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# SOME FACTORS AFFECTING INTENSIVE REARING ADOPTION ON BEEF CATTLE FARMERS IN WAJO REGENCY, SOUTH SULAWESI PROVINCE

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## ABSTRAK

Konflik penggunaan lahan antara pertanian dan peternakan menyebabkan ternak sapi potong harus dipelihara secara intensif. Tujuan penelitian ini adalah untuk mengetahui tingkat adopsi pemeliharaan sapi potong secara intensif serta faktor-faktor yang mempengaruhi peternak mengadopsi pemeliharaan intensif. Jenis penelitian adalah penelitian survei dengan jumlah responden 90 orang dari 578 petani. Pengumpulan data menggunakan kuisioner dengan pertanyaan tertutup. Analisis data menggunakan model regresi berganda. Tingkat adopsi pemeliharaan intensif (variabel dependen) diukur berdasarkan tingkat adopsi perkandangan, pemberian pakan, penanganan reproduksi, penanganan kesehatan ternak dan pemanfaatan feces. Variabel independen terdiri dari intensitas penyuluhan yang diterima, keuntungan relatif, norma subyektif peternak, kontrol perilaku, sikap, umur peternak, luas lahan sawah dan skala usaha. Tingkat adopsi perkandangan, pemberian pakan, penanganan reproduksi dan penanganan kesehatan ternak oleh peternak berada pada level sedang (rata-rata >50% peternak) sedangkan pemanfaatan feces berada pada level rendah. Faktor yang berpengaruh positif terhadap adopsi pemeliharaan secara intensif di kabupaten Wajo adalah kemampuan peternak mengontrol perilaku adopsi pemeliharaan intensif (signifikan pada level 1%), posisi peternak pada strata sosial masyarakat atau norma subyektif (signifikan pada level 5%) dan keuntungan relatif yang dirasakan peternak dari usaha sapi potong (signifikan pada level 5%). Lain halnya dengan kontak dengan penyuluh, umur, sikap, luas lahan dan skala usaha tidak berpengaruh signifikan pada tingkat adopsi pemeliharaan intensif. Untuk mendorong adopsi teknologi pemeliharaan intensif, maka materi penyuluhan yang dikembangkan hendaknya menyentuh proses psikologi yang terjadi dalam diri peternak seperti materi tentang tingkat keuntungan dari pemeliharaan intensif dan tingkat kemudahan dalam melaksanakan pemeliharaan.

*Kata kunci: adopsi, sapi potong, pemeliharaan intensif, penyuluhan*

## ABSTRACT

Land use conflict among agriculture and animal husbandry caused beef cattle must be kept intensively. The objective of this research was to identify adoption level of beef cattle intensive rearing and some factors that affecting farmers adoption. Research design was survey with 90 respondents from a total of 578 farmers. Data were obtained through interview and observations using questionnare with close question. The data were analyzed with multiple regression models. The level of intensive rearing adoption (dependent variable) was measured based on housing system, feeding, reproduction, health management and feces utilization. While, independent variables were based on the intensity of extension, relative adventage, subjective norm, control of behavior, attitude, age, land area and scale of business. Level of housing system, feeding, reproduction and health management were in the medium

level (average >50% of farmers), while feces utilization was in the lowest level. Factors that positively affected farmer adoption in Wajo regency were the ability of the farmers to control their behavior ($p<0.01$), farmer position in social community or subjective norm and relative adventage were significant with $p<0.05$. Another case with contact to the extension, age, attitude, land area and scale of business were no significant affected farmers adoption. To enforce adoption of intensive rearing technology, extension program should be developed to influence farmers psychology such profit level of intensive rearing and convenience on cattle handling.

Keywords : adoption, beef cattle, extension education, intensive rearing

## INTRODUCTION

The beef cattle intensive rearing have to be applied to the current farming conditions because availability land for agriculture is going to be decreased. Land use conflicts with other sectors such as housing, industry and even the growing of food crops is still occur. In intensive rearing, land use is limited. Beef cattle is kept in restricted area so that control of animal health, feed quality, robing, waste management and sanitation can be intensively from beef cattle farmer (Rahmanto, 2004).

