

琉球大学学術リポジトリ

沖縄に於ける農地利用状況

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Preliminary Report on Agricultural Land Use in Okinawa

By

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INTRODUCTION

This land use was made in Okinawa for the following purposes:

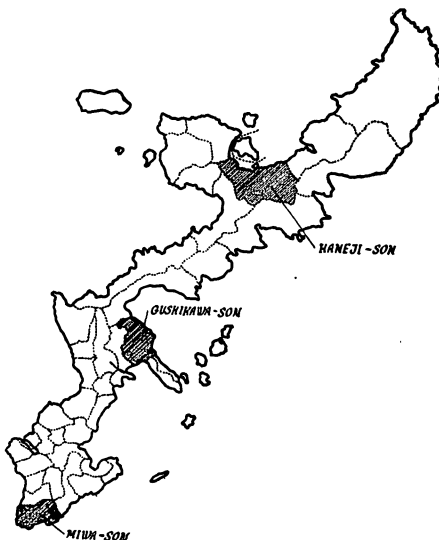
1. To aid the Agricultural Division of the University of the Ryukyus in determining some major problems in the use of land in Okinawa as a basis for guiding their programs in teaching, research and extension work.

2. To bring some of the agricultural problems on Okinawa to the attention of professional farm leaders and the general public, so that they might be discussed and studied, and solutions reached that will benefit farm people and total economy of Okinawa.

As resources in money and manpower were available only in limited amounts, a sampling procedure was used to secure the needed information. However, the study was made as extensive as possible within the limits of these resources. These three areas were studied: Miwa-Son; Gushikawa-Son; Hanechi-Son.

Miwa-Son was chosen as representative of the Okinawa and Chinen clay soils in the southern part of the island, which is almost entirely rural and removed from the various urban influences.

Gushikawa-Son was selected as an area of transition from the Shuri clay soils in the south, to the Ishikawa clay of the north central part of the island. It is a region influenced by the occupa-



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tion of considerable land by the military forces.

Hanechi-Son was selected as one of the northern rice production areas of the island.

In each area studied the statistical information was secured from the *son* office and from 12 to 20 farmers selected by a random sampling procedure. The whole area of each *son* was visited to observe the types of land use in each area. The map shows the locations of the *sons* studied.

The units of acreage, volume, weight, and currency used in the following reports are shown below.

Acreage	Volume	Weight	Currency
1 tan=300 tsubo	1 sho=10 go	1 kin=1.33 lb.	\$1.00=120 yen
1 cho=3000 tsubo	1 to=100 go		
1 acre=1224 tsubo	1 koku=1000 go		
	1 litre=5.5 go		
	1 bushel=195 go		

PART I

Land Use in Miwa-Son, Okinawa

This *son* is located, as shown in the map on the previous page, at the southernmost part of the island. The soils of the *son* is composed of Okinawa clay loam and Chinen stony clay. The main agricultural enterprises are sweet potato and sugar cane production, cattle raising, and a small amount of rice production.

Seventeen farmers were selected for questioning, representing farmers of different classes, villages and enterprises in the *son*.

I. The Soils of the Son

The area is traversed by four high ridges. Two of these rows of hills run generally north and south, while the other two lie in an east to west line. These hills have several inches of fertile, dark brown, crumbly clay or clay loam soil over bedrock. The surface is generally steep and interspersed with outcrops of limestone that occupy from 20 to 75 percent of the surface. Such land is non-arable but is covered with considerable growth of grasses. The grasses now growing are not well suited for grazing, and are largely used for fuel and for thatching of roofs. Before the war this hilly area was covered with pine which was destroyed during the fighting.

The agricultural soils lie between the hills. The principal soils of the *son* are Okinawa clay loam and Chinen stony clay. They are well drained, clay soils. The Okinawa clay loam is deep and the Chinen stony clay is shallow and stony. These soils occur together, and are crumbly, granular, porous, permeable and of good tilth. The Chinen stony clay often has outcrops of large limestone rock, which hinder its use as crop land, unless worked by hand in small patches. This soil dries out readily, a characteristic that is favorable for the development of the sweet potato weevil. There are some occurrences of Shuri clay. These are heavy clay soils, quite often present on sloping to hilly steep land.

II. Population Characteristics

The population of the *son* according to data secured in 1955 is 8569 persons. Of these 98% are engaged in agriculture.

From data secured in 1953 the age distribution of the *son* as a whole is shown in the table that follows:

Table 1. Age Distribution (1953)

	0-14	15-24	25-39	40-59	60 & above	Total
Numbers	3446	1808	1498	1342	510	8604
Percent	40.0%	21.0%	17.4%	15.6%	5.9%	99.9%

This table shows that 55% of the population are a part of the available labor force, and that probably within ten years the labor force will be increased by as much as 25%. But the picture is a little different when we take the farm population only.

Table 2. Agricultural Labor Force (1953, Dec.)

Total	7610	Labor force	3452	45.2%
Male	3601	Male	1761	
Female	4009	Female	1691	

Some of the people between 15 and 60 years of age are not able to work for various reasons. The table above shows that only 45% of the farm people are a part of the agricultural labor force.

III. Land Ownership and Land Utilization

The following table will show the amount of land operated solely by the owner, land operated as owned and rented land, and land that is primarily operated by renters.

Table 3. Land Acreages According to Ownership (1954)

<i>Total</i>	<i>Owned by the operator</i>	<i>Owned & rented by the operator</i>	<i>Largely rented by the operator</i>	<i>Rented by the operator</i>
1807	1101	504	150	52
	60.0%	27.9%	8.3%	2.9%
8942 tan	5364	2320	1161	97
	60%	26%	13%	1%

The first column in the above table shows the number of farmers who farm their own land, the second column states the number of farmers who own most of their land and rent some land, the third column shows the number of farmers who rent more land than they own, and the last column refers to farmers who rent all of the land they farm. About 60% of the farmers are owner operators. It should be well established from the table above that more than 80% of the land is owned by the operators.

Renting of land is not an extensive practice among farmers in this *son*. With the additional formerly cultivated land not being used, it seems strange that more farmers do not rent the idle land.

There may be some other reasons for this situation than those which will be mentioned on pages from 268 to 273. Perhaps rental agreements are not commonly used, and thus are not a part of the experience of farmers. Perhaps rental arrangements cannot be made with owners over a sufficient period to pay for the added cost of bringing the idle land into production. This phase of the farm problem needs further study in this *son* and in all of Okinawa if the condition exists generally on the island.

The rental rate varies from nothing to ten yen per tsubo. Where no rent is charged it is usually because the farmer is operating land owned by a relative, or because of the added labor and expense of bringing idle land into production.

The following table will show some of the going rental rates for different classes of land in Miwa-Son. The information was obtained from data in the *son* office.

Table 4. Rental Rates (1955)

Rental rate	<i>Rice paddy land</i>			<i>Upland crop land</i>		
	<i>High</i>	<i>Middle</i>	<i>Low</i>	<i>High</i>	<i>Middle</i>	<i>Low</i>
Per Tsubo	10-Yen	7-Yen	--	3-Yen	2-Yen	1-Yen
Per Year						

The table that follows shows, according to 1953 data, the amount of upland crop land, rice paddies, grass land and forest land in the *son* and the average amount of land controlled by one family.

**Table 5. The Acreage of Upland Cropland, Rice Paddy
Grass Land, and Forest Land (1953)**

	<i>Tsubo</i>	<i>Ave. per. family</i>	<i>Arable not cultivated</i>	<i>Ave. Tsubo Cultivated per family</i>
Upland	3,333,327	1830	1,039,000 (38.8%)	1265
Rice paddy	21,751	11		
Grass land	1,052,611	578		
Forest land	713,994	392		

Note: Not all of the agricultural land owned by the farmers in the *son* is being used, but the idle land seems to be over-estimated.

There is a small acreage of rice fields which are mostly concentrated at north-eastern and middle parts of the *son*. No rice field is seen in the southern and south-eastern parts of the *son*. An average farmer owns and operates 1936 tsubo of upland which is above the average for Okinawa.

As it has been previously mentioned, the grass obtained from the grass land is used for fuel and for thatching of roofs. Woods from forest land are used for fuel. Farmers feel that it is necessary for them to provide their own fuel from either grass or forest land under their present system of agricultural practices.

There is variation in the size of farms which is shown in the following table. About 88% of the farmer own 900 to 3000 tsubo of land. Some own more than 3000 tsubo. It should be noticed that quite a number of farmers own less than one tan of land (one tan=300 tsubo, 1224 tsubo=1 acre).

Table 6. The Sizes of Farms (1954)

	<i>Below 150</i>	<i>150-300</i>	<i>300-900</i>	<i>900-1500</i>	<i>1500-3000</i>	<i>3000-9000</i>	
	<i>Total</i>	<i>tsubo</i>	<i>tsubo</i>	<i>tsubo</i>	<i>tsubo</i>	<i>tsubo</i>	
No. Families	1807	8	41	101	1020	69	
Percent		0.4%	2.2%	5.5%	56.4%	31.4%	3.8%
Amt. of Land in Tsubo	2,682,000	960	10,250	60,600	1,181,990	1,142,800	286,000
Percent		0.03%	0.4%	2.2%	44.0%	42.6%	10.6%

The above tables again emphasize that scattered ownership of small tracts of land by each family is a major problem if Okinawa farmers are ever to achieve more than a mere subsistence for the farm family. Improved living for the family on the land can be achieved through consolidation of ownership, and improved farming methods, but improved living will be limited if the land must support the number of people that is at present required. To make a desirable improvement in farm living would require the opportunity for large number of people now farming to find work in industry, leaving the total amount of arable land to be farmed by much fewer people.

Such a situation would make possible greater income to the farmers remaining on the land, and consequently better living condition.



Fig. 1. A view of good agricultural land that if combined into larger fields would be adapted to power equipment.

In addition to the problem of the small size of farm, there is another land problem which hinders the development of agricultural practices. The following table shows the size of fields. More than 60% of fields are less than 300 tsubo. It shows that quite a number of fields are more than 500 tsubo, but in reality, there are very few fields with more than 500 tsubo. Many of these

fields are further divided into smaller units for the purpose of cultivation.

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Table 7. The Size of Each Unit of Upland Crop Land (1955)

	99 & below	100-199	200-299	300-399	400-499	500-999	over 1000
Amount of Land in Tsubo	8790	33139	48676	51046	40963	62203	4175
Percent	3.5%	13.3%	19.5%	20.5%	16.0%	25.0%	1.6%
No. of Field	135	224	203	149	92	99	4
Percent	14.6%	24.7%	22.4%	16.4%	10.1%	10.9%	.4%

A similar situation with rice paddy land is shown in the next table.

Table 8. The Size of Each Unit of Rice Paddy (1955)

	below 99	100-199	200-299	300-399	400-499	500-599	1000 up.
Amount of Land in Tsubo	549	3220	3124	2272	1342	2703	1574
Percent	3.6%	21.8%	21.1%	15.3%	9.0%	18.3%	10.6%
No. of Field	9	22	13	7	3	4	1
Percent	15.2%	37.3%	22.0%	11.8%	5.0%	6.9%	1.0%

There are about 1224 tsubo in one acre of land. The number of samples taken is not many enough, still the table shows the same

kind of trend with the upland in the size of fields. The majority of them are concentrated around 150 tsubo. It shows that about 8% of rice paddies are 500 tsubo or above, but as a matter of fact there is absolutely no rice paddy with more than 500 tsubo. Again they are divided into several units for the purpose of cultivation.

The following figure shows the distribution of the fields owned by some farmers. As it is shown, the fields scatter in every direction, which means a lot of waste of time in walking to and from the fields. It is not strange in some cases that farmer has to travel as far as two miles in order to get to a field. Three farmsteads are shown in Fig. 2, and the distance from the farmsteads to the fields and their acreages.



