Chinese-American
Joint Commission on Rural Reconstruction
Food & Fertilizer Series No. 4

SURVEY REPORT ON USE OF CHEMICAL FERTILIZERS AND FARM-SUPPLIED MANURES BY TAIWAN FARMERS ON 1954 RICE CROPS

by
Ralph N. Gleason
and
Mo-si Hu

Taipei, Taiwan, China
June 1956

Chinese-American
Joint Commission on Rural Reconstruction

Food & Fertilizer Series No. 4

SURVEY REPORT
ON
USE OF CHEMICAL FERTILIZERS
AND FARM-SUPPLIED MANURES
BY TAIWAN FARMERS ON 1954 RICE CROPS

by

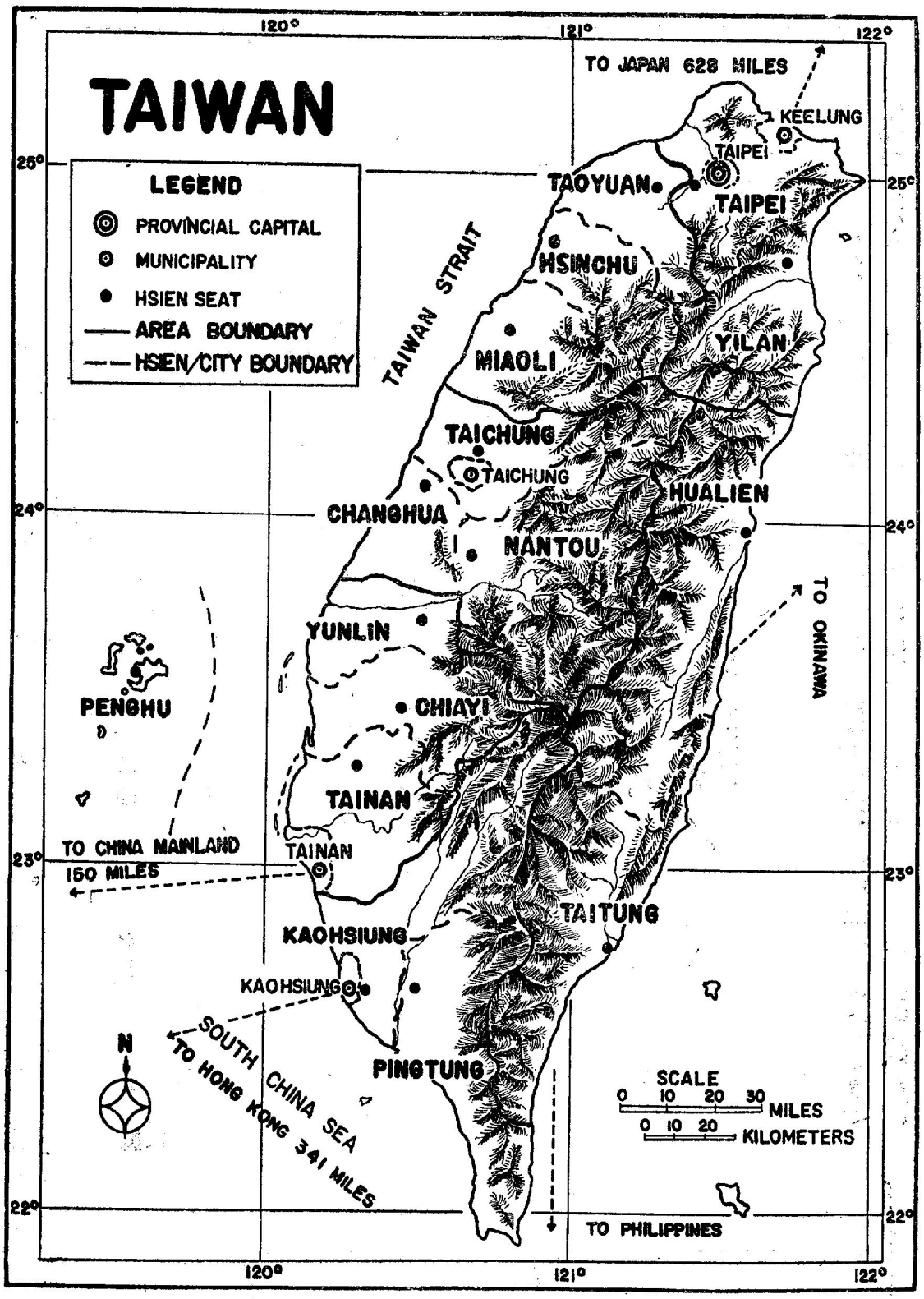
Ralph N. Gleason
Chief, Food & Fertilizer Division, JCRR
and
Mo-si Hu
Field Inspector, JCRR

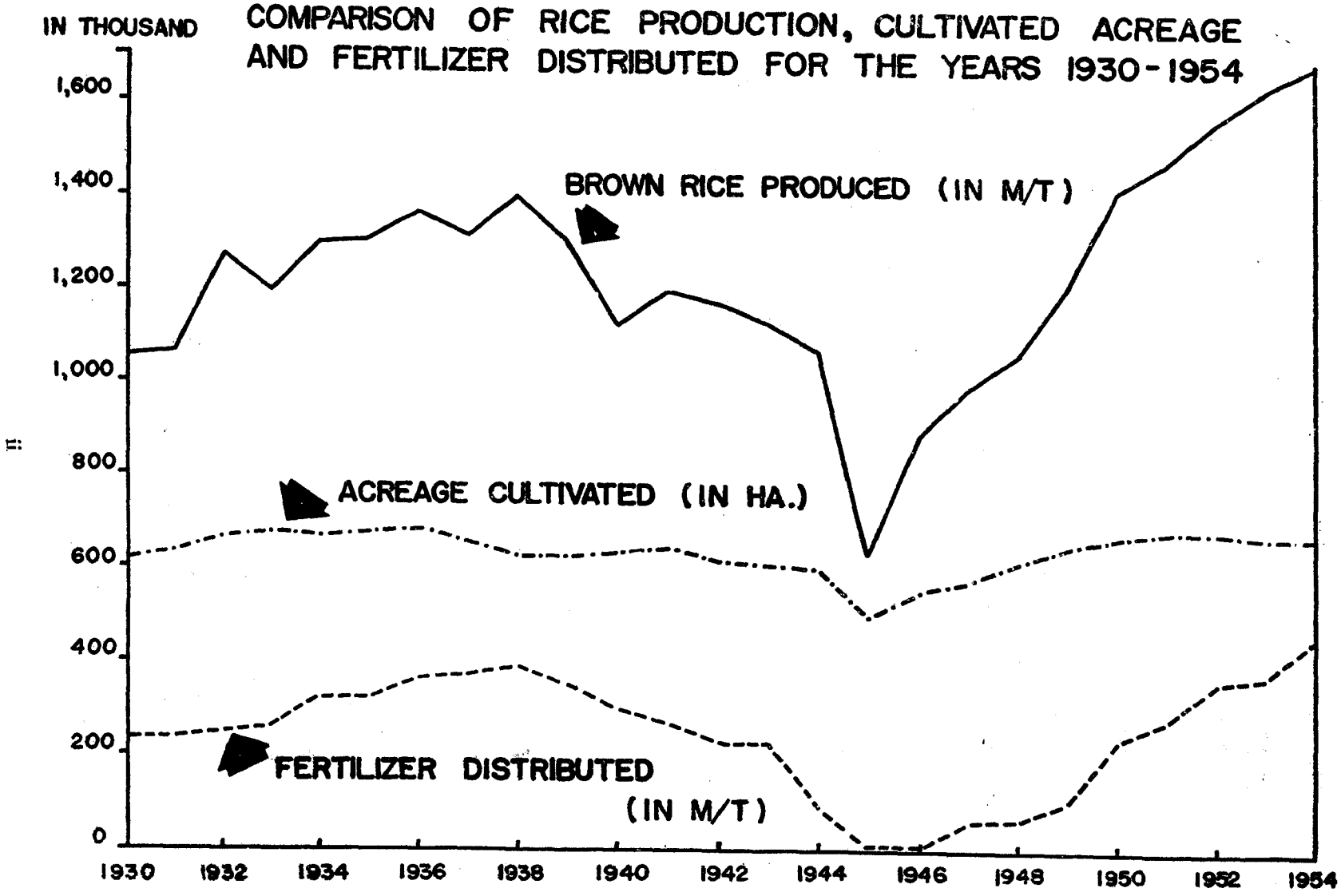
Taipei, Taiwan, China
June 1956

Table of Contents

Tables

Tables (cont'd)


TAIWAN
LEGEND
PROVINCIAL CAPITAL
MUNICIPALITY
HSIEN SEAT
AREA BOUNDARY
HSIEN/CITY BOUNDARY
120°
121°
122°
25°
24°
23°
22°
TO JAPAN 628 MILES
KEELUNG
TAIPEI
TAOYUAN
TAIPEI
HSINCHU
TAIWAN STRAIT
MIAOLI
YILAN
TAICHUNG
TAICHUNG
HUALIEN
CHANGHUA
NANTOU
TO OKINAWA
YUNLIN
PENGHU
CHIAYI
TAINAN
TO CHINA MAINLAND
150 MILES
TAINAN
TAITUNG
KAOHSIUNG
KAOHSIUNG
N
SOUTH CHINA SEA
TO HONG KONG 341 MILES
PINGTUNG
SCALE
0 10 20 30 MILES
0 10 20 KILOMETERS
TO PHILIPPINES


IN THOUSAND
COMPARISON OF RICE PRODUCTION, CULTIVATED ACREAGE AND FERTILIZER DISTRIBUTED FOR THE YEARS 1930-1954
1,600
1,400
1,200
1,000
800
600
400
200
0
BROWN RICE PRODUCED (IN M/T)
ACREAGE CULTIVATED (IN HA.)
FERTILIZER DISTRIBUTED (IN M/T)
1930
1932
1934
1936
1938
1940
1942
1944
1946
1948
1950
1952
1954

ACKNOWLEDGMENT

The authors are especially indebted to Mr. Hai-fan Chu, Senior Specialist, Soils and Fertilizers, Plant Industry Division, and Mr. Chun-muh Wong, Specialist, Food & Fertilizer Division, for technical advice and assistance in the preparation and conduct of the surveys and the preparation of this report; to Miss Sylvia Lee, Assistant (Statistics), for assistance in compiling and analyzing the statistics, and to the field personnel of the Food & Fertilizer Division who participated in, and directed, the survey work in their respectively assigned areas and assisted in compiling and interpreting the findings: Messrs. Tsung-hun Chen, Yu-tso Cheng, Wei-huai Horng, Te-jui Hsu, Chiu-fong Huang, Wee-teng Huang, Nai-un Lin, Ching-po Liu, Tien-su Lu, Shan-hong Shen, Kian-ing Ting, and Tien-lin Yeh.

Besides the FFD field personnel, several others also read the report in draft form and offered helpful comments and suggestions regarding its final preparation: Mr. I.R. Combs, Information Officer, JCRR; Dr. P.C. Ma, Dean of College of Agriculture, National Taiwan University; Dr. S.C. Hsu, Director and Mr. H.T. Tseng, Specialist, Taiwan Agricultural Research Institute; Dr. H.T. Chang, Chief, Plant Industry Division, JCRR; and Mr. P.C. Lee, Section Head and Specialist, Fertilizer Sales and Transportation Department, Taiwan Provincial Government.

Appreciation is extended also to the agricultural supervisors of the farmers' associations and to the staff and faculty members and students of the several vocational agriculture schools for their participation; and, lastly, to all the farmers for their cooperation in providing the required information. These groups contributed their services without receiving any remuneration whatsoever.

Without the contributions of these persons the survey could not have been conducted nor this report prepared.

ABBREVIATIONS USED

A/S – Ammonium sulphate

A/S/N – Ammonium sulphate nitrate

C/C – Calcium cyanamide

C/SP – Calcium superphosphate

FFD – Food and Fertilizer Division

F/P – Fused phosphate

FSTD – Fertilizer Sales & Transportation Department

JCRR – Joint Commission on Rural Reconstruction

K_2O – Potash

M/F – Mixed fertilizer

N – Nitrogen

P/C – Potassium chloride

PDAF – Provincial Department of Agriculture & Forestry

PFB – Provincial Food Bureau

P_2O_5 – Phosphoric acid

TARI – Taiwan Agriculture Research Institute

TFC – Taiwan Fertilizer Company

TSC – Taiwan Sugar Corporation

FOREWORD

Taiwan is the second largest consumer of chemical fertilizer per unit of cropped land in southeast Asia. Only Japan uses a larger amount. About 75 to 80 per cent of the annual consumption of chemical fertilizers is for rice. The overall average distribution of chemical fertilizers for rice was 486 kilograms per hectare in 1953 and 593 kilograms in 1954. It has increased year after year since the restoration of Taiwan to China in 1954.

Production of rice ranks first in the Island's economy. Arable land is limited and population pressure on land is extremely high, so special efforts have been made to raise unit yields. The intensive use of fertilizers, both commercial and farm-supplied, is largely responsible for record rice crops in recent years. The pre-war record production of 1,402,414 metric tons of brown rice reached in 1938 was surpassed in 1950. New records have been established every year since, reaching the all time high of 1,695,107 metric tons in 1954.

On Taiwan, chemical fertilizers are controlled in all aspects by the Provincial Government. The only exception is 5,000 to 6,000 metric tons of ammonium sulphate produced annually by the Kaohsiung Ammonium Sulphate Works, sale of which is permitted in the open market. A Fertilizer Committee is entrusted with the responsibility of assessing annual fertilizer requirements for rice, sugarcane and the so-called miscellaneous crops such as sweet potatoes, wheat, banana, pineapple, etc., and recommending plans for procuring the needed quantities, transporting them to end-release warehouses and supervising their distribution.

In assessing the total requirements, the Committee also determines per-hectare allocations for each crop. Past distribution records, farmers' habits of fertilizer application, and requirements of crops and soils are considered in the determination. Among the allocations of fertilizers for the various crops, that for rice is the most complicated. For other crops except sugarcane there is one standard allocation for the whole province but the allocation plan for rice has different standards for different hsien (county)/cities.

