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# Theoretical Analysis of the Rice Economy in Hokkaido

Sakujiro Momono

## Introduction

There was an agricultural boom after 1945, owing to high rice prices resulted from general food shortages and to favorable weathers. But whole rice crops were almost ruined by cold summers of 1954 and 1956, and the boom was over. Since the many people have been trying to find the answer to the question what can be done to relieve a precarious living of rice farmers of Hokkaido. Author will be too happy if this paper proves to be of some help for such hard working researchers and agriculturists.

## chapter I Basic Problems

some people say they are for and others against rice cultivation of Hokkaido. And these opinions may be classed in three:

1. To develop further
2. To give up
3. To let it go

The idea of class 1 disregard cultivators' economical problems. The advocates insist upon expansion of a uniform social structures, which is unique to any rice cultivating society, in Hokkaido area. In other words they want to enlarge the Japanese economical organization which depends entirely on rice production.

Class 2 opinion finds rice cultivation not the the type of agriculture to be able to succeed under physical and economical conditions of Hokkaido.

Partly of class 3 says that it is necessary to prepare whatever is needed by rice cultivators so that they can continue to operate.

In the past, agricultural policies used to put more emphasis on keeping and developing of social relations or social systems that were considered

best suited to protect the traditional rice cultivating practices than on matters of economical success in individual farm management. This is why technical improvement mostly dealt with plant breeding, related methods of raising seedling or rich soil cultivation. And such important matters as providing plants with better physical environments by soil-improvement or as higher balro skills were left behind over along period.

Author presents in next lines his views on the theories of maintaining rice cultivation and of agricultural reorganization in rice region

1. Brief consideration will be given on the theory of maintaining rice cultivation in terms of management or farm economy. It is evident that rice cultivation is much more preferable in land use to any other way under today's farm-products-price-system even after frequency of past cold summers and possible changes in food policy are taken into account. Table I gives (1) net income per ha as index of commercial agriculture and (2) gross income per ha as index of characteristic of family form of small size the results of production costs survey of 7-year-period 1949-1955. Economical relations of staple crops are seen from the table contents.

Table 1 Index of production economy of staple crops

(1949-1955)

	Net income per ha	Income per ha
Paddy rice	24,630 yen	80,800 yen
Winter wheat	12,190	32,100
Potato	35,650	61,700
Soy bean	30,460	52,400
Red bean	42,500	45,570
Beans	28,650	46,290
Flax	7,210	29,230
Sugar beet	28,870	63,570

Note: production costs survey of 1949-1955 by Ministry of Agriculture and Forestry

Net income from rice is less than from any other upland fieldcrops except wheat and flax. So rice can not be said economically preferable from this point of view. But when economy of rice cultivation is looked

at from the point of view of intensive family labor which is not exceptional to rice farmers at large, it is plain to see that rice brings them the largest gross income.

2. views on agricultural reorganization in rice belt were born to expect development of local economy through successful farm management based on the sound farm productions, economically as well as physically.

In short, the former theory deals with such corrective measures as will intensify the present land use, while the latter aims at forming more conscious farmers of their own problems like small landsize, insufficient capital and under-developed techniques. Successful local agriculture consistent with natural and economical laws may be established when practical improvements have been made on them.

Now we may wonder how these two views can be evaluated in relation to bringing sound farm economy of Hokkaido. If it is assumed that an ideal form of agriculture can be operated only in the flow of general economy, the question is to be answered as follows. That is, the practical answer may not be complete without full understanding of stiffened rural communities, small land problem, least capital accumulation and unsatisfactory technical systems. All of these are typical features in Japanese farms which have been in existence hundreds of years. So the basic practical answer is to modify the whole economical structure which is responsible for status quo in agriculture. In farming of Hokkaido is seen the most typical of the Japanese farm situations. Crop damage by cold summer is the worst of all. Author thinks it best for each management to step forward to labor techniques, but not those on which they are applied, and integrate and employ every possible factor within the management to build up a better production system. Now that feudal landlord system was abolished and the whole economy of Japan is at a turning point, rice cultivation of Hokkaido must also change its course. Next chapter deals with low downs of characteristics of ripe cultivation of Hokkaido.

## Chapter II Factors in developing rice cultivation

To help understand situations of rice cultivation, author collects the following data and presents results of analysis;

1. Long-year-trends in rice yields per ha
2. Long-year-trends in costs per koku

3. Costs-price relation
4. Trends in size of management
5. Trend in techniques

Interrelationships of above data can explain systematically the developments of rice cultivation and may show a few pointers on necessary counter measures.

### 1. Trends in Rice Yield per ha

Since past agricultural policies were chiefly centred on rice, they had great effects on the amount of increase in yield per ha. It is seen in steady increase in yield over a long period. Table 2 gives trends in yield per ha of 53-year period 1903-1955 according to areas.

