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PACKAGE OF PRACTICES

BIOSECURITY MEASURES IN PIG PRODUCTION

ICAR -NATIONAL RESEARCH CENTRE ON PIG
Rani, Guwahati -781131, Assam, India

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Foreword

In the ever-evolving landscape of animal husbandry, maintaining robust health standards is of paramount importance, especially in the context of pig farming, where emerging diseases pose significant threats to productivity and food security. Biosecurity is the cornerstone of disease management in pig production. It is not only the most effective control measure but often the only feasible preventive health strategy against numerous emerging and re-emerging diseases. In the Indian context, where pig farming is a growing industry with unique challenges, tailored biosecurity practices are indispensable for sustaining and improving farm productivity. Interestingly, the "Package of Practices - Biosecurity in Pig Production," addresses this crucial aspect with precision and depth, particularly within the framework of Indian farming conditions.

This book guides the readers into the various aspects of biosecurity that are crucial for pig farmers and veterinary practitioners alike. The book leads through the various pig diseases and principles of farm biosecurity in the initial chapters, the book covers practically important topics ranging from the layout of biosecurity infrastructure, biosecurity measures for movement of personnel, animals, and vehicles, biosecurity associated with feed and water, biosecurity measure of waste etc in subsequent chapters. I am sure that the reader will gain invaluable insights into biosecurity measures during health emergencies and outbreaks, the collection of biological samples and carcass disposal. Biosecurity risk assessment, an often-overlooked aspect of farm management, is also comprehensively covered, providing a systematic approach to identifying and mitigating potential risks.

The holistic treatment of the subject matter makes this book an indispensable resource for those involved in pig production. It is a must-read for all stakeholders in the pig farming industry, from small-scale farmers to large commercial operations. By adopting the practices outlined in this book, farmers can safeguard their livestock, enhance productivity, and contribute to the overall biosecurity of the pig farming sector in India.

Vivek Kumar Gupta
Director, ICAR-NRC on Pig

Contents

Basics of biosecurity

The emerging and transboundry diseases, pose an existential threat to the swine industry. In addition to the financial impact of a disease on the piggery unit, it has wider implications ranging from food safety concerns to zoonotic significance. So, it is crucial for the livestock sector to implement suitable scientific interventions which could stop the spread of infectious diseases from an outside farm, and/or within a farm. Infectious diseases have a huge impact from the perspective of animal and public health. The last decades witnessed the emergence and reemergence of zoonotic infectious diseases, and new human pathogens originating from animals. A shift from curative to preventive medicine in both medical and animal health has necessitated the application of biosecurity as the modern epidemiological intervention for minimizing risk factors associated with an outbreak. To minimize risk in all activities that involve the transmission of diseases from pigs or other domestic, captive/exotic, and wild animals and their products, a farm manager may employ a set of preventive measures and actions. Biosecurity is a collective term for such actions.

Biosecurity may be defined as the implementation of measures that reduce the risk of disease-causing agents being introduced and spread. Maintaining a “farm-biosecurity” is a proven managemental intervention to restrict, reduce, and remove the infectious pathogens in a farm. The success of a biosecurity protocol relies on its ability to provide bio-insulation and bio-containment. Bio-insulation measures, as the name indicates, insulate the farm from external

outbreaks, by avoiding the entry of pathogens into a herd or farm. The bio-containment measures are used to stop the transmission of pathogens from infected farm animals to healthy ones and/or to stop the infectious agents from leaving the farm.

Biosecurity requires the adoption of a set of attitudes & behaviours by people and operational procedures for restricting the disease. The biosecurity measures adaptable at the field level depend on the type of production system (*viz*., intensive production system or backyard piggery), type of stock maintained (*viz*., breeder unit or finisher unit), and epidemiological factors. In addition to the practices in a conventional piggery, implementation of biosecurity measures may include infrastructural improvisations, amendments in the farm operation and imparting training to human resources.

The package of practices on biosecurity measures comprehends the biosecurity principle, farm biosecurity infrastructure, and protocols for the movement of men, machinery, inputs, and outputs in a swine production unit. Practical considerations for small-scale production units, typical to Indian conditions are also included. Biosecurity measures during health emergencies, sample collection and transportation are also covered for easy reference purposes. The package of practice on biosecurity measures intends to serve as a framework recommendation to all stakeholders involved in the production, processing, transportation, veterinary service, and policy making.

Major Pig Diseases

Diseases caused by viruses

African Swine Fever (ASF)

African Swine Fever (ASF) is a highly transmissible viral disease affecting domestic pigs. It manifests through symptoms such as fever, blotching of skin, and haemorrhage of the lymph nodes, internal organs, and gastrointestinal tract. The disease can appear in acute, subacute, or chronic forms. The natural cycle of the ASF virus occurs between pigs, warthogs, giant forest hogs, and ornithodorus tick where it replicates. Transmission occurs through contact with infected pigs and fomites, ingestion of contaminated uncooked pork garbage, tick bites and contact with domestic or wild carrier pigs. The incubation period ranges from 3 to 15 days.

ASF virus exhibits notable resilience to cleaning and disinfection, surviving for 2 to 4 months in infected areas and 5 to 6 months in contaminated meats. Therefore, disposal of carcasses and waste management of farms in affected areas require special attention for disease control and eradication. Once the disease infection occurs on a farm, the pathogen can be transmitted through contaminated fomites to other farms, especially if biosecurity is not maintained.

Symptoms: Fever (up to 42°C), laboured breathing, coughing, nasal and ocular discharge, loss of appetite and diarrhoea, vomiting, incoordination, cyanosis of the extremities, and

haemorrhages of skin. Emaciation, edematous swelling under the mandible and joints leading to recumbency are observed in chronic cases. Postmortem findings include blotchy skin cyanosis, hydrothorax, hydropericardium, ascites and enlarged spleen. Haemorrhages on the kidneys, gastrohepatic and renal lymph nodes, heart, and serous membranes are observed. In chronic ASF pericarditis and emaciated carcasses are found.

Foot and Mouth Disease (FMD, Aphthous fever)

Foot-and-mouth disease (FMD) is a contagious vesicular illness affecting pigs and other cloven-footed animals, caused by the Picornaviridae family within the Aphthovirus genus. FMD represents a significant barrier to international trade in animals and animal-derived products. Transmission occurs through direct contact with infected animals as well as indirectly through various means. The incubation period ranges from 3 to 15 days.

In pigs, the virus primarily spreads through the oropharyngeal route, but can also disseminate *via* aerosols, saliva, nasal discharge, blood, urine, faeces, semen, contaminated animal by-products, and swill containing meat or bone. Pigs are capable of transmitting the disease to cattle and other susceptible animals and viceversa. Pigs that are fed food wastes contaminated with FMD virus usually develops symptoms in 1– 3 days.

Symptoms include vesicles or erosions lesions of membranes on the snout and tongue, dullness and lack of appetite, salivation and drooling, detachment of the skin on a pig's foot, shaky gait, and lameness due to leg lesions. In neonatal piglets, it causes myocarditis. In adult pigs it is usually associated with low mortality but with high morbidity.

Porcine Reproductive and Respiratory Syndrome (PRRS)

PRRS is a highly infectious disease of pigs characterized by reproductive impairment or failure in breeding animals, and respiratory disease in pigs of any age. PRRS virus is an enveloped single-stranded RNA virus belonging to the family Arteriviridae.

