Grassland-Livestock Management System in Mountainous Inclined Lands — A Low-Cost Beef Production Technology—

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Mainstay of beef production in Japan is still now consisted of processing industry-like fattening which depends mostly on imported cereals. Even the production of beef from dairy breeds tends to follow the inefficient way of producing high-quality beef of Japanese native cattle. If it is not done to go back to the original principle of beef production depending on grasslands, the increased scale of management will result in only an increased cost of production and increased nuisance caused by animal excreta, but not the increased stability of livestock-farming management.

It is anticipated that the use of bull calves, produced in dairy, for meat production will become the mainstay of beef production in Japan, for the reasons that it is efficient in roughage utilization, it has a stable basis for production, and calves of highly productive dairy cattle have high meat-productivity. Particularly in alpine regions with rich grass resources, this type of beef production is expected to be most promising.

Based on the 10 years research on mass-management of calves, the author attained a prospect for a low-cost, grassland-dependent beef production system, which will be presented in this paper.

Grassland-livestock management system and technology

Economical breeding of calves (of dairy cattle or beef cattle) is regarded to be the main type of livestock farming in alpine regions, and is considered to be supported by the systematization of the following component techniques:

1) Establishment of grasslands

Mountainous sloping lands are featured by not only low soil fertility, but also complicated topography with steepness, which causes soil erosion, leaching of fertilizers, and much labor consumption for management. Consequently, to develop grasslands, the cutting grasslands should be developed (by plowing method) on gently sloping lands with favorable conditions (less than 15°) as a site of producing storage feeds for winter. On the other hand, on steep lands, the grasslands with high soil-conservation functions are produced by the no-till, direct sowing method (Alpine Region Branch's method), which aims at not to disturb top-soil, but replace wild grasses to pasture plants without causing any rapid change by taking advantage of the difference in fertilizer response between them. Combination of the former with the latter at the ratio of 1:2 is good enough to carry out all the year-round feeding efficiently.

2) Intensive grassland management

The definite means for getting high productivity from grazing are to practice short-term rotation by limiting grazing period at each grazing plot to 3–5 days,, to return the nutrients removed from the soil as soon as possible, and to limit the daily grazing time to that only needed for herbage intake in order to minimize demerits of grazing.

3) Utilization of surplus harbages

On selected grazing plots of good conditions, surplus of herbage is intentionally produced and stored as silage in these plots. This is supplied to cattle in parallel to the grazing during a period of shortage of grasses. By this method, an extension of about 1 month of grazing period is made possible.[1)]

4) Winter grazing with grasses kept fogging on fields

As the cost of stored feeds for winter is about twice that for grazing, grasses left fogging on fields without final cutting are used for grazing in order to reduce the consumption of stored feeds. It serves as a good feed, with daily gain of 0.64–0.68 kg, similar to silage, and is very economical.[2)] Thus, the year-round feeding based on effective grazing was made possible by extending grazing period as far as possible and supplemented by good quality storage feeds for winter. At the present level of technology, 100 days of drylot feeding and 265 days of grazing can be assured at the altitude of 1,000 m.

5) Grazing in the first season as an acclimatization

When nursing calves in lowlands are transferred directly to grazing runches at high evalation, their normal growth can not be expected due to frequent occurrence of alimentary and respiratory diseases caused by accumulated stress derived from changes in feeds, competition among individuals, sensitization to wind, rain, and low temperature, changes in air pressure, and excessive movement, etc. Therefore, it is important to acclimatize the calves to grazing, by organizing them into groups in outdoor paddock and giving them disease protection treatments at about 20 days prior to the grazing. During about 20 days after the beginning of grazing, supply of roughage and limitation of daily grazing time are also practiced. At least one season of grazing is needed before the calves adapt themselves physiologically and ecologically to manifest their original capacity.[3)]

6) Importance of supplementing minimum amount of calorie-feeds

Net herbage intake time of grazing calves is usually 5–7 hrs so that grazing for 24 hrs is not only useless, but also inhibits grass production by trampling. As grasses grown with fertilizer application tend to be of high protein and low calorie for young cattle, showing digestible crude protein more than 2%, and total digestible nutrients of 11–13%, it is needed to supplement calorie-feeds at about 0.5% of body weight. This is used as a tool for unattended guidance of cattle behavior, as shown later.