Annual average increment of about 1.3kg in yield of Hokkaido is comparable with that of about 1.5kg in all Japan. In 53 years, the increment amounted up to 62.9kg in Hokkaido while all Japan increment did to 79.1kg. The difference in annual yield of the two become 93.9kg from 73.8kg of the base year.

Table 2 Trends in annual average crop according to ha  
(1903 as base year)

	koku	koku
All Japan	$Y = 1.7006 + 0.09958X$	
Hokkaido	$Y = 1.140 + 0.08715X$	
Ishikari	$Y = 1.079 + 0.06024X$	
Sorachi	$Y = 1.152 + 0.11741X$	
Kamikawa	$Y = 1.086 + 0.13523X$	
Shiribeshi	$Y = 1.133 + 0.05311X$	
Hiyama	$Y = 1.363 - 0.06307X$	
Oshima	$Y = 0.993 + 0.08720X$	
Iburi	$Y = 1.127 + 0.03153X$	
Hidaka	$Y = 1.202 + 0.00188X$	
Tokachi	$Y = 1.061 + 0.00497X$	
Kushiro	$Y = 1.127 - 0.05359X$	
Abashiri	$Y = 1.030 + 0.03196X$	
Rumoi	$Y = 1.412 - 0.06727X$	

Note: (a) 53-year-period 1903-1955

(b) with negligibly small acreages. Nemuro and Sōya area omitted

(c) "koku" is about 150kg

Table 3 Distributiou of number of years according to range of crop variation per-centage (paddy rice) (1903-1953 Hokkaido statistics)

Area	Ishikari	Sorachi	Kamikawa	Hiyama	Oshima	Iburi	Hidaka	Tokachi	Rumoi	Abashiri	Shiribeshi	Kushiro	Total	Hokkaido
Year	53	53	53	53	53	53	53	53	53	53	53	44	627	53
{ +	34	33	38	25	34	33	32	33	27	30	34	27	380	23
{ -	19	20	15	28	19	20	21	20	26	23	19	17	247	30
100%	-	-	-	-	-	-	-	-	-	1	-	-	1	-
95-100	-	-	-	1	-	-	-	-	-	-	-	1	2	-
90-95	-	-	-	-	-	-	-	-	-	-	-	-	-	-
85-90	-	-	-	-	-	-	-	1	-	-	-	-	1	-
80-85	-	-	-	-	1	-	-	-	1	-	-	-	2	-
75-80	-	-	-	-	-	-	1	2	-	-	-	1	4	-
70-75	-	-	-	-	-	-	-	-	1	-	-	1	2	-
65-70	-	-	-	-	-	-	-	-	-	-	-	-	-	-
+ 60-65	-	-	2	1	-	-	-	-	-	1	-	2	6	-
55-60	-	-	-	-	-	-	1	-	-	2	-	3	6	-
50-55	-	-	-	1	1	-	-	-	-	4	-	-	6	-
45-50	-	-	1	1	1	1	-	4	3	-	-	2	13	-
40-45	2	1	-	3	1	2	1	4	5	3	2	3	27	-
35-40	-	1	2	3	-	2	-	5	4	3	-	1	21	3
30-35	-	-	1	2	3	3	3	2	1	3	2	2	22	-
25-30	4	3	8	2	3	8	4	3	4	2	5	3	49	5
20-25	7	4	5	1	11	1	8	3	2	1	3	3	49	7
15-20	8	8	7	2	4	7	5	3	1	2	8	2	57	6
10-15	6	5	4	6	5	4	5	3	4	4	4	2	52	5

Area	Ishikari	Sorachi	Kamikawa	Hiyama	Oshima	Iburi	Hidaka	Tokachi	Rumoi	Abashiri	Shiribeshi	Kusiro	Total	Hokkaido
+ 5- 10	3	6	7	2	4	2	1	-	1	2	5	-	33	4
0- 5	4	5	1	-	-	3	3	3	-	2	5	1	27	3
0- 5	3	3	2	2	2	4	3	2	3	1	4	1	30	6
5- 10	3	4	1	5	1	2	3	1	2	1	1	1	25	1
10- 15	1	3	1	4	2	1	-	1	2	1	1	-	17	-
15- 20	-	-	1	2	-	-	4	-	2	-	2	-	11	-
20- 25	-	1	-	2	1	2	-	1	2	1	4	1	15	1
25- 30	4	3	1	2	1	1	1	1	2	1	-	1	18	2
30- 35	-	2	1	2	1	-	1	-	1	1	-	-	9	-
35- 40	1	1	-	-	1	3	1	1	3	1	1	2	15	2
40- 45	1	-	2	1	2	1	-	2	2	1	1	-	13	1
45- 50	2	1	3	3	1	-	2	-	2	1	2	-	17	2
50- 55	-	1	1	1	-	-	2	-	-	1	1	-	7	1
55- 60	2	-	-	-	1	1	-	-	1	1	-	-	6	-
60- 65	-	-	-	1	2	2	-	3	-	1	-	2	11	1
65- 70	1	-	-	1	-	-	-	1	1	2	-	-	7	1
70- 75	-	1	-	-	1	1	1	1	-	-	-	1	5	-
75- 80	-	-	1	1	-	-	-	1	1	-	1	1	6	-
80- 85	-	-	-	-	2	-	-	-	-	-	-	3	5	-
85- 90	-	-	-	-	-	1	-	2	1	3	-	-	7	-
90- 95	-	-	1	1	-	1	2	-	-	2	-	-	7	1
90-100	1	-	-	-	1	-	-	2	1	3	1	-	9	-
100(%)	-	-	-	-	-	-	1	1	-	1	-	4	7	-

