STUDIES ON PIG MANAGEMENT PRACTICES VIS A VIS PRODUCTION AND REPRODUCTIVE EFFICIENCY IN DIFFERENT ZONES OF PUNJAB

Thesis

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(Minor Subject: Veterinary Gynaecology and Obstetrics)

By

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CERTIFICATE – I

This is to certify that the thesis entitled **"Studies on pig management practices vis a vis production and reproductive efficiency in different zones of Punjab"** submitted for the degree of **M.V. Sc.** in the subject of **Veterinary and Animal Husbandry Extension Education (**Minor subject**: Veterinary Gynaecology and Obstetrics)** of Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana is a bonafide research work carried out by **Mandeep Singh (L-2012-V-24-M)** under my supervision and that no part of this thesis has been submitted for any other degree.

The assistance and help received during the course of investigation have been fully acknowledged.

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ABSTRACT

The study was undertaken to know the different pig production management practices, pig performance under different farm sizes and effect of management practices and their effect on production and reproductive efficiency in two agro climatic zones of Punjab. 50 piggery farms were selected from each agro climatic zone. Majority of the farmers (87%) in Punjab were rearing pigs in smaller groups (<15 pigs/pen) and they provided sufficient floor area to them. At 73% farms had provision of guard rails. At About 86 percent of farms deworming is performed. 63% farmers were rearing pigs on a combination of kitchen waste, concentrate ration and industrial by-products. 50 % of the farmers used to detect the heat by just observing heat signs. Majority of the farmers were rearing one boar for each 10 breedable sows. About 73% farmers isolated pregnant sows from rest of the herd more than a week from expected date of farrowing. 83% farmers in the present study provided water for the animals to reduce heat stress by making some open space of the pen lower than the plinth level. 85% farmers had combination of facilities like heaters and bulbs, while 36 per cent of the farmers used bulbs only as a source of heat to reduce winter stress.The smaller the herd size, the greater was the weaning age. The Pearson correlation coefficient between herd size and weaning age was -0.413 ($P < 0.01$). The overall age at first mating was 7.94±0.98 months. The overall litter size recorded in the present study was 9.56±1.37. Age of the sow at first mating was significantly ($P < 0.05$) lower (7.59±0.90 months) than that of medium and small sized farms. The overall average number of days a sow required to come in heat after farrowing was14.22±9.12 days. The overall age and weight of pigs at sale were 10.27±1.39 months and 94.32±15.51 Kg, respectively. In this study higher the education level of the farmer better were the management practices and higher was production as well as reproductive performance of the animals.

Keywords: Reproductive efficiency, agro climatic zones, sows, education level, management practices, relationship, herd size.

_____ _____

Signature of Major Adviser **Signature of the student**

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Place : *Ludhiana*

Date : ***(Mandeep Singh)***

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LIST OF ABBREVIATIONS

%	:	Per cent
<	:	Less than
>	:	More than
≥	:	More than or equal to
≤	:	Less than or equal to
GADVASU	:	Guru Angad Dev Veterinary and Animal Sciences University

CHAPTER I

INTRODUCTION

Punjab is primarily an agricultural state where the main stay of rural masses is agriculture and allied enterprises. In 2010-11, animal husbandry alone contributed 7.43 per cent to the economy of the state against 15.47 per cent from agriculture constant (2004-05) prices (Singh *et al* 2012) although the proportionate investment in animal husbandry is much less than agriculture. The contribution of this sector to the economy has been progressively increasing over the previous two plan periods whereas the one from agriculture had declined. There is a definite scope to augment the contribution of this sector by adopting modern techniques for increasing livestock production because of lack of awareness about improved animal production practices and poor financial resources for managing the input systems. Compared to dairy farming, pig farming is quite cost-effective. A dairy farmer can rear only five heads of cattle on one acre of land, as he has to grow fodder for the animals too. Land is very expensive and rents are exorbitant. Buying fodder makes the dairy venture unviable in many situations. In contrast, pig farming is a lucrative preposition for small and marginal farmers.

Pig farming is an emerging field in Punjab. Total pig population in India was 111.34 lakhs according to Census of 2007. Punjab had only 26,000 pigs in 2007 with decreasing growth rate of 3.41. There is a huge demand in the international market also. The players in the business of meat processing in Punjab plan to diversify it but the volume of meat is not available to them as per the records of Animal Husbandry Department, Punjab. The Punjab Government started a scheme in 2005 for small pig farmers to provide subsidy of Rs 1.70 lakh on bank loan of Rs 6.00 lakh. Pig farming also fits well in the present scenario of crop diversification in Punjab as it does not

require any complex technology and skill. It requires comparatively less land and investment on buildings and equipments. Farmers are also showing increased interest in this field. Modernization of pig farms has been undertaken and new imported breeds of pigs are being reared by some farmers.

Piggery is a most potential source of meat production and more efficient feed converter after broilers. It is a high-yield business. In poultry, one kilogram of bird gives 700 grams of meat while a live pig can yield 90 per cent meat. Pig farming is a low-risk business that is suitable for Indian climatic conditions. It also provides employment opportunities to seasonally employed rural farmers and adds supplementary income to improve their living standards. Pigs can utilize a wide variety of feeds and garbage and convert them into valuable nutrients. They are prolific breeders with shorter generation interval. A sow can be bred as early as 6 months of age and farrows twice a year. Sow produces 6-8 piglets in each farrowing. Pigs are also in great demand in industries related to poultry feed, soap, paint and other chemical industries since they can store huge quantities of fat. Pig farming provides quick returns to the farmer since the marketable weight is achieved very early. Pig products such as pork, bacon, ham, sausages, lard etc are in great demand in domestic market. They are also exported. No scientific study is available regarding pig management practices followed by farmers in Punjab.

Keeping in view the facts stated above, present study was planned to achieve the following objectives:

1. To study pig production management practices in Punjab.
2. To evaluate pig performance under different farm sizes.
3. To find out the relationship of different pig management practices with swine reproduction.

CHAPTER II

REVIEW OF LITERATURE

2.1 Importance of colostrum feeding

Colostrum is the rich source of nutrients and is secreted immediately after farrowing. Colostrum intake during first few hours of birth is must for the survival of the piglets and their life-long performance. Newborn piglets cannot keep themselves warm immediately after birth because the bodily energy reserves necessary to keep them warm are very limited (Mellor and Cockburn 1986). Body fat is too little and there is no hair on their body leading to very low insulation. Small size of the body causes fast heat loss. Piglets are born wet with birth fluid which further increases chilling. Therefore, colostrum intake is must for the piglets to maintain their body temperature immediately after farrowing. Colostrum is also required for the growth of the gastrointestinal tract of piglets. Further, piglets are born with little immunity (Gaskins 1998) which can only be gained by consuming colostrum soon after birth. Antibody level falls dramatically immediately after birth and it falls to 35 per cent by 12 hours of the birth of first baby (King'ori 2012). Colostrum intake is must for the survival of the piglets and its life-long performance. Maximum colostrum should be fed in first six hours of birth. The piglet should consume at least 100 ml of colostrum within 16 h of birth. It is crucial for energy, nutrients and immunity needed for survival. Beyond 16 h, it becomes too late for the piglets' intestines to absorb the antibodies present in the colostrum. Moreover, colostrum is secreted in sufficient quantities only in first 12 hours and after 20 hours sow starts producing milk.

To ensure proper colostrum intake, suckling should be done under supervision after farrowing. Many ways are followed for proper colostrum intake - 1. Split

suckling- it is used when litter size is large and there is considerable variation in piglet size. 2. Assisted suckling- it is used when high number of small and low viability piglets are born and there is considerable variation in piglet size. 3. Hand feeding colostrum- it is used when high number of small and low viability piglets are born. Each piglet must be fed with at least 30 ml colostrum per kg body weight four times a day. It will provide required IgG level (Stevenson *et al* 1983). Colostrum effectiveness in disease prevention and control is determined by the amount ingested and concentration of the immune-globulins present in it and also on the absorptive capacity of intestines. Number of parity and sow genotype are the main factors that influence the quantity and composition of the colostrum (Farmer and Quesnel 2009). Utilisation of glycogen store is equally important for homeothermic balance even in the well-fed piglets (Dividich *et al* 1994).

2.2 Cross fostering

It is a common practice followed at many farm. If a number of farrowings happen on a particular day, then, one can transfer the piglets from high litter-size sow to the small litter-size sow. It will ensure proper colostrum intake by all the piglets. This will reduce the lactational stress on the sow having larger litter-size. Pre-weaning mortality will also get reduced (English *et al* 1982). Size of litter and littermates significantly affect the low-bodyweight-piglets' survival through direct competition for access to teats (Caceres *et al* 2001). Cross fostering must be completed within first 48 hours of birth (Beymon 1997). All the piglets must receive colostrum from their real mother before transferring to the foster mother. The number of functional teats of the foster mother must be taken into consideration before transferring the piglets.

2.3 Naval cord disinfection

Naval cord enables the piglets to obtain nutrients from the dam and removal of waste from its body during gestation. The condition of naval cord at farrowing is very important for the viability of the piglets. It is possible that some bacteria and viruses may enter the body of piglets by travelling through this cord and may cause infection. Piglets may bleed excessively through this cord if it gets broken accidently. Generally umbilical cord tears up within seven minutes of birth. Piglets may suffer irreversible brain damage if umbilical cord ruptures five minutes prior to farrowing (Alonso-Spisbury *et al* 2005).

The umbilical cord must be tied off tightly after application of iodine over it. The scissors or blade employed for this purpose must be sterilised properly. Iodine solution must be prepared afresh. If the cord has already dried up or get shrivelled it should not be treated at all. It should be left as such. Piglets born with naval cord injury have less chance of survival (Mota-Rojas *et al* 2012).

2.4 Needle teeth cutting

Piglets are born with eight sharp teeth including three incisors and one canine. Presence of these teeth can lead to injuries on the teats of the dam. Littermates as well farm staff may also get injured (Hutter *et al* 1993). So, these teeth must be clipped or grinded immediately after birth. Adoption of this practice may warrant reduction of various teat injuries (Estienne *et al* 2003).

2.5 Prevention of anaemia

Iron is the vital nutrient of piglet diet. Deficiency of iron leads to piglet anaemia. Rapidly growing young ones get deprived of iron in their diet. This problem

is usually faced by confined animals having least access to the soil (Victor and Mary 2012). Normally piglet is born with blood haemoglobin level of 12-13 g %. Thereafter, haemoglobin level drops down rapidly to 6-7 g % by 10^{th} day of life. Piglets weighing 1-5 kg require daily iron intake of 25 mg (National Research Council, 1988). Piglets suffering from anaemia are usually listless and have wrinkled skin with rough hair coat. Mucous membranes are usually de-pigmented (Victor and Mary 2012).

Various practices have been adopted to prevent this anaemia. Maximum growth rate was achieved through supplementation of 100 mg in the form of injectable iron dextran to piglets weaned at three weeks of age. Vitamin C or ascorbic acid has also been shown to have beneficial effects on iron absorption. It shows that iron-deficient rats had increased efficiency of absorption of iron when Vitamin C was given with Fe supplement Supplementation of fresh earth sprinkled with $FeSO_4$ helps in reducing anaemia in piglets. Paste of iron sulphate on the teats of sow helps in controlling anaemia. Iron dextran (200mg) as single dose is sufficient to reduce the incidence of piglet anaemia.

2.6 Castration

Castration is routinely performed in male piglets in first week in order to make them docile and to prevent boar taint which is a distinctive odour that comes during cooking. Main substance that produces boar taint is androstenone synthesised in testicular tissue (Thuni *et al* 2006). Castration is usually performed at organised piggery farms. Generally castration is performed without any analgesia (McGlone *et al* 1993). Castration results in better growth rate and docile behaviour (Rydhmer *et al* 2006) and better feed conversion ratio (Pauly *et al* 2008).

