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Automatic versus conventional rearing systems in commercial piggery farms: A survey

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Abstract
An automatic rearing system in commercial pig farming helps to reduce manpower requirements and also increase the efficiency of the productive animal. Automatic rearing systems (ARS) have recently been introduced in commercial piggery farms and little information is available regarding their feasibility to the Indian farmers. The primary Objective of this paper was to identify differences in economic parameters between ARS and Conventional rearing systems (CRS). The survey was conducted in 10 piggery farms of Karnataka state in India, out of which 20 per cent were using ARS and 80 per cent of the farms were on CRS. The nature of survey conducted was through interview and a set of a questionnaire. During the interviews, which lasted about 2 h, the following information was obtained: i) farm characteristics, ii) feeding systems, iii) Feeding strategies, iv) Watering system and v) Meat and skin quality. The farms were divided into two groups where the first one (n=50) utilized ARS while the second group (n=50) had CRS. The average width of the Sty, Farm area, pork production, number of pigs maintained in group I and II was observed 30±1.4 ft, 5000±282.8 sqft, 8±0.2 MT, 102±1.4 and 26.75±0.4 ft, 7962.5±127.6 sqft, 6.08±0.1MT, 103±0.6 respectively. The breed at 86% of all surveyed farms in Group I was three way cross bred commercial lines while remaining 14% were pure lines, such as Large white Yorkshire, Landrace and Duroc. The average of these lines pork yields of Group I farms was 8 MT. Whereas, in group II was having 72% three way cross bred commercial line and 28% indigenous Ankamali breed. The average yield for Group II farms was 6MT of pork. The most striking differences in the two surveyed groups were related to the feeding systems. Their entire systems featured auger driven suspended feeders, electric powered, with nominal volume ranging from 3.0 to 4.0 m^3, that were filled on average, at 55% of their capacity. They delivered feed with an average frequency of 4 times per day. Ninety per cent of the CRS farms delivered Hotel or kitchen waste by manual feeding system. The remaining 10% of these farms offered ration components along with Hotel or kitchen waste by means of manual feeding system. The majority of Farms in Group II (85%) provided only one ration irrespective of Balanced ration and remaining 15% were provided single ration with different measured quantity to lactating sow, pregnant sow, Dry sow, Gilt and Fattener pigs. Whereas, in Group I followed phase feeding method for the fatteners as per the NRC (1998) recommendation, in these farms feeding was done in three difference phases and also split sex feeding for the breeders was observed. Water quality with respect to Coli form Bacterial counts (per ml), Nitrate (mg/l), Total Hardness (ppm), pH in Group I and II were 55.3±7.1 and 75.0±7.6; 9.0±1.4 and 32.5±2.6; 62.0±2.8 and 181.5±5.4; and 6.7±0.07 and 6.4±0.1 respectively. The average mean of back fat thickness (mm), Fat firmness in Loin and shoulder, water content (mg/g) and lipid content (mg/g) in pork in Group I were 16.5±0.70, 685±7.07, 785±7.07, 197.9±0.56 and 8.7±0.12 respectively. These values for Group II were 25.3±0.28, 735±5.80, 840±10.69, 167.67±1.42, 14.06±0.38 respectively.
The study revealed that when compare to the Conventional Rearing Systems (CRS), the Automatic Rearing System (ARS) farms showed efficient farm production with regard to less farm space utilization, eased and better feeding strategies, quality supply of water, increased liveability, improved FCR and ease of leaner meat production was observed.

Keywords: Automation, piggery, management, feeding

Introduction
In Indian context, culture, traditions, customs and taboos influence meat consumption to a great extent especially in the rural societies. However, urbanization has been causing a rise in demand for meat products. As people move to cities, they start getting into meat consumption. The present production of meat in India is estimated at 7.4 million tons in 2016-17 (19^{th}census) in that contribution of meat from buffalo is about 19.80%, while cattle contributes about 4.72%, sheep 7.68%, goat 14.25%, pig 6.50%, poultry 47.05%. The meat production has increased from 1.9 million tonnes in 1998-99 to 7.4 million tons in 2016-17.

The compounded average growth rate (CAGR) during the last two decades works out to be 4.5%. According to 19thLivestock Census of India (2012), the total swine population, while small, has grown consistently over the past 50 years. However, in the most recent decade, the population has declined to approximately 10.29 million from 11.13 million in 2007, as indicated by the 18th Livestock Census of India.