Intensive beef cattle rearing in Wajo Regency, especially in Pammana sub district has grown extensively and serve as a refference for other areas in this region. Intensive rearing started from a pilot project of Wajo Livestock Services in 2001 by implementation of integrated stable system with biogas production, ricestraw feed processing and organic fertilizer production from animal waste and biogas slury. On progress, this project could be adopted by most of the farmers in various level. Not all of intensive rearing package could be adopted by farmers, especially in terms of biogas technology and processing of animal waste as organic fertilizer.

Dissemination of intensive rearing to the beef cattle farmer has been carried out using several media and method such as demonstration plot, mass education, leaflets, polder and audio visual (Sariubang and Pasambe, 2005; Elizabeth, 2006; Yufdi *et al*., 2006). However, the level of adoption of intensive rearing is still low. The Application of cattle housing, feeding, reproduction and waste management is not fully adopted by the beef cattle farmer. They only adopted cattle housing system without adopting feed technologies or reproduction and waste management. In Maros, Baba *et al*. (2014) showed that the adoption of beef cattle intensive rearing is medium level because beef cattle farmer have adopted feed technology such as using rice and corn straw and the application of using manure as organic fertilizer.

Research on factors that influence the adoption of technology has been widely applied. Broadly speaking, the factors that influenced technology adoption include those derived from farmer characteristics such as age, education, business experience and gender (Marenya and Barrett, 2007; Bayard *et al*., 2007). Other variables that influenced adoption of technology were characteristics and integrity of the extension agent, farmer linkages with sources of technology and cosmopolite of the farmer (Mardikanto, 2009) and technological characteristics as proposed by Rogers (2003) and Reimer *et al.* (2012) such as compatibility, relative advantage, complexity, and trial ability of the technology.

Research on the factors inhibiting the adoption of technologies focused more on related to the behavior of farmers caused by external stimuli (Rogers, 2003; Mardikanto, 2009). Research related farmer as human psychology such as how farmers perceive the technology, how social norms by farmers and farmer attitudes toward the technology is still developed. Based on theory of planner behaviour (Fishbein and Ajsen, 2010), psychology process was the main factor that influence farmer behaviour. Even for intensive rearing of beef cattle related to some issues such as agriculture sustainability, economic and issues of farm business strategic role in human life was less to do. Commonly, human psychology research on factors inhibiting the adoption of technologies related with environment-friendly technologies, sustainable agriculture and a wide range of technologies that require farmers' alignments in its application (Reimer *et al*., 2012; Martinez-Garcia *et al*., 2013).

Lack of research related factors inhibiting adoption of technology from human psychological perspective related with response to external stimuli cause farmer extension models proposed are relatively monotonous. In fact, information about the beef cattle farmer

psychological factors associated with the response to the stimulus received can be the basis for developing better methods of extension education. Extensionist or policy maker can create an extension method that is more creative and adaptive for the development of intensive beef cattle rearing.

The objective this study was to determine the factors that influence the adoption of intensive rearing of the psychological aspects of the beef cattle farmer and the stimulus it needs. If these factors can be identified, it can be argued that the extension model can be made to enhance the adoption of intensive beef cattle rearing.

## MATERIALS AND METHODS

The method of research was survey and it was held in Pammana Wajo District because the district is the center of intensive beef cattle rearing. The survey was conducted in July-October of 2010 by trained enumerators. The number of farmers who rear animals intensively reached 578 people. The number of samples was 90 respondent and was determined by using the Slovin formula (Umar, 2001). The data were collected through observation and interviews.

The empirical model used in this study was a multiple linear regression model as follows:

$$Yi = A + \beta_1 INTEXT\ (X_1) + \beta_2 RELADV\ (X_2) + \beta_3 SJNORM\ (X_3) + \beta_4 ATTD\ (X_4) + \beta_5 BEHAVC\ (X_5) + \beta_6 AGE\ (X_6) + \beta_7 FARMSIZE\ (X_7) + \beta_8 FAMLY\ (X_8) + \varepsilon$$

where:

Yi: The adoption rate of intensive rearing measured by the cattle housing system (the suitability of the location, shape, material and size availability), feeding technology (feeding forages, concentrates and supplements), reproduction (utilization of Artificial Insemination (AI), natural mating scheduled, without planning), prevention and disease control (attention to sanitation, vaccination and treatment), waste management (processing into organic fertilizer, biogas and bio urine)

INTEXT ($X_1$): Intensity of extension was expressed as intensity of contact with extensionist or mass media (number of contact)

RELADV ($X_2$): Relative advantage was expressed as perceptions of farmers to the relative advantage gained from intensive rearing (score).