7) A new grazing method developed

By combining all the above techniques, a new grazing method was developed. Calves produced in dairy farming are mass-reared for 6 months in a nursing center, and then transferred to raising ranches in mountainous areas for grazing in one season. The time-limited grazing (limited time for daily grazing) combined with the early morning grazing is adopted with an aim of reducing excessive grazing and diseases of calves.

As shown in Fig. 1, a number of grazing plots with an automatic gate for each plot were constructed. Grazing is made from early morning, and the cattle group is called back to the paddock by the sound of ringing bell in the evening, and then fed with concentrates to keep cattle healthy. When the cattle are accustomed to this method, a large group of them can easily be handled. As shown in Table 1, the grazing capacity of this method is higher than the day-and-night grazing by 39% in cow days and 33% in body weight gain.

In winter, self-feeding of silage is allowed, aiming at the similar daily gain as in the case of grazing. In the second season, day-an-night grazing is practiced. During that period, a remarkable increase of grazing effect is intended by taking advantage of compensatory growth, as shown later.

Finishing fattening is made by self-feed, following the second grazing season to

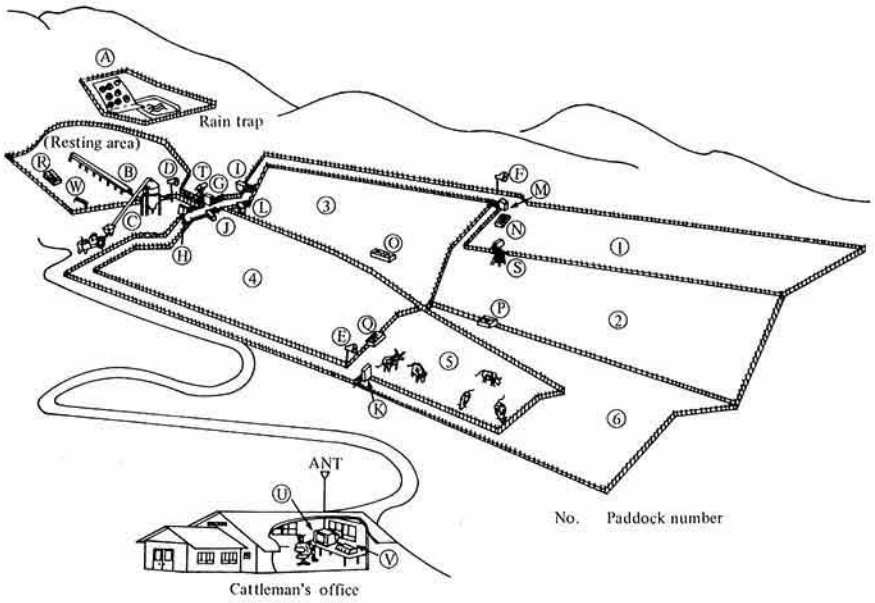

Fig. 1. Layout of equipments for grazing

A. Rain trap
B. Automatic feeder
C. Screw conveyor
D. E. F. Loud-speaker
G. Automatic paddock gate
H. I. J. K. L. M. Guide gate
N. O. P. Q. R. Automatic water-supplier
S. T. Television camera
U. Monitor television
V. Transmitter
W. Saltcat

Table 1. Comparison of grass-livestock productivity by grazing types

Grazing type	Year	Grassland area (ha)	Fertilizer (N. P.K) applied (kg/ha)	Grass production (ton/ha)	Efficiency of grazing (%)	No. of cattle (head)	Days of grazing	Grazing capacity: Cow day (C.D.)	Grazing capacity: Weight gain (kg)
Customary (whole day) grazing	1970	10.0	20. 10. 20	44.5	40.3	35	153	284	412
	1971	10.0	20. 10. 20	59.9	45.3	50	180	386	428
	1972	10.7	16. 8. 16	67.7	61.4	40*	176	511	486
	1973	11.3	16. 14. 16	70.0	48.6	50	199	448	492
	1974	11.3	17. 11. 17	75.4	36.5	50	196	326	419
	Average	10.7	—	63.5	46.4	45	181	391(100)	447(100)
Improved timelimited grazing	1970	8.8	20. 10. 20	63.0	58.1	50	190	630	596
	1971	8.8	20. 10. 20	81.0	46.8	50	214	485	623
	1972	8.3	16. 8. 16	78.6	49.3	50	214	584	526
	1973	7.5	16. 14. 16	70.4	45.3	50	223	546	681
	1974	8.9	17. 11. 17	82.5	41.5	50	221	463	541
	Average	8.5	—	75.1	48.2	50	212	542(139)	593(133)

Note 1) * indicates the second season's grazing.
2) Figures in parenthesis indicate index against customary grazing.

increase quality and quantity of meat.

