



## Assessment of autoflush machine for cleaning of toilet area/elimination area in weaner pen

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### ABSTRACT

An attempt was made to develop auto-flush machine for cleaning of toilet area/elimination area. To study the auto-flush system, a total of 10 weaners were divided into two groups (having 5 each), viz. G<sub>1</sub> (weaners kept in a modified intensive pen with auto flush system) and G<sub>2</sub> (weaners in intensive pen without auto-flush). The defecation pattern/trend was observed 24 h consecutively for 5 days. Each weaner defecated 8.40±0.23 and 8.92±0.13 times per day in G<sub>1</sub> and G<sub>2</sub> respectively. The auto-flush was assessed indirectly based on parameters like hygiene score of floor, hygiene score of animals, amount of water consumed and manpower required for cleaning of pen in 5 days. Hygiene score of floor was higher in G<sub>1</sub> (143±0.63) compare to G<sub>2</sub> (112.2±1.7). Hygiene score of animals was higher in G<sub>1</sub> (5) compared to G<sub>2</sub> (2.6). Water consumed for cleaning was lower in G<sub>1</sub> (162.8±9.06 litres) than G<sub>2</sub> (212±1.4 liters). Manpower requirement in G<sub>1</sub> (7.85±0.24 sec) was lower than G<sub>2</sub> (175.48±2.11 sec). It can be concluded that all weaners used the elimination area for defecation in G<sub>1</sub>. The auto-flush system helped in saving water, labour time and maintained the cleanliness of both floor and animal.

**Key words:** Assessment, Autoflush machine, Toilet area, Weaner

Intensive pig production has grown all around the world and has increased with greater pace in Asian countries (Cameron 2000). Since organized piggery farm are located around urban and peri-urban areas, where nearly 50% of initial expenditure goes towards shed construction, therefore, now-a-day's open area is being reduced or not provided. If proper space is provided, they can separate area for resting and eliminating (Hal 2015) and hence pig is one of cleanest animals. This natural behaviour is utilized in commercial pig production where separate elimination area is provided. Pig preferred to defecate near gate, water or all along the wall in the intensive system and outside the pen in the semi-intensive system (Singh *et al.* 2017). Keeping this background in view, we created elimination area along with flush system for Indian condition farmer. Creation of elimination area and provision of autoflush machine not only help in cleanliness and hygiene of the farm but also helps in reduction in the initial cost which will be a boon to pig farmer.

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### MATERIALS AND METHODS

*Development of autoflush machine:* In order to develop the auto-flush machine, the following steps were followed. Cost of one auto-flush system was ₹ 1038.5.

*Selection of water reservoir for flush:* The fabricated reservoir was made by using empty phenyl disinfectant barrel (capacity 55 litres) based on auto siphon principle with the help of Farm Workshop, IVRI, Izatnagar, India. Reservoir was made using plastic material so that corrosion would not take place and lighter in weight. Tank volume (14 inch×12 inch×19.8 inch) was 0.0545 m<sup>3</sup> (54.5 litres). An inverted PVC 'U' shape pipe of 1 inch (0.025 m) diameter and 37 inch (0.94 m) length was used for making siphon.

*Selection of vertical pipe:* Fabricated water reservoir was kept on the roof of modified pen at height of 2.5908 m from the ground and it was connected with GI pipe of diameter of 1 inch (0.0254 m). Height of circular vertical pipe was 102 inch (2.5908 m) excluding the height of siphon.

*Selection of outlet materials for sprinkling:* Efforts were made to make outlet of the auto flush system in such a way that it can clean the larger defecation area. In order to get the best result metallic tapering outlet was designed having 14 inch width for quick flushing. For maximum area coverage, it was made flat and fan shaped. To create good pressure, rectangle perforations were made by welding

machine (to spread maximum water). Total number of perforation in outlets was 15.

*Physical parameter of machine:* The machine parameters were constant during the experimental period like velocity at outlet (8.34 m/sec), volume/second (flow rate) at outlet ( $31.65 \times 10^{-5} \text{ m}^3/\text{sec}$ ). Volume of water per flush was 37.175 litres because inverted U tube was at lesser height than drum for facilitating the siphon effect. The duration of each flush of auto-flush machine was  $40.8 \pm 2$  sec. for 12 days observation period. Since autoflush discharge the water after  $12.6 \pm 0.10$  min when input nozzle velocity was 0.38 meter/sec. To adjust the speed of water, there was provision of knob on input pipe (0.5 inch diameter) at average height of  $1.18 \pm 0.003$  m from ground. To save water, we made autoflush to discharge only 2 times a day. Hence, this requires further improvement.