The primary reason for slow growth rate and decline in swine population when compared to previous census might be due to poor management, poor skin quality and conventional farming methods. Majority of the pig farmers fed hotel or kitchen waste to their pigs which results less cost of production but reduces the lean meat quality and skin quality of carcass. This makes repulsion among exporters to export in EU market where quality pork is priority. The objective of this paper is to publicize the modern technologies adopted in commercial piggery farming, among pig farmers for the quality meat production for competing in International market. Increasing labour cost and sounder sizes have led to significant interest in the use of automation. Most recently, the concept of precision piggery farm has been introduced, thanks to the availability of sensor-based management tools that define animal needs.

The primary difference between conventional feeding systems (CFS) and Automatic feeding systems (AFS) is that, with AFS the farmer will not be directly involved in feed preparation and delivery, and the feed delivery is programmable, which makes it easy to increase the feeding frequency. Few studies have investigated this technology; most report the possibility of reducing human labour or making the work schedule more flexible. Therefore the current was undertaken to compare the practical differences exists between ARS and CRS farms, further their economic feasibility in adapting either of the systems.

Materials and Methods

To identify these features, we conducted a survey between November 2017 and December 2017 involving 10 commercial piggery farms. The farms where identified with the cooperation of the manufacturers of Automatic rearing systems; main criteria were that at least two farms automatic feeding systems. The farms were divided into two groups where the first one (n=50) utilized automatic rearing systems while the second group (n=50) had conventional rearing systems. The survey was conducted in-person to each farm by means of a questionnaire. During the interviews, which lasted about 2 h, the following information was obtained: i) Farm characteristics, ii) Feeding systems, iii) Feeding strategies, iv) Watering system and v) management and economic aspects.

In general, the measurement of back fat thickness was performed by A-mode ultrasonography. An average value from both sides of P2 position used as back fat thickness (mm) of individual pigs.

Back fat is measured at the P2 position which is 65mm down the left side from the midline, at the level of the head of the last rib. The procedure is performed with the pig standing. Pigs are usually restrained in a stall, weigh crate or walkway; however, no restraint is needed if the pig stands quietly.

To locate the P2 site and measure back fat:

1. Find the rearmost edge of the last rib on the pig's left hand side.
2. Mark a spot vertically above on the midline.
3. From this spot, measure 70mm forward on the midline, and then 65mm down the left side from the midline.
4. Place the probe of the ultrasound machine directly over the P2 site according to the manufacturer's instructions, and record the fat measurement (a contact solution is usually required to get an accurate reading).

Post slaughter

Back fat thickness (P2: at the last rib, 6cm from the mid-line) measurements were made on the hot carcasses and, after overnight chilling, subcutaneous fat firmness was recorded in the loin in the region of the last rib and over the shoulder using the Fat Penetrometer developed at the IFRh Bristol (Dransfield & Kempster, 1988) [1]. A sample of both layers of back fat at the level of the last rib was analysed for water content by lyophilisation and lipid content by extraction with diethyl ether in a Soxhlet apparatus. A 5 cm diameter core from the centre of the M. *longissimus dorsi* at the level of the last rib was removed and its extractable fat content determined by Soxhlet extraction with diethyl ether as described above. This was designated intramuscular fat.

Results and Discussion

Farm characteristics

The farm characteristics of the CFS and AFS farms with respect to layout, flooring systems, waste disposal were found to be different in two groups. The average width of the Sty of group I pigs was observed 30 feet while each pen size had average dimension of 4 feet x10 feet where as in group II the average width of the sty were observed 25-28 feet while the dimensions of each pen observed 6 feet x 9 feet. The average farm area was 5000 sq. ft and 8000 sq. ft of group I and II respectively. The average no. of pigs maintained 102 and 103 in Group I and II respectively. The breed at 86% of all participating farms in Group I was three way cross bred commercial lines while remaining 14% are pure lines Large white Yorkshire, Landrace, Duroc yields 8MT pork whereas in group II 72% three way cross bred commercial line,28% indigenous ankamali breed Yields 6MT pork.