Within Hokkaido, most rice cultivating areas showed increase. Especially Kamikawa and Sorachi-central rice regions showed a sharp increase, and Oshima came along with the figure of Hokkaido average. The rest of areas showed negligible increase except Hiyama, Rumoi and Kushiro with a negative trend. But this trend value does not present absolute production level per ha in cash corresponding year, but it was obtained by averaging variations in yield during 53 long years. In extreme years, there were no crops to be harvested in some areas. In Table 3 is shown distribution of ranges of variation in actual yield per ha from averaged trends of table 2, of total 627 years of 12 areas there are 57 years, only 9.1% to the total year, in which variations in increase and decrease from averaged trend of corresponding years were kept within 5% (yield per ha is considered normal within 5% variations). Even if the range of variation is extended to within 10%, the number of years is only 115, 18.3% to the total year (fairly good crop fairly bad crop within 10% variations). According to Dr. Aramata's study which was performed in much the same way to find the similar variations in Prefectures (1907-1931) the number of years of variation within 5% is 43% of the total year and if the range is extended to 10% variations 73% of the total year comes in this class. This result shows a sharp contrast with that of Hokkaido, in which the number of years of yield variation over 5% is 90% of the total year and 82% comes under the class of years with variation over 10%. So it may be logically concluded that the degree good or bad crop and its variation is large in Hokkaido.

Table 4 Range distribution of Percentage in yield variation according to areas

Range of Variation	Ishikari	Sorachi	Kamikawa	Shiribeshi	Hiyama	Oshima
Less than 10 %	13	18	11	15	9	7
10-30 %	30	27	27	27	21	27
Over 30 %	10	8	15	11	23	19
Range of Variation	Iburi	Hidaka	Tokachi	Abashiri	Rumoi	All Hokkaido
Less than 10 %	11	10	6	6	6	15
10-30 %	24	27	15	12	19	26
Over 30 %	18	16	32	35	28	12

Note: This table was made from tables 2 and 3.

The comparison of local yield variation shows a certain difference among areas Table 4 was compiled after such local comparisons in yield to classify the total year number according to ranges of yield variation. It is seen in this table that Sorachi, Shiribeshi, Ishikari and Kamikawa can be placed in order of least variation and the range of variation is more or less close to Hokkaido average. But wide range variation is seen in Hiyaama, Tokachi, Abashiri and Rumoi. The number of years of yield variation within 10% was only 6 out of 53 in Tokachi, Abashiri and Rumoi. Over 30% variations were seen in 32 years out of 53 in Tokachi, in Abashiri and 28 years in Rumoi. It is plain to see how unreliable yields can be in Hokkaido.

Table 5 gives local distribution of rice cultivation in Hokkaido. And tables 2, 3, 4 and 5 will be reviewed in connection with interrelations. Then it is noted in table 2 that trends in annual average yield bear comparatively small variations when Hokkaido is considered as one unit. This is because cultivation in Ishikari, Sorachi Kamikawa and Shiribeshi play a major role in calculating the figures in the table.

In tables 3 and 4, areas with outstanding variations in per ha yield are mostly in East Hokkaido, where the proportion of rice paddy to total field area is low, on the other hand, 93% of total rice cultivation of Hokkaido is concentrated in West Hokkaido. In this part, the proportion of rice paddy to total field area is high as 34.5%, compared with in West Hokkaido. These facts with per ha yield level and variation indexes already mentioned must throw some light on recognition of rice cultivation of Hokkaido in the true sense.

So far author has observed the trends in rice yield per ha on all Hokkaido and areas levels, the following summary is considered prerequisite knowledge before going into next chapter :

(1) Rice yield per ha is increasing annually in Hokkaido but the same increase is higher in prefectures making the difference of the two from the base year still larger every year.

(2) Variations in yield per ha are rather remarkable in Hokkaido in comparison with that in prefectures. The further east the area is the smaller is the proportion of rice paddy to total fields and the greater the variations become.

(3) Under normal weathers average yield level in Hokkaido is more

or less the same as in prefectures. Yet great variations in long years must be the top factor of unstability. This is seen in sea's edge of both East and west Hokkaido.

## 2. Trends in production costs per ha

In table 5 is seen the fact that 93% of total rice cultivation is scattered in west Hokkaido and the ratio of rice paddy to total field is high enough to be par with prefectural level. In fact, rice cultivation of Hokkaido can be best characterized as what is in Table 5.

