FEEDING STRATEGIES FOR SHEEP ON JAVA, RESULT FROM ON-STATION AND ON-FARM RESEARCH

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ABSTRACT

In many farming systems the output of animal in term of meat and milk is less than what could be expected based on on-station research in experimental conditions. This paper related the results of an on-station trial that measured the effect of using Urea Molasses Blocks (UMB) with expectations and perceptions about the technology by stakeholders in field conditions. Moreover, it reports animal performance under existing farming conditions and it summarizes results of meeting with farmers where the aims and economics of keeping animal were discussed. The on-station feeding trial with UMB were used as supplement to a basal ration of elephant grass (*Pennisetum purpureum*) showed no effect on dry matter intake, liveweight gain and meat quality, while blood metabolites (blood urea nitrogen) showed significant differences as a result of three different levels of feeding. DMI ranged from 53 to 59 g/kgW$^{0.75}$, CP intake from 6.6 to 7.5 g/kgW$^{0.75}$, TDN intake from 29 to 33 g/kgW$^{0.75}$. Average daily gain (AD) ranged from 24 to 45 g/day and physical meat quality as judged the same for sheep in each treatment. Discussion with extensionist, farmers, butchers and housewives showed large differences in expectations about UMB feeding. The main reason for non-adoption of UMB appears to be lack of awareness and high costs. The measurement of animal performance under on-farm feeding conditions without UMB showed that average liveweight gain were 0.029; 0.048; 0.055 kg/day for male sheep and 0.023; 0.027' 0.049 kg/day for female under grazing alone (sheep were grazed whole day), without grazing (cut-carry system) and mixed production systems, respectively. Farmers used to feed different level of locally available supplement, ranging from nothing to 0.3 kg/day/animal with a corresponding range of liveweight gains from 0.026 till 0.057 kg/day/animal. Economic analysis shows that if feeds are costed at market prices it seems to make no sense to supplement at all, unless the return on meat is exceptionally good. This indicates on the one hand that farmers should either not supplement at all, except when they have access to supplement at a very favorable concentrate/liveweight gain (*e.g. near cities*). For those farmers it might even pay to use a supplementation strategy with high levels of concentrate. On the other hand, the results of the tentative economic evaluation also showed that farmers supplement even when there seems to be no grounds for that. This issue was discussed with the farmers at a latter point in time and appeared that farmer uses the supplementation as saving. It means that supplementation will be done if the farmers have more money. In addition, supplementation offered when there is a limited source of feed, mainly in dry season and it has not been done simultaneously.

(Key words: Feed strategies, Sheep, On-station and On-farm research)

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STRATEGI PAKAN DOMBA DI JAWA, HASIL PENELITIAN LAPANGAN DAN LABORATORIUM