The virus is present in nasal secretions, urine, semen, mammary secretions, semen and faeces. The virus persists in long-term carrier pigs (greater than 200 days) but most infected pigs eventually become immune, and cease to shed the virus by 60 days post-infection.

The clinical signs include a period of anorexia, fever, lethargy, depression, and respiratory distress. Mild cyanosis of the ears, abdomen, and vulva was also observed in some cases.

Reproductive efficiency will be adversely affected as there will be a decrease in the number of dams that conceive or farrow. There is usually an increase in premature farrowing, late-term abortions, stillborn or weak piglets, and mummified fetuses. In young, growing and finishing pigs, symptoms like fever, depression, lethargy, stunting, pneumonia, and postweaning mortality are observed.

Classical Swine Fever (CSF, Hog Cholera)

The virus-causing CSF belongs to the genus Pestivirus of the family Flaviviridae. CSF virus (CSFV) is antigenically related to other pestiviruses, mainly to the bovine viral diarrhea virus (BVDV) of cattle and to the border disease virus (BDV) of sheep. Globally, CSFV is considered a high-consequence pathogen.

The most common method of transmission is through direct contact with infected animals. Infective pathogens sheds through saliva, nasal secretions, urine, and faeces. In chronic stages, animals act as carriers of the disease without any obvious clinical signs. Intrauterine transmission can result in infection of offspring. CSF virus persists in pork and processed products under refrigeration and for years when it is frozen. Infected animals and pork offals are sources of disease dissemination.

Swine infected with classical swine fever virus usually develop fever, hemorrhages, lethargy, yellowish diarrhoea, vomiting, and purple skin discoloration of the ears, lower abdomen, and legs. In the acute form of the disease, in all age groups, there is fever, depression (a hunched posture with a drooping head and a straight-hanging tail), huddling of sick animals, anorexia, weakness, conjunctivitis, constipation followed by diarrhoea. Central nervous system lesions result in reeling when forced to walk, eventualy leading to hindquarter paresis. Occasional tonic/clonic convulsions are seen in young growing pigs. After several days of clinical signs, the ears, abdomen, and inner thighs may turn cyanotic. Acute cases cause the death of infected animals within 1-2 weeks. Chronic cases may lack typical symptoms but often exhibit conjunctivitis, diarrhoea or constipation, and emaciation.

Porcine Circovirus Disease (PCVD)

Porcine Circo Virus is a DNA virus and is characterized by its sturdiness in the environment. PCV2 is associated with the occurrence of postweaning multisystemic wasting syndrome.

PCV can be secreted in various secretions and excretions of the body like nasal, tonsilar, bronchial and ocular secretions, faeces, urine, semen, saliva and milk. Direct contact with infected animals through the oronasal route is the most

common route of virus transmission. Also, pigs ingesting uncooked tissues of viraemic pigs cause infection. Indirect transmission also occurs when pigs are kept in adjacent pens.

Clinical symptoms include weight loss, respiratory distress, diarrhoea, pale skin, jaundice, enlarged subcutaneous lymph nodes, etc. Infection of the lung causes respiratory distress and dyspnoea. The reproductive form has clinical manifestations like abortions, stillbirths, mummification and pre-weaning mortality.

Diseases caused by bacteria

Colibacillosis

Colibacillosis, one of the major causes of illness and death in piglets is caused by pathogenic *Escherichia coli*. Dams often act as carriers. Colibacillosis causes neonatal septicemia and polyserositis. Diarrhoea associated with enteric colibacillosis occurs at three main periods of a pig's life; neonatal diarrhoea occurs at 0–4 days of age, neonatal- weaning diarrhoea at 4th day to 3rd week, and post-weaning diarrhoea after weaning.

Continuous farrowing along with poor sanitation predisposes colibacillosis. *Escherichia coli* are found in fecal contaminated feed, water, soil, and the environment of the pig barn. Long survival times in the environment are promoted by low temperature and sufficient moisture, among other factors. Transmission occurs *via* aerosols, contaminated feed and water, contaminated trucks that transport pigs, other vehicles, and possibly other animal species. Airborne transmission between pigs in wire cages 1.5m apart has been reported.

Symptoms include hypersecretory diarrhoea (either watery or white or yellow), and vomiting in some cases. There is progressive dehydration, subnormal body temperature, shivering, and rough hair coat.

Pasteurellosis

Pasteurella multocida is a significant bacterial pathogen contributing to respiratory ailments in swine, notably by triggering two economically consequential diseases: progressive atrophic rhinitis and pneumonia. The highly contagious nature of this pathogen, coupled with its substantial mortality rate, has led to substantial economic impact, particularly affecting rural communities in major pig-rearing regions across India. Types A and D of *Pasteurella multocida* are commonly linked with atrophic rhinitis, while type A is predominantly associated with pneumonia, pleuritis, and abscess formation.

It spreads *via* nasal routes as well as *via* vertical transmission from sow to piglet. Often, this is referred as a secondary respiratory pathogen, as it causes disease when the mucociliary apparatus becomes damaged due to other diseases. Primary infections with Pasteurella may also happen.

Both primary and secondary infections tend to culminate in chronic thoracic lesions and polyarthritis. It results in exudative bronchopneumonia, occasionally accompanied by pericarditis and pleuritis. Septicaemia caused by this pathogen can afflict pigs of all ages, including adults, presenting symptoms such as fever, dyspnoea, and congestion on serosal surfaces.

Swine Erysipelas

Erysipelothrix rhusiopathiae causes erysipelas in growers. The disease is characterized by sudden death, fever, skin lesions, and arthritis. The organism commonly resides in the tonsillar tissue.

Asymptomatic carriers can shed the organism in their faeces or oronasal secretions and are a constant source of infection on a farm. Infection is by ingestion of contaminated feed, water, faeces, or through skin abrasions.

Acute outbreaks are characterized by inappetence, febrile episodes, skin lesions, painful joints, and sudden and unexpected deaths. Skin lesions may be generalized cyanosis or diamond skin lesions (rhomboid urticaria). Pregnant sows may abort, and lactating sows may show agalactia in acute infections. Chronic erysipelas follows acute outbreaks and animals suffer from enlarged joints, chronic arthritis, vegetative valvular endocarditis, and lameness.

Streptococcus suis Infection

Streptococcus suis (S. suis) is a pathogenic gram-positive bacteria having zoonotic significance. *Streptococcus suis* causes septicemia with sudden death, meningitis, arthritis, and endocarditis, mostly in postweaning piglets.

Transmission between herds occurs through the movement and mixing of asymptomatic carrier pigs or subclinical cases with new stock. Piglets become colonized with *S. suis* from vaginal secretions during parturition and while nursing. Predisposing factors also include overcrowding, poor ventilation, excessive temperature fluctuations, and mixing of pigs with an age spread of greater than 2 weeks.

Clinical signs of infection are observed mainly in weaned pigs (2-5 weeks after weaning), but rarely in suckling and growing pigs, and adult animals. The earliest clinical sign is usually fever, accompanied by pronounced septicemia. Fluctuating fever, inappetence, depression, and shifting lameness are

also observed. In peracute cases, sudden death is without premonitory clinical signs. Post-weaned piglets are susceptible, owing to the absence of maternal antibodies between 4 and 9 weeks of age. It causes arthritis, septicemia, meningitis, endocarditis, abortions, polyserositis, encephalitis and broncho-pneumonia.

Brucellosis

Swine brucellosis is a zoonotic disease affecting pigs, caused by the *Brucella suis*. Porcine brucellosis is of widespread occurrence; yet, prevalence is low. In India, it causes production losses in pregnant sows.

