State Environmental Conservation Department (ECD-CAB), Sabah, Malaysia

Survey of pig farms in Sabah - summary report

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1 The survey – a summary

1.1 Methodology

The field survey of known pig farms in Sabah was started on 01 May 2001 and completed on 26 May 2001 (Figure 1).

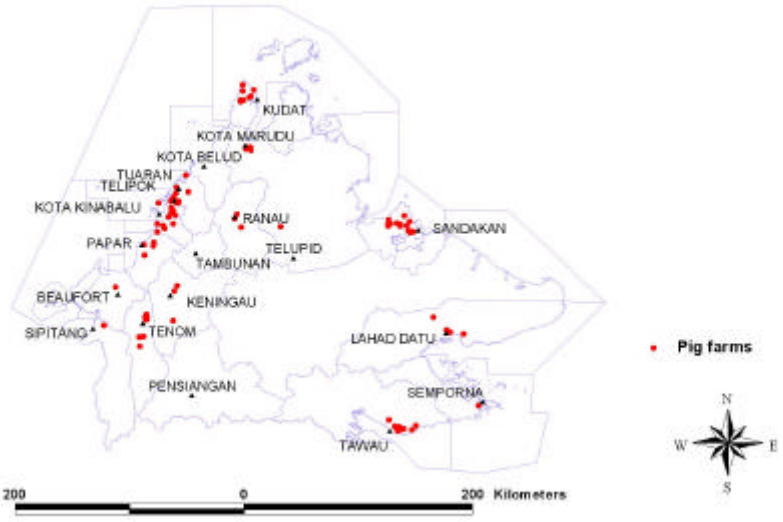


Figure 1 Distribution of known pig farms in Sabah – May 2001

All pig farms known to Jabatan Perkidmatan Haiwan dan Perusahaan Ternak (Department of Veterinary Services and Animal Industry) in Sabah were visited and the following data collected:

- Site specific data was collected using a structured survey form
- Of the 101 known farms only 68 were used in the final data analysis. Many of the excluded farms had either closed or no longer kept pigs
- Many small farms had closed stating that it was no longer economically viable to operate

- Wastewater sampling - all samples were collected by using a 'scoop' to obtain a grab sample from the point of final discharge from the pond/lagoon system, or the final storage pond if effluent was retained and not discharged. All samples were labelled and sent for testing to Jabatan Kimia, Kota Kinabalu. Effluent was tested for the following parameters: (i) BOD_5 (ii) COD, (iii) TSS and, (iv) Total N. The following sampling bottles were used (i) 1000 ml plastic bottle for BOD_5 and TSS, (ii) 200 ml plastic bottles for COD and (iii) 200 ml plastic bottle for Total N.

1.2 Assessment of farm

A provisional environmental assessment of each farm was made according to the following criteria:

Criteria	Score	
Locality		30 %
Laboratory Test Results[1]		60 %
	BOD_5 <250 mg /L = 30 %	
	COD <1000 mg /L = 10 %	
	TSS <100 mg /L = 10 %	
	Total N < 100 mg/L = 10%	
Pond Capacity		10 %
	Total Score	100 %

Pond capacity was determined by calculating the volume of treatment ponds/lagoon required and the actual pond capacity. Per cent under capacity was then determined.

No of pigs generating 40L waste/day
Hydraulic retention time (HRT) = 50 days (30 days if separator is used)

Total pond/lagoon size required:

$$\frac{\text{(No. of livestock x (40L) x (HRT)}}{1000}:$$

Existing volume of ponds:

Per cent under capacity

$$\frac{\text{Existing volume of ponds}}{\text{Required volume of ponds}} \times 100 =$$

[1] For the evaluation of the wastewater results, the Phase II Sarawak Standards for treatment were used as a guide to provide a tentative evaluation. If standard III had been used, most of the farms would not have been able to comply, while most of the farms complied with phase I standards.

The rational being that the greater the pond capacity the more efficient the biological breakdown process of wastes.

The final scoring is tentative and was carried out with the purpose of providing some focus for discussion.