INTISARI

Pada sebagian besar usaha ternak tradisional, hasil ternak yang berupa daging dan susu masih jauh di bawah hasil yang dicapai pada penelitian di stasiun percobaan. Penelitian ini memaparkan pengaruh pemberian Urea-Molases-Blok (UMB) pada domba yang dilakukan pada stasiun percobaan, disertai dengan persepsi dan harapan dari pihak-pihak terkait (peternak, dinas dan konsumen) tentang aplikasi teknologi pakan tersebut pada kondisi nyata/di tingkat peternak. Selain itu, penelitian ini juga melaporkan kinerja ternak domba yang dipelihara oleh peternak kecil, serta hasil diskusi dan wawancara tentang tujuan dan nilai ekonomis beternak domba. Hasil penelitian di stasiun percobaan tentang frekuensi suplementasi UMB pada pakan basal rumput gajah dan dedak halus tidak berpengaruh nyata terhadap konsumsi Bahan Kering (BK), Pertambahan Berat Badan Harian (PBBH) dan kualitas fisik daging, sedangkan kadar urea darah berbeda nyata. Konsumsi bahan kering berkisar antara 53-59 g/kg $W^{0.75}$, konsumsi protein kasar 6,6-7,5 g/kg $W^{0.75}$ dan konsumsi total nutrien tercerna adalah 29-33 g/kg $W^{0.75}$. PBBH domba bervariasi antara 24-45 g/ekor/hari, sedangkan penilaian yang dilakukan oleh konsumen tentang pengaruh frekuensi pemberian UMB terhadap kualitas fisik daging tidak menunjukkan perbedaan. Hasil diskusi dengan petugas penyuluh lapangan, peternak dan konsumen menunjukkan perbedaan persepsi dan harapan tentang suplementasi UMB. Alasan utama peternak tidak mengadopsi UMB adalah kurangnya pengetahuan, kesadaran dan biaya yang tinggi. Kinerja ternak domba pada kondisi peternak dan tanpa suplementasi UMB menunjukkan bahwa rata-rata PBBH domba jantan adalah 0,029; 0,048 dan 0,055 kg/ekor/hari, sedangkan pada domba betina adalah 0,023; 0,027 dan 0,049 kg/ekor/hari, berturut-turut pada sistem pemeliharaan yang digembalakan secara penuh, tanpa penggembalaan dan sistem pemeliharaan campuran. Peternak juga menggunakan suplemen dedak halus dengan jumlah pemberian antara 0-0,3 kg/ekor/hari dan menghasilkan PBBH antara 0,026-0,057 kg/ekor/hari. Analisis ekonomi menunjukkan, jika harga suplemen mahal, suplementasi tidak akan ekonomis, kecuali jika daging yang dihasilkan berkualitas sangat baik. Keadaan ini menunjukkan bahwa di satu sisi, peternak seharusnya tidak memberikan suplementasi, kecuali kalau akses terhadap suplemen tersebut mudah dan murah serta mampu meningkatkan PBBH. Di sisi lain, meskipun tidak bernilai ekonomis peternak tetap melakukan suplementasi karena mereka menganggap bahwa suplementasi merupakan salah satu cara menabung; suplementasi akan meningkatkan PBBH yang selanjutnya akan meningkatkan harga jual. Selain itu, suplementasi tidak dilakukan secara kontinyu, hanya dilakukan pada saat pakan hijauan terbatas terutama saat kemarau.

(Kata kunci: Strategi pakan, Domba, Penelitian laboratorium dan lapangan)

Introduction

In many farming systems the output of animal in term of meat and milk is less than what could be expected on the basis of feeding trials in on-station research. The reason for such disappointing production levels can lie in biological and socio-economic factors. Disease pressure, restricted use of scarce feed resources, other feed/or labor resource use, low nutritive content of the feed/or environmental stress are some of the biological factors that restrict animal output. Also the low prices of output compared with cost of feed and labor, the social relations in terms of gender issues etc., may lead a farmer

to go for output targets that are different from those achieved in literature or in other countries (Chamber et al., 1989; Schiere and de Wit, 1995; Rao et al., 1995). One of the ways to close the gap between on-station and on-farm realities is the use of methodologies from Farming System Research (FSR), in the case of this paper an on-farm trial and some topical PRA's. They help to identify any problem of farmers before introducing technologies, to enhance the effectiveness of agricultural research in order to improve the welfare of farm families (Collinson, 1983; Jain et al., 1995).

Animal output in the rural areas of Java is also lower than what is known to be biologically possible from literature. Sutama (1992) reported productivity in sheep with growth rate as low as 20-40 g/day, mortality rate of 40-50%, and birth and weaning weight as low as 1.5-2.1 kg and 5.9-9.7 kg respectively. When the birth weight of this sheep around 1.0-1.9 kg, the ADG was 43-52 g/day/animal when supplemented by commercial concentrate (Chaniago et al., 1988). Subandriyo (1998) stated that average weaning weight at 90 days of Javanese thin tail sheep less than 10 kg, while average weight at mature size around 20.9 to 24.8 kg.

This paper reports the result of both on station and on farm work. The work in the on station trial measured the effect of using UMB as supplementation strategy in nutritional term such as feed intake, liveweight gain and blood composition. Anindo et al. (1998); and Singh et al. (1999). While, others can claimed that results from UMB are low or absent (Chicco et al., 1972; Ernst et al., 1975; Schiere et al., 1989). The work with OFT's and topical PRA's relates the results with expectations and perceptions about the technology by different stakeholders in field conditions.