SJNORM ($X_3$): Subjective norm was expressed as the perception of farmers towards what should be done in the view of the surrounding community based on their position (score)

ATTD ($X_4$): Attitude was expressed as attitudes of farmers towards intensive rearing technology in the form of a tendency to behave (score)

BEHAVC ($X_5$): Behavioral control was expressed as the perception of the ability to control behavioral beef cattle farmer if they adopted intensive rearing in the future (score)

AGE ($X_6$): Age was expressed as the length of their life (year)

FARMSIZE ($X_7$): Farm size was expressed as the number of livestock intensively reared (head)

FAMLY ($X_8$): Family size was expressed as number of farmers family (person)

The multiple linear regression type is estimated using SPSS.17.00 program for Windows.

## RESULTS AND DISCUSSION

### The Characteristics of Beef Cattle Farmers

The average of age's respondent was 45.23 years in the lowest age was 27 years and the highest was 57 years old. Respondents were in the productive age so the ability to adoption of technology was high. The average of business experience was 5.01 years with the range 3-12 years. The longer the experience of farming, the more experience will be gained in managing farming. The average of the family member was 3.24 people with the lowest and highest member was 2 and 7 respectively. Family labor in beef cattle farming can increase productivity their bussines. Supporting of productive age, business experience and family labor available can help the development of intensive beef cattle rearing in Wajo.

In general, the farmer education was low level namely 91.12% no formal education and elementary school (Table 1). Low levels of education caused lack of adoption the technology. Similarly, the average of farm scale was 4.74 heads, it mean that farm scale was relatively not economical scale.

### Adoption Rate of Intensive Rearing

The adoption rate of beef cattle intensive rearing measured using five indicators: cattle

Table 1. The Characteristic of Beef Cattle Farmers in Wajo Regency

| Variable | Average | SD |
|---|---|---|
| Age (Year) | 45.23 | 11.07 |
| Farming experience (year) | | |
| Main committee | 11.05 | 2.32 |
| Member | 6.26 | 3.45 |
| Family member (people) | 3.24 | 1.33 |
| Herd size (head) | 4.74 | 3.82 |
| Education (%) | | |
| No formal education | 35.56 | |
| Elementary School | 55.56 | |
| Junior High School | 6.67 | |
| Senior High School or more | 2.22 | |

SD: Standard Deviation

housing system, feeding, reproduction management, disease control and management of livestock waste using a three-level measurement, namely high, medium and low. The adoption rate is presented in Table 2.

Most of farmer have used materil of cattle barn to fullfilled the technical requirement (80%) while 20% did not use concrete or wood. Beef cattle farmers provided elephant grass (*Pennisetum purpureum)* or processing agricultural wastes (eg. paddy straw) and concentrates (14.4%) or pasture plus concentrate (60%). Twenty five point six percent of farmer provided a pasture without concentrates. Cow reproductive handling used AI technology (12.2%) and scheduled natural mating (53.3%). There were only 34.5% of farmers who did not have a cow mating program. In terms of disease control, there were 15.6% of farmers who had disease control programs along with the extension but 56.7% of farmers who controlled the disease without program. There were only 27.8% of farmers who did not exercise control of disease. Some beef cattle farmers have done composted waste management (41.1%) and biogas and compost bio urine together (14.4%). Fourty four point five percent of farmers did not do anything and just let the processing manure around the cattle barn (Tabel 2).

The intensive rearing adoption by the farmers in Wajo District provided several advantages for example allow the application of biotechnology, utilizing livestock waste and facilitate control of animal health (Diwyanto, 2008). Utilization of agricultural waste as feed treated with concentrate plus was done by 74.4% of farmers in Wajo District and provided economic benefits for farmers. Sariubang and Pasambe (2005) showed that the pattern of intensive rearing by utilizing corn straw as feed in Takalar reached the R / C ratio of 1.8.