Now Table 6 gives the size of rice farms respectively in Hokkaido and prefectures. In prefectures, the size of the greatest number of farm is 0.1-1 ha and only 11.1% to total farm is on over 1 ha. But in Hokkaido, the largest group of farm is larger than 1 ha percentage of farms less than 0.5 ha is 69.5 in prefectures while the figure shows 31.8 in Hokkaido. Size of farm is larger in Hokkaido, it is sure.

Table 5 Geographical distribution of rice cultivation

(1953)

Region	Area	Total aerge of paddy	Percentage	Ratio of paddy to to- tal field
		ha	%	%
West Hokkaido	Ishikari	136,030	8.4	28.1
	Sorachi	569,810	35.3	54.2
	Kamikawa	480,310	29.8	39.8
	Rumoi	42,010	2.6	20.0
	Shiribeshi	78,300	4.9	20.7
	Hiyama	40,180	2.5	24.6
	Oshima	53,700	3.3	21.9
	Iburi	59,790	3.7	21.9
	Hidaka	40,350	2.5	17.9
East Hokkaido	Tokachi	35,310	2.2	2.0
	Kushiro	28	0.0	1.0
	Nemuro	0	0.0	0.0
	Abashiri	76,650	4.8	6.3
	Soya	0	0.0	0.0
	Total	1,612,720	100.0	25.2

Note: Made from 1956 Statistics by H. P. O.

A big difference is also notable in the relation of amount of commercial rice sold to farms of various sizes. That is, in prefectures, 31.5 % of total commercial rice was sold from farms of 0.6-1 ha 40% from 1-2 ha farms, 17.9 % from farms of under 0.6 ha and 10.6 % from farms of over 2 ha In Hokkaido, farms of under 1 ha sold 6.3 %, 1-2 ha farms 30.1 %, 2-3 ha farms 36.1 %, 3-5 ha farms 25.9 % and farms of over 5 ha 1.6 % ; as a matter of fact farms of over 2 ha sold 63.6 % of total commercial rice.

so, average amount of commercial rice per farm is less than 8 KOKU in Prefectures whereas the amount exceeds the prefectural average by 2.6-23 KOKU in Hokkaido.

From above facts, rice cultivation of Hokkaido is found very much on a commercial basis. It is further evidenced in that percentages of commercial rice and commercial farm are 55.4 and 64.1 respectively in Hokkaido, and less 40 and 59 in prefectures.

Though statistical data were of rice production costs survey conducted by Ministry of Agriculture and Forestry covering 25 year period (1931-1955), some of survey procedures were considered unscientific. So indexes were obtained on base figures of 1934-1936 because procedures were thought to be reasonably reliable in these years.

Table 7 gives production costs and yields in Hokkaido and prefectures. As is shown in the table, production costs are generally higher in Hokkaido. Costs registered higher in prefectures in only 4 years of 25 entire survey years. But there was seen 6 extreme years in which costs in Hokkaido were over 130 % of that of prefectures. And average costs in 25-year period is 120.6 %, 20.6 % higher in Hokkaido.

One basic reason for higher than national level production costs is due to low yield per ha. Throughout the entire survey period there was not even a single year in which per ha yield of Hokkaido exceeded that of prefectures. Yield was within the range of 90-100 % of prefectures' 80-90 % in 9 years, 60-80 % in 11 years, 40-60 % in 3 years and under 40 % in one year. In fact, average yield level over 25-year period is 73 % prefectures'; and this low yield level is accountable for high production costs of Hokkaido. Rice cultivation of Hokkaido can be said best characterized as higher than national average production costs resulted from low per ha yield level. Prior to 1937, when yield of Hokkaido was somewhere around

Table 6 Structure of rice production

(1952)

Item	Range of size Item	ha							Total
		-3.0	3.0-5.0	5.0-10.0	10.0-20.0	20.0-30.0	30.0-50.0	over 50.0	
Number of farms	Hokkaido	193,74 (16.7)	17,625 (15.1)	26,254 (22.5)	29,538 (25.3)	16,272 (14.0)	7,203 (6.2)	266 (0.2)	116,537 (100.0)
	Japan (except Hokkaido)	1,964,436 (36.8)	1,263,206 (23.8)	1,506,010 (28.3)	533,728 (10.0)	53,152 (1.0)	6,140 (0.1)	47 (0.0)	5,326,723 (100.0)
Number of farms selling	Hokkaido	1,104 (1.4)	4,482 (6.0)	16,889 (22.6)	28,561 (38.2)	16,236 (21.7)	7,200 (9.6)	266 (0.4)	74,738 (100.0)
	Japan (except Hokkaido)	374,901 (11.9)	797,612 (25.3)	1,382,844 (44.0)	530,072 (16.9)	52,929 (1.7)	6,137 (0.2)	47 (0.0)	3,144,442 (100.0)
Amount sold	Hokkaido	1,866 (0.1)	11,389 (0.6)	95,952 (5.6)	517,607 (30.1)	621,355 (36.1)	445,811 (25.9)	27,590 (1.6)	1,721,570 (100.0)
	Japan (except Hokkaido)	494,197 (4.9)	1,193,139 (8.8)	9,668,707 (38.7)	10,020,394 (40.0)	2,241,347 (8.9)	437,251 (1.7)	5,617 (0.0)	25,078,652 (100.0)

Note: This is printed at page 212 of "New ideas in farm management under the title of-Questions in rice farm management of Hokkaido, by author of this paper.

