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THE RICE SEED MULTIPLICATION SYSTEM IN TAIWAN

By

The Plant Industry Division, JCRR

TAIPEI, TAIWAN, CHINA

JUNE, 1956

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Compiled

by

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The Joint Commission on Rural Reconstruction

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FOREWORD

The history of the program for rehabilitating the rice seed multiplication and distribution is as old as that of the whole JCRR program in Taiwan. In the spring of 1949, when the Headquarters of JCRR was still in Canton, Kwangtung Province of Mainland China, the undersigned, then a senior specialist of the Agricultural Improvement Division (now called Plant Industry Division), was delegated by Mr. Tien-ho Chien, then the Division Chief and since 1952 the Commissioner of JCRR, to Taiwan to find out facts on problems of Taiwan agriculture. After a month's stay and travelling in Taiwan, he returned to Canton and proposed that the following were among the most urgently needed measures to be taken up in the field of crop production in Taiwan: (1) the rehabilitation of the rice seed multiplication and distribution system, (2) the manufacture of crystal-violet vaccine for control of hog cholera, and (3) helping farmers to repair or reconstruct their compost shelters so they can make compost manure with rice straw and hog excreta. For stepping up rice production and hog raising and to improve the productivity of soil are very important. These three measures were among the very earliest batch of projects approved by the JCRR for the Taiwan program.

The Joint Commission has spent considerable time in studying the proper steps to be taken for rehabilitating the rice seed multiplication system in Taiwan. Dr. Raymond T. Moyer, then Commissioner of JCRR, later the chief of ECA China Mission and now Regional Director for the Far East, ICA/Washington, personally spent a great deal of time and thoughts on this problem. The emphasis placed by the Joint Commission on this program can be illustrated by the fact that it invited Dr. H. H. Love, world known plant breeder, to visit Taiwan in 1949, especially to advise on the rice seed multiplication system. Before he left, Dr. Love prepared a report on the subject entitled "A Seed Multiplication Program - Some General Consideration", which was later on frequently referred to by the JCRR specialists.

When the program for rehabilitating the rice multiplication system in Taiwan was started, Messrs. Y. K. King and Peter Kung, then both senior specialists of the Agricultural Improvement Division, were placed in charge of the program under the direction of Mr. Tien-ho Chien. Beginning 1951, as programs for other crops had developed, Mr. King took up the work on the upland food crops, such as sweet potato, peanuts, soybean, wheat, etc. until he became the Commissioner

of the Provincial Department of Agriculture and Forestry in 1955. Mr. Peter Kung alone took up the rice program of JCRR since 1951, undr the direction of Mr. Tien-ho Chien at first, and later of Dr. Paul Ma who succeeded Mr. Chien as the Chief of the Plant Industry Division in 1952.

It was mainly when Mr. Peter Kung was in charge of the Program under the direction of Dr. Paul Ma that it grew to its final pattern as described in this pamphlet. When Dr. Ma became the Dean of Agricultural College of the National Taiwan University on January 1, 1955, the undersigned was appointed to succeed him as the Chief of the Plant Industry Division. Mr. Peter Kung, in the meantime, was appointed to succeed the undersigned as the Executive Secretary of Committee D, Economic Stabilization Board. Because of Mr. Kung's wide experience in promoting the rice seed improvement program, he was requested to remain concurrently as the senior specialist of the Plant Industry Division. The author of this pamphlet, Mr. H. S. Chang, was invited to join our staff in May 1955 to help, among other work, administer the rice projects under Mr. Kung's general advice.

1955 is a fateful year for the rice seed multiplication system in Taiwan. After seven years of continuous subsidy, cumulatively to a total sum of nearly NT$7,000,000, the program has reached a stage where JCRR believes that further assistance to the rice extension seed farms should be the responsibility of the local government or people. Further JCRR assistance to the system will be limited to technical or educational assistance rendered through the local extension system. Furthermore, important changes have been made by the Provincial Department of Agriculture and Forestry in 1955/1956 in rice seed multiplication itself. The two most important changes are: (1) Rice extension seed farms smaller than 0.5 hectare will be dropped, in order to consolidate the extension seed farms for more efficient management and supervision. (2) Varieties to be multiplied by rice foundation seed farms at various District Agricultural Improvement Stations must be approved by a committee of specialists convened by the Provincial Department of Agriculture and Forestry semi-annually. This means that the stock seeds and extension seeds multiplied in each year will eventually also be placed under more close supervision of the Provincial Department.

After seven years of continuous assistance from JCRR, the rice seed multiplication and distribution system in Taiwan is by now fairly well rehabilitated. Not only does it have important bearing on the rice production, but it also has the effect of familiarizing many farmers with the concept of seed farms and seed

renewal so that they are becoming more receptive toward the improved seeds of other crops.

This report, as compiled by Mr. H. S. Chang, represents an analytical account of the program for strengthening the rice seed multiplication system of the past seven years. It is sincerely hoped that the system will continue to flourish and improve under the full direction and supervision of the various levels of offices of our Government.

H. T. Chang
Chief
Plant Industry Division

June, 1956

The Rice Seed Multiplication System In Taiwan

I. Introduction

Rice is the most important crop in Taiwan, as it is the main food crop as well as one of the leading earners of foreign exchange. During the Period of Japanese occupation, many improved rice varieties, commercially called the Ponlai rice (Japonica type), were developed; and an effective rice seed multiplication and distribution system was established.

After the restoration of Taiwan to China, due to the long negligence during war time, many of the equipment and facilities needed for rice seed multiplication, i. e. seed storage, drying ground, compost houses, etc. were found dilapidated. This was also due to the lack of supervision during war time and therefore the management of seed farms was in very bad shape. Consequently the seed renewal system was not practised by most of the farmers. The seed multiplication system as carried out by Japanese authorities in pre-war days was largerly abandoned. In 1945, the total acreage of rice crop in Taiwan dropped to 502,019 ha. and the total production of brown rice to 638,828 m/t (the highest record in pre-war period was 625,398 ha. and 1,402,414 kg. respectively in 1938). The unit area productioin was also decreased to 1,273 kg/ha., which was the lowest record of unit production of rice crop in Taiwan since 1934. Compared with the pre-war highest record 2,242 kg/ha., the reduction in yield amounted to 54.45%.

