

# Development of a New System of Year-round Silage in Japan

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## Problems involved in cultivation and utilization of forage crops

At present, grasses and forage crops are grown on 969,000 ha of land and used for 2,067,000 dairy cattle and 2,083,000 beef cattle<sup>1)</sup>. However, as shown in Table 1, there is a big difference in the supply-demand pattern of feedstuff between main islands (Honshu) and Hokkaido.

In Hokkaido, area of forage crop field converted per one mature cattle is 80 a, supplying 29 ton (in fresh weight) of forage for one cattle per year. With dairy cattle, rate of self-sufficiency of TDN (total digestible nutrients) is as high as 67.0%, which is close to the rates in U.S.A. and Europe, showing the feeding type depending on self-sufficing feeds.

On the other hand in Honshu, forage crop field area converted per one mature cattle is only 10 a, with the yearly production of 8 ton in fresh weight, and very low rate of self-sufficiency of TDN, 29.0%, showing a high dependence on purchased feeds. In addition, the use of forage crops in Honshu depends on laborious green chopping practiced every day

for about 1/2 of the feed, while in Hokkaido grazing, silage and hay are mostly used.

In the Honshu, highly dependent on concentrates due to extreme shortage of self-sufficing feeds, the practice of green chopping reduces feed production per unit area of forage land and makes even supply of self-sufficing feed during a year difficult<sup>3)</sup>.

As the measures to solve these problems, the author has developed the following idea: (1) simultaneous cutting of a forage crop at the right time and 2-3 croppings a year in order to solve the shortage of self-sufficing feed, (2) year-round even supply of feed by the use of silage in stead of green chopping, and (3) a new system based on year-round silage combined with 2-3 croppings a year to be practiced by the application of a large amount of animal excretions.

## New techniques adopted

The new techniques were introduced to 25 dairy farmers (13 large, 8 medium, and 4 small farmers) who had been practicing the green chopping. The introduction was made by man-to-man guidance. New problems arisen

Table 1. Production and utilization of self-sufficing feed

Region	Forage crop area converted per 1 mature cattle (are)	Production of self-sufficing feed per 1 cattle (ton in fresh weight)	Ratio of self-sufficiency of TDN (%)	Main methods of utilization
Kokkaido	80	29	67	Silage, hay and grazing
Honshu	10	8	29	Green chop and silage



Plate 1. Joint operation for preparing corn silage in small farms by the use of a large scale movable cutter



Plate 2. Joint operation for preparing corn silage in medium to large farms by using a corn-harvester

from the introduction were feeded back to the research institute to solve them. Thus, in the period from 1971 to 1980, field studies to evaluate the new techniques were carried out with an effort to systematize them.

Techniques introduced to farmers are shown in Table 2. As to the method of producing

silage of good quality, (1) basic technique for silaging was introduced, and (2) crops with high WSC (water soluble carbohydrates) contents and easiness to silaging were grown. For the shortage of permanent silos, temporary silos were utilized at the initial stage of the introduction. For the shortage of large

**Table 2. New techniques introduced to dairy farmers**

Item	Actual methods
Making silage of good quality	1. Method of prepare good quality silage 2. Adoption of forage crops more suitable for silage
Temporary silo for supplemental use	1. Bag silo, 2. Stack silo, 3. Vinyl-trench silo, etc., are used at the initial stage of the introduction
Use of big machines	1. Joint-use of big machines by farmer's group 2. Effective use of existing small machines
New type permanent silo	Development and use of square-shaped underground silo of air-tight type with hoist
Improving cultural system	Stable, high yields by changing mixed-seeded forage crop to year-round cultivation of Italian rye-grass, and then to Italian ryegrass (winter) plus corn (summer)
Improving dairy cattle feeding	Improvement of technique of feed supply for increasing ability of individual cattle

scale machines, common use and joint operation by farmer's group were adopted. As a permanent silo adapted to the year-round silage, a square-shaped underground silo of air-tight type with hoist was developed for use.

As to the cultivation of forage crops, high-yielding ability, effective use of animal excretions, improved silage quality, and labor-saving were taken as targets. The mixed grasses—corn · root crop type, previously practiced, was first changed to a year-round cultivation of Italian ryegrass, and finally to the double cropping consisted of Italian ryegrass as winter crop and corn, as summer crop. To improve animal feeding, milk yield was checked aiming at increasing individual ability, and feed ration was improved.

### Effectiveness of the year-round silage system

#### 1) Effectiveness found with large farmers 8 years after the introduction

Table 3 shows the effectiveness of the new system introduced. In 1971 when the green chopping was practiced, forage crop field area per farmer was 360 a, including 30 a of rented field, and summer cropping of corn accounted for only 35% of it. Number of milking cows

**Table 3. Effectiveness of the year-round silage system introduced (average of 13 farmers)**

Item	1971 (green chop)	1979 (year round silage)
Forage crop field		
Owned (are)	360	643 (197)*
Rented (are)	30	192 (640)
Rate of summer cropping (%)	35	80 (267)
Dairy cattle feeding		
No. of milking cows	9.2	31.5 (342)
No. of converted mature cattle	12.2	43.8 (359)
Milk production (ton)	44.8	191.4 (427)
Milk yield/milking cow (kg)	4,900	6,080 (124)
Silo		
Permanent silo (m <sup>3</sup> )	65	380 (585)
Ratio of silaging (%)	32	94 (294)
Production of self-sufficing feed (ton of TDN)	22.26	77.90 (350)
No. of days of farm work		
Husband	200	74 ( 37)
Housewife	150	8 ( 5)

\* Numerals in parentheses indicate percentages to 1971.

and number of cattle converted to mature cattle were 9.2 and 12.2, respectively. Milk

production was 44.8 ton with average milk yield of 4,900 kg. In 1979, i.e., 8 years after the introduction of the new system, the forage crop field expanded to 643 a mostly by renting, and ratio of summer cropping increased to 80%. Labor surplus created by the joint use of big machines by a group of 3-4 farmers was utilized for the expansion of forage crop field.