Table 7 Trends in costs per ha and yield per ha

Year	Costs per ha			Yield per ha		
	Japan (except Hokkaido)A	Hokkai- do B	B/A	Japan (except Hokkaido)C	Hokkai- do D	D/C
	Yen	Yen	%	Koku	Koku	%
1931	206.90	280.10	135.4	22.85	11.12	48.7
1932	209.90	215.40	102.6	24.60	13.97	56.8
1933	223.20	226.80	101.6	26.12	17.59	97.3
1934	285.80	292.50	102.4	21.83	15.25	69.8
1935	273.00	289.00	105.9	23.32	16.03	68.7
1936	251.10	232.60	92.6	25.18	19.66	78.0
1937	268.10	237.50	88.6	25.24	20.94	82.9
1938	289.70	268.50	92.7	25.68	23.76	92.5
1939	312.90	315.60	100.8	28.32	22.71	80.2
1940	395.70	446.10	112.8	24.85	18.14	73.0
1941	449.40	557.90	124.2	22.46	15.90	70.8
1942	438.60	505.20	115.2	25.49	19.64	77.1
1943	499.00	526.10	105.4	23.79	20.25	85.1
1944	619.20	579.00	93.5	22.83	20.10	88.0
1945	1,227.70	2,042.20	167.3	17.68	06.54	37.0
1946	5,543.50	7,614.10	137.4	22.65	16.46	72.7
1947	14,788.10	1,925.50	130.2	23.11	18.66	80.7
1948	35,610.90	38,887.50	109.2	24.61	20.23	82.2
1949	52,800.00	56,010.00	106.1	22.00	17.10	77.7
1950	40,140.00	42,910.00	106.9	23.90	19.87	83.1
1951	45,710.00	53,990.00	118.1	22.90	18.07	78.9
1952	50,330.00	65,260.00	129.6	23.80	20.71	87.0
1953	62,370.00	93,000.00	158.8	20.60	15.00	71.9
1954	64,170.00	161,250.00	251.3	21.50	19.80	45.6
1955	54,430.00	68,780.00	126.6	27.60	23.70	85.9

- Note: 1. Made from production costs survey paper by M. A. F.  
 2. Capital interest and rent included in costs.  
 3. Yield per ha was on farms surveyed.

80% of prefectural yield level, per ha costs of Hokkaido and per KOKU costs of prefectures were just about the same. But the recent trends require yields to be as high percentage as 90-95 to prefectural level to maintain the same relationship. This fact may be illustrative of the tendency in Hokkaido of intensive use of technical systems common in prefectures and also of social, economical changes that necessitated it.

### 3. Costs-Price relationship

In operations of commercial rice farm, it is important to know of relation of costs to profit in the market.

In table 8, figures in column (A) are indexes of farm receipt price expressed in percentage of per KOKU costs (rent and capital interest included) which was already used in table 7, although data were available over 23-year period 1933-1955. There are seen 4 years in which farm receipt price was not enough to cover the cost, however small the difference was, in prefectures. But in Hokkaido, farm receipt price was very much lower than the cost in as many as 13 years. In 10 successful years in which the price was higher than the cost, the balance was small compared with prefectures'. Average percentage of this price to production cost over the entire period is 131.9 in prefectures and 96.2 in Hokkaido. This low percentage of Hokkaido is undoubtedly due to low yields as repeated and partly to grade, quality or distance to the market. According to (B) of table 8, it is only 5 years in which percentage of farm receipt price to costs in Hokkaido was higher than that in prefectures. This undesirable phase, a local characteristic of Hokkaido so to speak, was easy to recognize either in pre-war days of free market or in days of loose control of government. With strict orders of food control enforced during and after the war, the phase disappeared and economical standing of rice farms was boosted up to parallel, or even higher, to prefectural averages by extraordinary measures such as "early purchase" or "surplus purchase". The problem of quality, grade and distance to the market must be looked upon again as basic questions to be answered because the general trend is now on the way to loosening or lifting controls.

