



Vietnam National University of Agriculture



Institute for Global Environmental Strategies

# PIG MANURE AND EFFLUENT MANAGEMENT IN VIETNAM

Dinh Thi Hai Van, Nguyen Thanh Lam, Cao Truong Son,  
Vo Huu Cong, Pham Ngoc Bao, Tetsuo Kuyama

- 1) Dept. of Environmental Management, VNUA
- 2) Institute for Global Environmental Strategies

**Feb 21, 2017**

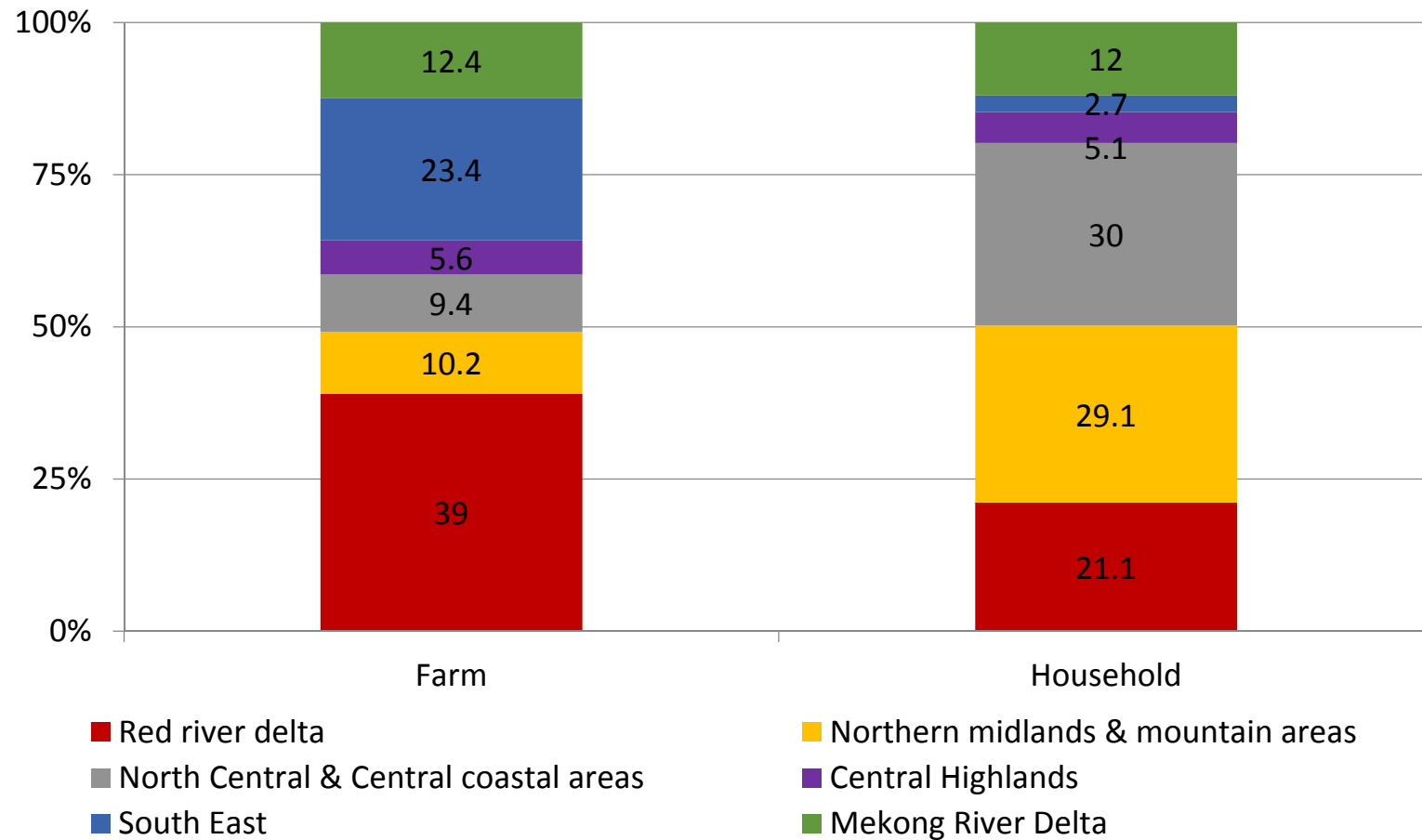
## Farm size and its distribution across the country