Fig. 2. Field distribution

As it is shown in the table 5 there are many acres of land now idle that were formerly cultivated. Why is it in a country where productive land is scarce, and much of the food for the people must be imported, that land lies idle? There may be many reasons for this situation that will be suggested. The farmers interviewed gave the following reasons why the land that was once suitable for cultivation and growing crops is now idle.

1. **Lack of Labor.** As nearly all land is now farmed by hand labor a family is limited in the amount of land it can farm by its

members capable of working. According to the data obtained from the *son* office in May 1955, the average number of workers per farm family is 2.2, including women. The farmers say that many families or working members of the families were killed during the war. A good young man, it is estimated, can only prepare 75 tsubo of land a day by hand methods. Thus it would take 18 days to prepare one acre for a crop. Most of the workers, either women, or older or younger men, would not be able to do as well. The population statistics predicts that within ten years there will be an added 25% to the labor force, and if they do not find employment elsewhere they will probably be forced to cultivate the land that is now idle.



Fig. 3. This agricultural road ends where the author is standing on the edge of undeveloped agricultural land.

The possibility of using animal or machine power would make possible the more complete utilization of the idle land. However for this to be highly successful would require the combination of the small fields, and probably the exchange of ownership of scattered tracts of land, so that present fields could be combined.

2. Distance to Field. Many farmers have to walk considerable distances to and from fields. A random sample of 93 fields shows that the average distance a farmer must walk to these fields is 545 meters (refer to Fig. 2). This is about 1/3 of a mile. These distances consume time, and is a factor in decreasing the amount of land one family can operate. It must also be realized that the crops harvested are carried from the fields on the shoulders of men and the heads of women, also all materials going back to the fields must be carried in the same way. Many of the fields that are now idle are so because of excessive distance to these fields.

3. Lack of Roads. In many cases the distance to fields could be compensated for by roads that would make possible the hauling of the products from the fields by animal or machine power. The above picture shows one of the desolated agricultural roads which was formerly used.

4. Land Less Suitable for Cultivation. Many of the lands not being farmed are less desirable because of lack of fertility, stoniness, or steepness of the slope. There is the possibility that

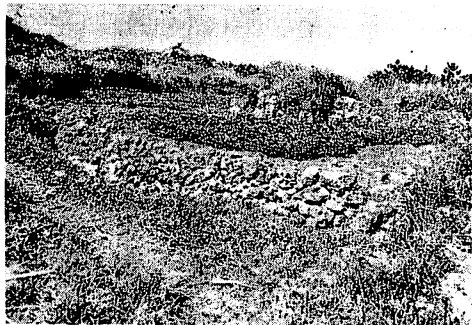


Fig. 4. Stony land occurs frequently in this *son*. What might be the possibilities of clearing such land with large power machines?

such land could be made more desirable by the use of large machines for clearing, leveling, and perhaps terracing. Fertility in many situations could be improved through known soil improvement practices.

5. Farm Product Prices Too Low. Farmers report that their returns from much of the present unused land is too low to warrant the

the extra cost of production. According to the statistical information secured from the statistical section of G.R.I. the price of one kin of sweet potatoes never went above 3 yen, which means that 10 kin of sweet potatoes is worth only one or one and a half packs of "Luck" cigarettes. Over-supply of a vegetable at a certain period of the year will result in very low price of that vegetable. The price is often too low to cover the expense of fertilizers. The establishment of the agricultural product processing plants is very urgent need to overcome such a fluctuation of the product prices.



Fig. 5. Many acres of land lie idle in this *son* as shown above.

IV. Sources of Power for Cultivation and Transportation

At present most of the farm work is done by the hands of the farmer and his family. The transportation from the field to the farmstead or to the nearest road is accomplished on the shoulders of men, or on the heads of women. This method of transportation limits the amount of farm product that can be produced by one family, and prevents volume production which is necessary if efficient farming is to result.

Some cattle and horses are used for plowing, but it is the exception rather than the rule. There is only one work animal available for

each eleven farmers in the son. Horses are commonly used for transportation after the farm products have been delivered to a suitable road. Trimobiles are also used for this purpose. Trucks do carry farm produce on the improved roads, and usually when longer distances are involved.



Fig. 6. Lack of roads makes necessary the movement of crop produce for considerable distances by man power, which limits agricultural expansion.

V. Farm Animals and Feeding Practices

The number of farm animals in Miwa-Son is shown in the table that follows:

Table 9. The Number of Animals (1954).

<i>Animal</i>	<i>Number</i>	<i>Av. Per farm.</i>
Cattle (24 mo. old or older)	46	2
Cattle (18 mo. to 24 mo.)	150	
Cattle (18 mo. or younger)	172	
Horses (24 mo. or older)	113	0.6
Horses (18 mo. & younger)	4	
Hogs	408	1.7
	2245	
	1094	
Goats (10 mo. & older)	256	.58
,, (10 mo. & younger)	694	
,, (kids)	111	

The agriculture in Miwa-Son is not an animal agriculture. Cattle seem to be on an increase as is shown by the relatively large number of young stock below 2 years of age compared to the animals 2 years or older. Cattle are not pastured, but are housed in sheds near the farm home. Thus all the grass fed must be cut and carried to the farmstead, and likewise the manure transferred back to the fields by human effort. The forage for cattle and other animals is harvested from the uncultivated land which is often very rough and stony, some of which could not be pastured. However there is a lot of land that could be pastured if there were no other reasons than roughness or stoniness to prevent it. The further development of cattle production seems to be dependent upon the utilization of

land and crops that cannot be used profitably for other purposes. As it has been said, animal power is not frequently used as sources of power for agricultural practices.

Cattle feeding practices as reported by the farmers visited were about as follows:

Calves are weaned and placed on feed when they weigh about 70 kin. They are fed cut grass, sweet potato vines and the following amount of sweet potatoes according to the weight of the animal.

70-240 kin	150	days	(ave.	of	.5	kin	per	day)
240-300 "	50	"	("	"	1	"	"	")
300-700 "	340	"	("	"	5	"	"	")



Fig. 7. It is only occasionally that animal power such as in this picture is available

This kind of feeding practice results in mostly grass fed cattle as the amount of sweet potatoes fed could not contribute much to the fattening process as sweet potatoes contain only about 25% of carbohydrates, and very little protein. The rate of gain per day is a little less than 1.2 kin which is about 1.4 lbs. of gain per day. This is a low rate of gain per day when compared to American standards. In America a steer fed the same length of time, but on different feed, would be expected to average close to 2 lbs. per day, needing about 18 months to reach market weight from birth.

The maintenance of the brood cow also requires considerable feed. This is commonly supplied through cut grass, sweet potatoes and sweet potato vines. Occasionally some soybean cake is fed as a small part of the ration. Only two of ten farmers were feeding it to their cows. The brood cow and the bull are also used for draft animals. The method of feeding cattle does utilize grass that would not otherwise be used, but the labor and time expended in cutting and bringing this grass to the animals may prevent other more profitable use of the time and labor.

The whole area of cattle feeding and management could very well be further investigated.

The hog feeding practices used by the farmers visited varied, and are only estimates as any record of weights fed are not kept. In fact there is no weighing of feed on the farm. Sweet potatoes are the main feed fed to hogs, and in some cases the only feed they receive. A little amount of sweet potato vine either raw or cooked

is fed too. Some soybean cake is used in the ration for hogs, and when used, if the amount reported is correct, makes a ration containing about 10% protein. This is too low for rapid growth and efficient feed utilization.

Again in the feeding of hogs there needs to be considerable experimental work to determine the best feeding and management practices and then the information brought out to the farmers.

Information on the feeding of goats was difficult to secure, as they receive only grass and sweet potato vines. The feeding is irregular and there is no record of the amount fed.

Most of the poultry are kept on farms, the chickens forage for their own food, and thus the keeping of poultry is largely for home food supply.

VI. Crops and Cropping Practices

The three main crops grown in this *son* are sugar cane, sweet potatoes, and soybeans. Some vegetables are grown for home consumption. Paddy land for rice production is very limited in this *son*. In general rain is the only source of water for rice production. Thus rice is normally grown only in the first half of the year when rainfall is usually abundant.

Crop rotations being followed in the *son* varies among farmers. Following are some of the typical rotations being followed.

A. Soybeans	Sweet potatoes	Sugar cane
Feb.-May (4 mo.)	June-Dec. (7 mo.)	Feb.-Jan. (12 mo.)

This is a two year rotation in which sugar cane occupies the land for 1 year.

B. Sugar cane	Soybeans	Sweet potatoes
Jul.-Dec. (18 mo.)	Feb.-May (4 mo.)	June-Dec. (7 mo.)
Sugar Cane	Soybeans	Sugar Cane
Feb.-Jan. (12 mo.)	Feb.-May (4 mo.)	Jun.-Jan. (18 mo.)

This is a 5½ year rotation that utilizes sugar cane twice, once for 18 months, and once for 12 months.

C. Soybeans	Sweet potatoes
Feb.-May (4 mo.)	Jun.-Dec. (7 mo.)

This is a one year rotation that is used on land considered too shallow for the growth of sugar cane.

D. Sugar cane	Sugar cane	Soybeans	Sweet potatoes
Feb.-Jan. (12 mo.)	Feb.-Jan. (12 mo.)	Feb.-May (4 mo.)	Jun.-Dec. (7 mo.)

This rotation uses sugar cane for two successive years, the

second year the crop being produced from the stubble of the first. This latter practice is not often used as it results in a reduced yield of sugar cane.

E. Sugar cane	Soybeans	Sugar cane
Feb.-Jan. (12 mo.)	Feb.-May (4 mo.)	Jul.-Dec. (18 mo.)

The above rotation makes maximum use of sugar cane in the rotation. There are other rotations practiced such as continuous sweet potatoes, and the use of vegetable crops during the winter season. Many farmers do not make any particular plans, and plant crops following harvest of another crop as their decisions dictate at the time.

Crop Practices

Sweet Potatoes Okinawa No. 100 is the principal variety grown. Other varieties are Nanyo, Hijagawa No. 1, Inayo, and Kuraga.

There seemed to be some difference among farmers of the adaptability and quality of the different varieties of sweet potatoes grown under different conditions of seasons, and soil. According to some farmers Nanyo yields more sweet potatoes of better quality than any other variety. They also said that Nanyo is more resistant to cold weather and sweet potato weevil than any other variety in this area. There should be some variety testing under different conditions before anything definite can be said about it.

The most favorable time for planting sweet potatoes is the early summer to be harvested in December. But the problem with the summer growing sweet potatoes is that they are subject to the serious attack of sweet potato weevil when there is very little rain during the summer season. When they are grown during the winter months it takes 2 to 3 months longer to secure a maximum yield. Farmers do plant and harvest sweet potatoes the year round, as they are the principal item in their diet, and are important feed for any livestock they may be keeping.

The farmers visited all used animal manure to fertilize their sweet potato crop. The application of animal manures varied according to their estimate between 900 kin per tan to 4500 kin per tan. This is the equivalent of 2.4 to 12 tons per acre. Many of these same farmers used some chemical fertilizer. In many cases they did not know the analysis, and the amount applied would be considered rather small. The average rate applied according to their estimates was 49 kin per tan, which is equal to 260 pounds per acre. In a number of cases the farmer knew this fertilizer

to be ammonium sulphate, but for the most part they did not know the analysis of the fertilizers they were using.

The yields of sweet potatoes varied from 3000 kin per tan to 7500 kin per tan. This is approximately 240 to 600 bushels per acre yield. The average of the farmers visited was reported by them to be 4400 kin per tan or about 352 bushels per acre. These yields are much higher than the averages reported in the annual statistics for the Ryukyu Islands. It must be remembered that the yields were estimates as the farmers do not have ways to take accurate weights or measurements.

The crops of sweet potatoes were in the ground from 6 to 9 months, the average being about 7 months. With these farmers visited planting dates were scattered throughout the year.

Sugar Cane Nearly all farmers plant one variety of sugar cane. That is POJ 2725.