Material and Methods

The research consisted of two parts, namely: an on-station research and an on-farm research and interview with the farmers and other stakeholders. Thirty (30) Javanese thin tail sheep (15 male and 15 female) of approximately one year old were used in the on station trial. They were allocated to three treatments that consisted of different frequencies of urea-molasses feeding, i.e.:

UMB 1X: urea-molasses was given once a day;
UMB 2X: urea-molasses was given twice a day;
UMB 3X: urea-molasses was given three times a day.

Basal diet was given 3.5% of bodyweight based on dry matter requirement and it consist of elephant grass (*Pennisetum purpureum*) and rice bran was offered 60% and 40% respectively, namely about 3 kg Pennisetum purpureum and 0.16 kg rice bran. UMB addition was given 2.5% based on rice bran percentage. The design of this present research was done based on the result of the previous research. Previous research uses four treatments of supplementation, namely without supplementation (control), only urea, only molasses supplementation and supplementation with urea-molasses. The result of the research showed urea-molasses supplementation has significant effect in term of liveweight gain (ADG), feed intake, improve feed conversion compared to supplementation by urea or molasses alone. In combination with the literature which mentioned that urea-molasses supplementation will give a significant effect if the frequency of urea-molasses feeding was given more than once time a day, leading to execute the present research. Individual pen was used to raise the sheep. The experiment consisted of a 14 days adaptation and three months growth measurement period. Feed offered and refused was weighed daily and bodyweight was recorded weekly prior to feeding. Blood sample were collected from jugular vein at the onset of measurement and before sheep

slaughtered to analyze the blood urea level. In addition blood urea nitrogen also measured from one to three hours post feeding at the end of UMB treatments (before sheep were slaughtered).

Approximately 30 household members (male and female) from three different villages and 15 other stakeholders (extensionist and consumers) were interviewed about their perception on trial; by using topical PRA's methods. These household members were chosen based on the previous information from Agricultural Department who has been applied UMB in those villages. Wives and husband of participating and non participating household were separately interviewed about their perception on urea-molasses feeding, whether or not they used this feeding, the reason of using urea-molasses, advantages/disadvantages of use this feed, why they keep or sell sheep, etc. Apart from this, bodyweight of male and female sheep that raised by non participating farmers in the different system were recorded every two weeks. Extensionist were interviewed in order to know how they though about the introduction, the possible adoption and the trial of UMB. To measure the perception of consumers, 15 of them were interviewed about the price, colour and tenderness of meat, and about their perception on the effect of consuming the UMB meat on their health. Meat from sheep fed normal and with UMB was used to identify whether or not consumer could differentiate this meat.

Intake and blood urea nitrogen was analyzed statistically using factorial design, while feed conversion and partial budgeting were analyzed by one way analysis of variance. Average daily gain was analyzed using covariance analysis with initial bodyweight as covariant. Preference ranking were used for analyze farmers and other stakeholders regarding their perception on UMB feeding.

Result

The on station research

Different frequency of UMB supplementation to a basal diet of elephant grass (*Pennisetum purpureum*) showed neither an effect on bodyweight gain, intake of dry matter, crude protein and total digestible nutrients nor on total feed conversion. Average daily gain varied between 24.2 to 45.3 g/day (Table 1).

Blood urea nitrogen (BUN) tend to be lower (P0.05) in sheep which were supplemented by UMB 2 and 3 times a day than those the once a day (Table 2). BUN also tended to be lower when the blood sample were taken 2 and 3 hours after feeding UMB (P0.05). The interaction effect between frequency of UMB feeding and time of taking blood sample was found no significant differences.

The field work

The discussion with extensionist, farmers, butchers and housewives showed large differences in expectations and/or perceptions about the UMB technology. Most farmers have never heard about the technology (76%) and those farmers that had heard about UMB feeding (24%) usually get the information from the extension worker. None of the farmers adopted UMB feeding, the main reason for non-adoption of UMB was determined by ranking as shown in Table 3.