B. suis is transmitted mainly *via* ingestion of infected tissues or fluids or through semen during service. In addition to the venereal route, exposure to aborted fetuses or other products of parturition is another route of infection. *Brucella suis* infection in humans and other species may occur through aerosol and oral routes, as well as *via* skin wounds.

Clinical signs commonly include abortion, temporary or permanent orchitis, sterility, lameness, spondylitis, metritis, hindlimb paralysis, and abscess formation (occasionally). Infection early in pregnancy commonly results in reproductive failure, decreased litter size, stillbirth, abortion, and weak piglets.

Diseases caused by parasites.

Ascaris suum infection

Ascaris suum is the most common roundworm of pigs in outdoor farming systems. Adults of the *Ascaris suum* live in the small intestine and can significantly reduce the growth rate of young pigs. It might cause mechanical obstruction of the intestine, in a few cases.

A single female worm may produce close to two million eggs per day hence the potential for environmental contamination is still very high. Surviving eggs can remain viable in the environment for up to at least nine years. Reports indicate that farrowing areas usually have a considerable number of infective *A. suum* eggs exposing piglets from very early in life.

Ascariosis in pigs may cause production losses due to altered carcass composition, reduced weight gain, and reduced feed conversion efficiency. Migration of larvae through the liver causes haemorrhage, fibrosis, and accumulation of lymphocytes seen as white spots (called “milk spots”) under the capsule and leading to condemnation of the liver at slaughter.

Coccidiosis of Pigs

Coccidiosis of Pigs is caused by Eimeria or Isospora species. While *Isospora suis* infects piglets, *Eimeria spp* are found in older pigs. Both types occur in all types of production system worldwide and can have marked economic consequences. Thoroughly cleaned slatted floors decrease or prevent illness.

The disease is more severe when contracted early in life. Infection may be introduced to a new herd by carrier sows. Sows rarely shed *I. suis* species, but *Eimeria* spp can be transmitted to offspring. Contaminated environment and the introduction of animals in infective or carrier stages are risk factors.

Affected piglets develop diarrhoea (either creamy, pasty consistency or whitish faeces to profuse watery yellowish diarrhoea). Mortality in the case of severely affected piglets happens. Surviving animals suffer from reduced growth rates. In older pigs, coccidiosis causes mild symptoms of diarrhoea (frothy, mucoid, or watery) with wasting.

Trichuris suis

Trichuris suis, called whipworms are 5–6 cm long and whip-shaped gastrointestinal parasites residing close to epithelial cells of the large intestine, especially the cecum. The prepatent period is 6–8 weeks; longevity is 4–5 months.

Ingestion of ova containing infective larval stages results in infection. Bipolar, thick-shelled eggs are intermittently shed in faeces. After 3 to 4 weeks in the environment, eggs are infective for as long as 6 years. Ingested eggs hatch in the small intestine and cecum, with newly released larvae penetrating cells lining the crypts.

Infection is usually asymptomatic. Clinical signs occur mostly in young animals. Heavy infestations may cause inflammatory lesions in the cecum and adjacent large intestine and may be accompanied by diarrhoea and unthriftiness.

Principle and practice of farm biosecurity

Designing a suitable biosecurity plan demands a clear understanding of the theoretical basis of biosecurity. Meanwhile, an idea of the routes of infections, disease aetiology, and epidemiology will prove useful for realizing the reasons behind the measures being adopted. Additionally, it will give the farm manager the flexibility to alter the processes in response to the risks and hazards specific to each farm. This chapter will discuss the disease epidemiology, principle of biosecurity, risk factors, routes of infection and prevention strategies.

An underlying principle of epidemiology is that diseases do not occur randomly in a population, but are more likely to happen when a pathogen, a susceptible host, and an environment that facilitates the pathogen-host interaction, occur simultaneously. If the three risk factors do not happen together at one place at a time, the disease can be prevented. Pathogens are disease-causing organisms. The host is “the pig” in our case. Environment refers to extrinsic factors that bring the pathogen and provide an opportunity for exposure. Environmental factors include physical factors such as wind, water and fomites or biological factors such as parasites, infected pigs, carrier animals or birds. “Preventing the exposure of susceptible hosts (pig) to the pathogen by suitable environmental interventions” is the key principle of biosecurity.

Routes of entry of pathogens

Disease-causing organism or pathogen reaches an individual animal from outside the farm or from within the farm. Understanding the routes of entry of a pathogen is critical in identifying the control points to check the entry of pathogens.

From the outside, the disease may enter through

1. Animal movement from outside: In the case of finisher farms, new stocks of weaners or growers are brought from breeder farms for rearing purposes. In breeder farms, pigs are brought as replacements for old stocks. Similarly, in the case of small scale pig-rearing practices were some farmers cannot afford to raise breeding boars, exchange of breeder males/females between the farmers happen. The incoming or outgoing animal may harbour pathogens even though they are asymptomatic and act as a source of infection to other animals.
2. Anthropogenic routes: Another possibility could be through visitors, animal attendants, or veterinarians who have attended to a diseased animal or animal in carrier status, before entering the farm.
3. Fomites: Pathogens may also enter the farm through clothes, shoes, and even vehicle tyres.
4. Contaminated feedstuffs and soiled roughages: Most of the farms receive feed from outside. Contaminated feedstuffs and soiled roughage could be another risk factor. Swill feeding, mainly with meat products or animal slaughter wastes, is another risk.
5. Stray/Wild animals or parasites: Diseases may also enter the farm through other animals like wild boars, bovines, stray animals, rodents, and migratory birds. Ectoparasites are also a source of pathogens to farm animals.
6. Air and water: Some diseases are airborne and some are waterborne. A disease outbreak in a nearby farm or locality can spread through air or water and hence adequate precautions need to be adopted.

If an animal gets infected within a farm, it may spread to other animals also. Within a farm, the disease may spread through-

1. Pig to pig contact: Infected animals are a potent source of infection to pen mates and pigs of nearby sheds. Here, it may be noted that the infected animals may shed pathogens even before showing obvious symptoms.
2. Farm staff: Attendants, who attended infected animals, may carry pathogens through their clothing and utensils.

3. Body fluids: Pathogens may be present in the secretions, excretions, semen *etc.*, of infected animals.
4. Carcass and slaughter wastes: Improperly disposed of carcass materials and slaughterhouse wastes are a potent source of infection.
5. Poor shed design: Overcrowding, poor ventilation, insufficient space allocation, poor housing plan, and mixing of animals of different age are risk factors favouring the spread of diseases.