Eight out of twelve farmers were following the practice of growing sugar cane for on 18-month period. Each of the twelve farmers was using some commercial fertilizer, the average being about 180 kin per tan. The amount varied between 75 kin per tan and 420 kin per tan. The average of 180 kin per tan is the same as 960 lbs. per acre. Farmers have been using less animal manure for sugar cane than for sweet potatoes. Compost has been used also for sugar cane production.

Seven out of the twelve farmers used on animal or green manure in growing their crop of sugar cane.

The yields of sugar can varied between 7500 and 15,000 kin per tan which would be equivalent to 20 to 40 tons to the acre. This yield is higher than the Ryukyuan average of 20 tons per acre. Even though these yields are high for the Ryukyus, they are low compared to the yields obtained in the principal sugar producing areas in the world.

One of the major problems in the growing of sugar cane is its bulk and weight, which must be harvested by hand. And also, in many instances, it must be carried on the shoulders of men quite some distances to the roadside where it can be picked up by animal or motor vehicles for transportation to the sugar mills.

One apparent reason for lack of yield of all crops in Okinawa, that is probably also true in the case of sugar cane, is the lack of organic matter in the soil. Farmers say that often green manure applied just previous to the planting of sugar cane reduces the yield, especially during dry weather. This would be expected especially if the green manure applied is largely carbonaceous ma-

terial that requires water and nitrogen for its decomposition. It could be overcome by applying the green manure during the wet spring season on other crops to be followed by sugar cane in June or July. The addition of nitrogen to the carbonaceous green manure would also supply the additional nitrogen needed for decomposition.

The average yield of sugar cane in the Ryukyus should be doubled or tripled to place it in a competitive position with other sugar producing areas.

Soybeans The soybean is a crop that is generally grown in the spring of the year. It is sown in February and harvested in May. It is a good crop to prepare the land for either sugar cane or sweet potatoes. Also it is a necessary food crop in the diet of the people.

The varieties most generally grown in Miwa-Son are Ohigu and Anda-Guwa. The twelve farmers visited used very little chemical fertilizer or animal manures on this crop. A little amount of ash is used. The yields averaged 762 go per tan which is equivalent to 15 bushels per acre. This again is a rather low yield, and should be possible of improvement. The lowest yield was 600 go and the highest yield 1050 go per tan. The main problem with soybean production is that the rainy season begins at the time of the harvesting season and destroy them seriously. Farmers could start sowing a little earlier but the yield would be much less. As this crop is grown during the season of heavy rainfall, it might be a good crop to apply the green manure in preparation for either the sugar cane or sweet potatoes that could follow soybeans in the rotation.

Rice Rice is the preferred food crop of the Ryukyus. It is grown wherever paddy land can be constructed. There is little of such land in Miwa-Son so the land devoted to this crop is relatively small in this son.

Eight of the twelve farmers visited were growing some rice. They were all using Taichu No. 65 variety. Most of the rice grown by these farmers is dependent upon rainfall for the water supply, so usually only one crop a year is grown. That crop is planted in February and harvested in June.

The average yield of rice as reported by the farmers visited was about 1.5 koku of hulled rice per tan, which is equal to a yield of 30 bushels to the acre. This reported yield is about 1/4 to 1/3 larger than the rice yield as reported in the "Civil Affairs Statistics for the Ryukyu Islands". It may be that the farmers visited are above average as farm operators, their estimates are faulty, or that the reports to the Dept. of Economics of GRI are underestimated.

The farmers visited reported that they all used chemical fer-

tilizer and either compost or manure as fertilizer for the rice crop. The average chemical fertilizer application was estimated to be 81 kin per tan, or 430 pounds per acre.

As the average yield of hulled rice averaged 1.5 koku per tan, and the highest 2.8 koku per tan, it is evident that fairly good yields are obtained. The major problems in rice production in this son appear to be:

1. More paddy land.
2. More water for irrigation.
3. Perhaps some foliar feeding of nitrogen would further improve yields.

Vegetables Vegetables are also produced for home consumption. It is difficult to judge the efficiency of production for the many vegetable crops grown, for the lack of suitable comparative data. For the reason no analysis of these crops will be made, except they like all crops are likely to respond to good soil management practices. It is also probable that there are some problems in insect and disease control.

VII. The Marketing of Agricultural Products

In Miwa-Son the sugar cane is manufactured locally into black sugar, sold to the local cooperative association, and then is marketed by the central cooperative to Japan. The price farmers reported receiving varied between a low of 800 yen per 1000 kin of sugar cane to a high of 1200 yen per 1000 kin of cane. This price is equal to 10 to 15 dollars per ton of sugar cane.

The sugar industry is supported by subsidies from the Government of the Ryukyus. The subsidies are intended to increase the amount of sugar produced in the Ryukyus, in order that exports can be increased to help balance the needed imports. It is also a cash crop for the farmer.

The following subsidies were given in 1955 to various groups in the sugar industry in Okinawa.

1. ¥3,900,000 for the establishment and repair of sugar mills.
2. ¥1,175,000 for the establishment and maintainance of a farm to increase and make available to farmers cuttings of the desirable sugar cane varieties.
3. ¥132,000 for the establishment of demonstrations on the production of sugar cane.
4. ¥93,000 for insect control.
5. ¥264,740 to pay storage costs, and to pay interest on money borrowed to pay cash to farmers for their cane.
6. ¥998,000 for the planting of sugar cane on land not presently being cultivated.
7. ¥520,000 for a part of the cost farmers pay for the sugar cane cuttings.

This represents a total of ¥7,082,000 per year used to encourage the sugar industry.

Some soybeans are sold for cash, and some is used at home both as food for the family and for livestock. The soybeans are sold to the agricultural cooperative, and also at local markets. Some farmers retail their soybeans directly to the consumer, but they are usually sold at whole sale to either the agricultural cooperative or to retailers at a local market. The price received during 1955 varied from 50 to 65 yen per sho. The price is lowest just after harvest in late May and early June. This is a high price for soybeans when compared to prices in the United States, as this price is about \$8.00 to \$10.00 per bushel.

Sweet potatoes are sold for cash, but the bulk of the crop is used as food for the family, or as feed for livestock.

The price varies, being lowest in the late fall or early winter, and highest in the early summer months. In 1955 sweet potatoes sold for 3.29 yen per kin, while in December they were worth 2.50 yen per kin. This price variation is the same as \$2.00 to \$2.80 per hundredweight in the States. While the price for soybeans is considered high compared to U.S. prices, the price for sweet potatoes is below average of U.S. prices for sweet potatoes, and would often be below the price received for white potatoes.



Fig. 8. This small market raises the question of the efficiency of the marketing system.

Not much rice is grown in Miwa, but most of that which is grown is sold for cash. Farmers then purchase imported rice for use by their families. Okinawan rice generally sells for 5 to 8 yen more per kin than for the imported rice. Rice is preferred to sweet potatoes as the staple food in the Ryukyuan diet, but its cost per unit of nutrients is 3 to 4 times higher than the cost of sweet potato nutrients.

The price for vegetable varies widely from the period of scarcity to the period of plentiful supply. The price of cabbage serves as a good illustration. When it first appears on the late fall market it sells for 15 to 20 yen per kin, but later when supplies become plentiful it may sell for as low as 1.5 yen per kin. This situation might be helped with proper storage, or with the development of processing facilities that would use the vegetables during the season of ample supply.

The retail price for vegetables varies between 70 and 100% above the wholesale price farmers receive.

VIII. Control of Insects and Diseases

Generally farmers seemed to have little knowledge of the use of chemical sprays and dusts for the control of insects and diseases. At least those interviewed did not seem to know what chemicals were needed for the various insects and diseases that are common to the crops they grow.

IX. Water Supply

The amount of water available for home use is limited. There are a total of 57 wells in the *son*. That means an average of 26 families per well. If more water, or if the means for distributing water could be developed there would be increases in production that would be possible through irrigation.

This situation suggests that there is a need for information on the quantity and location of underground water supplies. The probable cost of establishing the wells should also be determined.

The well water at present is limited to its use for drinking.

Water for other purposes such as washing clothing is the rainwater that is caught in depressions in the ground.

The problem of water supply is a major problem in this area to improve the living conditions of farmers.



Fig. 9. Wells such as this spring must serve an average of 26 families.

PART II

Land Use in Gushikawa-Son, Okinawa

This *son* in the middle part of the island, was selected to be studied to determine the agricultural practices and the use of land. The soil of the *son* is composed of seven different soils; Awase clay, Shuri clay, Okinawa clay loam, Chinen stony clay, Akamaru and Aha soils and Ishikawa loam.

The main enterprise is sweet potato production along with hog production. Almost all farmers own patches of rice paddies also.

Twenty two farmers were selected from middle and upper classes of farmers. No farmer from the lower class was selected because of his uncertainty and inaccuracy in answering the questions asked.

I. The Soil of the Son

This *son* is located at the middle part of this island and is surrounded by four *sons*, namely: Ishikawa, Goeku, Yonashiro and Katsuren. This *son* is composed of quite a number of different soils. The northern part of this *son* is covered by Ishikawa loam and the middle part is covered mostly by Okinawa clay loam and Chinen stony clay. Along the coastal line there is very fertile Awase clay which is an alluvial soil. These two soil areas are connected by steep rough broken land which consists of Shuri clay only. The area covered by Ishikawa loam is hilly and is not well suited for agriculture. The middle part is gentle sloping area and is well suited for agriculture. The south-west of the *son* is covered by Shuri clay which is gently sloping area and well suited for rice production. At the eastern part, there is a plot of Akamaru and Aha soil which is deep and fertile and is very well suited for rice production.

Geographically speaking, this *son* is a transitional area from Okinawa clay loam to Ishikawa clay loam area.

II. Population Characteristics

The population of the *son* according to the data secured in 1955 is 33,267 persons. Of these 71%, 23,689 are engaged in agriculture. From the data secured in 1953, the age distribution of the *son* as a whole is shown in the table that follows:

Table 10. Age Distribution (1953)

	0-14	15-24	25-39	40-59	60 & over	Total
Number	12659	6514	5702	4620	2633	32128
Percent	39.4%	20.2%	17.7%	14.3%	8.1%	99.7%

This table shows that 52% of the population are a part of the available labor force, but the picture is a little different when we take the farm population only.

Table 11. Agricultural Labor Force (1955)

Total	23,689	Labor force	6879	29%
Male	11,213	Male	2879	
Female	12,479	Female	4001	

Some of the people between 15 and 60 years of age are not able to work for various reasons. Besides, many young people in this *son* are employed by the American military forces and American businessmen. The table above shows that only 29% of the farm people are a part of agricultural labor force.

III. Land Ownership and Land Utilization

The following table will show the amount of land operated solely by the owner, land operated as owned and rented, and land that is primarily operated by renters.

Table 12. Land Acreage According to Ownership:

Total	Owned by the operator	Owned & rented by the operator	Largely rented by the operator	Rented by the operator
4,332	1,429	707	642	1,554
Percent	32.9%	16.0%	14.8%	35.8%
8212 tan	3719	2100	1130	1463
Percent	44.2%	24.9%	13.4%	17.4%

The first column in the above table shows the number of the farmers who farm their own land, the second column states the number of farmers who own most of their land, and rent some land, the third column shows the number of farmers who rent more land than they own, and the last column refers to farmers who rent all of the land they farm. Only 33% of the farmers are owner operators while 36% are renters. The number of renters exceeds the number of the owner operators. Many acres of farm land have been expropriated by American military forces; this situation has increased the number of the renters.

The following table will show some of the going rental rates for different classes of land in Gushikawa-son. The information was obtained from the data in *son* office.

Table 13. Rental Rate (1955):

Rental Rate	Rice paddy land			Upland crop land		
	High	Middle	Low	High	Middle	Low
Per Year	6.00 yen	5.40	4.80	3.00	2.40	2.04
Per Tsubo						

The table that follows shows the amount of upland, rice paddy, grass land and forest land in the *son* and the average amount of the land owned by one family.

