', from the standpoint of its natural features, it certainly fits the subtropical image and 'subtropical' would be the most fitting name for the prefecture' regional climate."

From this analysis, Mezaki proceeded to include the "Ryukyu Cresent between 30° N latitude and the Takara Strait, including Okinawa" within category of subtropical.[6]

I understand all of the above opinions to have taken into account the characteristics of Okinawa's climate. Okinawa's climate differs from tropical climates in that, despite a high annual rainfall, there are no distinct dry or wet periods throughout the year. It is also different from temperate climates with an annual average temperature of 22℃～24℃, and generally mild weather throughout the year without any distinct seasonal changes (refer to Figure 2). The climate in the region is also different from that of the temperate zone in that the variation in temperature from year to year and from day to day is minute and the period of higher summer and hot tropical nights is long due to high temperature. Furthermore, this temperature is compounded by the warming effect of the Black Current surrounding the islands on all four sides, which on average is 2℃～3℃ warmer than the continent. The resulting warmer weather is said to be the special privilege of the Ryukyu Cresent. On the other hand, there is no precipitation in the form of snow or frost, there are cold seasonal winds, high humidity, and little direct sunlight in the winter months, all of which combined with the onslaught of typhoons, pose major obstacle to agriculture in the region. Furthermore, if we look at 'subtropical agriculture' in a broader sense, there are many dry subtropical regions between the Temperate and Tropical Zones around the globe, but wet subtropical regions such as the Ryukyu Cresent exist in only an extremely limited portion of the area covered by the Asian

Monsoons. This is a point deserving serious consideration.

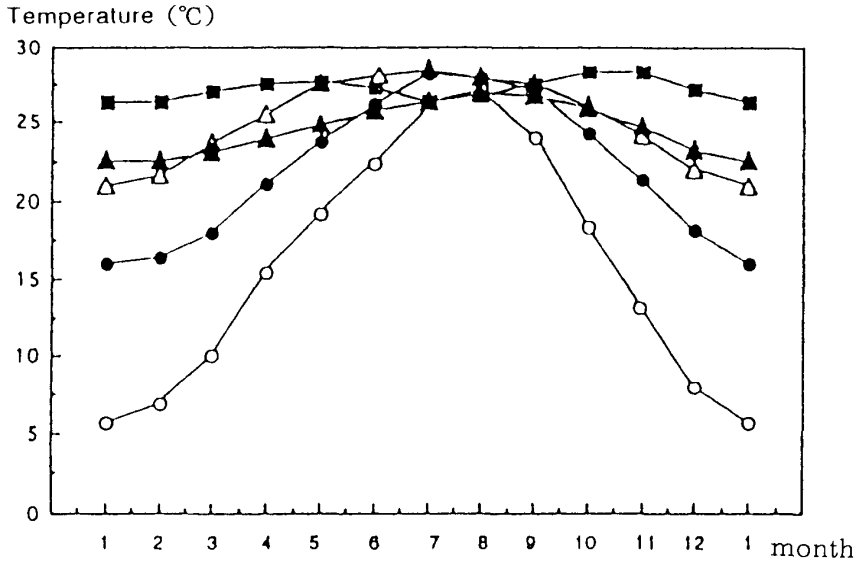

Figure 2: Average Monthly Temperature (℃) throughout the Year
●=Naha ; ○=Kouchi ; △、=Daichuu ; ▲、=Honolulu ; ■、=Jakarta
(Compiled from Rika Nenhyo (Science Almanac), 1991, Vol. 64, and the Japanese Meteorological Agency's Foreign Climate Charts, 1987)

2) The General Conditions of Okinawan Agricultural Production

Based on the explanation provided in the preceding section, I think it is safe to consider Okinawa as a wet subtropical climate within a larger subtropical ocean climate. But what types of agriculture production have come to these islands over the course of history? I would next like to review how Okinawa's geographical conditions affecting agricultural production by looking at changes in crop selection over the course of Okinawa' history.

Historically, Okinawa has raised both temperate crops from the north and tropical crops at the same time. However, I find that the further back we go in time, the more types of crops were being raised in the region. Of course, as is to be expected, the varieties of each crop were limited. Especially when the economy was still based on self-sufficiency, there was a rich variety of crops to cover all basic production and consumption needs (food, clothing, shelter). At the time, agricultural production was functionally organized throughout the entire region. This situation was markedly different from that in the temperate regions of Japan of the period, and made possible by the mild conditions of Okinawa's wet subtropical climate.

A look at the types of crops raised around the end of the Meiji Period shows the main staples were sweet potatoes, rice, and sugarcane. There were also many types of grain, beans, gourds, leafy vegetables, fruits, and juice fruits as well as over 50 different crops for the production of perfumes and spices, textile fibers, beverage, dyes, and medicines. After the Meiji Period, the types and varieties of crops went through major changes as Japan shifted to an industrial goods economy. However, these changes can be summed up by their major characteristics as explained in the next paragraph.

