# BETTER LIVELIHOODS THROUGH SCIENTIFIC PIG HUSBANDRY


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# Better Livelihoods through Scientific Pig Husbandry

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This e-book is a compilation of resource texts from various subject experts at ICAR- NRC on Pig, Guwahati, and MANAGE, Hyderabad, on various aspects of Scientific Pig husbandry for sustainable livelihood improvement. It is designed to educate extension workers, students, research scholars, progressive farmers, and academicians on improving livelihoods through scientific pig husbandry.



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Published for Director, ICAR-NRC on Pig, Guwahati and Director General, National Institute of Agricultural Extension Management (MANAGE), Hyderabad

# MESSAGE

National Institute of Agricultural Extension Management (MANAGE), Hyderabad is an autonomous organization under the Ministry of Agriculture & Farmers Welfare, Government of India. The policies of liberalization and globalization of the economy and the level of agricultural technology becoming more sophisticated and complex, calls for major initiatives towards reorientation and modernization of the agricultural extension system. Effective ways of managing the extension system needed to be evolved and extension organizations enabled to transform the existing set up through professional guidance and training of critical manpower. MANAGE is the response to this imperative need. Agricultural extension to be effective, demands sound technological knowledge to the extension functionaries and therefore MANAGE has focused on training programs on technological aspects in collaboration with ICAR institutions and state agriculture/veterinary universities, having expertise and facilities to organize technical training programs for extension functionaries of state department.

Scientific pig husbandry holds significant potential for improving the livelihoods of farmers and communities. By adopting modern, science-based practices, farmers can increase productivity, ensure animal welfare, and enhance economic returns. This message outlines the key aspects of scientific pig husbandry and its benefits. By embracing scientific pig husbandry, farmers can significantly improve their livelihoods. The increased productivity, better animal health, and enhanced economic returns contribute to a more sustainable and prosperous farming practice. Adopting these practices benefits the farmers and supports the broader community by providing high-quality, sustainably-produced meat products.

This e-book covers an array of subjects, Better Livelihoods through Scientific Pig Husbandry. I would like to extend my appreciation to, NRC on Pig & EAAS Centre, MANAGE, Hyderabad for the tremendous effort in compiling this e-book. I also thank the authors, editors, and designers who have contributed to this e-book creation.

(P. Chandra Shekara)
Director General, MANAGE, Hyderabad

# FOREWORD

Pigs are one of the most important livestock in the North Eastern Region of India, providing food and livelihood security to tribal and weaker sections of society. The demand-supply gap for pork in India is about 50%, highlighting a significant opportunity for entrepreneurship development in the piggery sector. In recent years, pig farming and value addition have attracted entrepreneurship and private investment, indicating a resurgence of piggery-based agribusiness. Small and marginal farmers can benefit from forming self-help groups or farmer producer organizations to establish processing units and develop branded products. Key priorities in promoting agribusiness in the piggery sector include clean and safe pork production, value addition, and brand development.

The ICAR-National Research Centre on Pig, Guwahati, aims to excel in pig production, health, and processing. The institute has been at the forefront of providing technological support to stakeholders in the piggery sector and enhancing their knowledge and skills. To promote piggery-based entrepreneurship, the institute has established an agribusiness incubator and transferred technology to several startups. I am delighted that the NRC on Pig is organizing an online training program on "Better Livelihoods through Scientific Pig Husbandry," sponsored by the National Institute of Agricultural Extension Management (MANAGE), Hyderabad, for extension officials of state/central animal husbandry departments, veterinarians, faculty of SAUs/KVKs/ICAR institutes, and research scholars from May 14-16, 2024. The lectures in this online course are designed to expose participants to various aspects and opportunities for entrepreneurship development in the piggery sector. I hope that participants from different parts of the country will benefit immensely from this course through interactions with the expert resource persons selected for this training. This compendium of lectures is designed to provide readers with comprehensive knowledge on the subject. I extend my best wishes to the organizing team and participants for a successful learning experience

(Vivek Kumar Gupta)
Director
ICAR-National Research Centre on Pig, Guwahati

# PREFACE

This e-book is the result of a collaborative online training program, “Better Livelihoods through Scientific Pig Husbandry,” held from May 14-16, 2024. It is designed to be a valuable resource for grassroots-level extension workers, entrepreneurs in the piggery sector, academicians, and research scholars.

The book addresses various aspects of piggery-based entrepreneurship development, including:

- Opportunities and challenges in pig farming in India.
- Breeding management and strategizing production in commercial pig breeding farms.
- Entrepreneurship development through Self-Help Groups (SHGs) and Farmer Producer Organizations (FPOs) in the piggery sector.
- Reproductive Management and Artificial insemination in pigs.
- Feed formulation and establishing large-scale pig feed production units.
- Value addition of pork and hygienic slaughter techniques.
- Bankable projects for pig farming and government initiatives to promote pig farming.

We extend our sincere thanks to all the chapter authors for their timely contributions. We also express our gratitude to the Director, ICAR-National Research Centre on Pig and Director General, MANAGE for their support and guidance. The financial support from MANAGE, Hyderabad, for this training program is greatly appreciated. We hope this e-book will help in promoting piggery-based entrepreneurship in India.

**Editors**

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# *Chapter 1*

# Pig Husbandry at crossroads: Embracing opportunities and overcoming challenges

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Pigs are domesticated in various parts of India, especially in the South-Central and North Eastern Region (NER). Each region has its own locally adapted pig breeds, and most households raise at least one or two pigs each year (Singh et al., 2020). Although the tradition of pork consumption in India varies across different times, places, and social relations, the smallholder model of raising pigs as part of diverse crop and livestock agro-ecosystems, coupled with occasional meat consumption, defines much of the country's pig and pork history (Das and Bujarbaruah, 2005; Kakati, 2019). However, 21st-century agricultural and dietary changes represent radical departures from this smallholder production system, with industry consolidation becoming clearly visible over the last two decades (Kumaresan et al., 2007; Anuj et al., 2016). The industrialization of pig production is a relatively recent global phenomenon, and in India, the speed and scale of change have been phenomenal, driven by policies, investments, and the transforming economic system. Pigs are widely distributed across all eco-regions of India and play a significant role in rural society, especially among tribal communities. Certain ethnic groups in the country prefer to keep pigs, particularly black-coloured ones, for festivals and ceremonial purposes. The highest pig populations are found in the eastern and north-eastern (NE) states, followed by northern, southern, central, and western regions of India.

## Challenges for modern pig farming in India:

Pig farming globally faces challenges such as shortages and rising prices of common feed components like corn and soybeans, which are often used for human consumption or diverted to biofuel production. Additionally, pig farming worldwide is subject to increasing government oversight and rising costs related to waste disposal and potential environmental issues. In India, pig farming faces several specific challenges, which are further elaborated below:

Lack of access to high-quality germplasm remains a significant challenge in India's pig farming sector. The majority of the pig population in the country consists of indigenous breeds characterized by low growth rates and productivity, as highlighted by Sahoo et al., (2012). Nonetheless, it's important to recognize that these breeds exhibit strong adaptability to harsh climates, limited nutrition, and tropical diseases. A considerable portion of India's pig population falls under the non-descript category, primarily due to uncontrolled breeding practices and crossbreeding among different breeds. The suboptimal productivity of these indigenous animals can be attributed to underutilization of their genetic potential and insufficient emphasis on selecting superior breeding stock. This issue is exacerbated by frequent crossbreeding activities among these breeds.

Endemicity of pig diseases presents a significant challenge in India. Major diseases such as Classical Swine Fever (CSF), Porcine Circovirus (PCV), and Foot and Mouth Disease (FMD) viruses are prevalent throughout the country's pig population. Additionally, India has reported cases of two notifiable diseases, namely Porcine Reproductive and Respiratory Syndrome (PRRS) and African Swine Fever (ASF), in recent times. While the government offers free FMD vaccines to producers (Sakamoto and Yoshida, 2002; McOrist and Done, 2007), the availability of vaccines for CSF is limited, and currently, there are no vaccines accessible for PRRS, PCV, and ASF within the country (Yang, 2008). Furthermore, the number of animal vaccine manufacturers in India, both semi-governmental and private, is significantly restricted. A prevalent issue in the pig farming sector is the insufficient level of training and expertise among farm managers and attending veterinarians, as highlighted by Sarma et al., (2016). This problem persists even on farms with substantial investments and expansion efforts. Moreover, only a handful of state veterinary laboratories possess the capability to provide pig farmers with essential services in fundamental disciplines such as pathology, microbiology, and epidemiology. The deficiency in diagnostic capabilities significantly impacts the scope and duration of disease outbreaks, as well as the overall quality of education and training accessible to farms. The absence of a unified voice among pig farmer groups or companies results in several repercussions. For instance, analysis of typical farm costs and requirements are predominantly conducted by government administrators, lacking input from a clear advocate for necessary facilities in pig production and marketing, as well as the requirement for suitable veterinary laboratories at the state or regional level (Rozelle and

Swinnen, 2004). A collective voice would also streamline the development of independent and accredited training programs focused on farm management and disease control measures.

**Opportunities prevailing in the piggery husbandry sector of India:**

Pigs serve as a live source of insurance, particularly for the weaker sections of the community, presenting significant opportunities for using pig farming as a medium for poverty alleviation in India. In regions like the North East, where over 50% of the country's pork is consumed, there is a need to procure live pigs from other parts of the country to meet local demand. This creates substantial opportunities for employment generation among rural youth in pig farming.

Furthermore, self-employment opportunities exist for pork product processors and workers, as well as for Self Help Group (SHG) personnel engaged in services like artificial insemination and vaccination. Given that pigs are prolific breeders, achieving the targeted growth of 10% in the meat sector is feasible through piggery. Specifically, in the North Eastern region, there is immense potential for employment generation for rural youth in the piggery sector.

**Strategies for development of the piggery sector in India:**

Implementing targeted strategies aimed at enhancing pig production outcomes has the potential to yield substantial socio-economic advantages for tribal and other underprivileged communities involved in pig farming. At present, the scale of production in backyard enterprises is primarily determined by local feed resources. Hence, enhancing feed resources and adopting improved feeding practices are pivotal interventions for augmenting the productivity and profitability of small-scale backyard piggery operations. Educating farmers on breeding, feeding, and healthcare management, alongside modern husbandry practices, as well as imparting knowledge on zoonotic diseases and market-oriented production systems, can contribute to producing high-quality pork from healthy pigs, thereby commanding better prices (Naidu and Kondaiah, 2004; Chander and Mukherjee, 2005). Consequently, there is an urgent need to develop client-focused and tailored extension programs employing participatory methods that engage stakeholders in addressing how to enhance production within the constraints of limited household resources, while ensuring the maintenance of pig health and the breeding of productive crosses.

- Utilizing indigenous breeds available to low-income rural communities can be advantageous due to their low input requirements. Crossbreeding to enhance pig traits could be conducted in commercial and large-scale farms, as these operations

typically possess the capacity to consistently provide intensive inputs (Das et al., 2012) Exotic pig breeds such as Large Black, Hampshire, Large White Yorkshire, Landrace, and Duroc have demonstrated promising performance within local conditions, making them suitable candidates for selective breeding programs. When practicing free-range rearing, incorporating exotic breeds to upgrade local non-descript ones can be a viable strategy. Nevertheless, it is crucial to establish measures for concurrent enhancement of feeding and management practices.

- To ensure profitable pig production, it is essential to prioritize specific breeds capable of yielding fast and efficient growth in their offspring. The majority of India's pig population consists of indigenous breeds characterized by low growth rates and productivity levels (Giuffra et al., 2000). The issue must be addressed by introducing exotic germplasm in field conditions.
- The animal industry has recognized the importance of optimizing the nutritional intake of animals to promote lean growth effectively. To maximize muscle development, it is crucial to provide feed with a specified amino acid ratio rather than solely focusing on total protein content. However, often the availability of feeds and fodder does not align with the animals' requirements. It is imperative to develop feeding strategies that utilize inexpensive local feed sources, such as leaf meals, oil cakes, grain by-products, and root tubers like tapioca and sweet potato, which are currently underutilized. This is particularly important for low-income communities.
- Developing community-based or cluster-based systems is essential, and encouraging private sector investments are crucial to address the unmet demand for improved breeding stock and high-quality piglets in the country. Additionally, exploring the introduction of artificial insemination in sows and implementing need-based training programs for smallholders on breeding stock care and management are important steps (Das et al., 2012). For instance, the ICAR-National Research Centre on Pig has initiated the 'Mega Seed Project' to integrate highly prolific germplasm under field conditions and distribute the improved germplasm to farmers from the nucleus herd.
- While pork and pork products are favoured by a certain portion of the population, their widespread acceptance is hindered by the unsatisfactory conditions prevailing in production, processing, and marketing.
- Addressing the deficiencies mentioned above in public health measures through risk assessment along the production-to-consumption value chain, establishing necessary

infrastructure and inspection facilities (including manpower and physical resources), and providing training to all stakeholders in meat hygiene and food safety are essential steps needed for wholesome meat production in the country.

- Reports indicate that value addition of meat remains significantly limited within the country, with less than 2% of total meat processed into tradeable products in India, in contrast to over 60% in developed nations. Despite this, the demand for processed meat is continuously rising domestically, indicating considerable potential in the pork processing and value-addition sector.
- The widespread distribution of simple, appropriately designed pig housing units, which are affordable for impoverished rural communities, is a significant intervention in ensuring the production of high-quality meat. These low-cost structures should incorporate adequate sanitation, proper ventilation, and improved hygiene conditions to effectively manage parasites and pathogens that affect pigs.
- Integrating pig farming with other livestock and crop activities enables the effective and comprehensive utilization of inputs such as feed, land, manpower, and capital. Moreover, integrated pig farming holds promise in augmenting employment opportunities, enhancing nutritional security, and boosting the income of rural populations, a trend that has garnered significant attention in recent years.
- The majority of government-sponsored schemes provide credit as an arm of extending micro-credit through NGOs. Other than that, different govt. schemes like NLM, RKVY, PMEGP provides financial support to pig farmers and aspiring entrepreneurs. Similarly, insurance coverage for pigs owned by small-scale producers could be facilitated through Group Insurance Schemes offered by insurance companies. This approach ensures an effective extension service that is farmer-oriented.

Piggery can seamlessly integrate into rural-based agricultural and livestock production systems, offering farmers a viable option to mitigate the risks associated with production failures and enhance profitability in a more sustainable manner.

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## *Chapter 2*

# Strategizing production enhancement through scientific pig breeding program

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Pig farming represents a lucrative opportunity for entrepreneurs and farmers alike. The success of a pig farm hinges on the productivity of the pigs raised within it, which, in turn, is influenced by factors such as breed selection and the quality of boars and sows chosen for breeding purposes. Indigenous pig breeds often exhibit smaller body sizes, poor reproductive performance, and slower growth rates, yet possess valuable traits such as adaptability to Indian conditions, disease resistance and quality pork production. Conversely, exotic, and crossbred pigs typically display higher growth rates and better reproductive performance but require significant investment in feed, housing, and health management. These costs can be circumvented by opting for local pigs, which can thrive in low-input or even no-input systems, such as backyard farming on kitchen scraps. Once you have chosen the breed of pig you intend to raise, your initial priority should be selecting the animals to acquire for your farm, as this decision significantly impacts the future generations of your pig farming venture.

Selecting the right pigs for breeding is paramount to the success of a pig farming operation. Effective animal selection enhances future generations' performance, leading to improved economic returns. This chapter will delve into the basis of selection, criteria for choosing breeding males and females in pigs, appropriate mating systems, and other critical aspects of pig breeding.

## What methods do you employ to choose pigs for breeding purposes?

Effective animal selection serves as a cornerstone of successful swine production, significantly impacting producers' profits over the long term. The process of choosing pigs for the next generation of parents can be done on the basis of-

a) ***Individual own performance:*** The selection of sow and boar will be done based on their own performance. Choosing animals with a track record of good performance can yield offspring with similar attributes.

b) ***Collateral relatives' performance:*** It is also known as family selection in which animals are selected based on performance of their family members. Assessing animals based on the performance of their relatives can guide breeding decisions.

c) ***Pedigree Performance:*** As like begets like, the sows and boars with good performance will produce piglets with good performance. Hence, the selection of animals is done based on their parents' performance. Considering the performance of an animal's parents can help predict the potential of their offspring.

There are two primary avenues for enhancing pig performance. Firstly, it involves selecting the best individuals to serve as parents for the next generation, constituting the selection process. Secondly, it entails controlling the mating practices of these chosen parents to produce offspring. By consistently breeding only the finest offspring, incremental improvements in animal performance can be achieved with each successive generation of pigs.

**Methods of selection:**

i) **Tandem Selection:** In this approach, selection is focused on one trait at a time. Once the desired improvement in one trait is achieved, attention is then directed towards improving another trait. One drawback of this method arises from negatively correlated traits, where enhancing one trait may lead to a decline in performance in the correlated trait.

ii) **Independent Culling Level:** With this method, a minimum threshold is established for each trait, and individuals failing to meet the minimum for any trait are excluded. Those meeting or exceeding the minimum for all traits are selected. However, this method does not allow for compensating the deficiencies in one trait by excelling in another trait.

iii) **Selection Index or Total Score Method:** Here, individuals are chosen based on a cumulative score assigned to each trait, considering their economic value, heritability, and genetic correlations between traits. This method is more efficient than the others, permitting the superiority of certain traits to offset minor deficiencies in others.

**Pig Mating Systems:**

The mating systems are the pairing of sow and dam for breeding to incorporate desired traits. Out of different types of out breeding system, selective breeding, grading up and

crossbreeding is generally adopted in swine breeding practice. There are following types of mating in pig breeding-

a) **Random mating within a breed**: mating individuals within a breed without considering their pedigree.
b) **Inbreeding:** mating between more closely related sow and dam within the breed. Inbreeding is avoided in pigs due to adverse effect of this type of breeding system in the performance of the animals.
c) **Outbreeding:** mating between unrelated sow and dam within the breed.
d) **Selective Breeding:** This is a method of breeding where superior male and female animals with in a breed are selected and mated. This method is useful for increasing the performance of a well-developed breed.
e) **Grading-up:** In this method, non-descript sows are mated with superior bores with high production potential of a well-developed breed from generation after generation. After the $7^{th}$ generation of crossing the indigenous non-descript, animal will have more than 99% inheritance with superior performance. As most of the pig population of the country is non-descript type; this method of breeding will be highly beneficial for genetic improvement of these animals.
f) **Crossbreeding:** This is the method of crossing between two well developed breed. This system of breeding is a recommended practice and widely accepted in commercial swine farming. Crossbreeding is used to exploit the heterosis which is the superiority of crossbred progeny over the mean performance of purebred parents. The crossbred progeny shows higher litter size and birth weight and weaning weight, greater resistance to environmental stress than exotic animals, better feed conversion efficiency, growth rate, high mothering ability and higher milk production. Commonly used crossbreeding system in swine industry are:
    i) **Two breed crosses:** This is a system of mating in which purebred animals of two different breeds are used for crossing and the purity of the parent breeds is not altered.
    ii) **Back cross and crisscross system**: It is the mating of crossbred animals ($F_1$) to purebred animal of either parent breed. This cross is made to exploit maternal or paternal heterosis. The back crossing between crossbred female and purebred males shows 100% maternal heterosis. The offspring crossbred gilts are mated back to a boar of one or other of the two original breeds.

iii) **Three breed crosses**: In this system of cross breeding three breeds are rotationally used and males from each of the three breeds are used in succession on cross bred females.

iv) **Four breed crosses or double two breed cross:** This involves the crossing of crossbred females produced by crossing two breeds (A & B) with crossbred male produced from crossing another two breeds (C & D). Thus, mating of two crossbreds (AB x CD) animals produce both maternal and paternal heterosis as well as individual heterosis.

**Criteria for Selecting Breeding Pigs:**

The following points should be considered while selecting pigs for breeding

***Physical Conformation:*** Desirable breeding gilts or boars should exhibit a well-proportioned appearance. When viewed from the side, the top line should form a strong, uniform arch, with a straight underline and medium-length legs. From the front or rear, the shoulders, back, loin, and rump should appear wide and carry uniform width from front to rear.

***Size and Weight:*** During selection, gilts and boars should not display excessive body depth, appearing somewhat leggy at a younger age. Ideal animals have a large heart girth, noticeable just behind the shoulders, with a trim head featuring good width at the snout and between the eyes. The length of the face varies by breed.

***Development in High-Value Pork Cuts:*** A quality breeding gilt or sow should exhibit adequate development in regions yielding high-value pork cuts, such as pork chops from the back and loin, ham from the rear quarters, and bacon from the sides. Animals with wide, full hams are preferred, and emphasis should be placed on a body that is wide across the back and loin, as well as long and deep.

***Performance and Productivity:*** Evaluating the actual performance and productivity of an animal is essential. For gilts or sows, factors such as weight gain efficiency and litter size are critical. Additionally, information on the number of piglets per litter and their average weight should be considered for sows.

**Performance Traits Considered in Selection:**

There are important economic traits which are considered while selecting male and females for breeding. These traits include litter size at birth and weaning, litter weight at birth and

weaning, growth rate, feed conversion efficiency, no. of litters per year, carcass traits, pre and post weaning mortality and genetic disorders.

**Boar Selection:**

Boars play a crucial role in herd genetics, exerting a significant influence on herd improvement. Thus, careful attention must be paid to their selection, management, and replacement. Boars have a greater impact than females, hence selection should be made with utmost care.

**Selection Criteria for Boars:**

- Acquire boars from breeders or farms with comprehensive performance records. The boar should be selected from a dam which has consistently farrowed and weaned high litters.
- A desirable breeding boar should ideally reach a weight of 90 kg within 5-6 months, with allowances made for Indian breeds based on their body confirmation.
- Emphasis should be placed on pigs achieving maximum weight by 6 months of age, along with efficient feed conversion to reach 90 kg.
- Traits such as growth rate and carcass quality can be inherited by offspring, underscoring the importance of selecting superior boars.
- Boars must possess genetic potential to enhance progeny performance and physical soundness for continued breeding activity.
- Final selection of young boars should be based on performance testing conducted between 20 and 30 weeks of age.
- Boars should be sourced from reputable, disease-free herds, with attention given to their leg and foot health.
- Boars should exhibit normal testicular characteristics and functionality, with good libido being a desirable trait.
- Selection should prioritize economically important performance traits, with preference given to boars from sources that extensively test or record performance.
- The dam of the selected boar should have consistently produced large litters of 8 piglets or more.
- Negative blood tests for brucellosis and leptospirosis, along with vaccination against swine fever, are essential.

- Boars should be culled when they reach 2 years of age, based on criteria such as poor conformation, lameness, libido, semen quality, disease presence, or aggressive behaviour.

**Selection Criteria for Gilts:**

- Gilts, typically purchased at market weight around 90 kg, are selected for breeding after reaching 7 or 8 months of age. It is advisable to procure breeding stock from reputable breeders with documented records of gilt lineage and performance.
- Gilts should be selected from dams with a history of consistently producing large, healthy litters at weaning.
- Desired traits in gilts include long bodies, correct structural conformation, and feminine characteristics.
- Gilts should have fully developed vulvas and functional underlines, with a minimum of six teats per side.
- Traits such as sound feet and legs, good growth rate, and appropriate back fat deposition are important considerations.
- When selecting gilts, attention should be paid to avoiding those that are overly muscled, short, or excessively fat.
- It is crucial to avoid selecting gilts with immature vulvas or inadequate teat structure.
- Isolating newly added gilts for 3-4 weeks helps prevent disease transmission and ensures herd health.

**Culling:** Regular culling of animals is vital in pig breeding to remove deformed, infertile, unproductive, or undesirable individuals from the herd. Reasons for culling boars may include poor conformation, lameness, libido, semen quality issues, death, disease presence, or overly aggressive behaviour.

**Record keeping**

Managing a pig farm which is a dynamic enterprise requires meticulous planning and detailed record-keeping due to constant changes in animal numbers, reproductive status, age structure, daily production and input needs (Banik *et al.*, 2022). Effective management involves tracking the total number of pigs, monitoring reproductive cycles and keeping age distribution records to optimize breeding programs. Daily production metrics such as piglet births, mortality rates and weight gain must be recorded alongside input requirements for feed, water

and medications to ensure resource optimization. Synchronizing activities like feeding schedules, breeding, and health checks is crucial for maintaining herd health and productivity. Records should be simple, complete, accurate and regularly updated to ensure reliability and usability. Regular updates and careful data collection are essential, with a choice of manual or digital systems based on the farm's needs. Analyzing these records enables better decision-making and overall farm management improvement (Fountas *et al.*, 2015).