II. The Importance of Rice Seed Renewal in Taiwan

The natural cross between different varieties of rice, though at low percentage, cannot be completely avoided. According to the report by Szuzuda and Tomoula, the percentage of natural cross pollination between varieties in Taiwan may range from 0.9 to 1.45 percent. Besides natural crossing, the raising of two or more varieties on the same farm or on the same seedbed, being commonly practised in Taiwan by rice growers, provides ample opportunity for mechanical mixture of seeds of different varieties during sowing, transplanting, harvesting, threshing, drying and also in storage. Finally, the natural segregation of some of the rice varieties under cultivation also results in increasing the off-types in paddy field. Because of the above phenomena, timely seed renewal is considered necessary for maintaining the purity of rice seeds.

III. The Rice Seed Multiplication and Renewal System in Taiwan

A. Ponlai rice (Japonica type)

Ponlai rice is the most important rice group in Taiwan. It has the following advantages over the Native rice varieties (Indica type):

1. It has better quality.
2. Its yield is higher than Native rice by 10-20%.
3. It requires a shorter growth period.
④ The same variety of Ponlai rice can be planted and harvested in the first as well as in the second crop. This is beneficial on account of its shorter period required both in breeding and in seed multiplication.
5. It has greater demand on the foreign market.

However, the Native rice also has the following advantages over the Ponlai rice:

1. It grows better than Ponlai varieties in poorly irrigated area.
2. It can tolerate better poorer soils or shortage of fertilizer.
3. It is more resistant to insect pests and diseases.
4. It generally thrives better in poorly managed farms.

The multiplication system of Ponlai rice seeds in Taiwan is established at three levels, viz. the foundation seeds, the stock seeds and the extension seeds. In the foundation seed farm, utmost care is taken in field management so that the plants are absolutely pure and true to the variety characteristics. In order to facilitate observation and operation, single plant per hill method is practised. Besides, rice should be transplanted in straight rows with regular distances between rows and hills. Any off-types or plants in question are rogued. In view of the strict technics that must be followed, the foundation seed farms are operated only by the Taiwan Agricultural Research Institute and the seven District Agricultural Improvement Stations located in various places in Taiwan. The expected yield of foundation seed farm is no less than 1,500 kg. of paddy per hectare. As the purpose of seed farm is to produce quality seeds, its yield is of less concern. Since the foundation seed farm is managed with utmost care and many roguings will be practised to remove the off-types and the number of plants is less in foundation seed farm (single plant instead of five to seven plants per hill) than ordinary farm, the expected amount of seeds to be produced is therefore set at a rather low level.

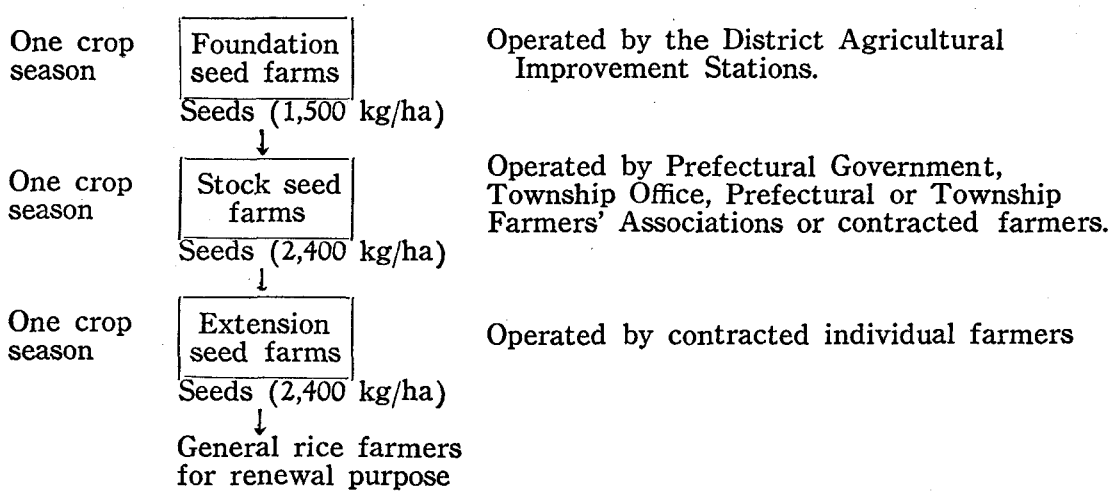
The stock seed farm constitutes the second level of the system. The foundation seeds produced from the District Agricultural Improvement Stations are to be used only by the stock seed farms. As the rate of seeding in Taiwan for Ponlai rice is 60 kg. of seeds for one hectare, the 1,500 kg. of seeds produced from each hectare of foundation seed farm is enough to supply 25 ha. of stock seed farms.

Thus, the number of stock seed farms is much more than the foundation seed farms. The operation of stock seed farm is similar to that of the foundation seed farm except that it has 4-6 plants (averaging 5 plants) per hill instead of single plant per hill. The stock seed farm is usually operated by the Prefectural/ Municipal Government, Township Office, Prefectural or Township Farmers' Associations or contracted farmers.

The third level of the seed multiplication system is the extension seed farm which receives the pure seeds from stock seed farm. Extension seed farm is generally operated by contracted farmers. Seeds produced from the extension seed farm will be used for extension to farmers for seed renewal and will be exchanged with seeds from general rice farmers. The expected yield of the stock seed farm as well as the extension seed farm is 2,400 kg. of paddy per hectare. Under the normal rate of seeding, each hectare of stock seed farm will be enough to supply seeds to 40 hectares of extension seed farm. In turn, the seeds produced in one hectare of extension seed farm will be enough to renew 40 hectares of paddy field of general farmers. Thus, one hectare of foundation seed farm, through the three level system, is enough to renew 40,000 ha. of rice paddy. The formula is as follows:

$$1 \text{ ha.} \times 25 \times 40 \times 40 = 40{,}000 \text{ ha.}$$

A diagram showing the seed multiplication system of Ponlai rice is presented hereunder:



Under this three-level multiplication system, pure seeds will be multiplied thrice before they reach the hands of general farmers. With Ponlai rice varieties which is capable of being planted both in the first and the second crops, if a new variety proves satisfactory and is ready to be introduced for multiplication, three crop seasons or one and half year would be required before the extension seed

reaches the rice farmers.