Generally, the allocation of fertilizers by the Fertilizer Committee meets the farmers' demands and is satisfactory to most of them. But the Committee must plan educational work as well as supply demands. Introduction of new types of fertilizers and improvement of methods to make best use of fertilizers also are

part of its work. Concerted efforts at educating the farmers about fertilizers made by the component members of the Committee's working group (Provincial Department of Agriculture & Forestry (PDAF), Taiwan Agriculture Research Institute (TARI), Provincial Food Bureau (PFB), and the Joint Commission on Rural Reconstruction (JCRR), have been generally successful. However, it has not been possible to overcome fully in a short time the farmers' reluctance to accept certain carriers. Consequently, tie-in allocation of these fertilizers with popular types is practiced and causes problems in many areas.

Inadequate information on the fertility of Taiwan soils on a regional basis creates another problem. Although experts in TARI, TFC and JCRR have contributed much to making detailed soil fertility maps, the data are incomplete and insufficient. The ideal way is to set separate allocations of fertilizers for each zone of similar soil conditions but, at present, allocation is set on the basis of hsien/city administrative areas. Since the soil conditions can vary greatly within a hsien/city, the allocations of fertilizers which meet the need of the majority may be excessive or insufficient for the minority.

For these reasons, all agencies and institutions concerned with fertilizers in Taiwan pay great attention to farmers' opinions on allocation. They are eager to collect information regarding actual quantities of commercial and farm-supplied manures applied and the fertilization methods used.

To supplement existing information, the JCRR sponsored two separate surveys on use of chemical fertilizers and farm-supplied manures by Taiwan farmers, one each for the 1954 first and second rice crops. The surveys for the first crop were carried out in June and July 1954, the surveys for the second rice crop, in January and February 1955. This report tells how the surveys were conducted and what they revealed.

The report reveals both problems and encouraging progress. We hope, by bringing them to light, to indicate the extent to which Taiwan farmers had progressed by 1954 in proper fertilizer usage and, at the same time, to furnish a basis for future plans and policies concerning Taiwan's fertilizer program.

SUMMARY

OBJECTIVES

This survey had four principal objectives: (1) To sample opinions of farmers as to the adequacy of the standard allocations of fertilizers for rice; (2) To determine how much of the fertilizers delivered to farmers actually were applied to rice crops; (3) To determine the amounts of fertilizers used as basic manure and the amounts used as top dressing; and (4) To determine the kinds and quantities of farm-supplied manures used.

INTERVIEWERS

The survey was carried out by JCRR field personnel with the assistance of agricultural advisors of township farmers' associations and students of the vocational agriculture schools. Seven in-service trainees (junior–senior university students) working with the Food and Fertilizer Division of JCRR also participated in the survey of the first rice crop. The students of the vocational agriculture schools were asked to survey their own homes.

COVERAGE

The first crop survey covered 227 townships, representing about 80 per cent of the rice planting townships in the plain areas. The second crop survey covered 245 townships representing about 86 per cent. Of the schedules sent out during the first crop survey, 2,906 were returned, and about 80 per cent were used after screening. Of the 6,877 schedules returned in time for screening in the second crop survey, only 8.6 per cent were discarded.

For the second survey, visits were made to each of the vocational agriculture schools to explain more thoroughly to teachers the purpose of the survey and how to conduct it. As a result, the schedules returned by the vocational agriculture schools were more accurate – 33 per cent were discarded in the second survey compared to 42 per cent in the first.

FINDINGS

1. Farmers' attitude toward the standard allocations of fertilizers:

The three principal fertilizers distributed were ammonium sulphate, calcium

superphosphate, and potassium chloride. A majority of farmers thought the allocations of these three fertilizers were sufficient. However, 13 to 23 per cent in different areas stated the allocations were excessive and 16 to 31 per cent thought they were insufficient.

The farmers' attitude toward a certain type of fertilizer is not necessarily based on the requirements of the soil and crop. Rather, it may be based on personal likes and dislikes. This is well demonstrated in connection with the allocations of calcium cyanamide; only 6 to 8 per cent said the quantities were insufficient while 36 to 51 per cent claimed they were too much. And with fused phosphate, a new fertilizer to Taiwan, only 5 to 6 per cent said the distribution was not enough while 40 to 65 per cent said it was excessive.

The farmers surveyed applied for 94.8 per cent of the total standard allocation of fertilizers for the first crop and for 93.4 per cent for the second crop.

2. Utilization of fertilizers:

Of the fertilizers received by farmers for the first rice crop, 94.9 per cent were used on that crop. Of the fertilizers received for the second rice crop, 96.6 per cent were so used.

For the second crop, of the 118 kilograms of nitrogen (N) applied per hectare, 36 kilograms or 31 per cent came from farm-supplied manures; of the 47 kilograms of phosphoric acid (P_2O_5) applied per hectare, 20 kilograms or 43 per cent came from farm-supplied manures; and of the 52 kilograms of potash (K_2O) applied per hectare, 37 kilograms or 71 per cent came from farm-supplied manures.

Comparable data were not obtained for the first crop. However, the quantities of farm-supplied manures used on the first crop would be higher since farmers have more time to prepare compost between the second and first crops. The average application of farm-supplied manures during the second crop was 7.5 metric tons per hectare including 4.14 metric tons of compost, 2.4 of green manures, 0.84 of nightsoil, and 0.12 of ashes.

Fourteen per cent of ammonium sulphate, 96 per cent of the calcium cyanamide, 27 per cent of the superphosphate, 82 per cent of the fused phosphate, and 30 per cent of the potassium chloride received by farmers were used as basic applications. The balances were used as top-dressing in two or more applications.

3. Yield of rice:

The surveyed farmers reported an average unit yield of rice 11 per cent higher

than the official estimate for the first crop and 6 per cent higher for the second crop. The yields in East Taiwan were 34 per cent and 15 per cent higher than those officially reported. However, those farmers who were surveyed might not be representative of all the farmers on Taiwan; probably they were the better ones.

4. Cost of fertilizers:

The average cost of fertilizers to the surveyed farmers for the first crop ranged from 14 to 16 per cent of their total rice production, and that for the second crop from 17 to 18 per cent.

Part I. Survey Methodology

A. Chief objectives of the surveys:

The major objectives of the two surveys were: (1) To sample opinions of farmers as to the adequacy of the standard allocations of fertilizers for rice; (2) To determine how much of the fertilizers delivered to farmers actually were applied to rice crops; (3) To determine the amounts of fertilizers used as basic manure and the amounts used as top dressing; and (4) To determine the kinds and quantities of farm-supplied manures used.

Besides these four major aims, questions about rice yields were also asked, though yields are affected by many factors other than fertilizers.

For each survey, a different questionnaire form was used. The form used for the second survey was actually a revision of the first form. The revised form provided space for the so-called "intermediate crop" along with the second crop, because, broadly speaking, the intermediate crop is essentially a part of the second crop planting.

Both forms called for certain basic information to be filled in by the surveyors, e. g., the surveyor's name and organization; the date of the survey; the name and address of the farmer interviewed, acreage of his rice fields and the acreage of his rice fields for which fertilizer was requested.

The revised form also included brief instructions to surveyors and tables showing quantities of per-hectare allocation to the intermediate and second crops for all hsien/cities. Other minor changes were made for clarity and simplification. (See appendices 1 and 2 for samples of the two survey forms.)

B. Surveyors:

Four different groups were mobilized as surveyors. These were:

1. Thirteen FFD inspectors (11 participated in both surveys).

2. Seven in-service trainees from the Agricultural College of National Taiwan University and Provincial Taichung Agricultural College (who participated in the first survey).

3. Some 220 agricultural supervisors in 199 township farmers' associations in 15 hsien (who participated in the second survey).

4. Some 3,600 farm boys studying in 36 vocational agriculture schools (About 1,400 boys representing 28 schools participated in the first survey, and about 2,200 representing 30 schools participated in the second. Twenty-two schools were represented in both).

The first three groups were well qualified to make such surveys. The FFD inspectors are veteran rural workers. It is part of their routine job to interview farmers on fertilizer matters and to give necessary advice. The seven in-service trainees had finished their junior courses at the time of the first survey. They were model students recommended by their respective colleges and subsequently screened and selected by JCRR. The agricultural supervisors in the township farmers' associations, mostly good farmers themselves, are men who know the local farming conditions best.

The fourth group, the farm boys of the vocational agriculture schools, were too young and immature to take full responsibility for this type of survey work. Several precautions and restrictions were found to be necessary:

1. They must be members of farm families growing rice at the time of the survey.

2. They must be in the third (last) year of a junior course or in either the second or the third (last) year of a senior course.

3. They were, in principle, to fill in only one survey form, for their own family farm. In case they should fill the limit of two, it should be on a neighbor's or relative's farm.

4. Before the survey, the concerned teacher must gather the prospective surveyors and explain to them how to conduct the interview and fill in the forms.

5. When the forms were filled, the teacher would screen and check them for completeness before submission to JCRR.

A further precautionary step was taken in the second survey after it was dis-

covered that a large percentage of the forms filled by agricultural students during the first survey could not be used. Just before the commencement of the second survey, visits were made to 37 vocational agriculture schools in western Taiwan and two in eastern Taiwan to explain in detail how to improve the survey techniques.

C. Sampling:

The chief regard in sampling was to cover as wide an area as possible. For this purpose special instructions were given to all surveyors who were expected to fill in more than two forms. The inspectors, each of whom filled in 100 forms in each survey, were required to cover at least 30 tsun/li (villages) in 10 or more townships and to avoid interviewing the same farmers whom other groups of surveyors had visited. The in-service trainees who had to fill in 60 forms each were to cover at least 20 tsun/li in 10 or more townships.

The agricultural supervisors of township farmers' associations were requested to survey from 10 to 25 rice growers in their own townships depending upon the acreage of rice. Supervisors in a township with less than 500 hectares were requested to survey 10 farmers distributed in at least 3 tsun/li. Supervisors in a township with 500 to 1,500 hectares were requested to survey 20 farmers distributed in at least 5 tsun/li. Those in a township that grew more than 1,500 hectares of rice were requested to survey 25 farmers distributed in at least 6 tsun/li.

Growers of upland rice were excluded from the survey as the manuring pattern of upland rice is quite different from that of paddy rice and the number of growers is relatively small.

All paddy-rice growers were prospective surveyees whether they had applied chemical fertilizers to their rice or not and regardless of their crop condition.

After proper preparations, the first survey was carried out in June and July 1954 and the second in January and February 1955.

There are 284 "plain" townships on the main island. Of these, 227, or 80 per cent of the total were covered in the first survey and 245 townships, or 86 per cent, were covered in the second.

The completed forms received totalled 2,906 for the first survey and 7,466 for the second; however, 589 of the latter were received too late to be included in the compilation.

D. Screening and tabulation:

All survey forms were carefully screened before they were either rejected or accepted for tabulation. From the inter-relationship among several items in the forms, and from a thorough knowledge of the stipulations governing distribution of chemical fertilizers, the screeners had ready criteria by which to judge the accuracy of the records.

1. Checking on consistency of farmers' opinion on sufficiency or deficiency of allocation:

For judging the accuracy or consistency of a farmer's opinion regarding sufficiency or deficiency of a certain type of fertilizer, the screeners would first check the relationship between his rice acreage and that for which fertilizer had been requested, and then see whether there was carry-over from the preceding crop. and/or carry-over to the next crop as well as whether fertilizers were shifted to other crops. The principles can best be shown by examples.

Example 1. Farmer A requested only 0.8 hectare of fertilizers for his 1.0 hectare of rice and had neither carry-over of ammonium sulphate from the preceding crop nor additional supply from other sources, but he expressed that the standard per hectare allocation of ammoniun sulphate for his hsien, 400 kilograms, was "too little." This is apparently inconsistent. In such cases "just enough" or even "too much" would be proper, and corrections were made accordingly.

Example 2. Farmer B requested 1.0 hectare of fertilizers for his 1.0 hectare of rice and shifted 100 kilograms of ammonium sulphate to vegetables out of the 400 kilogram allocation he got, while there was no carry-over from the preceding crop. Still he expressed that the standard allocation was "just enough." This is inconsistent too. In such cases correction was made as "too much," because the standard allocation was meant for application to 1 hectare of paddy only and not to cover other crops. In case the shifted amount was 15 kilograms or less, the farmer's opinion "just enough" was used. Nominal carry-over were similarly treated.

Example 3. Farmer C requested 1.2 hectare of fertilizers for his 1.0 hectare of rice and reported neither a carry-over nor a shift to other current crops. He expressed that the standard allocation of ammonium sulphate was "too little" that of calcium superphosphate "just enough" and that of potassium chloride "too much." These opinions are quite all right. He regarded the standard allocation of ammonium sulphate as insufficient, so he requested more--1.2 hectare against his actual acreage of 1.0 hectare – and his request was granted. For the sake of the

additional request of 0.2 hectare, he also obtained 20 per cent more of calcium superphosphate and potasssium chloride than the standard allocation, in accordance with the stipulation of compulsory tie-in distribution of phosphate and potash with nitrogenous fertilizers. The fact that he used more calcium superphosphate and potassium chloride than the standard allocation does not contradict his opinion of "just enough" and "too much" respectively. He was obliged to take more calcium superphosphate and potassium chloride than he would like, just because he wanted more ammonium sulphate.

2. Checking on accuracy of quantities of chemical fertilizers used by farmers:

The accuracy of the records on quantities of chemical fertilizers actually used was determined by checking five related figures. In the survey forms there were columns to complete showing: (1) the amount of each fertilizer carried over from preceding crops, (2) the amount taken from current distribution, (3) the amount received from other sources, (4) the amount shifted to other crops, and (5) the amount carried over. Besides the mathematical checking on these five entries, a careful examination was also made on the amount taken from the current distribution which was the main source of the farmers' supply.

The amount of each fertilizer taken from current distribution was related with two items, the acreage for which fertilizer was requested by the particular farmer and the standard per-hectare allocation for the hsien/city he lived in.. As no extra distribution of ammonium sulphate was allowed, the amount of ammonium sulphate any particular farmer got was exactly the same as the product of the standard per-hectare allocation and the acreage for which fertilizer was requested.