The first major change during this period, as society adjusted from a self-sufficiency economy to a money-based trade economy, was a decrease in the types of crops. However, at the same time, crop varieties and strains increased. This was true for both the region as a whole, and for individual farms. Also, there were ups and downs among farm crops, craft crops, and garden products in each period. Most recently has been remarkable growth in garden products raised for transport to a central market. Most of these changes were caused by the forces of open-market competition.

The second major change was the shift to more temperate crops compared to tropical crops. Strains and varieties of these temperate crops increased as well. Agricultural policy played a major role in the changes at this time as can be seen in the introduction of new crop types and improvements in the strains. This policy did produce some positive results, but in most cases the techniques and methods of temperate agriculture were applied directly and without adaptation to Okinawa's wet subtropical climate which, at best, bordered the southern limit for the cultivation of these temperate crops.

The third major change in this period was shifts in principal crops. The shifting of principal crops has significant impact in any agricultural society. In the case of Okinawa, the pattern went from sweet potatoes to sugarcane and pineapples, then to vegetables, flowers, and fruit trees. However, the basic mixed pattern of both temperate and tropical crops remained unchanged throughout. In other words, agriculture did not break away from the established pattern and switch to a unique subtropical crop. Okinawa's climate in like a marriage between a temperate climate (mild winter and spring months) and a tropical climate (hot summer and autumn months). Currently, only by raising both temperate and tropical crops, and timing them so that they will become ripe during the mainland's off-seasons, can Okinawa's agriculture survive.

3) The Socio-economics of Okinawa Agriculture

Up to this point, I have looked at Okinawan agriculture from the standpoint of its natural/geographical condition, and how these affect agricultural production. Now I would like to investigate the historical socio-economic conditions which have affected Okinawan agriculture.

Okinawa Prefecture was created by the Ryukyu Dissolution of the early Meiji Period. Prior to that, the region existed as the independent Kingdom of the Ryukyus. The kingdom's territory was composed of the islands of the Ryukyu archipelago south of and including Ibeya Island. This division actually breaks up present day Okinawa prefecture as well as the Amami Islands, but it is the basic stance of 'Ryukyunesian Culture' or 'Okinawaology' that all of the islands of the Ryukyu Cresent share not only a common set of environmental conditions, but for the most part a common historical and traditional culture as well. From the viewpoint of the characteristics of regional agriculture, there is a much larger difference between Okinawan and Kyushuan agriculture than there is between Kyushu agriculture and that of the Kanto region of mainland Japan.

The basic farm management style of temperate Japan is known as 'wet field rice cultivation farming' based on dual principle crops of rice and wheat. This style of

farming works best in a system of small scale, family (family labor management style) farms. On the other hand, in most tropical agriculture, the basic trend has been low yield self-sufficiency agriculture by native peoples. Historically, this self-sufficiency agriculture has been replaced by either monocultural plantation or estate farming of single crops such as coffee or sugarcane as a result of Western European colonization, to the gradual takeover of local farmland by a company or individual involved in the production of raw materials. In the latter case the native peoples were generally labored on the farms as tenants. In some countries, these historical practices have carried over to the present and tenant farms or plantations still are in existence. From this situation it is plain to see that there are major historical differences between temperate and tropical agriculture. These differences cover not only the crops raised or farm management style, but the very character of society as well.

What was the case with Okinawan agriculture in the Ryukyu Cresent? The basic farming pattern was 'dry field sugarcane cultivation farming', featuring a combination of family farming similar to that of the mainland, and the raising of both temperate and tropical crops. Therefore, it can be seen that although Okinawan agriculture developed along the same line as temperate agriculture technology, at the same time it contained certain elements of tropical agriculture. The elements of tropical agriculture are exemplified by the role of tropical plants such as sugarcane and pineapples as traditional principal crops. However, even when tropical crops were raised for use as raw materials, there was a unique Okinawan aspects in the absence of economic enslavement of the labor force to the processing/manufacturing companies. In this sense, Okinawan agriculture can be said to be symbolic of the character and the transformation of sugarcane farming to the present day. I think this is the subject which merits further future investigation.