B. Native (Indica type) and Upland rice

The seed multiplication system on Native and Upland rice also has three levels. Since not much breeding work on Native and Upland rice was done in the past, no foundation seed farm was established. Instead, the mass selection method is being used. Rice plants showing typical varietal characteristics will be selected for seed collection. Seeds obtained from mass selection of certain promising local varieties will be multiplied in the so-called primary seed farm. The third level of this system is the secondary seed farm which receives the seeds multiplied from the primary seed farm. Seeds produced from the secondary seed farm are used for general extension to farmers for seed renewal. The following diagram shows the gists of the multiplication system for the Native and Upland rice varieties:

Mass selection	Operated by Prefectural/Municipal Government, or District Station.
↓	
Primary seed farm	Operated by Prefectural/Municipal Government, Prefectural Farmers' Association or contracted farmers.
↓	
Secondary seed farm	Operated by contracted farmers.

The expected yield of native rice in the primary seed farm and the secondary seed farm is 1,500 kg/ha. and 2,000 kg/ha. respectively. For Upland rice, the yield of both the primary seed farm and the secondary seed farm is expected to reach 1,000 kg/ha. The rate of seeding for both Native rice and Upland rice is 50 kg. for each hectare. Therefore, one hectare of primary seed farm of Native rice could in three steps eventually produce extension seeds enough for renewing 1,200 ha. of paddy field; and one hectare of primary seed farm of Upland rice could produce seeds enough to renew 400 ha. of farmers' rice field. Three years would be required to complete the whole procedure in seed multiplication.

IV. JCRR's Participation in Rice Seed Multiplication and Renewal System

In 1949, JCRR started to give assistance in rehabilitating the seed multiplication and renewal system in Taiwan. Assistance from JCRR was firstly directed to the multiplication of Ponlai rice seeds and then of the Native rice and finally of the Upland rice. The JCRR assistance has been extended in the following manners:

A. Subsidies to both the foundation and stock seed farms

Funds were provided continuously by JCRR as cash subsidies to both the foundation and stock seed farms for buying the necessary farm implements, tools, fertilizers, etc. and for hiring farm hands to help attending the seed farms.

B. Funds for supervision

As the different levels of seed farms need supervision from time to time by technicians from the provincial, prefectural, and township governments, so JCRR has also allocated fund for defraying travelling expenses with the result that the supervisory work has been carried out rather smoothly without being hindered by financial trouble.

C. Funds for purchasing stock seeds

Meanwhile, grants were given by JCRR to purchase the seeds produced from the second level (either stock seed farm or primary seed farm) and then given it free of charge to the third level (the extension seed farm or the secondary seed farm). The foundation seeds were given free of charge to the stock seed farm. The stock seeds were purchased and then given free of charge to the extension seed farm. The extension seeds produced were exchanged with general farmers either at par or at a premium not exceeding 20% depending on the quality of extension seeds, the enthusiasm of general rice farmers, etc.

D. Contests of seed farm management

Except for free stock seeds, there was no cash subsidy of any kind given to the extension seed growers. For strengthening the seed multiplication and renewal system, contests on the farm management were conducted and prizes supplied by JCRR were awarded to the winners for encouragement.

In addition to these, publications and pamphlets issued by JCRR were also given to the seed farm operators free of charge for education purposes. All these approaches gave material support as well as spiritual encouragement to the seed growers. The JCRR subsidies mentioned above, however, were provided on a diminishing scale with the passing of each year, until in 1956, JCRR has completely stopped subsidizing for such purposes. The funds needed are now completely taken up by the Provincial Department of Agriculture and Forestry (PDAF) and the Prefectural and Township Governments.

E. Funds for strengthening physical facilities needed for rice seed multiplication

1. Drying ground

In the southern part of Taiwan, there are frequent rains during the harvest of the first rice crop, while in the north, the weather is rainy during the harvest period of the second rice crop. According to the estimation made by PDAF in many localities, the excessive rainfall may cause as much damage as 5-10 percent of the total production in the first rice crop in some areas, especially in Pingtung, Kaohsiung and Ilan. In view of such heavy losses, JCRR has made grants, since 1951, to help the seed farm operators to construct cement drying grounds to facilitate the drying of rice seeds. The plan for constructing cement drying grounds was on a cooperative basis. The cement required was given to farmers as a grant at a rate of one and half bags for each tsubo (equivalent to 3.3 sq. meters). The maximum amount of cement subsidy was 30 bags for a drying ground of 20 tsubo (or 66 sq. meters). The sand, gravel and labor needed were provided by the farmers. Under such cooperative arrangement, a total of 3,300 applicants were selected out of 5,257 seed farm operators (mostly extension seed growers and a small portion of stock seed growers) to construct cement drying grounds in 1951. Again in 1952, another lot of 2,810 drying grounds were constructed for seed farm growers with JCRR assistance.

After completion of these drying grounds, not only the damages caused by excessive rainfall could be greatly minimized but the purity of rice seeds could also be improved considerably. According to the estimation made by the Provincial Department of Agriculture and Forestry, each piece of drying ground can be used by 5-10 neighboring families besides the seed grower himself. Consequently a total of 30,550 to 61,100 farm families would benefit under this program.

The drying grounds constructed as mentioned above are exclusively for Ponlai rice seed growers, either of extension seed farmers or of stock seed farmers. After the improvement work on Native and Upland rice was started in 1951, JCRR again subsidized the construction of 56 drying grounds with a total area of 1,200 tsubo in 12 Prefectures in 1953.

Besides rice seed growers, JCRR assistance had also been given to some agricultural experiment stations and farmers' associations for the construction of drying grounds, as a part of the support to the seed multiplication and renewing system (Table 1).

Table 1.

Prefecture/ Municipality	No. of drying grounds constructed by				No. of drying grounds repaired by FAs or Experiment Stations	Total
	Ponlai seed growers	Native or Upland rice seed growers	Experiment Stations	Farmers' Associations		
1. Taipei Prefecture	446				1	447
2. Ilan Prefecture	325		1	1		327
3. Taipei Municipality	45					45
4. Keelung Municipality	14					14
5. Yangmingshan Adm.	69					69
6. Taoyuan Prefecture	792					792
7. Hsinchu Prefecture	360	4			1	365
8. Miaoli Prefecture	449	6		2		457
9. Taichung Prefecture	338	4			2	344
10. Changhua Prefecture	561	7			3	571
11. Nantou Prefecture	155	2				157
12. Taichung Municipality	125					125
13. Yunlin Prefecture	552	3				555
14. Chiayi Prefecture	307	17				324
15. Chiayi City					1	1
16. Tainan Prefecture	306	6			1	313
17. Tainan Municipality	14	2				16
18. Kaohsiung Prefecture	399	1		1	1	402
19. Pingtung Prefecture	500					500
20. Pingtung City					1	1
21. Kaohsiung Municipality	81					81
22. Taitung Prefecture	128	2	1			131
23. Hualien Prefecture	144	2				146
Total:	6,110	56	2	4	11	6,183

Data based on the results of JCRR projects TW-A-99, -205, -343, -169, -240, 274, -474 and -40. Under another JCRR supported program, assistance is also given to general rice farmers (not seed growers) for construction of cement drying ground.