The situation is a little different with other fertilizers. Farmers were allowed to request extra distribution of calcium cyanamide, calcium superphosphate, potassium chloride, fused phosphate and mixed fertilizer (a mixture of calcium cyanamide and fused phosphate) besides the compulsory tie-in quota with ammonium sulphate. This measure was set up in order to encourage farmers to use more basic fertilizers. Under such situation, the amounts of these fertilizers a farmer obtained, was either the same as the product of the standard per-hectare allocation and the acreage for which fertilizer was requested, or more—never less.

These facts furnished clear criteria for judging the accuracy of the record on quantities of chemical fertilizers taken from current distribution. When a figure was found to be contradictory to these criteria it was corrected if the difference was within 15 per cent. In case the difference was over 15 per cent, the form was dropped. Such rejection was necessary because, as shall be mentioned later, there

were no criteria to judge the dependability of some items in the forms. Therefore, when an entry was found to be radically erroneous in certain well known aspects, it was assumed that it was likewise erroneous in those which could not be checked.

3. Checking on accuracy of records on manuring methods and on quantities of farm-supplied manures:

There were no clear criteria by which to judge these two items. All that could be done was to see if the information was radically different from the general patterns. It was the screeners' rule not to drop any form merely on account of its doubtful information on these two points, provided that the form had passed the first two series of checkings mentioned above. In such cases only the doubtful portion was dropped in the tabulation, and all the other apparently sound information was used.

All survey forms which arrived in time underwent these checkings. Five hundred and eighty-three, or 20.1 per cent, of the 2,906 forms of the first survey and 593, or 8.5 per cent , of the 6,877 forms of the second survey that arrived in time, were discarded in the process.

Nearly all of the rejected forms were from students of vocational agriculture schools. This group of surveyors filled 1,400 forms in the first survey and 2,229 forms in the second. However, of the latter only 1,778 were received in time to be included in the tabulation. In the first survey 42 per cent and in the second 33 per cent (of the total student questionnaires screened) were rejected.

The number of farmers whose records were included in the tabulation was 2,323 for the first survey, and 6,284 for the second. The distribution by hsien/city and areas is shown in Table 1.

The 5 cities uuder the jurisdiction of the Provincial Government, i.e. Keelung, Taipei, Taichung, Tainan and Kaohsiung, and the one administration, Yangmingshan, have only limited rice acreages and were either not surveyed or inadequately covered. Therefore, statistical data appearing in the tables for these localities are liable to considerable error.

Part II. Survey Findings

A. Standard allocation of chemical fertilizers:

1. Establishment of standard allocation:

About two months before the beginning of each fertilizer distribution for the rice crops, the Provincial Government announces the per-hectare allocation for each

hsien/city as recommended by the Fertilizer Committee. Farmers are then requested to register their planned rice acreage and the amount of fertilizers they need at either township offices or small agricultural unit chiefs' houses. They indicate the desired acreage of tie-in distribution of all types (generally called "request acreage" of fertilizer distribution), and the extra amount of certain basic application fertilizers desired, if any. Farmers are encouraged to request "standard allocation" fertilizer for up to 20 per cent more than the acreage they cultivate; but up to 20 per cent less is also officially allowed. They are encouraged also to request extra amounts of calcium cyanamide, phosphate, and potash which are provided in addition to the standard allocation.

The standard allocations for the 1954 first and second rice crops are shown in Tables 2 and 3.

The Fertilizer Committee in determining the standard allocations takes into account soil types and productivity, results of regional field experiments on the three major nutrients, statistical data of crop yields, and farmers' opinions and habits. Some general impressions regarding Taiwan's fertilizer program may be obtained from a study of the allocation tables:

a. Considerable quantities of chemical fertilizers are applied to rice crops. Heavier applications are required for the first crop than for the second.

b. Nitrogenous fertilizers occupy the dominant position in the allocation, phosphoric acid comes next, and potash last.

c. The principal carriers for nitrogen, phosphoric acid and potash are ammonium sulphate, calcium superphosphate and potassium chloride, respectively. Considerable amounts of calcium cyanamide are applied, but mostly to the first crop. The application of fused phosphate is negligible.

A brief explanation of the so-called "intermediate crop" is necessary. In Tainan Area, extensive acreages produce only one rice crop every three years because of limited irrigation water. However, much of this land is devoted to one crop of rice almost every year either by special arrangements for irrigation or in the hope there will be sufficient rainfall. In order to meet the needs of these as well as other early planters, a special fertilizer distribution is made in Tainan and Kaohsiung Areas from May through June, which is called "intermediate crop" distribution.

In reality no clear line can be drawn between the so-called "intermediate crop" and the second crop proper. Depending on the time of maturity of the crop which

rice follows, rice is sometimes planted in these paddy fields as late as the end of July, in which instance there is no difference between this crop and the ordinary second crop. Also, some farmers take delivery of fertilizers from both the intermediate and second crop distributions for use on the same land; others receive either intermediate distribution or second crop distribution alone but divide it between their intermediate and second crops. However, farmers are not allowed to obtain duplicate allocations for the same acreage.

For these reasons, farmers' opinions on the intermediate allocation and the second allocation in the second survey were grouped together. It turned out that among the 1,639 and 937 farmers included in the second crop survey in Tainan Area and Kaohsiung Area, respectively, only a total of 382 took intermediate distribution alone. As the quantitative difference between these two allocations was negligible, the grouping together seems justified.

2. Farmers' opinions on the standard allocation:

a. Farmers' opinions on the allocations are shown in Tables 4 and 5. Certain factors must be understood in considering their opinions on excessiveness, sufficiency, or deficiency of the allocation, i. e., these opinions reflect not only an actual need for the particular fertilizer but farmers' personal likes or dislikes for them as well. Therefore, both objective elements are involved. This is very evident from a comparison of the opinions of the same group of farmers on two different types of either nitrogenous or phosphatic fertilizers.

For example, both ammonium sulphate and calcium cyanamide contain 20 per cent of nitrogen, and are about equally effective on rice. However, 17 per cent of all the farmers in the first survey expressed that the allocation of 300 to 400 kilograms of ammonium sulphate was excessive, while 51.4 per cent stated that 100 kilograms of calcium cyanamide was excessive. If the farmers had considered only the actual nitrogen requirements and forgotten their favoritism, 30.5 per cent of them would not have said that they needed more allocation of ammonium sulphate. These figures are contradictory and puzzling unless one understands that ammonium sulphate is a favorite of Taiwan farmers, whereas calcium cyanamide, a newer fertilizer to them and rather difficult to apply, is still not desired by many of them. Other undesirable fertilizers are fused phosphate and the mixture of it with calcium cyanamide. Calcium superphosphate and potassium chloride are, generally speaking, neither favored nor unfavored.

b. Although it is impossible to discern to what extent each objective need

and subjective favor or dislike are reflected in Tables 4 and 5, one can safely say that "excessive" is actually excessive in the favorite type—ammonium sulphate—and "deficient" is really deficient in the disliked types—calcium cyanamide, mixed fertilizer and fused phosphate. As far as actual soil and plant requirements are concerned, "deficient" in the favorite type and "excessive" in the disliked types may objectively mean "sufficient." One can better understand and interpret the findings with these points in mind.

c. A majority of farmers regarded the standard allocations of ammonium sulphate, calcium superphosphate and potassium chloride, the three principal sources of N-P-K, as "sufficient" in both crops. The provincial average was: First crop, ammonium sulphate 52.5 per cent, calcium superphosphate 61.8, and potassium chloride 59.6; second crop, ammonium sulphate 56.4 per cent, calcium superphosphate 57.6, and potassium chloride 61.4. These percentages are higher than the corresponding percentages of "excessive" and "deficient" combined.

On an area basis, the same is also true in all cases except ammonium sulphate and potassium chloride for first crop in Tainan Area and ammonium sulphate for second crop in East Taiwan. In these exceptional cases, the percentages of "sufficient" were still above 40 and higher than either of the corresponding percentages for "excessive" or "deficient."

That the "deficient" percentage of ammonium sulphate is higher (30.5 per cent in the first crop and 31.0 per cent in the second for the whole province) than that of any other type is understandable in the light of the explanation in (a) and (b) above.

d. With the quantitatively less important types, which also are the less favored ones, high percentages of "excessive" were discovered. The highest is 64.8 per cent for fused phosphate in the first crop, and the lowest is 36.3 per cent for calcium cyanamide in the second. With the exception of the latter, the percentages exceed 40 per cent in both crops.

e. It is obvious that the officially allowed variation of 20 per cent from the standard allocation serves, under such conditions, to permit farmers to adjust their fertilizer needs fairly well for the major types but not quite so well for the other fertilizers. Many farmers took more calcium cyanamide, mixed fertilizer and fused phosphate than they wished because of the obligatory "tie-in" system of allocation.

f. Some explanation concerning the Taiwan farmers' attitudes toward particular types of fertilizer seems proper:

(1) Ammonium sulphate was the first chemical fertilizer introduced to Taiwan farmers (in 1928). Its long history, quick effect on rice and ease of application and storage all combine to make it a favorite.

(2) Calcium superphosphate and potassium chloride were always distributed to Taiwan farmers as component elements of mixed fertilizers during the Japanese Administration period. Education on the effects of these two types of fertilizers was begun only after restoration of Taiwan to China in 1945. Delayed education and lack of easily visible response from rice in most localities are responsible for the farmers' present lukewarm attitudes toward them. Nevertheless, it is evident that the intensive education work in recent years has influenced farmers greatly.

(3) Calcium cyanamide gives ample reasons to be disliked in spite of its equal nitrogen content and effectiveness on rice comparable to ammonium sulphate. It was unknown to most Taiwan rice farmers until a few years ago. By nature it is a problem fertilizer. It cannot be used as top-dressing without difficulty. As basic manure it must be used at least a week before transplanting, otherwise the seedlings will be damaged or even killed by its toxic nature during decomposition. Being a fine powder, its even application is difficult on windy days and it will float on water and be carried away when the land is not well drained. Ill effects may result should the dust be breathed into the lungs or left on exposed parts of the body for any great length of time. Bursting of containers due to the absorption of moisture and high depreciation in storage plus occasional petrification also cause trouble.

That about 50 per cent of Taiwan farmers have come to welcome calcium cyanamide in so short a time is really surprising and a testimony to the intensive educational campaign of the organizations concerned. These organizations are still persuading farmers that defective as it is in many aspects, calcium cyanamide is an effective fertilizer for rice, is alkaline in nature and can help to improve acid soils, and that since it is locally produced, its use can save foreign exchange.

(4) Fused phospate is the newest fertilizer allocated. Its distribution presently is limited to East Taiwan in unmixed form and Hsinchu Area mixed with calcium cyanamide. Its newness to farmers, slow solubility and lack of quick and visible response from rice make this fertilizer least favored. However, it can be noted from Tables 4 and 5 that in Taoyuan Hsien, where the soils are quite acid and therefore more suitable for fused phosphate, the farmers reaction was least unfavorable. This demonstrates the fallacy of allocating fertilizers on the basis of administrative area rather than soil characteristics.

B. Quantities of chemical fertilizers actually used:

1. Quantities requested:

By the time of the announcement of allocation for each rice crop, the better farmers have long been considering the acreage and variety of rice to be grown, productivity of their lands, availability of farm-supplied manures, and their requirement for the various types of fertilizers. They have made a rough estimate of the quantity of chemical fertilizers they will need and have set aside the amount of paddy rice required as barter. The lesser educated farmers (their number is quite big in Taiwan) give little thought to their fertilizer needs until the day they take delivery of fertilizers at their local farmers' association.

Following the announcement, the farmers compare the allocation with that for the same crop the previous year and ascertain the proportion of their favored types especially ammonium sulphate, in the total allocation. They then decide how much they will request. Since all types are allocated on a tie-in basis, and will be distributed at the announced fixed ratio, farmers have only to decide the acreage for which a fertilizer allocation is desired and, if required, the extra amounts of basic fertilizers such as calcium cyanamide, calcium superphosphate, potassium chloride, mixed fertilizers and fused phosphate.

If the farmer has little surplus paddy rice for bartering, his request is always made with reserve. The Government allows him to take his share of fertilizers, providing he produces the minimum spot barter of 30 per cent.

In special cases, e.g., when the previous crop was severely damaged by drought, typhoon, etc., farmers are allowed to receive fertilizers wholly on a loan basis to be paid for in terms of paddy rice after harvest.

For the first and second rice crops of 1954, Taiwan farmers requested 460,179 metric tons of chemical fertilizers. A comparison between the surveyees' "cultivated acreage" and their "acreage for which the standard fertilizer allocation was requested" is shown in Table 6.

Some comments on Table 6 are necessary:

a. The data reveal that on a province-wide basis the "requested" acreage for fertilizer allocation approximated the cultivated acreage. This indicates that as a whole the standard allocation set by the Fertilizer Committee was generally accepted by the farmers.

b. In addition, the percentages in all are within the 20 per cent range, except that of Taipei which is under 80 per cent in both crops and that of East Taiwan

which is over 120 in the first crop. The soundness of the "20 per cent more or less" policy is again demonstrated.

c. The low percentage in Taipei Area has several explanations:

(1) Outstanding fertilizer loans from previous crops discouraged or disqualified farmers to request fertilizers.

(2) The rice acreage per farm family in Taipei Hsien is comparatively small. The farmers are reluctant to barter their already meager stocks of rice for fertilizer.

(3) Abundant supplies of cheap night soil are available from the cities of Taipei and Keelung.

d. That East Taiwan requested and was allowed to take, 122.2 per cent of the standard allocation in the first crop was unique and strange from the standpoint of the 20 per cent more or less limit. General negligence in enforcing the distribution regulations in this remote area coupled with the general lack of knowledge regarding effective and economical use of fertilizer were the main reasons.

e. The severe drought in both the first and second crop seasons in Hsinchu Area influenced to some degree the farmers' request for the first crop, but not for the second. The effect of the drought was reflected, however, in the farmers' withholding considerable quantities of the acquired fertilizers rather than applying them to the crop, as will be shown later.

The insignificant influence on the farmers' request for fertilizers, as revealed in this survey, was probably due to the following: (1) The farms that suffered from severest drought were not surveyed, beause they did not grow rice; and (2) At the time of fertilizer distribution the farmers were still hoping that it would rain in time for the transplanting, and so they requested all they might need.