2.7 Creep feeding

The dietary requirements of piglets increase with time. Milk consumption cannot meet the dietary requirements of the growing piglets. Therefore, they need creep feed along with the whole milk. Creep feed is basically a solid feed. It decreases the weaning stress over the piglets. It also increases the weaning weight of the piglets. It reduces the occurrence of diarrhoea during weaning time. Creep feeding must be started at seven to ten days of age. It should be provided to the piglets when sows are being fed. Creep feed must be easily digestible and should have good palatability. It must include fish meal of high protein value and powdered milk. When indigestible feed components are included, it promotes the growth of opportunistic bacteria like *E. coli* which can causes various diseases in the pigs (Plunske *et al* 1997). Supplementing creep feed with glutamine improves the health of intestine and enhances the feed conversion ratio (Cabrera *et al* 2013).

2.8 Weaning and reproductive performance of sow

Weaning is most crucial and stressful event in the life of piglets. Time of weaning is always a controversial topic among the researchers and farmers. It involves the separation of piglets from their mother. Weaning always bring significant challenges for the pig including physical, social and environmental challenge (Campbell *et al* 2013). As piglets have to shift abruptly from the highly digestible mother milk to the purely solid and comparatively less digestible diets, surely it reduces the growth and creates a stressful condition over the weanlings (LeDividich and Seve 2000). Diarrhoea is the major problem during weaning period. Stress of weaning can lead to dysfunctioning of gastrointestinal tract. It also decreases immunity. It further reduces the growth, health and feed intake especially in first week of the weaning. Good management, housing and nutrition can reduce this stress significantly (Campbell *et al* 2013).

Timing of weaning is more important as it significantly affects the reproductive performance of the sow. It is, however, a controversial issue. Mabry *et al* (1996) reported that early weaning brings the animals in reproductive cycle more early, while some reports also suggest that weaning does not affect reproductive cycle. Weaning age in the range of 14 to 21 days may not adversely impact sow reproductive performance (Alison *et al* 2008). Weaning if performed after 20 days significantly improves growth performance of the animals. It is the parity that brings about significant changes in piglet weight and reproductive performance of the dam.

2.9 **Type of floor and role of bedding material**

Good floor conditions are must for comfortable environment in farm. The floor must be non-slippery, easily washable and should have good bedding material. A bad floor causes different lameness like conditions (Mouttotou *et al* 1999). Floor abrasiveness is a common cause of superficial injury in piglets in farrowing pens. It can cause abrasions over skin of shoulders and back leading to reduced reproductive and productive efficiency of the pigs. Further, it opens gates for other problems like arthritis, joint ill etc. Good bedding material reduces the discomfort for the animals. It acts as insulator for both the seasons- summer and winter. Proper maintenance of the floor can prevent the degree of roughness and abrasiveness of the floors, which in turn can contribute significantly to prevention of abrasions, sole bruising and lameness in piglets as well as in growers. Free access to soil area or deep bedding has been connected with low prevalence of foot and limb lesions (Kilbride *et al* 2009) and with osteochondrosis (Van Grevenhof *et al* 2011).

2.10 Sanitation and ventilation of the farm

Poor sanitation at the farm may increase risk to exposure of pigs to the pathogens from the environment. Presence of pathogens or their vectors inside farm areas in combination with poor environmental conditions may result in high prevalence of various infectious or parasitic diseases, many of which may be zoonotic in nature. Leptospirosis is another problem in moist muddy conditions that can create a greater problem in poorly sanitized condition (Boqvist *et al* 2012). Sanitary challenges negatively affect feed intake and growth leading to negative impact on animal well-being and economic losses. Diseases negatively affect feed intake and growth in pigs. This often results in decreased feed efficiency, an increase in production costs (e.g. feed and veterinary costs), increase in nutrient excretion and in environmental impact. Medication and/or feed additives are often used to limit the negative consequences of diseases (Pastorelli *et al* 2012). A wide range of pathogenic agents such as viruses, bacteria, parasites and fungi, as well as social and climatic conditions (Wellock *et al* 2003) and the degree of hygiene can reduce feed intake, growth and feed efficiency. Rapid air movement over pigs increases the rate of evaporative and convective heat loss, and is particularly important in confinement buildings. Providing and operating supplemental fans over pens to increase air velocity to at least 3 mph is very effective in warm conditions. Additionally, air exchange in mechanically ventilated buildings should be increased in hot weather to increase the removal of humid air from barns. The deleterious effects on the performance of these factors are associated with the stimulation of the immune system which triggers a series of responses of the animal including a reduction in feed intake and increases in energy expenditure, body protein synthesis and catabolism and body temperature (Black 2009).

2.11 Stress management at the farm

The body temperature of any pig should remain within certain limits to safeguard production. When a pig's body temperature rises beyond these limits, the animal becomes heat stressed. The first sign is panting and, if the body temperature continues to rise, the animal will collapse, become comatose and finally die (Kimothi and Ghosh 2005). Extreme warm and extreme cold conditions can result in death losses if attention is not given to providing supplemental cooling to animals in summer. The losses are more commonly realized in reduced growth performance in nursery, growing, and finishing pigs along with decreased reproduction in the breeding herd. Heat stress can affect pigs of all ages, but becomes more pronounced and occurs at lower temperatures in heavier pigs due to lower optimum temperatures for these animals. There are two major methods pigs will use to minimize the effects of heat stress: increased heat dissipation and reduced production of body heat. Pigs will attempt to increase heat dissipation by increasing contact of their body with a cooler surface (floor) by sprawling out. Pigs do not sweat like humans, and therefore, cannot sweat or utilize evaporative cooling off their skin to cool off. Pigs also reduce the amount of body heat generated by reducing feed intake. There are number of methods that can reduce the heat stress. These are

1. Ample water supply- Provision of cool drinking water relieves the pigs of heat stress. A large amount of water consumed during hot weather is utilized to dissipate heat via evaporative heat loss from respiration. Waterers need to be adjusted and they must be functioning properly.There should be enough waterers available to allow adequate access (McGlone *et al* 1993).

2. Wet skin cooling and cooling pads -Pigs, under natural conditions outdoors, wallow in mud to cool themselves. The mud itself does not provide significant cooling directly, but instead evaporative cooling occurs as the mud dries. It also provides a protective barrier against the sun (Manteuffel *et al* 2004). In confinement systems, water sprinkler systems and drip coolers can also provide effective supplemental evaporative cooling. In group pens, sprinkling water in 1 to 2 minute intervals every 20 – 30 minutes allows moisture to evaporate off the pig's skin before wetting and starting the cooling process over again, and is more effective than leaving waterers ON continuously.

3. Floor space- Increased floor space improves the ability of each pig to dissipate heat, and is particularly important in larger pigs that are more vulnerable to increased temperatures (Caldara *et al* 2012).

4. Shade – Shade provides relief by blocking a significant proportion of the radiant heat load from the sun (McGlone *et al* 1993). If constructing artificial sources of shade, excellent roof materials include uninsulated aluminum or bright galvanized steel. The reflective surface helps deflect radiant rays from the sun

2.12 Stocking density

Stocking density depends on shed or paddock conditions (i.e. flooring, temperature, ventilation and general farm conditions). Stocking density should allow sufficient space for exercise and for expression of sexual behavior. Once stable groups have been formed, the mixing of unfamiliar pigs should be minimized wherever possible. Stocking density should be taken into consideration whenever there is any incidence of disease, injury, aggression or any other complication.

Stocking density for indoor housing is calculated on the basis of the usable floor area available for pigs to lie down and does not include the area taken up by feeding, watering or other equipment. For dry/gestating gilts/sows, a minimum lying area of 1.50 m² and minimum total area of 3.50 m² must be provided per sow. For farrowing or lactating sows, a minimum covered area of 7.50-9.00 m² and open area of 8.80-12.0 m² must be provided per sow. Creep area with dimensions of 2.40 m length and 0.75 m width is also provided in the farrowing pen. For boars, a minimum lying area of 7.50 m² and a minimum total area of 10.5 m² must be provided per boar. For growers/fattener a covered area of 0.60-0.80 m² per grower and 0.80-1.00 m² per fattener is provided where a maximum of 20 growers or 15 fatteners can be kept (Anon 2011). The floor should preferably be pucca concrete. Open area meant for exercise should be double than that of covered area (Warriss *et al* 1998).

2.13 Farrowing and farrowing crates

Parturition act of pregnant sow is called farrowing. Usually it takes around two to five hours to complete the farrowing and the interval between two consecutive births is 15-20 minutes. Placenta is normally expelled out within two hours after farrowing. The signs at the time of farrowing are nervousness, uneasiness, enlarged vulva with discharge and prominent teats, full with milk (Cronin *et al* 1996). Sow takes bedding material into her mouth to make a nest for the young ones (Burri *et al* 2009). The farrowing crate consists of a pen within which bars have been set up to prevent the sow from turning around. Outside the bars there is a separate space for the piglets and in some systems a roof covered creep area is situated in a corner of the pen. Usually, the creep area is installed with either floor heating and/or radiant heating from an infra-red lamp. Crushing of piglets by mother is the major cause of

piglet mortality (Andersen *et al* 2005). To lower down this mortality, farrowing crates are being used now-a-days. It has both positive and negative effects over the piggery business. These crates dramatically lower the mortality rate of the piglets during first few weeks after farrowing. The farrowing crate saves space and allows easy manure handling through slatted flooring behind the sow (Pedersen and Jensen 2008). Crates, however, restrict the movement of the sow leading to thickening of skin and there is increased stress causing reduction in performance (Leeb *et al* 2001). Each time the sow is moved to the farrowing crate, its long term negative effects get reduced (such as reduced muscle and bone strength) whereas the more immediate stress response will get increased (Boyle *et al* 2000).When gilts are moved to the farrowing crates for the first time, there is increased risk of still birth (Pedersen and Jensen 2008).

2.14 Litter size

Many factors influence litter size. These include genetics, gilt management, lactation length, parity distribution, disease, stress and boar fertility. As a result of heterosis, litter size of crossbred sows is on an average 0.25 to 0.5 pigs greater than that of pure bred sows (Aherne 2002). One of the most important determinants of litter size is failure of the developing foetus to survive (Spötter and Distl 2006). Selection for increased uterine capacity and, in particular, selection for reduced placental size and increased placental efficiency may also lead to increase in litter size (Ford *et al* 2002; Wu *et al* 2006). Gilts with a high back-fat at 100 kg have increased litter size in second parity as well as a shorter weaning to oestrus interval and a higher farrowing rate (Tummaruk *et al* 2001). Litter size increases with increase in age at first mating. However, there is a critical age above which litter size will not increase. When this critical age is reached, litter size will be determined by the number of oestrous cycles that the gilt has reached (Dewey *et al* 1995). Certain mycotoxins such

as zearalenone, if ingested in early pregnancy, can result in increased embryonic mortality and therefore, in reduced litter size (Aherne 2002). Moderate energy intake (31 MJ DE/day) compared to low energy intake (18 MJ DE/day), in the first three days after mating, may reduce litter size in gilts but not in sows. Litter size may actually be reduced by feeding a very low energy level in the first four weeks of pregnancy, especially where sows are in a very poor body condition. Tummaruk *et al* (2001) found that subsequent litter size decreased by about one pig when weaning to service interval increased from four to 10 days.

2.15 Feeder space and effect of dry and wet feed on pig performance

Pigs generally gained more daily live-weight and had better feed conversion ration when fed liquid diets as compare to dry feed (Jensen and Mikkelsen 1998). Pigs can also be allowed to have access to both water and dry feed from the same feeder. Such feeders are known as wet/dry feeder. Several studies comparing dry feeders to wet/dry feeders found that pigs fed with wet/dry feeders in general had 5 percent increased gain and intake and ate a similar quantity in a shorter time period than pigs on dry feeders (Gonyou and Lou 2000; Bergstrom *et al* 2012).