**Table 1: Distribution of pig population per geographical locations**

*Unit: thousands*

Regions	2011	2012	2013	2014	2015
<b>Red river delta</b>	7,092.2	6,855.2	6,759.5	6,824.8	7,061.3
<b>Northern midlands &amp; mountainous areas</b>	6,424.9	6,346.9	6,328.8	6,626.4	6,841.2
<b>North &amp; South Central coastal areas</b>	5,253.3	5,084.9	5,099.4	5,270.5	5,368.1
<b>Central Highlands</b>	1,711.7	1,704.1	1,722.3	1,742.4	1,797.3
<b>Southeast</b>	2,801.4	2,780.0	2,758.8	2,890.1	3,093.6
<b>Mekong River Delta</b>	3,772.5	3,722.9	3,595.6	3,470.4	3,589.3

## Farm size and its distribution across the country



**Figure 1: Distribution of pig farms according to geographical locations**

*Source: Vietnam GSO, 2013*

# Scale of pig farming in Vietnam

**Table 2: Distribution of Small – scale pig farming households according to pig quantity**

*Unit: thousands*

Regions	Total	According to quantity of pig per household			
		1-2 pigs	3-5 pigs	6-9 pigs	≥10 pigs
<b>Total</b>	4,131.6	2,144.0	1,060.0	367.22	560.4
<b>Red river delta</b>	870.7	454.4	170.4	66.1	179.9
<b>Northern midlands &amp; mountain areas</b>	1,204.3	615.5	351.0	120.6	117.2
<b>North Central &amp; Central coastal areas</b>	1,238.8	709.9	343.4	95.5	90.0
<b>Central Highlands</b>	210.8	106.3	50.7	20.5	33.3
<b>South East</b>	110.2	30.1	17.5	11.7	51.0
<b>Mekong River Delta</b>	496.7	227.9	127.0	52.8	89.0

*Source: Vietnam GSO, 2012*

# Scale of pig farming household

**Table 3: Size of pig households in study sites**

Study sites	Value	< 5 pigs	5–20 pigs	20–50 pigs	>50 pigs
<b>Thai Binh</b>	Number	4	5	1	0
	(%)	40	50	10	0
<b>Bac Giang</b>	Number	5	4	1	0
	(%)	50	40	10	0
<b>Ha Noi</b>	Number	0	2	2	6
	(%)	0	20	20	60
<b>Thanh Hoa</b>	Number	4	6	0	0
	(%)	40	60	0	0
<b>Total</b>	Number	13	17	4	6
	(%)	32.5	42.5	10	15

# Wastewater characterization

**Table 4: Characteristic of piggeries wastewater in Gia Lam District, Ha Noi**

Parameters	Unit	Type of pig production		
		Porker	Sows	Piglet
<b>pH</b>	-	6.73	6.55	6.41
<b>TSS</b>	mg/l	4,735	4,694	2,571
<b>TN</b>	mg/l	106.03	67.16	65.03
<b>NO<sub>3</sub><sup>-</sup></b>	mg/l	4.21	3.13	2.94
<b>NH<sub>4</sub><sup>+</sup></b>	mg/l	97.72	65.81	73.68
<b>TP</b>	mg/l	62.33	48.71	69.79

*Source: Nguyen Thi Thuy Dung et al, 2015*

**Table 5: Fish ponds' water quality of VAC systems in Hung Yen**

Parameter	Standard deviation	Mean	QCVN08: 2008/BTNMT Colume A <sub>2</sub>
<b>pH</b>	7.11-7.41	7.30	6.0-8.5
<b>COD (mg/L)</b>	120-240	160	15
<b>DO (mg/L)</b>	3.50-5.54	4.52	>= 5
<b>NH<sub>4</sub><sup>+</sup> (mg/L)</b>	1.36-4.64	3.00	0.2
<b>NO<sub>3</sub><sup>-</sup> (mg/L)</b>	1.16-2.88	2.20	5.0
<b>PO<sub>4</sub><sup>3-</sup> (mg/L)</b>	1.90-4.87	3.20	0.2