Table 14. The Acreage of Upland Crop Land, Rice Paddy, Grass land, and Forest Land (1955)

	<i>Tsubo</i>	<i>Ave. per. family</i>	<i>Arable not cultivated</i>	<i>Ave. Tsubo cultivated per family</i>
Upland	4,693,243	1083	430,000	970
Rice paddy	511,641	118	65,000	103
Grass land	737,031	170		
Forest land	1,290,824	298		

Note: Not all of the agricultural land owned by the farmers in the son is being used, it should be recalled also that many acres of land have been expropriated by the military forces and they are not available for agriculture.

As it has been mentioned previously, the Ishikawa loam area, the northern corner of the son, is mostly forest and middle and southern areas are used for agriculture. There is relatively a small acreage of rice fields in the *son*. They are found in low land areas. The tops of the low hills are used for growing grasses which are used as forage for the farm animals and as fuel. They are also used for thatching the roofs. The farmers near the forest obtain wood from their own forest and use it for fuel.

In spite of the fact that many acres of land have been expropriated by military forces, and the acreage of the arable land has been decreased, there are many acres of formerly cultivated land idle. The possible reasons for this situation will be mentioned in the later pages.

It should be noticed in the table above that an average farmer owns less than one acre of land, which is not large enough to keep even the subsistence level of living.

There is variation in the size of farms which is shown in the following table. About 83% of the farmers own less than one acre of land and it should also be noticed that one-third of all the farmers own less than one *tan* of land. Less than 1% of the farmers own 3000 *tsubo* or more of land which is just large enough for an average farm family to keep a subsistence level of living.

Table 15. The Sizes of Farms:

	<i>Total</i>	<i>Below-150 tsubo</i>	<i>150-300 tsubo</i>	<i>300-900 tsubo</i>	<i>900-1500 tsubo</i>	<i>1500-3000 tsubo</i>	<i>3000-9000 tsubo</i>
No. Family	4,332	490	1,011	2,100	560	163	8
Percent		11.3%	23.3%	48.4%	12.9%	3.7%	0.18%
Amt. of Land in Tsubo	2,523,600	54,900	266,100	1,249,500	631,800	294,000	27,300
Percent		2.1%	10.5%	49.5%	24.9%	11.6%	1.0%

The small size of field is another problem which prevents the use of power machine. The following table shows the size of field. About 72% of fields are less than 300 *tsubo*. The table shows that there are quite a few number of fields with 500 *tsubo* or more, but in reality those relatively large fields in the record book are further divided into smaller units for the purpose of cultivation.

Table 16. The Size of Each Unit of Upland Crop Land (1955)

	<i>Below 99</i>	<i>100-199</i>	<i>200-299</i>	<i>300-399</i>	<i>400-499</i>	<i>500-999</i>	<i>1000 & up</i>
Amt. of Land in Tsubo	5,836	27,795	36,529	26,595	19,909	37,642	21,917
Percent	3.3%	15.9%	20.7%	15.2%	11.3%	21.3%	12.4%
No. of Field	92	195	149	78	48	39	6
Percent	15.3%	32.2%	24.6%	12.6%	7.4%	6.4%	0.9%

The following figure shows the distribution of the fields owned by some farmers. It is again a great agricultural problem that farmers have their farm fields scattered all over, which means a lot of waste of time in walking to and from the fields. Some farmers have their fields two or more miles away from their farmstead.

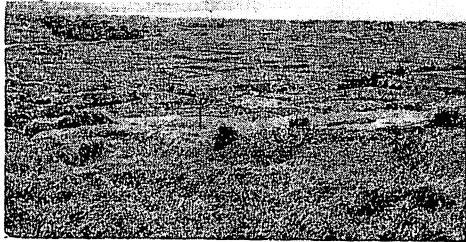


Fig. 10. Above picture shows the small size of field.

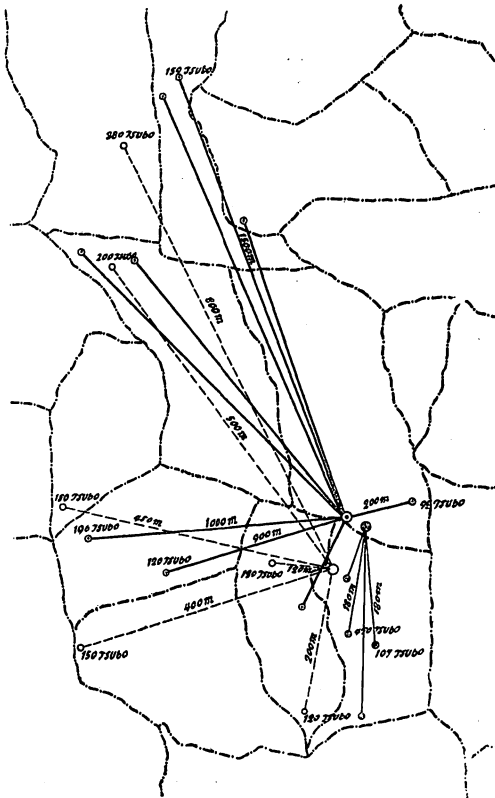


Fig. 11. Field distribution

As it is shown in table 14, there are many acres of land now idle that were formerly cultivated. The fifty farmers in nine *sons* at the middle part of the island interviewed gave the following reasons for the land which used to be suitable for cultivation but lies idle now.

1. Lack of Labor. Many young people have left farm to be employed by military forces. Unfortunately the statistical information is not available to show the number of people employed by military forces. Many farmers have lost the sources of cash income and they have to find it in some other fields of occupation. Some farmers are employed by American businessmen or by military forces or some are employed by Okinawan construction companies. Some other farmers may leave farm only to live in urban areas. About

30% of all the idle land is due to the lack of labor. It is a great problem that farmers leave farm. This situation should further be studied to to solve the problem.

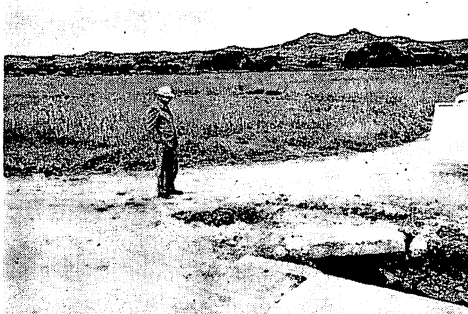


Fig. 12. This picture shows former rice paddy land not now used because of the break in the seawall that allows the overflow of salt water. The man standing is one of the co-authors, Kuhn.

2. Distance to Fields. Distance to field is another problem. A random sample of 112 fields shows that the average distance a farmer has to walk to these fields is 425 meters—refer to Fig. 11. About 13% of the idle land in

this area is now idle because of excessive distance to these fields.

3. Too Many Rocks in the Fields and Too Hard. The following pictures show the idle farm lands with too many rocks and which are too hard to cultivate. Those lands were leveled off by bulldozers and rocks were brought in by military forces in order to build some semi-permanent buildings such as quonsets.

Although they are now available for cultivation, they are too hard. Some kind of power machine must be introduced in order to make crop land out of them.

4. Farm Product Prices Too Low. Farmers report that



Fig. 13. The land in this picture has been scraped down to the rock in places for military uses,

their farm product prices are too low to support their subsistence level of life. Actually their farm product prices are not lower than those in other countries, but rather the prices of some of their products are higher than those in other countries. Last several years, a great amount of cheap agricultural products have been imported which lowered the prices of their farm products. Actually, problems are not the low prices, but either high cost of production or the low productivity of farm labor. This matter of prices of farm product should be further studied.

IV. Sources of Power for Cultivation and Transportation

In the middle part of the island, most of the farm work is done by the hands of the farmers. Like in the southern part of the island, transportation of farm products and manures is done on the shoulders of men and on the heads of women.

In some cases, horses and cattle are used for transportation and plowing but not all of the farmers could use animal power because only one working animal is available for each ten farmers in the son.

V. Farm Animals and Feeding Practices

The number of the farm animals in Gushikawa-son before and after the war is shown in the table that follows. The number of animals, except hogs, has been decreased a great deal. Cattle have been decreased to 29%, horses to 5% and goats to 76% while hogs increased to 116%.

Table 17. The Number of Animals.

	<i>Before War</i>	<i>After War ('55)</i>	<i>Increase or decrease</i>	<i>Ave. per farm after War</i>
Cattle	1,174	341	833	0.08
Horses	1,822	93	1,729	0.02
Hogs	3,620	4,224	604	0.9
Goats	4,941	3,797	1144	0.8

All these decreases are due to the battle fought on this island. The table above shows that animal industry is far below the prewar level. Before the war on the average one head of cattle used to be kept by every 3.7 farmers, but today by 12 farmers. A great decrease has taken place in the number of horses. Every 2.3 farmers used to keep one horse, but today one horse is kept by every 46 farmers. Too much change is not seen in the number of hogs and

goats. Because of the decreased number of the farm animals, farmers today are using less amount of farm manure than they used to before the war. Farmers mentioned that using less amount of farm manure has resulted in the decreased yield of crops.

It is common practice that horses and cattle are housed in sheds near the farm home and grasses fed must be cut in the grass lands and must be carried to the farmstead. No cattle nor horse is pastured.

Cattle feeding practices as reported by seven farmers visited are shown in the following table. Cattle are fed only sweet potatoes cooked, grasses and sweet potato vines either raw or cooked. Only one out of seven farmers fed his cattle ground soybeans once every two days.

The amount of the feed fed varies according to the weight of cattle, it also varies among the cattle with same weight. This kind of feeding practice results in mostly grass fed cattle as the amount

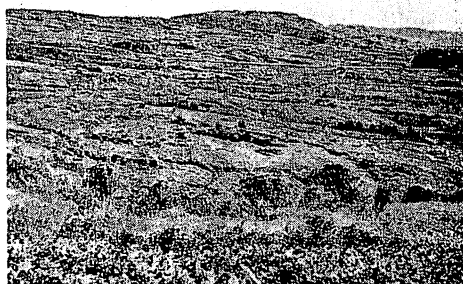


Fig. 14. There is a rather large area of land in this picture that was formerly cultivated, but not now in use.

Table 18. Cattle Feeding (Weight of Each Feed Fed One Day).

Cattle	No.	Weight (<i>kin</i>)	Sweet potatoes (<i>kin</i>)	Grass & sweet potato vine (<i>kin</i>)	Soybeans (<i>go</i>)
Cattle	No. 1	800	10	150	2
"	No. 2	500	3	150	
"	No. 3	500	5	60	
"	No. 4	500	5	60	
"	No. 5	400	5	60	
"	No. 6	400	3	50	
"	No. 7	400	3	50	

of sweet potatoes fed could not contribute much to the fattening process as sweet potatoes contain only about 25% of carbohydrates, and very little protein.

The table that follows shows the hog feeding practices in the *son*. As there is no weighing of feed on the farm, information on the weight of feed fed is not available. Sweet potatoes and sweet potato vines are the main feed fed to the hogs, and soybean cakes and ground soybeans are fed to a certain extent. Sometimes snails are fed too. Only one out of seventeen farmers used salt in hog feed. Sweet potato vines are fed either raw or cooked. Green

grasses are fed as substitute for sweet potato vines. Fish meals and lard are used once in a while only to improve their appetite.

Table 19. Hog Feeding Practices.

No.	Sweet potatoes	Sweet potato (Vine)	Soybean cake	Ground soybean	Snail	Salt
No. 1	X	X		X		
No. 2	X	X		X		
No. 3	X	X		X		
No. 4	X	X		X		
No. 5	X	X	X			
No. 6	X		X		X	
No. 7	X	X	X			
No. 8	X	X	X			
No. 9	X	X				
No. 10	X				X	
No. 11	X	X				
No. 12	X	X				
No. 13	X					
No. 14	X	X			X	X
No. 15	X	X		X		
No. 16	X	X	X			
No. 17	X	X	X			

Horses, goats and chicken are fed in the same way as in southern agricultural areas.

