# 6. PRESENT SITUATION AND FUTURE PROBLEMS ON FARM MECHANIZATION IN THE PHILIPPINES

JULIAN BULANADI*

## Introduction

Intensive efforts on the application of farm mechanization in the Philippines was started after the last world war. There was then an impending food shortage all over the world. The Philippines had always imported rice, to augment what is produced locally. To avert an imminent famine and produce enough rice, mechanized rice production was the best solution. There were few work animals but there were war surplus tractors available in abundance. The Agricultural Machinery and Equipment Corporation was created by Congress (the Diet). Later the Rice and Corn Production Administration (RICPA) was also organized, as a complement to the AMEC.

In the Bureau of Plant Industry, the Maligaya Rice Experiment Station was reopened and mechanization of land preparation was tried for the first time in December, 1946. During those days the people believed that wet land culture of rice production can never be mechanized. "No equipment can replace the old reliable carabao", was the contention of many people.

### (1) In the Maligaya experiment station

Mechanized rice production was pursued with two primary objectives. Firstly, to produce rice. Secondly, to experiment and gain experience in the use of farm machinery. The following were provided for the proposed Maligaya Project under the joint auspices of the B.P.I. and the AMEC:

1) One TD-9 (International) crawler tractor with:
   (a) One disk plow
   (b) One disk harrow
2) One Ford-Ferguson tractor with:
   (a) Three-point attached plow
3) One I. H. Grain Drill (Size 16 × 7)
4) One Massey-Harris 12-Foot cut self-propelled Rice Combine
5) One 6 × 6 Cargo truck.

The Bureau of Plant Industry provided the land and technical men. The Agricultural Machinery and Equipment Corporation supplied the tractors and implements and cash for operating expenses.

### (2) In the rice and corn production administration

Under the RICPA were four production projects on vast areas where the production of rice and corn was completely mechanized from land preparation, seeding, harvesting and drying, namely:

1) The Cotabato Project—Mindanao
2) The Bukidnon Project—Mindanao
3) The Panacan Project—Palawan Island
4) The Mallig Project—Cagayan Valley in Luzon

* Chief, Engineering Division, Bureau of Plant Industry, DANR, Republic of the Philippines.

The land was cleared off forest cover and cogon grass with tractors.

In 1950 the Land Settlement and Development Corporation was created to replace the RICPA, with an additional function of land settlement. After the land is cleared and planted once to rice or corn, the land was awarded to settlers, the cost of improvements payable in ten years.

Thus farm mechanization of rice production was undertaken in the B.P.I. as early as 1947; and in the RICPA-LASEDECO in 1949 up to 1953.

### Technical problems on farm mechanization

In the sugar industry, farm mechanization was started shortly after World War I. Tractors were used mostly in land preparation. Planting the sugar-cane cuttings was done by manual labor. The advent of sugar centrals for the processing of sugar gave impetus to farm mechanization. The sugar centrals came ahead of the sugar-cane production machinery. However, farm mechanization of sugar-cane culture is much older than in rice production.

#### (1) Introduction of the Japanese tractor in 1955

Rice production in the Philippines was (and still is) predominantly under wet culture. Many farmers believe that rice lands must be prepared in muddy condition, and that the more water given to the crop the bigger is the yield. In view of the big investment in agricultural machinery, only big farms can be mechanized.

When the Japanese tractors and tillers were introduced the mechanization of rice production became a certainty. They were relatively cheap and small to suit small farms.

**1) Efficacy of the roto-tiller**

The last decade (1959–1969) has ushered in tremendous development and marked improvements of the small agricultural equipment. The universality of their application and efficiency under various farming conditions was readily accepted.

Some farmers like to work the soil under upland culture. Others prefer the wet method. The consensus among old rice farmers that rice must be planted under puddled soil condition, or that the seedlings must be transplanted in the mud is satisfied. The cost of land preparation with a roto-tiller is cheaper than the old system. A system of minimum tillage in rice was evolved.