When adequate space was provided to all pigs, no significant difference was noticed between multi space and single space feeders in terms of feed efficiency over the entire feeding period (Nielsen *et al* 1996; Gonyou and Lou 1997). The number of pigs per feeder or the trough space per pig primarily affects the availability of feed to the pigs. If there are too few pigs per feeder space, some feeder space may not be used enough to provide fresh feed and the additional feeder space is simply extra cost. If there are too many pigs per feeder space, all pigs may not have enough time to eat what they desire, and competition and fighting increases at the feeder (Gonyou 1999).

Gonyou and Lou (2000) also noticed certain behaviours of pigs at feeder that lead to feed wastage. These included pigs backing away from the feeder, eating while their head was raised, fighting and stepping into the feeder. Dimensions of the feeders to minimize these behaviours cannot be evaluated precisely. However, aim should be to cover 40-60 percent of the feeder trough to reduce feed wastage.

2.16 Heat detection methods and artificial insemination in sow

Breeding is one of the most important aspects for better productivity of the animals. In temperate regions heat detection in swine is mostly based on behaviour and external changes in the reproductive organ of the sows (Losada *et al* 1997). Non availability of superior germplasm and high mating costs are the major constraints in producing good quality piglets. Artificial insemination is the best alternative for the small holder piggery farm which would save mating cost of Rs 1000-1200 and transport cost of 300-400 to the boar (Kadirvel 2013). Majority of the farmers in Aizwal district of Assam follow artificial insemination (Rahman *et al* 2008). No significant difference was observed in conception rate following natural service and AI, however, litter size was significantly greater with natural mating (10.6±0.64 vs 8.36±0.28) (Ronald *et al* 2013).

2.17 Feeding practices

The feed accounts for 70 percent of the total cost incurred on all the operations at the piggery farm (Saikia and Bhar 2010). Maize is the major cereal grain employed in the feeds of pig. Broken rice, wheat barley and oats are the other cereal grains which can be used in the pig diet. However, incorporation of rice bran or paddy can significantly reduce the cost of swine production (Lal and Makkar 1976, Bhar *et al* 2001). Moreover, these are available in plenty in India (Soren *et al* 2003). Inclusion of

paddy in the pig's diet leads to reduction in back-fat thickness linearly (Sikka 2007). It was mainly due to increase in dietary crude fibre (Sikka and Chawla 1985). Paddy based diets are, however, less digestible (Sikka and Chawla 1985)owing to protective effect of crude fibre on the digestion of all the nutrients of the diet and gel forming properties of carbohydrates present in paddy (Murray 1976), and reduced sojourn of digesta in the gastrointestinal tract (Kass *et al* 1980).

Grain based diets usually give better growth rate, however, they lead to increased cost of production. Swill or kitchen wastes are other nutrient rich materials that have high crude protein and energy (Westendorf and Myer 2004). Swill can be used regularly in the diet of pigs without any ill effect (Moon *et al* 2004). Swill feeding can significantly reduce cost of swine production in India (Ravi and Reddy 1997, Arnal *et al* 1996). Swill can be collected from vegetable /fruit market, hotels, restaurants, marriage palaces and house-hold at through-away prices. Feeding swill to pigs has been extensively practiced in Haryana and northern states of India (Rahman *et al* 2008, Kumar *et al* 2011).

CHAPTER III

MATERIAL AND METHODS

Data were collected as per questionnaire from 100 swine farmers through personal visits to their farms operational in rural areas of Punjab. The questionnaire was pre-tested on ten farmers residing outside the study area. The survey was conducted from February, 2014 through July, 2014. Information regarding identity and location of the farm, educational status of the farmer, herd strength, general management practices, feeding and health management practices and reproductive status of the sows was collected and was transferred to master sheet (Microsoft Excel) after editing it.

2.1 Location/Place of work:

The study was conducted in the Department of Veterinary and Animal Husbandry Extension Education, College of Veterinary sciences, GADVASU, Ludhiana.

2.2 Description of Study Area:

The study was carried out in State of Punjab which is located between 30.79°N latitude and 76.78°E longitude. The state is divided administratively into 22 districts and six agro-climatic zones.

2.2.1 Locale of the study

On the basis of agro climatic conditions, Punjab has been divided into six different zones (Mahi and Kingra, 2013). These include:

1. Sub mountainous undulating region
2. Undulating plain region
3. Central plain region
4. Western plain region
5. Western region
6. Flood plain region

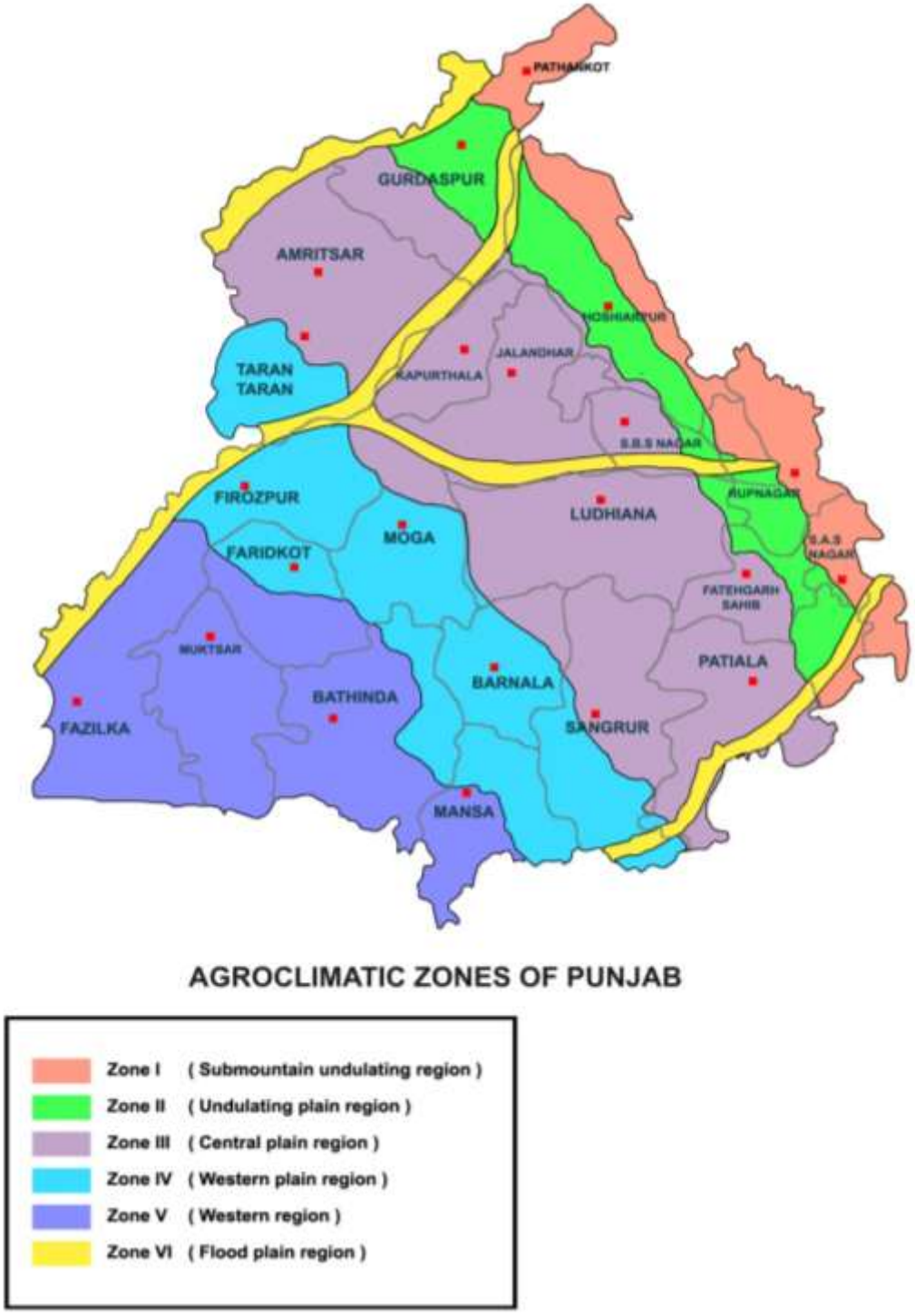

Fig. 1. Agro-climatic zones of Punjab

2.3 Target Population

Out of total pig population (26,000) of Punjab, 17331 (82.73%) pigs were being reared in two agro-climatic zones only viz Zone I, (Central Plain Zone) and

Zone II (Western Zone) (Table 4.1). So, these two zones were purposively selected for the present study. Only those farms were considered for the study where at least two breedable sows were being reared. Sampling frame was prepared by taking the help of personnel from State Animal Husbandry Department. Target population, thus, included 410 pig farms with average herd size of 16 breedable sows.

2.4 Selection of Respondents:

Farmers were selected randomly from two agro-climatic zones namely Central Plain Zone and Western Zone of Punjab State.

2.5 Research Methodology and Experimental Design:

2.5.1 Sample Design and Size:

Stratified random sampling technique was followed to select the respondents. Punjab state has been divided into six agro-climatic zones. Sample for the present research work was drawn from two agro-climatic zones i.e. Central Plain Zone comprising of Amritsar, Tarn Taran, Kapurthala, Jalandhar, Ludhiana, Fatehgarh Sahib, Sangrur and Patiala district, and Western Zone comprising of Moga, Bathinda, Mansa, Muktsar Sahib and Barnala districts. Thus, the agro-climatic zones served as the strata and two zones namely Central Plain Zone and Western Zone were selected purposively. A total of 100 respondents (50 from each zone) were selected randomly from already prepared sampling frame of total farms for obtaining the information regarding the study. A farmer maintaining a herd of at least two breedable sows was considered as a respondent. The data were collected by personally interviewing the respondents with the help of a structured questionnaire-cum-interview schedule (Annexure1).

2.5.2 Construction of Research Instrument:

The questionnaire-cum-interview schedule was prepared to obtain the relevant information from the respondents. The first part covered personal characteristics and management practices being adopted by the respondents. The second part included questions regarding pig performance. The third part included questions regarding sow reproductive efficiency.

2.6 Categorization of variables and their measurements

2.6.1 Fixed variables

They included agro-climatic zones (Zone I and Zone II) and herd size (small scale, medium scale and large scale). Zone I included Amritsar, Fatehgarh Sahib Jalandhar, Kapurthala, Ludhiana, Patiala, Sangrur and Tarn Taran, districts while Zone II comprised of Barnala, Bathinda, Moga, Mansa, and Muktsar Sahib districts of Punjab. Small scales pig farms managed six or less numbers of breedable sows. Farms having 7-15 breedable sows were defined as Medium scale pig farms. Large scale pig farm comprised of more than 15 breedable sows (Bengtsson and Whitaker 1988).

2.6.2 Independent variables

2.6.2.1 Age of the farmer

It refers to the chronological age of the respondent in years to the nearest whole numbers at the time of interview and determined by direct questioning. The respondents were categorized as follows (Sharma 2003):

a. Up to 35 years : Young
b. 36-45 years : Middle-aged
c. >45 years : Old

2.6.2.2 Education of the farmer

It refers to the academic qualification of respondents acquired through formal schooling and collegiate education. The procedure followed by Sharma (2003) was adopted in this study.

Category	Year of schooling
a. Illiterate	No formal education
b. Primary	1-8th Std.
c. Secondary	9-12th Std.
d. Tertiary	>12th Std.