**Importance of Record Keeping**

- **Pedigree and History Tracking:** Maintaining detailed records of each animal's production, reproduction and health performance is crucial for understanding pedigree and making informed management decisions.
- **Herd and Breed Registration:** Helps in implementing herd and breed registration programmes by identifying animals with optimal performance levels. It also aids in registering and tracking breed-specific characteristics.
- **Breeding Value Estimation:** Maintaining records helps estimate the breeding value for various economic traits, aiding in selection and culling of animals leading to improvement of overall herd quality and efficiency.
- **Selection of Breeding Stock:** Records help identify suitable animals for breeding based on their performance, pedigree and performance of progeny and relatives, ensuring the selection of high-quality breeding stock.
- **Culling Decisions:** Performance monitoring helps distinguish between high-performing animals and those with issues, facilitating the identification of animals needing special attention or culling.
- **Research and Development:** Detailed records support planning and conducting research to improve pig farming practices and provides data for scientific studies and development projects planning.
- **Breeding Management:** Breeding records improve accuracy in detecting heat and scheduling mating at optimal times, are essential for tracking the breeding activities of each sow and boar, enhancing management efficiency. They also improve accuracy in predicting farrowing times, aiding in farm planning. These records help identify infertile animals and facilitate the analysis of infertility causes, enabling corrective measures to enhance breeding success.
- **Prevention of Inbreeding:** Keeping detailed pedigree records help prevent inbreeding by ensuring genetic diversity within the herd.

- **Performance Comparison:** Records allow farmers to benchmark their farm's performance against industry standards or other farmers which helps identify strengths, weaknesses and areas for improvement in production, efficiency and management practices.
- **Feeding Management:** Supports appropriate feeding tailored to the specific production levels of animals ensuring optimal health and performance.
- **Young Animal Identification:** Maintaining detailed records ensures proper identification of young animals by documenting individual identification numbers or tags.
- **Input/Output Calculation:** Records aids in determining the efficiency and profitability of farm operations by analyzing the relationship between resources invested (inputs) and the resulting outputs.
- **Financial and Health Status:** Detailed records help determine both the financial status of the farm and the health status of the animals, providing critical insights for effective management decisions.
- **Pricing:** Detailed records assist in setting competitive prices for animals based on their performance, pedigree and market demand.

**Important records to be maintained in a pig farm**

There are several types of records crucial for effective pig farming, each serving as essential tools for monitoring and optimizing farm performance. Key records include animal performance, economic transactions, daily activities and notable events. These records enable farmers to track progress towards production goals and ensure efficient management practices. The important records to be maintained in a pig farm include:

**Grower or finisher record card**

The grower or finisher record card typically includes essential information such as individual pig identification numbers, dates of birth, breed and gender. Additionally, the card records key performance metrics such as initial and final weights, average daily weight gain, feed consumption, and feed conversion ratios. By maintaining accurate and comprehensive records on grower or finisher pigs, farmers can assess the effectiveness of their management practices, identify areas for improvement and make informed decisions to optimize pig growth and overall farm profitability.

| Animal No | DOB | Sex | Breed | Sire No | Dam No | Date of Slaughter |
|---|---|---|---|---|---|---|
| Birth weight | **Weekly body weight** | | | **Body weight at weaning** | **Average Daily Gain** | **Feed Conversion Ratio** |
| | **Week 1** | **Week 2** | **Week 3** | **Week 4** | | |
| | | | | | | |

| Monthly body weight | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Month 1** | **Month 2** | **Month 3** | **Month 4** | **Month 5** | **Month 6** | **Month 7** | **Month 8** | **Month 9** |
| | | | | | | | | |

**Sow record card**

A sow record card is a crucial tool for tracking the breeding performance, health and overall productivity of individual sows on a pig farm. It includes detailed information on mating dates, pregnancy checks, farrowing outcomes, health events, weights, and feeding records. This information helps farmers monitor each sow's performance and make informed decisions about breed selection. Accurate and systematic record-keeping on these cards ensures effective management and optimal breeding practices.

| **Animal No** | **DOB** | **Sex** | **Breed** | **Sire No** | **Dam No** | **No of teats** | **Date of culling/ disposal** |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

| **Date of estrus** | **Date of Service** | **Date of Successful Service** | **Boar No used** | **Breed of boar** | **Date of Farrowing** |
|---|---|---|---|---|---|
| | | | | | |
| **Parity** | **No. of piglets born alive** | **No. of piglets born dead** | **Litter weight at birth** | **Litter size at weaning** | **Litter weight at weaning** |
| | | | | | |

**Boar record card**

The boar record card is an essential tool for monitoring the performance and health of individual boars in a pig farm, facilitating corrective measures when necessary. It includes key details such as the boar's identification number, date of birth and breed. Additionally, it records the sow number served by the boar, along with the date of service and the number of piglets born (both dead and alive) as well as the number weaned.

| Animal No | DOB | Sex | Breed | Sire No | Dam No | No of rudimentary teats | Date of culling / disposal | Congenital defects if any | Results of any disease testing |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

| Date of puberty | Date of first semen collection | Date of service | Sow No served | Type of mating (AI, hand or pen mating) | Litter size at birth | Litter size at weaning | Litter weight at birth | Litter weight at weaning |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |

**Breeding record**

A well-maintained breeding record is crucial for the successful management of a pig farm's reproductive activities. It helps in tracking breeding performance, ensuring the health of the animals and ultimately contributing to the productivity and profitability of the farm.

| Animal no | Date of Service | Date of Successful Service | Boar No used | Breed of boar | Expected date of Farrowing | Date of Farrowing |
|---|---|---|---|---|---|---|
| | | | | | | |

**Farrowing records**

Maintaining detailed and accurate farrowing records allows pig farmers to track the reproductive performance of individual sows, and identify trends in litter size and piglet health. These records also serve as valuable historical data for future breeding decisions and farm management strategies.

| Animal no | Date of Farrowing | Litter size at birth(born alive) | No. of Still births, mummified or macerated fetuses | Date of weaning | Litter size at weaning |
|---|---|---|---|---|---|
| | | | | | |

**Animal stock register**

**T**his register tracks essential information about the pigs in the herd.

| Month | Year | No of piglets | No of growers | No of sows | No of boars | No of culls and mortalities | Total no of animals |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**Mortality register**

A mortality register in a pig farm aids in tracking and analyzing the deaths of pigs. It helps in identifying patterns or causes of mortality, which can inform better management practices, improve animal welfare and enhance overall farm productivity. Here's a sample of what a mortality register for a pig farm might include:

| Date of death | Animal no | Pen no | Age | Sex | Cause of death | Postmortem findings |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |

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## *Chapter 3*

# Feed formulation and setting up of large-scale pig feed production units

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Feed costs are the major recurring expenditure in pig farming, accounting for nearly 70% of the total cost. Scientific interventions in animal feeding are critical to curtail costs while also increasing farm profitability. Pigs are monogastric and omnivorous animals, just like human beings. Therefore, we can compare the dietary requirements of pigs to those of humans. Pig farming began with an extensive rearing system in which the animals roamed free for the entire day, scavenging for feed. The semi-intensive system received some household kitchen or hotel waste as input. Recent developments in pig rearing encourage intensive systems to maximise production and profitability. The importance of feeding evolved as pig populations in the intensive farming system increased. Animals in the intensive system will be given balanced diet in the form of concentrate to full the nutrient requirements. Pigs should receive a balanced feed that includes nutrients such as carbohydrates, proteins, fats, minerals, and vitamins. A diet balanced with all the nutrients improves the feed utilization efficiency, growth rate, and body weight of the animals. The amount of feed required in pigs depends on the breed, age, body weight, and physiological status (pregnant, lactating, breeding, etc.) of the animals, as well as environmental conditions. The animals' nutrient requirements vary as they age, leading to the modification of feed formulation to meet these requirements at different stages. In India, we primarily divide the life stages of pigs into three stages for feeding purposes.

| | | |
|---|---|---|
| Stage I | Starter/creeper | 14 days after birth to 2months, Body weight : 5 – 12 kg |
| Stage II | Grower | 2 to 5 months, Body weight : 12 – 50 kg |
| Stage III | Finisher | After 5 months, Body weight : 50 – 100 kg |

Starter, grower, and finisher pigs have slightly different nutrient requirements, which necessitates different stages of nutrient supply. The advantages of different-stage feeding include (a) improved nutrient utilization by the animals; (b) decreased feed cost; and (c) reduced environmental pollution (due to the excretion of excess nitrogen or phosphorus).

**Starter/creep feed**

After the birth of piglets, they are allowed to suckle the first milk (colostrum) of sow which will ensure development of immunity, disease resistance, and saves the animals from hypoglycemia, and helps in maintenance of body temperature. Milk feeding is continued until the weaning. Orphaned piglets due to loss of dam after farrowing shall be fed with the milk replacer. A good milk replacer should contain at least 24 -28% protein and 8 -10% fat. Milk replacer may be prepared by skim milk powder (60%), oat flour (30%) and whey protein powder (10%), 15 g of this mixture in 100 ml of water along with 5 ml of soybean oil is added, and warming to body temperature can be used in place of sow milk (Lodh et al., 2023). Sow milk is deficient in iron (1.4 – 2.6 mg/L) and provides only 1 mg/d while piglet's daily requirement is 7-16 mg. Consequently, piglets are highly susceptible to anaemia. To prevent iron deficiency anemia iron injections are given on $4^{th}$ and $14^{th}$ day after birth. Piglets after reaching 2 weeks of age are fed with creep feed in a separate enclosure to deny the access to mother. Since this is the first solid food to the piglets it should be highly palatable, easy to ingest and digest type. Developing digestive system of piglets do not have established enzymes for digesting solid food. Introducing creep feed in the early stage of piglets helps in development of digestive system for utilization solid feed given after weaning. Practice of creep feeding in piglets shortens the age of weaning from 8 weeks to 5-6 weeks. To prevent iron deficiency creep feed may be mixed with ferrous sulphate salt in the ratio of 9:1. Example of creeper ration is shown in the table 1. Since piglets in this age have high growth rate their proteins requirement should be satisfied accordingly. Relative biological value of protein from animal origin is more than the plant-based proteins, hence inclusion of animal's proteins such as skim milk, fishmeal, or meat meal augments the growth of the piglets in the early stages. Piglets at the age of $5^{th}$ weeks are given with the starter ration. By this stage piglets are capable of digesting the starch, sugars and proteins. Lactose based skim milk powders are replaced by grains like maize, sorghum or rice. Less fibre digestibility restricts its percent of inclusion to less than 5%. Good quality creep feed and starter diet with 20 – 22% protein results in body weight gain up to 12 -20 kg at the time of weaning.

**Table 1. Example of creep ration**

| Ingredients | Parts (%) | | |
|---|---|---|---|
| | I | II | III |
| Maize powder | 47 | 35 | 30 |
| Rice powder | 0 | 15 | 20 |
| Skim milk powder | 10 | 10 | 10 |

| | | | |
|---|---|---|---|
| Soyabean meal | 6 | 6 | 6 |
| Sesame oil cake | 12 | 12 | 12 |
| G.N cake | 15 | 15 | 15 |
| Molasses | 5 | 5 | 5 |
| Mineral mixture | 1.5 | 1.5 | 1.5 |
| Lysine | 1.5 | 1.5 | 1.5 |
| Methionine | 0.01 | 0.01 | 0.01 |

**Grower feed**

After attaining the body weight of 12-15 kg weaning is practiced and the piglets enters the stage of grower. Gower animals have well developed digestive system, feed utilization efficiency is also more. Hence fiber content can be increased to 8%. Microbial digestion in the large intestine also provides some required nutrients to the animals. Therefore, for effective feed utilization protein content can be reduced to 18% and total digestible nutrient (TDN) to 80%. Limiting amino acid lysine shall be added at the rate of 0.8% for supporting lean growth.

**Finisher feed**

Grower pigs after reaching the body weight of 35 -50 kg enters the finisher stage. Growth of the animals in finisher phase is almost static therefor requirement of energy and protein will be lesser than the grower phase. Higher energy supplied in this stage will be utilized for fat deposition in the body. Excess protein leads to the loss of nitrogen in the form of urine and feces. This, in turn, contributes to environmental pollution. Therefore, protein and TDN requirement is restricted to 16 % and 75% respectively.

**Feeding of pregnant and lactating sows**

Flushing: 1-2 weeks before breeding of gilts or sows are encouraged to increase the number of ovulations by fallowing method of feeding (with 16% protein, 3,000 kcal DE/kg diet, and 0.7% lysine) called flushing. Practicing flushing by feeding 2 – 2.5 kg feed per day stimulates the reproductive hormones such as follicle stimulating hormone (FSH) and luteinizing hormone (LH) thereby produce increased quality and quantity of oocytes. This leads to an increase in the number of piglets born. Gestation period of pigs lasts for nearly 114 days

**Table. 2. Nutrient requirements of pigs in different stages**

| Parameters | Starter feed | Grower feed | Finisher feed |
|---|---|---|---|
| Moisture, percent by mass, Max | 11 | 11 | 11 |
| Crude protein, (N × 6.25) percent by mass Min | 20 | 18 | 18 |
| Crude fat, Percent by mass, Min | 2.0 | 2.0 | 2.0 |
| Crude fibre, percent by mass, Max | 6 | 8 | 12 |
| Total ash, percent by mass, Max | 8.0 | 8.0 | 8.0 |
| Acid insoluble ash, percent by mass, Max | 4.0 | 4.0 | 4.0 |
| Metabolizable energy (k cal/kg), min | 3360 | 3170 | 3170 |
| Aflatoxin B1 (ppb), Max | 20 | 20 | 20 |

**Table 3. Minerals requirements of pigs in different stages**

| Sl.No | Minerals (Moisture free basis) | Starter | Grower | Finisher |
|---|---|---|---|---|
| 1 | Calcium (Ca), percent by mass, min | 0.6 | 0.6 | 0.6 |
| 2 | Available phosphorus, percent by mass, Min | 0.6 | 0.4 | 0.5 |
| 3 | Iron (Fe), mg/kg, Min | 100 | 90 | 80 |
| 4 | Copper (Cu), mg/kg, min | 8 | 6 | 6 |
| 5 | Manganese, mg/kg, Min | 30 | 30 | 20 |
| 6 | Zinc, mg/kg, min | 50 | 50 | 50 |
| 7 | Common salt (NaCl), percent by mass, Max | 0.5 | 0.5 | 0.5 |

**Table 4. Vitamin requirements of pigs in different stages**

| Sl.No | Characteristic | Starter | Grower | Finisher |
|---|---|---|---|---|
| 1 | Niacin, mg/kg, Min | 17 | 14 | 10 |
| 2 | Pantothenic acid, mg/kg, min | 11 | 10 | 10 |
| 3 | Riboflavin, mg/kg, Min | 3 | 2.4 | 2.2 |
| 4 | Vitamin B12 activity, µ/kg, min | 15 | 11 | 11 |
| 5 | Vitamin A, IU/kg, Min | 1700 | 1300 | 1300 |
| 6 | Vitamin D, IU/kg, Min | 190 | 180 | 130 |

Feeding of pregnant animals includes feeding of developing fetus therefore diet supplied should be well balanced with all nutrient. Energy content of the pregnant animals is restricted to avoid fattening which will hamper the growth or causes embryonic mortality of the developing fetuses. Nutrients other than energy such as protein, minerals and vitamins needs to be well balanced to support the healthy growth of mother and fetuses. Pregnant sows

are fed at 6000 kcal ME per head per day. Quantity of feed should not be more than 2 kg/per head/day. Nutritional composition shall include 14% crude protein, and 9 g lysine, 16 g calcium and 14.5 g phosphorus daily. Two to three days around the farrowing sows are fed with bulky feed such as wheat bran, oats or ground legumes to easy the parturition. After farrowing feed of the lactating sows are fed by gradually increasing the amount so that by 5$^{th}$ day sow shall get feed to its appetite. Feeding of good quality feed is crucial to recover body weight loss of 20 – 25 kg around farrowing as well as for milk production. Lactating sows are fed with the 3 - 4 kg of feed plus 0.2 kg of extra feed/piglet to meet the requirement. This shall be fed twice a day in 8 hr interval. To avoid constipation laxatives such as wheat bran, oats or succulent green fodder may be offered with the concentrate feed. Towards the end of weaning of piglets feed is reduced for drying of sows.

**Feeding of boars**

Breeding boar requires extra care to avoid being overweight or obese. Feed the finisher diet (containing 16% CP, 3,000 kcal DE/kg diet, and 0.7% lysine) to boars, limiting their daily intake to 2.5 kg per head. Additionally, you may feed 4–5 kg of green fodder, such as berseem or lucerne. Additionally, boars require increased calcium, phosphorus, and vitamin D requirements to support bone development.

**Table 5. Daily feed requirement of different classes of pigs**

| Stages of pigs | Days | Body weight (kg) | Feed requirement (kg/pig/day) |
|---|---|---|---|
| Weaner | 56 - 120 | 12 – 15 | 0.25 – 0.75 |
| Grower | 121 - 180 | 15 – 35 | 0.75 – 1.50 |
| Finisher | 181 – 300 | 35 – 80 | 1.50 – 2.50 |
| Pregnant gilt | 2 – 2.5 kg feed per day | | |
| Lactating sows | 3.0 – 4.0 kg feed + 200 g feed/piglet | | |
| Boar | 2.5 kg feed + 4 – 5 kg succulent green fodder | | |

**Table 6. Example of feed formulation for different stages of pigs**

| Ingredients | Starter (%) | Grower (%) | Finisher (%) |
|---|---|---|---|
| Maize | 60 | 64 | 60 |
| Wheat bran | 6.5 | 6.5 | 14.5 |
| Soyabean meal | 13 | 12 | 10 |
| Ground nut cake | 12 | 10 | 10 |
| Fish meal | 6 | 5 | 3 |

| | | | |
|---|---|---|---|
| Mineral mixture | 2 | 2 | 2 |
| Salt | 0.5 | 0.5 | 0.5 |
| Lysine | 1.25 | 0.8 | 0.7 |

**Commonly used feed ingredients for feed formulation**

**Energy sources**: Cereal grains including maize, sorghum, wheat, bajra (pearl millet), barley, rice, oats, and other millets are primary conventional sources of energy in animal feeds. Additionally, byproducts from the cereal milling process, such as wheat bran, rice bran, deoiled rice polish, and sugarcane molasses, provide cost-effective and nutrient-rich energy alternatives.

**Protein sources**: Cakes resulting from oil extraction from oilseeds are vital protein sources for pig ration preparation. Depending on the extraction method, the fat content in these oil cakes can range from less than 1% to 10%. Common examples include soybean cake, groundnut cake, linseed cake, rapeseed cake, sesame cake, sunflower cake, and safflower cake. Additionally, byproducts from the milling process of pulses—known as dal chunnies—which include hulls, embryos, and broken cotyledons, are also rich in proteins and minerals. However, their use in pig feeds is limited due to their high fiber content, which can affect digestibility and nutrient absorption.

**Animal protein sources**: These are highly valued for their rich content of essential amino acids vital for pigs' growth and health. Compared to plant protein sources, animal proteins generally offer superior bioavailability. Among the most prevalent animal protein sources in pig diets are fishmeal, meat meal, blood meal, and skim milk powder. These ingredients provide a complete amino acid profile and are readily absorbed and utilized by the animals. In recent years, there has been growing interest in alternative protein sources, particularly insect meals such as silkworm pupa meal and black soldier fly larvae. While these insect-based proteins offer a sustainable and nutritious option, their usage in pig diets is still somewhat limited but gaining traction. As research continues, these alternative protein sources could play a more significant role in pig nutrition, contributing to both sustainability and performance in pork production systems.

**Miscellaneous feeds**: Various agricultural practices yield byproducts that possess feeding value for pigs. However, using these miscellaneous feeds as the sole diet is often restricted due to the presence of anti-nutritional factors, which can impair digestibility. Roots and tubers,

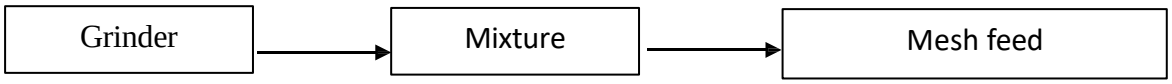
abundant in certain regions, serve as valuable carbohydrate sources for pig feeding. Common root crops like carrot, turnip, and beetroot, along with tubers such as potatoes, sweet potatoes, and tapioca, are utilized, albeit with caution due to anti-nutritional factors. Before inclusion in pig diets, pretreatment methods are typically employed to mitigate these factors. For instance, boiling tapioca tubers and potatoes helps eliminate cyanogenic glucosides, chaconine, and solanidine, which are anti-nutritional compounds. Additionally, other unconventional feeds include minor oilseed cakes (such as neem seed cake, rubber seed cake, and nahar seed cake), fruit wastes (like pineapple, banana, jackfruit, and apple pomace), aquatic plants (including azolla, spirulina, and water hyacinth), agro-industrial byproducts (such as brewer's grains), animal byproducts from slaughterhouses, and vegetable wastes (like cabbage, tomato pomace, and radish). These diverse feed sources provide supplementary nutrition and contribute to overall diet diversification for pigs, enhancing both sustainability and resource efficiency in swine production systems.

**Table. 7 Commonly used unconventional feeds and their inclusion levels**

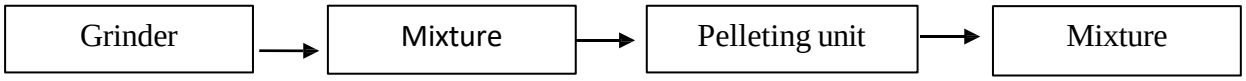
| **Ingredients** | **Anti-nutritional factor** | **Inclusion level and remarks** |
|---|---|---|
| Molasses | High ash content | Used as an energy source at 10% in weaner diet, 20% in grower diet and 30 % in finisher diet |
| Topioca starch waste | Cyanogenic glycosides | Replacement of maize up to 20 -30 % in grower-finisher ration. Boiling is needed before feeding |
| Potato | glycoalkaloids, α-solanine and α-chaconine | Boiling is required before feeding, Replace cereal grains up to 10% in starter, 25% in grower and 30% in sow diet |
| Sweet potato | Tannins, Phenolic compounds | Boiled before feeding, can replace 10 -20 % cereal grains |
| Cabbage | Oxalate, saponin and phytate | 10 – 20% in grower-finisher diet |
| Radish | Glucosinolates, nitrate | 10 % in grower-finisher diet |
| Sugar beet pulp | High fiber content | 10 % in grower-finisher diet |
| Turnip | High fiber | 8-10% in grower-finisher diet |
| Bakery waste | High Salt | 25% cereals can be replaced in grower-finisher diet |
| Blood meal | Imbalanced amino acids and less palatability | 2 – 2.5% in weaner diet, 3 -4% in grower-finisher diet |
| Water hyacinth | Oxalate, tannins, high fibre | 6-7% in grower-finisher diet |
| Fruit waste | High fibre | 10 -20 % in grower-finisher diet |

**Different component of pig feed plant**

For mesh feed (only grinding and then mixing) formulation two component of feed plant is required- Grinder and Mixture unit. For formulating pelleted feed (cylindrical feed) for pigs three components are required- grinder, mixture and pelleting unit.




**Component of mesh feed plant**




**Component of pellet feed plant**

Proper planning is required for management of feeding of swine for economic production. Phase feeding in different stages of growth and production in pigs is required for efficient utilization of nutrients without causing any waste and environmental pollution. High nutritious diet is requited for pigs just before start of breeding in order to get large litter size and similarly such type of nutritious diets also required 2-3 weeks before expected date of farrowing in order to get uniform litter weight at the time of farrowing with optimum growth.

**Conclusion:**

In conclusion, the three-stage system of feeding (weaner, grower, and finisher) widely practiced in India offers a cost-effective and environmentally friendly approach to swine nutrition. Feeding pigs according to their age and physiological stage optimizes growth and performance while minimizing waste and resource usage. The use of unconventional feed resources holds promise for supplementing conventional diets, but it necessitates careful consideration of anti-nutritional factors and inclusion levels to ensure animal health and productivity. Strict measures implemented in swill feeding protocols play a crucial role in ensuring economic pork production by mitigating the risk of disease transmission and maximizing nutrient utilization.