**Factors Affecting the Adoption of Intensive Rearing**

The multiple regression analysis was conducted to determine the factors that influence the adoption rate of intensive rearing of beef cattle. Based on the statistical results can be obtained a number of factors that affect farmers adopting intensive rearing system:

From the data processing using SPSS 17.00 be adjusted R squared value of 0.435. That mean, 43.5% dependent variable was determined by independent variables while the influence of other factors excluded in the model was 56.5%. The following significant variables were relatively advantage ($p<0.05$), subjective norm ($p<0.05$) and behavioral control ($p<0.01$) while the variable extention intensity, attitudes, age, farm size and number of family members did not significantly influence the rate of adoption of beef cattle intensive rearing (Table 3).

The coefficient of the variable relative advantage was 0.21 and a positive significantly influenced to the rate of adoption changing. Increasing the value of relative advantage perceived by farmers in intensive system rearing will lead to increase adoption rate. This research was in line with the results of the D' Emden *et al.* (2008) that the economic benefit factor was one of the keys in the adoption of technologies by farmers because the farmers were rational profit maximize (Edward-Jones, 2006). The economic benefits was not only to the acceptance of the production but also in the overall context of farmer, including the provision of limited labor of small-scale farming (White *et al.,* 2005). In Wajo, the advantage of intensive rearing for beef cattle farmer was ease for feeding and reproduction control, reducing the use of labor, ease to control health and livestock theft. For example, the application of hay (paddy straw) as feeding in intensive rearing can reduce the obstacle of labor shortages in the rice-planting season.

Tabel 2. The Rate of Intensive Rearing System Adoption in Wajo Regency

| Maintenance Technology | Adoption Rate | | | Total (People) |
|---|---|---|---|---|
| | High | Medium | Low | |
| Cattle housing system | 13 (14.4) | 59 (65.6) | 18 (20.0) | 90 |
| Feeding practice | 13 (14.4) | 54 (60.0) | 23 (25.6) | 90 |
| Reproduction management | 11 (12.2) | 48 (53.3) | 31 (34.5) | 90 |
| Disease Control | 14 (15.6) | 51 (56.7) | 25 (27.8) | 90 |
| Waste Management | 13 (14.4) | 37 (41.1) | 40 (44.5) | 90 |

Number in the bracket: % of people

Tabel 3. The Factors Affecting the Farmers Adopted of Intensive Rearing

| Variable | Standradized Coefficient | Standard Error | T-Value | Significance |
|---|---|---|---|---|
| Constant | $3.473^{**}$ | 0.854 | 3.147 | 0.002 |
| Extent Intensity($X_1$) | $0.042^{ns}$ | 0.104 | 0.445 | 0.658 |
| Relative Advantage ($X_2$) | $0.201^{*}$ | 0.244 | 2.191 | 0.031 |
| Subjective Norm ($X_3$) | $0.223^{*}$ | 0.225 | 2.065 | 0.042 |
| Attitude ($X_4$) | $0.138^{ns}$ | 0.253 | 1.292 | 0.200 |
| Behavioral Control ($X_5$) | $0.333^{**}$ | 0.242 | 3.164 | 0.002 |
| Age ($X_6$) | $-0.010^{ns}$ | 0.014 | -0.126 | 0.900 |
| Farm Size ($X_7$) | $-0.045^{ns}$ | 0.042 | -0.547 | 0.586 |
| Family Size ($X_8$) | $-0.052^{ns}$ | 0.122 | -0.616 | 0.540 |

*Significance level at 5%; ** Significance level at 1%; ns: non significance; Adjusted $R^2$ : 0.435; F : 9.479; Number of sample : 90

In this study, subjective norm was defined as the perception of farmers to social pressures (role models, people and extensionist views) to him so that farmers adopt or not adopt intensive rearing system (Ajzen, 1991; Bergevoet *et al.,* 2004). Subjective norms significantly influenced to the rate of adoption of beef cattle intensive rearing ($p<0.05$). Increasing the perception of farmers against social pressure to behave increased the adoption rate of farmers towards intensive rearing system. In Wajo, a breeder who was a farmer group committee (chairman, secretary and treasurer) adopt intensive rearing was better than other farmers because they feel as an example or role model for other farmers. They had to adopt intensive rearing because their position in social system. This was same with the opinion of Heong *et al.* (2002) and Manner and Gowday (2010) that farmers were trying to put themselves in accordance with their social status. The main committee of farmer group was the view as a leader for other farmers, they should be a good person for other farmers. The main committee should be the person who first implemented the technology intensive rearing before the other farmer adopt it. Beef cattle farmer was not the main committee adopted the intensive rearing due to imitate the main committe of farmer group.