A summary of the program for assisting the different levels of seed farms to construct and repair the cement drying ground is given in the following table (Table 2).

Table 2. Drying Grounds Constructed and Repaired under JCRR Assistance (1951 to 1955)

Beneficiary	No.	Area	Budget (NT$)		Total
			JCRR Appropriation	Local Contribution	
		(Tsubo)			
Extension and stock seed growers of Ponlai rice (farmers)	6,110	183,748.15	3,048,687.01	5,347,274.60	8,395,961.61
Seed growers of Native & Upland rice (farmers)	56	1,200.00	43,200.00	73,119.00	116,319.00
National Bureau of Agricultural Research	1	95.00	2,375.00	2,425.00	4,800.00
Taitung District Agricultural Improvement Station	1	126.00	12,000.00	—	12,000.00
Stock seed growers in Miaoli, Ilan & Kaohsiung (farmers' associations)	4	494.60	29,570.00	—	29,570.00
Stock seed growers in 11 localities (repaired)	11	2,010.00	25,168.00	22,632.00	47,800.00
Total:	6,183	187,673.75	3,161,000.01	5,445,450.60	8,606,450.61

2. Storage facilities

a. *Construction and repair of seed granaries:*

In order to improve the facilities for safe storage of the rice stock seeds, JCRR has assisted various seed farms in constructing or repairing of seed granaries.

Altogether 20 such seed granaries were improved with JCRR subsidies, among which 8 were newly constructed and 12 were repaired. Of the 8 newly constructed seed granaries, 3 belong to agricultural experiment stations, and 5 belong to stock seed farms of Ilan, Kaohsiung, Miaoli, Nantou and Changhua Prefectures operated by local farmers' associations. All of the 12 seed granaries being repaired belong to stock seed farms of 8 localities. The total increase in storage area, the amount of subsidies paid and their distribution are shown in Table 3.

Table 3. Seed Granaries Constructed and Repaired with JCRR Assistance (as of 1955)

Locality	Repaired			Constructed		
	Area (Tsubo)	No. of wooden bins installed	JCRR grant (NT$)	Area (Tsubo)	JCRR Appropriation (NT$)	Local Appropriation (NT$)
1. Taipei Prefecture	15.0	8	14,450			
2. Taipei Municipality (Dist. Sta.)	—	—	—	30.2	29,155	5,845
3. Ilan Prefecture (Toucheng)	—	—	—	30.0	9,900	41,900
4. Ilan Prefecture (NBAR)	—	—	—	21.0	55,000	—
5. Hsinchu Prefecture	15.0	8	14,450	—	—	—
6. Miaoli Prefecture	—	—	—	44.5 (2 granaries)	42,430	80,200
7. Nantou Prefecture	—	—	—	10.4	56,237	—
8. Taichung Prefecture	34.2	10	14,450	—	—	—
9. Taichung Municipality	15.0	10	14,450	—	—	—
10. Taichung Municipality	24.0	—	—	—	—	—
11. Changhua Prefecture (Hwatan)	10.0	—	—	—	—	—
12. Changhua Prefecture (Yuanlin)	20.0	5	7,238	—	—	—
13. Changhua Prefecture (Peitou)	10.0	—	—	—	—	—
14. Changhua Prefecture (Yuanlin)	50.0	—	11,000	—	—	—
15. Kaohsiung Prefecture	20.0	10	14,450	21.2	4,250	31,150
16. Chiayi City	30.0	8	14,450	—	—	—
17. Pingtung City	14.7	8	14,450	—	—	—
18. Hualien Prefecture (Dist. Sta.)	—	—	—	19.6	44,500	—
Total:	257.9	67	119,388	176.9	241,472	159,095

Data based on JCRR projects TW-A-40, -240, -274, -309, -343, -434, -455 and -484.

All the seed granaries constructed or repaired are regular type seed granaries either of wooden or brick walled construction, with or without wooden bins installed in it. These structures are comparatively larger in size and capacity as compared with the bowl-typed storage huts which are very popular among farmers in coastal areas of central and southern parts of Taiwan.

b. *Construction of bowl-typed seed storage huts:*

The Native rice varieties suitable for the first crop season are not interchangeable with those suitable for the second crop season, and vice versa. The Native rice seeds therefore have to be stored for at least six months before distributing to farmers. Also, the seeds of varieties for intermediate crop, which gorws only for one crop season in a year, must be kept for at least five or six months. In 1952, JCRR allocated funds to assist secondary seed growers of both Native rice and of intermediate crop of Ponlai rice, which were located mainly in Tainan, Chiayi and Yunlin Prefectures, to construct the small sized storage huts for proper seed storage. These storage huts are small in size, each having a capacity for storing 3,000 kg. of paddy rice, and can be erected outside the farmer's house without occupying too much area. They are rat-proof and rainproof and are much preferred in Tainan area, so the program resulted in providing the seed growers with storage which they are already familiar with; and was carried out rather successfully. Altogether 971 storage huts were erected in Yunlin, Chiayi, and Tainan area. These huts have a total capacity to store 2,913,000 kg. of paddy rice seeds. The total amount of fund spent on this project was NT$678,179.60, toward which JCRR contributed NT$406,299.60 while the balance NT$271,880.20 was appropriated by the local organizations including farmers themselves. The distribution of storage huts is shown in Table 4.