2. Actual use:

How much of the fertilizers received by individual farmers is actually applied on the rice crop? This is of utmost concern to all parties interested in fertilizer distribution and fertilizer education. The utilization status of the surveyees in 1954 is shown in Tables 7 and 8. The averages appearing in these tables, as well as in other tables in the remainder of this report, were calculated on the basis of per-hecture application, and not on the basis of total quantities consumed.

The quantities of the three major nutrients contained in the fertilizers actually

applied by farmers as listed in Tables 7 and 8 are shown in Table 9. The N P K contents were calculated according to the following analyses:

Fertilizer	Per cent of element		
	N	P_2O_5	K_2O
Ammonium sulphate	20	0	0
Ammonium sulphate nitrate	26	0	0
Calcium cyanamide	20	0	0
Ammonium phosphate	16	20	0
Mixed fertilizer	8.3	10.5	0
Calcium superphosphate	0	18	0
Fused phosphate	0	18	0
Potassium chloride	0	0	50

a. In both crops the actual total consumption in "province" average and in all "area" averages compares favorably with the standard allocation (Tables 2 and 3). Actual consumption by the surveyee farmers is even closer in "province" average to the standard allocation than the quantities distributed to them (Table 6), 94.9 against 94.8 per cent in the first crop and 96.6 against 93.7 per cent in the second.

b. Farmers generally used more fertilizers on the first crop than on the second. The primary reason is that the growth period of the first rice crop is longer and unit yields are higher than in the second crop.

But the farmers in Taichung Area (with the exception of Nantou Hsien) and in Taipei Hsien, Taoyuan Hsien, Yunlin Hsien and Taitung Hsien were different. They used more fertilizers on the second rice crop. The differences between the two crops are considerable in Taichung Area (Nantou Hsien excluded), Taipei Hsien, and Yunlin Hsien, but they can be explained.

Taichung Area is noted for its intensive use of land. Wheat, tobacco, vegetables, peas, beans, flax, fruits, corn, sweet potatoes and other crops are grown extensively. Taipei Hsien which surrounds Taipei City, the headquarters for both the National and Provincial Governments, is a principal source of Taipei's vegetable supply, especially following the second rice crop. The townships in Yunlin Hsien that are irrigated by the Chushui (muddy water) River also produce many vegetables and other crops after the intermediate or second rice crops. The farmers may actually reserve a part of the "rice" fertilizers for these crops while reporting "officially," but erroneously, that it was used on rice.

c. Farmers used more nitrogenous and phosphatic fertilizers in the first crop,

but more potash in the second, in conformance with the standard allocation. Continuous experiments have revealed that in Taiwan nitrogen and phosphoric acid are effective on the first crop, while potash is more effective on the second.

d. Comparisons between the average quantities of fertilizers distributed per hectare and the quantities actually applied are shown in Tables 10 and 11. In these tables the following differences can be observed:

(1) In total quantities, the farmers surveyed applied more than the overall average of distribution on the first crop (except in Taichung Area) and less in the second (except in Taipei, Kaohsiung and East Taiwan Areas). That the surveyee farmers applied more than the overall average distribution is explainable as the investigation was carried out mainly in the rice-producing "plains area" townships and nearly all the farmers received fertilizers. Acreage in remote places which received no fertilizers and that of small farmers who did not take fertilizers were included in calculating the overall average per-hectare distribution.

On the other hand, the application of less than was distributed indicates carryovers to the next rice crop and/or diversion to other crops. This is especially apparent in the second crop in the drought-stricken Hsinchu Area. The fact that province-wide average application was 11 kilograms less than distribution on the second crop can be attributed mainly to the Hsinchu Area record of applying 193 kilograms less than was distributed.

(2) In all areas, more ammonium sulphate was applied to the first rice crop than was distributed. The same was true on the second crop except in Hsinchu, where less was applied, and in Taichung, where the quantities applied and distributed were the same. The surveyees generally applied more potash but less calcium cyanamide, on both crops, than was distributed. The application of calcium superphosphate was generally more than the distribution to the first crop but less to the second.

(3) The average distribution of 748 kilograms per hectare for the second crop in Hsinchu Area, which is the highest of all the areas for either of the 1954 crops, is a strange phenomenon caused by the drought. It represents a sharp increase compared to that area's averages of 532 kilograms in the 1954 first crop and 514 kilograms for each crop of the previous year.

The increased average resulted from an unexpected decrease in cultivated rice acreage due to drought (50,342 hectare, or 19,138 hectares less than the same crop in the previous year) coupled with a small increase in fertilizers distributed (37,588

metric tons, or 1,449 metric tons more than the same crop in the previous year) which was an island-wide tendency.

Substantial quantities of the remaining 111 kilograms of ammonium sulphate and 84 kilograms of other types per hectare may have been converted into cash or food by the drought-stricken farmers as well as used on other crops in some cases.

(4) That the surveyees reported less use of "other types" of fertilizers than the overall average distribution is of little concern since the quantities of these other types were all negligible.

e. A comparison of the amounts of fertilizers purchased by farmers (expressed as percentages of the standard allocation requested) with amounts actually applied to the rice crop (expressed as percentages of the standard allocation actually applied) is shown in Tables 12 and 13. Generally, the surveyee farmers applied more ammonium sulphate to the first crop than they had purchased from the current distribution and to the second crop about the same amount as purchased for that crop. As distribution of ammonium sulphate was limited to the standard allocation, the extra amounts actually used must have been purchased either from the free market (5,000 to 6,000 metric tons is produced and freely marketed annually by the Kaohsiung Ammonium Sulphate Works) or from fertilizer distributions for other crops, or both.

The quantities of calcium superphosphate and potassium chloride actually applied are generally higher than the quantities of these types included in and obtained from the standard allocation. This is understandable since additional amounts of these two fertilizers may be and were freely purchased by farmers apart from the standard allocation.

f. Although resale of chemical fertilizers by farmers is prohibited by the Government, they sometimes sell to neighbors and friends. In the country-side, the so-called "fertilizer experts" or "fertilizer doctors" often boast how much potassium chloride and fused phosphate they have bought and how generously (and often wastefully) they have applied them to their rice fields with good results.

C. Methods of fertilizing rice:

In Taiwan, fertilizer distribution for rice begins well ahead of the fertilizing season. Farmers are advised to take delivery of fertilizer before preparation of paddy fields for transplanting, in order to ensure basic dressing. There is no problem for the farmers to follow this advice in the first crop, because the interval between the harvest of the second rice crop of the previous year and the land preparation for

the first is comparatively long. They have more leisure than in June and July, even when they grow a third crop after the second crop of rice. In June and July, Taiwan farmers are busy on their farms and unless they are well educated regarding the importance of applying fertilizer as basic dressing it is most difficult to persuade them to take delivery of fertilizers and apply a part before transplanting.

A revolutionary experiment was carried out in 1954 by several enterprising farmers' associations to improve the situation. According to official regulations, farmers are allowed to take fertilizers only after they have cleared their previous loans. Nevertheless, in order to encourage more farmers to use fertilizers as basic dressing, to allow them to take fertilizers during their leisure time, to avoid the congestion from the collection of paddy rice and the distribution of fertilizers at the same, and to clear fertilizer warehouses early so as to accommodate the harvest of the first rice crop, the Shulin Chen Farmers Association in Taipei Hsien and several followers in other areas ventured to distribute fertilizers before harvest of the first crop.

The adventure was made with good faith that the farmers would repay all the first crop fertilizer loan and the required spot barter for the second crop allocation, immediately after harvest of the first crop. This was an experiment, and also a test of Taiwan farmers' honesty. To everyone's satisfaction, it proved to be a great success and should be promoted in other areas.

All Taiwan farmers use farm-supplied manures as basic dressing; but their practice with chemical fertilizers varies widely. All of them use calcium cyanamide as basic, either directly to paddy fields about two weeks before transplanting or after having mixed it with compost. The fused phosphate and mixed fertilizer are also used as basic dressing by nearly all. Farmers also apply the other three types, namely calcium superphosphate, potassium chloride and ammonium sulphate, either wholly or partially as basic dressing. The practice differs from area to area, depending mainly on soil conditions and local customs.

The proportion between the quantities applied as basic dressing and those applied as top-dressing also varies. Weather and soil conditions, as well as farmers' knowledge of the nature of different types of fertilizers, are contributing factors affecting the proportions. The situation in the various areas was surveyed and tabulated for the second crop. However, no tabulation was made for the first crop as many forms did not show this information.

The average percentages of the fertilizers applied as basic dressing and as top-dressing on the 1954 second rice crop are shown in Tables 14-a and 14-b.

Table 14-a shows that the majority of farmers applied calcium cyanamide and the mixed fertilizer as basic dressing. This finding could be expected, because of the toxic nature of calcium cyanamide during decomposition. Those applying these fertilizers as top-dressing did so only when they could not use them as basic dressing because of late delivery, bad weather, or for other reasons. In such cases, these fertilizers were applied as components of matured compost.

More farmers applied fused phosphate as basic dressing than calcium superphosphate and potassium chloride. This is due to effective extension work on fused phosphate. Generally, farmers now apply more calcium superphosphate and potassium chloride as basic dressing than before.

Ammonium sulphate is primarily applied as top-dressing. This was found to be true especially in Yilan Hsien, Yangmingshan Administration, Taitung Hsien and Hualien Hsien. In some areas, particularly Taipei Hsien, Taoyuan Hsien, and several cities, a substantial portion was applied as basic dressing. The small number of farmers interviewed in the cities may be cause for error in the statistics obtained but their higher educational level could also explain the higher percentages obtained there.

Most Taiwan farmers apply fertilizers for top-dressing in two even applications, very few apply them in three or more. Their general practice is to apply a mixture of ammonium sulphate, calcium superphosphate and potassium chloride and work it into the soil with the hands in the course of weeding. However, in some places in the southern part of the island, the mixture is trodden into the soil with the feet. In the central part some apply the mixture after weeding without working it into the soil.

The first top-dressing is applied about 10 days to two weeks after transplanting. Subsequent applications are made at about the same interyals.

D. Use of farm-supplied manures:

Taiwan farmers apply large quantities of farm-supplied manures. The most important are compost, stable manures, green manures, nightsoil and grass or wood ashes. Larger quantities are applied to the first crop than the second because of the longer interval (about 3 months) between the harvest of the second crop and the transplanting of the first crop in next year.

About one-half of the farm families on Taiwan possess compost shelters. A relative abundance of animal manure is provided from the Island's hog population

of approximately 3 million, or about one hog to every 3 persons. The annual cultivation of green manures approximates 200,000 hectares. Those grown extensively in the rice producing areas include Sesbania sesban, soybeans, peas, and Raphanus sativa. Taiwan farmers utilize all the nightsoil produced on the farm and also a great part of that produced in the villages and cities. In addition, most farmers use grass or wood ashes from the fuel for heating and cooking, which in many rural areas comprises only straw, chaff, and other plant refuse.

In both surveys, information was obtained regarding the types and quantities of the farm-supplied organic manures applied. However, due to the incompleteness of this information in the first survey, a tabulation was made only for the second. The types and the average quantities applied per hectare on the second rice crop of 1954 are shown in Table 15.

The N-P-K content of the gross quantities applied, which were calculated according to the following analyses, are shown in Table 16.

	N (%)	P_2O_5 (%)	K_2O (%)
Compost and stable manure	0.50	0.35	0.50
Green manure	0.45	0.10	0.43
Nightsoil	0.50	0.10	0.23
Grass/wood ashes	—	1.67	3.38
Others	Analysis of each specific item included.		

A comparison of the sources of the major plant nutrients, i.e. whether from farm-supplied organic manures or chemical fertilizers, applied to the 1954 second rice crop is shown in Table 17.

E. Fertilizer application in relation to rice production:

The farmers surveyed applied an average of 628 kilograms of chemical fertilizer per hectare on the 1954 first rice crop and 590 kilograms on the second crop. The average N-P-K content of the former was 88 kilograms of N, 31 kilograms of P_2O_5, and 13 kilograms of K_2O. For the second crop the average content was 82 kilograms of N, 27 kilograms of P_2O_5, and 15 kilograms of K_2O.

A similar survey conducted by the Taiwan Provincial Food Bureau in 1952 revealed the quantities of N-P-K used as shown in Table 18. A comparison indicates that within two years Taiwan farmers came to apply from chemical origins 23 kilograms more of N, 7 kilograms more of P_2O_5, and 3 kilograms more of K_2O in the first crop, and 16 kilograms more of N, 3 kilograms more of P_2O_5, and 5 kilograms

more of K_2O in the second crop. Compared to 1952, farmers in 1954 used slightly more nitrogen and potash but the same amount of phosphoric acid in the form of farm-supplied manures.

The increased application of fertilizers and manures has enabled Taiwan farmers to produce more rice. This is evident in (1) the relation between the quantities of fertilizer distributed in the past years and the corresponding records of rice production during the same period (note chart at beginning of this report), (2) the fact that fertilizer use is more intensive in high-yielding rice areas than in low-yielding areas, and (3) the higher rice yields (compared to the official province-wide average) reported by the surveyees, who are probably better than average farmers. The third point needs elaboration.

The surveyee farmers reported their rice yields in terms of paddy or rough rice (not in brown rice) on a per-hectare basis, and distinguished Ponlai (Japonica type) rice from Chailai (Indica type; also referred to as "native" type) rice. These yields after being converted into brown rice using Provincial Food Bureau's official factors, i.e., 77.5 per cent for Ponlai rice and 75.5 per cent for Chailai, are shown in Table 19.

Table 19 shows the yields of Ponlai rice reported by the surveyees to be higher than the officially announced provincial and area average yields of Ponlai and Chailai combined, while their yields of Chailai rice are higher in some localities and lower in others. When the surveyees' yields of both Ponlai and Chailai are recorded higher than the official combined averages, there is little doubt that the surveyees' yields were actually higher, as is the case with the provincial average in both crops. Although in several areas the surveyees' yields of Chailai are lower than the official combined averages, the actual differences are slight. This is shown in Table 20 where the yields of Ponlai and Chailai varieties on the surveyees' farms have been incorporated into one according to the proportion between the total acreages of Ponlai and Chailai varieties in the respective areas. The acreages of Ponlai and Chailai varieties in the 1954 first and second crops are shown in Table 21.