The grading of the farms was then based on the standard scores as follows:

Grade	Score
A	90 – 100%
B	80 – 89.9 %
C	70 – 79.9%
D	60 – 69.9%
E	50 – 59.9%
F	Below 50%

The farms were furthermore tentatively classified into three size groups, namely:

Group	Pigs	Description
I	SPP < 100	Mainly kampong type farm
II	SPP > 100 but < 1000	Family business farms established many years ago
III	SPP > 1,000	Farms operated and managed by private limited companies

1.3 Finding I: General site observations

The following summarises immediate site observations:

- Most of the existing farms use a lagoon or pond waste treatment system, however, it was observed that at some farms the final effluent was discharged directly to nearby streams or watercourses without any treatment. Some farms had no effluent discharge as the final storage pond was large enough to retain all waste

- Most of the lagoon/pond systems were simple earth excavations without lining. Therefore wastewater can percolate into the ground with the potential to cause ground water pollution

- Smell or odour was encountered at all farms visited

- Three farms used a separator to isolate liquid and solid wastes

- Larger farms are situated close to the major urban areas i.e. Kota Kinabalu, Sandakan and Tawau to cater and provide for market demand. The larger

farms were managed and operated by established private limited companies

- There was a broad range of conditions encountered at the farms. Some made considerable effort to keep the premises clean and orderly while others made no effort at all. In general the larger farms were better managed.

1.4 Finding II: Classification

Based on the tentative size classification the farms in Sabah are grouped as follows:

Group	Size classification	Number of farms	Number of pigs	Per cent population
I	SPP < 100	22	1,072	1.6%
II	SPP > 100 but < 1000	26	9,524	14.4%
III	SPP > 1,000	20	55,480	84%
Total		68	66,076	100

1.5 Finding III: Grading per group

Group I (SPP < 100)

Grade	Number of farms	Score
A	**7**	90 – 100%
B	**10**	80 – 89.9 %
C	**0**	70 – 79.9%
D	**1**	60 – 69.9%
E	**4**	50 – 59.9%
F	**-**	Below 50%

Group II (SPP> 100 < 1000)

Grade	Number of farms	Score
A	**8**	90 – 100%
B	**11**	80 – 89.9 %
C	**0**	70 – 79.9%
D	**4**	60 – 69.9%
E	**3**	50 – 59.9%
F	**-**	Below 50%

Group III (SPP> 1000)

Grade	**Number of farms**	Score
A	**5**	90 – 100%
B	**10**	80 – 89.9 %
C	**2**	70 – 79.9%
D	**1**	60 – 69.9%
E	**2**	50 – 59.9%
F	**-**	Below 50%

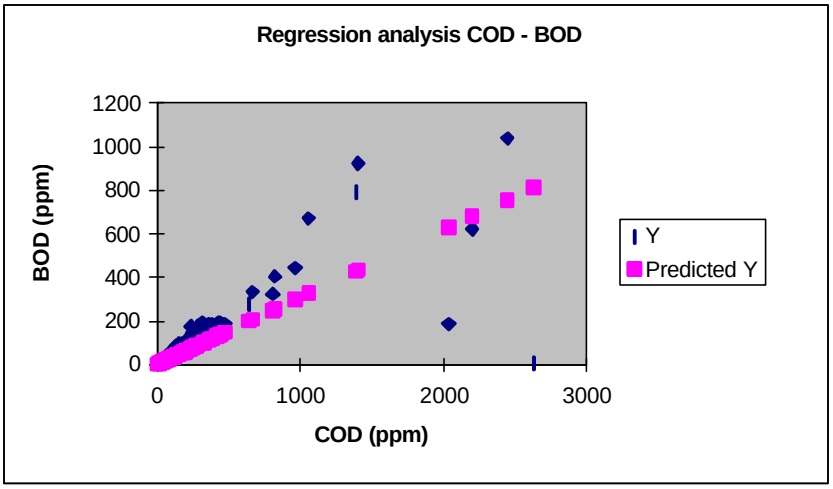
Odour is a serious environmental side effect for most of the farms under group III, no matter how well managed.

1.6 Finding IV: Effluent standards

The following could be observed regarding the use of wastewater effluent standards:

- If the Phase III standards as adopted by the State of Sarawak are used, then only 5 farms comply.

As would be expected there is a relationship between the results of COD and BOD_5, with one parameter being able to explain approximately 50% of the variance of the other (Figure 2).



Regression Statistics	
Multiple R	0.677581
R Square	0.459116
Adjusted R Square	0.443964
Standard Error	155.5301
Observations	67

Figure2 Linear regression analysis BOD_5 and COD

For all other parameters there was no relationship. For example

- There was no relationship between pond capacity and any of the effluent parameters measured.
- There was no relationship between Standing Pig Population and any of the effluent parameters measured
- There was no relationship between the final environmental grading of the farms and Standing Pig Population.
- It should be noted that the grading is dependent upon the weight given to the parameters used in the assessment. For example, if increasingly higher weightage were to be placed on a single parameter, eventually there would be correlation between the parameter and grading.
- Pathogens were not measured and therefore the associated impact on stream waters remains unknown

The above would suggest that effluent standards are poor indicators of environmental management and conditions at a farm.