In summation, it can be said that the basic conditions of Okinawan agriculture in the Ryukyu Cresent are a combination of three major ingredients: first, special natural and geographical characteristics; second, a history of changing principal crops, and third, a system of farm management that falls somewhere between traditional temperate and tropical agricultural management patterns. Okinawan agriculture has its own unique characteristics as well. As a result, it can be seen that 'subtropical agriculture' cannot be achieved by merely changing the type of crops grown. In order for Okinawa to truly establish subtropical agriculture, it will be necessary to see what kind of regional application of the background of temperate and tropical agriculture can be achieved. This is because the history of the regions has taught us that: "agricultural production is strongly influenced by natural conditions and therefore develops by sinking its roots deeply into the nature of the soil. However, historically, depending on the socio-economic conditions, those natural conditions will either be used efficiently, or be warped and destroyed by the production system."[8)]

2. The Basic Character of Agricultural Management in Okinawa[9)]

1) The Modernization of Okinawan Agriculture

When considering the current situation and future prospects of Okinawan agriculture,

one must take into account both Okinawa's uniqueness and the problems of its being behind the times due to its "tendency to backtrack."[10] The ratio with which Okinawa's farm managers shifted towards the capitalist production of goods, and the characteristics of this shift, play an extreme important role in the analysis of Okinawa's approach to modernization. And this approach towards modernization can be seen as directly impacting Okinawa's current technological level. With this point in mind, I would like to take a look at the type of farm management established in Okinawa as a result of agricultural modernization from the end of the Meiji Period to the present, paying special attention to the agricultural management systems and technologies established in this period.

(1) Characteristics as a Borderline Region for Temperate Agriculture

Okinawa is geographically a borderline region for temperate agriculture, but it is also a borderline region in an economic sense because it is situated so far from the central market areas of mainland Japan. Produce raised in Okinawa must be shipped long distances across the ocean to reach central market areas. In the process, Okinawa produce suffers high transportation costs, additional losses from damaged and lost produce, reduced salability because of lost freshness, and insurance expenses to cover the risk of maritime accident during shipping. An additional handicap is that almost all the materials required for raising crops must be imported from the mainland at high cost in order to raise the crops in the first place. All of these factors combined result in an almost non-existing profit margin between production cost and market price. It is obvious that Okinawan produce is at a major disadvantage in competing with produce raised in the mainland. Thus, the question of how to survive as a borderline production region has been very important to Okinawan farmers throughout the modern period.

(2) Subtropical 'Dry Field Sugarcane Cultivation Farming'

The traditional management style of Okinawan agriculture has been subtropical "dry field sugarcane cultivation farming"[11] as opposed to the wet field rice cultivation of temperate regions. This of course means growing a tropical crop, sugarcane, as the principal crop in a field cultivation agriculture. Compared to the technologies required for growing rice in wet fields where water provides both a means of fertilization and protection from harmful insects and weeds. Okinawa's field cultivation agriculture required the development of a subtropical fertilization system. Rice also has another advantage over sugarcane in that it is the main staple of the daily Japanese diet, and as such, is protected by the technological and economic policies at the national level. This protection has obviously aided in the development of rice agriculture.

Sugarcane farming faces another disadvantage compared to rice in that in rice farming, the individual farmer can raise a complete product ready for the market and maintain control of the crops until they are sold. However, sugarcane is a raw material which must be processed before it can enter the market. Therefore it leaves the farmers hands in an unfinished state, and must go through an intermediary to be processed for sale. Of course, the decision to raise sugarcane as a principal crop had to have been

made with the prior knowledge that it would need to follow this indirect route to market, and must have been based on the precondition that the capital required for processing would be supported by the market for the end product, sugar. However, at the very least, these examples show that the management styles and agriculture technologies required for 'wet field rice cultivation farming' and 'dry field sugarcane cultivation farming' differ not only in the type of field utilized, but also vary considerably due to the characteristics of the principal crops of rice or sugarcane.

(3) The Collapse of Traditional Technological Systems

The typical land utilization of a traditional 'dry field sugarcane cultivation farming' society included raising sweet potatoes, sugarcane, beans, and various grains and livestock. Sweet potatoes grown for self-consumption and sugarcane raised for sale, formed the basis of the farm economy. In addition, the beans and grains could be used for trade and the livestock used as a complementary side business. By 1935, Okinawa had already settled into the most stable technological system in its history, with an efficient economy where the sweet potato was a staple of human consumption and as feed for livestock, sugarcane served as a cash crop, and beans, grains, and meat served as source of protein in the diet. At the same time, this agricultural economy was supported by a technologically efficient family-diversified farm management system, which resulted not only in the improved land utilization and soil fertilization, but also allowed for efficient distribution of the labor resources of the farm family.

As can be seen from Figures 3 and 4, however, there were major fluctuations in the type of crops grown following World War Two and into the mid-fifties. Then, over the ten-year period from 1955 to 1965, there was a storong shift towards the monoculture production of sugarcane and single crop farming. This ten-year period of radical change was the historical transition period, which clearly broke away from the traditi onal "dry field sugar cultivation farming" in Okinawa. The background behind, and the reasons for this change are an important subject which merit future study. In this way, the traditional technological systems of the former "dry field sugarcane cultivation far ming" were entirely abandoned, and a new technological system based on the growing of sugarcane as a monocultural crop took hold, and still survives to this day. This can be graphed as follow:

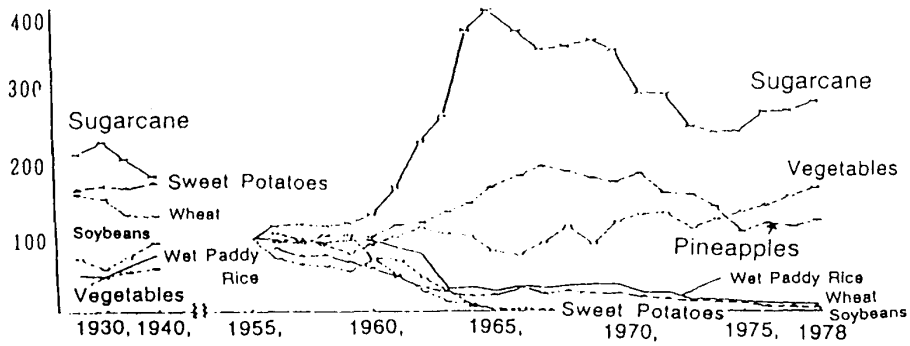

Figure 3: Transitions in Planted Area by Crop Type (Index)

Sources : 1) For the period up to 1940 'Agriculture and Forestry Ministry's Annual Statistics Chart

2) For the period from 1940-1978, each annual version of the 'Okinawa PrefecturalStatistics Yearbook' (however, the data for wheat in 1955, and the data for vegetables from 1955-1964 was compiled from the Ryukyu Government's 'The Pathway of Agricultural Policy'

Notes 1) 1955=100

2) For pineapples, 1960=100

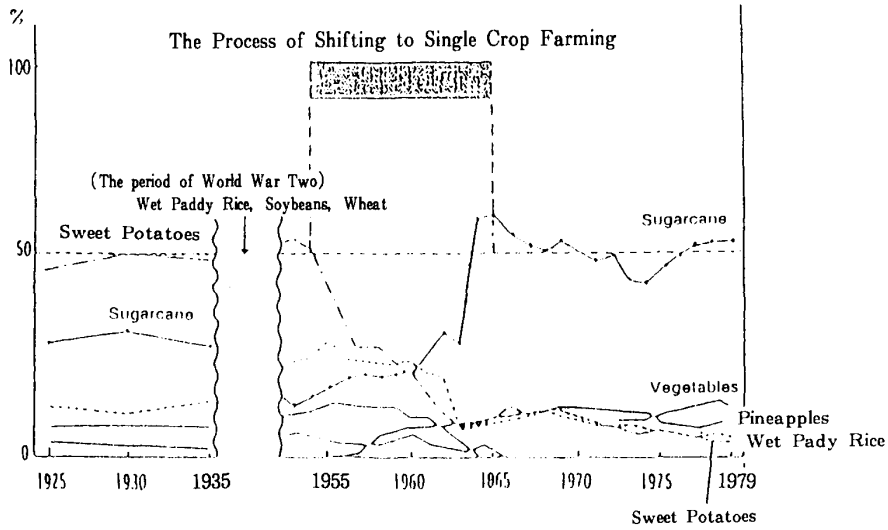

Figure 4: Movement in the Ratio of Area Planted Versus Total Tillable Land Area By Crop Type

Notes : 1) Total tillable land area figures for 1966, 1967,1969, and 1970 have been approxi mated based on the figures for the preceding and following years.

2) Planted area figures for sugar cane and vegetables were derived from the area harvested. In the case of pineapples, the actual area cultivated was approxi mated.

3) The data for vegetables prior to the year 1971 was omitted.

Sources: 1) Tillable land area data and (from 1955 on) planted area data were compiled from the Ryukyu Government's (Okinawa Prefecture's) 'Okinawan Statistical Yearbook' for the corresponding year However, tillable land area data from 1970 on was taken from the Okinawan General Affairs Bureau's 'Agriculture, Forestry, and Marine Industry Statistics Yearbook' for the corresponding year.

2) Planted area data for the period up to 1954 was compited from the Ryukyu Government's 'The Pathway of Agricultural Policy' (1969).

sweet potatoes + sugar cane + beans and grains + livestock

↓ (shifting)

sugar cane (first cutting) + second cutting + third cutting + ……

In short, basic Okinawan agriculture began to lack in the production of trade crops and livestock. Livestock was necessary to produce by-products and to support processing of the trade crops, which supplemented and complemented the principal crops. Thus we have seen a growing pattern of single crop farming and growing the same crop in the same field many years in a row (crop repetition). This is especially the case in sugarcane farming where as many as 70 percent of Okinawa's farmers practice 'multiple cut farming'. In the case of multiple cut farming of sugarcane, the performance of the first cutting, in terms of both yield and brix level (percentage of sugar), is almost the same as that for the secondary cutting, and production capacity peaks out at a certain ceiling level. Under the economic calculations of the time, the yield per 10 ares for secondary cuttings was known to be inferior to that for new summer plants. However, when labor investment was added into the calculation, the labor invested was clearly higher than that for either new spring or summer plants (Chart 1). But this thinking has had negative impact in Okinawa. "Multiple cut farming is a type of farming which reduces labor investment and expensed. However, in the case of Okinawa's sugar cane farming, in recent years this concept of reducing labor and expenses has given way to a mentality which could be better described as 'rough farming' or 'corner cutting farming'."[12)]