Table 8 Index of farm receipt price to  
production costs as 100. (KOKU unit)

Year	Farm receipt price (A)		Index of farm receipt price of Hokkaido to that of prefectures as 100 (B)
	prefectures	Hokkaido	
1933	93.4	79.1	86.0
1934	95.2	81.5	87.7
1935	102.1	87.9	91.1
1936	111.5	102.8	85.4
1937	111.6	109.5	83.5
1938	111.3	106.8	88.9
1939	129.8	104.2	81.0
1940	105.6	84.9	90.7
1941	96.8	73.0	93.7
1942	111.7	94.2	97.1
1943	126.3	114.2	95.3
1944	104.2	104.4	93.7
1945	131.1	72.3	92.3
1946	103.0	72.7	97.0
1947	119.7	89.4	97.3
1948	102.0	97.4	104.0
1949	82.2	81.4	105.1
1950	129.3	124.1	102.5
1951	151.3	124.7	97.4
1952	149.8	117.6	101.8
1953	131.0	81.0	100.4
1954	139.9	55.4	99.5
1955	195.6	153.9	99.9

Note: Made from "production costs survey" by M. A. F.

#### 4. Trends in size of management

It is generally understood that the size of management has effects on productivity and there's no reason why the same principle can not be applied on rice cultivation of Hokkaido. They must expand their individual farm size to raise productivity. But contrary to this belief,

acreage per farm is decreasing steadily. Table 9 gives ever increasing number of rice farmers and reduced acreages in rice, in particular, at post-war periods (though it's recovering to prewar level). Under such circumstances acreage per farm can not be helped going smaller and in 1952 it was only 57% of average per farm acreage if pre-war 3-year period 1933-35. Because of lack of statistical data, comparative chronological observation is impossible in ratio of rice farmers to total agriculture or changes in acreages in rice.

Table 9 Trends in acreage in paddy rice and number of paddy rice farms

Year	Acreage in paddy rice	Number of paddy rice farms	Acreage per paddy rice farms
	ha		ha
1933	193,195	87,677	2.21
1936	183,173	82,820	2.21
1939	186,123	81,958	2.27
1941	178,753	81,570	2.19
1949	144,840	108,014	1.34
1952	146,370	116,491	1.26

Note: Hokkaido statistics, statistical annual of food control

Table 10 Comparative table of productivity according to various size of rice farms

Range of acreage	Per KOKU unit		Yield per ha		
	Production costs	Index of total average	Average yield	Index total of average	Production per 10 hour labor
	Yen		KOKU		KOKU
0.5-1 ha	74,320	113.9	21.3	102.9	0.97
1-1.5	69,400	106.3	21.5	103.9	1.13
1.5-2	65,740	100.7	22.5	108.7	1.14
2-3	64,320	98.6	20.1	97.1	1.22
Over 3	62,680	96.0	26.9	130.0	1.39
Average	65,260	100.0	20.7	100.0	1.23

Note: Made from 1952 survey of rice production costs of Hokkaido

But composition of total rice farms-116,537-according to various ranges in acreage in 1952 (c.f. table 6) was as follows: under 0.5 ha 31.8%, 0.5-1 ha 22.5%, 1-2 ha 25.3%, over 2 ha 20.4%, more than half, 54.3%, of total farms, is less than 1 ha.

Results of Production on these extra small farms:

1. Productivity index numbers are small of per ha yields, costs per KOKU and production amount per work-unit as shown in Table 10. Taking into consideration unfavorable factors of productions and frigid rules of marketing, we may conclude that base of rice cultivation of Hokkaido is not well founded.

2. Financial standing of extra small farms can not be disregarded. Table II gives the financial low down of farms of 1-2 ha with over 80% paddy ratio to total holding field. Figures in the table may require 30 % deduction to show actual values because of small number of sample farms and unusually good harvest of 1955.

Table II. Economy of rice farming on extra small farm (1955, average per farm of 1-2 ha)

Item		Amount
Gross income (a)	Rice	448,780 Yen
	Dry field crops	5,502
	Livestock	15,304
	Others	4,427
	Total	474,013
Farm expens (Exclude own family labor value) (b)		152,619
Net income (a-b)		321,394
Reference	Taxes, other charges (c)	34,860
	Family living expenses (d)	332,097

Note: Made from survey of farm economy by M. A. F.

As is shown in the, table, net income was 321,394 yen, but it still includes value of own family labor, taxes and other charges. It can pay for the management only after these items are paid up. In this case, taxes and other charges and family living expenses amount up to 336,957 Yen, which is 45,563 Yen over the net income. This minus in farm operation is well anticipated by operators so they try to cover the shortage by working as hired labor, But in Hokkaido the market for hired labor is scarce and their income from this source is figured roughly 20% of what needed. In this particular year, 80,000 Yen gift money composed part of incomes of farms of this range of acreage (1-2 ha). It must be reminded again that

this financial comment was made on results in the year of strikingly good harvest. So the minus in farm economy would go to approximately 162,000 Yen in normal years.

At year-end of 1955, statistics show that account balance recorded loan of about 130,000 Yen and cash or saving of 40,000 Yen, while inventory value was slightly lower than at the beginning of year. Thus economy of these extra small farms tends to grow harder by each turnover.

So far characteristics of rice cultivation of Hokkaido have been discussed with reference to acreages per farm. And the acreage is found growing smaller every year producing greater number of extra small farms. And this is worsening the economy of rice production.