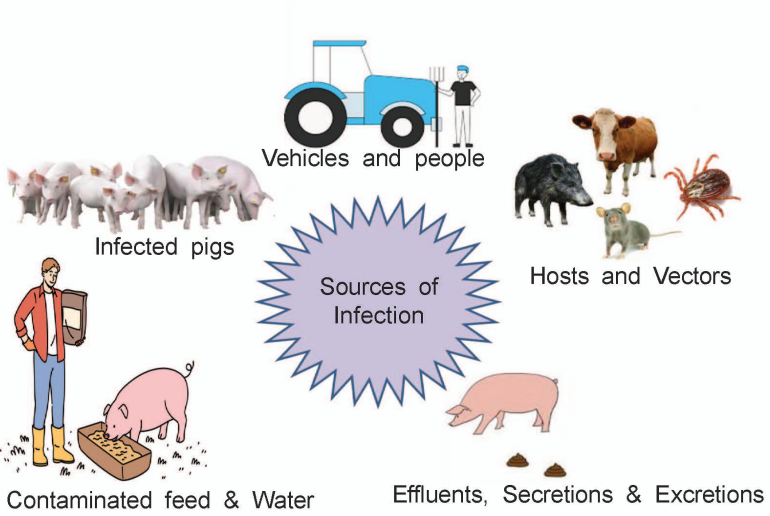


Fig 3.1 Routes of transmission of diseases

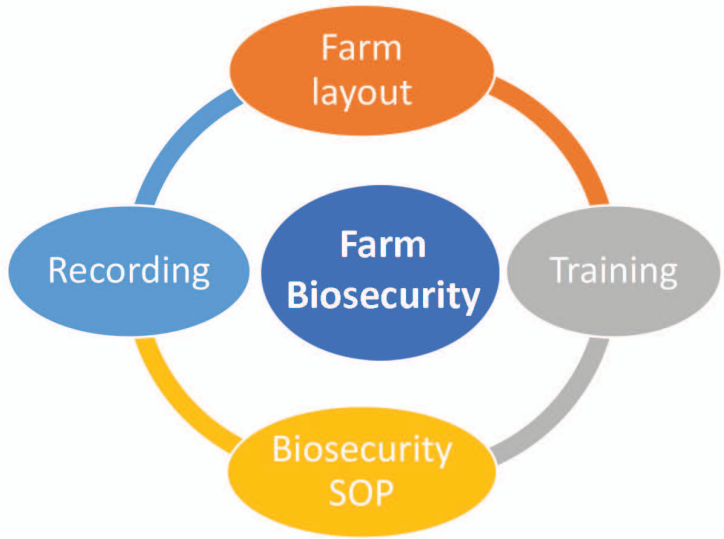
Table 3.1: Route of transmission of diseases

Sl. No.	Route of transmission	List of diseases/pathogens
1	Direct contact	Foot-and-Mouth Disease (FMD), African Swine Fever (ASF), Classical Swine Fever (CSF), Porcine Reproductive and Respiratory Syndrome (PRRS), Transmissible Gastroenteritis (TGE), Enzootic pneumonia, Swine influenza, parasites (sarcoptic mange, lice) etc.
2	Semen	Aujeszky's disease virus, parvovirus, CSF virus, PRRS Virus, and bacterial pathogens, like Brucellosis, Leptospirosis etc.
3	Airborne transmission	FMD virus, PRRS virus, pseudorabies virus, Swine influenza virus, *Mycoplasma hyopneumoniae* etc.
4	Vehicles & other fomites	ASF, *Actinobacillus pleuropneumoniae*, TGE, *Streptococcus suis* etc.
5	Feed & Water	FMD, CSF virus, ASF Virus, PRRS virus etc., through pork of infected animals. Tuberculosis, Brucellosis *etc.*, through unpasteurized milk-related items.

Sl. No.	Route of transmission	List of diseases/pathogens
6	Pig manure & Bedding	Ascaris, Taenia, Cryptosporidium, Yersinia, Salmonella, Campylobacter, faecal coliforms, faecal Streptococci and even hepatitis E virus.
7	Birds and wild animals	CSF, PRRS, influenza and TGE through birds. Atrophic rhinitis, *E. coli* diarrhoea, Leptospirosis, Rotaviral diarrhoea, Salmonellosis, swine dysentery, PRRS, *Streptococcus suis* infection *etc.*, through rodents. Brucellosis, Leptospirosis, Trichinella, Pseudorabies *etc.*, through wild animals. Cats can transmit toxoplasmosis.
8	Arthropods	ASF, JE and PPRS through ticks or mosquitoes. Flies can mechanically spread TGE and *Streptococcus suis* between farms.

Moreover, some diseases are of zoonotic significance like leptospirosis, brucellosis, erysipelosis, tuberculosis and Japanese encephalitis etc. Pork can be a source of a number of pathogens, such as *Trichinella spp., Cysticercus spp., Salmonella spp. Listeria spp.* etc.

Prevention strategies



Layout of the farm

A biosecurity plan should be kept in mind while preparing the layout and location of a farm. There should be a unidirectional flow of inputs and outputs with regular checks at each level. Zonal classification of the biosecurity zone is recommended. Details of shed design, layout, drainage, and distribution of animals according to the perceived biosecurity risks are mentioned in Chapter number 4.

Biosecurity Plan

Beyond the establishment of requisite infrastructure, the efficacy of any biosecurity guidelines hinges upon the adeptness of its implementation on daily farm operations. Once a farm is established, a biosecurity plan for routine farm management should be initiated. The steps include routine cleaning, sanitation, feeding, regulating movements of man, animal, and materials etc. The procedures are detailed in subsequent chapters. In addition to the routine laid-out procedures, an emergency biosecurity plan comes into play when a disease incidence happens. That includes the segregation of the infected ones from healthy animals and thorough cleaning and disinfection of sheds and premises.

Each swine husbandry facility must develop a comprehensive biosecurity strategy encompassing actionable protocols to be executed on a daily, weekly, and monthly basis. Such measures optimize human resource utilization while mitigating the risk of disease incursion within the swine production environment.

Farm-biosecurity also involves bio-insulation and bio-containment. In other words, an effective biosecurity protocol should keep a watch on the risk factors from outside (bio-insulation) and from within the farm (bio-containment). Monitoring and sanitization of man, animal and fomite movements from the outside will be the first step in achieving farm biosecurity. Healthcare, vaccination and monitoring of early warning symptoms of diseases on the farm and nearby areas are equally important.

Training

Farm staff should receive regular training on biosecurity aspects. Since animal attendants are the primary human-animal interaction point, an appropriate training plan should cover the code of conduct to prevent entry and spread of diseases on a farm. It may also be noted that in addition to regular training, an atmosphere of constant communication between the workers and veterinarians will aid in the implementation of biosecurity measures and the detection of early warning symptoms of diseases on a farm. A suggestive format of the training record is provided in the annexures.

Training in the following areas is very important in implementing an effective biosecurity plan on a farm.

- Handling Techniques: Effective pig handling serves as a fundamental pillar in safeguarding the well-being of both farm workers and swine populations. Instruction in this domain encompasses the mastery of gentle, low-stress pig manipulation techniques aimed at mitigating stress and minimizing the likelihood of injury to both animals and personnel. Seamless animal handling

methodologies facilitate routine surveillance for clinical signs, the relocation of ailing individuals, and the collection of biological samples with minimal impediments or complications.

- Maintenance of hygiene: Comprehensive training in biosecurity protocols instills in farm workers the importance of maintaining strict hygiene standards for both staff and visitors.
- Surveillance: Farm managers/workers should be well informed about the disease outbreaks in the nearby localities. They should be trained to take preventive measures during such emergencies. Any man/animal movements from suspected areas must be seriously monitored.
- Disease identification: Overall knowldedge about the disease symptoms and epidemiology is important in devising suitable biosecurity plans according the disease of concern.
- Reporting: Staff should initiate prompt reporting as per the farm biosecurity heirarchy/ reporting plan. A farm manager / farmer should be well informed about the guidelines in reporting outbreaks to government authorities.
- Training on biosecurity protocols: Classes on disinfection procedures, quarantine measures, farm access guidelines, farm management interventions etc., on a regular basis will update them to become ready for any emergencies. Proper training will eneble early identification of disease symptoms.
- Technology and data management: Accurate data collection and analysis are at the heart of informed decision-making on the farm. Training imparts the skills needed to collect, organize, and interpret data related to pig health, growth, and performance.