Chart 1. Comparison of the Labor Return per 10a for Different Ways of Raising Sugar Cane (data for 1972)

	Average	Ratooning	New Spring Plants	New Summer Plants
Yield	6,661kg	6,695	4,346	7,143
vs Average	100%	100.5	65.2	107.2
vs New Summer Plants	93.3%	93.7	60.8	100
Labor Hours	174.0hours	162.2	199.0	244.3
vs Average	100%	93.2	114.4	140.4
vs New Summer	77.2%	66.4	81.5	100
Labor Return	1,203Yen	1,525.0	73.0	547.0
vs Average	100%	126.8	6.1	45.5
vs New Summer	219.9%	277.8	13.3	100

Note: Compiled from the Okinawan General Secretariat's "Production Survey of Agricultural Products"

Another important point is that despite the dramatic increase in the volume of vegetables, flowers, and tropical fruit trees produced in recent years, this trend does not

necessarily represent a shift towards multiple crop farming among Okinawa's farm managers. In actuality, it is nothing more than the single crop farming of secondary crops aimed at meeting the needs of the mainland during the off season (Figure 5). This is because the technologies used for raising these secondary crops are no different than those used for the monoculture raising of sugarcane. Therefore, it can be said that single crop farming continues to send its roots deeper in every region of Okinawa, including the very regions where soil development and structural improvement projects are being carried out.[13)]

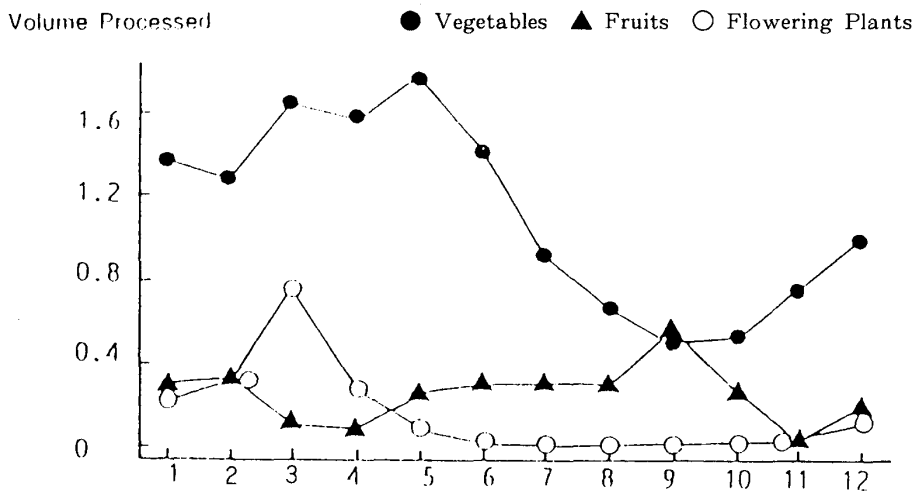

Figure 5: The Volume of Okinawan produced Garden Plants in the Okinawa Prefectural Central Wholesale Market

Unit of measure for shipments: 10 cubic tons for vegetables and fruits; 10^9 stalks for flowers.

Source: Okinawa Prefectural Central Wholesale Market 1989.

2) The Ryukyu Agricultural Papers' and Okinawan Agriculture

Research into the writings of the Ryukyu Kingdom period of modern Okinawan history such as the Ryukyu Agricultural Papers, and accounts left by foreigners during visits to the Kingdom, have been carried out in great detail, mainly by historians and those interested in their cultural value. However, the documents are yet to be scrutinized from the standpoint of agricultural technology. The study of agricultural history in this country generally starts with the introduction and spread of Western agricultural techniques in the Meiji modernization of Japanese agriculture. However, the indigenous, traditional agricultural technologies and farming methods which were placed for a long span of history have been largely ignored.

In Okinawa as well, it goes without saying that modernization policies were based on the farming methods of the West. It is important to remember that the fundamental requirements of mainland Japan's temperate agriculture were the basis of the farming policies and agricultural theories at this time and that these were applied by the central government to all regions of the country. As we have already seen, the technologies and economies of dry field sweet potato cultivation farming in a wet subtropical region like Okinawa were quite different from those of wet field rice cultivation farming in the

mainland's temperate regions. A certain level of agricultural technology had been established in response to the special climate characteristics of the region by the Ryukyu Kingdom period of modern history. Therefore, the Ancient Ryukyu Agricultural Papers can serve as a starting point to re-establish the traditional agricultural methodologies used in Okinawa's wet subtropical climate. The recreation of this traditional agriculture is of great significance because it can be used as a starting point to help grasp the steps taken towards agricultural modernization in the post-Meiji period.

