Effect of integrated technology for fattening beef cattle in the livestock zone of North Sulawesi

Ratri Retno Ifada¹, Paulus C Paat¹ and Yusuf²

¹Agricultural Institution of Assessment Technology – North Sulawesi
²Indonesia Center of Horticulture Research and Development, Indonesia

E-mail: ra3.ifada@gmail.com

Abstract. This on-farm study aims to increase beef cattle productivity by utilizing integrated technology packages for local cattle fattening with a target of at least 800g/head daily gain. This study was carried out in the Minahasa Selatan district from August to October 2018. The integrated technology package for the fattening business pattern included: (1) complete feed, (2) intensive maintenance in multi-purpose cages, and (3) eradication of complete parasites. A complete feed is formulated in a balanced feed consisting of ammoniated rice straw and concentrate locally. The amount of dry matter concentrate was given per head is 1.5% of body weight (50% total consumption), while the ammoniated straw was ad libitum. For multipurpose cages, the upper part is equipped with a multipurpose tower as a barn while simultaneously serving straw, ad libitum, and continuous. Complete eradication of parasites using broad-spectrum anti-parasites to eradicate endoparasites that attack digestive tissues and other internal organs and ectoparasites to control the skin worms and eyeworms, cattle grubs, mange mites, sucking lice, sand tampans, and ticks. This study used fifteen local PO bulls fattened with an initial body weight of an average of 278.4 kg (± 54.34) with an observation period of 12 weeks. The observations showed that the average daily gain was 1,158 g / head, feed consumption 8,358 kg DM/head / day, and feed conversion ratio of 7.56. In contrast, the results of the business feasibility analysis showed a BCR coefficient of 1.69. The results of statistical analysis showed that the average weight gain increased significantly (p <0.01) after utilizing integrated fattening technology (308.8vs278.4 kg). It was concluded that the use of integrated technology for cattle fattening in beef cattle could increase productivity significantly and economically feasible.

1. Introduction
Predictions of beef consumption in Indonesia in 2018 are 663,000 tons, but the reality of the ability of domestic production is only about 60%. One of the Agriculture Ministry Programs to achieve beef self-sufficiency targeted to be achieved in the next year 2026 is the establishment of the National Development Zone of beef cattle through Ministry of Agriculture Decision no.83/2016 including North Sulawesi Province.

The performance of slaughtering fattening at the rural peasant level in the Cattle Zone of South Minahasa Regency of North Sulawesi is still 100-200 g/head/day [1-4]. Rearing cattle practice that is still commonly traditionally extensive is the primary reason to do transformation drastically by adopting modern management and high-productivity to be a stepping-up in production and productivity.
In supporting high-yielding of beef cattle farming, the Central Research Institution of Animal Science (CRIAS) has issued standards for achieving performance in production; 12 months calving interval, fattening with gain 800 g/head/day of local breed, gain 1,200 g/head/day of crossbreeding, and a minimum gain 1,200 g/head/day for imported cattl. A technical package for innovation to support the production of beef cattle is available thoroughly at the Indonesian Agency for Agriculture Research and Development (IAARD).

The introduction of technology is still generally found some problems in the field, shown by the gap that appeared to the animal performance in the field compared to research results. There is no denying that the adoption of innovations is still foreign to farmers who have not experienced it. The farmers commonly can not apply the technology thoroughly but still partially. Therefore, it is necessary to compile a complete technological form of information in the form of integrated technology packages that are implemented together.

The assessment carried out in the National Beef Cattle Development Zone in South Minahasa Distrik involved the local beef cattle fattening scope. This study aims to increase the productivity of fattening cattle by utilizing integrated innovation to achieve a weight gain of at least 800 g/head/day.

2. Methods
The assessment was carried out in South Minahasa District - North Sulawesi Regency in 2018, held for 12 weeks (August - November 2018). Integrated technology packets for fattening cattle include, among other things, (1) complete feed, (2) intensive maintenance in a multi-function shed, and (3) complete eradication of parasites.

Completed feed is formulated in a balanced feed consisting of ammoniation rice straw and local concentrate. The ammoniation process uses a 25 m³ concrete silo with an estimated capacity of 5 tons of fresh straw [4,5]. The dosage of urea fertilizer used in urea solution to be sprinkled on the straws is 5 kg per 100 kg dry matter (DM) of rice straw [4,6]. The volume of water in the urea solution 1 litre per kg of rice straw DM [7]. The duration of fermentation in ammoniation is 20 days [4,6,8].