Lack of information/demonstration from extensionist according to farmers mean that the farmers have never been heard about this technology either from extensionist nor government, the farmers who get information usually only from the theoretical point of view, while lack of awareness according to the farmers means that the farmers did not apply UMB for small ruminant diet although they had information that UMB can be supplemented in small ruminant feeding.

Table 1. The average intake and standard deviation of Dry Matter (DM), Crude Protein (CP) and Total Digestible Nutrient (TDN) (g/kgW$^{0.75}$) as affected by different frequencies of UMB feeding

Parameters	UMB 1X		UMB 2X		UMB 3X		Level of Sign.
	Male	Female	Male	Female	Male	Female	
DM intake	59.3±2.7	52.7±2.9	58.3±4.5	55.9±2.0	57.3±3.9	57.0±0.83	0.83
CP intake	7.5±0.4	6.6±0.4	7.4±0.6	7.1±0.3	7.3±0.5	7.2±0.5	0.83
TDN intake	32.7±1.5	28.9±5.5	32.2±2.5	30.7±1.1	31.6±2.1	31.4±2.0	0.81
ADG (g./day)	30.8±16.3	29.3±11.4	45.3±11.9	26.4±13.7	36.3±17.6	24.2±8.3	0.73
Conversion	12.0±2.5	13.6±6.9	9.7±2.4	14.0±5.6	9.6±3.7	15.5±4.2	0.97

Table 2. BUN level of sheep on different frequency of UMB feeding

Time of Blood Sampling	UMB 1X	UMB 2X	UMB 3X	Average	Level of Significance
The onset of treatment	33.7	34.9	20.6	29.7±12.4	*0.18*
1-hour after feeding	52.4	41.1	37.5	43.6±12.1	*0.12*
2-hour after feeding	48.2	34.2	33.8	38.7±12.8	*0.12*
3-hour after feeding	33.3	36.0	28.1	32.5±11.1	*0.55*
Average	41.9±14.9	36.5±11.9	30.0±10.3		
Level of significance	*0.07*	*0.82*	*0.04*		

Table 3. Main reason of farmers for not adopting UMB

Reason	Respondents							Total Score
	1	2	3	4	5	6	7	
Lack of information/ demonstration from extensionist	5	5	5	5	5	5	5	35
Increased feed cost	3	4	2	2	4	4	4	23
Sheep did not need UMB	4	3	4	4	3	2	3	23
UMB only for cattle	2	2	3	3	2	3	2	17
Lack of awareness of the farmers in using UMB	1	1	1	1	1	1	1	7

1= least important, ... 5= most important.

Table 4. Problems encountered by extensionists when addressing farmers about the use of UMB

Reason	Respondents							Total Score
	1	2	3	4	5	6	7	
Education background	4	1	4	4	4	3	3	23
Application need long times	3	2	2	2	3	2	4	18
Difficult to find material	2	4	3	3	1	4	2	19
High cost	1	3	1	1	2	1	1	10

1= least important, ... 5= most important.

Contradicting perceptions were found when interviewing the extensions. On the one hand, most extensions said that farmers adopted what they advised about UMB (57%), sometimes farmers would like to adopted (14%) and only 29% the farmers did not want to apply UMB supplementation, on the other hand farmers said that they did not apply UMB due to lack of information they got from extension worker. However, the extensions also recognised problems on introducing UMB (Table 4).

According to the extensionist, UMB application need long times due to UMB should be applied continuously in a certain period of time in order to obtain significant results. In addition, UMB can not be found easily by the farmers, its availability is limited, therefore the farmers have not access to reach and use UMB. According to the extensionist, these problems lead to non-adoption of UMB technology by the farmers.

Some 65% of consumers can not differentiate between normal and UMB meat, while 35% of them guessed that they could recognise meat from UMB. Colour of UMB mutton did not differ from normal feed according to the consumers (100%), in terms of tenderness 80% consumers did not detected a difference, while 10% said that mutton from sheep fed by UMB contain higher fat and 10% perceive the UMB mutton more tender.