*Chapter 4*

# Reproductive Management of breeding pigs and Artificial Insemination

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Pig farming is popular among rural residents, particularly among India's tribal populations. More than 40% of the nation's total pig population lives in the North-Eastern Region, which has the highest concentration of pigs. The North Eastern region has tremendous potential for pig farming to provide food security and a means of subsistence for the economically disadvantaged parts of society. Due to the quicker financial returns, pig farming is currently attracting a growing number of young entrepreneurs to start their own businesses. The fact that technically capable and skilled individuals are being attracted to this farming is encouraging for the nation. According to the 20th livestock census, there are 9.06 million pigs in the country, and their number is now declining. India's pig population is dropping as a result of the enormous disparity between supply and demand for pork, particularly in North East India. Another obstacle to increasing the population of pigs is a lack of sufficient outstanding males for breeding. Thus, accurate monitoring of immediate past performance is essential to identify problems quickly and to initiate solutions before consequences become too severe. Information on the reproductive management techniques to optimize reproductive performance are presented in this chapter.

## Boar Selection & Management

The boars have more impact than the females, hence selection may be performed on the basis of performance trait(s) of economic importance. For physical soundness traits like strong feet and legs, watch them walk, no buckling of front legs or stiffness in hind may be ensured. Boar must have good general conformation and willingness to breed (good libido) need to be selected. Boars can be initiated for training purpose by 7-8 months of age and mature boars can perform 6-10 services per week. For natural service, 1 boar for every 10 females may be maintained. For Artificial insemination a boar is sufficient for every 40-50 females.

Selecting the proper time to breed replacement gilts is an important part of reproductive management. A few precocious females may begin estrous cycles and show estrous signs by

five months but most do not reach sexual maturity until around six months of age. Since the ovulation rate increases at each subsequent estrus period, many farmers delay mating until the second or even the third cycle to increase litter size.

**Artificial insemination in Pigs**

In Western and developing countries, artificial insemination (AI) is commonly used for pig breeding. However, in India, AI has not been widely adopted due to the limited availability of semen doses nationwide. Currently, AI is primarily practiced only near certain research stations or veterinary facilities. This limitation stems from challenges in storing boar spermatozoa for extended periods, whether at low temperatures of 5°C or in frozen form at -196°C. AI holds the potential to deliver enhanced pig genetics directly to farmers and accelerate the spread of elite germplasm. However, boar spermatozoa are particularly sensitive to cold shock, which can undermine the production of high-quality frozen sperm needed for effective AI. Extended storage during liquid preservation reduces sperm fertility, with boar spermatozoa showing decreased viability, motility, and permeability over time. Currently, less than 1% of global pig inseminations utilize frozen-thawed semen, although the use of stored semen for AI has tripled in the past 15 years. Approximately 19 million inseminations are performed annually worldwide, with over 99% of the semen being extended in a liquid state and used on the same day or within seven days at 15-20°C, having minimal impact on fertility. Most inseminations occur on the day of collection or the following day.

The AI procedure involves collecting live sperm from trained boars, assessing and processing it, and then introducing it into the female (gilt/sow) reproductive system using AI catheters under hygienic conditions to produce viable offspring. Compared to cattle and buffalo, AI in pigs is relatively straightforward.

**Advantages of Artificial Insemination in Pig**

- Making the most of the genetic potential of the greatest boars with a large number of sows. In addition, reproductive performance is better in AI than that attained through natural mating and AI also facilitates genetic progress easier.
- Keeping male/boar for natural service is an expensive endeavour. Additionally, the market value of that male becomes very low after a certain age of roughly more than 3–4 years since the boar meat emits a foul scent that is not tolerated by meat consumers. These pigs end up being a burden for the farmers. By

lowering the expense of maintaining males and boars, A.I. offers a very good answer for these animals.

- It gives young people a way to work for themselves as inseminators and make money.
- Artificial insemination can produce the fastest genetic progress. Since polytocous species suffer from inbreeding depression, which affects reproduction, productivity, carcass characteristics, and feed conversion efficiency and causes economic loss, the AI technology can be used to solve this problem.
- Using a large sized boar from an exotic breed of pigs, the finishing weight and production performances of native pigs (small size) can be improved in a shorter amount of time.
- Large-scale crossbreeding is feasible for synthetic breed development programmes.
- Using superior quality boar semen, AI can be performed remotely.
- Importing semen and using that semen for artificial insemination can reduce the expense of importing live animals.
- Sexually transmitted illnesses can be avoided.
- A.I. overcomes the gender-specific size inequalities.
- As record keeping for production and pedigree sheets improves, it becomes easier to maintain the dam and sire lineages.
- For marginal and small farmers, A.I. is a very economical technique of reproduction since it avoids the expense of maintaining and feeding a breeding boar.
- It reduces management expenses when used with synchronisation techniques for inducing estrus or heat, allowing a group or number of sows to breed at a predetermined time and resulting in more synchronous farrowing.
- Under the AI programme, evaluation of sperm. enables early investigation of low fertile boars.

**Training of Boar**

Effective semen collection from boars requires rigorous training on a dummy sow. The success of an artificial insemination (AI) program heavily relies on the proper training of boars. The

success rate of training boars to mount a dummy sow is influenced by several factors, including age, breed temperament, seasonal conditions, and the trainer's expertise and patience. Age is particularly critical; training should ideally commence when the boar is between 7 to 8 months old. Most boars can be trained to mount a dummy sow within one to ten days. Boars with no prior sexual experience are generally easier to train than those that have already mated.

The height of the dummy sow must be accurately adjusted. Training requires a calm and patient approach; boars subjected to rough handling are unlikely to perform effectively. It is essential to create a positive experience for the boar, fostering an association between the collection area and the procedure. Discomfort can impede the semen collection process. The boar should be introduced to the dummy sow daily for three to four days, with stimulation through prepuce and scrotum massage. Post-training, the boar should be collected daily for one week, followed by one to two collections per week for the subsequent month. Introducing the trained boar to the dummy sow should occur promptly after collecting semen from an experienced boar. Training duration may extend to three to four weeks.

**Semen Collection and Handling**

The gloved hand method is the preferred technique for collecting boar semen. The penis should be held with warm fingers, first lightly and then firmly, focusing on the first and second ridges of the spiral section. Applying pressure to the spiral region initiates ejaculation. The little finger should be positioned close to the penis tip, allowing natural extension as the boar thrusts without pulling. Once a clear, watery ejaculate is produced, the penis should be directed into the collection container. Ejaculation will occur when the boar reaches full extension and assumes a firm, "locked-on" position. Maintaining a firm grip throughout ejaculation is critical, as relaxing the grip may interrupt the process. Ejaculation typically lasts five to ten minutes and yields 200 to 500 ml of semen.

**Storage of Semen**

Boar spermatozoa are highly sensitive to cold shock, necessitating storage at temperatures between 15 and 20°C to prevent severe jeopardization of sperm viability. Lower storage temperatures, such as 5°C or frozen at -196°C, are more effective in preserving sperm due to reduced cell metabolism and controlled microbial contamination. Antibiotics are essential for mitigating bacterial growth at these temperatures.

Semen extenders are categorized based on storage duration. Short-term extenders, effective for up to three days, and long-term extenders, which maintain viability for over four days, should be selected based on storage needs. Short-term extenders are often preferable due to their cost-effectiveness and efficiency, especially as 85% of AI procedures using extended semen occur within the first two days post-collection.

**Heat Detection**

Accurate heat detection is crucial for the success of an AI program. While daily checks may suffice in some cases, twice-daily evaluations at consistent times are recommended. The "Back Pressure Test," where pressure is applied to the sow or gilt's loin, identifies "standing heat" when the animal becomes rigid and immobile. The presence of a boar can enhance the accuracy of this test. Utilizing a vasectomized or intact boar is a vital component of an effective heat detection program. Proper timing of insemination hinges on detecting standing heat, and meticulous record-keeping of reproductive events is essential for precise heat detection.

**Signs of Heat (estrus)**

- Early heat
    - Swollen and red vulva (more typical in gilts but not consistently in sows)
    - Climb on gates and walls
    - Produce a watery discharge from the vulva
    - Emit a high -pitched whine
    - Mount other females but do not stand themselves
- Period of Heat: The sow is getting ready to stand for mating around this time.
- Signs of heat:
    - Normal vulva (swelling and reddening subsides)
    - Stands with tail upright and flicking up and down
    - Reduced appetite (less interest in feed)
    - Repeated grunts or growls for a long time.
    - Displays a standing reflex
    - Stands with arched back
    - Be attracted to stockperson
    - Stand rigid if mounted by another female
    - Respond positively to the "back pressure test" when the boar is present.

**Reddening and Swelling of the Vulva:**

Red and swollen vulva are typically more noticeable in gilts than in sows. The swelling of the vulva is possibly the most readily apparent physical symptom that an animal is entering the heat cycle. Many animals experience vulva swelling and reddening 2 to 5 days prior to breeding. Some animals show little or no swelling. Reddening and swelling of the vulva peak and begin to subside 24 to 36 hours prior to the animal reaching standing heat.

**Discharge of Sticky Mucous:**

Most sows and gilts release mucus from the vulva as standing heat approaches. The mucus starts out clear, smooth, and oily but changes to cloudy and sticky during standing heat. Put on a latex glove and use your thumb to wipe the interior of the vulva to see how thick the mucus is. Draw the thumb and pointer finger apart gradually by pressing them together. The mucus is sticky if it forms a thread between the thumb and pointer when they are pulled apart. Another indication that the animal is exuding sticky mucous is straw or bedding stuck to the vulva. An engorged clitoris and sticky mucous are physical indicators that a female is in standing heat, or that standing heat is only a few days away.

**Roaring:**

When sows and gilts achieve standing heat, they may "growl" or "roar." A sow or gilt that emits deep growls should be checked straight away for standing heat.

**Back Pressure Test for Confirmation of Standing Heat**

To confirm standing heat, it is essential to conduct the back pressure test following the observation of preliminary heat signs. This assessment should be performed twice daily, ideally after the animal has completed its feeding. Employ both hands to apply pressure to the sow or gilt’s loin, or alternatively, sit on the loin to evaluate the response. A female in standing heat will exhibit rigidity and immobility, often "pushing back" by slightly arching her back when pressure is applied. This reflex action is a physiological response to brace herself for the weight of the boar. Exposure to a mature boar in a nearby pen enhances the response to loin pressure, while constant exposure may diminish the reaction. The classical sign of standing heat is "ear popping," where the female's ears are held upright upon application of pressure to her loin. Breeds with floppy ears, such as the Duroc, may only partially lift or twitch their ears, yet if the ears are popping, the animal is in standing heat.

**Female Reproductive System and Artificial Insemination (AI)**

Artificial insemination (AI) is relatively straightforward in pigs due to their reproductive anatomy. The vulva, which becomes red and swollen during estrus, leads to the vagina and cervix. The cervix, with its numerous ridges, acts as a barrier to prevent the entry of bacteria and foreign objects into the uterus. During estrus, the cervix swells, facilitating the insertion of the AI spirette or catheter. AI spirettes, equipped with spiral-shaped plastic tips, and catheters with foam tips are utilized to initiate uterine contractions and minimize semen backflow, essential for the sperm's journey through the uterus to the oviduct, where fertilization occurs. Oocytes are released from the ovaries during ovulation and travel to the oviduct for fertilization.

**Timing of Artificial Insemination**

The timing of insemination is critical for optimizing fertilization rates and overall, AI success. Spermatozoa must undergo capacitation within the female reproductive tract to bind and penetrate the oocyte. Spermatozoa seek out eggs between 30 minutes and 8 hours post-deposition. If no oocytes are present, sperm adhere to the oviduct surface, awaiting ovulation and hormonal signals for release. The fertilization window post-ovulation is approximately 8 to 12 hours.

Spermatozoa from natural copulation remain viable in the oviducts for up to 24 hours, whereas frozen-thawed spermatozoa have a viable life of only 8 to 10 hours. Oocytes are viable for less than 6 hours. To maximize conception rates, inseminations using fresh or refrigerated semen should occur around 12 hours before ovulation. Insemination occurring too early (24 hours before ovulation) or too late (post-ovulation) may result in reduced litter sizes and lower farrowing rates, even if fertilization occurs.

Typically, gilts should be inseminated 12 hours after detecting standing heat and again 12 hours later. Sows should be bred 24 hours after heat detection, with a second insemination 12 hours afterward. While these regimens generally apply, adjustments may be necessary for animals with unusually short or prolonged heat periods.

**Method of Artificial Insemination in Pigs**

The AI process involves preparing a semen dosage by combining 20 ml of semen with 60 ml of extender. The resulting 80 ml pack, containing 2 to 3 billion spermatozoa, is introduced into

the deep cervix of the estrus sow or gilt using an insemination catheter. The catheter tip is lubricated with a non-spermicidal gel and inserted into the vulvar lips, following cleaning with an antiseptic. The catheter is advanced until resistance is encountered, then turned counterclockwise. Semen is allowed to flow naturally into the genital tract, which may require a light squeeze to initiate. Once semen flow begins, uterine contractions should facilitate the process, typically requiring at least 3 minutes. Gilts may take longer than sows due to variability in uterine contractions.

Excessive semen spillage indicates improper deposit technique. Significant backflow suggests either rapid semen deposition or inadequate catheter placement. Adjusting the spirette by a quarter turn or moving it slightly may remedy flow interruptions. If a vacuum causes flow cessation, cut a small hole in the semen bottle. Significant resistance during semen flow suggests the catheter tip may be pressed against a cervical fold, requiring repositioning. To prevent disease transmission, use a new spirette or catheter for each insemination. Maintain the sow or gilt in a calm environment for 20 to 30 minutes to minimize stress that may hinder fertilization. The catheter is removed by rotating it clockwise and withdrawing it from the genital tract post-semen deposition

Procedure of Artificial Insemination (A.I.)

Step1:

- Identify the female pig in standing heat.
- Use a gentle paper towel to wipe off the vulva.
- Apply a little amount of sterile, water-soluble, non-bactericidal lubricant to the catheter tip.
- While positioned on the left side of the estrus female, widen her vulval lips with your left hand before inserting the catheter around three to four inches.
- Shift your position such that you are behind the female.
- Hold the catheter with the tip pointed upwards at a 20 to 30 degree angle. Push the tip a little bit forward and backwards until it is about 4 to 6 inches forward. (It will prevent entering the urethral [bladder] opening)

Step 2:

- Place the catheter in a more horizontal position and advance it slowly until resistance is felt. That should be enough to show that the tip is at the cervical opening.

- As the catheter is inserted into the cervix, turn it slowly counter clockwise. Get a firm lock; which is indicated when the catheter feels tight and will spring back about a quarter turn. Don't push it too hard.

Step 3:

- Attach the bottle or tube to the catheter's shaft and hold it upright. By gently pressing the bottle or tube, start the flow of semen. Semen flow may be improved by the catheter being moved gently and alternately.
- Apply pressure on the female's back and rub her flank and underline. Be patient; some females will "take" the semen with little to no pressure being given to the bottle or tube, whereas others may need to apply alternate pressure. Give each female a minimum of 3 minutes. Some take longer than others. NEVER RUSH.
- When finished, remove the catheter by gently rotating it in a clockwise direction. Dispose of the catheter and the semen bottle properly. DO NOT REUSE. Record and rate the mating.

**Post Artificial Insemination Measures**

A successful AI programme requires meticulous record keeping. Record the boar that was used, the dates and times of the inseminations, the 21-day check-back date, and the due date. Note down information that can help you make improvements, if necessary, on subsequent inseminations

**Post Insemination Advice to Farmers:**

- Request that the animal is under observation for the ensuing 12–24 hours.
- Call for a repeat AI if the signs of heat continue even after 18–24 hours; otherwise, check for heat symptoms after 18–21 days and also after 36–42 days.
- After two to three months from the date of insemination, contact an AI technician for a pregnancy diagnosis if the animal does not repeat heat at intervals of 18 to 21 days for two consecutive times.
- If necessary. keep the animal's body cool by keeping it in the shed and sprinkling it with water.
- After three consecutive AIs, if an animal still isn't pregnant, the farmer should be advised to get the animal examined by a veterinarian and follow his advice.

**Post insemination follow-up**:

- After about 21 days, check on each and every animal that was inseminated to see if it was repeated.
- Follow up on every inseminated animal for a pregnancy diagnosis after two to three months, note the date and result in the format provided, and send it to the area office every month.
- Check the results of the pregnancy diagnosis against the date of insemination, and if necessary, ask the farmer about the post-insemination events to learn whether the animal remained in heat for a long time or came into heat again. If so, how many days later? And whether the farmer scheduled a natural service for the same or a subsequent heat or used AI services from another service provider.
- Keep track of every pregnant animal and record the details of the animals that were artificially inseminated in the format given.
- Keep track of all documentation relating to artificial insemination, pregnancy detection, farrowing, and financial transactions.
- Give advice to farmers on how to properly detect heat, feed their animals and health care as recommended by specialists. Also, advise them on the care and management of animals during advance pregnancy and after farrowing, including care and management of new born piglets.

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# *Chapter 5*

## Shelter, care and management of pigs

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In India, small pig farms raise pigs traditionally. Growing meat demand pushes for more intensive methods of management. This requires good shelter for pig comfort and easier management. Proper housing is key to successful pig rearing and simplifies farm activities. Pigs need fresh air, weather protection, room to move, and predator protection. Better shelters can address these needs while considering ambient environmental needs and biosecurity. Smart shelter design can even improve farm processes.

### *Location to begin a pig farm*

Selecting a pig shed location involves:

- Elevated terrain for easy drainage and flood prevention.
- Natural shade and good air circulation for pig comfort.
- Distance from residences to minimize odor and noise.
- Road access.
- Clean water and electricity.
- A designated area for manure disposal.

### *Minimum requirements:*

New farmers can keep costs down by using readily available local materials. The design should consider your climate and chosen pig production system. Here are the key elements for a comfortable pig environment:

- Adequate Ventilation and Shelter: Ensuring proper airflow within the shelter is crucial to prevent heat accumulation, unpleasant odors, and moisture. Providing ample shade, particularly on the eastern and western sides, shields the pigs from direct sunlight.
- Climate Adaptation: Designing a rainproof roof that also offers continuous shade is vital. Orienting the shelter in an east-west direction aids in minimizing direct exposure to the sun.

- **Separate Pens:** Recognizing the diverse needs of pigs at various ages and stages of production, consider constructing separate pens to optimize their welfare and management.
- Cost-Effective Construction: Strive to keep construction costs aligned with your chosen production system to ensure affordability without compromising functionality.

***Space requirement***

| Type of animal | Cover area/animal ($m^2$) | Dimention (m X m) | Open area/animal ($m^2$) |
|---|---|---|---|
| Boar | 6.25 to 7.50 | 2.5 x 2.5 to 2.5 x 3.0 | 8.8 to 12.0 |
| Farrowing sow | 7.50 to 9.00 | 2.5 x 3.0 to 3.0 x 3.0 | 8.8 to 12.0 |
| Weaner /fattening pig | 0.96 to 1.80 | 0.8 x 1.2 to I.2 x 1.5 | 8.8 to 12.0 |
| Dry sow or gilt | 1.80 to 2.70 | 1.2 x 1.5 to 1.8 x 1.5 | 1.4 to 1.8 |

Animals should be housed in pens based on their physiological stage, age, and gender, either individually or in groups. The dimensions of the pens can be adjusted according to the number of animals. Boars and farrowing sows are typically kept in individual pens.

***Feeding and watering trough***

Inside the pig shed, troughs are essential for providing easy access to feed and water. To prevent fighting over feeding space, troughs should be wide enough for all pigs to eat comfortably. A minimum width of 50 cm is generally recommended.

| Type of animal | Length in cm |
|---|---|
| Boar | 60 to 75 |
| Farrowing sow | 75 to 100 |
| Weaner /fattening pig | 30 to 40 |
| Dry sow or gilt | 20 to 30 |

***Different Pens:***

In commercial farming, animals are typically housed based on their various age and physiological stages, facilitating simpler management practices. In large-scale operations,

separate sheds are often favoured, whereas in smaller-scale production, distinct pens within the same shelter are arranged. Common types of pens include:

- Boar pen,
- Dry sow and gilt pen,
- Farrowing pen,
- Fattening pen, and
- Sick pen.

**Boar Pen:**

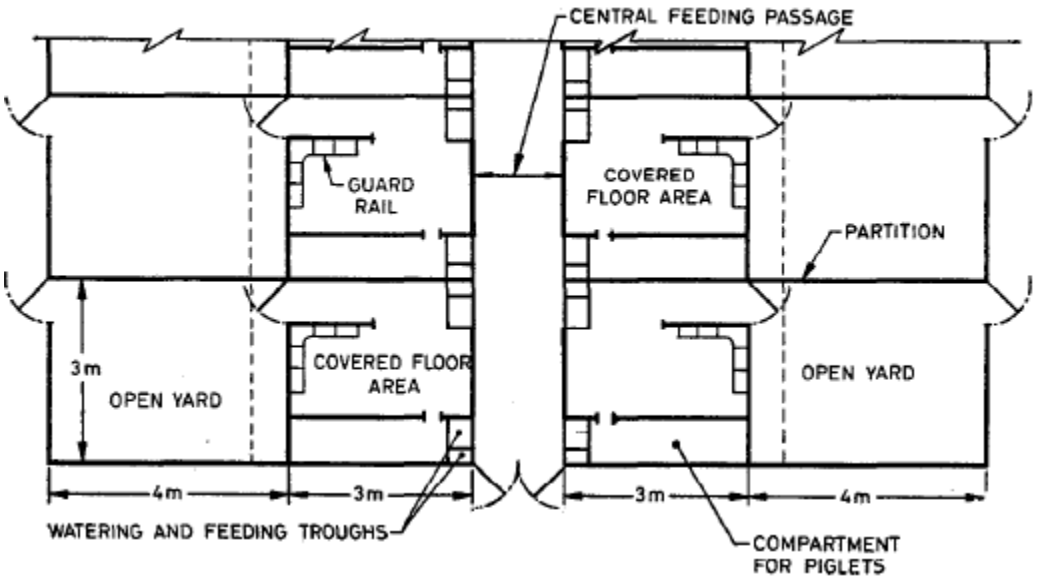
In a boar sty, it's crucial to house boars in **individual pens**. Provide 6-8 square meters of space per pen. Use strong sidewalls and tall, sturdy partitions to prevent escapes and boar contact with females in heat. Generally recommended to construct a maximum 24 pens in a single boar stay.

**Dry Sow and Gilt Pen:**

Sows typically return to heat 5-7 days after weaning of her piglets and every 3 weeks until bred. Weaning to conception generally takes between 8-20 days. During this period, house dry sows and gilts individually or in groups, close to the boar area. A dry sow/gilt shed can house up to 40 pens in two rows. Each animal needs 1.5-2.0 square meters of space.

**Farrowing or Nursing Sow Pen:**

In intensive pig farming, a combined farrowing, suckling, and rearing pen is commonly utilized. Typically, the pregnant sow is transferred to the farrowing pen approximately one week before farrowing and remains there with her litter for 5 to 8 weeks until the piglets are weaned. Each farrowing animal is housed individually in a pen from seven days before farrowing until weaning. These pens are equipped with heating and cooling systems, piglet nests/boxes, and creep feed/starter feed for piglets to ensure the proper care and management of newborns. Each individual pen should measure between 4 to 6 square meters. Along the walls, an area for piglets should be designated, with each compartment measuring 2.5 x 0.75 x 1.2 meters. An opening of 300 x 225 mm should be provided in each compartment facing the nursing sow. Additionally, watering and feeding troughs should be available in each compartment. Guard rails can be installed 25 cm above the floor level to protect piglets from being crushed by the sow.




**Farrowing Sty**

**Fattening Pen:**

Each fattening sty typically accommodates no more than 20 pens under a single roof, with each pen containing 16 to 32 animals intended for fattening. The area allocated to each pen should range from 0.5 to 1.0 square meters per pig.

**Replacement Pens:**

In intensive production systems, sows are typically culled after completing 3-4 farrowing. To replenish the breeding stock, new sow gilts need to be raised separately for better management. Therefore, it is advisable to have a separate shed and pen dedicated to this purpose. Young breeding stock, known as the next-generation sow, are separated at 4 months of age, while the remaining pigs are sent for fattening. Replacement stocks are fed at a less intensive rate compared to fattening pigs, hence separation is required. Gilts are first bred when they reach 7 to 9 months of age or weigh between 105 to 120 kg. After mating, they can either remain in the same pen until one week before farrowing or be housed in the gestating sow accommodation, albeit in a separate group.