Among the Ancient Ryukyu Agricultural Papers, Saison's agricultural affairs handbook is known to have been of great importance. This handbook was made official in 1734, and the imperial officials of each district gave orders to the local villages of their jurisdiction, based on its contents. Going one step further, the local villages created their own local agricultural affairs handbook by adapting these official orders to meet the reality of every day farming. This handbook was a type of agricultural instruction booklet that took the form of an official government document. The handbook gave thorough instructions for improvement in all aspects of agriculture starting with land preservation and touching on a variety of other subjects. Topics covered included measures for the prevention of erosion, flood control techniques, ways to avoid damage from typhoons, and hints for everyday farm management and the growing of trees.[14] Furushima states that "the biggest single reason (for the handbook) was to avoid soil erosion." He also thought that the concepts of "watching nature and looking at nature as a logical system" and "a way of thinking which places great value on the climate and its relationship to agricultural problems" existed in the handbook. This led him to say that "from (the point of these concept), the Ancient Agricultural Papers are different from any others."[15]

On the other hand, there are also agricultural journals which were written by actual farmers such as the 'Advice on Farming Methods to the Soshida Regional Government', which Wasai Kinjo compiled from the experiences of fellow veteran farmers. These journals contained detailed advice and instructions on subjects related to farming, like information on different types of soil, ways to grow different crops, and how to fertilize soil using farm generated refuse.

Also, as examples of writing by foreigners who visited the Ryukyu Kingdom, Mr. J. M. Bruck said in his 1859 account of the Ryukyus "The most remarkable thing about the (Ryukyuan) people is their diplomacy, their politeness, and their fields which grow such wonderful crops."[16] Also Admiral M. C. Perry's troop left records saying "It is surprising to see that they are making such a large profit from agricultural labor. In fact, judging from the quality of the soil and its condition or from the techniques they possess to get the greatest yield from any given field regardless of its location, I think it is safe to say that there is no group of people anywhere in the world with a better understanding of farming than the Ryukyuan People" and "(The Ryukyuan people) take full advantage of any favorable characteristics in their surroundings. They also have a good understanding of irrigation and what is more, they use irrigation both skillfully and successfully. Given the fertile soil and the mild climate of the region, if all of the land of the Ryukyu Kingdom were cultivated, the region could easily feed a large

population."[17]

The social systems of the mid-1800s were completely different from those today. At the time farming wasn't managed, there simply was a natural efficiency in the techniques used to raise the principal crops required for everyday life. In order words, the unique land utilization system of the region was achieved by complementary crop selection. The raising of livestock such as horses, cattle, pig, sheep, and chickens resulted in the production of meat for human consumption, but at the same time provided a source of fertilizer to maintain soil quality. In this way, the lifestyle of the region was in close accord with nature. The agricultural papers of the modern period were already emphasizing ways to make and use many types of organic fertilizers. These fertilizer derived from a compost/seaweed base and included straw, grain, field cuttings, brushwood, sand, and garbage. All of this refuse was thrown in with the animals to be trampled and to get mixed in with the livestock's droppings to make manure. There were even methods for making fertilizer out of household drain water and stagnant river water. The farming of this period did not waste a single stalk of straw or a drop of urine. All waste was returned to the soil in a natural cycle that proceeded modern day movements toward soil revival and organic farming.

With the coming of the Meiji period, however, there was a radical shift towards the modernization of Okinawan agriculture. By the early days of the Taisho period, things had already changed so much the following comments could be seen. Mr. Taniguchi, a professor of the Kagoshima Agricultural Senior High School who later become principal, said in regards to the growing of sweet potatoes, "I believe that if we want to improve our farming we must be meticulous in the selection of our seed like they were in the days of the Ryukyu Kingdom. Each farmer must use the methods that work for him, or the methods in the journals and pass them on to his descendants. If this long-standing knowledge is not passed on, our farming will surely fall into decay. If one were to make a list of all the benefits of deep planting, or that the way to prepare potato field depends on whether the area is humid or not, or the points of farming hillside land, there would be no end of praise. The only doubt is whether today's farmers are paying proper attention to these old truisms when they raise sweet potatoes or not."[18]