Table 5. Economic analysis of supplementation

Parameters	Supplementation (kg/day/animal)				UMB
	0	0.1	0.2	0.3	
Number of farmers	11	12	6	7	-
ADG (kg/day)	0.026	0.024	0.044	0.057	0.032
Rice bran supplementation (kg)	0.0	0.1	0.2	0.3	0.16
UMB feed (g)	-	-	-	-	6.9
Cost of concentrate (Rs)	-	60.0	123.3	175.7	93.6
Cost of UMB (Rs)	-	-	-	-	11.51
Good market situation					
Value of LWG (Rs/kg)	5500	5500	5500	5500	5500
Value ADG (Rs)	143.0	132.0	242.0	313.5	176.0
Benefit (Rs)	143.0	72.0	118.7	137.8	70.9
B/C ratio	∞	2.2	2.0	1.8	1.7
Normal market situation					
Value of LWG (Rs/kg)	4000	4000	4000	4000	4000
Value ADG (Rs)	103.1	95.2	176.2	229.3	128.0
Benefit (Rs)	103.1	35.2	52.9	53.6	22.9
B/C ratio	∞	1.6	1.4	1.3	1.2
Risk market situation					
Value of LWG (Rs/kg)	2500	2500	2500	2500	2500
Value ADG (Rs)	64.3	59.5	110.	143.3	80.1
Benefit (Rs)	64.3	-0.5	-13.2	-32.4	-24.6
B/C ratio	∞	1.0	0.9	0.8	0.8

Meat consumption pattern of consumer were affected by the price of meat (45%), allowed/avoided by religion (45%) and only 10% of the consumers consider about meat quality before deciding to buy meat. In term of meat preferences, meat from chicken and egg take place in the highest rank (90%), while mutton and beef only the second option (both 5%). An important figure of consumer regarding their acceptability of mutton fed by UMB id related to the health status, part of consumers (50%) will refused if they know that mutton come from sheep fed on UMB, while 50% others will accepted this meat.

The animal performance under on-farm feeding condition without UMB gave average liveweight gain of 0.038 kg/animal/day. It was also established that farmers fed different levels of locally available supplement, ranging from nothing to 0.3 kg/day/animal with a corresponding range of liveweight gain from 0.026 till 0.057 kg/day/animal.

Discussion

The trial with different frequencies of UMB feeding showed no effect of feeding UMB for conditions with this basal ration consisting of elephant grass and rice bran. No effect was found on intake of dry matter, crude protein and total digestible nutrient, nor on feed conversion. The absence of effect on liveweight gain agrees with Chicco et al. (1972; and Ernst et al., 1975. Schiere et al. (1989) argues that the effect of UMB depends on basal ration and level and type of other supplements. The basal ration in this research is likely to contain adequate nutrients, since NRC (1976) states that urea is a useful source of nitrogen in diets containing no more than 10% protein.

Feeding of UMB did increase BUN level compared to initial BUN when the blood sample was taken in the onset of UMB treatment. Such a result agrees with the previous experiment (Garg and Gupta, 1992) who showed that supplementation of UMB will increase blood urea nitrogen level due to increased absorption into the blood of ruminal to be detoxified in the liver to form urea. Brand et al. (1997) found that BUN level increased from 28.6 mg/100 ml with no supplementation to 30.9 mg/100 ml with supplement.

Consumer perception regarding UMB mutton indicated a slight and non-significant tendency that UMB feeding increase tenderness. Some consumers also found that meat contain more fat (not marbled), an effect that was confounded by the feeding of ricebran to the experimental animals. Overall consumers tend to dislike UMB meat because they fear that it will affect their health. They also consider the price of meat before asking where the meat comes from. As long as lower price, they will choose this meat. This is in agreement with Taverner (1991) that the effect of biotechnology on the risk human health was not the major issues. This agrees with previous research (Hoban and Burkhardt, 1991) that income levels and higher education were positively associated with acceptance of technology.

Extension workers had high expectations of the technology, even though their expectations were ranked differently. In other words, the extensionists were not well informed of the possible benefits and drawbacks of the technology. In addition the extensionist did not investigate why farmers are not adopting the technology as such (Schiere, 1999), and also lack of awareness regarding farmers' priorities (Trutmann et al., 1996). Experience has shown that a new technology will be well adopted if it has more perceptible advantages and is easier to apply than present technology.