**Weaner Piglet Pens:**

After being separated from their mother in the farrowing shed, weaned piglets are transferred to the weaner piglet sty. Typically, a maximum of 30 pens are constructed under a

single roof for this purpose. Each pen can accommodate 10-20 animals up to 6 months of age from the time of weaning. Providing approximately 0.3 – 0.5 square meters of area per piglet is recommended for their comfort and well-being.

**Sty for Sick Animals:**

The sick animal shed is commonly constructed at a reasonable distance from another shed for proper segregation. The sick animal shed should have the capacity to accommodate 5% of the total stock of the farm.

***Construction details***

**Flooring -** A sturdy, water-resistant, and moisture-free surface is essential for optimal pig housing. It should also facilitate easy cleaning. Therefore, consider materials like cement concrete, cement concrete flooring tiles, stone slabs, or bricks set in cement mortar or lime mortar. Where necessary, insulation can be incorporated into the flooring. For stone slabs or brick flooring, ensure that joints are properly filled with binding material. A slightly rough surface is preferable to reduce the risk of leg injuries from slipping. The floor should be sloped towards drains for efficient drainage. Construction details may vary depending on climatic conditions and should be determined based on recommendations from local housing experts. Typically, 80 to 100 mm of concrete on a well-compacted gravel base is sufficient for a durable floor.

**Wall -** The ideal height for the shed or wall should range between 3 to 35 meters from the floor level, ensuring ample space for ventilation. It's crucial that the wall design does not impede the free movement of air within the shed. For sidewalls of the pen, a height of 5-7 feet is recommended, with the lower at least 3 feet constructed from brick and concrete, and the upper 3-4 foot made from wood or GI railing pipe. Regardless of the materials used, the wall surface should be smooth to prevent injuries. A sturdy wall is preferred to withstand the pressure exerted by pigs, as they tend to lean against the walls.

**Roof -** The roof should be waterproof and provide some insulation to minimize heat transfer. Roofing options include RCC (Reinforced Cement Concrete) or gable type roofs. Lintel roof is also effective but it can be expensive. Alternatively, a gable roof can be constructed using materials such as asbestos cement sheets, corrugated galvanized sheets, or clay tiles. Thatching

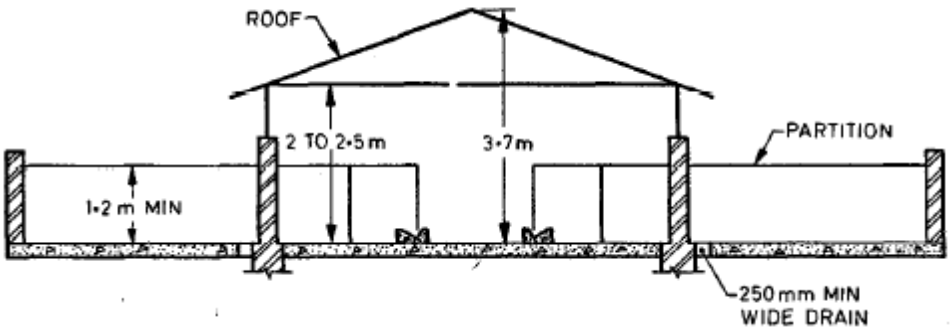
or locally available materials are also viable options. In regions with harsh climatic conditions, it is advisable to consider thatching or covering the ceiling with gunny bags to mitigate extreme heat buildup inside the shed.

**Doors -** The number of doors in each sty depends upon the dimensions of the shed. Anyway, the doors must be strong and fitted close to the floor level. The door frame preferably to be made up of angle irons. In an individual pen the door maybe 0.75 to 1 m. The doors of the shed may be of 1.2 to 1.5 m with a height of 1.2 to 2 m. Doors have to be tight-fitting and any other openings in the lower part of the wall surrounding the building should be avoided to exclude rats. Apart from stealing feed and spreading disease, large rats can kill piglets.
Windows - If required, individual windows can be installed to facilitate ventilation and natural sunlight.

**Drainage -** To ensure effective drainage and ease of cleaning, each shed should be equipped with at least one drain positioned on one side. The drain should have a minimum width of 250 mm and a slope of 25 mm every 10 meters to facilitate proper drainage.

**Feeding Trough -** Concrete feed troughs with partition walls help prevent feed wastage. A trough space of 2.5 feet in length is adequate for each pig to feed without overcrowding or fighting. Alternatively, galvanized iron sheet feeding troughs can also be utilized.

**Water trough** - Water used for cleaning and drinking. The water trough can be made up of concrete or galvanized sheet; even the feeding trough can be used for watering. However, portable water should be available throughout the day.



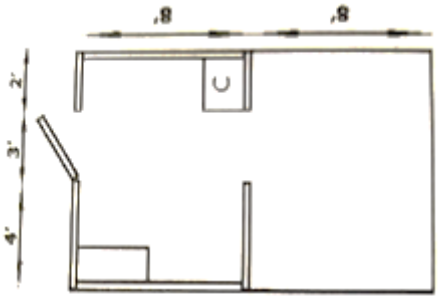

*Source: Text book on Scientific practises and Techniques for economic pig production*

**Housing Design for Breeder Farms**

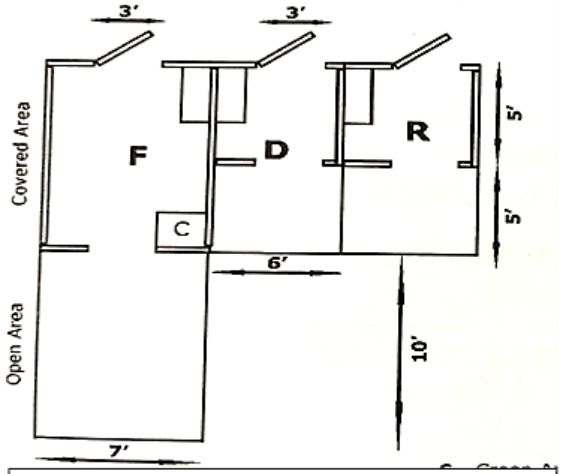
In small-scale production systems, where farmers have limited resources and space, they often begin their pig farming enterprise with just one or two pigs. These farmers typically rear a small number of pigs for either fattening or breeding purposes. Breeder farmers primarily keep adult sows for breeding and sell the piglets after weaning, usually at a price ranging from ₹3000 to ₹3500 per piglet. Given the simplicity of this management system, housing requirements for breeder farms are minimal.

**One Sow Unit:**

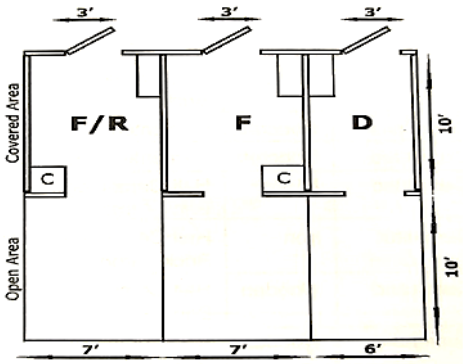
A small-scale farmer can effectively manage one sow for breeding purposes with a covered area of 70-100 square feet, accompanied by an equivalent open space for housing. Constructing a separate structure for replacement stock is not advisable due to increased expenses. Instead, farmers can raise replacement stock in a temporary structure, considering that replacement stock needs to be raised only once every two years.




C: Creep area
**Ground plan for one sow unit breeder farm**




C: Creep area; F; farrowing pen; D: dry sow pen; R; replacement pen
**Ground plan for one sow unit breeder farm**




C: Creep area; F; farrowing pen; D: dry sow pen; R; replacement pen
Ground plan for three sow unit breeder farm

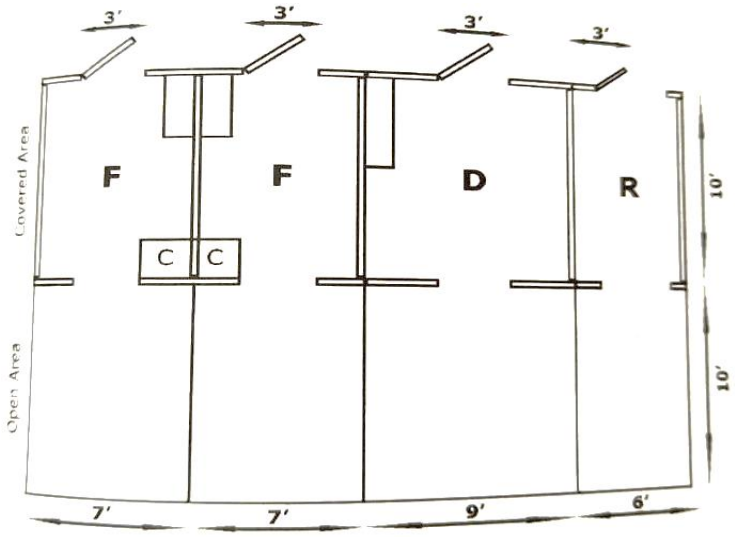
*Source: Text book on Scientific practises and Techniques for economic pig production*

**Two Sow Unit:**

For farmers intending to keep two sow units, they will require one farrowing pen sized at 70 square feet and one dry sow pen sized at 30 square feet. Additionally, it's recommended to have an additional pen of 30 square feet size for raising replacement stock in this scenario.

**Three sow unit**

In a three-sow unit management system, effective pen management is crucial to minimize investment in shed construction. If a farmer intends to keep three sow units, it's advisable to plan breeding in such a way that all sows do not farrow simultaneously. Instead, they should farrow alternately in a rotational manner. This means that when one sow is about to farrow, another should be pregnant, while the third is in a non-pregnant condition.

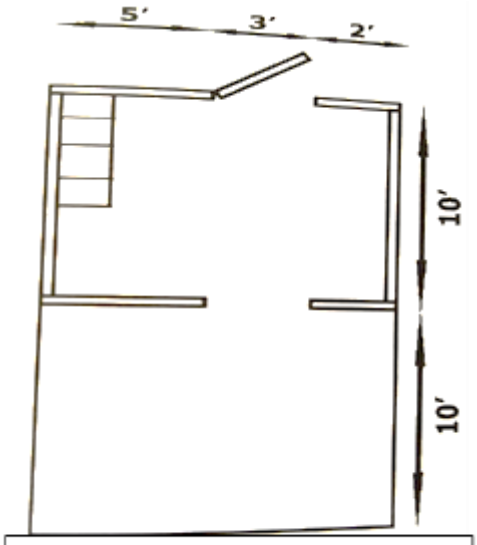



C: Creep area; F; farrowing pen; D: dry sow pen; R; replacement pen

**Ground plan for four to five sow unit breeder farm**

Considering that the farrowing pen remains occupied for approximately 70 days during each farrowing, one farrowing pen can suffice for three sow units if farrowing is planned meticulously. However, there may be instances where it's challenging to coordinate farrowing schedules, resulting in two animals farrowing simultaneously or overlapping farrowing periods. In such cases, it's advisable to have additional space available where the sow and her litter can stay comfortably. This same space can also be utilized for raising replacement stock when no overlapping occurs.

Similarly, five and more sow units can be constructed. Four to five sow breeding units require two farrowing pens, one dry sow pen of 90 sq ft area; where all the dry sows can be kept together and another replacement stock area of 60 sq ft




Ground plan for fattener farm

**Housing Design for Fattener Farm**

Small and marginal farmers typically rear one or two pigs for fattening purposes. They commonly purchase weaned piglets and raise them until they reach 7-8 months of age, selling them at market weight for around ₹110 per kilogram of live weight. Housing requirements for this type of farming are straightforward.

For housing two pigs, a single shed measuring 40 square feet (8 feet by 5 feet) is sufficient. However, if the farmer intends to expand the unit to accommodate 4-5 pigs, a shed with an area of 100 square feet is recommended. This larger shed can comfortably accommodate up to 20% extra capacity, allowing for the housing of up to 6 pigs in case of emergencies. It is advisable to keep castrated animals together for better management.

**Care and Management of breeding gilts and sows**

Similar to boars, the nutritional supply to the breeding female stock should be adequately taken care of. Excess energy intake of selected gilts should be restricted to prevent overweight conditions.

Gilts may be housed in groups. Moving gilts to new pens, increased exercise, and daily exposure to boars beginning from 160 - 180 days of age will help to stimulate the onset of

estrus. Breeding should be delayed until the second or third estrus to increase the probability of large litters and prevent dystocia. The gilts that do not conceive after mating at two successive estrous periods may be medically examined or marketed. Likewise, gilts that have not expressed heat by 9-10 months of age should not be kept in breeding stock.

The week before insemination in case of gilts, and the 4-5 days period between weaning of piglets from previous farrowing and insemination in case of sows, are critical. Bio-stimulation and flushing are two concepts of relevance for a farm manager, during this period.

1. ***Bio stimulation***: Repeated studies have shown that daily physical contact with a mature boar (the 'boar effect') is an effective method of stimulating reproductive efficiency and onset of estrous in females. To utilize this bio-stimulation there should be intensive boar contact using a teaser boar, twice daily.
2. ***Flushing***: Flushing is a practice of giving extra feed to sows and gilts from 1-2 weeks prior to mating and returns to normal feeding after mating. Providing an extra 1Kg feed per day has been shown to increase litter size.

Routine heat detection, preferably two times a day, should be carried out. A teaser boar may be brought to the pen where females are kept for heat detection. Apart from the estrus behaviour activities and signs of heat, riding test / back pressure test may be performed where a female remains immobile on applying a pressure on the rump area (even when an attendant sits on its back). Riding test is confirmatory for a female in heat.

Pen mating, hand mating and artificial insemination are the different mating systems usually practiced in organized pig farms. Hand mating, where the female in heat is brought to the pen of desired boar, is practiced in majority of organized farms in India. The breeding arena on kuccha floors may be used for heavy animals to avoid hoof injury during mating.

Breeding in batches is the most effective breeding strategy in an organized farm, where all the breedable female stock are inseminated during the selected months. Breeding in the selected season and batch farrowing optimize the labour management, improve piglet crop, facilitate better health care and address many biosecurity concerns. The management of weaners, growers, and finishers in batches facilitate better resource utilization.

**Care and management of pregnant sow**

The care and management of gilt or sow during their pregnancy is important because production of more piglets will ultimately influence the farm economics. The inseminated gilt/ sow which do not show sign of estrus within 21 days after service is consider as pregnant. Other behavioural changes and physical changes like increase in body weight and size are also important.

Adhering to the following points is important in pregnant animal care

- Record the date of mating and find the farrowing date. This will help to monitor the feed intake during pregnancy and facilitate animal movement to the farrowing sheds in time.
- Provide a separate sty for each sow. Mixing pregnant gills/sow with others is not recommended. Stress, kicking, abusing, pushing etc., should be avoided and train staff to treat them kindly. Don't make the animal to walk a long distance which may cause fatigue.
- Floor should be kept clean, dry and non-slippery. Provision of bedding of 8-10 cm chopped straw under covered area is preferred especially as farrowing approaches.
- Deworm 2 weeks before farrowing with piperazine 1 gm/kg of body weight.
- **Steaming up** which is also called "**bump-feeding**", aims at providing 1-1.5 kg of extra feed for 2-3 weeks before farrowing to increase birth weight. This is beneficial for thin sows and gilts from Day 100 of gestation to farrowing, but feed allowance for fatty sows should not be increased.

**Care and management of farrowing sow**

The sow may be transferred to farrowing pen at least 8-10 days before the expected date of farrowing to accustom her in the new environment. The sow should be cleaned and washed properly just before transferring to farrowing pen. The farrowing pen should have non-slippery floor and provided with guard rails to protect the piglets. Thorough cleaning and disinfection of farrowing pen should be done one day before the transfer to ensure dry surface when the animal is brought in. Batch farrowing is always recommended where all-in-all-out strategy is adopted. Batch farrowing facilitates better newborn care round the clock and hence ensure better piglet crop.

The following points should be noted around the farrowing.

- The sow should be provided bulky ration and it should be reduced to 1/3 on the days before farrowing and withdraw 12 hours before farrowing.
- Every farrowing, irrespective of the time of farrowing, should be attended by trained attendants. This is more important during night when the ambient temperatures are low.
- Some gilts and sows may attempt savaging the piglets when they approach the dam for suckling. This is attributed to pain experience during the farrowing. Attendants should be trained to massage the udder to facilitate milk letdown and reduce the pain.
- Don't wash the animal on the Day1. If necessary clean hind portion of sow with Luke warm water. Cleaning with normal water should be avoided at any cost as washing the farrowing pen may also make the animal and piglets wet. The piglets have limited mechanisms to maintain homeothermy, hence splashing of water can lead to mortality.
- Sow should be provided free access to clean and fresh water for drinking. Provide adequate balance nutritional ration to the lactating sow for sufficient milk production for piglets
- Prevent sow from eating placenta and dispose off safely.
- Load noise and dog barks which irritate the sow may hinder the farrowing process. Calm and silent area is preferred for farrowing.

**Care and management of piglets**

1. **Cleaning the nostrils**: Attendants should check the patency of breathing passage of piglets. Remove the mucus from nostrils using a piece of cloth. In case of difficulty in breathing, swing the piglets at arm's length to initiate breathing. Each piglet should be rubbed carefully, dry with a cloth.

2. **Cutting the navel cord:** A few minutes after the birth the umbilical cord may be pulled gently away or cut if necessary. Navel cord may be cut with sterilized scissors leaving 3 cm from the body. Afterwards, the navel should be soaked in a cup of iodine solution to prevent inflammation.

3. **Colostrum feeding** within the initial 30 minutes after farrowing is very important. Colostrum is rich in immunoglobulin which protect the piglet from diseases. Make sure the piglets are able to suck from the udder as soon as possible after birth. Check the udder for agalactia (lack of milk), mastitis (inflammation of udder) and number of functional teats to assess the nourishing capacity of sow.

4. **Nursing Management**: The nursing behavior should be closely monitored. Smaller piglets have lesser opportunity to get sow's milk, hence it should either be cross fostered or provided with artificial milk. The same principle should be followed for the orphan piglets.

   Cross fostering can be done with another sow, which farrowed up to three days before, with more milk production and lesser number of piglets than its teat number. This is because the teats which are not being used by piglets dry off after three days. Piglets normally take control of one teat at birth and continue to feed from it until they are weaned. Transfer extra piglets to the sow with fewer

piglets after disguising them with a spray which has a strong smell e.g. engine oil diluted with water will have a smell for at least 1 or 2 days. All piglets in that litter should be sprayed when introduction of orphan piglet is done, so that the foster mother cannot differentiate them.

If there is no sow to take over feeding the piglets, then goat/cow milk or mashed bean porridge to which a little sugar has been added are alternative options. The milk should not be diluted, as sow's milk is very concentrated. The pan containing milk may be lowered into a larger pan containing boiling water to warm the milk to body temperature (37° - 40°C).

5. **Transferring piglets to creep area**: Creep area in a farrowing shed should be made to provide a micro-environment of light and heat to keep neonates comfortable. Arrangement to provide temperature of 25°C to 34°C, is required in creep area to protect piglets from chilly weather. The newborn pig has a "lower critical temperature" of about 30°C-34°C. When the environmental temperature falls below 34°C, the neonates experience cold stress. An infrared lamp or even an incandescent lamb can be utilized. The area will also protect the piglets from crushing and can be utilized to provide creep food. In case of nervous/irritable dam, piglets should be transferred to creep area to protect them from savaging dam.

6. **Iron Injections**: Sow's milk is deficient in Iron, which can provide only 1-2 mg/day through milk while they need 7mg during the first week. The quantity of iron decreases in blood rapidly causing anaemia, if not supplemented and their growth slows down. This is an important problem, especially for young piglets kept indoors.

For preventing piglet anaemia, Iron sorbitol 50 mg along with Folic acid, Hydroxycobalamin injections are given in the neck on 4$^{th}$ and 14$^{th}$ day of age, under veterinary supervision.

7. **Castration of pigs**: Castration is essential to eliminate undesirable males from the population, prevent indiscriminate breeding, make animal

more docile, develop pork of superior quality and most importantly to prevent boar odour in cooked meat. It should be done at an age of 3-4 weeks, under veterinary supervision. Open method of castration is used for removing testes of the piglets. Scrotum and surrounding must be applied with disinfectant after castration. Application of fly repellent is advised.

8. **Weaning Management**: Weaning is the process of separating piglet from its mother. The age of weaning is an integral part of the breeding programme and a reduction in weaning age bring the dam in heat early, thus help in achieving more piglet production. Moreover, the sow's milk production starts falling dramatically by 5 weeks after farrowing. Sow's milk is inadequate to maintain piglet growth rates beyond this point, so early weaning is beneficial. On the contrary, weaning is a stressful experience for young piglets, affecting them both socially and physiologically. High standards of management can dramatically reduce post-weaning losses and improve growth rates by moderating the stress of weaning. So the weaning practice depend on the management practice adopted at each farm. Pre-weaning complications can be reduced by offering creep ration.

**Points to be noted during weaning**

- Changes in the stomach occur within 6 hours of weaning. The pH of the gut contents rises, making it more favourable for rapid growth of some organisms, especially the *E. coli* bacteria. Overeating, especially the first few days destabilize the intestinal flora. So a good feeding practice is to continue to feed the same high quality creep diet for 10-14 days after weaning. Feed little and often. Feed at least twice daily and match the feed consumed with a gradual increase in feed offered. A target should be 150 g/day in the first week, rising to around 250-300 g/day in the second week. The use of flavourings or sweeteners could be considered if the consumption of high-quality diets is still low.
- Provide clean water. Upgrading the water quality in the farrowing and weaner areas has resulted in dramatic improvements in young pig performance.
- Weaners are highly susceptible to any disease challenge. Therefore, highest level of hygiene should be maintained. The 'all-in, all-out' system is ideal

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# *Chapter 6*

## Health care and biosecurity measures in Pig Farm

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**Bacterial diseases of pig**

**Colibacillosis**

**Clinical signs of the disease**

- Most common during the first two weeks of life.
- Diarrhoea occurs even within the first 2-3 hours
- Affects individual piglets or whole litters
- Faeces may be clear white/brown
- Dehydration in severe cases

**Treatment**

- Should be treated with an oral antibiotic preparation
- Dehydration can be treated with ORS.
- Probiotics can also be used to check diarrhoea in piglets.

**Prevention and Control**

**The following measures can be adopted:**

- Managing suckling and fostering in order to ensure that all piglets consume colostrum.
- Reduction in feed intake of sows and weaned piglets through supplementation of high protein and fibre diets.
- **Keeping** sufficient levels of clean and dry straw in farrowing pen.
- Proper disinfection of farrowing pen
- Bedding should be either removed or burned properly

**Salmonellosis**

**Clinical signs**

- Generally occurs between weaning and 3 or 4 months of age.
- Affected pigs often bury themselves in straw and show cyanosis of the ears, limbs and centre of the back.
- High rise of temperature and pigs may die within 24-48 hours.

- In acute enteric form in younger pigs, animals pass thin watery yellowish diarrhoea.
- Pneumonia, weakness and nervous signs such as paralysis and tremor may occur.
- In severely affected cases, skin discolouration is present.

**Treatment and control**

- Affected animals should be treated with antibiotics.
- Antibiotics such as amikacin and gentamicin are found to be effective against *Salmonella* infection in pigs.
- Adoption of strict hygienic measures in the farm, provision of clean water, rodent and fly control and netting against birds will help in preventing the introduction of salmonellosis to a farm.
- Control on infected farms will require medication when disease is expected and should be accompanied by disinfection.

**Pasteurellosis**

**Clinical signs**

- The main clinical signs of the disease are coughing, dyspnoea, fever and extreme weakness.
- Chronic cases have less fever, a persistent cough and a more marked dyspnoea.
- When pneumonia develops there is abdominal breathing.

**Treatment and Control**

- Antimicrobials such as long acting oxytetracycline, chlortetracycline, ceftriaxone and ciprofloxacin are found to be effective against pasteurellosis in swine.
- Newly purchased animals should be quarantined for at least a few weeks before introduction to the existing herd.
- Mixing and sorting of pigs should be minimized.
- Avoiding stresses to the animals along with control of other endemic respiratory tract pathogens.