Method of controlling cattle group behavior

Although the time-limited grazing is very productive, it required much labor, and in case of daytime grazing herbage intake in summer season apts to be insufficient sometimes. To overcome these problems, the following method of controlling cattle group behavior was deviced.

1) Automatic guide, using light, for early morning grazing[4]

It was recognized that apetite of cattle is caused by a stimulus of morning light at about 10 Lux together with hungry feeling, so that grazing behavior is induced. Based on this fact, a method of inducing unattended grazing was deviced, by which cattle group is introduced into a certain grazing plot through the light-controlled gate, which opens automatically in response to the morning light. By this method, cattle begin herbage intake from 4–5 o'clock in the summer season, resulting in the dry matter intake of 2.1%. There is no fear of insufficient herbage intake which often occurs by day-time grazing in the summer season (Plate 1).

2) Automatic handling of cattle group using the sound and supplemental feeds[5]

The important point of grazing is to supply adequate amount of nutrients for growth, so that it is desirable to call back the cattle to paddock after they took adequate amount of nutrients. By selecting the audition as a means to handle cattle, they were trained to respond to a given sound. To increase the responsiveness, the sound was combined with the supply of supplemental feeds. The result of training showed that on the first day the cattle were guided by man, and from the second day the guiding by man was not necessary. On the 4th day the response time was shortened to 30 min: the training was almost finished. The training effect varied with differences in shape of grazing plots, range of sight, woodland, vegetation, and weather, but the use of experienced cattle increased remarkably the efficiency of sound-guiding (Plate 2).

Overall process of the new method of beef production

The target is to raise beef cattle with 600–650 kg by a very short-term fattening of feeder cattle, 24 months of age with body weight more than 500 kg, by reducing cereal consumption by 30% and production cost by about 50% of those of the customary fattening practice.

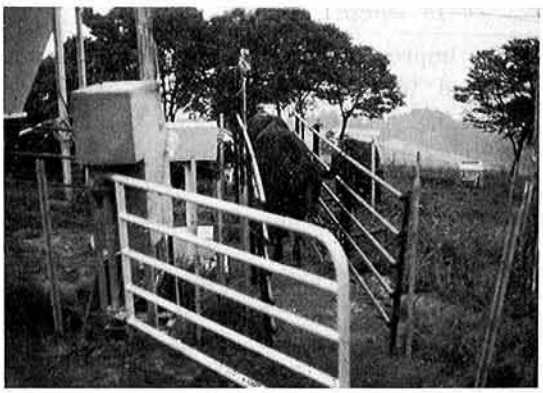

Plate 1. Automatic opening of gate to the grazing plot

Plate 2. In response to the sound of ringing bell, cattle move towards the sound source from grazing plot

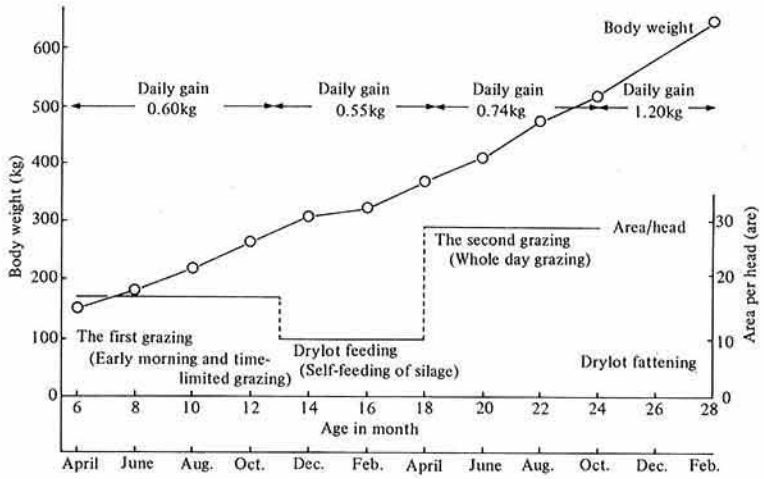

Fig. 2. A new method of beef production by grazing for two seasons

1) Time-limited grazing in the first season (6–15 months of age)

The improved method of grazing, which is regarded to be optimum to the calf physiology, i.e. the early morning grazing and the time-limited grazing, were adopted.