Table 4. Number of Bowl-typed Storage Huts Constructed (as of 1953)

Locality	No. of huts erected	JCRR contribution	Local contribution	Farmers appropriation	Total
		(NT$)	(NT$)	(NT$)	(NT$)
Yunlin Prefecture	318	128,600	—	89,040	217,640
Chiayi Prefecture	270	109,400	3,700	71,900	185,000
Tainan Prefecture	349	141,200	58,800	38,920	238,920
Tainan Municipality	34	13,800	5,100	4,420	23,320
Other project expenses		13,299.60			13,299.60
Total:	971	406,299.60	67,600	204,280	678,179.60

Data based on the results of JCRR project TW-A-262

c. *Provision of metal bins:*

Metal bins are preferred for the following advantages:-

(1) It is small and handy and may be easily and quickly installed.

(2) It is light in weight and movable.

(3) It is rat-proof.

(4) It keeps grains well for a considerable length of time.

(5) It suits well for the stock seed farm where smaller amount of seeds of several varieties are produced at the same time.

In supplementing the rice seed multiplication and renewal system in Taiwan some 783 metal bins were installed for stock seed growers of Ponlai, Native and Upland rice with JCRR assistance. Among the 783 installed, 84 bins were for Ponlai rice, 560 for Native rice and 139 for Upland rice seed growers. The total amount of JCRR funds spent on this project was NT$125,264.10. Table 5 shows the distribution of metal bins purchased for stock seed growers in different localities.

Table 5. Number of Metal Bins Installed for Stock Seed Farmers (1953)

Locality	Number of metal bins installed			Budget (NT$)
	Ponlai stock seed farms	Native rice stock seed farms	Upland rice stock seed farms	
1. Taipei Prefecture		32		5,119.40
2. Ilan Prefecture		53		8,478.90
3. Tiapei Municipality		2		319.90
4. Keelung Municipality		2		319.90
5. Yangmingshan Adm.		2		319.90
6. Taoyuan Prefecture	72	20		14,718.20
7. Hsinchu Prefecture		19		3,039.60
8. Miaoli Prefecture		28		4,479.40
9. Taichung Prefecture		67		10,718.70
10. Changhua Prefecture		132		21,117.40
11. Nantou Prefecture		40		6,399.20
12. Taichung Municipality		19		3,039.60
13. Chiayi Prefecture			20	3,199.60
14. Tainan Prefecture			80	12,798.40
15. Kaohsiung Prefecture		54	39	14,878.10
16. Pingtung Prefecture		59		9,438.80
17. Kaohsiung Municipality	12	8		3,199.60
18. Taitung Prefecture		8		1,279.80
19. Hualien Prefecture		15		2,399.70
Total:	84	560	139	125,264.10

Data based on the results of JCRR project TW-A-343.

3. Construction of compost house

In addition to furnish drying and storage facilities, PDAF and JCRR further helped the rice seed growers to build compost houses so that good compost manure may be produced to help keep up the productivity of the seed farms. During 1950 to 1955, 11 compost houses were constructed and 2 compost houses were repaired, with a total floor space of 237.4 tsubo (783.4 sq. m.). The amount of compost manure that can possibly be made therein is estimated from 1,990,800 to 2,280,800 kg. annually. The total JCRR and local appropriation for this program were NT$197,953.40 and NT$1,294.54 respectively (see Table 6).

Table 6. Number of Compost House Constructed and Repaired for Rice Foundation or Stock Seed Farms

Locality	Beneficiary	No.	Area	Total budget		Estimated am't of compost manure made annually
				JCRR contribution	Local appropriation	
			(Tsubo)	(NT$)	(NT$)	(kg.)
Kaohsiung Prefecture	Stock seed farm	1	13.2	21,400.00	—	120,000
Changhua Prefecture	Peidou FA	1	17.5	11,821.90	—	120,000-185,000
Changhua Prefecture	Hwatan FA	1	17.5	11,821.90	—	120,000-185,000
Taichung Municipality	Dist. Station	1	16.0	13,281.40	—	120,000-180,000
Hsinchu Prefecture	Dist. Station	1	24.0	16,560.00	—	217,000
Chiayi City	Dist. Station	1	24.3	19,878.20	—	220,000
Ilan Prefecture	NBAR	1	9.8	9,917.00	788.64	75,000-100,000
Taitung Prefecture	Dist. Station	1	9.8	14,420.00	410.00	75,000-100,000
Kaohsiung Prefecture	Dist. Station	1	15.7	13,260.00	—	147,800
Hualien Prefecture	Dist. Station	1	20.0	26,840.00	—	150,000-200,000
Changhua Prefecture	FA stock seed farm	1	13.5	20,000.00	95.90	120,000
Chiayi City	Stock seed farm	2 (repaired)	56.1	18,753.00	—	506,000
Total:		13	237.4	197,953.40	1,294.54	1,990,800-2,280,800

Data based on results of JCRR projects TW-A-83, -115, -150, -162, 234, -239, -274, -288, and -484.

4. Provision of bicycles

As the seed multiplication and renewal program must be operated on an island-wide basis, the number of extension seed farms runs to over 6,000. The supervisory work expanded with the advancement of the seed multiplication program. Agricultural personnel in all levels of government organizations gradually felt the pressing need for better means of transportation for making calls on seed growers and general farmers. The appropriation of funds for travelling expenses made by JCRR to the different levels of government technicians could only solve the problem temporarily. Since the local government was in short of budgetary funds, JCRR appropriated funds for purchasing bicycles once and for all for the use of the agricultural workers of the township public offices. In 1952, 303 bicycles were bought with JCRR's assistance and were allocated through PDAF to township offices of different Prefectures and Municipalities. In some aboriginal township offices, transportation by bicycle in some area is not possible, and rainfall is frequent so raincoats and rubber boots were supplied to facilitate the agricultural workers to make field trips and to conduct supervisory work. Table 7 indicates the budget and the allocation of bicycles.

Table 7. Number of Bicycles Allocated to Agricultural Extension Workers in Charge of Rice Seed Program in Township Public Offices of Different Prefectures and Municipalities (1952)

Locality	No. of bicycles allocated	Total budget
		(NT$)
Taipei Prefecture	30	24,000
Ilan Prefecture	10	8,000
Taipei Municipality	6	4,800
Keelung Municipality	4	3,200
Yangmingshan Adm.	2	1,600
Taoyuan Prefecture	12	9,600
Hsinchu Prefecture	12	9,600
Miaoli Prefecture	14	11,200
Taichung Prefecture	20	16,000
Changhua Prefecture	26	20,800
Nantou Prefecture	10	8,000
Taichung Municipality	7	5,600
Yunlin Prefecture	20	16,000
Chiayi Prefecture	18	14,400
Tainan Prefecture	31	24,800
Tainan Municipality	4	3,200
Kaohsiung Prefecture	25	20,000
Pingtung Prefecture	24	19,200
Kaohsiung Municipality	7	5,600
Taitung Prefecture	10	8,000
Hualien Prefecture	11	8,800
Total:	303	242,400

Data based on the results of JCRR project TW-A-276.