The concentrate feeds formulated from the local feedstuffs such as cornflour, rice bran, and coconut meal are relatively abundant in North Sulawesi. It is recommended to use complete commercial mineral, which is available in local shops for the mineral. It refers to the national nutrient requirements requirement, which is crude protein 12-14% and metabolic energy 2,800 kcal/ kg (table 1). The amount of concentrate given per animal was as much as 1.5% of body weight by assuming it has reached 50% of the total standard feed consumption.

| Feedstuffs      | Protein | Metabolic energy |
|-----------------|---------|------------------|
| Corn flour 30 kg | 2.10 %  | 645 kcal/kg      |
| Coconut meal 20 kg | 4.32 %  | 570 kcal/kg      |
| Rice bran 50 kg | 7.00 %  | 1,660 kcal/kg    |
| Total 100 kg    | 13.42 % | 2,855 kcal/kg    |

Source: Calculated based on Composition Table of local Indonesian Feedstuffs

In this study, the number of animals was 15 crossbred Ongole feeder cattle with an average initial body weight of 278.4 kg with a standard deviation of 54.34 during the 12-week observation period. Livestock is placed in a shed condition that can easily consume continual forage from rice straw tower with ad libitum, while concentrate feed is offered using feed box individually.

This study used broad-spectrum anti-parasitic injection to eradicate parasitic technology to stop parasitic invaders that attack digestive organs and other internal organs, whereas ectoparasites that are exterminated cover the flea group the clay group, the skin and eye groups, and the larval larvae. Drugs used are injected with a subcutaneous dose of 1 ml per 50 kg of live weight. The frequency of eradication is only done during observation at the beginning of the study [9].
For the shed technology, at the top, it is equipped with multipurpose rice straw towers while at the same time functioning automatically and offer the forage feed ad libitum. Straw tower type letter V or inverted prism [10] with a volume size of about 25 m$^3$ with a capacity of about 5 tons of rice straw. The construction of the shed, which is equipped with a straw tower, allows the plant to never run out of forage like in pastures.

Observed data include body weight gain, feed consumption, feed conversion, cost and income structure, and farmers' responsiveness. Weighing the body weight gain of animals was done two times, i.e., before applying the weighted technology as the initial body weight data and after the application as the final body weight. For statistical analysis, the impact of assisting innovation on body weighting is by "after-before" approach using non-parametric statistical analysis in paired or t-test [11], with mathematical analysis as follows:

$$ t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2} - 2r \left( \frac{s_1}{\sqrt{n_1}} \right) \left( \frac{s_2}{\sqrt{n_2}} \right)}} $$

where:

- $\bar{x}_1$ = average data 1
- $\bar{x}_2$ = average data 2t
- $S_1$ = deviation of data 1
- $S_2$ = data deviation 2
- $S_{21}$ = data variance 1
- $S_{22}$ = data variance 2
- $r$ = correlation between samples

For financial analysis, an analysis of the feasibility of a profit-sharing effort or cost or BCR [11]. Criteria for B / C Ratio of an enterprise is a value $> 0$ means a profitable business, a value of $< 0$ an unfavourable business, and 0 a breakeven point business. The BCR mathematical formula as follows:

$$ \text{B/C} = \frac{\text{Benefit}}{\text{Cost}} $$

To measure the efficiency of each business against each use of one unit of data input, it is described by the balance between the amount of revenue and the total cost (expenditure) through the approach [1,11,12] as follows:

$$ \text{R/C} = \frac{\text{Revenue}}{\text{Total Cost}} $$

The value of $\text{R} / \text{C} > 1$ indicates that the business is financially feasible because the amount of revenue is greater than the amount spent. Meanwhile, the Break Event Point, which is a condition in which the business results obtained are the same as the capital issued, meaning that the business that is being carried out does not get a profit, but also does not experience a profit break-even loss [12]. This break-even point can be seen from BEP for production price/kg and BEP for production volume.
The production BEP value (BEP in price) can be obtained using the formula [12] as follows:

$$BEP\ in\ price = \frac{Total\ Cost}{Price\ of\ Products}$$

(4)

To find out the level of production and the minimum price for the impact of the introduction of this integrated technology to benefit farmers, a break-even point analysis (BEP in production) is approached. The break-even point formula [12,13]:

$$BEP\ in\ production = \frac{Total\ Cost}{Price\ of\ Products}$$

(5)

3. Results and discussion

3.1. Performance of Fattening Cattle

Table 2 shows that during the 12-week or 84-day observation period, feeder cattle experienced an average body weight gain of 97.3 kg, with such a daily gain is 1,158 g/head. This result is relatively high because the daily gain target achieved is a minimum of 800 g/head/day for the PO local breed. The standard daily gain of local cattle like PO is 800 g/head, 1,000 g/head for cross-breed.