*Auto-flush assessment:* In order to assess the auto-flush machine, a total of 10 weaners were divided into two groups each having five weaners. In group 1 ( $G_1$ ), five weaners were kept in modified intensive pen. The modified intensive pen had covered area and toilet area (47 inch  $\times$  33 inch). The developed auto-flush machine was fixed on the roof of modified pen and the outlet was fixed at the 4–5 inch above ground of elimination area. Group 2 ( $G_2$ ), five weaners kept in intensive pen without autoflush machine.

*Defecation pattern in  $G_1$  and  $G_2$ :* In order to study defecation pattern, pen floor of  $G_1$  and  $G_2$  animals were designated into six location, viz. a, b, c, d, e, f (Figs 1 and 2). The defecation pattern/trend was observed 24 h at every 1 hour interval consecutively for 5 days. In  $G_1$ , observation was done with installation of CCTV camera; however, in  $G_2$  observation was done by single person.

*Cleanliness of floor:* Cleanliness of floor was recorded 24 h at every 1 hour interval consecutively for 5 day. For cleanliness of floor six designated locations, viz. a, b, c, d, e, f, were utilize in both group. (Figs 1 and 2). Cleanliness of the floor was evaluated by using the following score system.

Score	Floor condition
Score 6	If all locations are clean
Score 5	If any 5 locations are clean
Score 4	if any 4 locations are clean
Score 3	if any 3 locations are clean
Score 2	If any 2 locations are clean
Score 1	If any 1 location is clean
Score 0	If no location is clean

*Cleanliness of the animal:* Cleanliness of the animal were evaluated by modified hygiene score (Maw *et al.* 2001), continuously for 5 days. Observation was made at 24 h interval at around 11 AM of each day. For easy scoring, lateral body part of animal was equally divided into five parts from belly to top.

*Water consumed in cleaning of dung:* Quantity of water consumed was measured by measuring bucket.

*Manpower required in dung cleaning:* In both groups,

Score	Body condition
Score 5	No dung particles on any part of the body
Score 4	More than 15% of the lateral part of the body including limbs is dirty
Score 3	More than 30% of the lateral part of the body including limbs is dirty
Score 2	More than 45% of the lateral part of the body including limbs is dirty
Score 1	More than 60% of the lateral part of the body including limbs is dirty
Score 0	More than 75% of the lateral part of the body including limbs is dirty

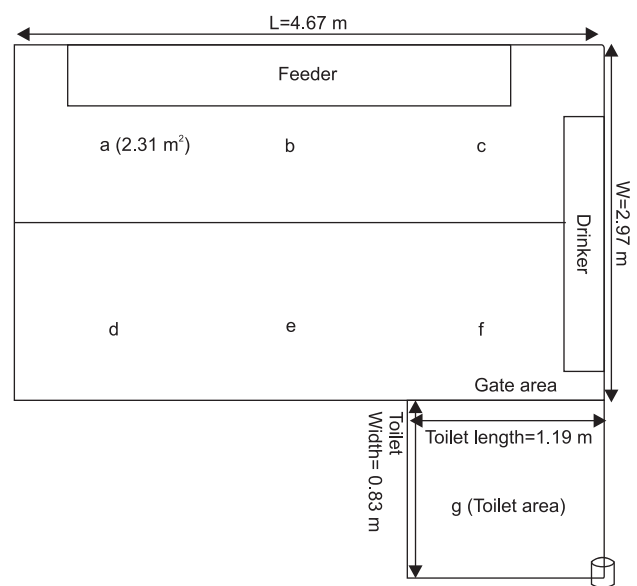


Fig. 1. Designated locations ( a, b, c, d, e, f) for defecation pattern in a modified intensive pen ( $G_1$ ).