V. Progress and Accomplishment

The amount of extension seeds of Ponlai rice, Native rice, and Upland rice multiplied and distributed during the past years are given in Tables 8, 9, and 10 respectively.

Table 8. Amount of Ponlai Rice Seeds Multiplied and Distributed in Taiwan from 1949-1955

Year	Amount of extension seeds (kg.)			% to project amount	% to actual production	Acreage of renewal
	Projected	Actually produced	Amount distributed			(ha.)
CY 1949 (2nd crop)	7,200,000	7,326,578	5,872,934	82	80	97,882
CY 1950	14,400,000	16,473,269	12,953,174	90	79	216,203
CY 1951	14,400,000	16,504,572	12,793,439	89	78	213,222
CY 1952	14,400,000	16,584,375	13,212,538	92	80	220,209
CY 1953	10,800,000	12,870,720	9,868,278	91	77	164,471
CY 1954	12,480,000	14,615,891	11,259,766	90	70	187,664
CY 1955	14,400,000	15,761,956	12,367,367	86	78	206,123
Total:	88,080,000	100,137,361	78,327,496	89	78	1,305,774

Data based on results of JCRR projects TW-A-4 and -404.

Table 9. Amount of Native Rice Seeds Multiplied and Distributed in Taiwan from 1951-1955

Year	Amount of extension seeds (kg.)			% to project amount	% to actual production	Acreage of renewal
	Projected	Actually produced	Amount distributed			(ha.)
CY 1951	3,369,600	3,859,938	2,682,968	79.6	69.5	53,659
CY 1952	6,000,000	7,333,524	5,577,163	93.0	76.1	111,543
CY 1953	6,000,000	7,013,591	5,059,813	84.3	72.1	101,196
CY 1954	6,000,000	6,910,611	4,957,863	82.6	71.7	99,158
CY 1955	4,260,000	4,698,810	3,298,350	77.4	70.1	65,967
Total:	25,629,600	29,816,474	21,576,157	84.1	72.3	431,523

Data based on results of JCRR projects TW-A-117, 167, -222, -276, -317, -350, and -404

Table 10. Amount of Upland Rice Seeds Multiplied and Distributed in Taiwan from 1953-1955

Year	Amount of extension seeds (kg.)			% to project amount	% to actual production	Acreage of renewal
	Projected	Actually produced	Amount distributed			(ha.)
CY 1953	42,500	44,002	40,877	96.2	92.9	8,175
CY 1954	750,000	755,690	656,695	87.6	86.9	13,134
CY 1955	850,000	983,796	711,507	83.7	72.3	14,230
Total:	1,642,500	1,783,488	1,409,079	85.8	79.0	35,539

Data based on results of JCRR projects TW-A-317, -350 & -404

From the above tables, it may be seen that the system of rice seed multiplication in Taiwan has by now been fairly stabilized. The equipment and facilities needed are largely rehabilitated. The multiplication and distribution of pure seeds have become a regular practice to the different levels of seed farms and rice farmers in general. Roughly speaking, enough Ponlai rice extension seeds are multiplied yearly for the renewal of 200,000 hectares, Native rice extension seeds, 100,000 hectares, and Upland rice over 10,000 hectares, which are approximately 50, 30 and 25 percent of the total acreage respectively.

In 1952, a sample survey of around 600 farm families in various Prefectures and Municipalities was conducted for the evaluation of the effect of the rice seed renewal on the rice yield. The result of the sample survey (Tables 11 and 12) showed that at that time, the yield of fields of Ponlai rice using pure extension seeds was on an average 7.9 percent (or 273 kg. of paddy) higher than that using farmers' own seeds. The difference for the Native rice was 6.6 percent (or 189 kg. of paddy).

Table 11. Comparison between the Yields of Ponlai Rice Fields Planted with Pure Extension Seeds and with Farmers' Own Seeds (1st rice crop of 1952)

Locality	No. of farms investigated	Yield of paddy rice		% of increase
		With extension seeds	With farmer's own seeds	
		(kg.)	(kg.)	
Taipei Prefecture	31	2,809	2,615	7.4
Ilan Prefecture	24	2,903	2,691	7.9
Taipei Municipality	6	3,283	3,110	5.6
Keelung Municipality	6	3,088	2,920	5.8
Yangmingshan Adm.	6	4,288	4,185	2.5
Taoyuan Prefecture	28	2,697	2,542	6.1
Hsinchu Prefecture	41	2,905	2,780	4.5
Miaoli Prefecture	54	3,703	3,448	3.6
Taichung Prefecture	60	3,741	3,504	6.8
Changhua Prefecture	26	4,627	4,213	9.8
Nantou Prefecture	39	3,246	3,117	4.1
Taichung Municipality	21	5,249	4,991	5.1
Yunlin Prefecture	18	3,959	3,564	11.1
Chiayi Prefecture	51	3,495	3,236	8.0
Tainan Prefecture	39	3,994	3,617	10.4
Tainan Municipality	3	4,420	4,133	6.9
Kaohsiung Prefecture	28	3,985	3,550	12.3
Pingtung Prefecture	72	3,505	3,226	8.6
Kaohsiung Municipality	17	5,394	5,065	6.7
Taitung Prefecture	3	3,863	3,163	22.1
Hualien Prefecture	36	2,782	2,530	10.2
Total:	609	3,711	3,438	7.9

Data based on results of JCRR project TW-A-222.