**2) Minimum tillage method and cost**

(a) The method—The soil is submerged at a depth of 10 cm for about 24–36 hours. The land is worked with the roto-tiller. The weeds and trashes are mixed with the mud and then allowed to decompose under sufficient water depth for 10–15 days.

The second roto-tilling and leveling is followed by immediate transplanting of seedlings. However, if the weeds are not fully decayed transplanting may be delayed for 7 or 10 days. Before transplanting, however, the mud must be puddled again and the land, levelled ready for transplanting.

(b) The cost—Under the M. T. system the total minimum cost is about ₱67.98. If the soil is difficult to work it may cost about ₱84.52.

The expenses are:

| | |
|---|---|
| First rotivation | ₱28.94 |
| Second rotivation | 28.94 |
| Levelling | 10.00 |
| Total | **₱67.98** |

All farmers aim for high yields. But high yields do not always mean bigger profits. Production costs affect profits.

### (2) Research works on machinery use

While the Japanese engineers were busy in improving and developing the small equipment, the agricultural engineers in the Philippines were busy in studying various phases of farm mechanization.

Comparative costs on land preparation, between the animal-drawn implements and using a ₱20,000 tractor with suitable implements, were made in 1964–1966.

The tractor was used on an average of 90 days, and the implement 60 days per year on the farm.

**1) Cost per ha old system of land preparation**

(Wet culture: Carabao-drawn implement)

| | | Maximum |
|---|---|---|
| (a) | Plowing | ₱48.00 |
| (b) | First harrowing | 36.00 |
| (c) | Second harrowing | 30.00 |
| (d) | Leveling | 18.00 |
| | Total | **₱132.00** |

**2) Mechanized cost per ha**

| | | |
|---|---|---|
| (a) | Plowing | ₱35.30 |
| (b) | First harrowing | 17.65 |
| (c) | Second harrowing | 17.65 |
| (d) | Pegtooth harrowing | 6,60 |
| | Total | **₱77.20** |

Under the mechanized method, it requires only 14–16 man-hours to prepare a hectare of land ready for transplanting, whereas under the old system it may require from 140 to 175 man-carabao hours. The timeliness of planting is assured with mechanization. (Other advantages are too well-known to discuss in this paper.)

The average cost of preparing the land under the old method of using carabao drawn implements was ₱132 per hectare, whereas with mechanized method the average cost was ₱77.20. Thus the mechanized cost is only 60% as much as the cost of the old system.

**3) Studies on equipment made in Japan**

The advantage in operation costs gave farm mechanization the necessary impetus. The Japanese tractors came in various sizes, with a wide range of horse-power ratings to suit various farming systems and sizes of farm business. Special wheels for wet paddy fields are easy to replace with exchangeable attachments. Now small farmers can afford to mechanize and offer custom jobs to or employ multi-farm use with their neighbors.

## Evaluation and improvement of farm machinery

In 1966–1968 farm mechanization research was expanded in the Bureau of Plant Industry. The well-known "miracle rice" from the IRRI was grown in extensive areas in many provinces in the Philippines. Our mechanization research had to be re-oriented accordingly.

**(1) Market quotations on Japanese made equipment were as follows:**

1) **Kubota power tiller,** Model KR 8 × KND 5.5, standard accessories coupled with radiator cooled diesel engine, Model KNDR 5.5–7 hp Max. 2200 RPM ..... ₱5,645.00
Attachments: Sleigh, leveler, duplex rear wheels, reversible plow ..... ₱550.00
(Similar models of Iseki, Shibaura, Satoh, Mitsubishi, etc., have similar attachments and comparable prices.)