2.6.2.3 Occupation

It is the main and subsidiary / secondary source of livelihood. It was categorized as follows:

a. Agriculture
b. Government Service
c. Business
d. Combination

2.6.2.4 Family Size

It was measured as the total number of members residing together in one household at the time of investigation. Family size has been categorized (Singh 2004) into:

a. Small (members up to 4)
b. Medium (members between 5 and 8)
c. Large (members >8)

2.6.2.5 Land holding

It refers to the total area of land in acres under cultivation and owned by the respondent at the time of investigation. The information was obtained by direct questioning. The respondents were, then, classified into three categories:

Category	Land owned by respondent
a. Small	(< 5 acres)
b. Medium	(5 – 10 acres)
c. Large	(> 10 acres)

2.6.2.6 Training received in piggery:

When the farmer received any formal training regarding pig farming from GADVASU, or any other agency, the variable was recorded as 'Yes'. Otherwise it was recorded as 'No'.

2.6.2.7 Extension agency contacts:

When the respondent had any contact with the change agents such as Veterinary Officer/ Veterinary Assistant Surgeon, Extension Officer, KVK Scientists, Officers of different departments like Agriculture, Horticulture, Soils, Dairy Development Board, Fisheries Department, Progressive farmers, NGO's and NAREGA in connection with seeking information, the response was mentioned as 'Yes', otherwise it was regarded as 'No'.

2.6.2.8 Housing Index

To evaluate housing management of different respondents, an Housing Index was prepared. It was adopted and modified from Sharma (2003). Various components included in the Housing Index along with their scores have been mentioned in Table2.1. Each farm could get a maximum possible score of 23. Based on housing

index different farms were categorized as having good (20-23), medium (16-19) and poor (<16) housing management.

Table 2.1 Housing Index

S. No	Housing Component	Score
1	Direction of the shed	East west---2; Other than East West---1
2	Direction of Open Paddock	South---2; other than South----1
3	Height of the Roof	>10 ft---2; <10 ft--0
4	Type of the Roof	*It-Bala*—2; Thatched—1; Asbestos sheets—0
5	Type of the floor	Concrete—2; Bricks—1; *Katcha*—0
6	Stocking density	Sufficient---1; Insufficient—0
7	Length of feeder	Sufficient---1; Insufficient—0
8	Length of the Waterer	Sufficient---1; Insufficient—0
9	Slope of the Floor	Present—2; Not present—0
10	Frequency of cleaning of the floor	Thrice in a day—3; Twice in a day—2; Once in a day 2; Not done---0
11	Ventilation in the farm	Sufficient---1; Insufficient—0
12	Provision of the tree shade	Sufficient---1; Insufficient—0
13	Prevention of summer stress	Sufficient---1; Insufficient—0
14	Prevention of the winter stress	Sufficient---1; Insufficient—0
15	Provision of creep area	Sufficient---1; Insufficient—0

Total Score-23

2.6.2.9 Source of the parent stock

The farmers in the study area had started their piggery farm by buying the stock either from existing private farms or government farms. Government farms were located in Gurdaspur, Kharar, Mattewara, Jalandhar and Nabha cities.

2.6.2.10 Stocking density of the sow with growing piglets and growers

Stocking density of the sow with growing piglets and growers was recorded as sufficient or insufficient. When the farmer provided space (covered area and open area) equal to or more than the space mentioned in the following table, the variable was recorded as "sufficient" otherwise it was recorded as "insufficient" (Anonymous).

Table 2.2: Recommended floor space for different categories of pigs

Category	Covered Area	Open Area	Maximum No. of Animals/Pen
Breedable Boar	6-7 m^2	8.8 - 12 m^2	1
Sow with Suckling Piglets	7-9 m^2	8.8 - 12 m^2	1 Sow + 10 Piglets
Weaner & Growers	0.9-1.8 m^2	1.4 - 2.7 m^2	30

2.6.2.11 Provision of creep area

When creep area was provided to the piglets the response was recorded as 'Yes'. Otherwise it was recorded as 'No'.

2.6.2.12 Provision of guard rails

When guard rails were installed in the farrowing pen, the response was recorded as 'Yes'. Otherwise it was recorded as 'No'.

2.6.2.13 Naval Cord Disinfection

When naval cord of piglets was disinfected, the variable was recorded as 'Yes'. Otherwise it was recorded as 'No'.

2.6.2.14 Castration of male pig

When castration of male piglets was performed, the response was recorded as 'Yes'. Otherwise it was recorded as 'No'.

2.6.2.15 Deworming

When deworming was performed at the farm it was recorded as 'Yes'. Otherwise it was recorded as 'No'.

2.6.2.16 Vaccination

When piglets were vaccinated against swine fever and/or Foot and Mouth Disease and/or Hemorrhagic Septicemia, the variable was recorded as 'Yes'. Otherwise it was recorded as 'No'.

2.6.2.17 Heat detection

Farmers were detecting oestrus in sows by different methods. Based on method of detection of heat they were categorized into three.

a. Farmers using rump pressure for detecting heat in sows. When sow turned its head towards back on pressing rump area she was considered in heat.
b. The second category of farmers included those who depended on visual heat signs.
c. The third category included Farmers employing both the above said methods.

2.6.2.18 Ratio of the Boar: Sows in herd

Farms were categorized into two groups depending upon the number of boars kept for breeding purpose per ten sows. First category farmers were using one boar for ten sows. Second category farmers were using one boar for more than ten sows.

2.6.2.19 Isolation of the sow before expected day of farrowing.

When the farmer isolated pregnant sows from rest of the herd prior to farrowing, the response was recorded as 'Yes'. Otherwise the response was recorded as 'No'.

2.6.2.20 Stress management in summer

Farmers followed different management practices to counteract the ill effects of summer. Based on the type of practice followed at the farm, they were categorized as

a. Farmers using water baths
b. Farmers using foggers
c. Farmers using both these practices

2.6.2.21 Stress management in winters

Farmers under present study used one or the other facility to warm up the premises. These included bulb, heater or combination of both or whether he is not providing any kind of heat source.

2.6.3 Dependent variables

2.6.3.1 Average Litter Size

It is the average number of live piglets born at the farm in each farrowing.

2.6.3.2 Weaning Age

It was the age of piglets in days when they were separated from their mothers.

2.6.3.3 Pre-weaning piglet mortality

It was the average number of piglets died between day of farrowing and day of weaning.

2.6.3.4 Age at first mating

It was the average age of sow in months at the time of first mating.

2.6.3.5 Resumption of post farrowing ovarian cyclicity

It was the number of days a sow required to resume ovarian cyclicity post farrowing.

2.6.3.6 Average age of the pig at the time of sale

It was the age of pigs at the time of sale into the market. It was measured in months.

2.6.3.7 Average weight of pig at the time of sale

It was average weight of pig at the time of sale. It was taken in kilograms.

2.6.4 Pig production management practices

The management practices followed by the respondents and included in the present study were cutting of needle teeth in newborn piglets (Yes/No); Deworming (Yes/No); Prevention of anaemia (Followed/Not Followed); Method of preventing anaemia- provision of soil (sod), green vitriol or injection of iron dextran; Feeding practices-Feeding of concentrate ration, feeding of kitchen waste (swill) or both; Castration (Followed/Not Followed); Housing and Floor type; Stress management of animals; Seasonal health management; Colostrum feeding to piglets.

2.6.5 Statistical Analysis:

The independent variables (Socioeconomic profile of the farmers) were described by frequencies and means along with Standard Deviation (Mean ± S D). The data were analyzed with the help of statistical software SPSS (Version 20). Independent variables were described as Mean ± S.D. Significance of differences among means was analyzed by one way ANOVA. Association between management practices and reproductive parameters were depicted by Pearson Correlation Coefficient (r) and its significance was judged by t-test. Differences in zones were studied by $\chi 2$ test and its significance was set at 0.05 and 0.01 level.

CHAPTER IV

RESULTS AND DISCUSSION

The present study was conducted on 100 piggery farms situated in two agro-climatic zones of Punjab. These zones were selected purposely since they harboured the maximum population of pigs in Punjab (Table 4.1) (Anon 2012). The data on common management practices followed by the piggery farmers was collected through a structured interview schedule (Annexure 1). The interview schedule was pre-tested on ten piggery farms situated outside the study area. The data so collected was transferred to the Master Sheet (Microsoft Excel) after properly editing it. The data was analysed statistically to evaluate the effect of management practices on production and reproductive efficiency of the pigs.

Table 4.1: Zone-wise distribution of pigs in Punjab

S. No	Zone	Districts	Pig Population
1	Central Plane Zone	Amritsar, Tarn Taran, Kapurthala, Jalandhar, Ludhiana, Fatehgarh Sahib, Sangrur and Patiala	13,517
2	Western Zone	Moga, Bathinda, Mansa, Muktsar Sahib and Barnala	4,214
3	Sub Mountain Undulating Zone	Gurdaspur and Hoshiarpur	1,049
4	Undulating Plane Zone	Ropar and NawaShehar	1,123
5	Western Plane Zone	Ferozpur and Faridkot	1,076

4.1 Distribution of piggery farmers on the basis of socio-personal characteristics

The socio-personal profile of piggery farmers has been described under following heads.

4.1.1 Age

Among 100 respondents, more than half (55 per cent) of farmers were young below the age of 35 years and 38 per cent of them belonged to middle aged group. Only 7 per cent of the farmers were older than 45 years. This study revealed that piggery in Punjab is mostly in the hands of young farmers below the age of 35 years. However, majority of pig farmers in Aizawl district of Mizoram (Tochhawng and Rewani 2013) and Kamrup district of Assam (Payeng *et al* 2013) belonged to middle age group of 36-45 years while majority of pig farmers in Kancheepuram district of Tamil Nadu state belonged to older age group (Sasikala *et al* 2012). They explained that such distribution of pig farmers might be because of subsidiary occupation to agriculture over the years in Tamil Nadu. In Mizoram, piggery is mostly in the hands of tribal population and adoption level had a negative and significant relationship with age of the farmer (Rahman 2008) In Assam, increased demand of pork made the middle age group more interested in pig rearing for uplifting their family income (Payeng *et al* 2013). In Punjab, mostly the enthusiastic young farmers have been taking up piggery as a vocational enterprise.

Table 4.2 : The socio-economic profile of piggery farmers

S. No	Variables of Socio-economic profile	Classification	Overall (Frequency)
1	Age of the farmer	Young farmer (<35 years)	55.0
		Middle aged farmer (35-45 years)	38.0
		Old farmer (> 45 years)	7.0
2	Education of the farmer	Primary (Upto-8th Std.)	13.0
		Secondary (9-12th Std.)	70.0
		Tertiary (Above 12th Std.)	17.0
3	Occupation	Agriculture	16.0
		Government job	2.0
		Others	19.0
		Combination of any of the above	63.0
4	Average annual income	Upto-Rs 1,20,000	4.0
		Rs 1,20,000-Rs 2,40,000	25.0
		More than Rs 2,40,000	71.0
5	Herd size	Small herd (Upto-6 breedable sows)	23.0
		Medium herd (7-15 breedable sows)	40.0
		Large herd (Above 15 breedable sows)	37.0
6	Cultivable land	Landless	22.0
		Small farm (Upto-5 acres)	48.0
		Medium farm (6-10 acres)	17.0
		Large farm (>10 acres)	13.0
7	Formal training	Yes	74.0
		No	26.0
8	Advisor to start piggery	Any farmer	57.0
		TV/Radio	4.00
		Newspaper	23.0
		Self	16.0
9	Contact with any extension agency	Yes	100.0
		No	0.0
10	Family Size	Small (upto-4 members)	18.0
		Medium (5-8 members)	61.0
		Large (>8 members)	21.0

4.1.2 Education

Majority of the pig farmers (70 %) in Punjab got schooling up to 12th Standard. Similar results were reported for pig farmers of Kamrup district of Assam (Shyam and Borgohain 2012, Payeng *et al* 2013), and for pig farmers of Tamil Nadu (Sasikala *et al* 2012).

4.1.3 Family Size

Based on number of members in a family, these were divided into three groups- small (1 to 4), medium (5-8) and large family (more than 8). Majority of the farmers (61 %) in the present study had medium sized families. Similar results were obtained by Shyam and Borgohain (2012), Payeng *et al* (2013) for pig farmers of Kamrup district of Assam.

