SUSANE - Sustainable, sanitary and efficient management of animal manure for plant nutrition

During the winter 2007 and spring 2008 PhD student Vu Thi Khanh Van has carried out a most interesting study with focus on assessing amount and composition of excreta from growing pig fed with typical Vietnamese diet. In this newsletter preliminary result of her study is presented.

Picture 1. Pig was kept individually at metabolic cage for collecting manure at animal level.

Picture 2. Pig was kept individually at piggery for collecting manure at housing level.

In the following is presented results from a study of measuring DM and nitrogen in excreta from growing pigs fed typical Vietnamese diets

Introduction

The Vietnamese government is supporting an increase and an intensification of livestock production. However, increase in animal production may cause unacceptable pollution of rivers, lakes and of groundwater. This problem will become more significant as production intensification results in animal excrement being concentrated in smaller areas.

On the other hand the problem can be solved if the production is controlled by adequate regulations for an environmentally safe management of manure. To facilitate environmental friendly and sustainable manure management there is a need of a farm manure management tool. Input to this tool must be a precise knowledge of excretion of animal manure and composition of the manure.

In Vietnam, the feed vary between different farm categories and this affect excretion. Feeds with low protein and high fiber content are used on small-scale farms, while feeds higher in protein and lower in fiber content are used on large-scale. Excretion is related to both dietary fiber and protein contents of diets, and the amount of excreta from pigs fed diets with high

contents of low fermentable fiber is almost twice the amount from pigs fed standard diets containing a low level of dietary fiber.
Existing models do not take account of Vietnamese feeding practice. Therefore, there is a need for assessing excretion that include prevalent varieties of pigs and feeding practices. The intention of this study is, therefore, to provide experimental data on excreta of nitrogen (N) from prevalent varieties of pigs which is raised in Vietnam and given typical Vietnamese diets at animal and housing levels.

Experimental design
Twelve castrated males of F1 crosses between Landrace and Yorkshire were during the experiments kept individually in metabolic cages and piggeries (Picture 1&2). The experiment consisted of 8 replications for each of two growing stages at initial body weight (BW) at 40 and 64 kg for period 1 and period 2 respectively.
At each replication three different diets were given to the three groups of pigs. The diets were representative for small, medium and large scale farms, namely, high protein and low fiber content (H-L), medium protein and medium fiber content (M-M), and low protein and high fiber content (L-H) respectively (Table 1). Drinking water was provided *ad libitum* by auto nipples.
Each replication consisted of 7 days for adaptation and 5 days for collection of faeces and urine separately (Picture 3).

Picture 3. Prepare for collecting excreta

Table 1. Diet composition, animal performance, manure excretion and characteristics at different growing periods by diets (pigs kept in metabolic cages)

Raising periods	Period 1			Period 2		
Diets	H-L	M-M	L-H	H-L	M-M	L-H
Diet compositions						
N (% DM)	2.8	2.51	2.21	2.58	2.18	1.85
Fiber (% DM)	4.75	5.73	6.82	5.17	6.61	7.9
Animal performances						
Initial body weight (kg)	35.4	36.1	36.6	57.9	58.8	58.6
Weight gain (g/day)	0.67	0.52	0.52	0.74	0.67	0.58
Manure excretion (kg/day)						
Fresh faeces amount	0.63	0.80	0.94	1.12	1.26	1.41
Faecal dry matter	0.20	0.24	0.26	0.30	0.34	0.38
Manure characteristics						
Faecal dry matter (%)	32.6	29.0	27.1	26.9	27.1	27.2
Faecal N (% of DM)	2.97	2.92	2.52	2.72	2.54	2.29

Results

Table 1 showed that the pigs fed low fiber diet H-L had a higher rate of gain than the pigs fed the other diets. Fresh amount of manure excretion was different among diets and the value was highest at L-H diets (Table 1) because of higher content of dietary fiber. Faecal N content highest at diet H-L and lowest at diet L-H supports the concept that faecal N content are positively related to dietary N content.

Similarly, daily N intake significantly differed among diets by two growing periods. This resulted in a lower the total N excretion from the pigs fed diet L-H within each period (Table 2). Daily amount of faecal N excretion was relatively equal among diet by periods while urinary N excretion was different. More attentions need to be focus on urinary excretion from pigs fed diet H-L because higher rate of ammonia emission leading to more environmental concern in term of ammonia emission.

The nitrogen excretion pattern, which is indicated by the ratio of total nitrogen excretion to nitrogen intake, was showed in Table 2. The total N excretion was similar for all diets. Faecal N excrete was increasing with lowering dietary fiber while N urinary was decreasing. Effect of dietary fiber, which shift N from urine to faeces, resulted in higher excretion of faecal N from pigs fed diet L-H.

The total nitrogen excretion in percentage of intake by diet was not significantly affected by the diets but urinary N excretion, implicates that diet with a low protein and high fiber content will contribute less ammonia emission. However, another environmental concerns need to be consider such as higher manure amount and odor problem due to lower digestibility.