##### 5. Trends in techniques

Technical innovation was advanced as rice farm took on small size. And it is evident plant breeding played the most important role in the development of rice cultivation of Hokkaido. Cultivation of varieties raised in Prefectures was never a success until an early mature "AKAGE" was discovered. And "AKAGE" pushed forward northern boundary of rice cultivation as far as in the vicinity of Sapporo. The following discovery of "BOZU" opened a promising new rice in Kamikawa. Later on an ultra early mature type was successfully discovered by means of separations and hybridizations which had been employed since early in this century. This new variety was raised in Kitami and Tokachi and rice cultivation was once thought possible in these areas as the modernized technique of direct seeding was a key factor which kept rice cultivation as reasonably economic management in the first quarter of this century. And great portions of rice paddy was made during this period. But there was not much further improvement of direct seeding method and with the advent of new social phase in 1920s' practices were brought in from Prefectures. Since then plant breeding raising and rich soil cultivation have been studied on merely to spread the traditional practices in Hokkaido. It is seen in the fact that there was always a tendency to intensify technical study in plant breeding, seedling raising or rich soil cultivation to keep pace with continuously reducing size of farm but it was not thought of to stop this reduction in farm size. Summary in each technical field is as follows.

### (1) Plant breeding

Since 1930s, breeding of large yield varieties and disease resistant varieties was carried on mostly for concentrated rice areas and for other areas ultra early mature varieties were hoped to be developed. And in recent years, study has been made of breeding new varieties having not only large yield, better grade or disease-resistant character but adaptabilities to area, soil or farm class. 80 new recommendable varieties have been added to the list of less than 10 since late 1920s

### (2) Seedling raising

In late 1920s, successive cold summers and the changing social phase speed reduction in farm size. Then direct seeding technique and water seedling beds became gradually replaced by various methods of protective seedling beds so as to put up with unfavorable weather conditions and to cultivate varieties of rich fertilization, large yield. And much financial aids were given by the government when new techniques had to be introduced for old ones. In 1955 85% of total seedling is said to be raised in protective beds, 10% by direct seeding method and 5% in common water seedling bed as compared with 80% by direct seeding method and 20% in water seedling bed in late 1920s. In spite of numerous benefits brought by the techniques of seedling raising, its operation requires large expenses, labor and skills. As a result, increase in yield or a steady yield, secured at the cost of the like increased rush labor for transplanting seedling during short period, is likely to be offset by increased cost per unit of such operations.

### (3) Rich soil cultivation

Development of plant breeding and seedling raising is very much dependent upon intensity of rich soil cultivation. Table 12 gives expenses in fertilizer and labor hours composing component parts of production costs.

Average expenses in fertilizer over 4-year period 1933-36 was made as base. Trends in ratio of increase is seen much higher and actual expenses spent have gone far above that of Prefectures since 1952. That is, expenses in fertilizer in Hokkaido was 62% of Prefectural level in the base year but ratio registered 110% in the average of 1952-55. Because undesirable factors in production have been corrected since the base year, amount of fertilizer used must be evaluated as larger in respect to its

efficiency. The first sharp increase is seen in the table in 1938-40. This was when "FUKOKU" variety (fertile but fertilizer eating) was beginning to be cultivated. Second period is after 1952, when (1) intensification of protective seedling raising, (2) fertile-disease-resistant-late mature "EIKO" variety followed by "TOYO-HikaRi" and "TERUNISHIKI" were on their way.

Tadle 12 Trends in amount of fertilizer per ha and  
labor composing production costs

	Japan (except Hokkaido)	Hokkaido	Labor amount	
	12. 90=100	8. 12=100	Japan (except Hokkaido)	Hokkaido
8	810	947	-	-
9	768	1, 016	209. 8	1, 287
10	816	1, 038	205. 2	1, 298
11	853	1, 041	189. 7	-
12	906	1, 127	193. 5	-
13	1, 017	1, 440	187. 0	-
14	1, 126	1, 611	192. 1	1, 210
15	1, 576	2, 250	191. 9	1, 170
16	1, 488	2, 264	184. 0	1, 273
17	1, 269	1, 940	189. 6	-
18	1, 395	2, 134	183. 3	1, 352
19	1, 574	2, 376	190. 7	1, 544
20	2, 091	2, 883	181. 4	1, 543
21	31, 264	27, 209	208. 6	1, 681
22	65, 648	118, 424	212. 6	1, 741
23	140, 251	148, 821	209. 8	1, 870
24	177, 304	260, 591	2, 177. 0	1, 563. 0
25	155, 581	232, 635	2, 045. 0	1, 555. 0
26	181, 085	280, 542	2, 020. 0	1, 527. 0
27	240, 078	393, 473	1, 175. 0	1, 679. 0
28	203, 256	425, 369	1, 908. 0	1, 631. 0
29	238, 527	396, 182	1, 858. 0	1, 643. 0
30	246, 279	417, 365	-	-

Note : Made from production cost survey by M. A. F.