2) **Evaluation of tractor and implement use**

(Cost of tractor—₱5,645.00)

(a) Depreciation $= \frac{C-S^*}{Y(da)} = \frac{₱5.645 - ₱169.35}{8(133)} =$ ₱5.15

(b) Interest $= \frac{C+S}{2(133)} \times \frac{6}{100} = \frac{5645+169.35}{2(133)} \times \frac{6}{100} =$ 1.31

(c) H.I.T. $= \frac{C}{133} \times \frac{2}{100} = \frac{5645}{133} \times \frac{2}{100} =$ 0.85

(d) Repairs $= \frac{C}{133} \times \frac{4}{100} = \frac{5645}{133} \times \frac{4}{100} =$ 1.70

(e) Fuel and Oil = 4.95

(f) Labor (Tractor operator) = 12.00

Total cost of tractor use/day = **₱25.96**

3) **Plow use cost**

| | | |
|---|---|---|
| Equipment: | Moldboard plow ..... | ₱548.38 |
| | Large diameter steel wheel ..... | 321.00 |
| | Duplex rear wheel ..... | 139.10 |
| | Total ..... | **₱1,008.48** |

(a) Depreciation $= \frac{C-S}{Y(da)} = \frac{₱1008.48 - ₱30.25}{8 \times 53} =$ ₱2.31

---

Note: * $C$ = Initial cost, $S$ = Scrap cost
$S = \frac{3}{100} C$

(b) $\text{Interest} = \frac{C+S}{2\times53} \times \frac{6}{100} = \frac{1008.48+30.25}{2\times53} \times \frac{6}{100} =$ 0.59

(c) $\text{H.I.T.} = \frac{C}{53} \times \frac{2}{100} = \frac{1008.48}{53} \times \frac{2}{100} =$ 0.38

(d) $\text{Repairs} = \frac{C}{53} \times \frac{4}{100} = \frac{1008.48}{53} \times \frac{4}{100} =$ 0.77

Total cost of plow use/day ₱**4.05**

4) **Harrow and leveller use cost**

| | | |
|---|---|---|
| Equipment: | Tail skid (sleigh) | ₱ 40.83 |
| | Field Leveller | 121.71 |
| | Drum rotor for paddy field | 668.75 |
| | Total | ₱**841.29** |

(a) $\text{Depreciation} = \frac{C-S}{Y(da)} = \frac{₱841.29-25.24}{8\times60} =$ ₱1.70

(b) $\text{Interest} = \frac{C+S}{2(60)} \times \frac{6}{100} = \frac{841.29+25.24}{2\times60} \times \frac{6}{100} =$ 0.44

(c) $\text{H.I.T.} = \frac{C}{60} \times \frac{2}{100} = \frac{841.29}{60} \times \frac{2}{100} =$ 0.28

(d) $\text{Repairs} = \frac{C}{60} \times \frac{4}{100} = \frac{841.29}{60} \times \frac{4}{100} =$ 0.56

Total cost of harrow and leveller use/day ₱**2.98**

5) **Estimated cost per day of farm operations**

| | | | |
|---|---|---|---|
| (a) | Plowing cost | | ₱30.01 |
| | Tractor use | ₱25.96 | |
| | Plow use | 4.05 | |
| (b) | Harrowing cost | | ₱28.94 |
| | Tractor use | ₱25.96 | |
| | Harrow use | 2.98 | |
| (c) | Levelling cost | | ₱26.64 |
| | Tractor use | ₱25.96 | |
| | Leveller use | 0.68 | |

### (2) Improvement of farm machinery (especially those made in Japan)

Over the years (1959–1969 decade) many improvements were very evident on Japanese tractors and implements. Commendations are due to the engineers and other technicians who did most of the improvements on company experimental farms and training centers of various companies in Japan. Now there are larger riding tractors, rice transplanters and small rice combines, to cite a few examples.

The Filipino engineer (on their part) focused attention on man-power training

and development. The primary objective was (and is) to promote competence and efficiency in preventive maintenance, effective servicing and proper matching of power and implements.

There was the need for over-all land development, relocation of levees, land forming levelling, minor reclamation jobs, etc., to stimulate adoption of farm mechanization. Thus efforts were coordinated on the improvement of farm machinery by the engineers in Japan and land improvement or farm development by the engineers in the Philippines.