Table 2. Daily nitrogen balances and excretion in percentage of intake at different growing periods by diets (pigs kept in metabolic cages)

Raising periods	Period 1			Period 2		
Diets	H-L	M-M	L-H	H-L	M-M	L-H
Intake (g/day)						
N intake	32.4	29.2	25.6	47.1	41.5	35.3
Excretion (g/day)						
Faecal N	5.97	7.08	6.37	8.17	8.58	8.67
Urine N	11.5	9.1	7.1	17.5	15.7	12.4
Total N	17.5	16.2	13.5	25.7	24.2	21.0
Excretion/intake (%)						
Faecal N	18.5	24.0	25.1	17.2	20.6	24.5
Urine N	35.0	31.1	27.7	37.2	38.0	34.9
Total N	53.5	55.1	52.8	54.4	58.6	59.4

The results from Table 3 showed that the daily fresh manure from pigs kept in piggeries was higher than from metabolic cages but both were similarly in dry manure. The difference was due to a part of urine was mixed in faeces by pigs kept in piggeries.

Total N excretion from pigs kept in piggeries was lower than from pigs kept in metabolic cages. Percentage of N loss from animal to housing are estimated at 8.8 % and 12.1% for growing period 1 and period 2 respectively. Which is relatively high compared to other studies, considering that the solid was scraped of the floor and the liquid collected once a day. The reason for the relative high loss of nitrogen may be because of open housing system (Picture 2b).

Table 3. Daily manure, nitrogen excretion from growing pigs kept metabolic cages and piggeries

Raising periods	Period 1		Period 2	
Methods	Metabolic cages	Piggeries	Metabolic cages	Piggeries
Manure excretion (kg/day)				
Fresh manure	0.79	0.85	1.26	1.40
Dry manure	0.23	0.23	0.34	0.36
Nitrogen Excretion (g/day)				
Faecal N	6.47	6.75	8.47	9.66
Urine N	9.25	7.59	15.2	11.1
Total N excretion	15.7	14.3	23.6	20.8
N loss from animal to housing (%)				
N loss		8.8		12.1

Faecal amount, faecal N and urinary N excretion were estimated by fiber intake, feed intake and N intake respectively. Figures 5 showed that excretion of dry matter in excretion is related to amount of fiber intake, which agrees with previous studies. The amount of faecal N excretion closely related to feed intake while urinary excretion related to N intake. It is known that there will be interaction between pig weight or age, feed intake, composition of the feed etc. This interaction will have to be accounted for in a full model.

Conclusion

- The diets fed to the animals had an effect on the manure quality. Diet with a low protein and high fiber content will contribute less ammonia emission.
- Nitrogen losses from ex animal to ex housing estimated approximately about 9% and 12% for period 1 and 2 respectively.
- Statistical models were developed for assessing manure amount and nitrogen excreta using information about fiber intake, feed intake and N intake respectively as single predictor. The models can be used to assess storage tank capacity for manure or digester volume for biogas production as well as and the frequency of manure transportation/utilization.

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Figure 5. Faeces excretion depending on fiber intake

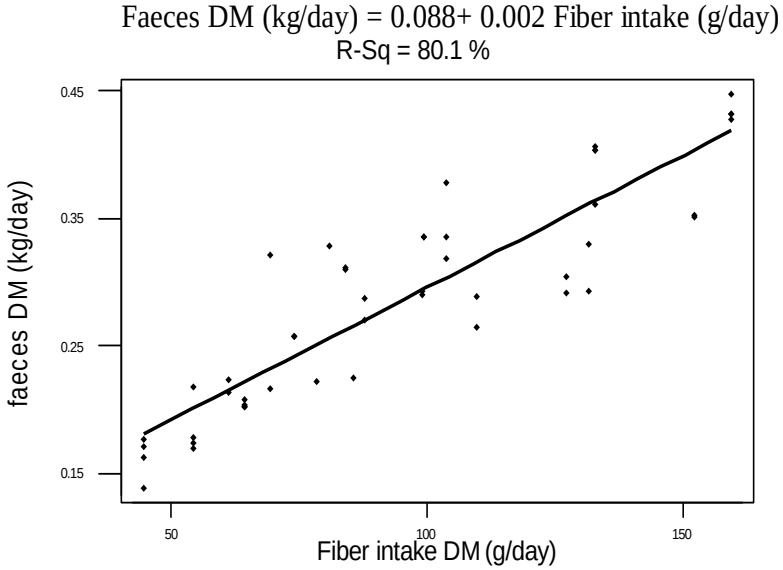

Figure 6. Faecal N excretion depending on feed intake

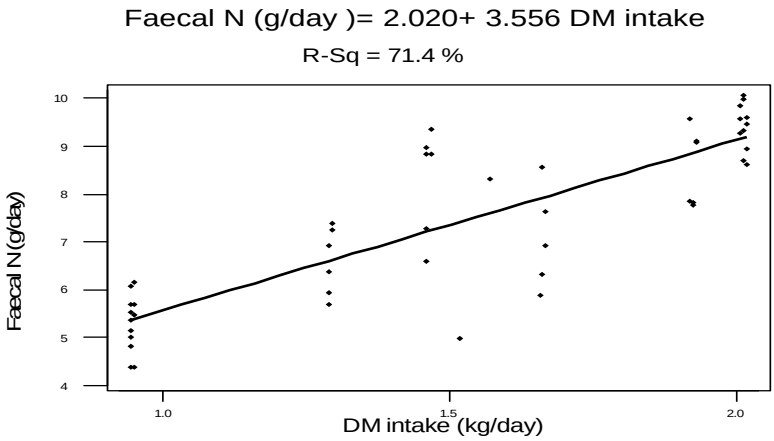

Figure 7. Urinary N excretion depending on N intake.