Similar observation on labor used shows a sharp increase in Hokkai-

do contrary to decreasing labor amount in Prefectures. An organized explanation on the table contents is rather hard due to changes in survey procedures. But if labor amount indexes in 1940-41 and in 1944-45 are to be compared with the average in 1934-35 as 100, they are 100:90.1:89.6 in Prefectural level and 100:94.6:119.5 of Hokkaido. Also recent trends (1953-54) may be expressed as 100:89.2 of Prefectures and 100:105 of Hokkaido (figure in 194-50 as 100). Such tendency has been influence by trends in techniques and undulying typical results may be seen in observation according to farms of various sizes.

### Chapter III Author's opinion on the subject

Author has analyzed five principal factors in connection with commercial rice cultivation and presented brief summaries or conclusions if necessary at the end of each section. To incorporate them, rice cultivation of Hokkaido is more on a commercial basis than in any other prefectures and is subject to "law of one thing one price", in the market. But possible increase in yield per ha has been checked by frequent crop damages of various causes and yield level has never exceeded Prefectural average yield on the other hand, trends is social and economical structure kept reducing the farm size. Consequently, intensive techniques with great amount of fertilizer and labor replaced the direct seeding method which had been highly successful. But most farms were financially on the rock and they found it hard to make the most of those new techniques. This resulted in weakening resisting force to hardships. And low grade rice is only common in farms of marginal types and the returns are very small. Repetitions of such have been providing a very precarious living.

What can be basic requirements to relieve these people Any consideration should start all the way from the search in agricultural structure and production level of Hokkaido. Then it must be admitted that increase in productivity depends largely on size of land and it small. Accumulation of capital in agriculture is also small. And there is not much prospect for these things to be changed or developed. what Would be the logical thing for the management to do within their power The answer was already given in explanation, of economical relations of staple crops in table 1. To make clear more detailed facts, farm economy in various

Table 13 Summary of farm economy in various size and farm of managements (1955)

Hem	Number of farms in survey	Gross income	Farm expenses	net income	Taxes and other charges	Family living expenses	c-(d+c)	non-agri-cultural income	Gifted subsidy or relief	Surplus in farm economy	
		(a)	(b)	(c)	(d)	(e)					
0-2	{Rice-farming	3	474,010	152,618	321,392	34,860	332,097	-45,565	6,709	78,039	39,183
	{Up-land farming	4	313,672	146,948	170,724	104,226	208,491	-141,993	8,517	14,379	-119,067
2-3	{Rice-farming	12	696,868	217,580	479,288	62,074	367,191	50,023	38,627	12,792	101,442
	{Up-land farming	15	376,976	165,128	211,848	23,263	309,863	-121,278	47,178	23,464	-50,636
3-5	{Rice-farming	10	959,740	286,805	672,935	90,056	493,017	89,862	38,396	29,704	157,962
	{Up-land farming	37	456,137	211,069	245,068	30,529	318,558	104,019	53,094	25,411	-25,516
5-10	{Rice-farming	4	1,553,965	451,052	1,102,913	225,831	804,607	72,475	88,732	51,691	212,898
	{Up-land farming	43	639,282	303,462	335,820	45,379	355,616	-65,175	30,560	34,615	0
10~	{Rice-farming	none	-	-	-	-	-	-	-	-	-
	{Up-land farming	14	577,503	265,639	311,864	42,008	366,181	-96,635	43,997	28,286	-24,042
Average	{Rice-farming	29	882,680	266,934	615,746	91,495	467,282	56,969	42,156	30,739	129,864
	{Up-land farming	113	577,503	265,939	311,864	42,008	366,181	-96,325	43,997	28,386	-24,042

Note Made from 'Survey of farm economy, by M.A. F. (for Hokkaido) over Rice cultivation Ratio of rice paddy to total field 80% Dry crop cultivation Ratio of rice paddy to total field under 40%

size and form of managements will be observed in table 13.

Table 13 shows remarkably low production level in up-land farming. If shares for own labor is expressed by family living expenses, only on rice farms of 0-2 ha range show the minus figure but up-land farms of all size ranges show the minus. It boils down to that the production on up-land farm is just two-thirds that of rice farm with approximately the same expenses used.

Through observations of several economical indexes. It must be concluded that productivity on upland farm, which is a major portion of agriculture in Hokkaido, much lower than rice farming

And unless some drastic measures can help increase productivity on upland farming to satisfactory extent, there will be north ward move of rice farming regardless of physical Laws and limits. And this nothing can stop. Farmers of East Hokkaido mean it when they tell, "Rice cultivation is more preferable to upland farming even if no crop is bound to come every third year., Majority of extra small farms are located in or outside of what is called "boundary area of rice cultivation., and most these farms were turned into paddy from upland for that region. When measures of up-land promotion mean to build "agriculture as it should be., then there may be expected sound production and economy.