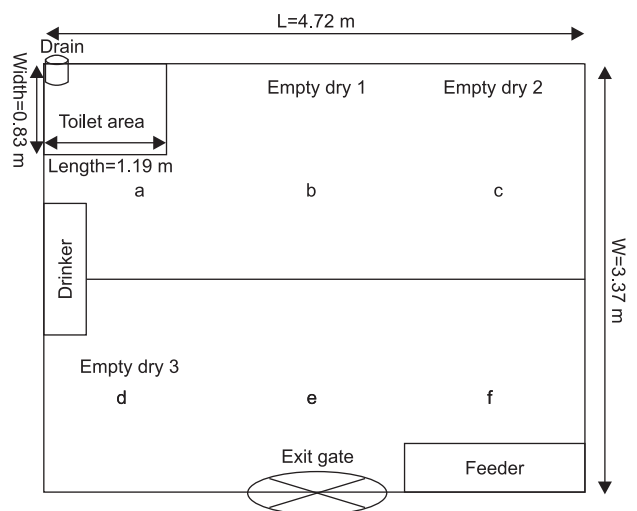


Fig. 2. Designated locations ( a, b, c, d, e, f) for defecation pattern in a intensive pen ( $G_2$ ).

Table 1. Defecation pattern in modified intensive pen (G<sub>1</sub>)

Day	Gate area (f)	Toilet area (g)	Total
1	3 (6.67)	42 (93.33)	45 (100)
2	2 (5.00)	38 (95)	40 (100)
3	0 (0.00)	44 (100)	44 (100)
4	0 (0.00)	41 (100)	41 (100)
5	0 (0.00)	39 (100)	39 (100)
Total	5 (2.39)	204 (97.61)	209 (100)

Values in parenthesis indicate defecation %.

single labour cleaned the dung by using hose pipe with intervention of observer.

**General management of animals:** Experimental animals were offered concentrate mixture *ad lib.* twice daily. Concentrate mixture offered was made up of crushed maize (35%), deoiled soyabean meal (10%), wheat bran (47%), fish meal (6%), mineral mixture (1.5%) and common salt (0.5%). The supply of clean, fresh and potable drinking water was ensured throughout day and night. Feeding space of 150 cm and watering space of 130 cm was available in each pen where pigs were housed. Mean temperatures (°C) observed in the month of November 2015, were 25.4±0.5, 29.2±0.3, 23.7±0.2, 27.4±0.2 in intensive and modified pens at 10 AM and 5 PM respectively.

## RESULTS AND DISCUSSION

**Defecation pattern in G<sub>1</sub> and G<sub>2</sub>:** In day 1, 93.33% defecation done in the toilet area, and rest near gate area (Table 1). On the day 2, 95% of defecation was done in toilet area, and rest near gate area. However, on 3rd day onward, animals completely defecated in the toilet area. During the experimental period, all animals of G<sub>1</sub> defecated in the toilet area. However, few animals attempted to defecate near gate of the covered area during first two days. Open fencing over partial slated flooring allow draft and wind current that keep the area cool and encourage the elimination (McGlone and Pond 2003). In our case created elimination area was also surrounded by iron mesh which enables the cool air to move in.

In G<sub>2</sub>, highest defecation was observed in area near waterer (a) and empty dry area-1(b) respectively. Pigs prefer to eliminate in cooler area (Aarnink *et al.* 2006) compared to warmer area. Since, drinker location (a) was constantly wet by spilled drinking water which may cause marginal cooling of that locations encouraged the weaner to defecate

most. Lowest defecation was observed in area near empty dry-3 (d) and gate (e) respectively. However, weaners did not choose feeder location to defecate. Sows tries to keep its head as far away from feeder location and resting location (Andersen and Pedersen 2011). Day wise total defecation does not vary much but location wise it varied too much (Table 2).

**Cleanliness of floor:** Modified weaner pen was more clean than closed housing pen indicating that both outside created toilet area and autoflush machine helped in directing the animal to eliminate in the demarcated location (g) however only created toilet area (a) inside the pen does not attract much weaner to defecate in (Table 3). Keeping drinker in outer location compared to inner location resulted in less pen fouling (Ocepek *et al.* 2017). Here in G<sub>1</sub>, outside created toilet area was also intermittently wet by autoflush machine which lead to more cleanliness inside the pen compared to other G<sub>2</sub> where machine was not installed.