An additional finding is that farmers were slowly but surely changing their mind about the usefulness of keeping sheep. In the past there was labour from children that now have to attend school and they have own activity, feed was easier available on roadside, communal land and sport fields that now should be compete with others livestock, making it difficult mainly in the dry season.

This agrees with Chicco et al. (1972); Wahyuni et al., (1993) that small ruminant under tropical conditions has limited access to feed particularly in the dry season.

The calculation of the"economics" of supplementation showed remarkable results. If feeds are costed at market prices than it seems to make no sense to supplement at all, unless the returns on meat are exceptionally good. This indicates on the one hand that farmers should either not supplement at all, except those farmers that have access to supplements at a very favourable concentrate/liveweight gain (*e.g. near cities*). In fact, for them it would then pay to use a supplementation strategy with high levels of concentrate, they could shift into the HEIA mode of farming (Schiere and de Wit, 1993). On the other hand, the results of the tentative economic evaluation also showed farmers supplemented even when there seem to be no ground for that. This issues was discussed with the farmers at a latter point in time and it appeared that farmers using the small ruminant as a saving, mainly if they have more money they will invest it to buy concentrate, although it was not done continuously. In addition, supplementation was done if the farmers though that there were no adequate grasses were offered to the sheep. Therefore, the farmers do not care whether the supplementation provide an advantage or not in economic term.

Conclusion

Technologies that seem to be promising from literature can have disappointing results in specific field conditions. UMB is reported to have beneficial effects in many situations, particularly where there is plenty of low quality feeds. However, the results seem to be much less when the basal ration consists of green grass and concentrates like rice bran. Also the emphasis on one aspect only may hide the trade off on the other aspects.

Furthermore, extensionists that have heard about the technology appear to have entirely different perceptions of the effects on animal performance. Moreover, farmers and other stakeholders such as consumers and butchers think that UMB supplementation increase feed cost and they also were rather unaware of the technology. Consumers' perception regarding mutton fed on UMB showed tendency that UMB feeding increases tenderness and also found that meat contains more fat (not marbled). Consumers tend to dislike UMB meat because they fear that it will affect their health.

Last but not least, the economic of supplementation in general show remarkable result. Based on tentative extrapolations of the measurements it can be conclude that supplementation makes no economic sense unless the farmer has access to feeds with a very favourable ratio of cost to benefit and the price of supplementation relatively cheap compared to the meat. A situation that is unlikely to exist for small farmers in conditions distant from market and low purchasing power of both farmers and consumers.

References

Anindo, D., F. Toe, S. Tembley, E.M. Mugerwa, A.L. Kassi, and S. Sovani. 1998. Effect of Molasses-Urea Block (MUB) on Dry Matter Intake, Growth, Reproductive Performance and Control of Gastrointestinal Nematode Infection of Grazing Menz Ram Lambs. *Small Rum. Res.* 27:63-71.

Brand, T.S., F. Franck, A. Duran, and J. Coetzee. 1997. Use of Varying Combinations of Energy and Protein Sources as Supplementary Feed for Lambing Ewes Grazing Cereal Stubble. *Aust. J. Exp. Agric.* 37:1-9.

Chambers, R., A. Pacey, and L.A. Thrupp. 1989. *Farmers First.* Farmer Innovativion and Agricultural Research. Intermediate Technology Publ., London.

Chaniago, T.D., A. Natasasmita, and I.C. Fletcher. 1988. Effect of Supplementary Feeding Around Lambing Time on the Productivity of Javanese Thin Tail Ewes. *Trop. Anim. Hlth. Prod.* 20:57-64.

Chicco, C.F., T.A. Shultz, E. Shultz, A.A. Carnevali, and C.B. Ammerman. 1972. Molasses-Urea for Restricted Forage Fed Steers in the Tropics. *J. Anim. Sci.* 35:859-863.

Collinson, M.P. 1983. Farm Management in Peasantt Agriculture. 2nd.ed., Westview Press, Boulder, Colorado.