On both provincial and area bases, the surveyees' yields are higher than the officially announced yields, except in Taichung and Kaohsiung Areas in the second crop where they were slightly lower. The surveyees reported a provincial average yield of 11 per cent more than the official yield in the first crop and 6 per cent more in the second crop. The difference is biggest in East Taiwan, amounting to 34 per cent in the first crop and 15 per cent in the second. In this

relatively remote, mountainous area many farmers do not use chemical fertilizers. That fact combined with other unfavorable cultural practices, results in low yields and reduces the area average.

The second biggest difference is in Tainan Area, which has the largest acreage of low-yielding upland rice, about 12,600 hectares representing nearly 70 per cent of the province's total in the first crop, and about 18,200 hectares or nearly 60 per cent of the total in the second crop. Since in this study the dryland rice growers were not included the average yields obtained were higher than the official area-wide estimates.

Taiwan rice growers barter rice for chemical fertilizers. The province-wide average use of 628 kilograms of fertilizers per hectare for the first crop and 590 kilograms for the second required, as shown in Table 22, 514 kilograms and 491 kilograms of paddy rice (Ponlai basis), respectively. For the first crop, the average cost of fertilizers to the surveyed farmers represented 14.2 per cent of the average Ponlai rice yield and 16.2 per cent of the average Chailai rice yield. For the second crop, these percentages were 17.3 for Ponlai and 18.2 for Chailai.

Tne average of fertilizer usage was not calculated separately for Ponlai and Chailai types, although the actual application to Panlai is almost invariably higher than that for Chailai. Therefore, the actual percentage of the crop required to barter for fertilizers must be a little higher for Ponlai and a little lower for Chailai than those shown in Table 22. However, the 3 per cent additional payment required if Chailai rather than Ponlai rice is bartered is not considered in the table.

It should be noted in Table 22 that in the provincial average and in all area averages the per cent of production required for barter is lower in the first crop than in the second and is also lower with Ponlai than with Chailai. (The only negligible exception to the latter point is Taipei Are's 12.9 per cent for Ponlai and 12.8 per cent for Chailai in the first crop.) These two findings support past experimental results showing that in Taiwan fertilizers are more effective on the first crop than on the second and that Ponlai is more responsive to fertilizers than Chailai.

From area to area, the percentage of the Ponlai rice yield required in payment of fertilizers varies from 12.9 to 16.3 for the first crop, and from 13.7 to 20.4 for the second. For Chailai it varied from 12.8 to 19.4 for the first crop and from 15.5 to 26.5 for the second. That of the Taipei Area is lowest while that of East Taiwan

Area usually is the highest.

A lower percentage means a lower proportionate cost of fertilizers and could indicate higher returns for the farmers. But more important is the quantity of rice remaining in the farmers' hands after paying for the fertilizers. Column C of Table 22 shows the quantities to be generally highest in the areas of Taichung, Tainan, and Kaohsiung and lowest in the drought-stricken area of Hsinchu and in East Taiwan. When the barter percentage and the remaining quantity are considered together, one may conclude that farmers in the Taichung Area enjoy the best returns. The record for Kaohsiung Area in the first crop is very favorable, but not so in the second.

The question should be raised as to the comparison between the rates of fertilizer application by the surveyed farmers and the optimum rates recommended by the fertilizer specialists. For this purpose, reference is made to a report entitled "Fertilizer Application in Relation to Rice Production in Taiwan", prepared by Mr. H.F. Chu, Senior Specialist, and Dr. P.C. Ma, former Chief of Plant Industry Division, JCRR, and also to the optimum rates of application recommended by Mr. S.C. Chang, Soil and Fertilizer Specialist of the Taiwan Agricultural Research Institute. Mr. Chu and Dr. Ma reported that on a province-wide basis the optimum ratio of N, P_2O_5, and K_2O is 110 : 45 : 35 kg/ha for the first crop of Ponlai rice and 110 : 50 : 45 kg/ha for the second crop, while that for Chailai rice is 110 : 45 : 40 kg/ha for the first crop and 90 : 35 : 50 kg/ha for the second. Mr. Chang's recommendations are as follows.

Number of region	Name of region *	N-P-K recommendation (kg/ha)
1	Yilan	60–40–40
2	Eastern Taiwan	80–40–40
3	Taipei	80–40–40
4	Taoyuan	80–60–60
5	Hsinchu and Miaoli	100–40–40
6	Taichung	120–60–40
7	Muddy–River Valley	100–40–40
8	Saline soil	100–80– 0
9	Chiayi and Tainan	80–40–40
10	Kaohsiung and Pingtung	100–40–40

* See map for area location as used in this report.

As shown in Table 17, the farmers surveyed actually applied an average of 118 kilograms of N, 47 kilograms of P_2O_5 and 52 kilograms of K_2O per hectare to the 1954 second rice crop. Compared with Mr. Chu and Dr. Ma's optimum rates, an excess of 8 kilograms of N, a deficiency of 3 kilograms of P_2O_5, and an excess of 7 kilograms of K_2O for Ponlai rice are indicated. For Chailai rice there were excessive applications of all three major elements, namely to the extent of 28 kilograms of N, 12 kilograms of P_2O_5, and 2 kilograms of K_2O.

A comparison with Mr. S.C. Chang's recommendations on a hsien or county basis also shows that the farmers surveyed in all regions applied more N than the quantity recommended, but applied about the proper amounts of P_2O_5 and K_2O. The same situation may have occurred with the 1954 first crop, but unfortunately there are no available data either to prove or to disprove it.

Conclusion

Pressed by the necessity to produce the utmost from their small holdings, Taiwan farmers are using more and more fertilizers in order to raise unit yields of their crops. On the whole, they respond well to the Government's standard allocation of fertilizers and are fast accustoming themselves to new types of fertilizers. Many of the rice growers, particularly those living in the plains areas, are using more fertilizers, especially nitrogenous, than the optimum average quantities recommended by various soil and fertilizer specialists.

The following points may be suggested for the consideration and necessary action by the agencies concerned:

(1) Allocation of fertilizers solely on the basis of soil fertility and plant requirements. To do this a strengthened and extensive program of soil testing and soil mapping is required coupled with an intensive educational program among the farmers.

(2) Discouragement of further increased use of chemical fertilizer on rice in most areas. This is especially true in regard to N.

(3) Encouragement of chemical fertilizer use by the farmers, including aborigines, in remote regions.

(4) Continued encouragement to the farmers to apply a greater portion of phosphate and potash fertilizers as basic dressing.

(5) Continued education on calcium cyanamide and fused phosphate. The

use of these carriers in conjunction with compost should be emphasized.

(6) Continued encouragment for increasing the production and use of farm-supplied manures, especially in northern and eastern Taiwan.

Fact finding surveys are indispensable as a means of obtaining information on which to base future planning. It is hoped that similar fertilizer use surveys will be made on future rice crops and on sugarcane and the so-called "miscellaneous crops" as well. Any future survey should be so designed and implemented that the farmers surveyed will be truly representative of the whole. This study's major weakness may be on this point, but not to the extent that the findings are grossly unrepresentative or misleading.

Table 1. Distribution of Farmers Surveyed

Unit: No. of farmers

Locality	First Survey	Second Survey
WHOLE PROVINCE	2,323	6,284
Taipei Area	321	678
Yilan Hsien	145	240
Taipei Hsien	165	395
Yangmingshan Adm.	11	30
Taipei City	—	13
Keelung City	—	—
Hsinchu Area	261	1,162
Taoyuan Hsien	110	488
Hsinchu Hsien	70	292
Miaoli Hsien	81	382
Taichung Area	509	1,531
Taichung Hsien	211	538
Changhua Hsien	259	839
Nantou Hsien	29	150
Taichung City	10	4
Tainan Area	540	1,639
Yunlin Hsien	121	327
Chiayi Hsien	252	463
Tainan Hsien	167	839
Tainan City	—	10
Kaohsiung Area	380	937
Kaohsiung Hsien	186	382
Pingtung Hsien	177	547
Kaohsiung City	17	8
East Taiwan Area	312	337
Taitung Hsien	155	123
Hualien Hsien	157	214

Table 2. Standard Allocations of Fertilizers for the 1954 First Rice Crop

Locality	Standard Allocation (kg/ha)									
	Element			Type						
	N	P_2O_5	K_2O	Ammonium sulphate	Calcium cyanamide	Calcium superphosphate	Potassium chloride	Mixed * fertilizer	Fused phosphate	Total
Taipei Area:										
Yilan Hsien	90	30.6	10	350	100	170	20			640
Taipei Hsien	90	27.0	10	350	100	150	20			620
Yangmingshan Adm.	90	27.0	10	350	100	150	20			620
Taipei City	80	27.0	10	300	100	150	20			570
Keelung City	80	27.0	10	300	100	150	20			570
Hsinchu Area:										
Taoyuan Hsien	90	29.4	15	330			30	280		640
Hsinchu Hsien	90	29.4	15	330			30	280		640
Miaoli Hsien	100	33.6	10	360			20	320		700
Taichung Area:										
Taichung Hsien	100	36.0	10	400	100	200	20			720
Changhua Hsien	100	36.0	10	400	100	200	20			720
Nantou Hsien	90	27.0	10	350	100	150	20			620
Taichung City	100	36.0	10	400	100	200	20			720
Tainan Area:										
Yunlin Hsien	100	36.0	10	400	100	200	20			720
Chiayi Hsien	90	30.6	10	350	100	170	20			640
Tainan Hsien	90	30.6	10	350	100	170	20			640
Tainan City	80	27.0	10	300	100	150	20			570
Kaohsiung Area:										
Kaohsiung Hsien	100	36.0	20	400	100	200	40			740
Pingtung Hsien	100	36.0	20	400	100	200	40			740
Kaohsiung City	100	36.0	20	400	100	200	40			740
East Taiwan Area:										
Taitung Hsien	80	27.0	10	300	100	100	20		50	570
Hualien Hsien	80	27.0	10	300	100	100	20		50	570

* A mixture of calcium cyanamide and fused phosphate in the proportion of 100 : 140

Table 3. Standard Allocations of Fertilizer for the 1954 Intermediate and Second Rice Crops

Locality	Standard Allocation (kg/ha)																	
	Intermediate crop								Second crop									
	N	P_2O_5	K_2O	A/S	C/C	C/SP	P/C	Total	N	P_2O_5	K_2O	A/S	C/C	C/SP	P/C	M/F	F/P	Total
Taipei Area:																		
Yilan Hsien									74	27.0	15	370		150	30			550
Taipei Hsien			No distribution						80	21.6	15	400		120	30			550
Yangmingshan Adm.									80	21.6	15	400		120	30			550
Taipei City									70	21.6	15	350		120	30			500
Keelung City									70	21.6	15	350		120	30			500
Hsinchu Area:																		
Taoyuan Hsien									80	26.4	15	370		100	30	80		580
Hsinchu Hsien			No distribution						80	26.4	15	370		100	30	80		580
Miaoli Hsien									90	30.0	15	420		120	30	80		650
Taichung Area:																		
Taichung Hsien									94	30.6	15	420	50	170	30			670
Changhua Hsien			No distribution						94	30.6	15	420	50	170	30			670
Nantou Hsien									80	21.6	15	350	50	120	30			550
Taichung City									94	30.6	15	420	50	170	30			670
Tainan Area:																		
Yunlin Hsien	90	30.6	10	350	100	170	20	640	94	30.6	15	470		170	30			670
Chiayi Hsien	90	30.6	10	350	100	170	20	640	84	27.0	15	420		150	30			600
Tainan Hsien	90	30.6	10	350	100	170	20	640	84	27.0	15	420		150	30			600
Tainan City	90	30.6	10	350	100	170	20	640	84	27.0	15	420		150	30			600
Kaohsiung Area:																		
Kaohsiung Hsien	90	30.6	10	350	100	170	20	640	84	27.0	15	420		150	30			600
Pingtung Hsien									84	27.0	15	420		150	30			600
Kaohsiung City									84	27.0	15	420		150	30			600
East Taiwan Area:																		
Taitung Hsien			No distribution						80	21.6	15	400		70	30		50	550
Hualien Hsien									80	21.6	15	400		70	30		50	550

Table 4. Farmers' Opinions on the Standard Fertilizer Allocation for the 1954 First Rice Crop