4.1.4 Occupation along with piggery

None of the farmers in the present study was doing piggery as main occupation, rather they were doing it as a subsidiary to other activity. Majority of them (63%) were doing either agriculture or government job or business. Similar results were reported by Shyam and Borgohain (2012), and Tochhawng and Rewani (2013).

4.1.5 Adviser to start the piggery

Majority of the farmers in Punjab got motivated to start their piggery business after watching the success of fellow farmers. Newspaper also played an important role in promoting piggery farming in Punjab. About 23 percent of the farmers started piggery after reading success stories of other piggery farmers in newspapers.

4.1.6 Overall annual income of the farmer

On the basis of overall annual income of the farmer from all sources, they were divided into three categories namely small income group (up to Rs 1,20,000), medium income group (Rs 1,20,000 to 2,40,000) and large income group (more than Rs 2,40,000). About 70 per cent of the farmers had annual income beyond Rs 2,40,000. Only 25 per cent of the farmers had income between Rs 1,20,000 to 2,40,000. Payeng and his associates (2013) reported that 80 per cent of the pig farmers in organised sector of Kamrup district of Assam had overall annual income below Rs 91,000. The difference in income could be because of bigger herd size maintained by Punjabi farmers. Moreover, the Punjab farmers are also doing agriculture or any other business to supplement their family income. This could be the main reason for their higher annual income than their counter parts in other states of the country.

4.1.7 Land holding

Majority (48 per cent) of the respondents owned less than five acres of cultivable land and 22 per cent of them were landless farmers. The findings are in consonance with the study conducted by Jassi *et al* (1997) who reported that 50 per cent of dairy farmers in Punjab belonged to small farmers' category possessing 2.5 to 5.5 acres of land. Similar findings were also reported by Oladele (2001) who stated that 57.1 per cent of the respondents had farm size less than 1.6 hectares.

4.1.8 Herd size

In Punjab, the farmers possessed either medium-sized herds (40 %) or large sized herds (37 %). The reason attributed might be the farmer's perception towards

possessing more number of animal that yield more income. Most of the farmers possessed sufficient land and other resources to support large herds of pigs as indicated by significant positive correlation ($r = 0.45$; $P < 0.01$) between herd size and land owned by the farmer. Most of the farmers (74 %) also got the formal training regarding the piggery farming, so, they were educated, trained and were more inclined towards commercial rearing of pigs leading to large herd sized farms. The formal training might have motivated them to keep the large number of the animals in the herd. Similar finding were also reported by Akand and Borgohain (2010) from Dimoria block of Assam.

4.1.9 Formal training in piggery farming

Various Government agencies provide formal training to the farmers to start piggery farm. Majority of the farmers (74 per-cent) in present study received formal training and only 26 per-cent of them had no scientific knowledge about pig rearing. These results are in contrast to those reported by Shyam and Borgohain (2012). It could be because of lack of good training facilities in Assam (Johari *et al* 2014) while in Punjab, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana and State Animal Husbandry Department provide specialized training to piggery farmers regularly throughout the years. Training received by the farmers made them more aware of piggery related activities and this might have affected them in adopting a large herd size, commercially oriented farming generating more income for them.

4.1.10 Extension agency contacts

All the farmers in the present study had contact with one or the other extension agency. It could be due to greater awareness of the farmers because of grass root level approach of the media, formal training obtained by the farmers and better road

network in Punjab. Greater awareness might have made the farmers more progressive, educated and innovative. These results are in line with the findings of Payeng *et al* (2013) who stated that 65 per cent of the farmers of Kamrup district of Assam were in contact with extension agencies. However, Tochhwang and Rewani (2013) reported that only one-third of the farmers of Aizawl district of Mizoram had any contact with the extension agency. It could be because of the tribal nature of the farmers.

4.2 Management practices followed by piggery farmers of Punjab

Distribution of piggery farmers following different management practices has been depicted in Table 4.3.

4.2.1 Type of Farming

All the farmers under study were rearing pigs in loose housing system under intensive care. No such study was reported earlier in Punjab. However, similar results were reported by Muhanguzi *et al* (2012) reported similar results in Wasika district of Central Uganda.

Table 4.3 Distribution of farmers following different pig production management practices.

S. No	Variables of different management practices	Classification	Numbers
1.	Type of the farm	1)Intensive but free	100.0
		2) Tethered	0.00
		3) Both	0.00
2.	Location of the farm	1) Within the village	26.0
		2) At the periphery of the village	31.0
		3) Away from the village	43.0
3.	Breeds of The pigs	1) Desi	3.0
		2) Exotic	96.0
		3) Both	1.0
4.	Source of Parent Stock	1) From Government Farm	46.0
		2) From any other Farm	54.0

5.	Stocking Density of the Growers	1) Sufficient	87.0
		2) Insufficient	13.0
6.	Stocking Density of the Sow and Suckling Piglets	1) Sufficient	97.0
		2) Insufficient	3.0
7.	Provision of Creep Area	1) Yes/Provided	73
		2) No/Not Provided	27
8.	Provision of guard rails in the farrowing pen	1) Yes/Installed	72
		2) No/Not Installed	28
9.	Housing Index	1) Good (20-23)	31.0
		2) Medium (16-19)	56.0
		3) Poor (<16)	13.0
10.	Naval Cord Disinfection	1) Yes (Practised)	41.0
		2) No (Not Practised)	59.0
11.	Age of Weaning	1) Within 30 days	14.0
		2) Between 31-60 days	70.0
		3) After 60 Days	16.0
12.	Castration	1) Yes (Performed)	76.0
		2) No (Not Performed)	24.0
13.	Deworming	1) Yes (Practiced)	86.0
		2) No (Not Practised)	14.0
14.	Vaccination	1) Yes (Practised)	78.0
		2) No (Not Practised)	22.0
15.	Feeding Practices	1) Swill (Kitchen Waste) feeding	14.0
		2) Using branded feed	0.00
		3) Using homemade concentrate	23.0
		4) Using combinations	63.0
16.	Method of heat detection	1) By pressing back of the animal	17.0
		2) Observing heat signs	52.0
		3) Both	31.0
17.	Ratio of Boar : Sows	1) 1:10	63.0
		2) 1:>10	37.0
18.	Isolation of sow before farrowing	1) Not Done	11.0
		2) Done 7 Days earlier	16.0
		3) Done>7 Days earlier	73.0
19.	Stress management in summer	1) Provision of Bath	83.0
		2) Foggers	10.0
		3) Both	7.0
20.	Stress management in winter	1) Provision of heater	6.0
		2) Provision of bulb	36.0
		3) Combination of both	58.0

Table 4.4 Housing Index

S. No	Housing Component	Score
1	Direction of the shed	East west---2; Other than East West---1
2	Direction of Open Paddock	South---2; other than South----1
3	Height of the Roof	>10ft---2; <10---0
4	Type of the Roof	It-Bala—2; Thach—1; Asbestos sheets—0
5	Type of the floor	Concrete—2; Bricks—1; Katcha—0
6	Stocking density	Sufficient---1; Insufficient—0
7	Length of feeder	Sufficient---1; Insufficient—0
8	Length of the Waterer	Sufficient---1; Insufficient—0
9	Slope of the Floor	Present—2; Not present—0
10	Frequency of cleaning of the floor	Thrice in a day—3; Twice in aday—2; Once in a day 2; Not done---0
11	Ventilation in the farm	Sufficient---1; Insufficient—0
12	Provision of the tree shade	Sufficient---1; Insufficient—0
13	Prevention of summer stress	Sufficient---1; Insufficient—0
14	Prevention of the winter stress	Sufficient---1; Insufficient—0
15	Provision of creep area	Sufficient---1; Insufficient—0

4.2.2 Location of the farm

Majority of the farms (74%) in Punjab were located either in the agricultural fields away from human dwellings or at the periphery of the village. Only 26 percent of the farms were very near to the human settlements. This shows that pig farmers in Punjab are well aware of the public health importance of rearing pigs away from the human dwellings.

4.2.3. Breed of pigs

Almost all the farmers in the present study were rearing pigs of exotic breed (Large White Yorkshire). Similar results were reported by Rahman *et al* (2008) where 92 per cent of the farmers were rearing crossbred pigs. Fualefac *et al* (2014) in Cameroon reported that majority of the farmers (96 %) in urban and peri-urban zones of Dschang –West region were rearing cross bred pigs. Similarly, Sasikala *et al* (2012) reported that trained farmers in Kancheepuram districts of Tamil Nadu were more interested in rearing exotic animals as compared to indigenous breeds of pigs. The reason cited for this behaviour of farmers was their awareness about higher proliferation rate of exotic animals, better growth performance, higher litter size and low mortality rate as compared to desi breeds of pigs.

4.2.4 Source of the parent stock

To start a new piggery farm in Punjab, the stock can be bought either from existing private farms or government farms. More than half of the respondents in the present study (54 %) purchased new stock from other private farms while the rest of the farmers obtained it from government farms**.** It could be because of shortage of animals for sale at the government farms. Each government farm could provide piglets to approximately 30-45 needy pig farmers in a year. Total sale of piglets at each government farm during the last financial year (2013-14) has been depicted in Table 4.5. At present, government farms at Gurdaspur, Jalandhar and Mattewara have been closed.

Table 4.5 Total number of piglets sold in different government farms during 2013-14.

S. No	Name of Government farm	No. of piglets sold in last year
1	Gurdaspur	272
2	Nabha	236
3	Kharar	228
4	Jalandhar	200
5	Mattewara	198

Fualefac *et al* (2014) in Cameroon reported that majority of the farmers in urban and peri-urban zones of Dschang –West region purchased parent stock from the local market because of non existence of Government farms in Cameroon. Similarly, Muhanguzi *et al* (2012) reported that majority of farmers (55%) in Wakiso district of Central Uganda purchased the parent stock from other farmers.

4.2.5 Stocking density of the growing piglets

The number of pigs per pen (group size) and the floor area allowed per pig (stocking density) have been key factors to minimize housing cost, maximize housing use, and to improve overall profitability (Wolter *et al* 2002). The recommended floor space for growers in Punjab is 0.8-1.0 m^2 and each pen should have maximum of 15 growers (Anon 2011). Majority of the farmers (87%) in Punjab were rearing pigs in smaller groups (<15 pigs/pen) and they provided sufficient floor area to them.

4.2.6. Provision of creep area

In farrowing houses, lower room temperature is needed for the well-being of sows. As the temperature rises above 16°C, the appetite of the sow decreases drastically. The piglets, however, need higher room temperature for maintaining the normal health. So, it is advisable to provide separate covered area for piglets which is

known as creep area. Where creep facility is provided, piglets maintain their body temperature by themselves without using energy to produce body heat. In the present study, majority of the farms (73%) had the provision of creep area for the piglets. Pre-weaning piglet mortality has been found to be significantly associated ($r = -0.585$: $P<0.01$) with provision of creep area at the farm. Farms with creep area registered piglet mortality of 1.74±0.75 only out of average litter size of 9.89±1.21while those having no facility of creep area had 3.00±0.88 mortality out of average litter size of 8.67±1.41, the difference between average pre-weaning mortalities of the two groups being significant ($p<0.05$). Most of these mortalities occurred from crushing and starvation of the weaker litter-mates during first two days of their lives.

4.2.7. Provision of guard rails

In Punjab, majority of the farms (73%) had provision of guard rails for the safety of the piglets. It might be because of technical knowledge acquired by most of the farmers (74% of the farmers had acquired formal training to start piggery). There is strong negative correlation ($r=-0.53$: $p<0.01$) between pre-weaning mortality and provision of guard rails in the farrowing pen. Farms without guard rails (n=28) experienced pre-weaning mortality of 2.89±0.96 while farms with guard rails (n=72) registered only 1.76±0.76 pre-weaning mortality, the difference between the two being significant ($p<0.05$).