In Wajo, a main committee of farmer group adopted the intensive rearing since 2001 (first

introduced), while its members of farmer group began to adopt in 2006-2008. Adoption behavior of group members adopted intensive rearing termed imitation of peers (Schmit and Rounsevell, 2006; Efendi and Rashid, 2011) or imitate peer group intended to adopt intensive cattle maintenance. Rogers (2003) categorized groups of farmers such these in the majority of early adopters was a group that will do it after seeing evidence of other beef cattle farmers, they should be a good person for other farmers.

The Other factor that influenced farmers to adopt intensive rearing in Wajo was the perception of his/her ability to control the behavior of farmers ($p<0.01$). Farmers will adopt intensive rearing if he is able to control the behavior as a consequence of adopting the technology (Burton, 2004; Mzoughi, 2011). The consequences of intensive rearing was rising costs for the manufacture of cattle housing, handling and reproductive health of livestock, feed and waste treatment (Marawali *et al.,* 2004). In addition, intensive rearing required knowledge of farmers more than semi-intensive and extensive rearing systems. In Wajo, a farmer was able to hold the consequences of intensive rearing because of the high level of profits from intensive rearing. Beef cattle farmers had many advantages such as the sale of livestock, use of feces as organic fertilizer and the use of urine as a bio pesticide. The influence of economic factors are so strong was able to convince farmers to bear the consequences of the adoption of intensive rearing (Chouinard *et al.,* 2008).

To enhance the adoption of intensive rearing technology approach to the maintenance of the internal was important to note. Participatory extension methods can be done because, in principle, participatory extension methods will increase the intensity of its group of peer connectedness beef cattle farmer. Farmers who have successfully adopted the technology intensive maintenance have duty as a center for the dissemination of other beef cattle farmers. Other farmers will learn about the experiences of farmers who have successfully adopted the technology both in terms of benefits received and the consequences of the adoption of intensive rearing. Through the exchange of experience, the other farmers were expected to adopt the intensive rearing technology.

Besides that, the internal factors of farmer such as social norm, ability to implement intensive rearing technology and farmers perception to the relative benefit could affected farmers adoption and showed that farmers internal process becoming the main factors that could enforce farmers adoption. Internal factors that explained by Ajzen (1991) were the important factors enforcing someone attitude. Therefore, extension program should be described about advantages and convenience to be gained by farmers when adopting intensive rearing system.

## CONCLUSSION

The adoption rate of farmers towards intensive rearing system was at the medium level. Beef cattle farmers have adopted cattle housing system, utilizing forages and concentrates, the schedule of reproductive and health management while process and utilize feces as organic fertilizer was in the lowest level. The factors affecting the adoption of intensive rearing include the ability of the farmers to control their behavior, farmer position in social community or subjective norm, and relative advantage of intensive rearing perceived by farmers.

## REFERENCES


Ajzen, I. 1991. The Theory of planned behaviour. Org. Behav. and hum. decision proc. 50:179-211.

Baba, S., S. N.Siradjuddin, A. Abdullah and Aminawar. 2014. Hambatan adopsi integrasi jagung dan ternak sapi di Kabupaten Maros, Gowa dan Takalar. JITP. 3(2):24-28.

Bayard, B., C.M. Jolly and D.A. Shannon. 2007. The economic of adoption and management of alley cropping in Haiti. J. Env. Manag. 84:62-70.

Bergevoet, R.H.M., C.J.M. Ondersteijn, H.W. Saatkamp, C.M.J. van Woerkum and R.B.M. Huirne. 2004. Enterpreneurial behaviour of dutch dairy farmers under a milk quota system: goals, objectives and attitudes. Agric. Syst. 80:1-21

Burton, R.J.F. 2004. Reconceptualising the 'behavioural approach' in agricultural studies: a socio-psycological perspective. J. Rur. Study. 20:359-371.

Chouinard, H., T. Paterson, P. Wandshneider and A. Ohler. 2008. Will farmers trade profits for stewardship? Heterogeneous motivations for farm practice selection. Land Eco. 84:66-82.

D'Emden F.H., R.S. Llewellyn and M.P. Burton. 2008. Factors influencing adoption of

conservation tillage in Australian cropping regions. Aust. J. of Agric. Res. 52:169-182.