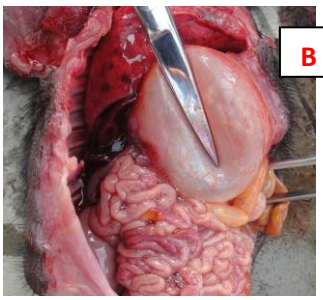
**Clostridial infection**

*Clostridium perfringens* types A and C cause diarrhoea, dysentery and death in pigs.

**Clinical signs**

- Affected piglets are normal at birth, sick on the first or second day of life and usually die within 12-24 hours of the onset of clinical signs.
- Profuse diarrhoea rapidly becomes claret-coloured.
- The hindquarters may be soiled with bloody faeces.

- Affected piglets become weak, collapse and die. Some may be found dead.
- In more chronic cases, shreds of necrotic (dead) material may appear in the reddish-brown watery faeces.


**Sudden death in piglets (A) due to Clostridium perfringens infection, (B): massive Haemorrhages in the intestine of affected piglets**

**Treatment and control**

- Affected piglets usually die. Oral ampicillin can be used to treat the survivors of an affected litter.
- Ampicillin given orally to piglets soon after birth will result in the prevention of occurrence of the disease. This measure along with improved hygiene may stop an outbreak.

**Swine mycoplasmoses**

This disease causes huge economic losses in pig production because of poor growth and poor feed conversion efficiency.

**Clinical signs**

- Mortality is low but several animals may be affected.
- Non-productive coughing is the most obvious clinical sign.
- Coughing is observed over a few weeks or months, but is not constant
- Affected animals find difficulty in breathing and there is fever

**Treatment and control**

- The most useful antibiotics to treat mycoplasma infection are the tetracyclines, the macrolides and some fluoroquinolones.
- Although antimicrobials are capable of controlling the infection, complete elimination of the organism from the respiratory tract cannot be achieved by medication.
- Effective control depends on an optimal environment (air quality, ventilation, temperature, etc.). Methods including the periodic examination of lungs from slaughter, clinical inspections and serological diagnosis, etc. are necessary.

**Swine erysipelas**

**Clinical signs**

- Sudden death or collapse with high temperature and a scarlet flush on the skin.
- Diamond skin lesions occur within 48 hours of the onset of clinical signs and can be felt as raised patches along the back or neck but rapidly become purplish-red.
- In chronic cases, there is arthritis and animals show lameness.

**Prevention and control**

- Acute outbreaks of swine erysipelas usually can be controlled by administering penicillin to affected pigs along with antimicrobials added to the drinking water until no sick pigs have been observed for at least three days.
- A combination of good sanitation, the elimination of carriers with skin and joint lesions, and appropriate quarantine measures for purchased stock will help in the control of swine erysipelas.

**Leptospirosis**

**Clinical sings**

- Loss of appetite
- Fever
- Depression
- Abortions during late pregnancy
- Stillbirths
- Increase in number of mummified piglets
- Increase of weak, nonviable piglets
- Increase in number of premature piglets

**Prevention and control**

- Antibiotics such as tetracycline or oxytetracycline can be used.
- Provide well drained concrete surfaces particularly in defecating areas and boar pens.
- Keep rodents under control
- Remove slurry regularly
- Where there is a history of periodic infertility, in-feed medication can be targeted just prior to the expected time of disease.

**Greasy pig disease**

**Clinical signs**

- This is particularly a disease of young piglets

- Characterized by excessive sebaceous secretion and the formation of a brownish coat of exudates over the body.
- Up to 90% animals can be affected in an infected herd.
- There is absence of itching in this disease unlike mange.

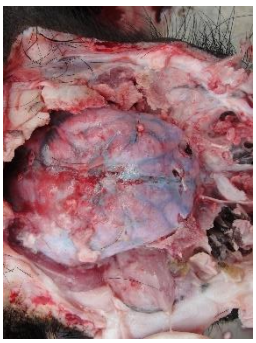
**Treatment and control**

- The disease can be effectively treated with antimicrobials.
- Antimicrobials such as ampicillin, penicillin, oxytetracycline, gentamicin, enrofloxacin, norfloxacin and ciprofloxacin were found to be effective against greasy pig disease.
- Prevention is possible only through adoption of strict hygienic measures such as regular disinfection and cleaning of pig shed.

***Streptococcus suis* infection**

**Clinical signs**

- There may be presence of wide range of clinical signs such as meningitis, arthritis, septicaemia including signs of pneumonia.
- In young piglets and disease has been observed most commonly during the first week of their life.
- The first sign noticed in young piglet is the swelling of the joints (both hock and knee joints are involved) and later on septicaemia and meningitis (when CNS is involved) develops. If treatment is not initiated in the early stage of the disease, treatment in later stage (when meningitis develops) is not fruitful.
- When nervous system is involved, signs like ataxia, incoordination and circling movement are observed.
- There is accumulation of excessive fluid in thoracic cavity (visible on post mortem)



A

B

C

**Congestion of brain (A), polyarthritis (B) and conjunctivitis (C) ( *S. suis* infection)**

**Treatment and control**

The disease can be effectively treated with antimicrobials. The most effective antibiotic against this infection was found to be penicillin and other antibiotics which can also be used in pigs are amikacin, enrofloxacin and gentamicin.

***Strategy for prevention of S. suis infection in piglets***

- Injection of piglets on day of birth with long-acting penicillin @ 70,000 IU per piglet (150,000 IU per ml).
- Adoption of strict hygienic measures in the farrowing pen.

**Brucellosis**

**Clinical signs**

- Generally, no signs of infection prior to evidence of infertility in the herd.
- In a herd several sows or gilts return to heat 30-45 days after breeding.
- Abortions or birth of dead and weak piglets.
- The incidence of abortion may vary from 0-80%. Abortions may also occur early in gestation.
- Usually, sows or gilts that abort early in gestation return to estrus soon and are rebred.
- Other signs include temporary or permanent sterility, orchitis, lameness, posterior paralysis, spondylitis and occasionally metritis and abscess formation.
- Sterility in sows, gilts and boars is common and may be the only manifestation.

**Treatment and control**

- Treatment with antibiotics is not very effective and generally should not be attempted. Affected pigs should be destroyed.
- If the herd becomes infected the most reliable method of control is to slaughter the herd, clean up the premises and restock with brucella-free pigs. This is also the safest procedure from the pig attendants' and public's stand-point and in the long term is usually the least costly.
- Other approaches include repeated herd blood tests with removal of positive reactors. This may be effective if only a few pigs are infected but is likely to be unsuccessful if many pigs are positive.

**Bacterial conjunctivitis in pigs**

**Clinical signs**

- Common clinical signs observed are redness and swelling of the eyes, photophobia, discharges from the eyes and sometimes discharge of mucopurulent materials from one or both the eyes.
- In most cases affected eyes remain closed because of excessive secretion of mucopurulent materials.

**Treatment**

- Bacterial conjunctivitis can be treated effectively with a combination of steroid and antibiotics given as eye drop.
- Prior to application of eye drops the affected eyes should be cleaned properly through a swab ringed in normal saline/sterilized water.
- The effectiveness of the antimicrobials depends on the type of bacteria involved. It has been observed that gentamicin is the most effective antibiotic for the treatment of conjunctivitis in pigs.

**Control measures**

- Adoption of strict hygienic measures in the farm.
- Quick separation of in-contact animals and prompt treatment of affected litters with suitable antimicrobials.
- Practice of keeping of different breeds of pigs in the same pen should be avoided.

**Bacterial abortion in pigs**

Although abortion in pigs may be caused by several agents bacterial causes are also responsible for considerable degree of abortion in pigs. Bacteria most commonly associated with abortion in pigs include *Brucella suis*, *Erysipelothrix rhusiopathaie*, *Leptospira pomona*, *Streptococcus suis* and *Mycoplasma species*. Bacteria such as *E. coli*, *Staphylococcus aureus*, *Corynebacterium* species and *Listeria monocytogenes* are also found to be associated with abortion in pigs.

**Management of abortion in sows**

The following points may be considered for the management of bacterial abortion in sows:

- Adoption of strict hygienic measures in the farm to prevent the occurrence of diseases those are responsible for abortion in pigs.
- Adoption of Artificial insemination (AI) in the farm

- Regular screening of boar semen for the presence of bacteria responsible for abortion in pigs.
- Regular screening of pigs against brucellosis and culling of the positive reactors.
- Boar for breeding purposes should be introduced to the farm only after thorough testing against reproductive diseases.

**Cutaneous abscess**

They commonly arise from fighting particularly when sows are grouped at weaning. Initially there is a break in the skin which leaves a scar followed by swellings beneath. Abscesses can also arise as secondary infection to other conditions such as swine pox, PRRS, pneumonia or tail biting and if they become widespread throughout the body, the result may be emaciation followed by death or condemnation of the carcass at slaughter. The presence of *S. aureus* infection cannot readily be suspected on clinical grounds. The organism can cause neonatal septicaemia and is often identified in small, hairy stunted piglets of 7-10 days of age with umbilical abscess and polyarthritis. Arthritis of the distal pharyngeal joints, enlargement of the hoof and sinus formation at the coronary band are also observed in affected pigs. Creamy pus is often seen to exude from the abscess.

**Treatment**

- Attempt should be made to drain the pus. Sometimes it will occur naturally after the abscess bursts but most require lancing or opening surgically. Following antimicrobials can be used for the treatment of abscess in pigs:
- Penicillin/streptomycin daily for 3-4 days.
- Amoxycillin long-acting (LA) every alternate day
- Oxytetracycline (LA) every alternate day
- Penicillin (LA) every alternate day.

**Control measures**

- Identify the various projections and sharp objects in the environment.
- Reducing fighting among animals.
- Preventing tail biting.
- Checking injection procedures.
- Adopting strict hygienic measures in the pen

## Viral Diseases of Pig

### African Swine Fever (ASF)

African Swine Fever (ASF) is currently the most important viral disease of pigs. It is a highly contagious and often fatal viral disease affecting both domestic and wild pigs. ASF is caused by the African swine fever virus (ASFV), a large double-stranded DNA virus that leads to mortality rates close to 100% in infected pigs. The virus is the sole member of the family *Asfarviridae* and is known for its ability to persist in various environmental conditions, contributing to its indirect transmission. ASFV does not infect humans but can devastate swine populations. The disease is characterized by the following clinical signs:

- High fever
- Difficulty standing up
- Loss of appetite, vomiting, and diarrhea
- Haemorrhages in the skin and internal organs
- Miscarriage, abortions, and stillbirths in pregnant sows.

African Swine Fever Virus (ASFV) spreads primarily through direct contact with infected pigs or by consuming contaminated pork products. Additionally, transmission can occur through ticks, acting as carriers of the virus. This disease poses substantial economic consequences, mainly due to trade limitations imposed on afflicted areas and the expenses associated with implementing control strategies. Prevention and control of ASF rely on strict biosecurity measures, including quarantine, disinfection, and surveillance. Culling pigs in affected areas is crucial to prevent further transmission of the virus. There is currently no vaccine available, making early detection and rapid response crucial for containing outbreaks.

**Fig. ASF affected pig with oozing of blood from nasal orifice and cyanotic and erythematous spots in the skin.**

### Classical Swine Fever (CSF)

Classical swine fever (CSF), also known as hog cholera, is a highly contagious and economically significant viral disease affecting domestic pigs and wild boar globally. The causative agent, Classical Swine Fever Virus (CSFV), is a small enveloped virus with a single-

stranded positive-sense genomic RNA, classified within the *Pestivirus* genus of the *Flaviviridae* family. CSF affects pigs of all ages and is characterized by fever, hemorrhages, and neurological signs. Mortality rates can be high, particularly in naive populations. CSFV is primarily transmitted through direct contact with infected pigs or ingestion of contaminated pork products. The virus can also be spread by fomites, contaminated equipment, or through infected bodily fluids. Wild boars can serve as reservoirs of the virus, posing a risk of transmission to domestic pigs.

Control of the disease relies on vaccination, strict biosecurity measures, and surveillance. Vaccination with live attenuated or inactivated vaccines can provide protection against the disease. Raksha CSF vaccine manufactured by Indian Immunologicals Limited is commonly used in India to control the disease. Recently, the Indian Veterinary Research Institute has developed a new CSF cell culture vaccine using an Indian field isolate, which is expected to be the most economical CSF cell culture vaccine costing less than Rs 2/- per dose once available in the market.

**Porcine Reproductive and Respiratory Syndrome (PRRS)**

PRRS is caused by Porcine Reproductive and Respiratory Syndrome Virus (PRRSV), a single-stranded RNA virus belonging to the family *Arteriviridae*. The disease occurs clinically in two forms: reproductive syndrome in sows and respiratory syndrome in swine of all ages. Clinical signs include reproductive failure, respiratory distress, and increased susceptibility to secondary infections.

PRRSV is primarily transmitted by direct contact with infected animals or contaminated materials. Transmission can also occur from pregnant sow to newborn piglets. The virus undergoes rapid mutation (changes), leading to the emergence of new strains which pose a challenge in vaccine development. Control of PRRS involves implementing strict biosecurity measures, vaccination, and herd management strategies. Vaccines are available, but they need to be imported from other countries and their efficacy varies depending on the strain circulating in the population.

**Porcine Circovirus-Associated Diseases (PCVAD)**

Porcine circovirus-associated diseases (also called PCVAD or PCVD) consist of a group of syndromes caused by porcine circoviruses (PCV), particularly PCV type 2 (PCV2). These syndromes include post-weaning multisystemic wasting syndrome (PMWS), porcine

dermatitis and nephropathy syndrome (PDNS), porcine respiratory disease complex (PRDC) and reproductive failures. In addition to PCV2, Porcine circovirus type 3 (PCV3) and Porcine circovirus type 4 (PCV4) has also been identified. PCV2 is ubiquitous in swine populations worldwide and can cause immunosuppression, leading to increased susceptibility to secondary infections. PMWS is characterized by weight loss, wasting, and enlarged lymph nodes in affected pigs. PDNS manifests as skin lesions and kidney inflammation, while PRDC involves respiratory signs such as coughing and dyspnea.

Prevention and control of PCVAD involve vaccination, strict hygiene measures, and management practices to reduce stress and minimize exposure to pathogens. Vaccination against PCV2 has been successful in reducing the incidence and severity of associated diseases. Several vaccines such as Circovac®, Ingelvac CircoFLEX® (Boehringer Ingelheim), Fostera® PCV (Zoetis), Suvaxyn® PCV2 One Dose (Merck Animal Health), and Porcilis® PCV (MSD Animal Health) are available commercially for the prevention of PCV2 associated PCVAD. Although indigenous vaccine for PCV2 is currently lacking in the country, Ingelvac CircoFLEX® is imported by some pig rearers to control the disease.

**Fig. Mummified foetuses along with stillborn foetuses and live born weak piglets associated with PCV2**

## Porcine Parvovirus infection

Porcine Parvovirus (PPV) infection poses a significant threat to the swine industry, particularly due to its impact on reproductive outcomes in sows. PPV (now called ungulate protoparvovirus 1) is a small, non-enveloped virus with a single-stranded DNA genome. While PPV infection typically causes mild to asymptomatic disease in adult pigs, it can have devastating effects on reproductive outcomes in pregnant sows, leading to reproductive failure, fetal death, and

mummification. Prolonged return to estrus and decreased litter sizes is also common in PPV infection.

Preventing and controlling PPV infection requires a comprehensive approach involving vaccination, biosecurity measures, herd management practices, diagnostic testing, and education. Inactivated PPV vaccines given to replacement gilts and sows can induce protective immunity and reduce the risk of reproductive losses. Regular monitoring of pig herds for PPV infection using serological and molecular diagnostic tests allows for early detection of viral circulation and timely intervention.

**Foot and Mouth disease (FMD)**

Foot-and-mouth disease (FMD) is a highly contagious viral disease that affects ruminants and pigs. The disease is caused by the foot-and-mouth disease virus (FMDV), which can have a significant economic impact on FMD-free countries and regions. Although pigs exhibit lower susceptibility to FMD when compared to cattle and sheep, they remain susceptible to infection and can act as carriers of the virus, aiding in its spread. In pigs, FMD is characterized by symptoms such as fever, lameness, and the formation of vesicular lesions (blisters) on the feet, snout, mouth, and occasionally on the teats. These lesions often cause significant discomfort and pain, resulting in diminished feed intake, weight loss, and decreased productivity. The prevention and control of FMD in pigs relies on approaches as described for other viral diseases above. Inactivated vaccines produced by different commercial firms are available in the Indian market for control of FMD.

**Japanese encephalitis**

Japanese Encephalitis (JE) is a viral disease predominantly spread by mosquitoes, particularly those belonging to the Culex species. Classified within the *Flavivirus* genus, it shares close association with other mosquito-transmitted viruses such as dengue, Zika, and West Nile virus. While humans serve as the primary hosts for the Japanese Encephalitis Virus (JEV), pigs function as amplifying hosts, crucial in the virus's transmission cycle. In pigs, JE is associated with severe neurological symptoms, including fever, lethargy, lack of coordination, and convulsions. This infection can result in elevated mortality rates among pig populations, inflicting significant economic losses on swine producers due to diminished productivity, heightened morbidity and mortality, and expenses linked to disease management and control measures.

Preventing Japanese Encephalitis in pigs involves vaccination, vector control, and surveillance. Vaccination with inactivated JE vaccines is a common practice in endemic regions in other countries, aiming to induce protective immunity in pigs and reduce the risk of infection. Vector control measures, such as mosquito population management and the use of insecticides, help reduce the transmission of JEV from mosquitoes to pigs. Recently, the Indian Veterinary Research Institute has developed a Vero cell based inactivated JE vaccine candidate for pigs for use in India.

**Parasitic Diseases in Pigs**

Curtailing disease occurrence and maintaining animals in good health condition is the foundation for any profitable livestock enterprise. In swine husbandry, appropriate managemental practices and preventive measures against diseases can result in enhanced reproductive performance, better feed utilization and reduce mortality and morbidity from diseases. Although pig farming in NER is an attractive business enterprise but, most of the pig farmers prefer backyard farming with animals scavenging in garbage dumps, eventually exposing them to a plethora of infections. Moreover, 90% of the pig population in India is restricted in rural areas and mainly restricted to low-income group families having poor hygiene standards.

Parasites are commonly found in domestic pigs in almost every kind of production system throughout the world. In ruminant production system worldwide, parasites and parasitic diseases are well addressed because of their effects on the host and associated economic losses. But, the parasites rarely cause per-acute clinical disease in pigs and are therefore neglected by farmers, veterinary parasitologists and clinicians. However, lately some studies on pig production system had revealed that after African swine fever and Classical swine fever, parasitic infections are probably the most important diseases in domesticated pigs in tropical and sub-tropical regions. The gastrointestinal (GI) parasites result in significant loss of productivity owing to loss of productivity due to inefficient feed conversion, meager growth rate, diminished weight gain, reduced litter size and condemnation of carcass parts and offal. The prevalence of GI parasites in pigs have been commonly reported from throughout the world, the major GI parasites in pigs have been documented as *Ascaris suum*, *Oesophagostomum* spp., *Strongyloides ransomi*, *Hyostrongylus rubidus*, *Trichostrongylus axei* and *Trichuris suis*. Apart from helminth parasites a wide range of intestinal protozoan parasites have also been reported from pigs, namely *Cryptosporidium* spp., *Giardia lamblia*,

*Balantidium coli* and *Eimeria* spp.. GI protozoan infections has been reported to cause reduced body weight gain and decreased haemoglobin concentration in infected pigs. In India, different studies have described the presence of helminths (Ascaris spp., *Trichuris* spp., *Strongyle* spp., *Strongyloides* spp.) and protozoa (*Isospora* spp., *Eimeria* spp., *Cryptosporidium* spp., and *Giardia* spp.) in pigs.

Apart from causing losses in the pig production system, these parasites also pose a serious threat to human health as many of these parasites are zoonotic in nature. Therefore, pigs harboring such infection are potential human health hazards.

*Chapter 7*

# Management of pigs during extreme weather conditions

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In order to achieve optimal production targets, information on the physiological health of pig herd is of prime concern (Bharati et al., 2022). Acquaintance with the normal physiology, body condition and conformation of pigs of different categories like piglets, growers, gilts, sows and boars is essential for maintaining a healthy and productive herd. Knowledge about basic physiological parameters is basic to selecting a breeding stock and assessing healthy and diseased animal. Furthermore, it also gives a clue on the breed characteristics and helps to distinguish different categories of animals during buying and selling. It also aids in improved understanding of terms related to the slaughter and pork production like carcass traits, carcass length, loin eye cut, primal cut percentage, back fat thickness, etc. The three basic physiological parameters like body temperature, respiration rate and pulse rate are vital signs indicating the health status of the animal. Hence, familiarity with the normal physiological parameters which are suggestive of good health is very significant for a pig farmer. Similarly, knowledge with the standard terms used for body parts of pig and internal organs, can support a pig farmer in identifying the animal in a better way and communicate any atypical changes in health with accuracy to the veterinarian or animal husbandry department authorities. Maintaining a record on basic physiological parameters and body condition during various growth stages can help in feed regulation, increased feed efficiency and timely intervention of veterinary treatment and farm regulation in case of any kind of disease outbreak.

## Physiological Parameters of Pig

Measurement of basic physiological parameters is very useful in monitoring of pig health and disease diagnosis. If any change in the physiological indicators of health like body temperature, breathing rate and pulse rate are correctly recognized and judiciously monitored, many pig diseases can be diagnosed in early stages and affected pigs can be treated or quarantined before the situation worsens and the disease spreads to the whole farm (Gupta et. al., 2022). The normal physiological parameters of pig under a thermal comfort zone are shown in Table 1 for

the reference and any deviations from these values can be suggestive of a compromised pig health. These values vary depending upon the physiological stage, time of recording, seasons, breed and handling or restraining during data recording. Using a conventional mercury thermometer is the traditional method of measuring body temperature which can be utilized for obtaining rectal temperature in pigs, however, digital thermometers are easily available these days, which can also be used for the purpose. The respiration and pulse rate can be measured by observation and palpation, which are subject to objectivity of the technical person taking the measurement. Nevertheless, these physiological parameters serve as a cornerstone to any disease diagnosis, before any diagnostic technique is applied for assessing the health status of an animal or herd.

**Table 1. Normal Physiological Parameters of Pig**

| **Parameter** | **Reference** Range |
|---|---|
| Respiration rate | 10-20 breaths/min |
| Pulse rate | 90-110/min |
| Body temperature | 38.0°C. – 40.0°C. |

**Recording of body temperature using mercury thermometer**

For the purpose, the mercury column or digital thermometer should be lubricated before measurement with any lubricating agent. Then the mercury column should be inserted into the pig anus and tilted, so that the bulb touches the rectal mucosa of the animal. The thermometer should be removed after 1-2 min in case of conventional mercury thermometer and after a beep sound if digital thermometer is used. The thermometers should be wiped clean and data should be recorded.

The procedure for use of mercury thermometer or digital thermometer to attain rectal temperature is complex and requires a large amount of labour, especially in case of aggressive animals of pig breeds. It involves restraining and laborious handling of pigs which makes the animals stressed, which affects the other physiological parameters. Also, it is the process of contact measurement of rectal temperature and hence, there exist risks of transmission of zoonotic diseases from animals to humans or transmission of a communicable disease of pigs from one animal to other. Therefore, in the recent past, the use of infrared thermometers to measure pig body surface temperature has been adopted and it offers benefit of non-contact temperature measurement. Moreover, it is very useful in screening of large number of pigs for quarantine, health assessment before and after transportation and routine health monitoring.

**Recording of body temperature using digital thermometer**

The infrared thermometer should be positioned perpendicularly in front of the pig, keeping it 30 cm away (the farmer can choose any fixed distance according to the sensitivity of the available thermometer) from the skin of pig or according to the manufacturer's instruction. The point should be targeted towards the base of the ear and reading should be taken twice and recoded as displayed on the screen of thermometer. The average readings can be recorded for further interpretation.

**Recording of respiration rate**

Respiration rate in pigs can be measured by observing flank movement and using a stopwatch. For the purpose, a stopwatch should be taken and the direct observations of respiratory movements of pig chest within 60 seconds can be made. The process should be repeated thrice and the average respiration rate in breaths/minute can be recorded for further interpretation. The animals should be minimally disturbed during the observation, since it may fluctuate the parameter and give a false conclusion.