Daily gain of fattening of local PO in Minahasa with complete feed from native grass as a basal feed and the addition of complete local concentrates obtained 860 g/head [5]. Fattening local POs in North Minahasa with complete feed from corn straw as basal feed and the additional total concentrate is given 760 g/head [5]. The average daily gain of Ongole Cross Cattle in Sumedang is only 250 g/head/day by using conventional raising in farmer condition [14].

The high performance achieved in this study was also caused by the high amount of feed consumption which was 8.35 kg DM/head/day, because the average body weight of feeder cattle which was fattened was more than 300 kg (initial weight 278.40 kg and final weight 375.27 kg) as appear in Table 2. The coefficient of feed conversion ratio is 7.6, which means that to raise 1 kg of live weight, it takes 7.6 kg of DMfeed (Table 2). Paat (2017) reports that complete feed conversion for fattening PO with an average body weight of 400 kg is 5.7 [15]. [16] reports that imported Limousine and Simental breed appear live weight gain 1.3-2.0 kg, cross-breeding Limousine x PO given weight gain 1.0-1.7 kg. Bali cattle give 600-700 g daily gain by using a complete local concentrate with rice straw forage as basal diet [17]. Adiwinarti (2011) reported that the local breed Sapi Jawa could grow 650 g/head/day using rice straw with a deference level of protein diet [18].

Table 2. Average feed consumption, daily weight gain, and feed conversion ratio.

| Variable | Kg |
|----------|----|
| Initial body weight of cattle kg/head (a) | 278.40 |
| Final body weight of cattle, kg/head (b) | 375.27 |
| Weight gain, kg/head (c) = (b) - (a) | 97.27 |
| Daily weight gain, g/head/day (d) = (c)/84 hari | 1.158 |
| Feed consumption, kg DM/head/day (e) | 8.35 |
| Feed conversion ratio (f) = (e)/(d) | 7.60 |

3.2. Financial analysis
Table 3 presents the financial analysis of the cattle fattening business for 84 days. The total production value of the body weight gain of the fattened cattle for around three months is IDR 583,362,500, with a profit of IDR 34,585,500 - after the costs of production facilities and labour as operational costs, and bank interest as fixed costs.

The relatively high value of BCR obtained in this study impacts the higher competitiveness of the fattening business. The low price of complete feed from the feed formula for fattening cattle is caused partly by the majority of which comes from rice straw waste as a basal feed or most of the reinforcing feed (concentrate ration from the rice straw waste product). The use of straw towers also dramatically saves the operational costs of fattening. In addition to accommodating a large number of trays as a feed bank, it can also work automatically to provide livestock who save farmworkers’ labour.

With a BCR coefficient of 1.69, it means that for each investment of IDR 1,000, a profit of IDR 1,690 will be obtained, so this business is feasible, while the BEP in Price is IDR 15,903.58. Paat (2017) reported that the value of BCR fattening beef cattle of local PO cattle in North Sulawesi was 1.63 [15], while for PO cattle fattening in Wonosobo was 0.26 [17]. Bawinto (2016) reported that BEP in beef cattle production in Bolmut District North Sulawesi is 5,0 head per farmer [19]. Sahala (2016) reported that BEP in Limosin x Po Cross Breed production is five head per farmer [17].

Table 3. Financial analysis of fattening cattle for 84 days period.

| No | Item                        | Volume               | Unit | Unit cost (IDR) | Total (IDR) |
|----|-----------------------------|----------------------|------|-----------------|-------------|
| I  | Cost                        |                      |      |                 |             |
| 1  | Feedstuffs                  | 12,600 (15 head x 10 kg x 84 days) | Kg   | 1,400           | 17,640,000  |
| 2  | Labor                       | 42 (84 MD x 0.5 days) | Man  | 100,000         | 4,200,000   |
| 3  | Drug                        | 1                    | Btl  | 475,000         | 475,000     |
| 4  | Bank interest¹)             | 12                   | %    | 1,461,500       | 1,461,500   |
|    | Total Cost                  |                      |      |                 | 23,776,500  |
| II | Revenue                     |                      |      |                 |             |
|    | Production value (gain x price per kg live weight) | 97.27 kg x 15 ekor=1,459.05 kg | 40,000 | 58,362,000     |
| III| BEP                         |                      |      |                 |             |
|    | a. BEP in price             |                      |      |                 | 15,903.58   |
|    | b. BEP in production        |                      |      |                 | 594.41      |
| IV | Profit                      |                      |      |                 | 34,585,500  |
|    | B/C Ratio                   |                      |      |                 | 1.45        |
| V  | R/C Ratio                   |                      |      |                 | 2.45        |