Majority of the pre-weaned mortalities (52.1%) occur because of crushing by the sow (Shankar *et al* 2009). Thus, provision of guard rails in the farrowing pen prevents such mortalities. This fact has also been supported by highest mortality rate (21.69%) observed in the age group of 0-15 days at Swine Production Farm, Indian Veterinary Research Institute, Izatnagar (Mondal *et al* 2012).

4.2.8. Housing index

Housing index was calculated by observing certain provisions that the farmer had made for the comfort of the animal. These facilities included direction of the shed, direction of the open paddock, height of the roof, material used for the construction of the roof, type and slope of floor, frequency of cleaning of the floor, length of the feeder and the waterer, ventilation in the farm, provision of tree shade, method of stress management during winter and summer and provision of creep area etc. Maximum score obtainable by any given farm was 23 (Table 4.4). The housing index was constructed to compare the level of comfort provided to the animals at different farms. Housing index was categorised into three classes-Class I (Poor housing management, HI <16), Class II (Medium type housing management, HI 16-19), Class III (Good housing management, HI 20-23).

Under the present study, majority of the farms (56%) had medium housing facilities with average HI of 17.77±1.04. Only 31 percent of the farms had good housing facilities (average score 20.03 ± 0.18).

The comfort of the animals is significantly related to the production and reproductive efficiency of pigs. The present study recorded correlations between housing index and average litter size ($r=0.45$: $p<0.01$), pre-weaning mortality rate ($r= -0.55$: $p< 0.01$), age at first mating ($r= -0.12$: $p>0.01$) and post farrowing resumption of ovarian cyclicity ($r=-0.25$: $p<0.05$). Significant linear trends ($P<0.05$) have been observed between housing index and average litter size, pre-weaning mortality rate, post farrowing resumption of ovarian cyclicity, weight of pigs at the time of sale (Table 4.6).

Table 4.6 Linear trends in production and reproductive parameters (Mean ± SD) in relation to Housing Index (HI)

Level of HI	N	Av. litter size	Pre-weaning mortality	Post farrowing resumption of ovarian cyclicity	Age at 1st mating	Weight at time of sale
≤ 14	8	8.00±1.07	3.5±0.76	17.50±8.01	8.38±0.92	91.25±15.53
15	5	7.60±5.5	3.4±0.89	16.40±9.07	8.00±00	91±19.81
16	9	9.00±1.23	2.11±1.05	12.22±5.31	7.44±0.53	87.22±16.79
17	11	10.37±0.91	2.09±0.95	16.64±15.31	8.18±0.98	96.36±17.04
18	20	9.40±1.14	2.15±0.86	19.00±11.05	8.25±1.12	89±16.59
19	16	10.56±1.21	1.69±0.70	11.69±6.30	7.62±1.20	99.38±12.76
≥ 20	31	9.77±1.23	1.64±0.61	10.80±5.45	7.84±0.90	99.64±14.25
P for linear trend			<0.05			

Table 4.7 Effect of housing management on production and reproduction efficiency (Mean ± SD) of pigs

Level of HI / Production parameters	**≤ 14**	**15-19**	**≥ 20**
N	13	56	31
Av. litter size (No)	7.85±0.89[a]	9.84±1.26[b]	9.77±1.23[b]
Pre-weaning mortality (No)	3.46±0.78[a]	2.00±0.87[b]	1.65±0.61[c]
Post farrowing resumption of ovarian cyclicity (Days)	17.08±8.08[a]	15.36±10.49[a]	10.97±5.41[b]
Weight at time of sale (Kg)	91.54±16.25[a]	93.12±16.08[a]	94.32±15.51[a]

Average litter size was significantly low (7.85±0.89 vs 9.84±1.26 and 9.77±1.23 in medium and good housing) when the housing management was poor (Table 4.7). Similarly significant variations were observed in pre-weaning mortality when poor, medium and good housing facilities were provided to pigs. Sows resumed ovarian cyclicity following farrowing significantly earlier (10.97±5.41 days) when they were provided good housing facilities as compare to those sows which were provided poor and medium type housing facilities.

No study has been conducted in India by taking into account all the component of housing management.

4.2.9. Naval Cord Disinfection

Naval cord disinfection is must for the health of piglets, as infection of the naval cord can cause serious health threats including naval ill and joint ill etc. Naval cord disinfection is a practice that is usually being practiced over various dairy farms of Punjab. In the present survey, only 41 percent of the farmers used to disinfect the naval cord of the piglets at the time of farrowing. The farmers who did not practise naval cord disinfection stated that they faced certain problems like bleeding and evisceration during cutting of naval cord. So, they discontinued this practice thereafter.

4.2.10. Weaning Age

Weaning is the age of separation of piglets from their dam. Weaning can be done either at four weeks of age (early weaning) or at eight weeks of age (Sorenson *et al* 2009). Early weaning is preferred where sows are to be rebred sooner. All the farmers in the present study did practise weaning but at different ages. Majority of the

farmers (70%) did weaning at the age of 31-60 days. Only 14 per cent of them did weaning at the age of four weeks or less while the rest weaned their pigs at the age beyond 60 days. Weaning age had significant negative correlation with formal training ($r = -0.39$, $P<0.05$) and formal education ($r = -0.25$, $P<0.05$). Johari *et al* (2014) stated that all the farmers of Dima Hassao district of Assam did practise weaning of piglets without considering the age of weaning. Fualefac *et al* (2014) found majority of the farmers (65 %) of urban and peri-urban zones of Dschang-West region of Cameroon were weaning their piglets at the age of more than 60 days and rest of the farmers were weaning piglets between 45-60 days of age. The reason could be low level of formal education (up-to primary level only).

4.2.11. Castration of male pigs

Castration of male piglets is a necessary practice as it enhances the growth performance and decreases the aggressive behaviour of boars. Handling becomes easy and it also prevents development of male taint/odour etc. Majority of Punjabi farmers (76 %) followed castration at their farms. Formal training about piggery and regular education of the farmer might have made them aware of the importance of castration in piglets. This could be the probable reason for high numbers of farmers practicing castration of male piglets. Similar results were reported by Rahman *et al* (2008) and Johari *et al* (2011) in Assam.

4.2.12. Deworming

Deworming of piglets is must for their optimum growth and heath. There are different parasites that can enhance the stress level in piglets and adults. In the present survey, majority of the farmers (86%) deworm their pigs at different ages. Formal training might have made the famers aware of importance of deworming in pigs as 74

per-cent of the farmers had obtained formal training. These findings are in line with the findings of Rahman *et al* (2008). However contradictory findings were obtained by Johari *et al* (2014) where only 1 to 2 per cent of farmers of the Dima Hassao districts of the Assam practised the deworming of the pigs the reason could be that the farmers of the area relied on their peers and close relatives for obtaining information rather than the extension personnel.

4.2.13. Vaccination

Vaccination is another practice that is very necessary in piggery. Pigs are usually vaccinated against Foot and Mouth Disease, Haemorrhage Septicaemia, Swine fever etc. Outbreak of these diseases can ruin whole farm or can cause severe financial losses to the farmers. In this survey 78 percent of the farmers did vaccinate their pigs against infectious diseases. Rahman *et al* (2008) also reported similar results in Aizawl district of Assam.

4.2.14. Feeding practices

Pig is an omnivorous animal. It can consume a variety of food stuff including kitchen waste (swill), industrial by-products, concentrate feed and leguminous fodders etc. This nature of pig can bring the cost of feeding into the budget of poor farmers. It also gives us liberty for the preparation of concentrate feed for these animals. In the present survey, majority of the farmers (63%) were rearing pigs on a combination of kitchen waste, concentrate ration and industrial by-products. Only 23 percent of farmers were using purely homemade concentrates while remaining 14 percent were keeping their pigs on swill (kitchen waste) only. Similar results were reported by Rahman *et al* (2008) in Aizawl district of Assam. Feeding swill along with

concentrate feed is a single way of reducing feed costs. The cost of feeding is always higher when pigs are kept under intensive management system (Ezeibe 2010).

4.2.15. Heat detection

Heat detection in sexually active sows is must for the growth of the farm. One must observe heat signs keenly for timely insemination of one's animals. Various farmers use different methods of heat detection in sows. In this survey, about half of the farmers used to detect the heat by just observing heat signs. Another 17 percent of the farmers detected heat by pressing the back of the suspected animal and animal's immobility indicating presence of heat. About 31 percent of the farmers were performing both of these methods. There is strong association (χ^2=23.04) between method of heat detection and formal training. The farmers who had obtained formal training relied on both the methods of heat detection. These finding are in line with the findings of Fualefac *et al* (2014).

4.2.16. Ratio of the Boar: Sows in herd

For economic reason, only a few boars are reared along with sows for breeding purpose. Availability of good breedable boars with high genetic merit is must for timely breeding of sows in heat. Rearing a large number of boars is highly expensive. In the present study, majority of the farmers (Table 4.3) were rearing one boar for each 10 breedable sows. Only 37 per cent of the farmers had one boar for more than 10 sows of herd for breeding purpose. Boar to sow ratio did not have any significant effect on litter size and pre-weaning piglet mortality. Eusebio (1980) also recommended to raise a maximum of 20 sows against one boar in the tropics.

4.2.17. Isolation of the sow before expected day of farrowing.

Pregnant sows must be isolated from rest of the herd in the farrowing pen before the expected date of farrowing. This practices increases extra care for the sows. It also increases the comfort level for such animals. Majority of the farmers (73%) in Punjab isolated pregnant sows from rest of the herd more than a week from expected date of farrowing while 16 percent isolated pregnant sows within 7 days of farrowing. There were only 11 percent farmers who continued to keep pregnant sows with rest of the herd till farrowing.

4.2.18. Stress management in summer

Pig is highly sensitive to heat stress and needs good management against it. Various farmers adopt different management practices to counteract the ill effects of summer. All the farmers in the present survey did follow one or the other measures to counteract summer stress. Majority of the farmers (83%) provided water for the animals by lowering the plinth level of certain part of the pen. During hotter part of the day, the pigs remained immersed under water. Only 10 farmers had implanted foggers/misters at their farms for the comfort of animals while another seven percent of the farmers had made both kinds of provisions to reduce the summer stress. The limited use of the foggers at piggery units in Punjab might be due to their cost factor. The provision of heat alleviating measures, however, did not have any significant effect on litter size pre-weaning mortality rate or post farrowing ovarian cyclicity resumption.

4.2.19. Stress management in winters

Winter management is as important as summer management for the pigs especially the young piglets. Almost all the farmers under present study used one or other facility to warm up the premises. Majority of the farmers (58%) in Punjab had combination of facilities like heaters and bulbs, while 36 per cent of the farmers used bulbs only as a source of heat to reduce winter stress. However, there was no significant difference in pre-weaning mortality rate after following different winter management procedures.

Table 4.8: Production parameters for different farm sizes (Mean ± S.D.)

S. No	Farm Size / Variables Studied	Small	Medium	Large	Overall
1.	Average Litter Size	9.22±1.73[a]	9.50±1.26 [a]	9.84±1.21 [a]	9.56±1.37
2.	Weaning Age (Days)	71.22±25.70[a]	55.90±13.07[b]	51.22±9.90 [b]	57.69±17.57
3.	Piglet mortality till weaning	2.74±1.05 [a]	2.10±0.84[b]	1.65±0.79[c]	2.08±0.96
4.	Age at 1st mating (Months)	8.22±0.90 [a]	8.10±1.03 [a]	7.59±0.90 [b]	7.94±0.98
5.	Post farrowing resumption of ovarian cyclicity (Days)	16.35±7.44 [a]	15.28±9.12 [a]	11.76±9.72 [a]	14.22±9.12
6.	Housing Index	16.52±2.98 [a]	17.90±1.88 [b]	18.81±1.56 [b]	17.92±2.24
7.	Age of the pig at the time of sale (Months)	10.48±1.44 [a]	10.15±1.52 [a]	10.27±1.19 [a]	10.27±1.39
8.	Weight of pig at the time of sale (Kg)	91.09±16.51[a]	93.88±18.03 [a]	96.81±11.39[a]	94.32±15.51

Figures with different superscripts differ significantly (P< 0.05) in each row

4.3 Pig performance under different farm sizes

4.3.1 Average litter size (number of piglets born alive per litter)

The overall litter size recorded in the present study was 9.56±1.37. There was no significant difference among the average mean values of three categories of farms. Similar findings were recorded by Singh *et al* (1989), Prasad *et al* (2011) and Fualefac *et al* (2014).