Table 1: Farm characteristics such as width of the shed (ft), Farm area (sqft), pork production (MT) and Number of pigs maintained in ARS and CRS groups and the average values for these groups

	Group I (ARS)		Group II (CRS)								Average values for the two groups	
	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5	Farm 6	Farm 7	Farm 8	Farm 9	Farm 10		
Breeds	Three way cross bred, LWY, LR, and DU		Three way cross bred, Ankamali								Group I	Group II
Width of the shed (ft.)	29	31	25	28	26	27	26	26	28	28	30±1.4	26.75±0.4
Farm Area (Sq.ft)	5200	4800	7500	8500	7800	8000	8200	7900	8100	8000	5000±282.8	7962.5±127.6
Pork Production (MT)	7.8	8.2	5.5	5.8	6.5	6.2	6.1	5.9	6.0	6.0	8±0.2	6.08±0.1
Number of Pigs maintained	101	103	101	105	103	103	104	102	105	101	102±1.4	103±0.6

Feeding systems

The most striking differences in the two surveyed groups were related to the feeding systems. Their entire systems featured auger driven suspended feeders, electric powered, with nominal volume ranging from 3.0 to 4.0 m3 that were filled, on average, at 55% of their capacity. They delivered feed with an average frequency of 4 times per day (see below). The AF systems comprised either stationary mixers or mechanic temporary storages for feed concentrates. These mixers or storages must be sheltered to prevent spoilage of the feedstuffs. The farmers loaded them with the various feedstuffs. 90% of the CFS farms delivered Hotel or kitchen waste by manual feeding system. The remaining 10% of these farms offered ration components along with Hotel or kitchen waste by means of manual feeding system. All Automatic feeders in the study featured a vertical auger mixing system with 1 or 2 augers.

Table 2: Summary of the average feeding mechanization features for AFS and CFS farms

	Group I		Group II							
	FRM 1	**FRM 2**	**FRM 3**	**FRM 4**	**FRM 5**	**FRM 6**	**FRM 7**	**FRM 8**	**FRM 9**	**FRM 10**
Feeding Frequency per Animal	4	4	1	1	1	1	2	2	2	1
Feeding space/animal(cm)	25	25	30	30	30	30	30	30	30	30
Feeding System	AFS	AFS	CFS	CFS	CFS	CFS	CFS	CFS	CFS	CFS

Feeding strategies

The two groups of farms adopted the different approach with respect to the ration composition with different feeding strategies. The majority of Farms in Group II (85%) provided only one ration irrespective of Balanced ration and remaining 15% will provide single ration with different measured quantity to lactating sow, pregnant sow, Dry sow, Gilt and Fattener pigs whereas in Group II phase feeding method for the fatteners as per the NRC (1998) recommendation where the feeding done in three difference phases and split sex feeding for the breeders. The phase-I (8-20 weeks), phase-II (21-24 weeks) and Phase-III (23-32 weeks) with target body weight 12-44 kg, 45-80 kg and 80-100 kg. The weaning age will be decided by the body weight instead of age i.e 10-11 kgs in 14 days**.**

Feeding is done by auger pan feeding system for controlling the wastage of feed and provides optimum feeding space. Feed used in the form of mash and pelleted. By reducing the particle size, the surface area of the grain particles is increased, allowing greater interaction with digestive enzymes. Addition of enzymes, such as phytase, amylase, protease, and glucanase, may release nutrients that will enhance nutrient retention and reduce excretion. This is especially true in corn-soybean meal diets**.** This improves the Feed conversion ratio and also facilitates the lean meat production.

Kitchen waste can be describe as any edible waste from food production, transportation, distribution and consumption. It is also referred to as garbage, swill, hotel waste, kitchen refuse etc. In addition, solid and liquid by product wastes, are generated throughout the food production and processing sector (CAST, 1995). In total this make constitute as much as 20% of the total human food supply from the stage of processing to the point of consumption. Feeding of food waste to livestock is not a recent innovation, it has been practiced throughout the world and is often concentrated around metropolitan centres.

The digestibility of food waste in swine was found to be similar to that of a commercial swine diet.

The following Table I and Table II illustrates the proximate analysis of feed of Group I and II.