*Source: Cao Truong Son et al, 2010*

# Current practices and existing technical approaches for pig manure management and treatment

**Table 6: Proportion of piggery waste treatment methods in some provinces**

Effluent management	Province (Unit: %)			
	Hung Yen <sup>1</sup>	Ha Noi <sup>2</sup>	Thai Binh <sup>3</sup>	Bac giang <sup>3</sup>
<b>Biogas</b>	47.6	91.5	30	25
<b>Compost</b>	9.5	6.4	37	29
<b>Used for plant</b>	38.1	23.4	-	-
<b>Directly discharge into environment</b>	28.6	4.3	14.0	0
<b>Discharge to fish ponds</b>	52.4	17.0	-	-
<b>Collection for sale</b>	28.6	34.0	-	-
<b>Stored</b>	-	-	8	14

*Source : <sup>1</sup>Cao Truong Son et al, 2014; <sup>2</sup>Bui Phung Khanh Hoa, 2014; <sup>3</sup>T.K.V.Vu et al, 2007*



# Waste management at farm scale

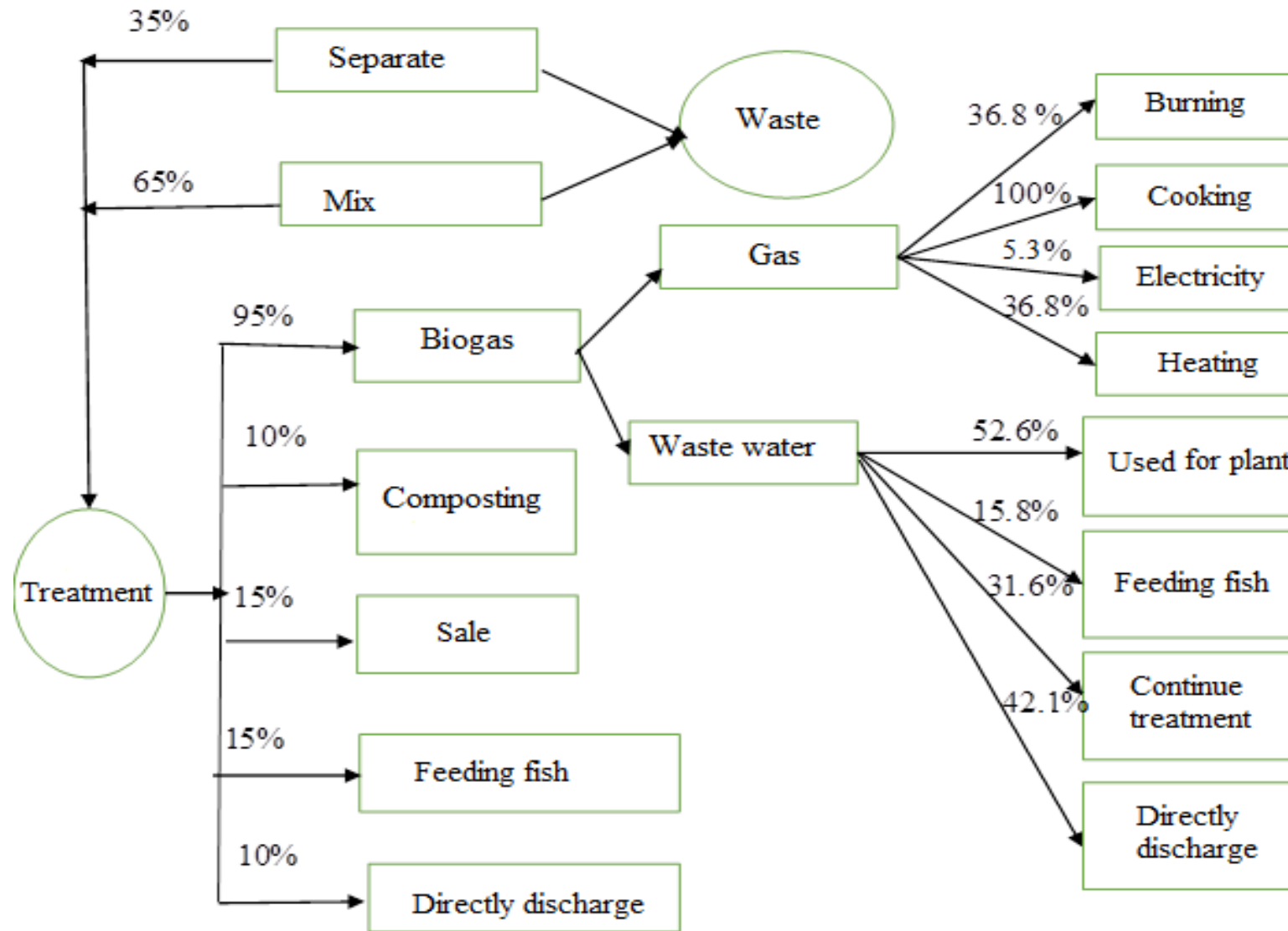


Figure 2: Application of waste treatment technology at farm scale

# Waste management at household scale

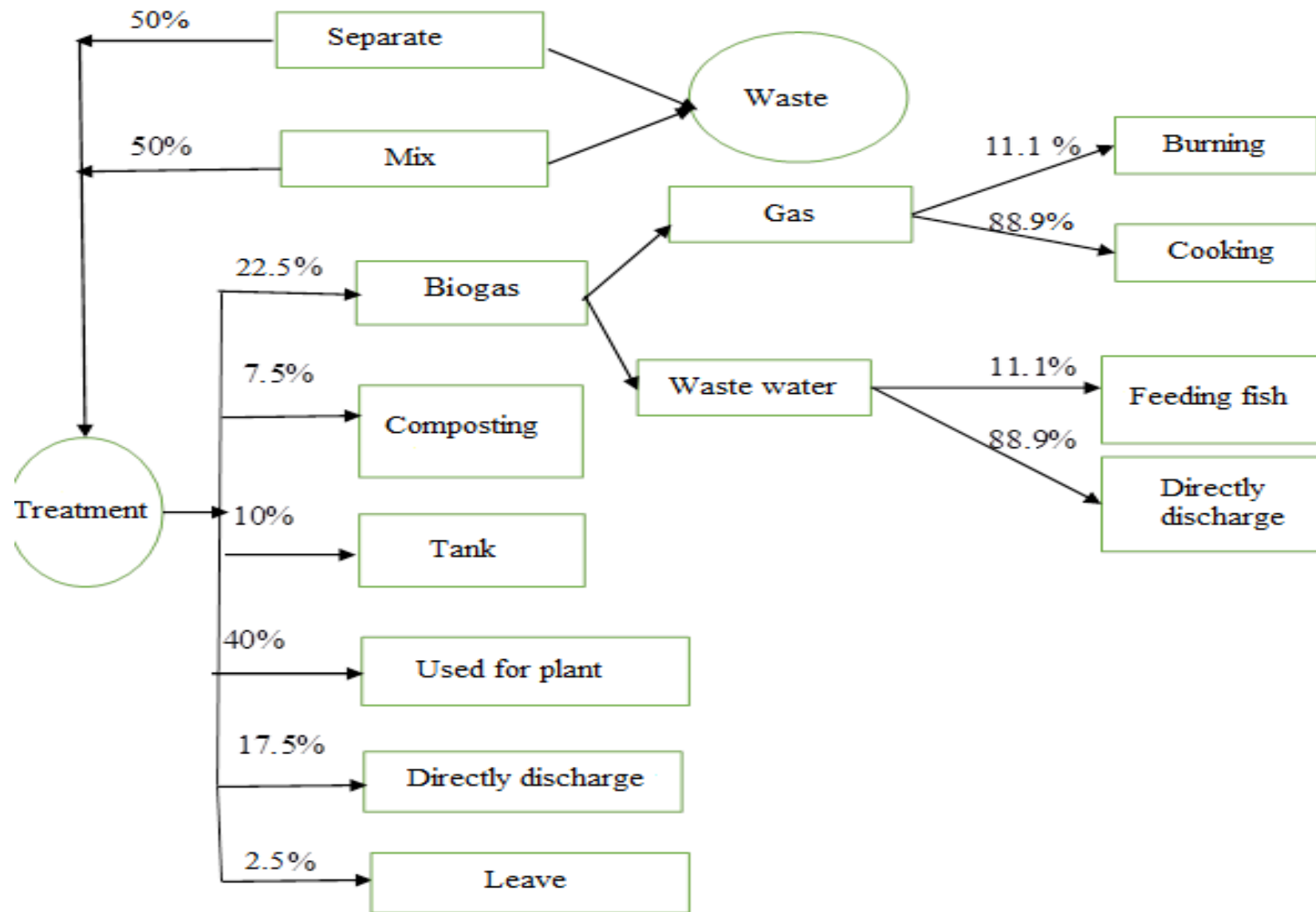


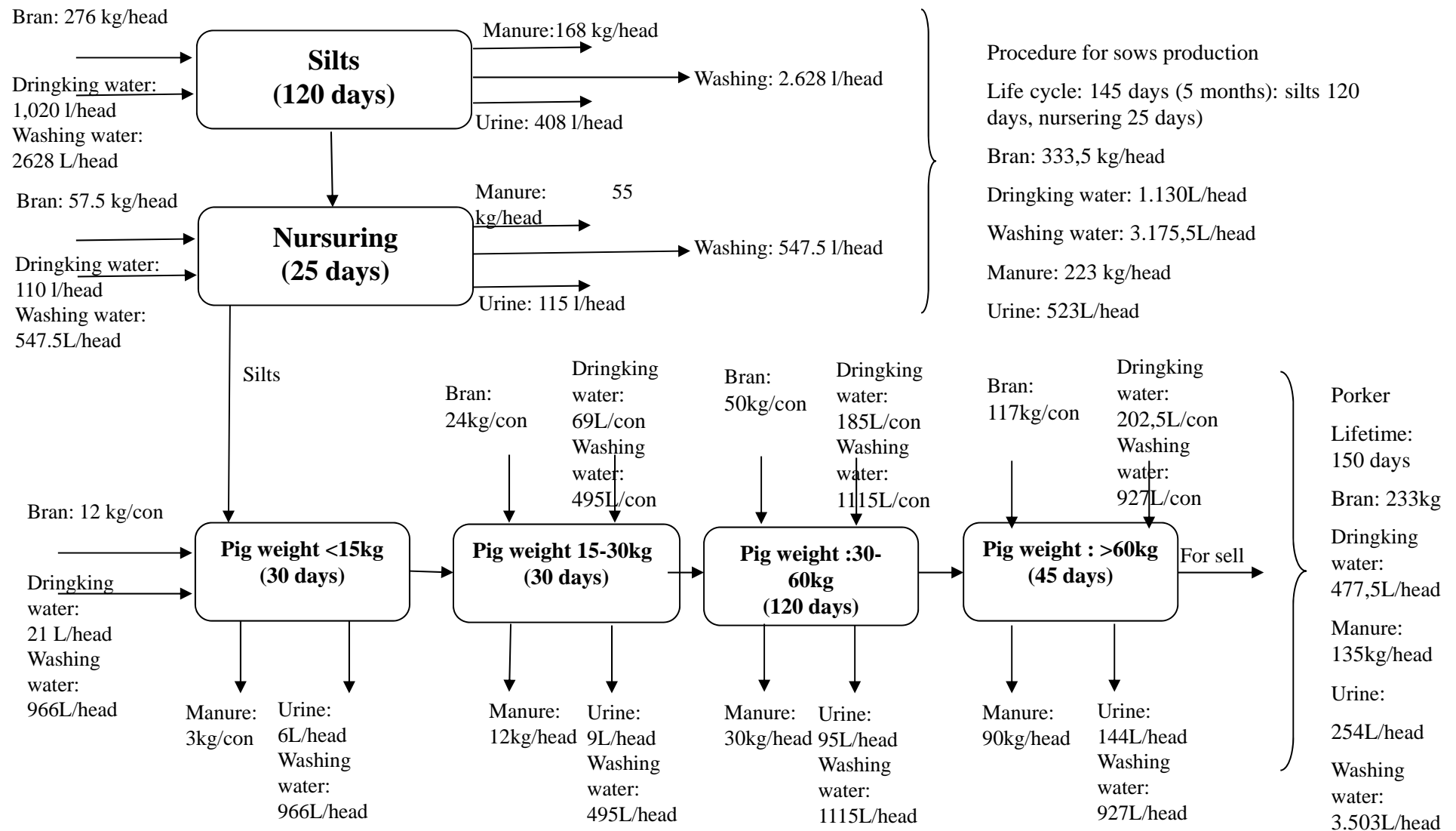
Figure 3: The rate of applicable treatment of waste disposal as household scale