Table 12. Comparison between the Yields of Native Rice Fields Planted with Pure Extension Seeds and with Farmers' Own Seeds (1st rice crop of 1952)

Locality	No. of farms investigated	Yield of paddy rice		% of increase
		With extension seeds	With farmer's own seeds	
		(kg.)	(kg.)	
Taipei Prefecture	18	2,360	2,264	4.2
Ilan Prefecture	23	2,662	2,460	8.2
Keelung Municipality	6	2,578	2,406	7.2
Yangmingshan Adm.	3	3,463	3,420	1.3
Taoyuan Prefecture	6	2,342	2,226	5.2
Hsinchu Prefecture	3	1,921	1,840	4.4
Miaoli Prefecture	54	3,373	3,198	5.5
Taichung Prefecture	60	3,621	3,436	5.4
Changhua Prefecture	26	4,112	3,848	6.9
Nantou Prefecture	39	3,020	2,913	3.7
Taichung Municipality	18	3,859	3,754	2.8
Yunlin Prefecture	10	2,856	2,622	8.9
Chiayi Prefecture	39	2,486	2,278	9.1
Tainan Prefecture	43	2,930	2,657	10.3
Tainan Municipality	3	3,890	3,624	7.3
Kaohsiung Prefecture	25	3,203	2,982	7.4
Pingtung Prefecture	57	1,798	1,623	6.7
Kaohsiung Municipality	8	3,819	3,553	7.5
Taitung Prefecture	42	3,177	2,805	13.3
Hualien Prefecture	36	2,446	2,240	9.2
Total	519	3,046	2,857	6.6

Data based on results of JCRR project TW-A-222.

However, it must be realized that as the purity of farmers' fields improves with the continuous seed renewal during the past years, the advantageous effect of further renewal would gradually reduce. This will tend to induce a part of the farmers to discontinue renewal. The result will be reflected in a lowering of percentage of actual distribution of extension seeds produced which actually has been the case, especially in the cases of Natiue rice and Upland rice.

VI. Recent Adjustment of the Rice Seed Multiplication System

In view of the above accomplishments aud problems, some rather significant readjustments are being made starting the first rice crop of 1956.

A. After having appropriated approximately NT$7,000,000 to help re-establish the rice seed multiplication system in Taiwan, JCRR has decided that starting 1956, it will discontinue its financial assistance to the purchase of stock seeds and the construction or repair of equipment or facilities of the rice extension seed farms. Hereafter, the government organizations and farmers themselves will be mainly responsible for the financing of the program.

B. In compliance with the Government's policy to promote the expansion of the Ponlai rice acreage at the expense of the Native rice, the future rice seed multiplication system will still place more emphasis on the Ponlai rice than on Native and Upland rice. The handling of seed multiplication of Native and Upland rice will be turned over from the provincial level to the prefectural level.

C. As mentioned above, the seed farms are operated by different operators. The foundation seed farms are operated by the District Agricultural Improvent Stations. They are only seven in number. There are over 100 stock seed farms, and from 6,000 to 7,000 extension seed farms (Table 13).

Table 13. Number of Ponlai Rice Seed Farms in Different Levels of Rice Seed Multiplication Program in Taiwan

Crop season & year	Number of seed farms		
	Foundation seed farm	Stock seed farm	Extension seed farm
2nd crop, 1949	7	326	6,526
1st crop, 1950	8	184	5,601
2nd crop, 1950	8	193	5,575
1st crop, 1951	7	119	5,810
2nd crop, 1951	7	142	6,710
1st crop, 1952	7	68	6,085
2nd crop, 1952	7	92	7,509
1st crop, 1953	7	80	5,996
2nd crop, 1953	7	93	6,526
1st crop, 1954	7	65	6,096
2nd crop, 1954	7	124	7,417
1st crop, 1955	7	62	6,511
2nd crop, 1955	7	105	7,315

Taking the figure of the 2nd crop of 1954 as an example, the number of extension seed farm was 7,417 including those of intermediate crop. Further analysis revealed the fact that the number of extension seed farms has heen so large is due to their average small areas. For instance, the size of the extension seed farm in the 2nd crop of 1954 varied from 0.106 ha. to 1 ha. For intermediate crop, the size of seed farm was more uniform, varying from 0.35 to 0.57 ha. in the same year. The large number of small extension seed farm is considered as not conducive to efficient management and supervision. So in 1956, plans have been mapped out to readjust the size and the number of the extension seed farms. The extension seed farm smaller than 0.5 ha. will be deleted. The projected number and area of the three levels of seed farms of 1956 and the projected amount of seeds to be produced have been set up as follows:

	Acreage	Number	Projected am't of seeds to be produced
	(ha.)		(kg.)
Foundation seed farm	3.75	7	5,625
Stock seed farm	93.75	161	225,000
Extension seed farm	3,750.00	4,000	9,000,000

The amount of extension seeds to be produced will be 9,000,000 kg. which could renew 150,000 ha. of Ponlai rice field. As the total acreage of Ponlai rice in Taiwan is around 400,000 ha., therefore, roughly one-third of the total acreage will be renewed annually and the complete renewal will need three years' period.

VII. Conclusion

In the last seven years (1949-1955), the rice seed multiplication and renewal system and the physical facilities of different levels of seed farms in Taiwan have been substantially strengthened. The total amount of fund used on the various phases of this program amounted to NT$14,151,066.25, toward which JCRR has contributed NT$6,997,309.11 or 49.4 percent and the local government agencies have contributed NT$7,153,757.14 or 50.6 percent, as shown in the following summary table (Table 14).

Table 14. JCRR & Local Appropriation toward Different Activities Relating to Rice Seed Multiplication and Renewal Program in Taiwan (1949-1955)

Kinds of activity	No.	JCRR appropriation	Local appropriation	Total
		(NT$)	(NT$)	(NT$)
1. Seed multiplication program	—	2,503,532.00	1,276,037.00	3,779,569.00
2. Drying ground	6,183	3,161,000.01	5,445,450.60	8,606,450.61
3. Seed granary	20	360,860.00	159,095.00	519,955.00
4. Storage huts	971	406,299.60	271,880.00	678,179.60
5. Storage bins	783	125,264.10	—	125,264.10
6. Compost houses	13	197,953.40	1,294.54	199,247.94
7. Bicycles	303	242,400.00	—	242,400.00
Total:		6,997,309.11	7,153,757.14	14,151,066.25

However, in reviewing the progress and the work accomplished in the past under the seed multiplication and renewal system, it is apparent that there is still ample room for improvement. From the Tables 8, 9, 10, it may be seen that the amount of pure seeds distributed in the past years as reported by the local governments were only about 70 to 80 percent of the amount produced. There are even reasons to believe that the reported figures are on the high side in some areas. In other words, there was at least from 20 to 30 percent of pure seeds not used for the purpose for which they were multiplied. The main reasons for such imperfection, as viewed by the writer, are as follows:

A. Some of the extension seed farms are not well managed. As a result, either the seeds produced are not of the desirable purity or the yield of the seed farm was apparently low. They thus failed to impress their neighbors that the extension seeds are actually better seeds.