Locality	Farmers' Opinions (%)																	
	Ammonium sulphate			Calcium cyanamide			Calcium superphosphate			Potassium chloride			Mixed fertilizer			Fused phosphate		
	Excessive	Sufficient	Deficient	Excessive	Sufficient	Deficient	Excessive	Sufficient	Deficient	Excessive	Sufficient	Deficient	Excessive	Sufficient	Deficient	Excessive	Sufficient	Deficient
WHOLE PROVINCE	17.0	52.5	30.5	51.4	41.0	7.6	22.2	61.8	16.0	22.6	59.6	17.8	44.1	49.4	6.5	64.8	29.5	5.7
Taipei Area	22.5	52.5	25.0	55.5	33.6	10.9	33.4	52.9	13.7	16.7	60.6	22.7						
Yilan Hsien	29.7	53.8	16.5	77.6	20.0	2.4	37.4	53.5	9.1	14.1	53.5	32.4						
Taipei Hsien	17.7	51.2	31.1	40.4	42.4	17.2	30.6	51.2	18.2	19.5	65.5	15.0						
Yangmingshan Adm.	—	54.5	45.5	10.0	70.0	20.0	20.0	70.0	10.0	9.1	81.8	9.1						
Hsinchu Area	14.3	56.1	29.6							6.6	68.6	24.8	44.1	49.4	6.5			
Taoyuan Hsien	26.4	59.1	14.5							5.6	58.4	36.0	41.8	52.7	5.5			
Hsinchu Hsien	5.8	60.8	33.4							7.2	79.7	13.1	42.6	54.4	3.0			
Miaoli Hsien	4.9	48.2	46.9							7.4	72.8	19.8	48.2	40.7	11.1			
Taichung Area	13.0	60.9	26.1	55.4	41.4	3.2	18.5	68.0	13.5	18.3	64.0	17.7						
Taichung Hsien	17.1	61.1	21.8	40.9	54.2	4.9	27.0	68.3	4.7	10.9	66.4	22.7						
Changhua Hsien	10.0	59.9	30.1	65.5	32.6	1.9	13.5	68.0	18.5	26.3	60.6	13.1						
Nantou Hsien	—	72.4	27.6	71.5	25.0	3.5	3.4	62.1	34.5	—	75.9	24.1						
Taichung City	40.0	50.0	10.0	50.0	50.0	—	10.0	80.0	10.0	20.0	70.0	10.0						
Tainan Area	25.0	41.8	33.2	47.7	42.7	9.6	33.3	54.0	12.7	36.4	49.0	14.6						
Yunlin Hsien	19.0	40.5	40.5	56.0	34.5	9.5	10.7	57.9	31.4	21.5	40.5	38.0						
Chiayi Hsien	30.1	39.3	30.6	47.6	42.8	9.6	35.1	56.6	8.3	41.1	49.8	9.1						
Tainan Hsien	21.7	46.4	31.9	41.8	48.7	9.5	47.2	47.2	5.6	40.5	54.0	5.5						
Kaohsiung Area	12.6	57.1	30.3	46.5	47.8	5.7	16.8	69.2	14.0	27.0	60.0	13.0						
Kaohsiung Hsien	13.4	46.8	29.8	39.4	53.7	6.9	20.5	65.4	14.1	41.1	50.3	8.6						
Pingtung Hsien	12.4	66.1	21.5	53.4	42.4	4.2	13.9	72.9	13.2	12.5	69.2	18.3						
Kaohsiung City	5.9	76.5	17.6	52.9	41.2	5.9	5.9	70.6	23.5	23.5	70.6	5.9						
East Taiwan Area	11.9	48.6	39.5	54.1	35.8	10.1	10.4	65.8	23.8	19.9	62.0	18.1				64.8	29.5	5.7
Taitung Hsien	7.8	42.2	50.0	51.0	36.4	12.6	10.4	70.1	19.5	15.8	60.6	23.6				54.6	37.7	7.7
Hualien Hsien	15.9	54.8	29.3	57.2	35.1	7.7	10.3	61.5	28.2	23.7	63.5	12.8				74.2	22.0	3.8

Table 5. Farmers' Opinions on the Standard Fertilizer Allocations for 1954 Intermediate and Second Rice Crops Combined

Locality	Farmers' opinions (%)																	
	Ammonium sulphate			Calcium cyanamide			Calcium superphosphate			Potassium chloride			Mixed fertilizer			Fused phosphate		
	Excessive	Sufficient	Deficient	Excessive	Sufficient	Deficient	Excessive	Sufficient	Deficient	Excessive	Sufficient	Deficient	Excessive	Sufficient	Deficient	Excessive	Sufficient	Deficient
WHOLE PROVINCE	12.6	56.4	31.0	36.3	57.3	6.4	16.2	57.6	26.2	18.6	61.4	20.0	49.8	45.9	4.3	40.1	53.6	6.3
Taipei Area	14.9	69.5	15.6				32.2	56.5	11.3	19.2	61.7	19.1						
Yilan Hsien	22.4	59.0	18.6				30.3	59.7	10.0	16.2	57.3	26.5						
Taipei Hsien	11.7	76.5	11.8				33.8	54.4	11.8	19.4	64.8	15.8						
Yangmingshan Adm.	3.3	53.4	43.3				33.3	56.7	10.0	40.0	50.0	10.0						
Taipei City	—	84.6	15.4				15.4	61.5	23.1	15.4	76.9	7.7						
Hsinchu Area	10.8	61.3	27.9				15.5	55.9	28.6	16.9	63.0	20.1	49.8	45.9	4.3			
Taoyuan Hsien	4.7	74.7	20.6				2.2	50.7	47.1	4.3	63.9	31.8	25.5	68.9	5.6			
Hsinchu Hsien	6.6	53.3	49.1				19.0	57.1	23.9	14.6	66.2	19.2	51.7	41.0	7.3			
Miaoli Hsien	21.6	51.3	27.1				27.6	58.2	14.2	33.4	59.5	7.1	76.3	23.2	0.5			
Taichung Area	8.9	57.0	34.1	39.0	55.8	5.2	10.4	61.1	28.5	15.8	66.3	17.9						
Taichung Hsien	13.3	64.2	22.5	27.3	66.8	5.9	14.7	67.6	17.7	8.8	76.0	15.2						
Changhua Hsien	5.7	51.8	42.5	44.9	50.2	4.9	8.4	59.0	32.6	21.3	59.5	19.2						
Nantou Hsien	11.3	58.7	30.0	46.7	48.6	4.7	6.7	48.6	44.7	10.7	69.3	20.0						
Taichung City	—	100	—	50.0	50.0	—	—	100	—	—	75.0	25.0						
Tainan Area	9.4	51.7	38.9	29.4	61.2	9.4	20.8	59.8	19.4	24.0	59.3	16.7						
Yunlin Hsien	7.2	51.1	41.7	95.8	4.2	—	3.4	56.7	39.9	10.0	59.8	30.2						
Chiayi Hsien	9.8	57.3	32.9	17.6	74.0	8.4	19.3	64.9	15.8	20.9	65.1	14.0						
Tainan Hsien	10.1	49.4	40.5	29.7	59.9	10.4	28.5	57.9	13.6	30.1	56.8	13.1						
Tainan City	—	10.0	90.0	—	100	—	—	100	—	100	—	—						
Kaohsiung Area	25.9	52.1	22.0				11.2	58.5	30.3	17.9	58.8	23.3						
Kaohsiung Hsien	22.4	49.7	27.9				9.5	61.0	29.5	25.9	52.3	21.8						
Pingtung Hsien	28.4	53.8	17.8				11.9	56.7	31.4	11.7	63.6	24.7						
Kaohsiung City	37.5	50.0	12.5				50.0	50.0	—	50.0	50.0	—						
East Taiwan Area	8.0	46.2	45.8				5.7	35.7	58.6	11.1	50.4	38.5				40.1	53.6	6.3
Taitung Hsien	5.9	38.3	55.8				9.3	26.6	64.1	5.0	35.0	60.0				21.6	70.0	8.4
Hualien Hsien	9.4	50.5	40.1				3.7	40.6	55.7	14.3	59.0	26.7				50.5	44.4	5.1

Table 6. A Comparison of the Surveyees' Cultivated Acreage and the Acreage for Which the Standard Fertilizer Allocation was Requested

Unit: hectare

Locality	First crop			Second crop *		
	Cultivated acreage	Fertilizer requested acreage	Percentage (%)	Cultivated acreage	Fertilizer requested acreage	Percentage (%)
WHOLE PROVINCE	2,887.17	2,737.08	94.8	7,815.85	7,324.57	93.7
Taipei Area	489.86	344.58	70.3	942.70	733.48	77.8
Yilan Hsien	228.62	171.60	75.1	355.73	258.83	72.8
Taipei Hsien	250.17	162.05	64.8	537.30	424.40	79.0
Yangmingshan Adm.	11.07	10.93	98.7	34.81	39.55	113.6
Taipei City				14.86	10.70	72.0
Keelung City						
Hsinchu Area	402.35	327.98	81.5	1,341.05	1,308.57	97.6
Taoyuan Hsien	221.81	171.89	77.5	670.92	688.42	102.6
Hsinchu Hsien	90.20	74.94	83.1	284.54	275.68	96.9
Miaoli Hsien	90.34	81.15	89.8	385.59	344.47	89.3
Taichung Area	538.70	528.99	98.2	1,626.94	1,654.16	101.7
Taichung Hsien	210.13	194.35	92.5	547.20	549.95	100.5
Changhua Hsien	288.77	299.14	103.7	934.09	990.21	106.0
Nantou Hsien	28.31	25.30	89.4	141.55	109.90	77.6
Taichung City	11.49	10.20	88.8	4.10	4.10	100.0
Tainan Area	620.82	622.14	100.2	2,227.51	2,040.38	91.6
Yunlin Hsien	140.01	150.80	107.7	439.83	494.17	112.4
Chiayi Hsien	286.99	283.50	98.8	645.99	546.26	84.6
Tainan Hsien	193.82	187.84	96.9	1,131.49	989.75	87.5
Tainan City				10.20	10.20	100.0
Kaohsiung Area	407.23	390.34	95.9	1,227.62	1,083.98	88.3
Kaohsiung Hsien	198.61	200.78	101.1	510.71	447.99	87.7
Pingtung Hsien	188.83	169.64	89.8	708.26	630.84	89.1
Kaohsiung City	19.79	19.92	100.7	8.65	5.15	59.5
East Taiwan Area	428.21	523.05	122.2	450.03	504.00	112.0
Taitung Hsien	244.43	294.05	120.3	187.22	218.20	116.5
Hualien Hsien	183.78	229.00	124.6	262.81	285.80	108.7

* Both intermediate and second crop proper are included.

Table 7. Quantities of Fertilizer Applied on the 1954 First Rice Crop Compared to the Standard Allocation

Unit: kg/ha:

Locality	Ammonium sulphate		Calcium cyanamide		Calcium superphosphate		Potassium chloride		Mixed fertilizer		Fused phosphate		Others 1/	Total	
	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	Quantity	%
WHOLE PROVINCE	355(359)2/	98.9	65(86)	75.5	153(145)	105.6	25(24)	104.6	25(40)	62.1	4(7)	54.1	1	628(661)	94.9
Taipei Area	254(350)	72.6	51(100)	51.0	115(159)	72.2	18(20)	90.0					2	440(629)	69.9
Yilan Hsien	273	78	37	37	131	77	32	160						463	72
Taipei Hsien	230	66	60	60	98	65	14	70					5	407	66
Yangmingshan Adm.	375	107	120	120	140	93	21	105						656	106
Taipei City															
Keelung City															
Hsinchu Area	293(337)	87.0	1		42		27(28)	97.1	224(289)	77.5			3	590(654)	90.3
Taoyuan Hsien	252	76	1		56		33	110	206	74			1	549	86
Hsinchu Hsien	317	96	1		25		26	87	216	77			4	589	92
Miaoli Hsien	329	91	2		37		18	90	255	80			7	648	93
Taichung Area	382(397)	96.1	79(100)	79.0	191(197)	96.8	20(20)	100					1	673(714)	94.2
Taichung Hsien	360	90	82	82	178	89	19	95					0	639	89
Changhua Hsien	409	102	88	78	204	102	21	105					2	714	99
Nantou Hsien	319	91	68	68	160	107	24	120					5	576	93
Taichung City	306	77	64	64	202	101	18	90						590	82
Tainan Area	370(361)	102.7	77(100)	77.0	173(177)	97.9	23(20)	115.0					2	645(658)	99.0
Yunlin Hsien	433	108	82	82	220	110	25	125					6	766	106
Chiayi Hsien	367	105	71	71	161	95	22	110						621	97
Tainan Hsien	331	95	82	82	156	92	21	105					4	594	93
Tainan City															
Kaohsiung Area	399(400)	100.0	74(100)	74.0	204(200)	102.0	41(40)	102.5					1	719(740)	97.2
Kaohsiung Hsien	433	108	83	83	211	106	41	103					1	769	104
Pingtung Hsien	362	91	62	62	195	98	41	103					2	662	90
Kaohsiung City	421	105	90	90	213	107	38	95						762	103
East Taiwan Area	386(300)	128.7	74(100)	74.0	130(100)	130.0	26(20)	130.0			30(50)	60.0		646(570)	113.4
Taitung Hsien	388	129	68	68	130	130	26	130			30	60		642	113
Hualien Hsien	384	128	79	79	129	129	27	135			29	58		648	114

1/ Ammonium sulphate nitrate, calcium ammoninm nitrate, ammonium phosphate, etc.

2/ The figures in parentheses are Province and Area averages of the standard allocations. The Province and Area averages were calculated in the following way: Area average = (allocation of A hsien x its cultivated acreage) + (allocation of B hsien x its cultivated acreage) + (allocation of C hsien x its cultivated acreage) ÷ total cultivated acreage of A, B, and C

Table 8. Quantities of Fertilizer Applied on the 1954 Second Rice Crop Compared to the Standard Allocation

unit: kg/ha

Locality	Ammonium sulphate		Calcium cyanamide		Calcium superphosphate		Potassium chloride		Mixed fertilizer		Fused phosphate		Others	Total	
	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	%	Quantity	Quantity	%
WHOLE PROVINCE 1/	380(404) 2/	94.0	22(19)	118.6	142(141)	100.4	30(29)	101.7	11(14)	81.0	3−(3)	89.7	2	590(610)	96.6
Taipei Area	303(388)	78	6		100(131)	76	24(30)	80					0	433(549)	79
Yilan Hsien	275	74	3		111	74	22	73						411	80
Taipei Hsien	313	78	9		93	77	25	82					0	440	80
Yangmingshan Adm.	442	111	3		105	88	33	110					2	585	106
Taipei City	252	72	1		84	68	21	68					1	359	72
Keelung City															
Hsinchu Area	330(384)	86	7		119(106)	112	30−(30)	98	65(80)	81	1		1	553(600)	92
Taoyuan Hsien	316	86	4		139	139	32	108	70	87	1		0	562	97
Hsinchu Hsien	312	84	19		77	77	26	88	56	69	1		2	493	85
Miaoli Hsien	366	81	4		115	96	27	90	63	79	0		0	575	88
Taichung Area	427(414)	103	53(50)	105	186(166)	112	35(30)	116	0		0		5	706(660)	107
Taichung Hsien	421	100	52	105	177	104	31	104					1	682	102
Changhua Hsien	454	108	54	108	201	118	38	127	0		0		7	754	113
Nantou Hsien	275	78	45	90	120	100	28	93					5	573	86
Taichung City	419	100	59	117	189	111	32	106						699	104
Tainan Area 1/	406(409)	99	28(29)	99	150(159)	94	27(27)	100					1	612(624)	98
Yunlin Hsien 1/	546	119	15	183	210	124	39	133					5	815	122
Chiayi Hsien 1/	257	88	26	112	134	87	24	86					1	542	89
Tainan Hsien 1/	379	96	34	88	135	85	25	95					0	573	93
Tainan City 3/	440	126	103	103	218	128	20	100						781	122
Kaohsiung Area 1/	365(419)	87	2+(2−)	160	151(150)	101	30(30)	100					2	550(601)	92
Kaohsiung Hsien	366	88	3	81	156	104	29	94					5	559	93
Pingtung Hsien	365	87	2		148	99	32	106					0	547	91
Kaohsiung City	250	60			89	60	18	60						357	60
East Taiwan Area	439(400)	110	17		81(70)	116	33(30)	111			43(50)	86	0	613(550)	112
Taitung Hsien	474	119	22		77	111	36	121			50	100		659	120
Hualien Hsien	414	103	13		84	119	31	104			38	75	1	581	105

1/ In these localities intermediate crop and second crop proper are combined. The standard allocation was calculated in the following manner: Combined standard allocation = (allocation for intermediate crop x total cultivated acreage) + (allocation for second crop x total cultivated acreage) ÷ (total cultivated acreage of intermediate crop + total cultivated acreage of second crop).