# National technical standards on pig's manure management

**Table 7: Regulations and Legislations on livestock sector and pig farming**

National technical standards			
<b>1</b>	81/2009/TT-BNNPTNT	Curcular on National Technique regulations on animal feed	25/12/2009
<b>2</b>	04/2010/TT-BNNPTNT	Circular on promulgating national technical regulations on conditions for biosafety pig farms, poultry farms;	15/01/2010
<b>3</b>	61/2011/TT-BNNPTNT	Curcular on National Technique regulations on animal feed	12/09/2011
<b>4</b>	23/2012/TT-BNNPTNT	Circular on amending and supplementing some national technical standards of animal feed.	18/06/2012
<b>5</b>	04/2016/TT-BTNMT	Circular on promulgating the national technical regulation on the effluent of livestock, symbol: QCVN: 62-MT:2016/BTNTM.	29/04/2016

# Estimation of the emission coefficient



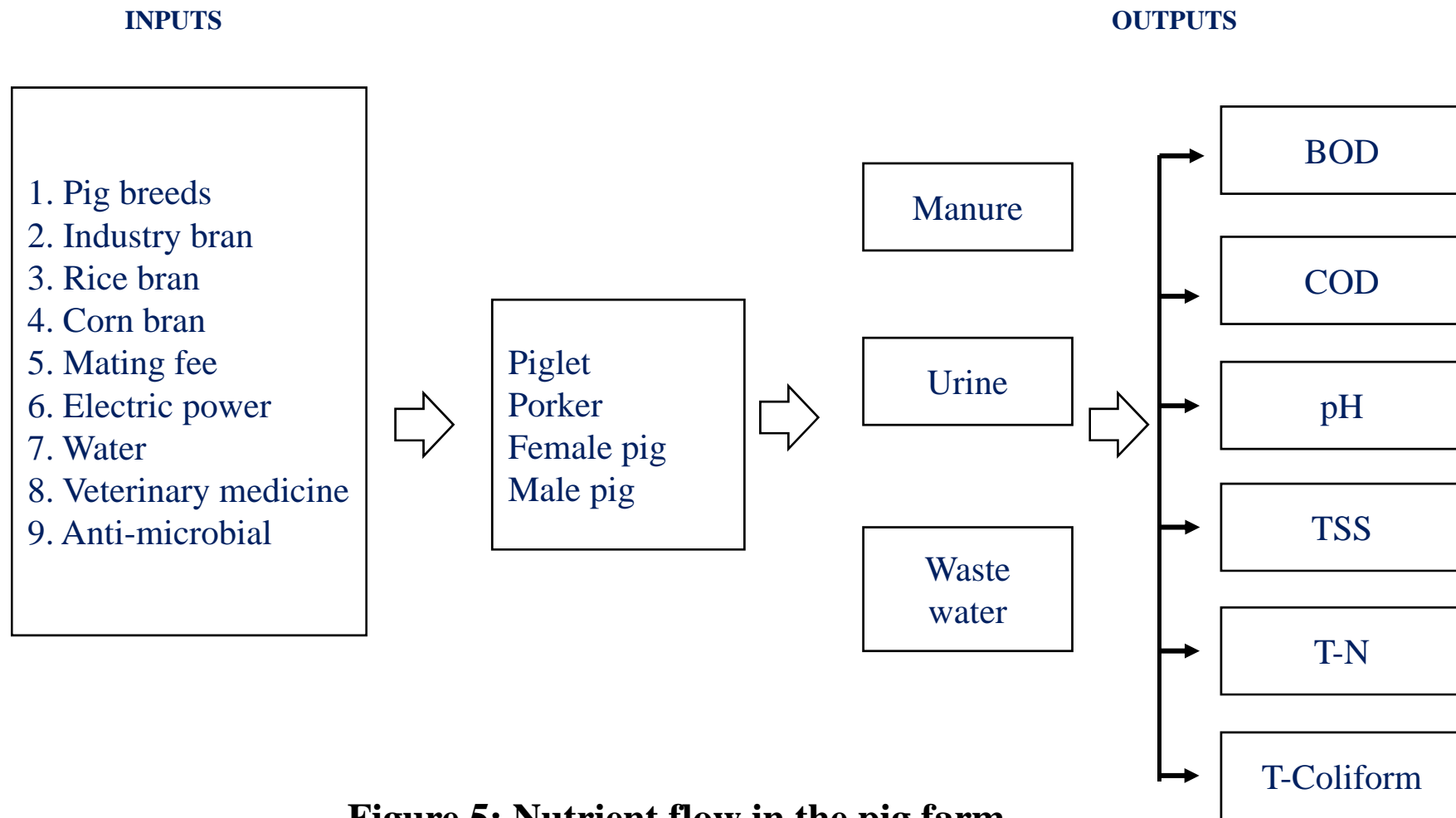
**Figure 4: Estimation of the quota on material consumption and waste generation at a farm scale**