Recording

Proper records on routine cleaning and disinfection, vaccination and deworming, movement of workers and visitors, movement of new stock and diseased animals, disposal of carcass and collection of biological samples are very critical in auiditing the implementation of a biosecurity plan for its susequent improvement.

The establishment of a robust recording system facilitates enhanced traceability and surveillance capabilities. The proficiency of staff members in recording diverse activities, inferring biosecurity risks associated with them, and identifying early indicators of disease outbreaks is very important. Formats for the various farm biosecurity records are provided in the annexures.

Layout of biosecurity infrastructure

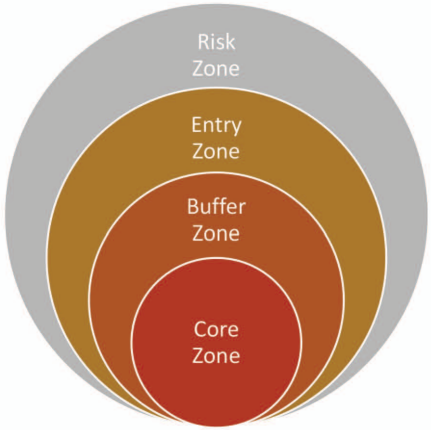
Ideally, a pig farm should be situated in an isolated area, far away from other animal farms, to minimize the spread of disease. This is practically difficult, especially considering the decreasing trend in the per capita availability of land. A possible intervention could be the construction of a barrier or fencing that strictly separates the farm from the outside. Demarcate the farm area into "Clean zone" & "Risk zones". Animal sheds will be in the clean zone where entry of pathogens is strictly controlled. An outside area should be considered a risk zone, from where pathogens may enter. All movements from the risk zone to the clean zone should be strictly monitored.

Farm biosecurity infrastructure

Biosecurity zones in a pig farm

Zoning is the division of farms into separate areas based on the level of biosecurity that is needed to minimize the possibility of pests and diseases from coming onto and moving around the farm. For a pig farm, the tetra-zone biosecurity concept has evolved as a result of efforts to minimize exposure to biological risks. The concept envisages classification into four zones *viz*., Risk zone, Zone I (entry zone), Zone II (buffer zone), and Zone III (core zone). A graphical representation is shown in figure 4.1. The area outside the outer perimeter of the farm may be considered a Risk zone, from where most of the biological risks arise. Within the boundaries of the farm area, the entry zone (Zone I) is conditionally open to

visitors and staff and for delivery access. Farmhouses/ offices, parking lots/garages, slurry /manure pits, fodder cultivation plots etc., should be in this area. Road for essential vehicles for the on-farm supply of feed, livestock, and facilities for storage and processing of feed may be located in the buffer zone. Monitored entry is allowed to this area. The change room should be located in the buffer zone. It is preferred that the livestock and feed movement across the separation between the buffer zone and core zone be allowed through loading ramps.



Location

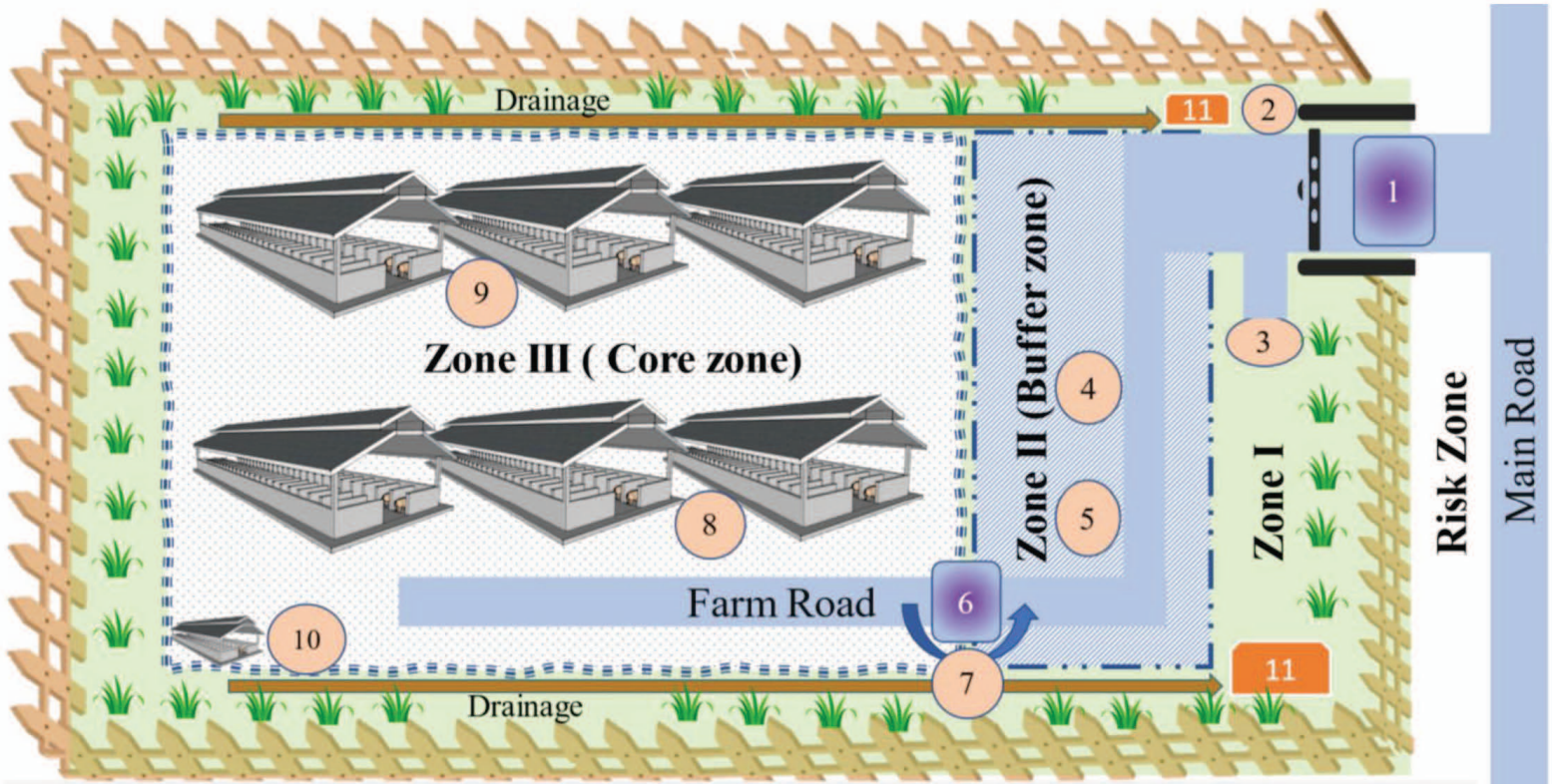
The location of a pig farm is a critical factor in the control of diseases. Practically location often depends on other factors like land availability, community acceptance/ sensitivity, pollution-related concerns, etc. Ideally, the pig farm needs to be in an isolated area, far away from other pig farms, and free from exposure to vectors of various diseases. Moreover, high-density intensive pig production in a farm or cluster of nearby farms poses higher risks of outbreaks on the incidence of epidemics that spread through air and water.

Location plays a significant role in disease outbreaks in case of diseases like Foot and Mouth disease, African Swine Fever, Classical Swine Fever, Swine Enzootic Pneumonia, Porcine Reproductive and Respiratory Syndrome, etc.