VI. Crops and Cropping Practices

There is a great change in production of different crops. The following table shows the acreages of different crops grown before and after the war.

Table 20. Acreage of Each Crop (tsubo)

	Rice	Sweet potatoes	Sugar cane	Mulberry tree	Orchard
Before War	589,560	2,131,980	3,105,150	3180	210
After War	310,500	1,740,000	174,000		

Note: Before the war (1940), After the war (1955)

As it is shown in the table above, sugar can used to occupy more land than any other crop before the war in this *son*. This *son* used to produce 1/10 of the total sugar produced in Okinawa, but today its sugar production has been decreased to 5% of its prewar production.

Although sweet potatoes are the main crop, its production has been decreased a great deal also. Rice production has been decreased to about 50%.

Crop rotation being followed in this *son* varies among farmers. The following are some of the typical rotations being followed.

A. Soybean	Sweet potatoes	Soybeans
Feb.-May (4 mo.)	June-Jan. (8 mo.)	Feb.-May (4 mo.)

This is the most typical rotation being followed by farmers. This is one year rotation in which sweet potatoes are grown once a year. When additional amount of sweet potatoes are urgently needed they are grown twice before next soybeans are sown. How often farmers grow sweet potatoes depends on how many farm animals they keep and how many acres of land they own. If a farmer keeps two or more large animals when he owns only one or two acres of land, he has to grow sweet potatoes oftener than one who owns more land and fewer animals. This should be well understood when the feeding practices of animals is recalled.

B. Sugar Cane	Soybean	Sweet potatoes
Mar.-Feb. (12 mo.)	Feb.-May (4 mo.)	June-Nov. (6 mo.)

This is a two year rotation in which sugar cane occupies the land for one year. After harvesting the first crop of sugar cane, commercial fertilizer is applied to the stubble which will bring forth the second crop next spring. This is illustrated in rotation C.

C. Sugar cane	Sugar cane	Soybean	Sweet potatoes
Mar.-Feb. (12 mo.)	Feb.-Jan. (12 mo.)	Feb.-May (4 mo.)	June-Nov. (6 mo.)

This is a three-year rotation in which two crops of sugar cane occupies the land for two years.

D. Sugar cane	Soybean	Sweet potatoes
Jul.-Dec. (18 mo.)	Feb.-May (4 mo.)	May-Dec. (7 mo.)

This is a 2½ year rotation in which the summer sugar cane takes 1½ years.

E. Sweet potatoes	Vegetables	Sweet potatoes
May-Jan. (8 mo.)	Feb.-May (4 mo.)	May-Jan. (9 mo.)

This is a one year rotation. This kind of rotation is followed on the fields which are located near the farmstead.

It is not uncommon that many farmers grow nothing but sweet potatoes year after year. This practice is followed by the farmers who own very small acres of land.

Two crops of rice are harvested per year, one spring rice another summer rice. No other crop is grown in rice paddy.

Crop Practices

Sweet Potatoes Teruma-gwa is the principal variety grown. Other varieties are Okinawa No. 100 and some other minor varieties. Farmers said that Teruma-gwa thrive best on thin soil and most resistant to cold weather among the varieties grown in this region.

The most favorable time for planting sweet potatoes is the early summer, May or the early part of June, which is right after the soybean harvest, to be harvested in December. The sweet potatoes grown on Okinawa clay loam are subject to the attack of sweet potato weevil, while those grown on Awase clay and Ishikawa loam are less subject to its attack. Sweet potatoes grown during the winter months takes two or three months longer than spring and early summer sweet potatoes to secure the maximum yield. Farmers do plant and harvest sweet potatoes all year round, as they are the principal item in their diet, and are important feed for any livestock they may be keeping.

About 80% of the farmers visited used animal manure to fertilize their sweet potato crop. The application of animal manure varied according to their estimate between 1000 kin to 3700 kin per tan. This is equivalent of about 2.7 to 10 tons per acre. Some of the farmers used some night soil, and no commercial fertilizer at all.

The yield of sweet potatoes varied from 1500 kin to 9000 kin per tan. This is approximately 120 to 720 bushels per acre yield. The average of the farmers visited was reported by them to be 5321 kin per tan or about 420 bushels per acre. It must be remembered that the yields were estimates as the farmers do not have ways to take accurate weight or measurements. The crops of sweet potatoes were in the ground from 5 to 9 months, the average being 7.9 months. With these farmers visited planting dates were scattered throughout the year.

Sugar Cane All of the farmers plant one variety of sugar cane. That is POJ 2725. As it was mentioned before, this *son* used to produce about 10% of the total sugar cane in Okinawa. But after the war, farmers did not start growing sugar cane until 1953.

Ten farmers were visited about the sugar cane production. Eight of them were using some commercial fertilizer, the average being about 89 kin per tan. The amount varied between 45 kin and 180 kin per tan. The average of 89 kin per tan is the same as 473 lbs. per acre. On the average, 1710 kin of animal manure per tan and 3330 kin of night soil have been used for sugar cane production.

The yield of sugar can varied between 4,500 kin and 30,000 kin per tan which would be equivalent to 12 to 80 tons to the acre. This

80 ton of yield is high when compared with the yields obtained in the principal sugar producing areas in the world.

The farmers have the same kind of problems as those in southern agricultural areas in transporting sugar cane from field to the agricultural roads where they can be picked up by trucks.

One apparent reason for lack of yield of all crops in Okinawa, that is probably true in the case of sugar cane, is the lack of organic matter in the soil. It is evident that farmers are using less amount of animal manures than before because the number of large animals has been decreased a great deal.

Soybeans Soybean is a good crop to prepare the land for either sugar cane or sweet potatoes. And it is necessary food crop in the diet of people and is very good source of protein animal feed. For many farmers it is the only cash crop they grow.

Soybeans are grown between February 5 and February 30 and is harvested in middle and later part of May. The varieties most generally grown in this *son* are Ohigu and Anda-gwa. The average amount of animal manure used per tan was 990 kin, and very little amount of commercial fertilizer.

The yield averaged 571 go per tan which is equivalent to 12 bushels per acre. This again is a very low yield, and should be possible of improvement. The lowest yield was 210 go and the highest yield was 1,200 go per tan. It is common problem for soybean producers that many times soybean is destroyed by the seasonal rain at its harvesting time.

Rice Farmers grow rice twice a year, spring and summer rice. As most of the farmers are dependent upon rainfall for the water supply of rice paddies, many farmers do not grow summer rice when there is little rain during summer.

There is wide range of sowing season for the spring rice, the earliest one is sown around November 5 and the latest one around January 20. The reason for sowing so early is to strengthen the seedlings before the cold weather comes and let them get it over without too much injury. The early sowing makes transplanting possible as soon as the weather becomes warm next spring. But sometimes there is a severe cold and seedlings are destroyed, therefore some farmers who do not want to go through such a risk will wait to sow until the weather becomes warmer.

There is also the wide range of harvesting period; some are harvested as early as around May 10 and the latest ones in early part of July. The summer rice is sown sometime around July 20 and it is transplanted around August 5.

There are several varieties of rice grown, they are: Kunigami No. 1, Kofuku, Taichu No. 65, Tohoku No. 401, Takashiro, and Takashiro-mochi etc. They are grown in most cases separately and sometimes grown in mixture.

The average yield of rice as reported by the farmers visited was about 2 koku of hulled rice per tan, which is equal to a yield of 40 bushels to the acre.

The farmers visited reported that few of them used chemical fertilizer and almost all of them used either animal manure or green manure. The average animal manure and green manure application was estimated to be 842 kin per tan or 2.3 tons per acre.

Vegetables Vegetables are produced mainly for home consumption and some are for marketing. It is difficult to say how much is consumed at home and how much is sold. It is also difficult to judge the efficiency of production for the many vegetable crops grown, for the lack of suitable comparative data. For this reason no analysis of these crops will be made, except they like all crops are likely to respond to good soil management practices. It is also probable that there are some problems in insect and disease control.

VII. The Marketing of Agricultural Products

As it has been mentioned a small proportion of agricultural product are being sold. Most of the farmers are self-sufficient. There is no statistical information available which would show the amount of each farm product sold in this *son*.

Sugar cane production, in this *son*, is still far below the prewar level but the acreage of sugar cane is increasing every year. Most



Fig. 15. A small retail market in one of the villages in this *son*.

of the sugar cane produced is sold as cuttings to take care of the increasing acreage being planted. Some farmers at western part of the *son* send their sugar cane to Akamichi sugar mills for manufacturing.

Some amount of the soybeans produced is sold for cash, and some is used at home as food both for the family and for livestock.

The soybeans are sold to the agricultural cooperative and also at local markets. Some farmers retail their soybeans to the consumer,

but they are usually sold at wholesale prices to either the agricultural cooperative or to a retailers at a local market. The price received during 1955 varied from 50 to 65 yen per sho. The price is lowest right after harvest in late May and early June. This is a high price for soybeans when compared to the prices in the United States, as this price is about \$8.00 to \$10.00 per bushel.

Sweet potatoes are sold for cash, but the bulk of the crop is used as food for the family, or as feed for livestock. Farmers bring sweet potatoes to the local retailers and sell them at a wholesale price. Sometimes, farmers retail their sweet potatoes. The price varies, being lowest in the late fall or early winter, and highest in the early summer. The average is about 25 yen per 10 *kin* of sweet potatoes.

Most of the rice harvested is used for home consumption and some is sold for cash. For many farmers, this is the only source of cash income. Some farmers sell their rice and purchase cheaper imported rice for use by their family.

The price for vegetables varies widely from the period of scarcity to the period of plentiful supply. The price of cabbage serves as a good illustration. When it first appears on the late fall market, it sells for 15 to 20 yen per *kin*, but later when supply becomes plentiful it may sell for as low as 1.5 yen per *kin*.

Some amount of vegetables is brought to this area from the southern section of this island to be sold. In that case the local farmers suffer much.

VIII. Control of Insect and Diseases

No extensive use of farm chemicals is seen in this *son*. Farmers cooperative association supplies farmers with chemicals but very little instruction is given to the farmers. The agricultural leaders do not know much about how to handle each chemical.

PART III

Land Use in Hanechi-son, Okinawa

This *son* was selected as a representative of the rice producing *sons* in the northern mountainous part of this island.

Generally speaking, the farmers in this mountainous region own less agricultural land than those in the middle and southern parts of this island, therefore most of the farmers have to do forest work in order to earn a living. But there are more acres of rice fields

than in other parts of this island.

The main enterprise in this *son* is rice production and almost all farmers keep one or more farm animals. Sweet potatoes are also grown to a certain extent.

Eighteen farmers were selected from the upper and middle classes of farmers. No farmer in the lower class was visited.

I. The Soils of the *son*

Along the coastal line of this *son*, there lies a ridge of low hills. The inner area is also traversed by the same kind of low hills. The soils of these hills are composed of Ishikawa loam which is deep, rapidly drained acid soil, low in fertility and its surface soil is pale-brown friable loam 3 to 6 inches deep. This soil is covered with grasses and small trees.

Rice paddy lands lie between the hills. The principal soils of the low land area are Akamaru and Aha soils which are deep, fertile and most poorly drained alluvial soils. In the interior of this area, there lies a steep mountain which is composed of shallow acid soils. They are very low in fertility and their surface soil is less than 15 inches deep.

Although Ishikawa loam and these shallow acid soils are not well suited for cropland, parts of the areas occupied by these soils are being used for farming. The very steep and infertile areas of these soils are used for growing trees and grasses.

II. Population Characteristics

The population of the *son* according to data secured in February 1955 is 10,155 persons. Of these 86.3% are engaged in agriculture.

From the data secured in 1953, the age distribution of the *son* as a whole is shown in the table that follows:

Table 21. Age Distribution (1953)

	0-14	15-24	25-39	40-59	60 and over	Total
Number	3996	1983	1653	1610	1085	10327
Percent	38.7%	19.2%	16.0%	15.6%	10.0%	

This table shows that 50.8% of the whole population are a part of the available labor force. The picture is a little different when we take the farm population only. Some of the people between 15 and 60 years of age are not able to work for various reasons.