**Recording of pulse rate**

Pulse rate is recorded by feeling the ventral coccygeal artery at the base of the tail. The pulsation between the fingers in the ventral coccygeal artery at the base of the tail of pig can be felt and recoded within 60 seconds with the help of a stopwatch. The process should be repeated thrice and the average pulse rate per minute should be recorded for further interpretation.

**Assessment of body condition score (BCS)**

Assessment of physiological condition pigs at different stages of life cycle can be easily done by body condition score (BCS) and accordingly farm management can be regulated, especially for feeding. Periodical evaluation of BCS is important in pigs because the physiological status and health of pigs significantly influence economic efficiency of the farm (Gupta et al., 2022). The BCS combines both the visual appraisal and feel, since visual assessment alone is not capable enough to assess the health condition and physiology of pig, hence a hand pressure is applied on the body in the definite areas where the only fat tissue lies between the skin and bones. These specific areas on the pigs include the ribs, back bone, "H" bones, and the "pin" bones. The process of evaluation mainly involves determining the ease or difficulty of feeling or palpating these bones and approximating the fat stores of the pig as shown in the Figure 1a

and 1b. Based on the observations, a scale from 1 (thin/very thein or emaciated) to 5 (grossly fat or obese) is applied in the scoring system as shown in Figure 1c. In practice extreme scores (1 or 5) rarely found in a scientifically managed pig farms while the majority of pigs fall into the middle scoring range (2, 3 or 4). Hence, BCS can be used to check whether the presently applied feeding management, parasitic control actions and farm management practices is optimal or not. Sows with BCS 5 may experience farrowing complications like dystocia and hence feeding schedule should be adjusted consequently. The BCS of 1-2 during lactation and gestation is not satisfactory and the farmer should change feeding management protocols and include food supplements to avoid this problem. BCS is also an indicative of microenvironment of shed, since heating, inadequate ventilation and unhygienic condition in a pig farm also affects the BCS of pigs. Good BCS i.e., maximum number of pigs with 3 score, ensures that the growing piglets in the farm is well fed and have adequate physiological indexes for better feed conversion efficiency and the sows and boars are well maintained. This method is very crucial for selecting the founder stock of animals for establishing a pig breeder farm. A healthy sow/gilt and boar can only breed a healthy and optimally productive pigs. Practicing BCS system in pig farm also leads to better feed conversion ratio and decreases cost of feeding in the pig enterprise. One thing to mark is that this visual scoring method is subjective method and hence, depends upon the observational skills of the person involved in assessing BCS in pigs. Nevertheless, the technique is simple and can be easily adopted. With the increasing duration of practice and experience the scoring skills of the technical person progresses and the precision obtained by this system in evaluating BCS upsurges manifold.

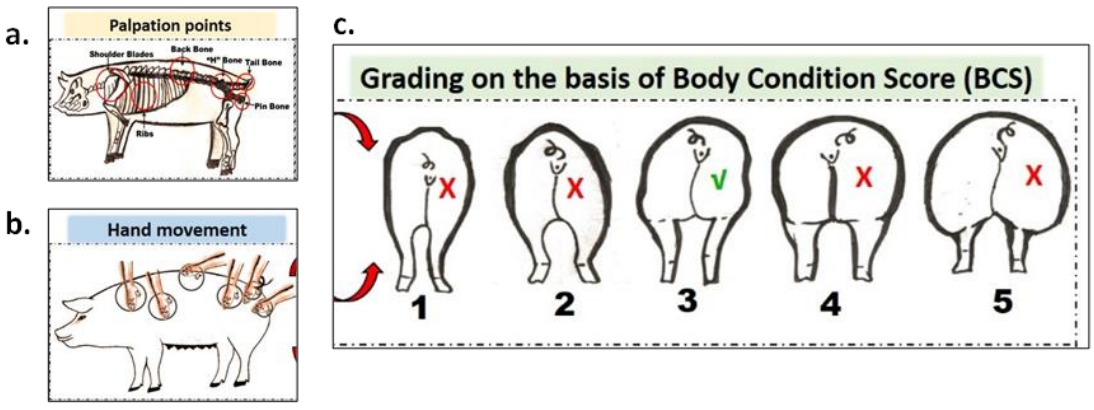


Figure 1. The diagrammatic representation of steps of determining body condition score (BCS) in pigs a. The different palpation points (indicated by the circles in red) used for assessing the BCS b. The sequence of hand movement (indicated by the circles in black) for assessing BCS c. The grading of pigs on the basis of BCS, wherein (√) in green indicates the optimal BCS for a healthy sow.

**Biological responses of animals to increasing temperature**

The direct impact of climate change on livestock productivity remains largely unknown (Thornton et al., 2009). Using pigs as a model, studies have shown that under heat stress, pigs, like other animals, reduce their feed intake to limit metabolic heat production due to the thermal effect of feed. This reduction in appetite is influenced by factors like breed, genetic potential, and physiological stage, as well as environmental factors like housing, feeding management, and climatic parameters like relative humidity, air flow, ambient temperature. Body weight gain in growing pigs and milk output in lactating sows are directly related to feed intake (Renaudeau et al., 2005). Consequently, an increase in ambient temperature above the thermoneutral zone (25°C for growing pigs and 18°C for lactating sows) negatively affects their growth and reproductive performance. Reduced feed intake also exacerbates the energy deficit in reproductive sows, potentially decreasing fertility, fitness and longevity. Elevated ambient temperatures can reduce reproductive efficiency in both male and female pigs. Studies suggest that heat stress during early pregnancy can alter the endocrine system, particularly the control of oocyte development, ovulation, corpus luteal function, fertilization and may directly affect embryo or conceptus development.

In boars, elevated temperatures lead to reductions in semen quality, sperm output and fertility. High temperatures inhibit spermatid maturation and testicular androgen biosynthesis. Studies have indicated that improvements in reproductive performance can be achieved by increasing evaporative cooling for boars (Wettemann and Bazer, 1985). High temperatures also affect lying and excreting behaviour in growing pigs. At lower temperatures, pigs prefer to lie on slatted floors, whereas high temperatures lead to increased fouling of solid floors. At high humidity, these behavioural changes occur at lower temperatures as well (Huynh et al., 2005). In dairy cows, increased milk yield raises metabolizable energy requirements by two times, with approximately 35% of this energy dissipated as heat (Kadzere et al., 2002). Thus, high-yielding cows, such as crossbred animals, become more vulnerable to fluctuations in ambient temperature compared to low-yielders. Under heat stress, lactating animals, including pigs, respond physiologically through various molecular and cellular mechanisms, partitioning nutrients to minimize heat load. Similarly, other domesticated animals, poultry and fish genetic resources may face the impacts of climate change, and endangered species risk extinction due to loss of natural habitats.

**Modification of Ambient Environment through Optimal Housing Conditions**

Optimal ventilation is essential to manage the heat and moisture produced by pig metabolism. In India, pig houses are typically semi-open with a wallowing tank in the open area, ensuring proper ventilation and allowing surface cooling during the hottest parts of the day. Water sprinklers can also help reduce ambient temperature, although they may increase humidity inside the housing. The use of fans to enhance evaporative cooling has proven successful on many farms. Studies have compared various methods to alleviate thermal stress, such as water drips, different flooring materials, and types of cooling systems (Hahn, 1981; McGlone et al., 1988; Malmkvist et al., 2009). One study found that water drips effectively cooled heat-stressed sows, especially on plastic floors. However, snout coolers, partial concrete slots, and high-energy-density diets provided only minor benefits to heat-stressed sows and did not benefit nursing piglets (McGlone et al., 1988). During winter, covering windows and open areas with jute sacks or plastic sheets can reduce wind circulation, preventing excess heat loss from the skin surface.

1. **Nutritional Management**

A common nutritional strategy to reduce heat stress involves increasing the nutrient density, particularly energy density, to compensate for reduced feed intake. Adjusting the feed to include extra protein and fat while reducing fiber content is crucial during hotter months. Providing clean, ad libitum drinking water is essential and must be available at all times. The use of probiotics, minerals, and vitamins has also been explored. However, ensuring optimal nutrition throughout the pigs' lifetime is key to maximizing performance and ensuring successful pig farming, as feed accounts for about 70% of animal raising costs.

2. **Genetic and Breeding Strategies**

Implementing genetic and breeding strategies to develop heat-tolerant pig breeds can also be effective. Selective breeding for traits associated with heat tolerance, such as thinner back fat, lighter coat color, and larger surface area to volume ratio, can help improve pigs' resilience to thermal stress. Additionally, incorporating heat tolerance traits into breeding programs can create pig populations better suited to hotter climates, enhancing overall productivity and welfare.

### 3. Genetic Improvement and Development of Heat-Tolerant Animals

Differences in thermal tolerance among various animals, breeds, and strains have been well-documented, indicating significant variation within and between breeds. For instance, there is notable variation in thermal tolerance among different sow lines (Bloemhof et al., 2008). This variation presents an opportunity to select and develop animals with enhanced heat tolerance. At ICAR-National Research Centre on Pig, it has been observed that purebred exotic pigs such as Hampshire, Large White Yorkshire, and Landrace, despite their temperate origins, perform exceptionally well in India's agro-climatic conditions. Furthermore, crossbreeding these exotic breeds with indigenous pigs reared in different agro-climatic zones has resulted in well-adapted animals with improved performance.

## Conclusions

In summary, the increasing temperature poses multidimensional challenges, affecting physiological resilience and triggering various adaptability responses while depleting natural resources. Key measures to mitigate the adverse impact of climate on animal production include adopting optimal management practices such as improved housing, modified management techniques, genetic selection of animals with increased stress tolerance, enhanced biosecurity measures for disease prevention, early diagnosis, and treatment, exploring alternative feed resources, implementing contingency plans and emergency preparedness for natural disasters, including the development of resource inventories and locators. Moreover, raising awareness among stakeholders including veterinarians, farmers, researchers, building engineers, and policymakers through print and electronic media is essential. This awareness should be complemented by definite policy support, long-term planning, research initiatives, and the implementation of measures to promote climate-resilient agriculture.

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*Chapter 8*

# Management of reproductive problems and estrus synchronization in pigs

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Reproductive issues in swine are often linked to management, nutrition, environment, and genetics rather than specific pathogens. However, role of many known pathogens has direct adverse effect on the reproduction in pigs. The present chapter will only discuss the reproductive problems in pigs due to noninfectious causes. The infectious causes and its adverse effects on reproduction have already been discussed in chapter 6 of this e-book. While some level of reproductive failure is typical in all breeding operations, it's considered significant only when production falls below expected norms, which include metrics like cycling percentage, conception rates, farrowing rates, average litter size, and yearly pig production per sow. Identifying moderate subfertility requires keen observation, regular recording, and analysis of reproductive records. Addressing these problems involves a deep understanding of herd management, collecting and analyzing objective data, and possibly sending samples to a diagnostic lab. However, pinpointing the exact cause can be challenging, especially if the problem stems from past management or environmental issues and the causative agent is no longer present.

## Delayed puberty

The onset of puberty indicates the gilt's future reproductive performance. Early onset of puberty in gilt must be ensured for increasing profit in commercial pig farms. In fact, almost 10% of gilts are slaughtered before their first artificial insemination (AI), mainly due to reproductive problems (Boulot, 2004)). Gilts reach puberty between 150 and 220 days-of-age or 6 to 7 months (Patterson et al., 2010). Accurate detection of first estrus in gilts is key to optimize the correct time of AI in their second or third estrus (Kummer et al., 2006). In a pig farm, about 10% to 25% of gilts may not reach puberty, even at older ages. The condition is considered as ‘delayed puberty’. This occurs in a pig farm as ‘herd problem’. Large batch of gilts may show delayed puberty, if it is related to genetics, nutrition, micro-environment and other managemental faults in the farm. The root cause needs to be identified and timely measures

need to be taken to get rid of huge economic loss. The Gilts that don't show oestrus by 220 days of age should be culled. The female progeny of the delayed-pubertal gilts should not be included in the future breeding programme. Gilts that have been bred for two consecutive estrous cycles with fertile boars and do not conceive, should also be culled.

Onset of puberty is influenced by a variety of factors, including genotype, liveweight, nutritional status, season, and management. The exposure of a sow or gilt to a sexually mature boar is the most influential of all management factors and it hastens onset of puberty and expression of estrus. This is known as 'boar effect'. For exerting this effect, females are exposed to the sight, sound, touch, and smell of a mature boar. If direct contact using a mature boar can't be given, it can also be effective when proper fence-line exposure is given. Exposure of peripubertal gilts to a mature boar is given for 10–15 minutes/day. Other management tools like, improving nutrition crossbreeding, gilt relocation to novel housing and forming new groups by mixing gilts from different pens of similar age group and health status can advance the onset of puberty.

**Anestrus**

Common issues with gilts include delayed puberty, silent estrus, and anestrus after a few heats. To address undetected heats mistaken for anestrus, heat detection methods should be evaluated, ideally with daily estrus tests using a mature boar. Stockpersons should recognize heat signs such as swollen, red vulva; increased vocalizations; decreased appetite; pinning of ears; mucus discharge from the vulva; restlessness; and mounting behaviors. For weaned sows, anestrus often results from insufficient energy or protein intake during lactation, especially in sows weaning their first litters. Adjusting the lactation diet to include more energy or protein can help, particularly if feed intake is low. Excessive weight loss during lactation or inadequate weight gain during pregnancy also contribute to anestrus. The length of lactation affects heat return, and exposure to a mature boar, either in adjacent pens or through daily movement among the sows, can stimulate early cycling. Additionally, mixing 3-4 sows with the boar for the first 48 hours after weaning can reduce fighting and help initiate cycles through boar stimulation. If the sow becomes weak and debilitated due to delay in weaning or from insufficient energy or protein intake during lactation, immediate proper feed and feed supplement must be provided. Many times, in small and marginal farms, anestrum in pigs is seen due to the insufficient or non-supplementation of vitamins and minerals. In such case, the

farmer should immediately start the vitamin and mineral supplement initially at therapeutic dose rate and subsequently for maintenance.

**Low conception/repeat breeding**

When more than 15% of the bred sows return to estrus within 18 to 23 days, both male and female infertility must be investigated. Primary considerations are boar infertility and poor timing of matings that result lower conception rates. Very low conception rates often indicate male infertility. Diagnostic efforts should include semen quality examination, observation of boar behavior and mating ability and a review of boar management and use. When AI is employed the following points should be considered to get the maximum conception or to avoid repeat breeding

**The correct time to inseminate**

Gilts or sows should only be inseminated during a strong standing heat i.e. rock steady when firm pressure is applied to the top of pelvis area and/or when the stockperson can sit astride without the sow moving off. Ovulation occurs at the end of the estrous cycle in both gilts and sows. Suggested guidelines for insemination in gilts is 12 hours after the first detection of estrus. A second insemination should follow12 hours after the first. Sows should be inseminated 24 hours after the first detection of estrus and a second insemination should occur 12 hours later. If a female stands for three days, a third insemination may be beneficial for optimum timing of ovulation and success in conception.

**AI dose Care, transportation and delivery**

When semen dose needs to be brought from a distant AI production station, semen should be ordered the day of early heat signs, before standing estrus, to ensure next day delivery. Transportation target is to protect the doses against temperature fluctuations, jolts, physical damage and sunlight. Proper handling and storage of semen is crucial to keep the quality of semen and conception rate high. The semen must be protected from environmental stress such as sunlight, too much heating or cooling, or preparation with impure water. Target is to maintain semen doses at a temperature of 17± 2°C without temperature fluctuations. Semen bottles/packets should be carefully swirled one to two times daily. Semen must be kept in the polystyrene transport box once contents have been checked. Do not use any water, soap, disinfectant, as sperm may be killed, and the process is a dry technique.

Proper insemination technique: The required material such as semen dose, catheter, disposable gloves, protective clothing etc. should be sufficiently cleaned and sterilized. Use clean equipment for every insemination and ensure the sow is adequately stimulated before insemination. Proper insemination technique should be followed for maximum conception rate.

**Dystocia**

After a pregnancy period of 114 days, the farrowing occurs and the farrowing process may vary from 3 to 8 hours and piglets are usually delivered every 10 to 20 minutes interval. But the time of delivery of fetus varies widely. Obstetric intervention is indicated if more than 45 min have passed since the last piglet was expelled (Peltoniemi et al., 2019). Dystocia is rare in swine. However, uterine inertia cases are seen in swine, which may lead to dystocia. Failure to begin farrowing by 115 days subsequent to behavioural signs of approaching parturition may be due to the following reasons.

- The cervix has not opened,
- There may be torsion (twisting) of the uterus,
- Physical blockage of the cervix by a piglet which is dead, oversize, abnormally presented or malformed or
- Illness of the sow resulting in uterine inertia (No contraction of the uterus to expel fetus)

If some piglets have been delivered prior to the development of uterine inertia, vaginal examination may reveal the presence of piglets in the uterus close to the cervix. The sow becomes distressed, pants heavily and trembles, in case she suffers from hypocalcaemic condition. Retained piglets or placental material if left untreated in the uterus, it may lead to fever, bloody discharge, inappetence and agalactia. Treatment of dystocia and uterine inertia depends upon the actual cause. It is primarily important for the veterinarian to establish the cause of the problem as early as possible and early initiation of the treatment can save the piglets as well as mother. The manual examination of the cervix through vagina and suckling by the delivered piglets also cause oxytocin release, which may stimulate the uterine to deliver further piglets and placentas without any additional treatment. However, under the supervision of qualified veterinarian, oxytocin treatment needs to be initiated in case of confirmed uterine inertia. When manual examination after washing and disinfection reveals an open cervix, any piglets or placentas within reach needs to be delivered. Jammed piglets needs to be brought

into position and delivered. In case of manual examination of the reproductive organs, antibiotic treatment is a must to reduce the possibility of uterine infections.

**Abortions**

An abortion rate of 1-2% is regarded as normal in the swine breeding herd. The number increases slightly during the fall months. When many abortions occur, specimens should be submitted to a diagnostic laboratory. An exact diagnosis is achieved only 20-30% of the time. Abortions are caused by infectious, toxic, genetic, metabolic and other factors.

**Mummified Fetuses and Stillbirths**

Mummified fetuses can occur in normal farrowings at a rate of 4-5%. Both infectious and noninfectious factors can contribute to the presence of mummies. Increased stillbirths may result from various factors, including infections like leptospirosis or pseudorabies, and carbon monoxide toxicity. Supervising farrowing closely can significantly reduce the incidence of stillbirths and help manage these issues more effectively.

**Mastitis – metritis - agalactia (MMA) syndrome**

`MMA' is a complex syndrome that can affect sows shortly after farrowing. This is characterized by inadequate milk production, inflammation of the mammary glands and reproductive system, and bacterial infection of the urogenital tract of the affected sows immediately after parturition. In some sows, involvement of udder without metritis is also seen. In that condition, agalactia (failure to produce milk) or hypo-galactia (insufficient milk production) is seen in the affected dam. The high risk of mortality in litter of piglets is occurred due to starvation in first few days of life.

- Mastitis: It is the inflammation of the udder. The affected udder becomes firm and hot. On touch the sow feels severe pain. Therefore, it does not allow suckling by the piglets.
- Metritis: It is the inflammation of the uterus. Sometimes purulent discharge is seen to be dropping through vulva.
- Agalactia: It is a abnormal condition of the udder of the affected sow in which inability to release milk or Inadequate milk production

The affected sow may reveal the following symptoms:

- Fever
- Vaginal discharge

- Listlessness
- Weakness
- Anorexia
- Sternal recumbency
- Declining by the sow to allow nursing by the piglets
- Deteriorated body condition
- Prostration
- Reluctance to move

MMA syndrome can be developed in the sow due to mismanagement, infections, hormonal causes, and endotoxins produced by bacteria like E. coli. These serious postpartum complications lead to increased piglet mortality and reduced weaning weights due to the starvation in the piglets. The affected sow becomes restless and aggressive. Few mothers become ferocious and even bites their piglets. The condition may be properly treated based on the clinical signs. Dams usually recover within a few days to two weeks. The affected sow may be treated with suitable antibiotic, antipyretic and products to stimulate milk production. The dams need to be rehydrated properly by encouraging drinking of water/ electrolytes. The Piglets of the affected mother may be fostered by other lactating sow, or supplemented with milk replacer, skim milk or diluted cow/ goat milk if the mother not at all allow to suckle milk. Regular nursing/ hand feeding of the piglets is required to minimise the piglet mortality.

**Pseudopregnancy**

Pseudopregnancy occurs in exposure to estrogenic agents such as zearalenone (sometimes produced in moldy feed). Pregnancy detection procedures, possibility of moldy feed and infectious agents should be assessed for the diagnosis of the problem. Examination of reproductive tracts at slaughter may reveal uterus full of mummified fetuses.

**Estrus synchronization**

Estrus synchronization encompasses estrus in large numbers of gilts/sows expressed at given time. This can be done by several managemental practices such as synchronized weaning, boar parading, biostimulation and transportation. Weaning of piglets also causes a natural synchronization for the onset of oestrus in sows. Delay in returns to oestrus after weaning may be adversely influenced by long lactation length, low feed intake during lactation, season, parity, genetics etc. Most sows should return to oestrus in one week after the weaning. But

some sows exhibit oestrus at various times after weaning. The target of around 90-95 per cent sows to be bred within 7-10 days post weaning may be failed due to the delayed return to estrus by the reminder sows. The reason needs to be identified and timely measures need to be addressed with improved managemental interventions. Synchronization of estrus can also be done with the manipulation of estrous cycles using pregnant mare serum gonadotropin (PMSG) and human chorionic gonadotropin (hCG) combinations. The synchronization of estrus in pigs also helps in managing the breeding of female pigs particularly those are shy in expressing estrus behavior and remaining 'silent'. But use of these hormones can only be used under the strict guidance and supervision of qualified veterinarians following the norms of the respective state.

**Summary**

The first step in addressing swine reproductive failure is recognizing the issue through a comprehensive review of production records. Often, multiple problems may be present simultaneously. Even if a definitive diagnosis isn't made, focusing on these issues can enhance reproductive management and productivity. This proactive approach can lead to improvements in overall herd performance.

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*Chapter 9*

# Basic principles of hygienic slaughter and value addition of pork

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Pig population in NE states is around 40% and Assam is ranked top in pig production in the country. More than 95% of indigenous people of NER are meat eaters and pork is considered as a principal meat among the different kinds of meat. Pig is considered as an animal of choice because of natural attraction of our local tribal people towards the avocation of pig rearing. In fact pig is considered as a prized animal and consumption of pork is the highest in NER. Of late pork products are also becoming popular and varieties of pork products are being imported to the region to satisfy the palate of our local people.

Meat processing scenario of our country is awfully underdeveloped. More than one percent of the total production of meat is converted into processed meat. Thus, considering the effect of globalization and free marketing concept of WTO, there is tremendous scope of meat processing in our country. Otherwise, some other countries will occupy and fulfil the present need with their products at a cheaper rate. This will cause big harm both for the producers and the farmers as well. Therefore, India should take all possible steps to develop the meat processing sector on priority basis.

## Meat/pork processing

Pork processing refers to any treatment which brings about substantial physical and chemical changes in the natural state of pork. In broadest sense this includes grinding, curing, smoking cooking, canning freezing, fermentation, dehydration, production of intermediate moisture products and use of certain additives such as seasoning, chemicals and enzymes etc. In processing, properties of fresh meat have been modified, however, the inherent property of "being meat" must remain intact even after processing.

## Meat technology

It is the practice of any or all of the applied science that have practical values or industrial use. It is the application of all scientific or modern knowledge for the production of meat in easier

methods which include slaughter, processing, transportation, storage and marketing etc. in such a way that has some practical value over traditional way of production. Thus, processing is a part of meat technology.

**Advantages of meat processing**

i. To change the form or characteristics of the products so as to make it easier to market and more attractive to the consumers
ii. Facilitates in incorporation of non-meat ingredients for quality and economy
iii. Helps in preservation, transportation and distribution to cover larger population (City life becomes easier)
iv. Helps in utilization of low-quality meat and by-products
v. Development of different products with different recipe, thus varieties of value added and functional pork products can be produced
vi. Helps in fast food chain of food industries
vii. Inhibit climatic factors and destroy microorganisms that might cause deteriorative changes or spoilage
viii. Improves nutritive values

**Requirements for pork processing**

For successful processing of pork following infrastructures are required.