Layout of sheds

The sheds are located inside the core biosecurity zone of a pig farm. The design of a farm is also very important. Overcrowding and poor ventilation resulting in stress, render the animal more susceptible to diseases. It should also be noted that older pigs have greater resistance and immunity to diseases than younger pigs. Therefore, the different age groups must be kept separately (See Fig 4.1).

- The layout of the sheds should be such that boar pens or mating area should be farthest from the entry gate, followed by sow sheds, farrowing sheds, weaner sheds, and grower-finisher sheds in decreasing order of distance from the farm gate. This will reduce the exposure of more precious stock from extrinsic risk factors.



1. Tyre Dips & Disinfection area at the entrance, 2.Security check/Documentation, 3. Farmhouse/office, 4. Feed storage and processing, 5. Change rooms, 6. Tyre Dips/Disinfection area, 7. Loading ramp, 8. Sheds for growers/finishers, 9. Sheds for breeder stock, 10. Isolation shed, 11. Manure disposal/processing.

Figure 4.1: Pictorial representation of biosecurity infrastructure in a Pig farm

- Holding pens for market-age pigs should be the nearest to the loading ramp or fence.
- Loading ramp should facilitate animal movement across the core zone to the buffer zone without entry of vehicles or buyers from outside. The office should be near the loading ramp. This will keep transactions easy with minimum interaction with outsiders (drivers of vehicles or buyers)

Fencing or Boundary wall

A biosecurity plan requires external perimeter fences and internal fences separating various units of the farm. Pig farms require strong fences that are built close to the ground to prevent animal movement and to provide protection against pests and invaders. Barbed wire along the ground helps prevent rooting. Fences of height 1-1.2 meters will be sufficient for a pig farm.

Permanent fences should be well constructed using high-quality materials so they will last a long time with minimum repairs. Fences may be erected with woven wire, barbed wire, electric, or a combination of any of these.

- In the case of woven wire fences, several horizontal lines of smooth wires will be held apart by vertical wires called stays. The distance or spacing between horizontal line wires may vary from as close as 4 cm at the bottom. Stay wires should be spaced 15 cm apart. Thickness of 12-to-14-gauge size may be used.
- Barbed wire fences are made of two or more strands of smooth, galvanized-coated, steel wire twisted together with two or four barbs spaced every 10-12 centimetres. Standard barbed wire fences usually have three to five strands of barbed wire stretched between posts that are spaced between 5 - 7 meters apart.

- Farms located near forest areas can also install electric fences and they can be used for the control of feral and wild animals. It must be well designed and there should be provisions to ensure adequate power for the length of fencing. It should be noted that prior approvals from the authorities should sought to safegaurd human and wildlife.

Water supply & Drainages

Drinking water distribution systems within buildings on pig farms must have critical elements of their design and management that impact water provision to pigs, water quality, the efficacy of in-water supplement dosing, and, thus, pig health and performance. Similarly, the system of drainages has an important role in securely disposing of the contaminated water/effluents from the sheds.

- Ensure potable drinking water supply, and avoid chances of mixing with contaminated water. Regular cleaning of pipelines, drinkers or pans should be included in the operational biosecurity plan.
- Farm drainages should be designed in such a way that the effluents should flow from more biosecure areas to less biosecure areas and not *vice versa* (See Fig. 4.1).
- Effluents from the isolation shed should never be allowed to pass through the healthy animal shed areas.

Foot dips and tyre dips

Vehicle tyres, carriages, and trays can carry diseases, and pests in soil, plant material and manure. The tyre washing facility and tyre dip should be located at the farm gate. The dimensions are shown in fig 4.2. Ensure that vehicles are clean and are parked in a designated area away from core biosecurity zone.

- Tyre dip should have sufficient length to facilitate at least two tyre rotations while passing through it.
- The width should be more than the width of the road to avoid the chances of bypassing.

- Depth should be sufficient to facilitate disinfection of all treaded areas of the tyre.
- A facility for draining off the disinfectant solution should be provided in the dip. This will reduse stagnation, dirt accumulation and facilitate routine cleaning.

- Central walking alley should have provision for foot dip. Foot dips should be provided before the farm gate, buffer zone, core zone and individual sheds.

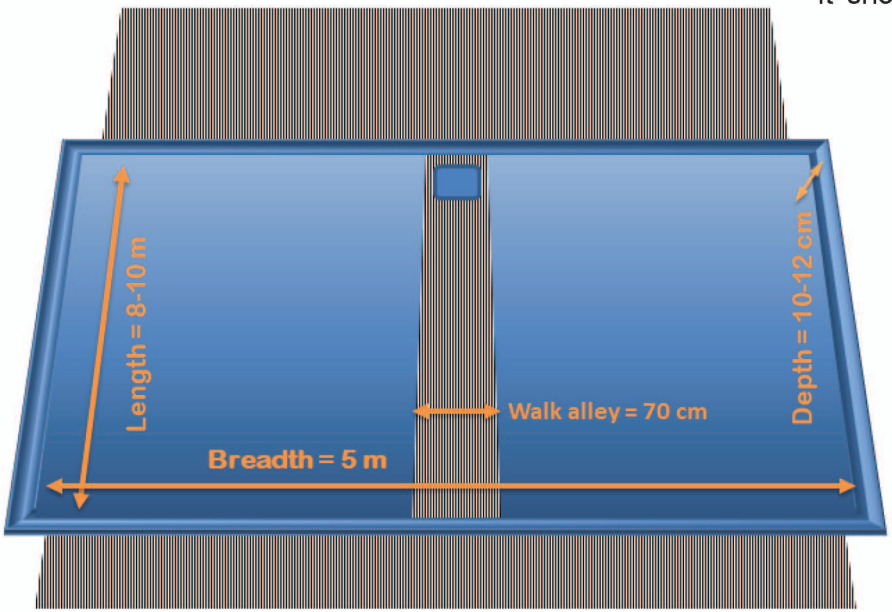


Fig 4.2 Dimentions of Tyre Dip

Change rooms/Ante rooms

The change room/anteroom play a critical role in nullifying the contamination from man-material movement. It serves as the single point of entry for all staff, workers, visitors and others. The location of change rooms should be before reaching up to the core biosecurity area or well before the main shed area.

It should have-

1. Structures to ensure unidirectional movement from entry to exit.
2. Provisions for keeping external clothing and personal accessories
3. Facilities for personal hygiene like toilets, bathrooms, wash basins etc.
4. Facility for cleaning and laundering clothing and footwear

As far as possible, all employees, managers, office staff, veterinarians and visitors should only enter the farm through the single entrance and follow the same changing and hygiene procedures.

Functional requirements of changing room

- A changing area should provide basic privacy while changing to farm uniforms. Separate areas for males and females with separate washroom facilities are required.

- Provision of air-curtain between external side and changeroom, self-closing doors, proper lighting, and ventilation are required
- Display boards providing step-by-step information on procedures to be followed and personal hygiene practices that need to be installed.
- Change rooms may have a definite barrier, which divides the external side of the changing room from the clean farm area. This barrier can be a bench that operators can sit on when applying footwear cover before swinging their legs over into the next area (*ie*., the clean area).
- There should be the provision of individual shelf cabinets for staff to keep their shoes, dress, and other belongings from home during duty hours.
- Facility to wash, undertake hygiene procedures and change to uniform clothing at the time of entry to the farm
- Hand wash basins may have automatic or elbow /foot-operated water supplied at a suitable temperature.
- While returning from farm duty, the clothing should be changed and given to the laundry at the end of the day.
- Closed-circuit cameras/sensors to monitor compliance may be installed.
- Ensure the availability of sanitizer dispensers.
- It is preferred to have an area designed with suitable drainage for boot-washing.
- First aid kit to be made available.
- The facility to dispose of the contaminated water used by farm staff to clean themselves is equally important.