Milking cows increased in number from 9.2 to 31.5. The number of cattle converted to mature cattle was increased from 12.2 to 43.8. The yearly milk production increased by 4.27 times from 44.8 ton to 191.4 tons, and milk yield per one milking cow also increased by 1.24 times from 4,900 kg to 6,080 kg. Capacity of permanent silo, which was 65 m<sup>3</sup> per farmer previously, was increased by 5.9 times to 380 m<sup>3</sup>, and the ratio of harvest used for silage was increased from 32% to 94%. The TDN production of self-sufficing feed was increased by about 3.5 times from 22.26 ton to 77.90 ton, by the introduction of summer cropping of corn, and the increased area of rented field.

In addition, farm labor was markedly reduced from 200 days for husband and 150 days for housewife to 74 days for husband and only 8 days for housewife, respectively.

In 1979, average of 13 farmers showed that ratio of the total selling value of milk to purchased feed cost was 38.2%, average number of mating of a multiparous cow was 1.9, average calving number was 4.1, and work required for managing one mature cattle took 97 hrs, that for cultivation and storage of forage crops 726 hrs, showing 11.8 hrs per 10 a. Average milk composition was good with 3.52% for milk fat, and 8.51% for SNF (Non-fat solid). Machines owned, in case of joint operation by 3 farmers for 20 ha of forage crop field, were 3 tractors of 50-90 ps; 1 big cylinder-harvester, 2 forage wagons, 1 corn planter: sprayer, and 1 pump tanker, in an average.

## 2) Cost of silage

Cost of silage studied with 11 dairy farmers is shown in Fig. 1. Cost of production for 1 kg of Italian ryegrass and corn was Yen 6.02,

composed of cost for seeds, agricultural chemicals and fertilizers (34%), fuels (5%), agricultural machines including depreciation account and repairs (33%), cost of silo (9%), labor cost (16%), and land rent (2%).

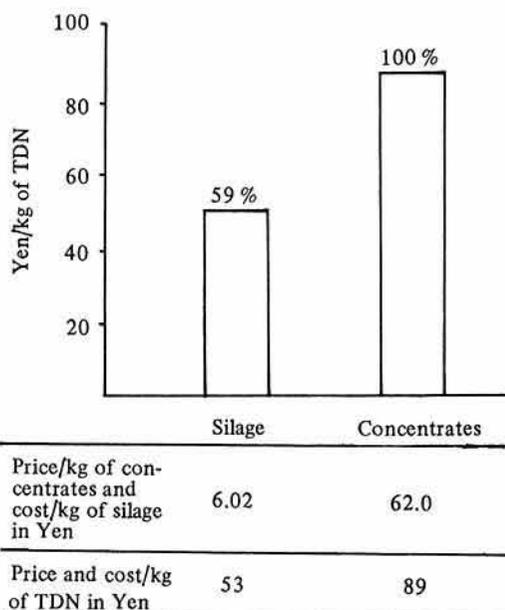


Fig. 1. Price/kg of TDN of concentrates and cost/kg of TDN of silage

As the cost of silage per 1 kg of TDN was Yen 53.00, as compared with Yen 89.00 (1979) for concentrates for milk cattle, it was confirmed that the silage TDN was produced at the cost only 59% of the price of concentrates TDN. It is much advantageous economically.

## Advantages of the year-round silage system

Effectiveness of this new silage system was proved not only with large scale dairy farming but also with medium to small scale dairy farming similarly. The effectiveness is summarized as follows:

(1) Production of self-sufficing feed can be increased by the adoption of double or triple cropping a year and harvesting all of a crop at once.

(2) Expansion of forage crop area, for example by rent, can be done by the joint use

and joint operation of big machines by farmer's group.

(3) Labor of women can be released from farm works.

(4) Milking ability of individual cow can be increased by increasing ratio of self-sufficiency of feed and even feed supply during the whole year, and

(5) This new system encourages dairy farmer's self-confidence.

At present, it is estimated that about 10% of the dairy farmers in Japan have moved to this new system from the traditional one, and further rapid shifting trend is being recognized. Thus, the high adaptability of this system to the areas of wet climate with heavy precipitation, where forage crop field and hence self-sufficing feed are lacking was confirmed. In a word, this is a systematized technique to improve soil, forage crop production, and cattle feeding, through the effective utilization of animal excretions, and to increase yield of self-sufficing forage crops, on

the basis of joint use and joint operation of big machines by farmer's group.

As the future problems, it will be necessary to carry out tests on milk yield and milk quality and on roughage in order to increase ability of individual dairy cattle, and further to establish techniques for the use of legumes together with corn silage and year-round even supply of hay.

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