2/ The figures in parentheses represent Province and Area averages of the standard allocations.

3/ Only intermediate crop (no second crop) was surveyed in Tainan City.

Table 9. Element Content of the Chemical Fertilizers Applied on the 1954 First and Second Rice Crops

Unit: kg/ha

Locality	First crop			Second crop		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
WHOLE PROVINCE	88	31	13	82	27	15
Taipei Area	63	21	9	62	18	12
Yilan Hsien	63	24	11	61	20	11
Taipei Hsien	60	18	7	63	17	12
Yangmingshan Adm.	101	25	11	89	19	17
Taipei City						
Keelung City				50	15	10
Hsinchu Area	80	31	14	73	28	15
Taoyuan Hsien	69	32	17	70	33	16
Hsinchu Hsien	84	27	13	71	20	13
Miaoli Hsien	96	33	9	79	27	14
Taichung Area	94	34	10	97	33	18
Taichung Hsien	90	32	10	95	32	16
Changhua Hsien	100	37	11	104	36	19
Nantou Hsien	80	29	12	65	22	14
Taichung City	76	36	9	96	34	16
Tainan Area	92	31	12	87	27	14
Yunlin Hsien	107	40	13	113	38	19
Chiayi Hsien	89	29	11	85	28	14
Tainan Hsien	85	28	11	83	24	12
Tainan City				109	39	10
Kaohsiung Area	97	37	21	74	27	15
Kaohsiung Hsien	106	38	21	75	28	14
Pingtung Hsien	87	35	21	73	27	16
Kaohsiung City	104	38	19	50	16	9
East Taiwan Area	94	29	13	91	22	17
Taitung Hsien	93	29	13	99	23	18
Hualien Hsien	95	28	14	86	22	16

Table 10. Fertilizers Distributed [1/] for the 1954 First Rice Crop Compared to Application

Unit: kg/ha

Locality	Gross fertilizers								Element contents		
	Ammonium sulphate	Calcium cyanamide	Calcium super-phosphate	Potassium chloride	Mixed fertilizer	Fused phosphate	Others	Total	N	P_2O_5	K_2O
WHOLE PROVINCE	302(+53) 2/	68(− 3)	134(+19)	20(+5)	47(−22)	3(+1)	8(−7)	582(+46)	81(+7)	30(+1)	10(+3)
Taipei Area	197(+ 57)	57(− 6)	91(+24)	12(+6)			1(+1)	358(+82)	52(+11)	16+5)	6(+3)
Hsinchu Area	243(+ 50)	3(− 2)	49(− 7)	20(+7)	214(+10)	0	3(same)	532(+58)	69(+11)	31(same)	10(+4)
Taichung Area	370(+ 12)	96(−17)	189(+ 2)	19(+1)		0	14(−13)	688(−15)	99(− 5)	34(same)	9(+1)
Tainan Area	346(+ 24)	97(−20)	173(same)	18(+5)			9(−7)	643(+ 2)	93(− 1)	31(same)	9(+3)
Kaohsiung Area	327(+ 12)	86(−12)	170(+34)	33(+8)			10(−9)	626(+93)	87(+10)	31(+6)	16(+5)
East Taiwan Area	273(+113)	92(−18)	93(+37)	18(+8)		46(−16)		522(+124)	74(+20)	25(+4)	9(+4)

1/ Represents the average distribution per hectare of rice acreage, calculated as follows:
Average distribution per hectare of rice acreage=total quantity distributed in the locality + total acreage of rice in the locality.

2/ Figures in parentheses compare the quantities applied as shown in Tables 7 and 9, Plus (+) means more was actually applied than distributed, and minus (−) means less.

Table 11. Fertilizers Distributed [1/] for the 1954 Second Rice Crop Compared to Application

Unit: kg/ha

Locality	Gross fertilizers								Element contents		
	Ammonium sulphate	Calcium cyanamide	Calcium super-phosphate	Potassium chloride	Mixed fertilizer	Fused phosphate	Others	Total	N	P_2O_5	K_2O
WHOLE PROVINCE	373(+ 7) 2/	28(− 6)	152(−10)	27(+3)	11(same)	2(+1)	8(− 6)	601(− 11)	85(− 3)	29(− 2)	14(+1)
Taipei Area	259(+ 44)	3(+ 3)	94(+ 6)	21(+3)			2(− 2)	379(+ 54)	54(+ 8)	17(+ 1)	10(+2)
Hsinchu Area	441(−111)	3(+ 4)	172(−53)	36(−6)	93(−28)	0(+1)	3(− 2)	748(−195)	99(−26)	41(−13)	18(−3)
Taichung Area	427(same)	56(− 3)	191(− 5)	32(+3)			11(− 6)	717(− 11)	102(− 5)	34(− 1)	16(+2)
Tainan Area	383(+ 23)	38(−10)	164(−14)	25(+2)			11(−10)	621(− 9)	89(− 2)	29(− 2)	13(+1)
Kaohsiung Area	301(+ 64)	8(− 6)	120(+31)	22(+8)			8(− 6)	459(+ 91)	65(+ 9)	22(+ 5)	11(+4)
East Taiwan Area	394(+ 45)	1(+16)	75(+ 6)	30(+3)		48(−5)	2(− 2)	550(+ 63)	81(+10)	22(same)	15(+2)

1/ Represents the average distribution per hectare of rice acreage, calculated as follows:
Average distribution per hectare of rice acreage=total quantity distributed in the locality + total acreage of rice in the locality.

2/ Figures in parentheses compare the quantities applied as shown in Table 8 and 9. Plus (+) means more was actually applied than distributed, and minus (−) means less.

Table 12. Percentage of Standard Allocation Purchased by Farmers (A) Compared to Percentage of Standard Allocation Applied (B), 1954 First Rice Crop

Locality	Percentage (A)	Percentage (B)						
		Ammonium sulphate	Calcium cyanamide	Calcium superphosphate	Potassium chloride	Mixed fertilizer	Fused phosphate	Total
WHOLE PROVINCE	95	99	76	106	105	62	54	95
Taipei Area	70	73	51	72	90	78		70
Hsinchu Area	82	87			97			90
Taichung Area	98	96	79	97	100			94
Tainan Area	100	103	77	98	115			98
Kaohsiung Area	96	100	74	102	103			97
East Taiwan Area	122	129	74	130	130		60	113

Table 13. Percentage of Standard Allocation Purchased by Farmers (A) Compared to Percentage of Standard Allocation Applied (B), 1954 Second Rice Crop

Locality	Percentage (A)	Percentage (B)						
		Ammonium sulphate	Calcium cyanamide	Calcium superphosphate	Potassium chloride	Mixed fertilizer	Fused phosphate	Total
WHOLE PROVINCE	94	94	119	100	102	81	90	97
Taipei Area	87	78		76	80	81		79
Hsinchu Area	98	86		112	98			92
Taichung Area	102	103	105	112	116			107
Tainan Area	92	99	99	94	100			98
Kaohsiung Area	88	87		101	101			92
East Taiwan Area	112	110		116	111		86	112

Table 14-a. Fertilizers Applied as Basic Dressing and Top Dressing, 1954 Second Rice Crop

Unit: %

Locality	Ammonium sulphate		Calcium cyanamide		Calcium superphosphate		Potassium chloride		Mixed fertilizer		Fused phosphate	
	Basic	Top	Basic	Top	Basic	Top	Basic	Top	Basic	Top	Basic	Top
WHOLE PROVINCE	14	86	96	4	27	73	30	70	86	14	82	18
Taipei Area	18	82	97	3	31	69	29	71				
Yilan Hsien	2	98	88	12	3	97	2	98				
Taipei Hsien	27	73	100	—	47	53	44	56				
Yangmingshan Adm.	1	99	100	—	40	60	25	75				
Taipei City	43	57	100	—	47	53	61	39				
Keelung City												
Hsinchu Area	20	80	99	1	36	64	40	60	86	14	86	14
Taoyuan Hsien	27	73	100	—	40	60	48	52	90	10	75	25
Hsinchu Hsien	16	84	96	4	40	60	34	66	94	6	100	—
Miaoli Hsien	16	84	100	—	28	72	36	64	76	24	100	—
Taichung Area	15	85	95	5	23	77	36	64				
Taichung Hsien	20	80	98	2	37	63	42	58				
Changhua Hsien	14	86	93	7	29	71	37	63				
Nantou Hsien	6	94	98	2	9	91	14	86				
Taichung City	40	60	100	—	45	55	15	85				
Tainan Area	9	91	97	3	17	83	17	83				
Yunlin Hsien	11	89	100	—	19	81	23	77				
Chiayi Hsien	9	91	86	14	15	85	12	88				
Tainan Hsien	8	92	100	—	17	83	16	84				
Tainan City	51	49	100	—	95	5	100	—				
Kaohsiung Area	14	86	100	—	34	66	34	66				
Kaohsiung Hsien	15	85	100	—	36	64	43	57				
Pingtung Hsien	14	86	100	—	31	69	28	72				
Kaohsiung City	29	71			81	19	88	12				
East Taiwan Area	4	96	97	3	12	88	20	80			82	18
Taitung Hsien	6	94	100	—	6	94	14	86			86	14
Hualien Hsien	4	96	96	4	16	84	23	77			79	21

Table 14—b. N—P—K Applied as Basic Dressing and Top Dressing, 1954 Second Rice Crop

Unit: %

Locality	N		P_2O_5		K_2O	
	Basic dressing	Top dressing	Basic dressing	Top dressing	Basic dressing	Top dressing
WHOLE PROVINCE	19	81	31	69	30	70
Taipei Area	19	81	31	69	29	71
Yilan Hsien	3	97	3	97	2	98
Taipei Hsien	30	70	47	53	44	56
Yangmingshan Adm.	2	98	40	60	25	75
Taipei City	44	56	47	53	61	39
Keelung City						
Hsinchu Area	26	74	49	51	40	60
Taoyuan Hsien	33	67	51	49	48	52
Hsinchu Hsien	25	75	56	44	34	66
Miaoli Hsien	21	79	40	60	36	64
Taichung Area	24	76	23	77	36	64
Taichung Hsien	28	72	37	63	42	58
Changhua Hsien	22	78	29	71	37	63
Nantou Hsien	19	81	9	91	14	86
Taichung City	47	53	45	55	15	85
Tainan Area	15	85	17	83	17	83
Yunlin Hsien	13	87	19	81	23	77
Chiayi Hsien	11	89	15	85	12	88
Tainan Hsien	16	84	17	83	16	84
Tainan City	60	40	95	5	100	—
Kaohsiung Area	14	86	34	66	34	66
Kaohsiung Hsien	15	85	36	64	43	57
Pingtung Hsien	15	85	31	69	28	72
Kaohsiung City	29	71	81	19	88	12
East Taiwan Area	8	92	37	63	20	80
Taitung Hsien	10	90	37	63	14	86
Hualien Hsien	7	93	36	64	23	77

Table 15. Types and Quantities of Farm-Supplied Manures Applied on the 1954 Second Rice Crop

Unit: kg/ha

Locality	Compost and stable manure	Green manure	Nightsoil	Grass/wood ashes	Others *	Total
WHOLE PROVINCE	4,142	2,400	836	119	38	7,535
Taipei Area	3,280	118	1,911	203	21	5,533
Yilan Hsien	2,371	8	410	385	—	3,174
Taipei Hsien	3,969	201	2,906	93	36	7,205
Yangmingshan Adm.	2,442	—	1,092	63	—	3,597
Taipei City	2,100	—	3,762	148	—	6,010
Hsinchu Area	3,995	1,547	1,769	213	54	7,578
Taoyuan Hsien	3,637	539	2,328	286	1	6,791
Hsinchu Hsien	4,216	1,959	1,632	169	223	8,199
Miaoli Hsien	4,462	2,998	901	118	20	8,499
Taichung Area	5,678	875	621	173	22	7,369
Taichung Hsien	6,056	553	1,300	223	30	8,162
Changhua Hsien	5,495	1,085	233	126	20	6,959
Nantou Hsien	5,555	753	559	299	—	7,166
Taichung City	1,024	317	300	5	—	1,646
Tainan Area	4,056	4,101	192	42	76	8,467
Yunlin Hsien	4,104	5,031	233	44	53	9,465
Chiayi Hsien	4,123	3,098	167	17	268	7,673
Tainan Hsien	4,008	4,301	192	55	—	8,556
Tainan City	2,931	2,765	—	—	—	5,696
Kaohsiung Area	3,316	4,765	668	50	—	8,799
Kaohsiung Hsien	4,443	1,766	679	44	—	6,932
Pingtung Hsien	2,504	6,973	636	55	—	10,168
Kaohsiung City	3,330	1,110	2,567	—	—	7,007
East Taiwan Area	3,521	558	235	36	—	4,350
Taitung Hsien	3,647	690	96	5	—	4,438
Hualien Hsien	3,425	121	333	58	—	3,937

* Includes poultry excreta, soybean and peanut cakes, silkworm dung, feathers, bonemeal, tobacco dust, hog bristles, pond sediment, etc.