The layout and flow of movement in a change room facility are illustrated the Figure 4.3. The area of entry (in red colour) is the risk area. The belongings from home will be

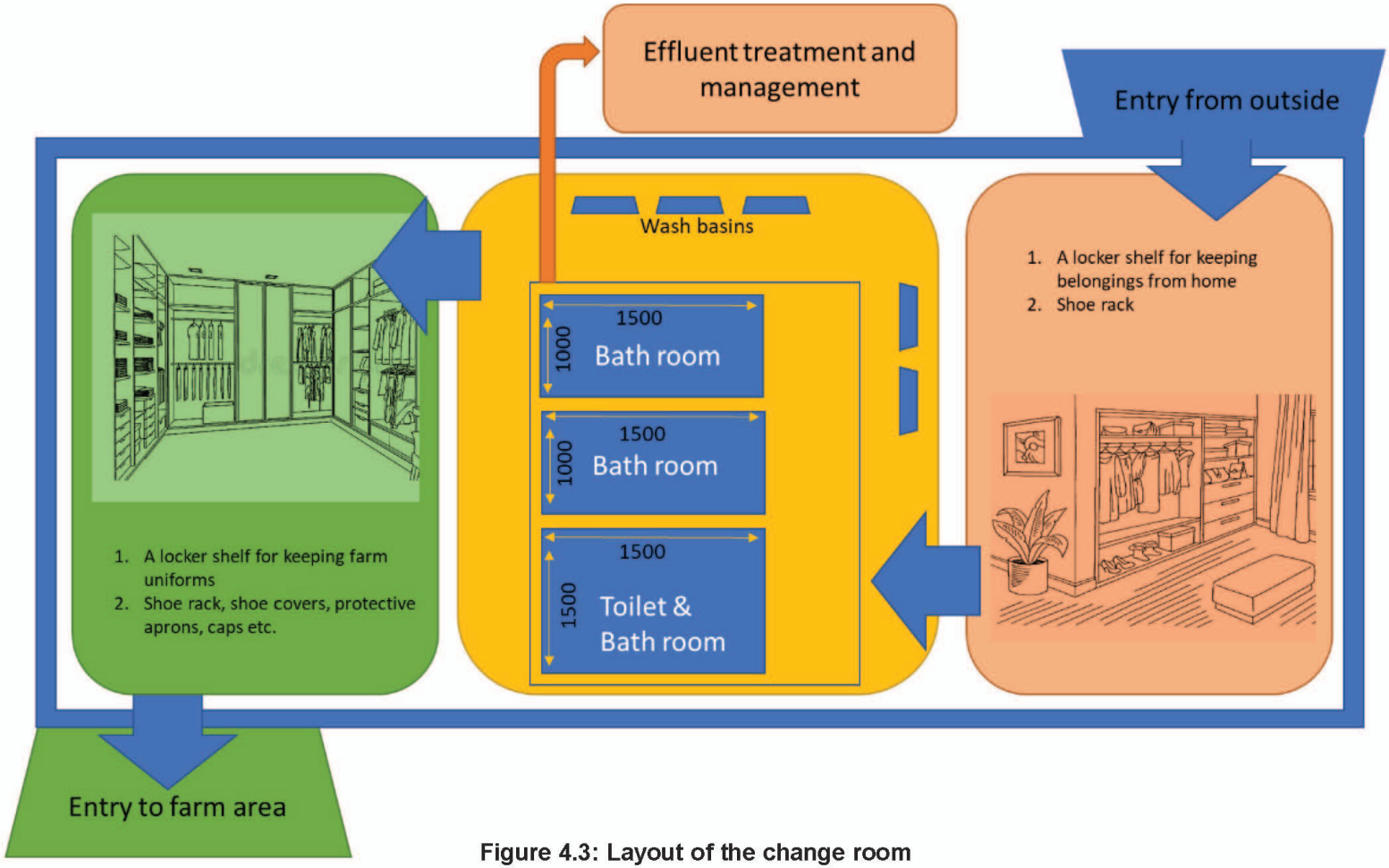


Figure 4.3: Layout of the change room

restricted to this area. Rooms shown in yellow colour denote washing and cleaning area. The room in green indicates a clean area where farm dresses and gumboots will be kept for changing purposes. Effluents should never be allowed to flow into the clean area or core biosecurity zone.

Isolation shed

Isolation of animals in a herd is required when symptoms of infectious disease appears in an animal or a group, which requires separation of the sick animals from the rest of the stock. Isolation is also practiced when breeding boars come in contact with suspected sows. The following considerations should be kept in mind while constructing an isolation facility.

Location:

Buildings used for the on-farm isolation must be dedicated for this purpose only. It must be physically separate from any buildings used for other livestock (Fig 4.1). Similarly, if pastures are used for on-farm isolation, facilities must be physically separate from any pastures or buildings used for other livestock on the premises. A minimum distance of three metres is required between the perimeter of the isolation area and livestock fields. Stock-proof double fencing is advised for this three-metre separation.

Accessory facilities:

The isolation shed must be designed in such a way that any discharges, effluent and manure are retained there or disposed of in such a manner that they do not come into contact with healthy animals of the pig farm. A dedicated loading and off-loading facility must be provided for each isolation facility. This facility must be fully cleansed and disinfected after use.

Categories of animals which require isolation:

1. Animals showing symptoms of infectious diseases or under treatment.
2. Animals exposed to infected pigs/penmates.
3. Animals exposed to visitors, veterinarians or farm workers who have a suspected exposure to infectious agents/diseased animals.

A shelter facility to accommodate 5% of the total adult stock strength may be allocated to an isolation shed.

Quarantine shed

Animals are quarantined when new animals are brought to the farm from outside sources. A quarantine shed should be preferably located in a distant plot. A minimum distance of 500 meters from the main farm area is necessary under

any circumstances. A quarantine shed should have provisions for the supply of potable water, a storage facility for feed and medicines, proper waste disposal pits etc. An all-in-all-out protocol is recommended for the quarantine shed. Cleaning and disinfection of sheds after every animal movement is necessary.

Quarantine serves the following functions:

1. Prevent entry of disease through apparently healthy animals in the incubation period of any disease.
2. Provide a platform to perform pre-entry vaccinations and deworming schedules.
3. Acclimatise the animals to the new climatic conditions.
4. Relieve transport-related stress. Opportunistic pathogens flare up during stress, causing diseases in the animals. Providing a transitory shelter before final induction to the main stock is necessary.

Categories of animals which require quarantine:

1. Replacement stock brought from other farms.
2. Breeding boars or sows from breeder units brought on to the premises for breeding purposes
3. Breeding boars or sows which came in contact with visiting pigs for breeding purposes or those went out of the premises for the purpose of breeding or artificial insemination, upon return
4. Boars, sows or other stock returning from a market unsold
5. Livestock returning from agriculture shows or exhibition

Location and Design:

- Choose a location that is isolated from the main farm and other pig populations, preferably with a separate entrance.
- Ensure proper drainage and avoid areas prone to flooding.
- Construct the shed with sturdy and easy-to-clean materials, such as concrete, to prevent the entry of pests and facilitate disinfection.
- Install separate water and feed systems for the quarantine shed to avoid cross-contamination.