Table 3: Group I

Proximate principles	**FRM 1**			**FRM 2**			**Mean with standard error**
	Phase I	**Phase II**	**Phase III**	**Phase I**	**Phase II**	**Phase III**	
CP (%)	21.5	16.5	12.6	21.8	15.5	13.5	16.9±1.7
CF (%)	6.9	7.0	7.8	6.4	7.1	7.5	7.1±0.2
ME(Kcal/kg)	3537	3058	2040	3548	3069	2240	2915.3±286.5
EE (%)	4.5	4.4	4.1	4.6	4.4	4.2	4.3±0.08

Table 4: Group II

Proximate principles	**FRM 3**	**FRM 4**	**FRM 5**	**FRM 6**	**FRM 7**	**FRM 8**	**FRM 9**	**FRM 10**	**Mean with standard error**
CP (%)	18.4	17.0	16.3	17.5	15.2	13.2	17.0	16.0	16.3±0.6
CF (%)	6.5	5.5	5.4	5.2	4.5	5.0	5.3	4.9	5.28±0.2
GE(Kcal/kg)	4560	4640	4800	4750	4860	4780	4600	4650	4705±40.4
EE (%)	6.2	6.1	6.3	6.2	6.5	6.9	6.8	6.2	6.4±0.1

Watering system

Both the farms in Group I are equipped with Bite Nipple drinking system imported quality with aid in providing clean and safe water. Bite nipples will prevent contamination by pigs in the sty. Water coming into the system travels first through filter and then through the pressure regulator to reduce pressure to approximately 15 psi. The sealing force in Nipple Waterers comes from a silicone rubber diaphragm, which provides the pressure necessary to hold the stem closed. This prevents water from flowing under the stem head and out of the nipple. Water is released only when the pig moves the stem by biting on it.

All the farms in group II provide tap water in drinkers to the animals made up of concrete. The Water was tested in all the farms to check the permissible limits of Bacterial load and Total hardness.

Table 5: Group II Farms (Water Hygienic standards)

Contamination/Characteristics	FRM 3	FRM 4	FRM 5	FRM 6	FRM 7	FRM 8	FRM 9	FRM 10	Mean with standard error
Coliform Bacteria/ml	50	80	100	60	80	80	100	50	75.0±7.6
Nitrate mg/l	25	35	40	30	45	30	25	30	32.5±2.6
Total Hardness	200	180	180	160	200	165	182	185	181.5±5.4
pH	6.2	6.1	6.3	6.2	6.5	6.9	6.8	6.2	6.4±0.1

Table 6: Group I Farms (Water Hygienic standards)

Contamination/Characteristics	FRM 1	FRM 2	Mean with standard error
Coliform Bacteria/ml	50	60	55.3±7.1
Nitrate mg/l	10	08	9.0±1.4
Total Hardness	60	64	62.0±2.8
pH	6.8	6.7	6.7±0.07

Back fat thickness

	Group I		Group II							
	FRM 1	FRM 2	FRM 3	FRM 4	FRM 5	FRM 6	FRM 7	FRM 8	FRM 9	FRM 10
Avg.P2 (mm)	16	17	25	26	25	25	26	24	26	26
Fat Firmness(Post slaughter)										
Loin	680	690	710	750	760	725	730	740	735	730
Shoulder	790	780	810	860	810	820	830	840	860	890
Water in fat(mg/g)	198.3	197.5	160.3	165.5	170.5	165.3	168.4	169.5	170.5	171.4
Lipid in LD(mg/g)	8.6	8.8	13.7	12.6	13.5	13.6	14.5	15.5	13.6	15.5

Fat firmness measured on a scale of 0-1000 (higher values indicate firmer fat) and corrected to a measuring temperature of 1°C. All values are corrected to a live weight of 62.5 kg

Mean with standard error	Group I	Group II
Avg.P2 (mm)	16.5±0.70	25.3±0.28
Fat Firmness(Post slaughter)		
Loin	685±7.07	735±5.80
Shoulder	785±7.07	840±10.69
Water in fat(mg/g)	197.9±0.56	167.67±1.42
Lipid in LD(mg/g)	8.7±0.12	14.06±0.38

Recent increase in demand of lean meat production in the international market and hotel industry in India forces the farmers to produce lean meat production. During the survey, it was observed that FRN-1 and FRM-2 is producing the quality meat as per the demand by consumer compare to Group II farms because Group I farms have control in their nutritional densities and can manipulate in due course of time.

Conclusion

The study or the visit revealed that with proper management and Automation one run piggery farming very successfully and can make maximum profits. Further one can sustain by becoming a model or consultant for establishing such units in the vicinity by other needy farmers and also there is intense labour saving with most of machine operations. However, the studies involving more number of farms especially Automatic Rearing Systems farms in needed to correlate the current findings.

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