Diwyanto, K. 2008. Pemanfaatan sumber daya lokal dan inovasi teknologi dalam mendukung pengembangan usaha sapi potong di Indonesia. Pengemb. Inov. Pert. I(3):173-188.

Edward-Jones, G. 2006. Modelling farmer decision-making: concepts, progress and challenges. Anim. Sci. 82:783-790.

Efendi, J. and A. Rasyid. 2011. Faktor-faktor yang mempengaruhi percepatan adopsi inovasi Inseminasi Buatan (IB) pada sapi Madura (studi kasus pada kelompok ternak Barokah). Proceeding seminar nasional teknologi peternakan dan veteriner, Puslitbangnak Deptan, Bogor Indonesia, 7-8 June 2011 P. 314-319

Elizabeth, R. 2006. Partisipasi sebagai Strategi Pemberdayaan petani Miskin Melalui Program Integrasi Jagung dan Ternak. Pusat Analisis Ekonomi dan Kebijakan Pertanian, Badan Litbang Pertanian, Bogor.

Fishbein, M. and I. Ajzen. 2010. Predicting and Changing Behavior: The Reasoned Action Approach. Taylor and Francis, New York.

Heong, K.L., M.M. Escalada, V. Sengsoulivong and J. Schiller. 2002. Insects management belief and practices of rice farmers in Laos. Agric. Ecosys. and Env. 92:137-145.

Manner, M. and J. Gowday. 2010. The evolution of social and moral behaviour: evolutionary insights for public policy. Ecolo. Eco. 69:753-761.

Marawali, H.H., S. Ratnawaty and J. Nulik. 2004. Analisis produksi penggemukan sapi potong dalam program sistem usaha pertanian di kabupaten Kupang Nusa Tenggara Timur. Proseeding seminar nasional teknologi peternakan dan veteriner, Puslitbangnak Deptan, Bogor Indonesia, 4-5 August 2004 P. 148-154.

Mardikanto, T. 2009. Sistem Penyuluhan Pertanian di Indonesia. UNS Press, Solo.

Marenya, P.P. and C.B. Barret. 2007. Household-level determinants of adoption of improved natural resources management practices among smallholder farmers in Western Kenya. Food Policy. 32:515-536

Martinez-Garcia, C.G., P. Dorward and T. Rehman. 2013. Factors influencing adoption of improved grassland management by small-scale dairy farmers in Central Mexico and the implications for future research on smallholder adoption in developing countries. Livest. Sci. 152:228-238

Mzoughi, N. 2011. Do organic farmers feel happier than conventional ones? An exploratory analysis. Ecolog. Econ. 103:38-43.

Rahmanto, B. 2004. Analisis usaha peternakan sapi potong rakyat. ICASERD Working paper No. 59. Puslitbang Sosek, Badan Litbang Deptan, Bogor.

Reimer, A.P., D.K. Weinkauf, and L.S. Prokopy. 2012. The influence of perceptions of practice characteristics: An examination of agricultural best management practice adoption in two indiana watersheds. J. Rur. Studies 28:118-128

Rogers, E.M. 2003. Diffution of Innovations 5th ed. Free press, New York.

Sariubang, M. and D. Pasambe. 2005. Sistem Integrasi Jagung-Sapi Potong di Kabupaten Takalar Sulawesi Selatan. Proseeding seminar nasional teknologi peternakan dan veteriner, Puslitbangnak Deptan, Bogor Indonesia, 12-13 September 2005, P. 285-290

Schmit, C. and M.D.A. Rounsevell. 2006. Are agricultural land use patterns influenced by farmer imitation? Agric. Eco. and Environ. 115:113-127

Umar, H. 2001. Metode Riset Perilaku Konsumen Jasa. Ghalia Indonesia, Jakarta.

White, D.S., R.A. Labarta, and E.J. Leguia. 2005. Technology adoption by resource-poor farmers : considering the implications of peak-season labor costs. Agric. Systems 85:183-201

Yufdi, P., Khairiah and Kaharuddin. 2006. Potensi dan peluang pengembangan sistem integrasi tanaman-ternak di Kabupaten Serdang Bedagai, Sumatera Utara. Prosiding Lokakarya Nasional jejaring pengembangan sistem integrasi jagung-sapi. Puslitbangnak Deptan, Pontianak Indonesia, 9-10 August 2006. P. 87-91