**Table 8: Material usage and waste generation per head of a pig in a process at scale farming households**

Material	Type of pig					
	Sows			Porker		
	Quota (kg/head/day) (l/head/day)	Time (day)	Total waste (kg/head) (l/head)	Quota (kg/head/day) (l/head/day)	Time (day)	Total waste (kg/head) (l/head)
<b>Input</b>						
Comercial bran	2.0	190	380	1.2	165	198
Rice bran	2.4	190	456	0.3	165	49.5
Corn bran	2.6	190	494	0.2	165	33
Vegetable	3.8	190	722	1.1	165	181.5
Drinking water	9.0	190	1,710	6.5	165	1,072.5
<b>Output</b>						
Manure	1.4	190	266	2.2	165	363
Urine	3.4	190	646	4.6	165	759
Washing water	21.9	190	4,161	21.9	165	3,613.5

*N = 40 (household)*

# Development of a scientific framework for better understanding of nutrient flows (MFA) from pig farms



**Figure 5: Nutrient flow in the pig farm  
(Volatile, compost, runoff lost, selling production)**

**Table 9: The volume of pollutants generated per pig life cycle at farm scale**

Types of pig		Wastewater (L/head)	Capacity				
			COD kg/head	BOD kg/head	TS kg/head	TN kg/head	TP kg/head
<b>Sows</b>	Silts	408	0.43	0.40	0.67	0.112	5.182
	Nursering	115	0.37	0.24	0.56	0.261	0.105
	Life cycle	523	0.80	0.64	1.23	0.373	5.287
<b>Porker</b>	<15 kg	6	0.01	5.56	0.006	0.003	0.030
	15-30 kg	9	0.03	18.71	0.041	0.018	0.090
	30 - 60 kg	95	0.29	187.48	0.040	0.203	1.197
	> 60 kg	144	0.50	324.72	0.073	0.536	1.872
	Life cycle	254	0.83	536.47	0.16	0.76	3.189

**Table 10: Load of pollution generated per pig head from washing water during a production cycle**

Types of pigs		Wastewater (L/head)	Capacity				
			COD kg/head	BOD kg/head	TS kg/head	TN kg/head	TP kg/head
<b>Sows</b>	Gilts	408	0.49	0.39	1.11	0.11	5.18
	Nursening	115	0.40	0.23	0.28	0.02	1.58
	Life cycle	523	0.89	0.72	1.39	0.13	6.76
<b>Porker</b>	<15 kg	6	0.004	0.003	0.003	0.001	0.040
	15-30 kg	9	0.005	0.004	0.004	0.001	0.064
	30 - 60 kg	95	0.140	0.080	0.060	0.010	0.990
	> 60 kg	144	0.290	0.170	0.370	0.020	1.680
	Life cycle	254	0.439	0.257	0.437	0.032	2.774



**Table 11: Load of pollution generated per pig head from waste manure during a production cycle**

Type of pig		Waste manure (kg/head)	OM kg/head	TN kg/head	TP kg/head
<b>Sows</b>	Manure	223	4.3	2	0.1
<b>Porker</b>	Manure of porker <15 kg	3	4.24	2.99	0.07
	Manure of porker 15-30 kg	12	8.43	0.36	0.25
	Manure of porker 30-60 kg	30	3.72	1.18	0.04
	Manure of porker > 60kg	90	4.17	2.06	0.07
<b>Total production cycle</b>		135	20.56	6.59	0.43