- Constant flow of healthy pigs to feed the plant
- Scientific transportation of live animals
- Slaughter house with lairage and modern slaughter equipment.
- Modern processing equipment.
- Pork products to be developed with good recipe
- Scientific packaging, cold storage and marketing facilities
- By-products utilization facilities
- Technical manpower

**Basic methods of pork processing**

***Comminution:*** It is a process by which raw meat is subdivided or reduced into small pieces, chunks, chips or slices etc. Such particle size reduction helps in the uniform distribution of seasoning, enhance the tenderness of meat of old animals and reduces the fuel cost for cooking

.Comminution is done with the help of meat mincer and bowl chopper is also used for making fine emulsion. e.g. Sausage. Non-comminuted meat products are-ham, bacon, corned beef etc.

***Emulsion:*** It is a process where two immiscible liquids are mixed together and one of which is dispersed in the form of small droplets or globules in the other liquid. Thus, emulsion has two phases- a continuous phase and a dispersed or discontinuous phase. These phases remain immiscible due to the existence of an interfacial tension between them. To stabilize the meat emulsion, emulsifying agents are used. Meat emulsion is an oil-in-water emulsion.

***Blending/preblending:*** Blending refers to an additional mixing, i.e. mixing of certain chemicals or other products in comminuted meat prior to further processing.- curing, and seasoning.

**Meat extension**

A variety of non-meat food items are incorporated into products which are commonly referred as extenders, binders and fillers. Reasons of incorporation: -

- To improve emulsion stability
- To improve water binding capacity.
- To enhance flavours
- To reduce shrinkage during cooking.
- To improve slicing characteristics
- To reduce formulation cost.

E.g. Fillers - Soy products, potato, starch

Extenders – Wheat, rice, pea, corn flours etc.

Binders – Milk powers, dried whey and sodium casinate

***Seasoning:*** Any ingredient that is added to improve or modify the flavours of process meat products. In addition to flavours, seasonings also help to preservation of meat. Seasonings include salt, spices, herbs, vegetable, sweeteners monosodium glutamate, e.g.-Anise, clove, cinnamon, cumin, garlic, ginger and onion etc.

***Use of humectants:*** Various additives employed for lowering the water activity of foods are know as humectants e.g. glycerol, propylene glycol, sorbitol sugars.

***Use of preservatives:*** Any substance which is capable of inhibiting, retarding or arresting the process of fermentation, acidification or other deterioration of food and enhances the shelf life of the food products is known as preservative. Two classes of preservatives are there.

Class I: - Common salt, sugar, honey, glucose, dextrose, spices, vinegar and edible oils etc. No restriction on the quantity is there.

Class II:- Permitted within specified limits in specified food and levels must be declared. E.g. Benzoic acid, nitrates, nitrites and ascorbic acid etc.

***Use of antioxidants:*** Delays or retards or prevents fat oxidation. e.g. BHT (Butylated hydroxyl toluene), BHA (Butylated hydroxyl anisole), Vit.C, and Vit. E

**Common processing technology for preparation of value added pork products**

***Drying:*** The purpose of drying is to reduce the availability of moisture. It also reduces the water activity of the food products and thus, hinders the growth and multiplication microbes. Rehydration is required before consumption. Used mainly for military purposes. It is not a usual method for preparation of value-added pork products.

***Salting and curing:*** High concentration of salt expel out the water by osmosis, thus, microbial growth is restricted. Another purpose is colour and flavour retention. Main disadvantage is that halophilic bacteria may grow. Salting and curing is a part of processing of some of the value added pork products.

***Smoking:*** Smokes contains formaldehyde, phenol, alcohol, cresol, aliphatic compounds, aldehyde and ketone which have bacteriostatic effect. Smoke is mainly effective against vegetative cells. It also coagulates the surface protein and blocks the entry of microorganisms. Liquid smoke is better. Certain carcinogenic and mutagenic substances like Heterocyclic amines (HCA) and polycyclic aromatic hydrocarbon (PAHs). Smoking enhances the flavour and acceptability of the pork products.

***Canning:*** It is a thermal processing method. Processed products are packed in hermitically sealed containers and then treated with heat (At least $121^0$C). Cans are then cooled and stored. Can meats are ready to eat products.

***Enrobed pork products:*** Coating of meat products with edible materials in the form of batter using flours, whole egg and other cereal products is done to produce enrobed pork products. Enrobing imparts the product a crispy texture, increases eating quality. Pork cutlets, pork patties and nuggets etc.

***Intermediate moisture pork products:*** Pork products with 15-50% moisture content with moderate juiciness and texture, inhibit growth of bacteria, moulds and yeast, water activity

between 0.6 to 0.85, self-stable at ambient temperature for a considerable length of time are known as intermediate moisture pork products. A mixture of sodium chloride, glycerin, lactic acid and antioxidants are used in the formulations.

***Restructured pork products:*** It is a process where pre-cut or comminuted meat is moulded into a shape resembling to a natural streak or intact cut. It is a good method of upgrading value of low-quality meat. The pre-cut meat pieces are tumbled or massaged and because of this process, protein exudes from the meat surface and thereafter high pressure is exerted to give a restructured new product.

***Fermented pork products:*** Fermented pork products can be prepared by using lactic acid producing specific microflora like Lactobacillus, Micrococcus and Pediococcus etc. The bacterial cultures create such an environment that other spoilage and harmful microorganisms can not grow. Based on the moisture contents, three types of fermented pork products can be manufactured, E.g. Dry, semi-dry and moist. Extension of storage life, safety of foods and improvement of sensory properties are the benefits.

***Heat processing (Cooking):*** Cooking must be done at an internal temperature of not below 65-70°C. There are few changes taken place during cooking. There is coagulation and denaturation of protein, connective tissue (Collagen) conversion into gelatin, increasing of tenderness, and development of brown colour and textural changes of meat tissue. Generally meat and meat products are cooked by three methods.

- Dry heat cooking: - Dry heat cooking involves either broiling, roasting or frying. This method is suitable for pork of low connective tissue like pork shoulder, loin cured ham etc.
- Moist heat cooking: - This method is recommended for relatively tough cuts with large amount of connective tissue. Pressure cooking, simmering, stewing and braising are the example of moist heat cooking
- Microwave cooking: - It is a modern and rapid method. The heating results from the conversion of microwave energy to heat by friction from internal molecular rotation caused by the interaction of molecules with the rapidly fluctuating electromagnetic field. This method is many times faster than conventional method.

***Designer pork products:*** Pork can be effectively utilized to produce designer/health pork products. This is achieved by lowering fat, sodium and calories by incorporating fat replaces, fibers and natural antioxidants. A combination of hydrocolloid fat substitute, sodium alginate

and carrageenan enhance the sensory attributes of low-fat meat products. It is now tried to formulate designer meat food with bioactive peptides to use as disease-preventing and health-promoting food.

**Formulation of processed pork products**

There are hundreds of processed pork products in the world. Some of the very common processed pork products are ham, bacon, salami, sausages, luncheon meat, pickles, patties, loaves, balls, nuggets, slices and pork snack products.

- The first goal of formulation of the product should be such that it maintains uniform appearance, taste, composition, nutritive value, physical properties. The product should be acceptable to the consumers.
- The second goal is that it must meet the quality standards.
- The third goal is that the proportion of meat ingredients like meat, fat and by-products to non-meat ingredients like binders, extenders, fillers, spices salt etc. should be such that the products become stable and cost effective.

**Selection and care of animal before slaughter**

Several factors should be considered before slaughtering a hog for consumption. The most important considerations are health, kind of animal '(barrow, gilt, sow, or boar), expected meat yield, and care of the animal before slaughter.

*Health:* One should take care that an unhealthy animal is not selected for slaughter. At the time of selection, look for signs of sickness such as fever, increased breathing rate, and diarrhea. Animals suspected of being unhealthy should be treated by a veterinarian until the animal is returned to a healthy state. As a general rule, food control regulations prohibit the sale for human consumption of the carcasses of an animal that has died from natural causes, in the case of animal killed by accident.

*Animal care:* It is important to exercise proper care of the animal prior to slaughter, if one expect to obtain high quality meat. Pen the animal in a clean, dry place the day before slaughtering. Restrict the animal from feed 24 hours prior to slaughter, but provide access to water at all times. The slaughter of hot, excited animals increases the risk of sickness, injury, and darker meat; therefore, do not run the animal or wrestle with it. Bruises and whip marks cause bloody spots which must be trimmed out.

*Animal type and meat yield:* Highest quality pork is produced from young, healthy, well-fed, meaty hogs that weigh from 80-100 kg. The meat-type hog should have full, plump, meaty hams and straight, smooth sides. Fat should be firm, evenly distributed, and not more than 1.6 to 1.7 inches average thickness over the back. The average meat-type hog produces as much pork as a family of two consumes in 10 to 12 months. Heavier, fatter hogs produce less lean and more excess fat. A meat-type hog, when cut and trimmed according to the methods described later, will yield approximately 65 to 70 percent of its carcass weight in ham, picnic shoulder, loin, bacon, and boston butt. The slaughter of boars is not recommended. Meat from boars has a strong odor during cooking, and an off-flavor. This "sex" odor and flavor is often identified as being "boar taint/ soapy," and the odor increases as boars approach sexual maturity. If old boars are to be slaughtered, they should be castrated and allowed to heal prior to being slaughtered.

**Preparing for slaughter**

Prior to the day of slaughter, select the slaughter site, accumulate all equipment, prepare for waste disposal, and, if necessary, arrange with a local processor or meat market for chilling and cutting the carcass. If one plan to have the carcass chilled and cut up, make arrangements concerning the time and day on which the carcass can be accepted, the charges, and specific instructions for chilling, cutting, and wrapping. All waste products should be disposed of in a sanitary manner. If the animal is to be slaughtered in the open, select a site with good drainage so that blood and water can drain away from the carcass. Do not allow blood and water to pollute nearby streams or other water supplies. Disposal of viscera and hair is often a problem. Arrange to have a local processor or rendering plant pick up these wastes. If this is not possible, bury them so that dogs and other animals cannot dig them up.

*Emergency slaughter:* It is used for sick or injured animals and is designed to save the meat for human food, wherever possible. Emergency slaughter should always be carried out in a special sanitary slaughter pen. In such cases, the meat should be subjected to bacteriological examination before final judgment is passed.

**Stunning**

The animal should be killed as quickly and humanely as possible. In most slaughter plants, hogs are immobilized either by electrical stunning or carbon dioxide gas suffocation. On the farm, a hog can be stunned by striking it one sharp blow with a mechanical stunner or by shooting it in the forehead midway between and slightly above the eyes. The first attempt should be successful. Improperly placed bullets could cause the animal much pain and injure

helpers or other livestock. Animals that become excited during stunning will not bleed as well as those less excited. As always the case whenever using firearms, exercise all appropriate safety precautions.

A key factor in achieving an effective stun in electric stunning method is the delivery of a sufficiently high electric current. For an effective stun, the electric tongs must span the animal's brain. A minimum of 1.25 amps (198 watts) must be passed through a pig's brain to reliably induce insensibility. This is especially important for heavy pigs (over 100 kg). The period of unconsciousness produced by an electrical stun does not last for long. In order to minimize the danger of animals regaining consciousness, the period of unconsciousness induced by the stun must be longer than the combination of the stun-to- stick interval and the time from sticking to loss of brain responsiveness. Therefore, the gap between stunning and sticking should not exceed 15 seconds if the danger of pigs regaining consciousness during bleeding-out is to be minimized. The presence of rhythmic breathing can be considered as an indication of recovery from a stun at the time of sticking. Unrestrained animals falling away from electrodes during the application and animals slipping from shackles also lead to the need for second stuns and/or prolonged stun-to- stick intervals.

The head-only stunning electrodes, when applied, should span the brain. The strength of electric current should be sufficient to induce immediate loss of consciousness. Good electrical contact must be maintained during application. Bleeding should be performed within 15 seconds from the end of stunning. Appropriate measures should be taken to reduce the incidence of mis-stun or repeat stun, and recovery of consciousness during bleeding.

Although permitted by the law, the gas stunning method by $CO_2$ departs from the normal legal requirement that stunning must produce immediate unconsciousness. Pigs which are not stunned properly by the carbon dioxide may emerge from the stunner appearing flaccid and recumbent, but sensitivity may return. They may appear unconscious, but may in fact be conscious and able to feel pain; careful observation of signs such as eye blink and rhythmic breathing would reveal that they were conscious or returning to consciousness. In practice, pigs are generally exposed to high concentrations of carbon dioxide for about 90 seconds. There is presently considerable interest in the use of either 90% argon in air or a mixture of 30% carbon dioxide and 60% argon in air for stunning/killing pigs. Also, pigs must be immersed in argon or the mixture of carbon dioxide and argon for adequate periods and/or then stuck relatively quickly if they are not to regain consciousness during bleeding out. One of the main factors mitigating against reasonable welfare standards at slaughter is the very high throughput rates

which are the norm at most modern slaughterhouses. A pig abattoir using electrical stunning may kill about 300 animals per hour, while one using carbon dioxide may slaughter up to 700 per hour, or even more. At high throughput rates one should extremely careful to attain proper welfare standards at slaughter for individual pigs.

**Bleeding**

Bleeding is a very important part of the slaughtering operation. The animal should be bled within 2 minutes after it is down because the blood pressure may increase and thus break the capillaries and cause an unattractive condition in the meat called “blood splash.” Although meat with this condition is safe for consumption, it is quite unpleasant in appearance. After stunning the animal, hoist the animal to the overhead rail and locate the tip of the breastbone, along the midline. A 6-inch sticking knife sharpened on both sides of the tip is best. However, a regular boning or skinning knife can be used. Hold the knife at a 35-to 40-degree angle, thrust it under the breastbone with the point aimed toward the tail and then give an upward thrust (dip the point) to sever the carotid artery. No twisting or cross-cutting of the knife is necessary. If the hog does not bleed, insert the knife a little deeper a second time and there should be little difficulty getting a good stick. To avoid a “shoulder stick.” do not insert the knife too far to either side. The bloody tissue resulting from a shoulder stick will subsequently require trimming. Blood shall be allowed to drain freely from the wound. However, many countries have already discontinued open collection of blood in this way, in order to eliminate the risk of contamination. An apparatus now in general use consists of a knife for making the incision, with a tube attached through which the blood drains away without coming in contact with the edges of the wound. This is a method that provides a product satisfying every reasonable hygienic demand. Stainless steel containers shall be used for storing the blood under refrigeration.

**Hair removal**

Once the animal is bled, the hair can be removed by scalding the animal in hot water followed by scraping either manually or with the help of machines. Traditionally, hogs have been scalded and scraped, and the skin is left intact. For scalding, the most important consideration is maintaining an adequate supply of properly heated water. Scalding water temperatures between 60- 65$^{o}$C are optimal. At these optimal temperatures, 4 to 6 minutes of scalding are required to loosen the hair and scurf (layer of accumulated oil, dirt, and the outer layer of cells on the skin). Check the hair often for ease of removal. The hair slips first over the back and sides, then in the flank regions. When the hair can be pulled easily in the flank regions behind the shoulders,

remove the hog from the scalding tank and put into the dehairing machine, where most of the body hairs will be removed mechanically. Once the dehairing is over, transfer the animal to gambrel table and the carcass is now ready to be suspended. Expose the gambrel tendons by cutting through the skin on the backs of the rear legs from dew claws to hock. Cut down each side of the tendons, being careful not to cut the tendons. Insert the spreader or gambrel under both tendons on each leg. Secure the legs to the overhead rail and suspend the carcass.

A gas singer or blowtorch can be used to singe the remaining hair and scurf. Singeing removes most of the hair and allows small, light hairs to be seen. Use caution during singeing to prevent burning the skin. Scrape as much of the hair on the head as possible, especially around the ears and snout. Scrape the hot carcass as quickly as possible because the skin tends to "set" as it cools. If patches of hair cannot be removed with the scraper, use a knife. Remove the toe nails and dew claws from the rear legs and pull the hair from the tail. Shave the remaining hair and wash the carcass thoroughly.

**Evisceration**

Loosen the anus by cutting around it, deep into the pelvic canal. Pull outward and cut any remaining attachments; be careful not to cut into the large intestine. When the anus is loosened, tie it with a piece of string to avoid contaminating the carcass. Remove the penis from a slaughtered barrow. Cut through the skin and fatty tissue along each side of the penis and around the penis opening. Lift upward and cut underneath it along the midline. Cut along the penis between the hams, pull the penis upward and remove it at its attachment at the base of the ham. Continue the cut made between the hams, at their natural separation, exposing the white connective tissue. Cut through the tissue to the pelvic (aitch) bone. Continue cutting through the cartilage between the aitch bone and separate the hams. This procedure is satisfactory in young pigs; however, a saw may be needed to split the aitch bone in older hogs. Make a cut through the lean and fat from the point where the pig was stuck to the upper end of the sternum or breastbone. Insert the knife at the top edge of the sternum, cut downward and slightly off-center to open the chest cavity. Open the midline, beginning at the opening made when the aitch bone was split. With the handle of the knife inserted in the opening and with the blade pointed outward to avoid cutting the intestines, open the midline to the opening made at the breast. Allow the intestines and stomach to roll outward and hang. Do not allow them to fall because the esophagus will tear and spill its contents onto the carcass. Pull the loosened large intestine down past the kidneys. Sever the attachments to the liver and remove it by

pulling outward and cutting the connective tissue. Remove the gall bladder from the liver by cutting beneath it and pulling. Be careful not to allow its contents to spill onto the liver.

Pull the stomach and intestines outward and cut through the diaphragm. This is the thin sheet of muscle and white connective tissue that separates the stomach and intestines from the lungs and heart. Pull outward on the lungs and heart and cut down each side of the esophagus, severing its attachment at the head. To separate the heart from the lungs, cut across its top. The heart should be split open to allow thorough washing.

**Splitting and head removal**

Wash the inside of the carcass before splitting. With the saw, begin splitting from the inside between the hams. Keep the split as near the center of the backbone as possible, and saw through the tail region to a point midway through the loin. Move around to the back and continue sawing through the shoulder and neck to the base of the head. If the split gets off center, continue sawing through to the next vertebra and then realign the saw.

Remove the head at the atlas joint (the joint closest to the head). This joint should be exposed if the carcass is properly split. After cutting through the joint cut downward along the jaw bone, leaving the jowls attached to the carcass. If desired, remove the tongue, wash it thoroughly, and place it with the liver and heart. Remove the kidneys and leaf fat. The leaf fat is removed by loosening it from the diaphragm muscle and lifting it upward. Wash the carcass thoroughly before chilling.

**Examining the carcass**

All the internal organs and the dressed carcass should be examined carefully for any abnormalities or conditions that might affect the fitness of the meat for food. Usually a meat inspector or graduate veterinarian is the only person qualified to do this, and one should be present to inspect the carcass. Bruises, minor injuries, parasites in the organs, enclosed abscesses, and single tumors are frequently local conditions that can be easily removed. However, congestion or inflammation of the lungs, intestines, kidneys, inner surface of chest, or abdominal cavity and numerous yellowish or pearl-like growths scattered throughout the organs should be viewed seriously.

**Chilling the carcass**

The surfaces of freshly slaughtered hog carcasses are contaminated with bacteria that can spoil the meat unless their growth is promptly checked. Bacterial growth can be slowed by prompt chilling and keeping the carcass at low temperatures ($4^{o}$C). Do not allow the carcass to freeze

because freezing within one day after death may toughen the meat. The carcass can be cut into retail cuts after it has been chilled for 24 to 48 hours.

**Sequence of events in pig slaughter**

Modern online rail system of slaughter of pigs involves following steps,

1. Stun the animal
2. Shackle and hoist
3. Stick
4. Operate scalding and dehairing machine
5. Insert gambrel and hang-off
6. Singe
7. Shave hams
8. Shave bellies
9. Shave shoulders
10. Shave heads and fore feet
11. Remove heads and place on table
12. Open and eviscerate
13. Trim bruises and enucleate kidneys
14. Head, viscera and rail inspection
15. Final inspection
16. Pull leaf fat and remove kidneys
17. Wash necks
18. Viscera and head take-off
19. Head work-up
20. Open stomachs
21. Wash hearts and livers

The above line can slaughter up to 100 pigs per hour.

*Chapter 10*

# Role of Self-Help Groups and FPOs in achieving self-sustainability in pig production

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Entrepreneurship development is crucial for a country's growth and development. In agriculture, entrepreneurship involves creating new business ventures aimed at profitability by utilizing agricultural resources. Entrepreneurs typically exhibit characteristics such as innovativeness, risk-taking ability, planning and goal setting, and time management. However, individuals with less education and exposure often hesitate to start new ventures due to perceived low risk-bearing ability. This is where group-based entrepreneurship development becomes important.

Forming groups of small and marginal farmers provides them with more confidence and strength than operating individually. The profit-making ability of a group depends on their cohesiveness and their linkages with stakeholders in the sector. New ventures in agriculture and allied sectors are gaining more attention, and government policies to promote agribusiness support agri-entrepreneurs through credit support and subsidies. Since Indian farming is predominantly done by small and marginal farmers, group formation is encouraged through various government schemes to improve their bargaining power.

Pig farming, a component of livestock farming, contributes 1.7% of the total livestock population in India, with the rural areas of the North Eastern Regions holding 40% of the total pig population. Pig farming is mainly practiced by tribal communities in this region as an integral part of their lives. Promoting group-based entrepreneurship development in the piggery sector can uplift rural poor communities. Organizations should first create awareness about different entrepreneurial opportunities and government support. Grassroots officers should understand the process of group entrepreneurship development to mobilize the rural poor effectively. By doing so, multiple goals such as poverty reduction, employment generation, nutritional security, and women empowerment can be achieved simultaneously.

This chapter discusses entrepreneurship development through self-help groups (SHGs) and farmer producer organizations (FPOs) in the piggery sector.

**Importance of entrepreneurship development in the Piggery sector:**

Pig farming is one of the aspects of livestock production that accounts for 1.7% of India's total animal population. 40% of all pigs in the nation live in the rural areas of the North Eastern Regions. The tribal communities in this area mostly engage in pig farming as an integral element of their way of life. So, it is possible to lift up the rural poor by encouraging group-based business development in the piggery industry. Organizations should start by raising public knowledge of the various entrepreneurial prospects and government funding. The officers who work at the local level must to be knowledgeable about how group entrepreneurship develops. Multiple objectives, including poverty reduction, employment creation, nutritional security, and women's empowerment, can be achieved at once by organizing the rural poor for group-based business development. So, in this chapter, we talk about how farmer producer organizations (FPOs) and self-help groups (SHGs) can both foster entrepreneurship in the pig industry.

**Concept of Self-Help Groups (SHGs):**

Self-Help Groups (SHGs) are small, voluntary, and informal associations of individuals, primarily women, who come together for collective savings, credit, and mutual support. SHGs aim to empower their members by providing them with a platform to pool their resources, enhance their livelihoods, and address socio-economic challenges. The concept of SHGs originated as a grassroots approach to poverty alleviation and social empowerment, particularly in developing countries. The phrase "for the people, by the people, and of the people" guided the creation of Self-Help Groups. People from the same socioeconomic class make up these groups. They voluntarily enlist in order to become independent. They turn to entrepreneurship to find solutions to their typical issues. SHGs are legal whether or not they are registered. Under the state cooperative legislation, the partnership act, or the societies registration act, SHGs may be registered. Through the provision of credit in times of need, SHGs help its members maintain greater financial security. The SHGs often keep records of financial transactions, loan registers, cashbooks, attendance sheets, members list, minutes of meetings, and general ledgers. Without any collateral securities, they have better access to bank borrowing as a group.

Therefore, enterprises initiated by SHGs have a greater chance of success and financial gain than individual attempts.