Table 16. Element Content of the Farm-Supplied Manures Applied on the 1954 Second Rice Crop

Unit: kg/ha

Locality	N	P_2O_5	K_2O
WHOLE PROVINCE	36	20	37
Taipei Area	27	17	28
Yilan Hsien	14	15	26
Taipei Hsien	36	19	31
Yangmingshan Administration	18	11	17
Taipei City	30	14	24
Hsinchu Area	36	21	38
Taoyuan Hsien	33	20	36
Hsinchu Hsien	38	21	39
Miaoli Hsien	41	22	41
Taichung Area	36	24	39
Taichung Hsien	39	27	43
Changhua Hsien	34	23	38
Nantou Hsien	34	26	42
Taichung City	8	7	7
Tainan Area	40	19	40
Yunlin Hsien	45	20	44
Chiayi Hsien	35	18	35
Tainan Hsien	40	19	41
Tainan City	27	13	27
Kaohsiung Area	41	18	40
Kaohsiung Hsien	34	19	33
Pingtung Hsien	47	17	46
Kaohsiung City	35	15	27
East Taiwan Area	21	14	22
Taitung Hsien	22	14	22
Hualien Hsien	19	13	20

Table 17. Sources of N-P-K Applied on the 1954 Second Rice Crop

Locality	N			P_2O_5			K_2O		
	Total quantity (kg/ha)	Chemical fertilizers (%)	Farm-supplied manures (%)	Total quantity (kg/ha)	Chemical fertilizers (%)	Farm-supplied manures (%)	Total quantity (kg/ha)	Chemical fertilizers (%)	Farm-supplied manures (%)
WHOLE PROVINCE	118	69	31	47	57	43	52	29	71
Taipei Area	89	70	30	35	51	49	40	30	70
Yilan Hsien	75	81	19	35	57	43	37	30	70
Taipei Hsien	99	64	36	36	47	53	43	28	72
Yangmingshan Adm.	107	83	17	30	63	37	34	50	50
Taipei City	80	63	37	29	52	48	34	29	71
Hsinchu Area	109	67	33	49	57	43	53	28	72
Taoyuan Hsien	103	68	32	53	62	38	52	31	69
Hsinchu Hsien	109	65	35	41	49	51	52	25	75
Miaoli Hsien	120	66	34	49	55	45	55	25	75
Taichung Area	133	73	27	57	58	42	57	32	68
Taichung Hsien	134	71	29	59	54	46	59	27	73
Changhua Hsien	138	75	25	59	61	39	57	33	67
Nantou Hsien	99	66	34	48	46	54	56	25	75
Taichung City	104	92	8	41	83	17	23	70	30
Tainan Area	127	69	31	46	59	41	54	26	74
Yunlin Hsien	158	72	28	58	66	34	63	30	70
Chiayi Hsien	120	71	29	46	61	39	49	29	71
Tainan Hsien	123	67	33	43	56	44	53	23	77
Tainan City	136	80	20	52	75	25	37	27	73
Kaohsiung Area	115	64	36	45	60	40	55	27	73
Kaohsiung Hsien	109	69	31	47	60	40	47	30	70
Pingtung Hsien	120	61	39	44	61	39	62	26	74
Kaohsiung City	85	59	41	31	52	48	36	25	75
East Taiwan Area	112	81	19	36	61	39	39	44	56
Taitung Hsien	121	82	18	37	62	38	40	45	55
Hualien Hsien	105	82	18	35	63	37	36	44	56

Table 18. Use of Fertilizers and Manures on Rice in Taiwan, 1952

	N		P_2O_5		K_2O	
	kg/ha	%	kg/ha	%	kg/ha	%
First crop:						
Total	109	100	50	100	54	100
Chemical fertilizers	65	60	24	48	10	18
Farm-supplied manures	44	40	26	52	44	82
Second crop:						
Total	101	100	44	100	45	100
Chemical fertilizers	66	65	24	55	10	22
Farm-supplied manures	35	35	20	45	35	78

Table 19. Yields of Rice (Brown) Reported by the Surveyees (A) and the Official Yields Announced by Taiwan Provincial Food Bureau (B)

Locality	1954 first crop			1954 second crop		
	A		B	A		B
	Ponlai variety	Chailai variety	Ponlai and Chailai combined	Ponlai variety	Chailai variety	Ponlai and Chailai combined
WHOLE PROVINCE	2,799	2,397	2,365	2,198	2,039	2,030
Taipei Area	2,182	2,136	2,139	2,089	1,802	1,812
Hsinchu Area	2,224	2,023	1,863	1,891	1,653	1,727
Taichung Area	3,277	2,984	2,895	2,564	2,278	2,426
Tainan Area	3,043	2,063	2,088	2,550	2,001	1,984
Kaohsiung Area	3,021	2,460	2,742	2,144	1,687	1,976
East Taiwan Area	2,616	2,148	1,812	2,031	1,523	1,671

Table 20. Adjusted Yields of Rice (Brown) Reported by the Surveyees Compared with Official Yields Announced by Taiwan Provincial Food Bureau (PFB)

Locality	First crop				Second crop			
	Surveyees'		PFB's		Surveyees'		PFB's	
	Yield 1/ (kg/ha)	Index	Yield (kg/ha)	Index	Yield 1/ (kg/ha)	Index	Yield (kg/ha)	Index
WHOLE PROVINCE	2,626	111	2,365	100	2,155	106	2,030	100
Taipei Area	2,159	101	2,139	100	1,953	108	1,812	100
Hsinchu Area	2,168	116	1,863	100	1,868	108	1,727	100
Taichung Area	3,086	107	2,895	100	2,388	98.4	2,426	100
Tainan Area	2,571	123	2,088	100	2,311	116	1,984	100
Kaohsiung Area	2,947	107	2,742	100	1,945	98.4	1,976	100
East Taiwan Area	2,430	134	1,812	100	1,925	115	1,671	100

1/ Ponlai and Chailai varieties combined in proportion to their respective acreages in the various areas (see Table 21).

Table 21. Acreages of Ponlai and Chailai Rice, 1954 First and Second Crops

Unit: ha.

Locality	First crop		Second crop	
	Ponlai	Chailai	Ponlai	Chailai
WHOLE PROVINCE	186,949	141,068	201,918	183,140
Taipei Area	24,263	25,285	30,513	13,443
Hsinchu Area	54,259	20,972	43,852	4,572
Taichung Area	33,827	63,817	38,855	62,371
Tainan Area	19,051	17,734	39,771	71,260
Kaohsiung Area	45,968	6,936	37,198	28,412
East Taiwan Area	9,581	6,324	11,729	3,082

Table 22. Quantities of Paddy Rice Required to Barter for Chemical Fertilizers (A), the Percentage These Quantities Occupy of the Total Rice Yield (B), and the Balance of Rice Remaining in Farmers' Hands after Barter(C) 1/

Locality	1954 first crop					1954 second crop				
	A	B		C		A	B		C	
	(kg/ha)	Ponlai (%)	Chailai (%)	Ponlai (kg/ha)	Chailai (kg/ha)	(kg/ha)	Ponlai (%)	Chailai (%)	Ponlai (kg/ha)	Chailai (kg/ha)
WHOLE PROVINCE	514	14.2	16.2	3,097	2,661	491	17.3	18.2	2,345	2,209
Taipei Area	362	12.9	12.8	2,453	2,467	370	13.7	15.5	2,325	2,017
Hsinchu Area	469	16.3	17.5	2,401	2,210	450	18.4	20.6	1,990	1,738
Taichung Area	548	13.0	13.9	3,681	3,404	581	17.6	19.3	2,728	2,436
Tainan Area	529	13.5	19.4	3,398	2,204	512	15.6	19.3	2,779	2,138
Kaohsiung Area	584	15.0	17.9	3,314	2,673	454	16.4	20.3	2,313	1,781
East Taiwan Area	540	16.0	19.0	2,835	2,305	534	20.4	26.5	2,086	1,483

1/ The present barter ratios for different fertilizers are as follows:

Fertilizer	Barter ratio * (unit of fertilizer : unit of paddy (rough) rice)
Ammonium sulphate (20—0—0)	1.0 : 1.0
Ammonium sulphate nitrate (26—0—0)	1.0 : 1.2
Calcium cyanamide (20—0—0)	1.0 : 0.9
Ammonium phosphate (16—20—0)	1.0 : 1.4
Calcium superphosphate (0—18—0)	1.0 : 0.4
Fused phosphate (0—18—0)	1.0 : 0.4
Mixed fertilizer (8.3—10.5—0)	1.0 : 0.6
Potassium chloride (0—0—50)	1.0 : 0.9

* Ratios are based on Ponlai variety of rice. If Chailai rather than Ponlai rice is bartered, three (3) per cent more is required. Table 22 assumes payment in Ponlai only.

Appendix 1.

Interviewer:_____

Investigation on Fertilizer

(For paddy rice)

Organization:_____

Date of interview:_____

Name of farmer:_____ Address:_____

Acreage of field:_____ha. Acreage applied for fertilizer allocation:_____ha.

Average yield during first crop of this year: (1) Ponlai:_____kg of dry paddy per ha.

(2) Chailai:_____kg of dry paddy per ha.

Fertilizer application to first rice crop of 1954:

Type of fertilizer	(1) Too much	(2) Enough	(3) Too little	(4) Amount applied (kg)	(5) Basic manuring (%)	(6) Top dressing (%)	(7) Left-over from 2nd crop of previous year	(8) Left-over from 1st crop 1954	(9) Amount of fertilizers shifted to other crops
Ammonium sulphate									
Calcium cyanamide									
Calcium superphosphate									
Total									
Compost or barnyard manure									
Green manure (fresh)									
Nightsoil									
Total									

Note: 1. Use check mark "V" for columns (1), (2), and (3).
2. Columns (7), (8), and (9) refer to chemical fertilizers only.
3. Please give the most accurate figures for column (4), which is most important.
4. The names of other fertilizers used should be listed.

Appendix 2.

Investigation on Fertilizer Application on Intermediate and 2nd Paddy Rice Crop, 1954

Interviewer:_____

Organization:_____

Date of interview:_____

Name of farmer:_____ Address:_____

Acreage of arable land: Paddy field_____ha. Upland_____ha.

1954 intermediate crop: Cultivated acreage____ha, Acreage applied for rertilizer allocation____ha. Ratio 1 : ____(to be filled in by JCRR)

1954 second crop: Cultivated acreage____ha, Acreage applied for fertilizer allocation____ha. Ratio 1 : ____(to be filled in by JCRR)

Average yield per ha. of 1954 intermedate crop (weight of dry paddy): 1. Ponlai_____kg. 2. Chailai_____kg.

Average yield per ha. of 1954 second crop (weight of dry paddy): 1. Ponlai_____kg. 2. Chailai_____kg.

I. Requirement, availability and use of all chemical fertilizers (unit: kg.)

Items of investigation / Name of fertilizer	A. Opinion on the quantity of standard allocation			B. Status of actual receipt and application							C. Application method		
				Quantity available				Quantity applied					
	Too much (1)	Enough (2)	Too little (3)	From carry-over (4)	From deliveries for current crop (5)	From other sources (6)	Total (7)	Total quantity applied on current rice crop (8)	Quantity diverted to other crops (up to harvest time of 2nd crop) (9)	Total (10)	Carryover (at harvest time of 2nd crop) (11)	Average quantity applied per ha. (to be filled in by JCRR) (12)	Basic manure % (13)	Top dressing % (14)
A/S														
C/C														
C/SP														
P/C														
N-P M/F														
F/P														
A/S/N	X	X	X											
Urea														
Total														

II. Use of farm-supplied manures: (unit: kg.)

Name of manure	Total quantity applied (15)	Average quantity applied per ha. (to be filled in by JCRR) (16)	Name of manure	Total quantity applied (15)	Average quantity applied per ha. (to be filled in by JCRR) (16)	Name of manure	Total quantity applied (15)	Average quantity applied per ha. (to be filled in by JCRR) (16)
Compost and barn manures			Nightsoil					
Green manures			Grass/wood ashes					
						Total		

o Please turn over for explanation on how to fill in this from.

Explanations on how to fill in this form:

1. Period of interview: Commence interview as soon as the blank forms reach you, and conclude on or before February 20.
2. Objects of interview: Check paddy rice only, no upland rice. All farmers who cultivated 1954 intermediate and second paddy rice crops are the potential objects of the interview, regardless of whether they have taken delivery of chemical fertilizers for current crop or not. Farmers who took delivery of chemical fertilizers for current crop but did not cultivate paddy rice or suffered from crop failure due to drought or other reasons can also be interviewed.
3. The "Intermediate Crop" mentioned in this form means the particular rice crop grown in the Tainan and Kaohsiung Food Areas which is transplanted around June, and for which the fertilizer distribution is concluded at the end of the same month. These items need not be filled in outside the said areas.
4. Items (1), (2) and (3) in this form shall be designated with a "V" sign. For instance, if the farmer regards the allocation of A/S to be excessive, mark a "V" under item (1); in case he regards it to be insufficient, mark the sign under item (3).
5. Item (6). "Other sources" means fertilizers diverted from other crops and/or borrowed from other people and/or purchased from the market.
6. The standard allocation of fertilizers for the intermediate and second rice crops 1954 in all hsien/cities are recorded below for the interviewers' reference: Unit: kg/ha.

Intermediate crop — A/S 350, C/C 100, C/SP 170 and P/C 20 in all hsien/cites in the Tainan and Kaohsiung Food Areas without distribution. (Including Yunlin Hsien, Chiayi Hsien, Tainan Hsien, Tainan City, Kaohsiung Hsien, Pingtung Hsien and Kaohsiung City)

Second crop — As in the following table: Unit: kg.

Locality / Allocation / Fertilizer	Yilan Hsien	Yangmingshan Adm. and Taipei Hsien	Taipei & Keelung City	Hsinchu & Taoyuan Hsien	Miaoli Hsien	Taichung City, Taichung and Changhua Hsien	Nantou Hsien	Yunlin Hsien	Tainan City, Tainan and Chiayi Hsien	Kaohsiung City, Kaohsiung and Pingtung Hsien	Hualien & Taitung Hsien
A/S	370	400	350	370	420	420	350	470	420	420	400
C/C	—	—	—	—	—	50	50	—	—	—	—
C/SP	150	120	120	100	120	170	120	170	150	150	70
P/C	30	30	30	30	30	30	30	30	30	30	30
N—P M/F	—	—	—	80	80	—	—	—	—	—	—
F/P	—	—	—	—	—	—	—	—	—	—	50
A/S/N	(Distributed either as "tie—in" or as substitute, without any fixed quantity)										
Total	550	550	500	580	650	670	550	670	600	600	550