Furthermore, Mr. Nakamura who worked as an engineer at the Okinawa Prefectural Sugar Industry Experiment Center has said "The fertility of the soil in Okinawa's farming areas has not been depleted regardless of the long span of years since the founding of agriculture in the region, because methods to prevent the erosion of the topsoil and agricultural practices to restore the topsoil have been in place." He also wrote, "It can be seen that Okinawan farmers in ancients times were extremely careful to prevent water damage. Modern Okinawan farmers should follow their ancestors' ways and use these methods of farming and foresting. They should change their ways of farming and transmit this success to future generation."[19] Mr. Nakamura noted the superiority of the farming and forestry methods of the past compared to the problems of topsoil erosion being faced today. In other words, one can see that the people of those days were already aware of the special regional requirements for agriculture. In the case of Okinawa's wet subtropical agriculture, the typhoons which come every year and frequent

droughts have contributed to the breakdown of the topsoil over the years. Also, the very nature of the islands themselves with their sloping hillside fields and tropical storms have worked to deplete the fertility of the soil. These early modern agricultural papers took such regional characteristics into account. Starting with the importance of soil maintenance, these writings emphasized the necessity for erosion prevention and flood control measures as the basic conditions for the stable development of agricultural production. These agricultural ideal are rooted deeply in the natural environment of the region, and incorporate both long term thinking as well as general ideas. In fact, the writings could be called a comprehensive investigation of the technological systems of family farm management with a focus on disaster prevention.[20)]

3. The Developmental Trends of 'Subtropical Agriculture' in Okinawa (Discussion)

There is a strong tendency to make the agriculture of mainland Japan a standard and to judge Okinawa's agriculture by how far it has veered from that of the mainland. This kind of thinking, which views Okinawan agriculture as a 'deviation' from temperate agriculture, could be described as looking at the situation from one side only. However, if we consider the establishment of subtropical agriculture in Okinawa based on the principles of both northern temperate agriculture and those of southern tropical agriculture, we can achieve an all round view. This overall view is necessary to gain an accurate understanding of Okinawan agriculture. This means we should approach the cultures and characteristics of the people of the Ryukyu Cresent from a 'wide field viewpoint', as is the basic principle used in Okinawan Research. We should not look at Okinawa only from its relationship from Japan. We should try to see a borderless view that includes Southeast Asia, continental China, and the islands of the South Pacific as well.

As we have seen so far, our Okinawan ancestors established a disaster prevention farm management that kept agricultural production in touch with nature. Over the long course of experience, they also developed ways of predicting weather as is evidenced by the many weather related proverbs of the region.[21)]

With the modernization of Okinawan agriculture, however, and the establishment of single crop farming, the traditional multi-crop farming of 'dry field sugarcane cultivation farming' as well as 'disaster preventive farm management' are being lost. In other words, just as the monocultural growing of sugarcane has spread throughout the region, the single crop farming of other products such as livestock has spread as well. Therefore, with the introduction of modern technology, we have seen the growth of large scale operations utilizing special machinery, facilities, and chemical fertilizers. These large scale capital intensive operations have yielded economic results. But, on the other hand, they have not been able to provide the long term stability and sustainable growth which the technological systems of small scale, multi-crop farming provided.

If we look at the process of the gradual breakdown of Okinawa's "upland sugarcane cultivation farming", the change of principal crops by individual farmers has followed the basic pattern, sweet potato→sugarcane, pineapples→vegetables, flowers and tropical fruit trees. These changes are nothing more than switches of crops within the same

basic pattern of growing both temperate and tropical crops at the same time. The most important natural requirements for each crop are temperature, the amount of sunlight required, and the length of daylight needed for the crop. As seen in Figure 6, the natural growing conditions of wet subtropical Okinawa as a 'place' for agriculture, are made up of as temperate winter and spring season and a tropical summer and fall season. Sugimoto has pointed out that "From the standpoint of whether Okinawa is ideal for the growth of either temperate or tropical crops, based on the normal yearly temperature in Naha City, I would say that the area is near the borderline for either type of crop."[21] However, if the growing temperature of the region is deemed marginal for both temperate and tropical crops, the best way to overcome this situation is to raise an original crop suited to the natural conditions of the region. But while the production of original crops may be the best long-term solution, for the time being it is more realistic to focus on growing temperate crops (Type A crops) in the temperate winter and spring months and tropical crops (Type C crops) in the tropical summer and autumn months. By combining the production of both types of crops, each in its own season, Okinawa can achieve a highly efficient land utilization rate. In order to successfully implement this system, we must increase the types of crops and at the same time, expand use of the temperature zone for the production of both Type A and Type C crops in the direction of the arrows on the graph in Figure 6. Once this has been achieved, it would be very effective to add in Type B crops which could be grown all year on the islands. If we look at things from the viewpoint of soil fertility maintenance, under the conditions of temperate agriculture where the crops are grasses such as wheat or rice, it is possible to maintain soil fertility through the practice of crop rotation. But in tropical agriculture, where crops fall into the category of trees, it is difficult to maintain soil fertility through crop rotation except over a long time scale. In the case of tropical agriculture where the crops are bushes, a shorter time scale for crop rotation is possible. Therefore, crops such as sugarcane and pineapples are extremely effective not only for their diversity as products but also for their abilities in crop rotation under the conditions of wet subtropical agriculture. Sugarcane is especially good in that it has a high production efficiency of substance energy, and it returns organic material to the soil, serving to restore the soil's fertility. This ability should be used to the fullest degree. Unfortunately, these advantages are not being put to work under the current method of sugarcane and pineapple growing.