## Socio-economic problems in farm mechanization

### (1) Re-orientation of national economy

During the half-century of American regime (1898–1946) and prior to Philippine Independence, development projects were mostly directed towards the promotion of our agricultural economy. The need for balanced industrial and agricultural development was becoming apparent. The first two decades of political independence (1946–1966) did very little to re-orient our economic plans and programs.

However, in 1968 a Board of Investment was created by the Congress (of the Philippines) to stimulate industrialization in the national economy. The government (through the BOI) encourages industrialization with attractive incentives.

#### 1) Labor force and unemployment*

In 1966, the total labor force was estimated 11,757,000. Of this figure, 10,936,000 (93%) are gainfully employed; 6,290,000 (57.5%) are employed in agriculture, forestry, hunting and fishing. Therefore, 821,000 (7%) were unemployed. The newly increased minimum daily rate of ₱8.00 for industrial workers and ₱4.75 for agricultural workers, may aggravate the unemployment problem in the Philippines.

#### 2) Number of farms and households

Available statistics show that the number of farms in 1960 were 2,167,644. From 1955 up to 1960 there seems to be but few changes. Below is a summary of number of farms taken from the *Handbook of Agriculture* prepared by the Agricultural Economic Division, Department (Ministry) of Agriculture and Natural Resources:

Number of farms:

| | | |
|---|---|---|
| (a) | 1948 | 1,638,624 |
| (b) | 1955 | 2,352,840 |
| (c) | 1958 | 2,257,906 |
| (d) | 1960 | 2,167,644 |

In 1960, a systematic agricultural census was taken. A summary of the number of farms by size is presented in Table 1.

---

* Source: Country Report on the Philippines Rice Processing Machinery Manufacturing Industry.
By : Ad-Hoc Group—PES, BPI, RCA, BOI, DCI, NEC, PAMMA. November, 1969.

**Table 1. Number of farms by size (1960)**

| Farm sizes (HA) | Number | Percent |
|---|---|---|
| Below— 0.2 | 20,019 | 0.9 |
| 0.2— 0.5 | 69,074 | 3.2 |
| 0.5— 1.0 | 160,680 | 7.4 |
| 1.0— 2.0 | 642,060 | 29.6 |
| 2.0— 3.0 | 458,914 | 21.2 |
| 3.0— 4.0 | 253,087 | 11.7 |
| 4.0— 5.0 | 152,398 | 7.0 |
| 5.0— 10.0 | 289,730 | 13.4 |
| 10 — 15.0 | 86,164 | 4.0 |
| 15 — 20 | 13,667 | 0.6 |
| 20 — 25 | 9,788 | 0.5 |
| 25 — 30 | 7,378 | 0.3 |
| 50 —100 | 2,466 | 0.1 |
| 100 —200 | 1,777 | 0.05 |
| Above—200 | 1,042 | 0.05 |
| Total | 2,167,644 | 100.0 |

Source: Agricultural Census of the Philippines.

It is quite safe to estimate that there are as many households as there are farms. From Table 1, there are 249,773 farms (comprising 11.5% of total) with areas less than one hectare. On these small farms one household may operate one or two farms. At the same time, there are 2,819 farms (which are 0.1% of total) with areas more than 100 hectares each. The average number of 30 households work on those farms. There is a close correlation between the number of farms and the number of households. (A general 1970 census is being undertaken.)

### 3) Changes of average farm wage per day*

During the last decade (1959–1969) the average daily wage rate of a plowman with a carabao has steadily risen from ₱3.31 to ₱4.78 in rice production. The trend was the same in corn production, and in the production of export crops, sugarcane and tobacco. In 1969 the plowman on a riding tractor was paid an average of ₱6.25 in rice and corn production, and ₱6.87 in sugar cane and tobacco production (these crops being export crops).

### 4) Changes in Numbers of Agricultural Machinery

The Agricultural Census of the Philippines (1960) lists the following machinery and equipment:

| | |
|---|---|
| Number of tractors | 7,931 |
| Number of plows | 1,916,207 |
| Number of harrows | 1,377,916 |
| Number of sprayers | 47,987 |

* Source: Condensed from survey reports (1961–1969) of the Bureau of Agricultural Economics, DANR.