¹) Monthly bank interest is 1% of the cost of a 15-head x 278 kg x IDR 35,000 = IDR 1,461,500

Break-even point in price value (BEP in price) for introducing integrated technology for beef cattle fattening in beef cattle areas in North Sulawesi (table 3) 594.41 kg. This means that the introduction of integrated technology breaks even when the business reaches production of 595.41 kg, with a price of IDR 40,000 / kg live weight of the cow. Meanwhile, the break-even point value of the integrated technology introduction of cattle fattening is IDR 15,903.48 / kg, meaning that 97.27 kg production will break even if the price per live weight of the cow is equal to IDR 15,585, - / kg.

3.3. Performance integrated technology and perspective of farmers
Table 4 presents data on the impact of integrated innovation on the productivity of the fattening cattle. The high achievement of the fattening performance of these studies can be caused by the innovations applied in the integrated facilitation of integrated technology that will be balanced or complete, eradicating parasites, and management of the shed (integrated technology for cattle fattening). Farmer
perspective also encourages application innovation with high precision to all standard operational procedures that are arranged participatory.

**Table 4.** Bodyweight change of fattening cattle before and after applies integrated technology (1 Sep - 16 Nov 2018).

| Eartag (replication) | Body weight (kg/head) | Before integrated technology | After Integrated technology |
|----------------------|------------------------|-----------------------------|-----------------------------|
| 1                    | 258                    | 300                         |
| 2                    | 355                    | 502                         |
| 3                    | 275                    | 371                         |
| 4                    | 316                    | 421                         |
| 5                    | 300                    | 414                         |
| 6                    | 359                    | 488                         |
| 7                    | 225                    | 321                         |
| 8                    | 245                    | 338                         |
| 9                    | 160                    | 247                         |
| 10                   | 232                    | 386                         |
| 11                   | 271                    | 358                         |
| 12                   | 297                    | 354                         |
| 13                   | 278                    | 338                         |
| 14                   | 334                    | 382                         |
| 15                   | 271                    | 316                         |  

Average initial and final body weight, g/head  
278.4                          375.7

**Table 5.** t-test: paired two samples for means.

|                                | Before integrated technology | After integrated technology |
|--------------------------------|------------------------------|------------------------------|
| Mean                           | 278.4                        | 308.8                        |
| Variance                       | 2,739.828571                 | 3,149.171429                 |
| Observations                   | 15                           | 15                           |
| Pearson correlation            | 0.982489417                  |                              |
| Hypothesized mean              |                              |                              |
| Difference                     | 0                            |                              |
| Df                             | 14                           |                              |
| t Stat                         | -10.87963376**               |                              |
| P(T<=t) one-tail               | 1.62803E-08                  |                              |
| t Critical one-tail            | 1.761310115                  |                              |
| P(T<=t) two-tail               | 3.25606E-08                  |                              |
| t Critical two-tail            | 2.144786681                  |                              |

***) Show significant difference (p<0.01)
In addition to the integrated technology for fattening cattle, elements technology tutorial, and application technology, demonstration plot has a powerful influence on technology adoption with high precision. The high yield obtained resulted from a combination of technology packages combined with improved farmer skills and knowledge that became one in the approach of accompaniment and escort of application technology.

The statistical test results showed that the integrated innovation had a very positive effect \( (p < 0.01) \) on weight gain (table 5). By adopting integrated technology that matches the needs of the farmers and sustainable assistance activities, the output produced from a business is more significant if it is compared to conventional practices.

Field observations showed that the assistance greatly affected the plots of farmers to make management changes. This has led to the implementation of innovations introduced quickly and effectively, which have impacted their very high performance. With such a function of assistance to increase productivity and accelerate the improvement of innovation is running well.

4. Conclusion

It was concluded that the use of integrated technology for fattening cattle in animal region areas could increase productivity significantly and profitable. The average body weight gain achieved more than 800 g/head/day. The coefficient benefit-cost ratio was 1.69 give a new hope to raise the fattening cattle in the National Beef Cattle Zone in South Minahasa of North Sulawesi. The introduction of integrated technology breaks even when the business reaches production of 595.41 kg for IDR 40,000 / kg live weight of a cow. In comparison, the break-even point value is IDR 15,903.48 / kg, meaning that for production of 97.27 kg, it will reach break-even point if the price per live weight of a cow is IDR 15,585 / kg.