4.3.2 Weaning Age

The overall weaning age recorded in the current study was 57.69±17.57 days. There was significant (P <0.05) linear trend between herd-size and weaning age.

Table 4.9: Linear trend in weaning age in relation to herd size (Breedable sows)

Number of Breedable sows	Number of farmers	Weaning age (Mean + S D)
2-9	34	65.62±24.08
10-19	38	56.24±11.35
20-29	14	51.36±10.19
30-39	7	48.29±11.28
≥ 40	7	49.14±10.43
P for linear trend <0.05		

The smaller the herd size, the greater was the weaning age. The Pearson correlation coefficient between herd size and weaning age was –0.413 (P <0.01). For the medium and larger sized farms, the weaning age was 55.90±13.07 days and 51.22±9.90 days, respectively. The difference between these two values was non-significant. However, both these values differed significantly (P <0.05) from that of smaller herd size (71.22±25.7 days). The farmers who were having medium and large sized farms had higher formal education and most of them had acquired piggery training also. This could be the reason for lower weaning age because of greater

awareness regarding early weaning of piglets. No such study was available in India where association between herd size and weaning age was recorded.

4.3.3 Pre-weaning piglet mortality

Pre-weaning piglet mortality is of great economic importance. The pre-weaning piglet mortality rate in the present study has been depicted in Table 4.8. The overall average number of piglets died during pre-weaning period was 2.08±0.96. There was significant negative correlation between pre-weaning piglet mortality and herd size ($r = -0.427$; $P < 0.01$). Average number of piglets died during pre-weaning period was1.65±0.79, 2.10±0.84 and 2.74±1.05 in large, medium and small farms, respectively, the difference among them being significant ($P < 0.05$). The lowest mortality rate observed in large sized farms could be due to better management practices (Housing and Feeding) followed at these farms (Table 4.10). In India, no study was available regarding pre-weaning piglet mortality at farms of different sizes. However, Prasad *et al* (2011) observed an overall pre-weaning piglet mortality of 20.16 per cent in Uttar Pradesh. There results were comparable to those obtained in the current study. Similar results were also reported by Payeng *et al* (2013) in Assam.

Table 4.10: Management practices followed at farms of different sizes

Farm Size / Management practice	Large (n=37)	Medium (n=40)	Small (n=23)
Housing Index	16.52±2.98[a]	17.90±1.88[b]	18.81±1.56[b]
Provision of Guard rail (% farmers)	91.89	67.50	47.82
Provision of Creep area (% farmers)	91.89	72.50	43.48
Provision of creep feed (% farmers)	75.67	47.50	26.08
Provision of balanced feed (% farmers)	89.18	85.00	82.60

4.3.4 Age at first mating

Age of the sow at first mating has been mentioned in Table 4.8. The overall age at first mating was 7.94±0.98 months. For medium and small sized farms, these values were 8.10±1.03 and 8.22±0.90 months, respectively, the difference between them being non-significant. Age of the sow at first mating in large sized herds was significantly (P< 0.05) lower (7.59±0.90 months) than that of medium and small sized farms. It could be because of effect of training and educational level (Table 4.11) and better management practices and better housing index (Table 4.10). Similar results were by Prasad *et al* (2011), however, Babu *et al* (2004) reported attainment of puberty at the age of 176.7±3.41 days in gilts raised on garbage. The lower age at first mating reported by Babu *et al* (2004) could not be explained. Fualefac *et al* (2014) reported average age at first mating of 315 days in urban and peri-urban zones of Dschang-West region of Cameroon. The higher age of sexual maturity in this study could be due to poor nutrition or a host of other management/health factors.

Table 4.11 Personal characteristics of the farmers with respect to their farm sizes

Farm Size / **Personal Characteristics of farmers**	**Large (n=37)**	**Medium (n=40)**	**Small (n=23)**
Formal Training (% farmers)	94.59	75.00	39.13
Secondary/Tertiary Education (% farmers)	97.29	82.50	78.26

4.3.5. Post farrowing resumption of ovarian cyclicity (Days).

The returning time of a sow into the normal reproductive cycle is almost similar at farms of different sizes. The overall average number of days a sow required to come in heat after farrowing was14.22±9.12 days.

4.3.6. Age and weight of the pig at the time of sale

Age and weight of pigs at the time of sale are the variables of great economic importance. However, among farmers of different sizes, these variables are not significantly different. The overall age and weight of pigs at sale were 10.27±1.39 months and 94.32±15.51 Kg, respectively. Prasad *et al* (2011) also reported weight of pigs at sale to be 80±1.75 Kg, however, this weight was attained by pigs at an average age of 12 months.

Table 4.12 Relationship of pig management practices with swine reproduction (Pearson correlation coefficients)

Management practices	**Age of sow at first mating**	**Litter size**	**Post farrowing resumption of ovarian cyclicity (Days)**
Location of the farm	0.059	0.175	–0.242*
Source of parent stock	–0.204	–0.253*	–0.040
Stocking density of the growers	0.070	0.170	–0.062
Stocking density of sow and piglets	0.045	0.330**	–0.209*
Provision of creep area	0.114	0.398**	–0.142

Provision of guard rail	0.119	0.484**	–0.299**
Housing index	0.108	0.446**	–0.251*
Naval cord disinfection	0.047	0.298**	0.009
Age of weaning	–0.179	–0.254*	0.289*
Castration	0.101	0.179	–0.084
Deworming	0.103	0.397**	–0.149
Vaccination	–0.041	0.129	–0.141
Feeding practices	0.108	0.293**	–0.162
Heat detection method	–0.026	0.228*	–0.120
Boar:sows	–0.158	–0.026	000
Isolation of sow before farrowing	0.036	0.318**	–0.239*
Stress management in summer	0.085	0.110	–0.214*
Stress management in winter	0.143	0.325**	–0.023

* Correlation is significant at the 0.05 level.

** Correlation is significant at the 0.01 level.

4.4 Relationship of pig management practices with swine reproduction

The reproductive efficiency of sow is determined on the basis of certain parameters such as litters per sow, litter size, average piglets born alive per litter, average number of piglets reared per sow per year, age of sow at first heat, number of days a sow requires to resume cyclicity and infertility rate etc. In the present study, reproductive efficiency of sows was studied by taking age of sow at first heat, litter size and number of days a sow requires to resume ovarian cyclicity. These parameters were studied by correlating them with relevant management practices which included location of the farm, source of parent stock, stocking density of growers, stocking density of sow along with suckling piglets, provision of creep area, provision of guard rail, housing index, naval cord disinfection, age of weaning, castration, deworming, vaccination, feeding practices, heat detection methods, ratio of boar to sows, isolation of sow before farrowing, management of summer stress and management of winter stress. Here different reproductive parameters have positive and negative correlation with management practices (Table 4.12). Age of sow at first mating had no significant relationship with any of the management practices.

Litter size had significant relationship with number of piglets raised in a single pen. When the number of piglets reared in each pen was sufficient, the litter size was 9.64±1.3 (n=97). When the number of piglets per pen was more than sufficient, the litter size was 7.00±1.00 (n=3).The correlation coefficient between number of piglets reared per pen and litter size was –0.33 ($P<0.01$). Litter size had also positive relationship with provision of creep area, guard rail, housing index, naval cord disinfection, better feeding practice and heat detection methods, isolation of sow before farrowing and provision of heating arrangement in winter (Table 4.12) Where creep area was provided to piglets, they had better litter size (9.89±1.20; n

=73). When no creep area was provided, they had litter size of 8.67±1.41 (n=27) only. Better housing facilities at the farm significantly increase the litter size. When good housing (HI=20-23) facilities were available, the litter size was 9.84±1.62. When medium type housing (HI=16-19) facilities were available, the litter size was 9.77±1.23. When poor housing (HI= <16) facilities were available, the litter size was 7.85±0.89. Deworming of pigs, better feeding management and efficient heat detection method improved litter size significantly (Table 4.8). When a combination of swill and concentrate ration was fed to sows, they had litter size of 9.84±1.30 (n=63) which was significantly ($P<0.05$) higher than that when only swill was fed to sows (8.71±1.38; n=14). When sows (n=89) were isolated one week prior to farrowing, they had significantly higher litter size (9.76±1.25vs 7.91±0.95) than those which were not isolated. Provision of bulb or heater or both for maintaining environmental temperature had significant ($P<0.05$) effect on litter size (9.90±1.34 vs 7.67±1.53).

Age of weaning had significant negative correlation ($r=0.254$; $P<0.05$) with litter size. When the piglets were weaned within 31-60 days following farrowing the sows yielded better litter size (9.79±1.21 vs 8.75±1.58; $P<0.05$).

CHAPTER V

SUMMARY AND CONCLUSIONS

Piggery is emerging farming system in Punjab. Piggery requires minimal expenditure and gives quick return. The contribution of this sector to the economy has been progressively increasing over the previous two plan periods whereas the one from agriculture had declined. Land is very expensive and rents are exorbitant. Buying fodder makes the dairy venture unviable in many situations. In contrast, pig farming is a lucrative preposition for small and marginal farmers. In Punjab no such work was recorded on piggery farming, so this study is an initiative in this field. Present study was planned to achieve the objectives regarding:

1) To study pig production management practices in Punjab. 2) To evaluate pig performance under different farm sizes. 3) To find out the relationship of different pig management practices with swine reproduction

Sample for the present research work was drawn from two agro-climatic zones i.e. Central Plain Zone comprising of Amritsar, Tarn Taran, Kapurthala, Jalandhar, Ludhiana, Fatehgarh Sahib, Sangrur and Patiala district, and Western Zone comprising of Moga, Bathinda, Mansa, Muktsar Sahib and Barnala districts. A total of 100 respondents (50 from each zone) were selected randomly from already prepared sampling frame of total farms for obtaining the information regarding the study. A farmer maintaining a herd of at least two breedable sows was considered as a respondent. The data was collected by personally interviewing the respondents with the help of a structured questionnaire-cum-interview schedule. Independent variables includes-Age of the farmer, Education of the farmer, Occupation, Family Size, Land holding, Training received in piggery, Extension agency contacts, Housing Index, Source of the parent stock Stocking density of the sow with growing piglets and

growers, Provision of creep area, Provision of creep area, Naval Cord Disinfection, Weaning Age, Castration of male pigs, Deworming, Vaccination, Heat detection, Ratio of the Boar : Sows in herd, Isolation of the sow before expected day of farrowing, Stress management in summer and Stress management in winters. Dependent variables-Average Litter Size (No.), Piglet mortality till weaning (No.), Age at 1st mating (Months), Number of days a sow required to resume ovarian cyclicity after farrowing, Average age of the pig at the time of sale (Months) and Average weight of pig at the time of sale (Kg)