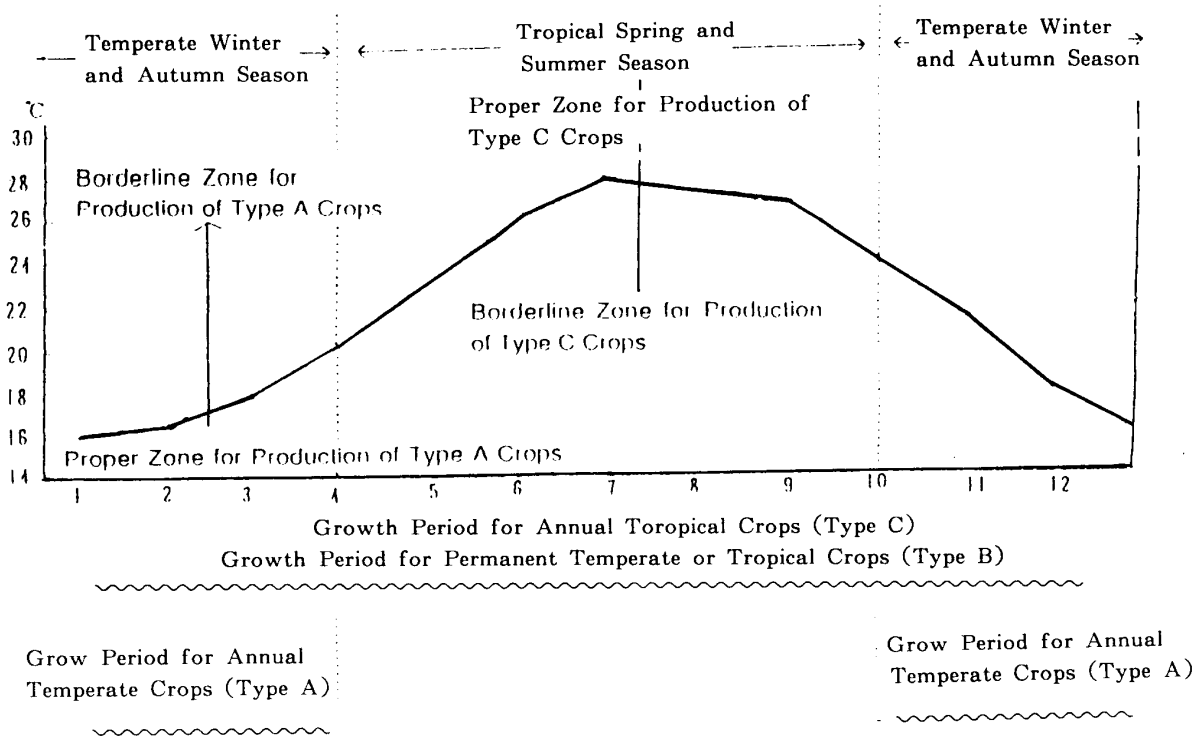

Figure 6: Graph of Growth Zones by Crop Type (Based on the average monthly temperature for Naha City)

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沖縄における「亜熱帯農業」の展開方向*

福仲 憲**

要 約

一般的に，日本本土の農業を基準にして沖縄の農業がそれからどれ程ずれているかを見ようとする考え方はかなり強いものがある。これは沖縄農業を温帯農業の「はずれ部分」としてだけ見るいわば単眼的な捉え方と言えよう。しかし，沖縄での「亜熱帯農業」の確立を考える場合には，北の温帯農業の原理と南の熱帯農業の原理を併せて複眼的に捉えることが基本的に必要である。

沖縄農業の近代化が進むにつれて伝統的な複合経営である「甘蔗畑作経営」が，したがってその「防災営農」の技術体系が崩壊し農業経営の単一化は確実に進んできている。つまり，さとうきびモノカルチュアに象徴されるように畜産を含めた他のどの作目もそれぞれが単一経営の技術体系に変わってきている。だから，近代化技術としての機械化，施設化，化学化は農業経営の規模拡大と資本集約化によって経済的な効率化を進めたが，複合経営の技術体系化による生産力構造の持続的な安定化には結びついてきていない。

かつて近世の琉球農業では技術的には地域の自然条件にみあった足腰の強い安定した「家族複合経営」があった。従って今一度，本来の複合経営の理念に立ち戻って，今日の発達した科学技術でもって改めて自然と人間のかかわりとして農業のあり方をとらえ直すことによって，地域農業を再編していくことが沖縄における「亜熱帯農業」確立の原点と言える。

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＊＊琉球大学農学部生物生産学科