Table 22. Agricultural Labor Force (1955)

Total	8766	Labor force	3270	37.3%
Male	4162	Male	1534	
Female	4604	Female	1736	

The table above shows that only 37.3% of the farm people are a part of agricultural labor force. That means about 1.8 persons in each farm family are able to work.

III. Land Ownership and Land Utilization

The following table will show the amount of land operated solely by the owner, land operated as owned and rented land, and that is primarily operated by renters.

Table 23. Land Ownership (1954. Dec.)

Total	<i>Owned by the operator</i>	<i>Owned and rented by the operator</i>	<i>Largely rented by the operator</i>	<i>Rented by operator</i>
1705 farms	599	473	334	299
	35.1%	27.7%	19.1%	17.5%
1,557,300 tsubo	721,200	437,700	242,100	156,300
	46.3%	28.1%	15.5%	10.0%

The first column in the above table shows the number of farmers who farm their own land, the second column states the number of farmers who own most of their land, and rent some land, the third column shows the number of farmers who rent more land than they own, and the last column refers to farmers who rent all of the land they farm.

One third of the farmers are owner operators who own just about one-half of the total land while renters are 17.5% of all the farmers and own only 10% of the total agricultural land.

Renting of land is practiced to a certain extent in this *son*. The following table will show some of the going rental rates for different classes of land in this *son*.

Table 24. Rental Rate (1954)

Rental Rate Per	<i>Rice paddy land</i>			<i>Upland crop land</i>		
	<i>High</i>	<i>Middle</i>	<i>Low</i>	<i>High</i>	<i>Middle</i>	<i>Low</i>
Rate Per	10.20	8.40	6.00	6.00	3.60	2.40
Tsubo Per Year	yen	yen	yen	yen	yen	yen

The rental rate varies from 2.40 yen to 6 yen per tsubo per year of upland crop land and from 6 yen to 10.20 yen for the rice

paddy land. The information was obtained from the data kept in the *son* office.

The table that follows shows, according to 1954 data, the amount of upland crop land, rice paddies, grass land and forest land in this son and the average amount of land controlled by one farmer.

Table 25. The Acreage of Upland Crop Land, Rice Paddy, Grass Land and Forest Land (1954)

	<i>Tsubo</i>	<i>Ave. per family</i>	<i>Arable not cultivated</i>	<i>Ave. Tsubo cultivated per family</i>
Upland	1,087,059 <i>tsubo</i>	673	88,800 <i>tsubo</i>	585 <i>tsubo</i>
Rice Paddy	946,117 "	554	5,000 "	552 "
Grass Land	834,101 "	489		
Forest Land	6,257,905 "	3676		

Note: Not all of the agricultural land owned by the farmers in the *son* is being used. The acreage of the idle land seems to be underestimated.

It should be noticed that an average farmer owns almost the same amounts of upland crop land and of rice paddy land. As it has been mentioned in the previously pages, the low hills which are composed of Ishikawa loam are covered by grasses which are used for forage and used as the material for compost. Fire wood is obtained from the mountain. No grass is used for fuel in this area as is practiced in the middle and the southern parts of this island.

It should also be noticed that there is a large amount of idle land when one considers that the average farmer is operating only an acre or so.

There is variation in the size of farms which is shown in the following table. Sixty five percent of the farmers own less than one acre of land. Only 0.6% of the farmers own more than 3,000 *tsubo* or more of land which is just enough to provide an average farm family with a subsistence level of living.

Table 26. The Sizes of Farms (1955)

	<i>Total</i>	<i>Below 150 tsubo</i>	<i>150-300 tsubo</i>	<i>300-900 tsubo</i>	<i>900-1,500 tsubo</i>	<i>1500-3000 tsubo</i>	<i>3000-9000 tsubo</i>
No. Families	1,694	65	257	787	418	157	10
Percent		3.9%	15.1%	46.4%	24.6%	9.2%	0.6%
Amt. of Land in Tsubo	1,557,300	6,000	55,800	628,500	501,000	327,000	39,000
Percent		0.4%	3.6%	40.3%	32.1%	20.9%	2.4%

As it has been previously mentioned, the mountain and hill sides are used for upland crop land, therefore the amount of the upland crop land an average farmer owns in this son is much less than that of the farmers in the middle and southern areas of this island.

The small size of each unit of field is another problem which hinders the development of agriculture. The following table shows the size of fields.

Table 27. The Size of Each Unit of Upland Crop Land Field. (1955)

	<i>Below 99</i>	<i>100-199</i>	<i>200-299</i>	<i>300-399</i>	<i>400-499</i>	<i>500-599</i>	<i>1000 & above</i>
Amt. of Land in Tsubo	12,544	27,337	10,677	6,609	1,686	5,069	3007
Percent	18.7%	40.8%	15.9%	9.8%	2.5%	7.6%	4.5%
No. of Field	200	192	45	19	4	8	2
Percent	42.5%	40.8%	9.5%	4%	0.8%	1.5%	0.4%

More than 80% of the upland fields are less than 200 tsubo.

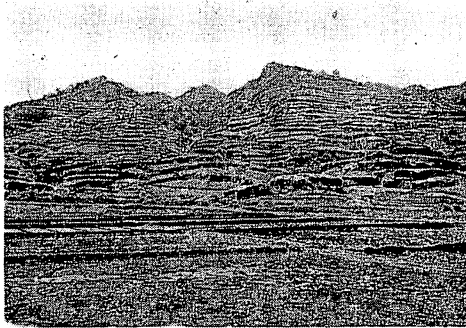


Fig. 16. Land such as in this picture can only be utilized through hand labor.

There are many fields with acreage of less than 50 tsubo. This table shows that there are some fields which are more than 500 or more of tsubo, but it should be well understood that this information was obtained from the record book kept at the *son* office. There is practically no field which contains more than 500 or more tsubo. They are

further divided for the purpose of cultivation.

Table 28. The Sizes of Rice Field (1955)

	<i>Below 99</i>	<i>100-199</i>	<i>200-299</i>	<i>300-399</i>	<i>400-499</i>	<i>500-599</i>	<i>1000 & above</i>
Amt. of Land in Tsubo	5036	28130	22817	10178	10281	21676	4376
Percent	4.9%	27.4%	22.2%	9.9%	10.0%	22.0%	4.2%
No. of Field	82	190	94	30	23	31	4
Percent	18.0%	44.4%	20.7%	6.6%	5.0%	7.0%	0.9%

Note: The upland crop land and rice paddies owned by two villages in this *son* were taken as the samples for table 27 and table 28.

A similar situation with rice paddy land is shown in the table above. Generally speaking, each unit of rice paddy is larger than that of upland crop land. Farmers in every section of this island cluster together in one place and make up one village, and the farm fields lie all around the village. The following figure shows the distribution of the fields owned by some farmers.

As it is shown, the fields owned by each farmer are not concentrated in one place, but rather scattered in every direction. It

may be a lot of waste of time and energy on walking to and from the fields.

Some people say that it is advantageous to have their fields all around in order to avoid the serious damage by typhoon which cannot be avoided when one farmer's fields are located in one place. The table 25 shows the amount of idle lands which were formerly cultivated. There is some idle land in every *son* of this northern section of the island. This may be very strange situation because an average farmer owns about one acre of land

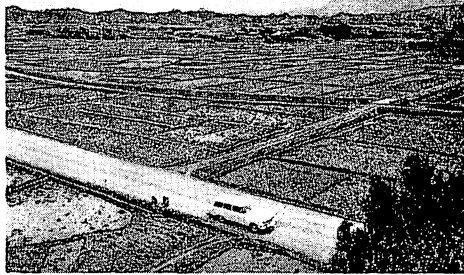


Fig. 17. The size of rice paddy land is shown in the above picture. Compare the size of field with the station wagon on the road.

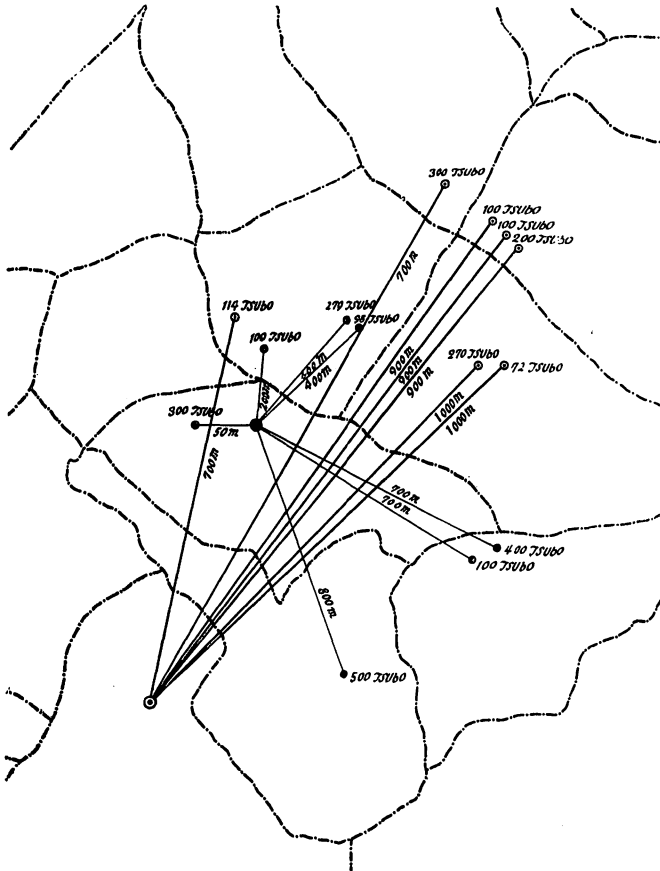


Fig. 18. Field distribution

and this country is importing a large amount of agricultural goods. There may be many reasons for this situation that will be suggested. Fifty one farmers in 13 *sons* of the northern section of this island interviewed gave the following reasons for the land which is now idle though it is suitable for cultivation and used to be growing crops.

1. **Lack of Labor.** It will be shown in the following pages that the number of large farm animals has decreased, which means the decrease of the source of power. It is also true in every *son* in this northern area. Besides that, there has been the movement of people from this area to southern urban areas. That means another decrease of labor force.



Fig. 19. A wild boar fence is needed in many of the northern areas to protect farmer's crops.

As it will be explained, there is no other sources of power for agriculture than human labor and animal power. The amount of land taken care of by human hand is limited, therefore there will be idle land when the amount of human labor is decreased. This is exactly what took place in many rural agricultural areas on the island. About

37% of the idle land in the northern area is due to this reason—lack of labor.

2. **Damages by Flood and Sea-water.** A large part of the northern area of the island is occupied by mountains. The narrow belt between coastal line and the mountains is used for agricultural land. Therefore there is a great damage by flood and sea-water, which takes place in case of typhoons as they are likely to occur every year. Farmers have been encouraged to establish shelterbelts of wood, but it doesn't help much. In most parts of the northern area, the cliffs stand right from the coastal line and leave no space to be used for agriculture.

3. **Better to Grow Grasses and Trees for Thatching Roof and for Fuel.** About 11% of the idle land is due to this reason. It is not understandable that there are idle lands for this reason when the village adjoins the mountains where fire wood and grasses can be obtained for fuel.

4. **Damages by Wild Boars, Rats and Wild Birds.** Fields at

the foot of a mountain are subject to attack by wild boars and wild birds. A wild boar hedge might be built around each field area but it is very costly to build one. Hunting and having a scarecrow in the fields are very helpful ways of preventing the wild animals. The damages of the wild animals is one of the great agricultural problems in this *son* as well as in other *sons* in northern area.

5. **Distance to Fields.** Many farmers have to walk a considerable distance to and from fields. A random sample of 130 fields shows that the average distance a farmer must walk to one of these fields is 471 meters—refer to Fig. 18.