Apparently the equipment are not classified. The number of plows is almost equal to the number of farms (see Table 1). The plows and harrows should have been grouped into: (a) carabao drawn and (b) tractor plows or tractor harrows.

(a) Tractors

Based from the Bureau of Agricultural Economics Survey conducted in 1967, the total number of tractors was 5,252; of which 4,357 were using diesel fuel, the rest (895) were using gasoline. Also 4,792 of the total were wheel-type, and the rest (460) were crawler type.

The Central Bank (Philippines) has reported to the Presidential Economic Staff that 2,083 tractors were imported during the period starting from January 27, 1966 to December 31, 1969, in connection with the implementation of the farm mechanization loan program of the Central Bank—World Bank (IRRD) first and second Rural Credit Projects. The total cost of the tractors was ₱18,605,119.25.

Summary: Tractors—1960 (Agr. Census) ..... 7,931
1967 (B.A. Econ.) ..... 5,252
1966–1969 (C.B.) ..... 2,083

**Table 2. Number of tractors in 1667**

| H.P. Rating | Units |
|---|---|
| 1 | 12 |
| 2 | 11 |
| 3 | 44 |
| 4 | 136 |
| 5 | 63 |
| 6 | 404 |
| 7 | 226 |
| 8 | 105 |
| 9 | 34 |
| 10—14 | 160 |
| 15—19 | 61 |
| 20—39 | 307 |
| 40—59 | 1,349 |
| 60—79 | 1,046 |
| 80—99 | 747 |
| Unknown | 547 |
| Total | 5,252 |

(b) Pumps—engines for irrigation

Before the Farm Mechanization Loan Program was finalized, the committee on planning decided to include irrigation machinery to ensure the success of the intensified rice and corn production program.

During the same period (January 27, 1966 to December 31, 1969) the importation of 262 pumps and engines was effected, with a total value of ₱940,066.77.

(c) Rice-threshers, hullers and cleaners

These rice processing equipment were mostly imported. However, there are a good number of Philippine manufacturers especially of threshers and rice hullers or (Kiskisan) and large cone-type rice mills.

**Table 3. Import data for 1963—1968***

| Year | Threshers | | Hullers & Cleaners | |
|---|---|---|---|---|
| | Units | Cost $ U.S. | Units | Cost $ U.S. |
| 1963 | 50 | 3,128 | 2 | 700 |
| 1964 | 70 | 2,602 | 10 | 2,124 |
| 1965 | 73 | 18,193 | 10 | 3,965 |
| 1966 | 133 | 36,034 | 964 | 18,166 |
| 1967 | 278 | 124,108 | 31 | 12,516 |
| 1968 | 3,844 | 95,195 | 636 | 21,164 |
| Total | 4,448 | 279,260 | 1,653 | 58,635 |

* Source: Central Bank (Philippines)
Reproduced from: Country Report on the Philippines, Rice Processing Machinery Manufacturing Industry.

The average prices indicate that the processing machinery are small equipment. Those may have come mostly from Japan. Similar equipment coming from Europe and the United States are generally big machines.

(d) Small engines for agricultural purposes

To a farmer-operator who uses animal drown implements, owning a small engine is probably one of his primary objectives. A small engine has many uses on the farm. Its many advantages over a draft animal are too well-known to discuss in this report.

Many small farmers own small engines now, as the following data will show.

**Table 4. Import data on small engines (Now-Automotive)****

| Fiscal Year | Diesel (Units) | Gasoline and Kerosene (Units) | TOTAL | |
|---|---|---|---|---|
| | | | Units | $ Value |
| 1962 | 1,073 | 1,946 | 3,019 | 284,603 |
| 1963 | 5,369 | 3,995 | 8,364 | 773,401 |
| 1964 | 7,707 | 9,503 | 17,210 | 1,233,561 |
| 1965 | 21,389 | 7,264 | 28,653 | 2,034,106 |
| 1966 | 34,273 | 4,085 | 38,358 | 2,616,662 |
| 1967 | 33,771 | 5,317 | 39,088 | 2,617,957 |
| 1968 | 17,560 | 9,888 | 27,448 | 1,920,337 |
| Total | 121,142 | 41,998 | 163,140 | 11,480,627 |

**Source: Central Bank of the Philippines.
Reproduced from: Country Report on the Small Engines for Agricultural Purposes.