With the intake of grasses of 1,187 kg (dry matter) and beetpulp of 210 kg, 135 kg of gain (daily gain 0.60 kg) was obtained. Results shown in Table 2 prove to be highly evaluated.

2) Ad libitum feeding of silage in winter (15–18 months of age)

Ad libitum feeding of silage with high moisture content after the end of the grazing season resulted in the intake of 1,001 kg of dry matter (1.9–2.0%/body weight) and 0.40–0.65 kg of daily gain.

3) Whole day grazing in the second season (19 to 24 months of age)

This grazing method was found most suitable for the second season, giving the daily gain as high as 0.74 kg with the consumption of 2,194 kg of dry matter during a period of 6 months. As summarized in Fig. 2, the body weight which tended to be stagnant during the drylot feeding period increased markedly in this season, showing 0.74 kg of daily gain without supplemental feeds. Thus, the com-

Table 2. Results of improved time-limited grazing for the first season

Breed	No. of cattle (head)	Weight gain (kg)			Index against Japanese Black (%)	Days of grazing (day)
		Drylot feeding period	Grazing period	All year round		
Japanese Black (steers)	10	79(0.49)	82(0.40)	161(0.44)	100	204
Japanese Brown (steers)	10	75(0·47)	103(0.50)	178(0.48)	110	204
Japanese Short Horn (steers)	10	105(0.65)	117(0.57)	222(0.61)	138	204
Holstein (steers)	10	113(0.63)	122(0.54)	235(0.64)	146	204
Hereford (steers)	10	92(0.57)	143(0.70)	235(0.64)	146	204
Charolais Holstein (steers)	6	— —	133(0.60)	— —	142	221
Charolais Japanese Black(steers)	6	— —	129(0.59)	— —	137	221
Holstein (heifers)	300	— —	114(0.60)	— —	130	153
Holstein* (steers)	35	— —	117(0.77)	— —	167	153

Note 1)* indicates the second season's grazing
2) Figures in parenthesis indicate daily gain

Table 3. Cost of feeds required for two seasons grazing + short term fattening
(unit: DM kg)

	Grazing period(212+187 days)		Drylot feeding(153 days)		Fattening period(140 days)	
Feed intake and feed cost	Pastures	Beetpulp	Grass silage	Beet putp	Formula feed	Rolled barley
Intake for the 1st season	1,187	210	1,001	183	0	0
Intake for the 2nd season and fattening period	2,291	0	0	0	725	295
Feed requirement / head	3,478	210	1,001	183	725	295
Unit price (yen/DM kg)	14.0	49.3	21.0	49.3	47.0	52.0
Cost of feeds (yen/head)	48,692	10,353	21,021	9,022	34,075	15,340

Note : The proposed method, the data of which are shown above, is as follows : Using calves of 6 months of age, 7 months of grazing, 5 months of drylot feeding, and the second season's grazing for 6 months, followed by the fattening for 4.7 months (Rice straw of 388kg was used additionally). Finished at 650kg. The customary method is fattening for 22 months, using calves of 8–9 months of age, to finish at 660kg. The cost of feeds for the former was 138,503yen (59.5%) in contrast to 232,921yen (100%) of the latter.

pensatory effect was apparently recognized. Cost of feeds required for the period from the beginning of the first grazing season to the end of the second grazing season is shown in Table 3, indicating only Yen 89,000 per head.

4) Fattening effect and meat productivity

After the second season's grazing, the fattening was made. By 140 days of self-feeding the cattle consumed 725 kg of formula feeds, 295 kg of rolled barley and 88 kg of rice straw. The finished weight was 640.8 kg. As to the meat productivity, dressed weight was 354 kg (dressing percentage 55.2%), marbling was +0.6, and the grading was medium standard.

Thus, it was verified that the stable production of medium grade meat of healthy cattle can be achieved quite efficiently with a very short period of fattening with the cost as low as 60% of that of the customary fattening (Table 3), when born formation is sufficiently made and grazing tolerance is increased in the first grazing season, followed by high compensatory growth in the second grazing season.

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