**Cleanliness of animal:** G<sub>1</sub> animals got hygiene score 5 and G<sub>2</sub> got 2.6, i.e. animals staying in modified pen were more clean than those staying in closed pen. Soiling of the lying area is abnormal behaviour in pigs, which indicates that the housing system does not facilitate pigs to express natural behaviour and that the welfare is reduced (Špinko 2006).

**Water consumed in cleaning of dung:** In G<sub>1</sub>, 5 weaners (13th to 14th week of age), produced an average 6.04±0.06 kg dung per day. For complete flushing of 6.04±0.06 kg dung, a total of 4.2±0.2 times (approx 4 times) machine flushing was required which utilized 162.80±9.06 liters of water. However, in G<sub>2</sub>, it required 212±1.4 litres per day (Table 4). In previous experiment, 60.8±1.60 to 62.4±5.14 litres of water was used to clean the intensive pen (Kaswan 2013) which is less amount as compared to our finding. The reason could be larger area in our case (15.96 m<sup>2</sup>) compared to other study (8.62 m<sup>2</sup>). This shows that our developed auto-flush system is good in water (49.20±7.87 litre/day) saving.

**Manpower required in dung cleaning:** In G<sub>1</sub>, single labour took 7.85±0.24 sec for cleaning of dung (by hose pipe). However, in G<sub>2</sub>, it took 175.48±2.11 sec (Table 5). Intervention of observer were common in both group. This shows that creation of elimination area saved 172.34±2.05 man-sec. The reason could be that in G<sub>1</sub> most of the defecation (94.12%) was done in toilet area in first two days but only minor (5.88%) defecation done in gate area

Table 2. Defecation pattern in intensive pen (G<sub>2</sub>)

Day	Water/drain/toilet area	Empty dry 1	Empty dry 2	Empty dry 3	Gate	Feeder	Total
1	22 (50)	12 (27)	6 (14)	1 (2)	3 (7)	0	44 (100)
2	21 (47)	14 (31)	8 (18)	2 (14)	0	0	45 (100)
3	22 (50)	13 (30)	9 (20)	0	0	0	44 (100)
4	22 (51)	14 (33)	7 (16)	0	0	0	43 (100)
5	21 (45)	14 (30)	11 (23)	0	1 (2)	0	47 (100)
Total	108 (49)	67 (30)	41 (18)	3 (1)	4 (2)	0	223 (100)

Values in parenthesis indicate defecation %.

Table 3. Cleanliness score of floor under different housing system

Day	Modified pen (G <sub>1</sub> )	Intensive pen (G <sub>2</sub> )
1	141	114
2	142	107
3	144	115
4	144	116
5	144	109
Mean±SE	143±0.63	112.2±1.77

Table 4. Water (in litres) used in dung cleaning in G<sub>1</sub> and G<sub>2</sub>

Day	Dung quantity (kg)	Modified pen (G <sub>1</sub> )	Intensive pen (G <sub>2</sub> )
1	5.97	148 (4)	212
2	6.21	185* (5)	216
3	5.95	148 (4)	210
4	6.15	185* (5)	214
5	5.94	148 (4)	208
Mean±SE	6.04±0.06	162.8±9.06	212±1.41

\*When amount of dung increased above 6 kg, it required one extra flush (37 litres/flush). Values in parenthesis indicate number of flush.

Table 5. Single manpower (sec) in cleaning of G<sub>1</sub> and G<sub>2</sub>

Days	Modified pen (G <sub>1</sub> )	Intensive pen (G <sub>2</sub> )
1	8.23	180.3
2	7.46	175.46
3	–	169.32
4	–	179.85
5	–	172.45
Mean±S.E	7.85±0.24	175.48±2.11

so it took very less time to flush with hose pipe. However, in G<sub>2</sub>, dung was spread in five areas and hence it took average of 175.48±2.11 sec to clean. In previous experiment, average man-sec (two labour) required for sweeping of covered area was 40.79±0.98 sec, after intervention (Mamta 2013). The difference in cleaning time could be method of sweeping and number of labour.

It may be concluded that all weaners used the elimination area for defecation in G<sub>1</sub>. The auto-flush system helped in maintenance of cleanliness of floor, cleanliness of animal and also saved water and labour time.

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