### 5) Policies on farm mechanization

The Philippine government, through the Board of Investments, encourages (with attractive incentives) the manufacture of agricultural machinery and equipment. It includes integrated rice processing equipment such as grain dryers, rice mills and related grain handling and storage facilities.

The Board of Investments (BOI) was recently established to promote areas of investments. The manufacture of small engines for agricultural uses has been given pioneer status, with some privileges, among the most important are:

(a) Tax-free importation of capital equipment
(b) Remittance of earning and repatriation of investment
(c) Anti-damping protection
(d) Accelerated depreciation
(e) Net loss carry-over
(f) Post operative tariff protection.

Being a free enterprise economy, the government can not force investors to set up industries for the manufacture of even small engines, much less bigger agricultural machinery like tractors and their complement attachments.

At present no diesel or gasoline engine is manufactured in the country. The BOI registered two enterprises, namely: (a) The Marsteel Incorporated, (b) The Igri-Kirloskar Incorporated.

Production has not yet commenced, however.

**Hereunder is a list of some farm equipment manufacturers:**

(a) Irrigation pumps
  1 U.S. Engineering Corporation
  2 Marsteel Incorporated
  3 Mechanical Center of Manila
  4 Feati Industries
(b) Rice hullers
  1 Grade Park Engineering
  2 Oberly and Company
  3 Parpana Machinery Mft., Inc.
  4 Trans Pacific Mill Supplies, Inc.
(c) Rice mills (Cone-type)
  1 Jose Bernabe & Co., Inc.
(d) Power tillers
  1 Marsteel Incorporated
  2 Sea Commercial Inc.

There are more than 3,000 cone-type rice mills in operation. Practically all have been manufactured by indigenous engineering companies.

In recent years much interest was focused on the production of higher grades of milled rice, with higher recoveries, especially in terms of head rice. Consequently, six engineering companies were engaged in the manufacture of rice dryers, including bulk handling and storage of paddy rice during the past two years.

## Discussion

**N. Yamada,** Japan: I am very much interested in the cost comparison between the old system using carabaos and the new mechanized system, shown in page 55. I would like to know about the method of estimating the cost of the maintenance of animals. Does this figure include the cost of the take-care for animals and their feed?

I appreciate it very much if you could find time to give a brief annotation on this matter in your paper which will be published as one of the proceedings of the symposium.

**Answer:** It is a very good question. This figure is based on the cost obtained from our contract farmers.

**N. Kawamura,** Japan: What is the biggest problem to solve for the mechanization of sugarcane or maize cultivation? Do you have any program to mechanize the harvesting of sugarcane or maize?

**Answer:** Sugarcane and corn production by mechanized equipments have no more problems because they are grown in the upland condition. Our problem is mechanized harvesting; we need cheap mechanized harvesters.

## References for Paper 6

1. Bulanadi, J.: The cost of mechanized operations in the Philippines. Published Brochure by the International Technical Congress of Agricultural Machinery. Parish, 1961.
2. Bulanadi, J.: Mechanization of rice farming. The Journal of the American Chamber of Commerce of the Philippines. October, 1965.
3. Bulanadi, J.: Mechanization and soil building in the sugar industry. Sugar News. 42(2): 77–80, 1966.
4. Bulanadi, J.: Farm mechanization. (Its technical aspects on selection and proper use of farm machinery). Plant Industry Digest. 29: (7–9), 8–11, 1966
5. Bulanadi, J.: Farm mechanization management. Expressly prepared for the 15th annual convention of the Philippine sugar Technologists held at the Manila Hotel. August 23–26, 1967. (Mimeograph Report)