**Table 12: Parameters and equations for estimating nitrogen flow in pig production**

Symbol	Description of data	Unit	Mean	SD
a feed_porker	Daily food for porker	kg food/head/day	1.4	0.3
d porker	Growing duration of porker	day	180.0	0.0
a feed_sow	Daily food for sow	kg food/head/day	2.7	0.1
d sow	Growing duration of sow	day	150.0	0.0
CN feed_pig	Nitrogen content in commercial food for pig	gN/kg food	26.0	0.0
n man-porker	Daily manure of porker	kg/head/day	0.9	0.4
n man-sow	Daily manure of sow	kg/head/day	1.5	0.2
aN man-porker	Nitrogen load in porker' manure	gN/kg	26.1	0.0
aN man_sow	Nitrogen load in sow' manure	gN/kg	39.2	0.0
n urine_porker	Daily urine of porker	l/head/day	1.6	0.9
n urine_sow	Daily urine of sow	l/head/day	3.2	0.4
aN urine_porker	Nitrogen load in porker' urine	g/l	3.7	0.0
aN urine_sow	Nitrogen load in sow' urine	g/l	7.4	0.0
n wastewater_porker	Daily wastewater of porker	l/head/day	20.5	9.6
n wastewater_sow	Daily wastewater of sow	l/head/day	21.7	2.8
aN wastewater_porker	Nitrogen load in porker' wastewater	g/l	0.1	0.0
aN wastewater_sow	Nitrogen load in sow' wastewater	g/l	0.3	0.0
rN emis_pig man	Ratio of N gas losses to N manure pigs		0.2	0.0
Y pork	Yield of porker	kg/head	123.3	11.6
CN pork	Nitrogen content in pork	gN/kg meat	26.0	0.0
N piglet	Number of piglet	No/head	12.0	0.0
Weight of pitlet	Weight of pitlet	kg	7.0	0.0

**Table 13: Parameters and equations for estimating nitrogen flow in pig production**

	Flow	Equation
<b>Balance equation</b>	Porker	$IN_{porker} - (OUT_1 + OUT_2 + OUT_3 + OUT_4 + OUT_5)$
	Sow	$IN_{Sow} - (OUT_6 + OUT_7 + OUT_8 + OUT_9 + OUT_{10})$
<b>Input</b>	IN_porker	$a_{feed\_porker} \times d_{porker} \times CN_{feed\_pig}$
	IN_sow	$a_{feed\_sow} \times d_{sow} \times CN_{feed\_pig}$
<b>Output</b>		
<b>OUT_porker</b>	OUT_1	$n_{man\_porker} \times d_{porker} \times aN_{man\_porker}$
	OUT_2	$n_{urine\_porker} \times d_{porker} \times aN_{urine\_porker}$
	OUT_3	$n_{wastewater\_porker} \times d_{porker} \times aN_{wastewater\_porker}$
	OUT_4	$n_{man\_porker} \times aN_{man-porker} \times d_{porker} \times rN_{emis\_pig\ man}$
	OUT_5	$Y_{pork} \times CN_{pork}$
<b>OUT_Sow</b>	OUT_6	$n_{man\_sow} \times d_{sow} \times aN_{man\_Sow}$
	OUT_7	$n_{urine\_sow} \times d_{sow} \times aN_{urine\_sow}$
	OUT_8	$n_{wastewater\_sow} \times d_{sow} \times aN_{wastewater\_sow}$
	OUT_9	$n_{man\_sow} \times d_{sow} \times aN_{man\_sow} \times rN_{emis\_pig\ man}$
	OUT_10	$n_{piglet} \times weight\ of\ pitlet \times CN_{pitlet}$

# Key findings

- Recently, increase of pig population posed high pressure on treatment systems
- Almost effluents of treated wastewater from biogas digesters higher than the national standards
- Given newly established regulation (QCVN:62-MT:2016/BTNTM), the number of observed parameters remains only 6 (pH, BOD, COD, TN, Coliform, TSS).
- Farmer used so much water during a life cycle of pigs.