Ernst, A.J., J.F. Limpus, and P.K. O'Rourke. 1975. Effect of Supplement of Molasses and Urea on Intake and Digestibility of Native Pasture Hay by Steers. *Aust. J. Exp. Agric. Anim. Husb.* 15:451-455.

Garg, M.R., and B.N. Gupta. 1992. Effect of Supplementing Urea-Molasses Mineral Block Lick to Straw Based Diet on Dry Matter Intake and Nutrient Utilisation. *Asian Australasian J. of Anim. Sci.*, 5(1):39-44.

Hoban, T.J. and J. Burkhardt. 1991. Determinants of public acceptance in meat and milk production: North America. In: P. van der Wal, G.M. Weber and F.J. van der Wit (Eds.). Biotechnology for Control of Growth and Product Quality in Meat Production: Implications and Acceptability. P229-244. Proceeding of an International Symposium, Washington D.C.

Jain, D.K., S.V.N. Rao, A. Yazman, and H.M.J. Udo. 1995. On-farm research and statistical inference. In: Kiran Singh and J.B. Schiere (Eds.). Handbook for Straw Feeding Systems. Principles and Application with Emphasis on Indian Livestock Production. P81-94. Indian Council of Agricultural Research, Krishi Bavan, New Delhi, India.

National Research Council (NRC). 1976. Urea and other Non-protein Nitrogen Compounds in Animal Nutrition. National Academy of Sciences, Washington DC.

Rao, S.V.N., D.V. Rangnekar, R. Dey, and A.W. van der Ban. 1995. Farmers' perception of innovation. In: Kiran Singh and J.B. Schiere (Eds.). Handbook for straw Feeding Systems. Principles and Application with Emphasis on Indian Livestock Production. P107-118. Indian Council of Agricultural Research, Krishi Bavan, New Delhi, India.

Schiere, J.B. 1999. Development and On-farm Testing of Innovation in Crop Livestock Systems. Seminar Notes. Kenya Agricultural Research Institute (KARI), Nairobi.

Schiere, J.B., M.N.M. Ibrahim, V.J.H. Sewalt, and G. Zemmelink. 1989. Response of Growing Cattle Given Rice Straw to Lickblocks Containing Urea and Molasses. *Anim. Feed Sci. Tech.* 26:179-189.

Schiere, J.B. and J. de Wit. 1995. Feeding Urea Ammonia Treated Rice Straw in the Tropics. II. Assumptions on Nutritive Value and their Validity for Least Cost Ration Formulation. *Anim. Feed Sci. Tech. 51:45-63.*

Singh, P., A.K. Verma, R.S. Dass, and U.R. Mehra. 1999. Performance of Pashmnia Kid Goats Fed Oak (Quercus semecarpifolia) Leaves Supplemented with a Urea Molasses Mineral Block. *Small Rum. Res.*, 31:239-244.

Subandriyo. 1998. Performances of Javanese thin tail sheep. *J. Indonesia Agric. Res. And Develop.* 20:65-71.

Sutama, I.K. 1992. Reproductive development and performance of small ruminants in indonesia. In: Ludgate, P. and S. Scholz (Eds.). New Technology for Small Ruminant Production in Indonesia. P7-14. Winrock

International Institute of Agriculture Development, Morrilton, Arkansas.

Taverner, M.R. 1991. Determinant of public acceptance in Australasia of biotechnology for the control of growth and product quality in meat production. In: P. van der Wal, G.M. Weber and F.J. van der Wit (Eds.). Biotechnology for Control of Growth and Product Quality in Meat Production: Implications and acceptability. P219-228. Proceeding of an International Symposium, Washington D.C.

Trutmann, P., J. Voss, and J. Fairhead. 1996. Local Knowledge and Farmer Perceptions of Bean Diseases in the Centrakl African highlands. *Agric. and Human Value*, 13(4):64-70.

Wahyuni, S., A. Suparyanto, Isbandi, and R.M. Gatenby. 1993. Re-evaluation of outreach pilot project. In: Subandriyo and R.M. Gatenby (Eds.). Advances in Small Ruminants Research in Indonesia. P51-64. Proceedings of Workshop Held at the Research Institutes for Animal Production, Ciawi-Bogor, Indonesia.