**Key aspects of Self-Help Groups:**

a) **Formation:** SHGs are formed by a group of individuals who share a common purpose or belong to the same community. Typically, these groups consist of 10 to 20 members who voluntarily join together. They may be organized based on geographical proximity, occupation, or common interests.

b) **Savings and Credit**: The primary function of SHGs is to promote savings and provide access to credit for their members. Members contribute a predetermined amount of money regularly into a common pool, which forms the savings component of the group. The accumulated savings are then utilized to provide loans to the members for various purposes, such as income-generating activities, education, healthcare, and emergencies.

c) **Mutual Support and Capacity Building:** SHGs foster a spirit of mutual support and cooperation among members. They provide a platform for sharing knowledge, experiences, and skills. Members engage in discussions, trainings, and workshops to enhance their capacities in various areas, including financial literacy, entrepreneurship, and social awareness. This collective learning and support system strengthen the social fabric and build confidence among the members.

d) **Microfinance and Financial Inclusion:** SHGs play a significant role in promoting financial inclusion, particularly among marginalized communities. By pooling their savings and accessing credit from their group, members can avoid exploitative moneylenders and formal financial institutions that may be inaccessible or unaffordable. SHGs often collaborate with banks, microfinance institutions, and development agencies to secure additional funds and financial services for their members.

e) **Women Empowerment:** SHGs have been instrumental in empowering women, especially in patriarchal societies. By participating in SHGs, women gain access to financial resources, decision-making opportunities, and a supportive network. SHGs enable women to build their confidence, develop leadership skills, and challenge social norms. They also serve as a platform for discussing and addressing gender-related issues and promoting women's rights.

f) **Community Development and Social Impact:** SHGs extend their impact beyond individual members to the broader community. They engage in community

development initiatives, such as awareness campaigns, health programs, education initiatives, and environmental conservation efforts. SHGs act as catalysts for social change, poverty reduction, and sustainable development at the grassroots level.

g) **Government Support and Policy Interventions:** Governments and development organizations recognize the importance of SHGs and provide support through policy interventions and financial assistance. Governments may offer subsidies, training programs, and access to markets for SHG members. They also collaborate with SHGs to implement welfare schemes, rural development projects, and poverty alleviation programs.

**Self Help Groups in the Piggery Sector:**

In Assam's rural communities, women's self-help groups collaborate by maintaining pig breeding farms. There is great potential for establishing small-scale pork processing businesses. Women's SHGs can produce their own line of pig products, such as pork pickles, momo, smoked pork, traditional sausage, etc. with no capital outlay. They can readily obtain loan support from banking institutions with subsidies from various government programs, such as the National Livestock Mission. The Self-Help Groups can receive hand holding support and access to skill development programs under the Deendayal Antyodaya Yojana-National Rural Livelihoods Mission (DAY-NRLM).

**Farmer Producer Organizations (FPOs):**

Farmer producer organizations (FPOs) are businesses created and legally registered by farmers. A FPO aims to distribute earnings among its members, and it may have any legal form, such as a producer company or cooperative organization (Anonymous,2013). FPOs are established as independent organizations to guarantee higher income.

By managing enormous volumes of inputs and produce, it aids farmers in gaining the advantages of economies of scale. FPOs increase the farmers' negotiating position and cut out lengthy networks of middlemen. By offering improved economic prospects like value addition, FPOs assist farmers. FPOs support farmers by giving them access to improved technology, investments, and marketplaces as well as better market information. FPOs are a means of empowering farmers and promoting collective action in agriculture. They aim to address the challenges faced by individual farmers by creating a platform for collaboration, sharing resources, and collectively undertaking agricultural activities. Farmer Producer Organisations (FPOs) are entities formed by farmers with the aim of

improving their economic and social status through collective action. FPOs are typically registered as cooperative societies, companies, or trusts, and they bring together small and marginal farmers to collectively undertake various agricultural activities.

**Key features of Farmer Producer Organizations:**

The features of Farmer Producer Organisations (FPOs) can vary depending on their specific context and objectives. However, here are some common features of FPOs:

i. **Collective Ownership:** FPOs are owned and governed by farmers themselves. The farmers come together as members and collectively own the organization. They have a say in decision-making processes and the distribution of benefits.

ii. **Farmer Participation:** FPOs encourage active participation of farmers in all aspects of the organization's functioning. Farmers contribute their knowledge, skills, and experiences to the collective decision-making process.

iii. **Legal Entity:** FPOs are registered as legal entities, such as cooperative societies, companies, or trusts, depending on the applicable laws of the country. This legal recognition provides the organization with a formal structure and facilitates its operations.

iv. **Membership Criteria:** FPOs typically have specific criteria for membership, which may include factors like landholding size, type of crops cultivated, or geographical location. The membership criteria ensure that the organization represents the interests of a specific group of farmers.

v. **Collective Marketing:** One of the primary objectives of FPOs is to collectively market the produce of their members. They aggregate the farmers' produce, negotiate better prices, and create market linkages to ensure better market access and higher profitability for farmers.

vi. **Input Procurement:** FPOs facilitate bulk procurement of agricultural inputs such as seeds, fertilizers, pesticides, machinery, etc. This enables members to access quality inputs at competitive prices, resulting in cost savings.

vii. **Value Addition and Processing:** FPOs often engage in value addition activities such as grading, sorting, packaging, and processing of agricultural produce. These activities help improve the quality and marketability of the products, leading to higher profits for farmers.

viii. **Capacity Building:** FPOs provide training and capacity-building programs to farmers. They impart knowledge and skills related to sustainable farming practices, modern techniques, post-harvest management, financial literacy, and entrepreneurship.

ix. **Access to Finance:** FPOs help members in accessing credit and financial services by facilitating linkages with financial institutions. They may also develop savings and credit mechanisms within the organization to meet the financial needs of farmers.

x. **Social Development:** FPOs often undertake activities for the social development of farmers and their communities. These may include initiatives related to education, healthcare, women empowerment, skill development, and environmental conservation.

xi. **Advocacy and Policy Engagement:** FPOs advocate for the rights and interests of farmers. They engage with policymakers, government agencies, and other stakeholders to influence policies, regulations, and programs that affect agriculture and farmers.

xii. **Transparency and Accountability:** FPOs maintain transparency in their operations and ensure accountability to their members. They maintain proper records, conduct regular audits, and share information with members regarding financial transactions and decision-making processes.

**Legal Forms of Farmer Producer Organizations:**

A FPO can take different legal forms under different acts as follows:

- Cooperative Societies Act/ Autonomous or Mutually Aided Cooperative Societies Act of the respective State
- Societies registered under Society Registration Act, 1860
- Section 25 Company of Indian Companies Act, 1956, as amended as Section 8 in 2013
- Producer Company under Section 581(C) of Indian Companies Act, 1956, as amended in 2013
- Multi-State Cooperative Society Act, 2002
- Public Trusts registered under Indian Trusts Act, 1882

**Farmer Producer Companies:**

The most popular legal form of FPOs is the Farmer Producer Company (FPC). According to the 2013 Indian Companies Act, FPCs are registered. In this case, cooperative organizations and private limited enterprises have combined. Its regulatory structure is comparable to that of private limited firms and it takes into account the particulars of cooperative enterprise (Singh, 2008). Ten or more producer farms, two or more producer institutions, or both can come together to form an FPC. The participants can participate in tasks like manufacturing, processing, marketing, etc. The equity shares that make up the share capital are transferable but not traded. Every member has a single vote when it comes to voting. A board of directors (minimum of 5 and maximum of 15) should be present in an FPC. The board of directors is chosen by the FPC members at the annual general meeting. The board should designate a chief executive officer (CEO) who works full-time. The government has minimal authority over the FPCs, which is restricted to what is necessary to comply with the law.

**Producer Organization Promoting Institution (POPI):**

The administration and staff of producer groups receive ongoing training and support from the institutions that promote producer organizations. A POPI can be a government agency, a non-profit, a cooperative society, a bank branch, or any other type of organization. By covering a portion of the ongoing expenses associated with producer organization promotion, NABARD and SFAC assist POPIs. The POPI makes sure that the producer groups are able to conduct their operations sustainably and that their personnel are better equipped to do so even after POPI help is no longer provided.

**Farmer Producer Companies in the Piggery Sector:**

The importance of FPCs in the piggery sector is particularly significant because small-scale pig farmers dominate the sector. Farmers may benefit from FPCs' collective activity by paying less for inputs and selling their output for more money. Examples of FPCs in the pig industry are Goreswar Piggery Producer Company Ltd., which has 2500 female pig farmers in the Assam districts of Dhemaji and Lakhimpur, and SAAR Pig Producer Company Ltd., which has 500 female pig farmers in the Baksa district of Assam.

The FPCs in piggeries are primarily engaged in activities like the affordable feed distribution to the member farmers, the direct market sale of pigs and piglets, the slaughter of pigs at a common slaughterhouse, the processing of pork into value-added pork products, and the

branding and marketing of the pork products. The FPCs also serve as a conduit between farmers and organizations that offer training and loans.

**Promoting entrepreneurial ecosystem in piggery sector through Self Help Groups (SHGs) and Farmer Producer Organisations (FPOs):**

Promoting an entrepreneurial ecosystem in the piggery sector through Self Help Groups (SHGs) and Farmer Producer Organizations (FPOs) involves creating a supportive environment that nurtures and encourages entrepreneurship (Bhadwal *et al.*,2022). Here are some strategies for fostering an entrepreneurial ecosystem:

**Formation of SHGs and FPOs:** Encourage the formation and strengthening of SHGs and FPOs specifically focused on the piggery sector. These groups provide a platform for aspiring entrepreneurs to come together, share knowledge, access resources, and collectively address common challenges.

**Capacity Building:** Provide training and capacity-building programs to SHGs and FPO members on various aspects of entrepreneurship in the piggery sector. This includes technical skills related to pig farming, business management, financial literacy, marketing, and value addition. Capacity building enhances their entrepreneurial competencies and increases their chances of success.

**Access to Finance:** Facilitate access to finance for SHGs and FPOs, as well as individual entrepreneurs within the groups. This can be done through linkages with financial institutions, government schemes, and microfinance initiatives. Accessible and affordable finance enables entrepreneurs to invest in infrastructure, purchase livestock, and cover operational expenses.

**Market Linkages and Value Addition:** Support SHGs and FPOs in establishing market linkages for their members. This can involve creating partnerships with buyers, processors, and retailers who are interested in sourcing pig products. Additionally, encourage value addition activities such as processing, packaging, and branding, which can increase the market value and profitability of pig products.

**Technology and Innovation:** Promote the adoption of innovative technologies and practices in the piggery sector. This can include improved breeding techniques, feed formulations, waste management systems, and health management practices. Providing access to modern technologies and promoting innovation helps entrepreneurs enhance productivity, reduce costs, and differentiate their products in the market.

**Networking and Collaboration:** Facilitate networking opportunities for SHGs, FPOs, and entrepreneurs in the piggery sector. This can include organizing industry events, trade fairs, and workshops where entrepreneurs can connect, share experiences, and explore collaborations. Networking helps in knowledge exchange, learning from successful entrepreneurs, and accessing new market opportunities.

**Policy Advocacy:** Engage with policymakers and government agencies to advocate for favourable policies and regulations that support entrepreneurship in the piggery sector. This can include measures such as tax incentives, subsidies, streamlined licensing processes, and access to infrastructure and utilities. Policy advocacy ensures an enabling environment for entrepreneurs to thrive and grow.

**Mentorship and Business Support Services:** Establish mentorship programs where experienced entrepreneurs or industry experts can provide guidance and support to budding entrepreneurs in the piggery sector. Offer business support services such as business planning, financial management, and marketing strategies to help entrepreneurs develop and execute their business ideas effectively.

**Research and Development:** Encourage research and development activities in the piggery sector to drive innovation and improve productivity. This can involve collaborations with agricultural research institutions, universities, and industry experts to develop new technologies, breeds, and management practices that benefit entrepreneurs.

**Recognition and Awards:** Recognize and celebrate the achievements of successful entrepreneurs in the piggery sector through awards and incentives. This creates role models and inspires others to embark on entrepreneurial ventures in the sector.

By implementing these strategies, SHGs and FPOs can contribute to the development of a vibrant entrepreneurial ecosystem in the piggery sector. This, in turn, leads to increased investments, job creation, innovation, and overall growth of the sector.

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# *Chapter 11*

## Bankable Piggery Projects and Government Schemes for Pig Farming

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In India, pig rearing is a prevalent practice among various tribal communities and economically disadvantaged groups. It significantly contributes to enhancing the socio-economic conditions of poor, marginalized, and weaker sections of rural society. Livestock, including pigs, complement the agricultural system in India, making them a sustainable part of integrated farming systems.Pigs are especially vital in Eastern and Northeastern India due to the high demand for pork among tribal communities. Despite strong interest and demand, the reality of pig farming often falls short. This is due to several factors, including farmers' lack of knowledge about scientific pig rearing methods, high animal feed costs, insufficient access to quality genetic material, and limited support from state veterinary departments and extension services.The current objective of the pig industry is to produce high-quality lean meat at minimal cost. Achieving this goal is crucial for improving the socio-economic status of marginalized communities and addressing the challenges faced by small-scale pig farmers

Creating a bankable project for pig farming and applying for various government schemes involves several steps, including thorough planning, preparing detailed project reports, and understanding the application processes for relevant schemes. Here's a comprehensive guide to help you get started:

### 1. Conduct Market Research

- **Demand Analysis**: Understand the demand for pork and pig products in your target market.
- **Supply Chain**: Analyze the current supply chain and identify gaps or opportunities.
- **Competitors**: Study your competitors to understand their strengths and weaknesses.

### 2. Develop a Business Plan

A detailed business plan is essential for convincing banks and government agencies about the viability of your project. Key components include:

- **Executive Summary**: Overview of your pig farming project.
- **Business Objectives**: Short-term and long-term goals.
- **Market Analysis**: Insights from your market research.
- **Operational Plan**: Detailed plan of farm operations, including breeding, feeding, healthcare, and waste management.
- **Financial Plan**: Budget, revenue projections, and break-even analysis.
- **Risk Management**: Identification of potential risks and mitigation strategies.

**3. Prepare a Detailed Project Report (DPR)**

A Detailed Project Report (DPR) is more specific and technical compared to a business plan. It should include:

- **Introduction**: Background and objectives of the project.
- **Project Description**: Detailed description of the farm setup, including location, infrastructure, equipment, and technology to be used.
- **Management Plan**: Information about the management team and their roles.
- **Production Plan**: Breeding plan, types of pigs, feed requirements, and growth schedules.
- **Financial Details**: Capital investment, operating costs, revenue projections, and profitability analysis.
- **Environmental Impact**: Measures for waste management and environmental sustainability.
- **Social Impact**: Potential benefits to the local community.

**4. Identify and Apply for Government Schemes**

Different governments offer various schemes to support pig farming. Steps to identify and apply include:

- **Research Schemes**: Look for relevant schemes offered by the central and state governments. Some common schemes include subsidies, loans, and grants for animal husbandry.
- **Eligibility Criteria**: Ensure you meet the eligibility criteria for the schemes.
- **Documentation**: Prepare all necessary documents, including your business plan and DPR.
- **Application Process**: Follow the specific application procedures for each scheme. This may involve online applications, visiting local agricultural offices, or contacting government agencies.

- **Liaise with Officials**: Maintain communication with relevant officials to ensure your application is processed smoothly.

**5. Financial Assistance and Loan Application**

To make your project bankable, consider the following:

- **Bank Selection**: Choose banks that have a history of financing agricultural projects.
- **Collateral**: Be prepared to offer collateral if required.
- **Subsidies and Grants**: Highlight any government subsidies or grants you are eligible for to strengthen your case.
- **Professional Presentation**: Present your business plan and DPR professionally. Consider hiring a consultant if necessary.

**6. Implement the Project**

Once you secure funding and approvals, proceed with the implementation:

- **Construction and Setup**: Build the infrastructure as per your plans.
- **Procure Livestock**: Purchase high-quality pigs for breeding and rearing.
- **Operations**: Start farm operations and manage them efficiently.
- **Monitoring and Evaluation**: Regularly monitor the farm's performance and make necessary adjustments.

**7. Maintain Compliance and Reporting**

- **Regulatory Compliance**: Ensure compliance with all local, state, and national regulations related to pig farming.
- **Regular Reporting**: Submit regular reports to the bank and government agencies as required.
- **Audit and Review**: Conduct periodic audits and reviews to ensure the project remains on track.

**Resources for Government Schemes in India**

- **National Livestock Mission (NLM)**: Supports various aspects of livestock production.
- **Rashtriya Krishi Vikas Yojana (RKVY)**: Provides funding for innovative agricultural projects.
- **NABARD Schemes**: National Bank for Agriculture and Rural Development offers various schemes for livestock farming.
- **State Government Schemes**: Check with your respective state agricultural departments for local schemes.

**Cost Estimates of a Farm**:

**Layout:** The layout of a pig farming unit can vary based on climate, landscape, and farm size. Buildings should be situated away from roads and congested areas to prevent disease transmission and avoid spreading unpleasant odors to the surrounding community. The design should aim to minimize construction costs and utilize local materials whenever possible.

**Building:** The pig house must be well-maintained and meet essential criteria: it should be dry, weatherproof, well-ventilated, not stuffy, properly drained, comfortable, and efficiently organized. Proper placement of different sections within the building is crucial for effective management.

**Feed Supply:** Feed typically accounts for 70-80% of the production costs in pig farming, compared to 50-60% in other livestock enterprises. Ensuring a consistent and reliable feed supply is critical for the success of the operation.

**Livestock Supply:** The performance of pigs is central to the success of the enterprise. It is important to source pigs with superior traits from reputable suppliers who provide detailed information about growth rates, piglet survivability, birth weights, and feed conversion ratios (FCR). Emphasizing the heritability of desirable traits will contribute to better economic outcomes.

**Technical Support:** To maintain the commercial viability of the piggery, expert technical support is essential for monitoring the health and performance of the pigs. This support can be provided by government institutions, central government agencies, or experienced private practitioners.

**Cost of Production Estimate:** The cost of production is a critical factor influencing the sale price of pigs. Entrepreneurs should consider the following aspects to manage production costs effectively:

a) **Production of Large Litters**: Aim for high litter sizes to maximize output. b) **Economical Resource Use**: Optimize feed, labor, buildings, and equipment to reduce costs. c) **Disease and Parasite Control**: Implement effective management practices to prevent health issues. d) **Marketing**: Sell pigs at the optimal age and weight, and secure the best terms and locations for sales. e) **Facility Efficiency**: Measure productivity based on annual pig production, the average number of litters per sow, and the utilization of farrowing and nursing facilities.

Raising two litters per sow annually is often more profitable, especially with early weaning practices.

To calculate the cost of production, consider the following components:

1. Cost of studs and structures.
2. Cost of equipment and facilities.
3. Cost of breeding stock.
4. Cost of feed, breeding stock, and piglets.
5. Feed Conversion Ratio (FCR).
6. Mortality rate.
7. Cost of veterinary care and insurance.
8. Labor costs.
9. Miscellaneous expenses.

**Parameters for Economic Pig Production (Ghungroo Breed):**

**A. Production Standard:**

| | |
|---|---|
| i) Sexual maturity | - Male 8 to 9 months<br>Female 9-10 months |
| ii) Age at first furrowing | - 12 to 14 months |
| iii) Litter size at birth | >10 |
| iv) Litter size at weaning | - 9 |
| v) Inter-furrowing interval | - 180 – 200 days |
| vi) Weaning period | - 35-42 days |
| vii) Service period | - 30 - 45 days |
| viii) Pre-weaning Mortality | -10%< |
| ix) Post-weaning mortality | - 5%< |
| x) Replacement stock | - 10% per year |
| xi) Ave. body weight at weaning | - 8 to 10 kg |
| xii) Weight at 8 months (Market age) | - >80 kg |
| xiii) Furrowing rate (no. of furrowing/sow/year | >1.8 |
| xiv) Fertility rate | >90% |

**A. <u>Manpower Requirement:</u>**

2 boar + 10 sow - self employment

**Financial involvement for starting a project of 10 sows unit.**

**1st Year investment:**

**A. Non-recurring (infrastructure/ building/ sty)**

| Sl. No | Type of sty | Area details | Approx. Cost |
|---|---|---|---|
| **1** | Boar pen – 2 pens | @ 80 sq. ft / pen X2 = 160 sq. ft @ Rs.200/ sq ft | 32,000.00 |
| **2** | Farrowing pen | 2 pens @ 100 sq. ft./pen = 200 sq. ft @Rs. 200 | 40,000.00 |
| **3** | Dry sow pen | 4 pens @120 sq ft /pen = 480 sq. ft @Rs 200 | 96,000.00 |
| **4** | Weaners sty | 2 pens @ (15 x 8 sq ft. for 20 piglets each ) = 240 sq. ft @Rs 200/ | 48,000.00 |
| **5** | Growers pen | 2 pens @ (20x 10 for 20 growers = 400 sq. ft. @ Rs 200/ | 80,000.00 |
| **6** | Feed store | 10ft. x 10 ft. = 100 sq. ft.@ Rs. 400/ | 40,000.00 |
| **7** | Others | Water connection, electricity connection, drainage system, waste pig preparation. | 20,000.00 |
| | | Total | 3,56,000.00 |

**B. Cost of Animals:**

| | | |
|---|---|---|
| 1 | 2mature male (9-10 months age) @ 5,000/ male | 10,000.00 |
| 2 | 10 mature females (8-10 months age)@5000/ female | 50,000.00 |
| | Total | 60,000.00 |

**C. Working Capital (Recurring Cost):**

**a. Feed cost:**

| Sl. No | Category of animals | Details | Total cost |
|---|---|---|---|
| 1 | 2 adult male animals | @2.5 kg per animal/day for 365 days @ Rs 25 per kg of finisher concentrate feed. | 45,625.00 |
| 2. | 10 adult female | @2.5 kg per animal/day for 365 days @ 25 per kg of finisher concentrate feed | 2,28,125.00 |
| 3. | Weaners feed (starter feed) | With 90 % fertility, 9 gilts will produce 90 piglets @ 10 piglets/female. Keeping 5 % mortality, remaining 85 piglets will have to provide starter ration @ av. 200 g/ piglet for 1 month @Rs. 28/kg starter. | 14,280.00 |

| | | | |
|---|---|---|---|
| 5. | Others | Cost of medicine, vaccines etc. | 3000.00 |
| 6. | Farm utensils | | 1000.00 |
| 7. | Misc. cost | Water, electricity charges etc | 5,000.00 |
| | | Total Running cost | 2,97,030.00 |
| **Total Investment for 1st Year (A+B+C)** | | | **7,13,030.00** |

**First Year Income:**

1. Sale of 80 piglets @4000/ piglet= 3,20,000.00
2. Sale of pig dung(5 tonnes @500/tone)= 2,500.00
3. Total income = **3,22,500.00**

***First-Year Profit and Loss:***

Expenditure= 7,13,030.00

Income= 3,22,500.00

Net Loss = **3,90,530.00**

**Second Year Income:**

A. Non-Recurring Cost:- Nil.

B. Recurring expenditure

a. Feed cost:

| Sl. | Animals | Details | Total cost |
|---|---|---|---|
| 1 | 2 adult male animals | @2.5 kg per animal/day for 365 days @ Rs 25 per kg of finisher concentrate feed. | 45,625.00 |
| 2. | 10 adult female | @2.0 kg per animal/day for 365 days @ 25 per kg of finisher concentrate feed | 2,28,125.00 |
| 3. | 5 ( F) and 1 (M) replacer stock | Av. @1.5kg per animal for 365 days @ Rs. 25 per kg. | 68,440.00 |
| 4. | Weaners feed ( starter feed) | With 90 % fertility of 10 sows with a furrowing rate 1.8 will produce gilts will produce 162 piglets @ 10 piglet / female with 1.8 furrowing per year. Keeping 5% mortality, remaining 154 piglets will have to provide starter ration @ av. 250 g/ piglet for 1 month @Rs. 28/kg starter. | 32,340.00 |

| | | | |
|---|---|---|---|
| 5. | Fatter pigs | 40 fattener animals @ 1.0 kg for 240 days (8 months) @Rs. 25 kg | 2,40,000.00 |
| 6. | medicine, etc. | | 5,000.00 |
| 7. | Farm utensils | | 2,000.00 |
| 8. | Misc. cost | Water, electricity charges etc | 5,000.00 |
| **Total Investment for 1st Year (A+B)** | | | **6,26,530.00** |

**Second year Income:**

1. Sale of 109 piglets @4000/ = 4,36,000.00
2. Sale of Adult animal 4 numbers females = 72,000.00 150 kg/animal @120 kg live weight basis
3. Sale of 40 fatteners @150 per kg live weight = 4,80,000.00 average 80 kg each.
4. Sale of one adult boar 150 @70/kg = 5000.00
5. Dung = 5000.00
6. Total Income = 9,98,000.00
7. Expenditure =Rs. 6,26,530.00
8. Profit =Rs 3,71,470.00
9. First year loss =Rs 3,90,530.00
10. Net loss =Rs 19,060.00

**From the second year onwards, net profit will start for the upcoming years**

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