Field observations noted that:

With a value of BOD5 > 25 mg/L a smell was also noticeable.

1.6.1 Farm location

The distribution of pig farms throughout Sabah is strongly controlled by domestic market forces with the majority of farms being located in and around Kota Kinabalu, Tawau, Sandakan i.e. the coastal areas nearby urban centres (Figure 3). Two farms house over 5,000 animals, one at Tuaran and one nearby Tawau. The distribution of numbers more or less follows the proportional size of the urban centres with the small towns having small farms located nearby. This also suggests that most of the farming in Sabah is to serve domestic markets.

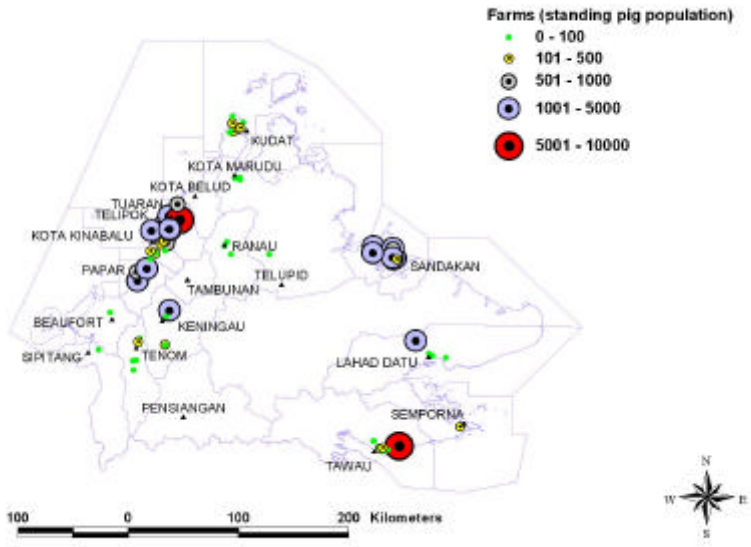


Figure 3 Pig farms and standing pig populations in Sabah – May 2001

It would appear that many of the farms with poor environmental management systems are concentrated along the west coast in and around the urban areas of Kota Kinabalu, Tuaran and Penampang (Figure 4). The farms in and around Sandakan would appear to have better environmental management systems. However four of the Sandakan farms are located nearby other residents and would therefore likely to encounter problems in the near future (Figure 5). These farms, which are among the better managed with some installed technology i.e. separators, remain under pressure to relocate or close down due to the encroaching rural settlements.