The policy implication is introducing integrated fattening technology in collaboration with entrepreneurs or cooperatives under the partnership scheme. To strengthen farmer group capital, program synergy, firm commitment, and budget sharing (in-kind) from the local government are needed.

Acknowledgement

This paper can be arranged for the support, assistance, and cooperation of various parties. To this end, the authors say thank you to Ir. Jantje G. Kindangen, MS, contributed to the writing of these scientific papers. The writing team also thanked Batu Kurung Farmers Group - South Minahasa for providing all research material during the study.

References

[1] Kaligis D A and Constantine Simolang 1990 Proceedings of workshop forages for plantation crops Aciar Proceedings ed H M Shelton and W W Stür (Canberra, AU: Australian Centre for International Agricultural Research) pp 45–8

[2] Paat P C 2018 Teknologi pakan ternak mendukung pengembangan sapi potong di Sulawesi Utara (Sulawesi Utara: IAARD PRESS)

[3] Paat P C, Erik I M, Aryanto and Derek P 2016 Laporan hasil pengkajian dan diseminasi (Sulut: BPTP Sulut)

[4] Paat P C 2016 Limbah padi dan jagung untuk pakan dan nutrisi sapi (Jakarta: I. IAARD Press)

[5] Paat P C, Derek P, Richard R and Jemmy W 2018 Laporan hasil kajian dan dieminasi (Sulut:BPTP Sulut)

[6] Winugroho M 1991 Pedoman cara pemanfaatan jerami pada pakan ruminansia Balai Penelit. Ternak, Bogor

[7] Soejono M 1998 Teknologi pakan untuk ternak ruminansia (Yogyakarta: Universitas Gadjah Mada)

[8] Badrudin U 2011 Teknologi Amoniasi untuk Mengolah Limbah Jerami Padi sebagai Sumber
Pakan Ternak Bermutudi Desa Pabuaran Kecamatan Bantarbolang Kabupaten Pemalang J. Abdimas 15

[9] Dirjen PKH 2016 Produksi daging lokal 2018 belum penuhi kebutuhan domestic. (Jakarta: Kementan)

[10] Paat P C, Ratri R I, Mardiana and James M 2018 Laporan Hasil Pengkajian dan diseminasi BPTP Sulut

[11] Hendayana R 2016 Analisis data pengkajian Indones. Agency Agric. Res. Dev. Press. Buku Badan Litbang Pertanian. Jakarta. Hal 180

[12] Yusuf 2012 Jeruk Keprok SoE (Jakarta: Orbit)

[13] Yusuf Y 2015 Pemanfaatan Pangan Lokal Di Provinsi Nusa Tenggara Timur: Pengolahan Pangan Lokal Menjadi Tepung, Analisis Usaha dan Implikasi Kebijakannya Agritech J. Fak. Pertan. Univ. Muhammadiyah Purwokerto 17 39–54

[14] Wiyatna M F 2012 Productivity of crossbred Ongole cattle on traditional farm system in Sumedang Region) J. Ilmu Ternak Univ. Padjadjaran 12

[15] Paat P C and Jantje G K 2016 Peningkatan Produktivitas Pakan dan Nutrisi Sapi pada Areal Kelapa Melalui Introduksi Pennisetum purpureum Schum cv. Mott Buletin Palma 17 71 - 78

[16] Varitsal A A 2016 Analisis penggemukan sapi potong jenis simental dan limousin (Kediri:UNPGRI)

[17] Sahala J R Widiati dan E. Baliarti. 2016. Analisis kelayakan finansial usaha penggemukan sapi simmental peranan ongole dan faktor-faktor yang berpengaruh terhadap jumlah kepemilikan pada peternakan rakyat di kabupaten Karanganyar Bul. Peternak. 40 75–82

[18] Adiwinarti R, Fariha U R and Lestari C M S 2011 Pertumbuhan sapi Jawa yang diberi pakan jerami padi dan konsentrat dengan level protein berbeda J. Ilmu Ternak dan Vet. 16 260–5

[19] Bawinto A, Mokoagouw D R, Elly F H and Manese M A V 2016 Analisis break even point ternak sapi potong kelompok tani “sumber hidup sejati” di Kecamatan Bintauna Kabupaten Bolaang Mongondow Utara ZOOTEC 36 262–70