Among 100 respondents, 55 per cent of farmers were young below the age of 35 years and 38 per cent of them belonged to middle aged group. Majority of the pig farmers (70 %) in Punjab got schooling up to 12thStandard.Majority of the farmers (61 %) had medium sized families. Majority 63% were doing either agriculture or government job or business. Majority of the farmers in Punjab got motivated to start their piggery business after watching the success of fellow farmers. About 70 per cent of the farmers had annual income beyond Rs 240 000. 48 per cent of the respondents owned less than five acres of cultivable land and 22 per cent of them were landless farmers.40 per cent possessed medium herd size similarly 37 per-cent of the farmers possessed large herd size and only 23 per cent of the respondents were maintaining small herd size. Majority of the farmers (74%) in present study received formal training. 74% farms in Punjab were located either in the agricultural fields away from human dwellings or at the periphery of the village. Almost all the farmers in the present study were rearing pigs of exotic breed (Large White Yorkshire). Majority of the farmers (87%) in Punjab were rearing pigs in smaller groups (<15 pigs/pen) and they provided sufficient floor area to them. At 73% farms had provision of guard rails for the safety of the piglets. At About 86 percent of the farms deworming is

performed. Majority of the farmers (63%) were rearing pigs on a combination of kitchen waste, concentrate ration and industrial by-products. About half of the farmers used to detect the heat by just observing heat signs. Majority of the farmers were rearing one boar for each 10 breedable sows only 37 % of the farmers had one boar for more than 10 sows of herd for breeding purpose. About 73% farmers isolated pregnant sows from rest of the herd more than a week from expected date of farrowing. Majority of the farmers (83%) in the present study provided water for the animals by making some open space of the pen lower than the plinth level. Majority of the farmers (58%) had combination of facilities like heaters and bulbs, while 36 per cent of the farmers used bulbs only as a source of heat. The smaller the herd size, the greater was the weaning age. The Pearson correlation coefficient between herd size and weaning age was –0.413 ($P < 0.01$). Weaning age had significant negative correlation with formal training ($r = – 0.39$, $P<0.05$) and formal education ($r = – 0.25$, $P<0.05$). There was significant negative correlation between pre-weaning piglet mortality and herd size ($r = –0.427$; $P < 0.01$). Average number of piglets died during pre-weaning period was1.65±0.79, 2.10±0.84 and 2.74±1.05 in large, medium and small farms, respectively, the difference among them being significant ($P< 0.05$). The overall litter size recorded in the present study was 9.56±1.37. When creep area was provided to piglets, they had better litter size (9.89±1.20; n =73). When no creep area was provided, they had litter size of 8.67±1.41 (n=27) only. Better housing facilities at the farm significantly increase the litter size. When good housing (HI=20-23) facilities were available, the litter size was 9.84±1.62. When medium type housing (HI=16-19) facilities were available, the litter size was 9.77±1.23. When poor housing (HI= <16) facilities were available, the litter size was 7.85±0.89.The overall age at first mating was 7.94±0.98 months. Age of the sow at first mating was significantly

(P< 0.05) lower (7.59±0.90 months) than that of medium and small sized farms. The overall average number of days a sow required to resume ovarian cyclicity after farrowing was14.22±9.12 days. The overall age and weight of pigs at sale were 10.27±1.39 months and 94.32±15.51 Kg, respectively. Brief conclusions are given below

1. Socio-economic profile of pig farmers was almost similar in both the zones of Punjab.
2. They followed similar management practices.
3. Average litter size, number of days required by sows to resume ovarian activity after farrowing, and age and weight of pigs at the time of sale were similar for small, medium and large sized farms.
4. Piglet mortality was significantly less in large sized farms followed by medium and small sized farms.
5. Age at first mating was significantly less in large sized farms.
6. Litter size had significant relationship with source of parent stock, stocking density of sow with piglets, housing facilities, feeding practice, deworming, provision of creep area and stress management practices in winter
7. Number of days required by sow to resume ovarian cyclicity following farrowing were significantly affected by location of the farm, stocking density of sow with piglets, separation of pregnant sows before farrowing and stress management practices during summer.

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ANNEXURE I
Department of Veterinary and Animal Husbandry Extension Education
GADVASU, Ludhiana, Punjab-141004

VILLAGE PROFILE

Date:

Tehsil:..... Block:.....

Village:.....

Investigator: Signature.....

Name of Sarpanch: Contact no: Signature.....

Background of the village:

Location

Distance from district headquarter:

Road link (Kacha/Pucca) Nearest National/State Highway

Nearest rail link

Prominent Personalities

Population Statistics (No.): Total Human population:.....

Male- Female: Children:

Literacy level (%): Male Female Overall

No of households

Working population (no): Agriculturist

Servicemen

Others, (Specify)

Type of progressive farmers (Crops/Livestock/Fruits/Vegetables/Any other)

No of progressive farmers

Livestock population (No):

Species	**Breeding male**	**Draft animals**	**Breedable females**	**Growing stock**	**young ones**	**Household (No)**
Buffaloes						
Crossbred cows						
Desi cows						
Sheep						
Goat						
Pig						
Others						
Poultry	No of birds	Backyard units	Commercial units	Production	Consumption (Domestic/Local/Outside)	
Layers						
Broilers						

Any industry existing in the area:

Name of the Industry: Distance:

Major religious, social, political and development achievements:

Educational institutions:

S. No	**Type of institute/school**	**No of students enrolled**
If school/college not existing in the village, then specify the school/college attended by the students		
S. No	Name of school/college	Distance

Migration status:

No. of persons migrated to other countries:

Name of the countries No.

Infrastructure development information:

S. No	**Infrastructure**	**Availability (Y/N)**	**Distance (Km)**
	Post office		
	STD/PCO		
	Health care centre		
	Veterinary services		
	Primary agriculture cooperatives		
	Financial institutes/banks (Public sector/rural/cooperative)		
	Mandi/market		
	Police station		
	Other, specify		

Outbreak of major diseases/natural calamities

Human being: Cholera/dysentery/dengue fever/cancer/stones/diabetes/heart diseases

Disaster: Forest fires/flash floods/famines/earthquakes etc

Animal disease; FMD, HS, BQ, Brucellosis etc

Crop/horticulture/vegetable/pulses/plant diseases-specify

No. and type of shops (Liquor shop, meat shop etc):

Reach of extension agencies	**Approx No. of visit/ month**	**Area covered**	**Inputs provided**
Agriculture department	----------	----------	----------
Horticulture department	----------	----------	----------
Forestry department	----------	----------	----------
Animal husbandry department	----------	----------	----------
Soil conversation/ Watershed department	----------	----------	----------
Health department	----------	----------	----------
Cooperatives	----------	----------	----------
NGO (Angan wari, NREGA,Mahila mandal etc)	----------	----------	----------
Others (FASS, KVK, RRS, DDD,Fisheries etc)	----------	----------	----------

Enlist the major problems of the village, if any:

Department of Veterinary and Animal Husbandry Extension Education
GADVASU, Ludhiana, Punjab-141004
BENCHMARK SURVEY OF PIG FARMS

Part-I (Personal Characteristics of Farmer)

Date of Recording:_____

Village:----------

Tehsil: ---------- Block:----------

Investigator:----------

Name of farmer:---------- Age--------- Father's name----------

Contact number:----------(R)----------(M)

Caste: Gen SC BC ST Any other(specify)

Main occupation and any subsidiary occupation(s):----------+----------+----------

Earlier Profession before adopting Piggery_____

Who encouraged for this profession_____

Training of the enterprise _____

Family size:-

Sex	**Adults**	**Children**	**Earning member(s)**		**Av monthly income**
			Number	**Occupation**	
Male					
Female					

Education status of family

Family members	**Primary**	**Middle**	**Matric**	**Above matric**

Note- Wherever required additional information may be recorded either on back side of the page or on separate blank sheet.

	Irrigated	**Unirrigated**
Value of land (per acre):	----------	----------
Rental value of land (per acre):	----------	----------

Soil type (sandy/loam/clay etc)

Type of Irrigation Facility

Canal Tube-well Water harvesting

If tube-well, whether electric, diesel-engine operated

Any innovation in irrigation system (Drip/Sprinkler/any other)

Land Inventory

Particulars	Area (acre)			Total Area (Acre)	Use of land for (Acre)					
	irrigated	unirrigated	Barren (specify)		Crop	Orchard	Grazing	Forestry	Fodder	Any other
Land owned										
Rented in										
Rented out										
Operational holding										

Livestock

Location of the Pig Farm

a) In the Village
b) Just at the periphery of the Village
c) In the Agricultural Field

Herd Strength

Total no of Pigs Sows including gilts Growing animals Piglets

Pregnant NP

Boars (For breeding purpose)

Other Species_____

_____

General Management

Direction of shed a) East-west b) others (specify) ----------

Height of roof a) >10 feet b) <10 feet

Type of roof a) *It-bala* b) Thatched c) Asbestos/ tin d) others-----

Floor area per animal a) Sufficient b) Insufficient

Type of floor a) Pucca b) Bricks c) Kutcha

Level of floor a) Sloppy b) Levelled c) Uneven

Cleanliness of floor a) Clean and dry b) Wet floor

Ventilation a) Good b) Fair c) Poor

Tree shade a) Available b) Not-available

Cooling in summer a) Provision of water b) Sprinklers/Foggers etc

Warming in winter (Provision of heater) a) Yes b) No

Provision of water for drinking/other purpose a) Sufficient b) Insufficient

Provision of bedding a) Yes b) No

Animal Density (No. per pen) Adult _____

Growing _____

Preweaned_____

Breeds of the pig being reared_____

Piglets purchased from_____

Provision of CREEP AREA a) Yes b) No

Cutting of Needle Teeth a) Yes b) No

If Yes, at what age?_____

Foster mother feeding practised a) Yes b) No

Prevention of piglet anaemia a) Followed b) Not practised

If Practised, which method followed? a)Feeding of roadside soil b) Green Vitroil paste c) injection of iron

Weaning done at (Age in months)_____

Identification methods_____

Diseases encountered in 1-2 yrs of age_____

Constrains_____

Problems faced during pig farming_____

Do you know about any govt. Scheme_____

Farrowing facilities

1) Transfer of sow to farrowing pen.....days prior to farrowing

2)Transfer of sow to farrowing pen a) After bathing b) Without bath

3) Provision of Guard Rails in farrowing pen a) Yes b) No

4) Provision of separate farrowing pen a) Yes b) No

5) Naval cord disinfection a) Followed b) Not followed

6) Agents used for disinfection .....

7) Castration of male pigs a) Followed b) not followed

If yes, at what age .....

By which method .....

Who does castration? .....

8) Provision of creep feed a) Yes b) No

9) Vaccination against swine fever

a) Age of vaccination

b) Procured from which agency

c) Who does vaccination

Deworming

1) Age at 1st deworming .....

2) Repetition .....

.

3) Agents for deworming .....

Feeding Practices

Type of feed

a) Kitchen waste b) Branded

c) Homemade concentrate ration

Quantity of feed a) Grower b) Sows c) Boar
Method of feeding .....
Feeding of peels of peas a) Yes b) No
Feeding of grains a) Yes b) No

Part II (Pig Production Efficiency)

Marketing

1) Marketable age .....

2) Weight at marketing .....

Part III (Pig Reproduction Efficiency)

Sow reproductive efficiency

1) Breeding methods
2) Method of heat detection
3) Age at 1st breeding
4) Weaning to estrous period
5) Weaning to mating period
6) Av Litter size at Birth
7) Av Litter size at Weaning
8) Mortality rate till weaning
9) Inbreeding
10) Do you know about A.I. a) Yes b) No

VITA

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EDUCATIONAL QUALIFICATION:

Bachelor's Degree	**:**	B.V.Sc. and A.H.
University	**:**	Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana (Punjab)
Year of award	**:**	2012
OCPA	**:**	6.49/10.00
Master's Degree	**:**	M.V.Sc.
OCPA	**:**	7.83/10.00
Year of award	**:**	2014
Achievements		
	:	Presented poster "ETHNO-VETERINARY MEDICINE PRACTICES USED FOR SOME COMMON DISEASES IN DAIRY ANIMALS IN RURAL AREAS" In international conference on "Sustainable Agriculture for Food and Livelihood Security" November 27-29, 2012 Organized by PAU Ludhiana, Punjab, India.