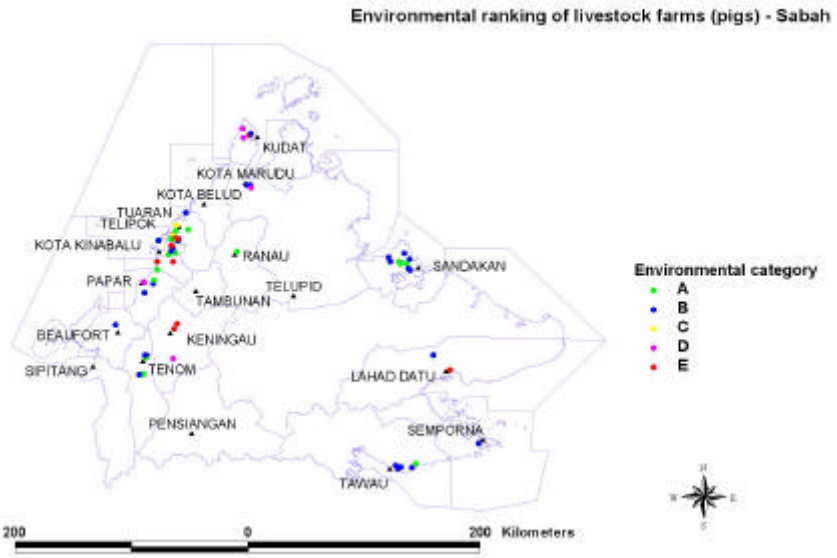


Figure 4 Tentative environmental ranking of pig farms in Sabah – May 2001

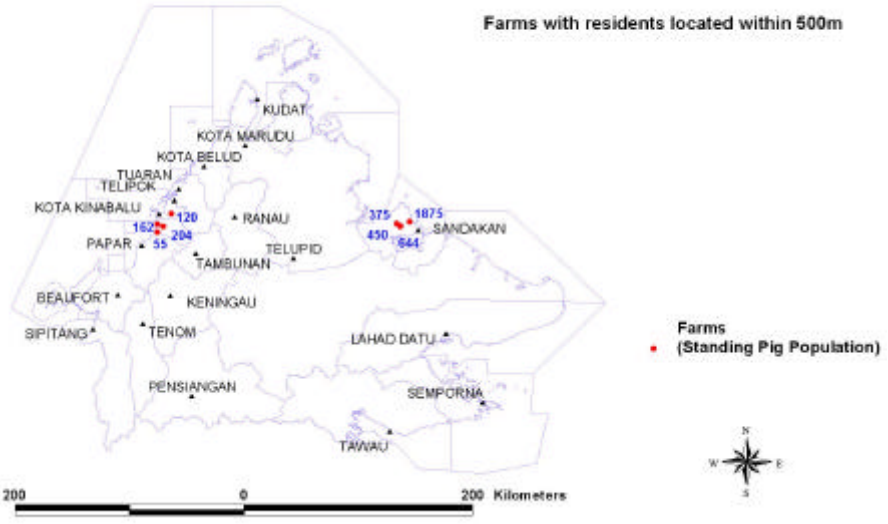


Figure 5 Pig farms with residents located within 500m – May 2001

1.7 Discussion

It would appear that the current sets of criteria are poor indicators of the state of wastewater treatment and general environmental management at each farm.

While some farms have more than sufficient lagoon capacity, the final effluent, although often more dilute, remains polluted. The issue here is probably related to the great deal of variability associated with the concentration of the measured parameters and other factors, which are difficult to assess. For example, (i) the maintenance schedule of a pond, if any, (ii) dilution factors such as amount of water used to flush or wash sheds (iii), time since washing or flushing. While it can be expected that there will be some association between pollution and retention time e.g. direct discharge into a river will be more polluting than some retention, at this level of analysis there would appear to be no measurable relationship. This would suggest that many of the ponds are full and no longer functioning.

While a multiple regression procedure based on principal components analysis of other independent variables will provide a better measure of the isolated effect of other individual variables, which in turn will provide a measure of the relative importance of variables in accounting for variation in the concentration of the final effluent parameter, such results will add little value to the overall exercise. Each variable would have to be assessed in detail and prescriptive recommendations specific to the variable made to improve the overall environmental management regime of the farm.

The overall environmental management may only be loosely assessed using the above parameters, however, the actual control of the factors is much more complex.

1.8 Recommendations

Environmental management/mitigation solutions include:

- Structural solutions i.e. installation of treatment, storage equipment.
- Planning – in relation to the location of the farm areas and control of the surrounding land use.

While the emphasis of the former lies with the farmer the latter remains with the government.

It is clear that even the best-managed farms with installed technology cannot avoid environmental problems and conflict due to locality issues. This suggests that workable environmental mitigation measures must lie in an integrated approach of structural and planning solutions.

As most of the farming activity is concentrated in a few large farms, environmental management solutions should address these farms with some priority. A constructive partnership between government and industry should be an approach to advise accordingly.

Some of the large farms have the capacity to introduce change, however, unless there are clearer signals from government they were reluctant to invest in additional infrastructure.

The other size class farms should also be addressed accordingly but again with some acknowledgement of the farm capacity to introduce change.

Regulations according to classifications

If regulations are to be used then it should be considered to develop regulations that relate to the different size classifications. For example Group III farms might be more able to comply with a zero runoff policy, while it would be more difficult to impose on Group II. The bulk of the industry is focussed on twenty or so large farms, which in practice should be logistically feasible to monitor and work with. Group II farms should also be able to meet and comply with mitigation measures that require structural solutions.

Regulations according to grace periods

It could be considered to develop regulations that would be in function after for example a 3-year grace period.

Effluent standards

If parameters are to be used to monitor the environmental quality of farms, then it is suggested that either BOD5 or COD is used. It is not necessary to use both. It is also probably not necessary to measure Total N as this provides little additional data. TSS. If discharge of final effluent is to be permitted then the following standards should be used:

- BOD_5 50 mg/L or
- COD 100 mg/L
- TSS 100 mg/L