B. The rice varieties multiplied in the extension seed farms do not meet the requirement of the nearby rice farmers, and therefore not welcomed by them.

C. The improvement of the purity of seeds of the general rice farmers through the renewal in the earlier years has made farmers feel further renewal is not as urgent as before.

D. The inadequate distribution of extension seed farm accounts partly the imperfection of this seed renewal system.

In solving the above problems, following approaches are suggested:

A. The supervision of extension seed farms should be strengthened.

As the number of extension seed farms in the past was so numerous and the distribution scattered, effective supervision of them was a practical problem. The provision of bicycles to the township office extension workers and the recent adjustment of extension seed farms by lessening its number and increasing its average size would help a great deal to make supervision more effective. Furthermore, discussion has been made to readjust the localities of the extension seed farms in the rural area, so that each village in a rice producing region may have at least one extension seed farm to supply rice seeds to its local rice growers. Over-crowding of seed farms at a locality will also be avoided. It is also suggested that in the future the supervisors should pay attention not only to the purity of the seed farm but also the overall management of these farms. It is of practical importance that the stand of the extension seed farms should not only be pure, but of higher than average yield as well in order to be attractive to farmers.

B. Care should be taken in selecting rice varieties for multiplication.

The rice varieties multiplied in the different levels of seed farms are generally in line with the demand of rice farmers. Discrepancies, however, do sometime occur. As the seed multiplication system is of three levels, it requires three crop seasons (one and half years for Ponlai rice, three years for Native rice and intermediate crop) to produce extension seeds. During this time, the farmers' interest might possibly have switched to other varieties. Such quick change of farmers' favor is especially liable to happen when the varieties under multiplication have relatively narrow regional adaptation. It is therefore advantageous as a principle that the varieties multiplied in the extension seed farms should be, as much as possible, those with wider regional adaptability, and the determination on which varieties to be multiplied and extended in any given area should be screened more carefully than before. Recently, a Committee has been set up by the Provincial Department of Agriculture and Forestry which will meet twice a year to decide the varieties to be multiplied in different areas for each crop of rice.

C. The need of rice inspection and grading system.

In the postwar years, about 30 percent of the total rice production is collected annually by the Government through the barter of chemical fertilizer, the

repayment of rice production loan, payment of land tax, etc. In such rice collections, inspection and grading system in the usual commercial sense has not been practised, for the obvious reason that if such systems are adopted, the operation, bookkeeping and accounting of the rice collection work will be greatly complicated, more time consuming and expensive, so that they may become impractical. Therefore, only rice for export is being strictly inspected and graded at present. The lack of grading for government rice collection, however, is obviously not conducive to farmers' incentive to keep their rice pure. Such lack of incentive on the part of the farmers will always be a retarding element to the seed multiplication and distribution program, which perhaps simply has to be condoned as long as the government rice collection program remains an administrative necessity. However, it is suggested that studies should be made for the development of simplified procedures so that some minimum grading work may be installed as soon as feasible.

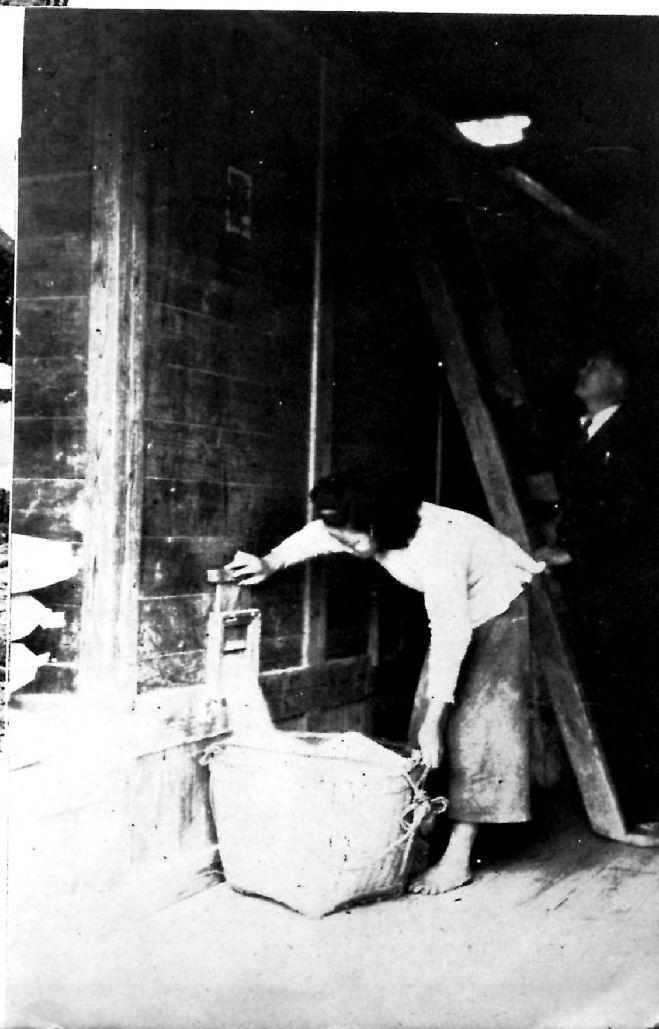
D. Educational campaign should be strengthened.

In view of the above handicap, the educational campaign for encouraging farmers to renew their seeds and keep their seeds pure should be specifically planned. Without the positive incentive, the educational theme would be a passive one to tell farmers what bad effect will be if the seeds are not timely renewed. It is also for this reason why it is thought that the overall good management and high yield of the extension seed farms is of particular importance to a successful seed multiplication and distribution program in Taiwan today, for a mere pure stand does not offer strong enough attraction.

Foundation Seed Farm of the Taipei District Agricultural Improvement Station.

"Single plant per hill" method practised on Foundation Seed Farm.

Drying ground in front of farm houses in operation.



Seed granary in operation.

Bowl-typed storage huts popularly used in Tainan area.

Metal bins for storage of rice seeds in small amount.

Drying ground and compost house constructed for one of the stock seed farm in Kaohsiung Prefecture.

Compost house built with JCRR's assistance.