IV. Sources of Power for Cultivation and Transportation

Because of the steepness of the agricultural land and the small size of each field unit, it seems to be harder to adopt machine or animal power to agriculture in this area than in middle or southern agricultural areas of the island. There is almost no possibility of adopting machine nor animal power to the fields on the hill and mountain sides. Most of the farm work is done by the hands of the farmer and his family.

Some horses are used for plowing of the fields in the low land rice field areas, but it is the exception rather than the rule. There is only one work animal available for each eight farmers in the *son*.

Canoes are also used for transportation in this *son* and in other areas of this northern section.

V. Farm Animals and Feeding Practices

The number of farm animals in Hanechi-son before and after the war is shown in the table that follows:

Table 29. Number of Animals (1955. July)

	<i>Before War</i>	<i>After War</i>	<i>Increase or decrease</i>	<i>Ave. number kept by one farmer after War</i>
Cattle	426	74	- 352	0.04
Horses	401	221	- 180	0.13
Hogs	3,291	2,259	-1032	1.32
Goats	1,343	1,364	+ 21	0.78

The number of animals except goats has decreased a great deal. Cattle have decreased to 17%, horses to 55% and hogs to 68%, while goats have increased to 102%.

All these decreases of farm animals are due to the battle fought on the island, the table above shows that animal industry is far below the prewar level. Before the war, on the average, one head

of cattle was used to be kept by every 3 farmers but today the ratio is 1 to 23. The number of horses has been decreased a great deal. Every 4 farmers used to keep one horse but today, it is kept, on the average, by every 8 farmers.



Fig. 20. This farmer owns one of the three horses in his farm village of seventy two families. He plows for others charging 70 to 90 yen per 100 tsubo.

As it is practiced in middle and southern areas of the islands, cattle and horses are not pastured, but rather are housed in sheds near the farm home. Thus all the grass fed is cut and carried to the farmstead.

It costs a lot of human effort to cut and carry the forage for farm animals, which would not be necessary if the

mountain areas where grasses are growing are fenced for pasture.

Only two farmers were asked of their feeding practices of cattle. Feeds produced on the farm are fed only; no protein supplementary feed is fed. Sweet potatoes and grasses are two main feeds for cattle. The table that follows shows the hog feeding practice in the *son*.

Table 30. Hog Feeding Practices (1955)

No.	Sweet potatoes	Sweet pot. vines	Soybean cake	Rice bran	Cabbage	Flour
No. 1	X		X			
No. 2	X	X		X		
No. 3	X	X			X	
No. 4	X		X			
No. 5	X	X		X		
No. 6	X	X				
No. 7	X	X				X
No. 8	X	X	X			
No. 9	X	X	X			

Sweet potatoes and sweet potato vines are the main feeds fed to hogs. Four out of nine farmers fed soybean cake. As it has been mentioned previously, rice production is the main industry in this *son*. The rice produced is cleaned at the rice-cleaning mills in the *son*; and the by-product, rice bran, is used as cattle, horse and hog feed.

When cabbages are over-produced and are not sold at market, they are fed to hogs. Flour and middlings are fed when there is

the short supply of sweet potatoes. The amount of feed fed varies according to the weight of hog; it also varies among the hogs with the same weight. On the average, the hogs weighing from 100 to 150 kin are fed about 15 kin of sweet potatoes, and the hogs 200 kin or above are fed about 20 kin of sweet potatoes per day.

Horse feeding practices are about as follows:

Table 31. Horse Feeding (kin) 1955

No.	Weight (kin)	Sweet potatoes	Grasses	Rice bran
No. 1	700	20	40	
No. 2	600	20	20	3 go
No. 3	600	20	60	15 "
No. 4	?	25	30	
No. 5	?	10	70	
No. 6	?	10	30	

A horse, 600 or 700 kin in weight, receives about the same amount of sweet potatoes as a hog about 200 kin in weight. But horses receive about 40 to 50 kin of grasses also. Information on the feeding of goats was difficult to secure as they received only grass and sweet potato vines. The feeding is irregular and there is no record of amount fed.

VI. Crops and Cropping Practices

The table that follows shows the amount of acreage occupied by each crop. The three main crops grown in this *son* are rice, sweet potatoes and sugar cane. It should be noticed that rice occupies more land than any other crop, and sweet potato comes next, then

Table 32. Crops in this *son* (1954)

	Rice	Sweet potatoes	Sugar cane	Soybean	Vegetable	Beans
Acreage	5056 tan	4753	3519	1820	828	423

sugar cane. Some vegetables are grown for home consumption. Sugar cane used to occupy almost the same amount of land as rice, but during the war, the sugar mills were destroyed and the sugar industry has declined after 1945.

Crop rotations being followed in the *son* varies among farmers. Followings are some of the typical rotations being followed.

A. Broad beans	Sweet potatoes	Vegetables	Soybeans
Oct.-Feb. (4 mo.)	Feb.-Sept. (7 mo.)	Oct.-Feb. (4 mo.)	Feb.-May (3 mo.)

This is a 1½ year rotation in which sweet potatoes occupy the land for seven months.

B. Broad beans	Sugar cane	Sugar cane	Sweet potatoes
Oct.-Feb. (4 mo.)	Feb.-Mar. (13 mo.)	Mar.-Feb. (11 mo.)	Feb.-Sept. (7mo.)

This is a three year crop rotation in which sugar cane occupies the land for two years. The second sugar cane is the stubbling of the previous crop. All the farmers who own rice fields grow broadbeans as green manure for the spring rice. Sometimes, broadbeans are grown in October together with sweet potatoes. It has the following advantage; by the time the severe cold comes in winter, broadbeans are tall enough to protect the sweet potatoes. In February, broadbeans are harvested and are used as green manure and by that time the sweet potatoes become strong enough to endure the cold weather. Soon after the harvest of broadbeans, the sweet potatoes are fertilized with some commercial fertilizer.

Besides such a mutual protection, there are some other advantages; the economical use of land and the greater yields of sweet potatoes.

There are some other ways of crop rotation.

C. Irish potatoes	Sweet potatoes	Irish potatoes
Dec.-Mar. (3 mo.)	Mar.-Nov. (8 mo.)	Dec.-Mar. (3 mo.)

This is a one-year rotation in which sweet potatoes occupy the land for 8 months and Irish potatoes for 3 months.

D. Sweet potatoes	Kidney-beans
May-Jan. (8 mo.)	Feb.-May (3 mo.)

This is a one-year rotation in which sweet potatoes occupy the land for 8 months and kidney beans for 3 months.

E. Sweet potatoes	Sugar cane	Sweet potatoes	Vegetable
May-Jan. (8 mo.)	Mar.-Mar. (12 mo.)	Apr.-Oct. (6 mo.)	Oct.-Feb. (4 mo.)

This is a 2½ year rotation in which sugar cane occupies the land for 1 year.

Most of the farmers do not have a long time land use plan. Therefore whenever land is open they may put in whatever crop is suited for that particular season.

Two crops of rice are grown every year, the spring rice and the summer rice. The time of production is as following A:

A.	Spring rice	Summer rice
	Mar. 5-10---July 20-30	Aug. 5-10---Nov. 24-30
B.	Spring rice	Sweet potatoes
	Mar. 5-10---July 20-30	July 25-Aug. 5---Jan. 1-10

Spring rice is transplanted from a seed-bed to the field in early part of March and will be harvested in later part of July. Summer rice is sown right after spring rice is harvested and transplanted

in early part of August and it will be harvested in later part of November.

Rain is the only source of water supply for many rice fields, therefore when there is very little rain in summer, the summer rice cannot be grown; instead, sweet potatoes are grown in those fields. These sweet potatoes are harvested in early part of January.

Crop Practices

Sweet Potatoes Okinawa No. 100 is the principal variety grown. Other varieties are the Hijagawa No. 1 and Hanechi Taiwan.

The most favorable time for planting sweet potatoes is the later part of spring or the early summer to be harvested in December. But sweet potatoes are grown throughout the year. The crops of sweet potatoes were in the ground from 4 to 10 months, the average being about 6.6 months.

The farmers visited all used animal manure to fertilize their sweet potato crop. The application of animal manures varied according to their estimate between 1,200 kin to 5,600 kin per tan. This is the equivalent of 3.2 to 15 tons per acre. Thirteen out of seventeen farmers used some chemical fertilizer. The average amount of commercial fertilizer used per tan was 23 kin which is equal to 122 pounds per acre. In many cases, rice straw is used in the place of animal manure or together with animal manure. Three out of seventeen farmers were using night soil to fertilize their sweet potato crop.

The yields of sweet potatoes varied from 1,500 kin to 6,000 kin per tan. This is approximately from 120 to 480 bushels per acre yield. The average of the farmers visited was reported by them to be 4,394 kin per tan or about 351 bushels per acre.

Sugar Cane Nearly all farmers plant one variety of sugar cane. That is POJ 2725.

Four out of five farmers were following the practices of growing sugar cane for a 12-month period. Each of the five farmers were using some commercial fertilizer, the average being about 132 kin per tan.

The amount varied between 60 to 204 kin per tan. The average of 132 kin per tan is the same as 702 pounds per acre. On the average, 2,750 kin of animal manure per tan is used for sugar cane production.

The yields of sugar cane varied between 7,000 and 20,000 kin per tan which would be equivalent to 18 to 53 tons to the acre. The average is about 28 tons per acre.

As it has been mentioned previously all the sugar mills were destroyed during the war and the sugar industry had to start anew. Sugar production is still far below prewar level. The rebuilding process has been very slow partly because of the fact that Okinawa had been cut away from Japan for several years in its trade and hadn't been able to export sugar to Japan.

Rice As it was mentioned before, rice is grown twice a year, namely: spring rice and summer rice.

Direct sowing practice is not adopted in Okinawa; instead, seedlings are prepared in seed beds and then transplanted to fields.

According to the weather condition, there is a little variation of the time of sowing from year to year, usually seeds of spring rice are sown sometime between January 25 and February 5. Fourteen farmers visited sowed their seeds sometime between January 28 and February 7. The length of time in the seed bed varies from 34 to 45 days, the average being 38.8 days.

In preparation of the seed bed, the first thing to do is to apply green manure; it is done 3 or 4 weeks before seeds are to be sown. Some farmers do not use either green manure nor animal manure because the roots of seedlings get coiled round with those manures and make the transplanting harder.

Ten to fifteen days before sowing the seeds, about 15 pounds of CaCN_2 , calcium cyanamide, is applied, to 100 tsubo of seed bed to kill earthworms and other worms and insects harmful to the seedlings. The amount of seed sown varied from 16 to 25.5 sho per 100 tsubo of seed bed, the average being 20.7 sho. 100 tsubo of seed bed will plant 1,500 tsubo of rice.

Twelve out of fourteen farmers visited used commercial fertilizer to their seed bed, the average amount being 23 kin per 100 tsubo, which is equivalent to 367 lb. per acre. Animal manure, straw and compost are used also, the average amount being 543 kin per 100 tsubo.

The principal variety grown is Taichu No. 65. There are other varieties like Kunigami No. 1 and Shinchiku No. 4.

Seedlings are transplanted to the fields sometime between March 8 and March 21. Each of fourteen farmers was using some commercial fertilizer, the average being about 65 kin per tan which is equivalent to 345 pounds per acre. The application of green or animal manure or straw varied according to their estimate between 1,080 to 6,700 kin per tan. This is the equivalent of 3.2 to 18 tons per acre. The average being 2,435 kin per tan.

Rice is harvested sometime between July 5 and July 20. The yields of unhulled rice varied from 2.4 koku, which is 2,400 go, to

5.4 koku. The average of the farmers visited was reported by them to be 4.057 koku.

As soon as spring rice is harvested, the seed bed is prepared for summer rice. Seeds are sown sometime between July 22 and July 29.

The length of time in seed bed is much shorter than that of spring rice. The average length of time is 17.5 days. About the same amount of seed is sown per 100 tsubo.

On the average, 15 kin of chemical fertilizer is applied per 100 tsubo of seed bed. No organic manure is used for summer seed bed.

The seedlings are transplanted to the fields around August 10 and the summer rice is harvested sometime between November 25 and 30.

The application of organic manures, animal and green manures and straw, varied from 600 kin to 9,000 kin per tan. Each of thirteen farmers visited used commercial fertilizer, the average amount being 55 kin per tan.

No adequate information was secured of the yield of summer rice. The amount of yield is influenced by many more factors than that of spring rice, such as typhoon, water supply, and damages by insects. Farmers said that they can expect only about 60% of the yield of spring rice.

Other Crops There are other crops grown mainly for the purpose of home consumption, they are barley, Irish potatoes, several kinds of beans, and vegetables.

Barley is sown in November and December. Most of it is used for making seasoning paste.

Irish potato is a very profitable crop because it can be grown in winter during which other crops do not grow too well. Besides, it can be harvested in three months. Irish potatoes are used as the substitute for either vegetables or sweet potatoes.

Soybeans, broad beans, horse beans, kidney beans, french beans, are grown and used for making seasoning paste. Vegetables are grown strictly for home consumption.

7. Marketing of the Agricultural Products

The majority of the farmers in this *son* have no other source of cash income than selling their agricultural products. The situation is a little different from that in middle part of the island where one or two persons of a farm family are employed by either American Military Forces or by Okinawan civilian companies.

The main cash crop in this *son* is rice. It is estimated that

approximately 42% of rice harvested is sold. For many farmers rice is the only source of cash income, therefore they have to sell a part of it, regardless whether or not they have enough to feed their families for the year.

Rice is sold through the local agricultural cooperative association, they are paid in cash by the cooperative association about 9/10 of the estimated price for which rice would be sold at the market. The rest of the money is paid after the rice is actually sold. The highest and the lowest prices of 100 kin of unhulled rice last year, 1954 were 1,800 yen and 1,200 yen respectively. The price of this year, 1955, has been 1,100 yen for the same amount, which means that the price of this year is lower than the lowest price of last year. Rice in some cases is sold through middle men also.

The agricultural cooperative association functions like a bank for the farmers. They can borrow money or buy fertilizer from the association by giving their growing rice as a security. The debts might be paid back soon after the rice is harvested.

Some farmers have their own special cooperative organization, the number of members is from 10 to 20. The purpose of the organization is to give mutual help. It functions as follows: each member of the group donates 100 kin of unhulled rice and the whole collected rice is given to one of the members, and the next man receives the next collection and so forth. The rice may be used for securing a large farm animal or some other permanent farm property. The collection is made twice a year, the first one is right after the harvesting of spring rice and the second one right after summer rice.

As it was pointed out previously, the amount of sugar produced has been decreased quite a lot. Today sugar cane production is practiced on a small scale.

The sugar cane is manufactured locally into black sugar, and sold either to the local cooperative association or to the central cooperative association. The price farmers reported were receiving varied between a low of 880 yen to a high of 900 yen per 1,000 kin of cane.

Some amount of pineapples is produced by the farmers near mountain sides. Pineapples produced are sold either to the local cooperative association or directly to the retailers in towns and cities.

The prices farmers received from the local association per 1 kin of pineapples is as follows:

Table 33. Price of Pineapples (per kin) 1955

<i>Grade</i>	<i>Excellent No. 1</i>	<i>Very good No. 2</i>	<i>Good No. 3</i>	<i>Moderate No. 4</i>
Price	7 yen	5.5 yen	4.5 yen	4 yen

The pineapples bought by the local cooperative might be sold locally or shipped to towns and cities.

Other agricultural crops are grown mainly for home consumption; very little, if any, is being sold.

CONCLUSIONS AND SUGGESTIONS

1. There is a considerable area of land that has formerly been cultivated but is unused at present. The reasons for this situation appear to be:

- (a) Lack of labor. The land on Okinawa is cultivated by hand which limits the amount of land one family can farm to a relatively small area.
- (b) Draft animals were severely reduced during the war, so that animal power cannot supplement hand power in the cultivation of land.
- (c) There is a lack of farm road, making it necessary that transportation to and from fields is slow and laborious, and limits the amount of land that can be farmed.
- (d) Farmers' fields are often widely separated, causing undue loss of time and effort in travel between fields.
- (e) Farmers report that farm product price is too low to be profitable for them to open other land for cultivation beyond their need for subsistence.
- (f) Some land is either too steep or too stony for profitable cultivation.
- (g) Some of the idle land is owned by persons having jobs in the urban areas, and for various reasons is not rented to the farm operators.
- (h) Much of the idle land has become heavily sodded, making it difficult to bring into cultivation by hand methods.

2. Farm incomes are too low because:

- (a) The size of farms are extremely small, and consequently the volume of business is low.
- (b) The production of crops and animals is not as efficient as it could be.
- (c) The farm business is not as intensive as is possible.

SUGGESTIONS FOR IMPROVEMENT

1. Improved roads and new roads built closer to farm fields would reduce the amount of hand labor in transportation of bulky and heavy materials from the fields to the present roads. Such roads

might make possible the use of some land unused at present, and save time and labor for productive work.

2. The exchange of land by farmers so that their fields are continuous would also save time and labor, and make feasible the use of animal or mechanical power. The use of animal or mechanical power would again release labor for additional productive work.

3. The use of large machines, such as, bulldozers, and scrapers, should be tried to clear, terrace or level hilly and stony land for the cultivation of crops. The high value of land on Okinawa would make it feasible to expend up to 15,000 yen per tan to make the land suitable for cultivation.

4. Credit facilities should be examined to see if they are adequate to finance improvements that are economically sound. Such credit could be used to purchase land, animals, or machines to expand the size of the farm business.

5. The rental practices should be examined to see if some of the unused land could be brought back into production through rental arrangements that would be satisfactory to the operator and the owner.

6. There should be some studies of machines that would be adaptable for use in Okinawa.

7. The production of draft animals by farmers should be investigated regarding its feasibility.

8. The improvement in the yields of crops could be secured through the following suggestions:

- (a) Varietal demonstrations to show their adaptability under varying soil and management conditions.
- (b) Fertilizer demonstrations, using different amounts, analysis and various placements of fertilizer.
- (c) The use of green manure both with and without chemical fertilizers.
- (d) The demonstration of other management practices.
- (e) The demonstration of the control of insects, such as the sweet potato weevil.
- (f) Investigating the possibilities of additional sources of water, as a means of increasing the amount of land that can be irrigated.

9. The improvement in the efficiency of livestock production through better feeding.

10. Investigate to determine the most profitable kinds of crops and livestock that can be produced on Okinawa.

11. There may be considerable savings possible in the direct importation of feed materials and local mixing of feeds for hogs and poultry.

12. Perhaps farm enterprises can be intensified by hog and poultry production.

13. There may be possibilities of improving the marketing situation for farmers through:

(a) Supplying more fully the possible demand for farm products by the U.S. forces, and other foreign personnel living in Okinawa. To fully exploit this market will require some study to determine the amounts needed of various products, and the ability of farmers to have the constant volume available in season to take care of the demand. It would also be necessary to establish sanitary practices acceptable to the U.S. market.

(b) Storage or the processing of some farm products would extend the period of use and reduce the surplus during the seasons of heaviest production.

14. A well trained staff in agricultural extension work would be essential to make progress in all of the foregoing suggestions. Such training should not be less than a B.S. degree in agriculture and in extension method.

沖縄に於ける農地利用状況 (摘要)

B. D. クーン, 嘉陽宗陰

沖縄本島の南中北部の3ヶ村の農業調査を総括して大要次のようなことがいえる。

I. 調査地の農業従事者人口

1. 村の総人口に対する農業総人口の割合は南部(三和村)に於いて最も高く北部(羽地村)がこれに次ぎ中部(具志川村)が最も低い。

2. 農業総人口に対する農業従事者人口の割合も南部に於いて最も高く中部に於いて最も低い。北部はその中間に来る。これらは中部地区に於ける軍に依る莫大な農耕地接収が大きく影響していると思われる。中部地区に於ける具志川村以外の他の村も村の大部分が接収されているからこの2つの割合はもっと低いものと推察される。即ち或者は農を離れ軍労務者となり或者等は農を離れなくとも残された僅かの土地を耕作しながら家族の1, 2名を軍労務者として働かせることに依って生計を営んでいる状態である。

3. 農業従事者人口の男女の割合は南部と北部に於いては男の方が多く中部に於ては女の方が遙かに多い。これからして農家から出て軍で働いているのは男の方が多いということが判る。

II. 農耕地の概況

1. 小作状況 三和村に於いては自農作が多く約60%それで小作者は少い。それに反し具志川村では自作者の数よりも小作者の数が多い。即ち前者は33%で後者は36%である。中部に於けるこの傾向も土地接収がその大きな原因となっていると思われる。

2. 経営耕地面積 調査の対象となった3ヶ村に於ける経営規模は大體同じで約4反歩前後となっている。中部地区に於ける具志川村以外の村の平均経営面積は4反を遙かに下廻るものと思われる。その理由は第一項に述べたものと同じ。北部では田と畑の割合は約半々となっており南に行くに従って田の割合が次第に減じ最南端もの多く、この三和村では僅かしかない。沖縄本島に於ける農家は過小農と称せられて然るべき調査でも全農家の約88%が僅か五反以下の耕地面積しか有しない。3町以上を有する農家は殆んどない。

3. 田畑一筆当りの面積 田畑一筆当りの面積も至極小さい。その傾向は特に山間地帯の北部に見られる。北部では全畑数の約83%は200坪以下であり、中部南

部に行くに従って一筆毎の面積が大きくなっている。南部では 200 坪以下の畑は全畑の約40%位になっている。これらの報告には 500 坪以上の畑もあるが実はこの資料は土地所有権証明書から得たもので実際は各筆とも使用便ならしめるために細分されている。田は一般に畑よりも大きい。

4. 田畑の分散状態 普通農家は 1ヶ所に集団をなして部落を形成する。そして田畑はその周囲に散在する。それで田畑は部落の直ぐ周囲の方から始まり、約一里時には一里半位の遠方に及ぶ場合もある。各田畑への平均距離は所に依って異なるが約五百米内外である。

III. 家畜状況

1. 家畜数 一般に豚以外の家畜は戦前より遙かに少くなっている。牛の頭数は 30% 下に減少している。馬の減少率は場所に依って異なり具志川村に於いては 5% へと著しい減少を見せ羽地村辺りでは約半数に減少している。豚の頭数に就いての戦前の統計資料は三和村にはないが具志川村と羽地村の統計に依ると戦前を遙かに上廻っている。

2. 飼育状況 これに就いて一概に云えることは沖縄の農民が科学的な飼料のやり方を行ってないということである。農家はその残滓物のみによって家畜を飼養しているようなものである。勿論時たまには大豆粕とか少量の魚粉をやる場合もあるがそれ等にしても科学的な配合をおこなってやっている訳ではない。

IV. 作物状況

南部では甘藷が最も多く栽培されその次に甘蔗, 北に行くに従って甘蔗の栽培面積は漸次減少している。稲作に就いては前述の通り。即ち稲作は北部に最も多く南部に行くに従って少くなっている。作物の輪作は至って不規則に行われ、時には甘藷の連作を行う農家もみられる。前述の如く戦前に比べて大家畜の数が非常に減少している。これは厩肥の使用量の減少を来たしこれと連作と相俟って作物反当収を減少せしめている。

V. 農産物販売

農業協同組合を通して共同購入及び販売を行っているが農民が実際に農協に親しみを感じていないためか農協を通じての販売購買がうまくいっていない。そのために農民は市場に出て個人で卸値或いは小売値で農産物を販売したり或いは農業必需品を他の店から買い入れたりとしている。彼等の生産物をもっと経済的に販売するため或いは必需品をより経済的に購入せしめるため農協の重要性をもっと認識せしめるよう啓蒙する必要がある。