- The quarantine facility should have dedicated equipment, storage, staff uniforms, etc.
- Efforts should be made, where feasible, to engineer drainage and waste disposal systems in a manner that effectively contains effluents, thereby mitigating the potential spread of pathogens to adjacent areas.

Loading ramps

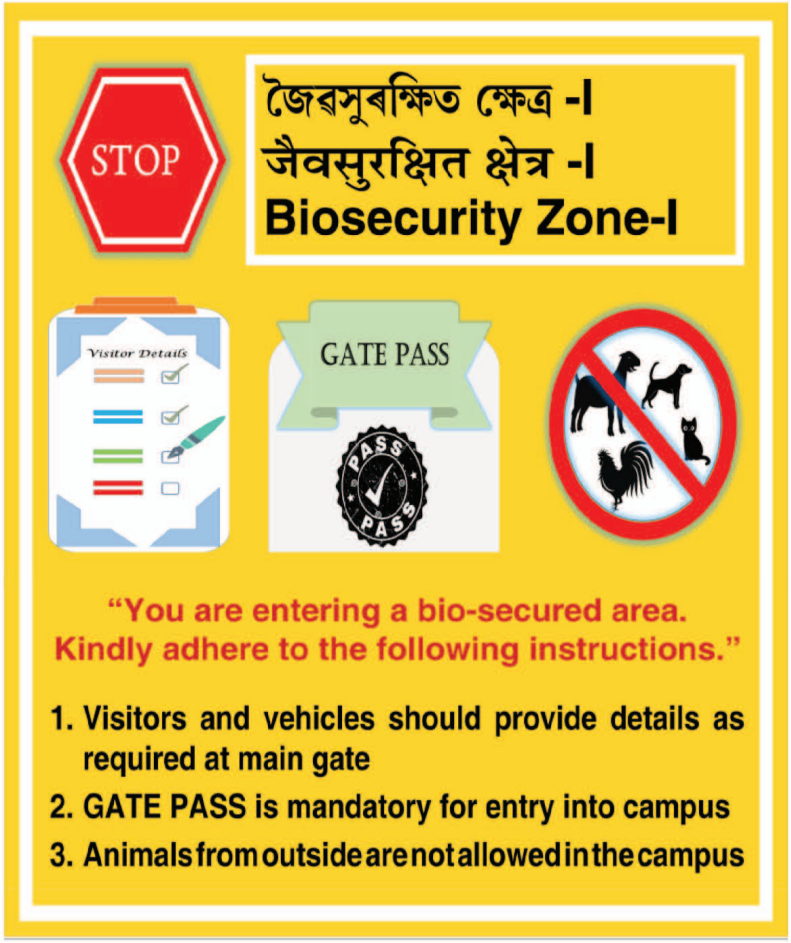
Loading and unloading animals with minimum exposure to incoming animal transport vehicles and animal handlers are also important in ensuring biosecurity. The construction of ramps helps animal loading from the core biosecurity zone to the buffer zone and vice versa. The following measurements will be helpful for designing a suitable animal loading ramp. Moreover, well-designed holding pens and loading ramps can help reduce bruises and stress.

- The maximum recommended angle for adjustable ramps is 25°. Twenty degrees is the maximum recommended angle for non-adjustable ramps. For pigs, 15° is recommended.
- Ramps should have a level dock at the top equal to one animal's body length. Stairsteps are recommended on concrete ramps.
- Recommended dimensions are a 30 cm minimum tread width and a 5 cm rise for slaughter-weight pigs.
- Both loading and unloading ramps should have solid fences. The crowd pen that leads to the ramp should also have solid sides and it must never be placed on a ramp. Single file, curved ramps with solid fences are very efficient for loading pigs onto trucks.
- Ramps used for unloading only should be 2.5 to 3 meters wide to provide animals with a clear exit from the vehicle.
- Ramps should be cleaned and sanitized after each operation.

Signage or Display boards

A critical infrastructure required in pig farms for ensuring biosecurity is the installation of display boards providing information on the biosecurity measures to be followed at each point of entry and exit. It will serve the purpose of instructing those involved in material and man-animal movements enforcing biosecurity at each level. For signage to be effective ensure that signs are clear, visible and well-maintained.

- The location of display boards is equally important. It should be placed well before the entry points of each biosecurity zones. It should be erected at an easily noticeable location.
- Obstructions to vision in the form of overgrown trees or other structures should be avoided before the display boards.
- Use signs to inform visitors about the biosecurity status.
- Signages should have wordings in authoritative language.
- The language should be simple, uncomplicated and short.
- Never assume that visitors know the appropriate biosecurity measures for your farm.
- The standard size of 7x4 feet size boards with instructions in the local language, and other languages, significant to the area, may be used. The instructions should be easily readable from a minimum of 20 feet distance.
- Pictorial representations are recommended, as they are more effective in conveying the message.



Biosecurity Display Board

Movement of personnel & vehicles

The prevention of the introduction of novel infections and the restriction of their spread will help to improve the welfare of pigs, productivity, and public health. Implementation of biosecurity has become a critical component of livestock production, especially in intensive systems like the pig sector. The design of an operational biosecurity plan should consider every minute aspect of farm operations. A greater understanding of the pig disease's epidemiology is important to improvise the biosecurity plan in case of emerging diseases. Each biosecurity measures are complementary to each other in preventing the disease and a breach in one step may nullify the benefit of the entire system. Routine farm operations should include the following biosecurity considerations for the prevention of diseases.

Vehicle movement

The most practical approach is to have clear instructions to visitors and staff on biosecurity, right from the front gate. Display boards giving clear directions should be placed at the entry point itself. The display boards should be placed so that they should attract the attention of every person entering the campus.

It is always recommended to minimize the number of entry points. Vehicles requiring their delivery up to the farm area may be cautiously and selectively directed to the farm and that too, only after performing the required sanitization procedures. The procedures should include mandatory tyre dipping, pressure washing, etc. If the vehicle has been used for transporting other animals in recent days, decontamination protocol should be initiated. A format for the vehicle decontamination record is provided in the annexures. Decontamination procedures including washing, cleaning, and disinfection of the vehicle should be carried out outside the farm premises. If the driver or loading workers were exposed to any biosecurity risk in the preceding days, the entry of such personnel may be restricted.

Checklist for vehicle entry

- Examine each vehicle entry and exit point for any risk.
- Keep a visitor/vehicle register.
- Disinfection log book of animal cages entering the campus.
- Source and quality declaration of vendor in case of the vehicle carrying feed.
- Display biosecurity signs at all vehicle access points.

Farm workers

Adherence to biosecurity measures by farm staff is essential for protecting the health of pigs and ensuring the productivity of the farm.

Arrival: All workers and visitors must report to the designated entry point for biosecurity checks. Personal belongings from home should be restricted from entering the farm area unless necessary and approved. Park vehicles in designated areas away from animal housing facilities. Before entry, each staff member must confirm that they are not suffering from any infections and have not been in contact with livestock or other farms within the last 48 hours.

Personal hygiene and clothing: All staff must change into clean farm-dedicated clothing and footwear before entering the pig units. Through disinfection at hand-washing stations are needed before putting on protective gear.

Entry into animal zones: Only authorized personnel should be allowed in core zone of the pig farm. Follow the farm's guidelines before entering each biosecurity zone, strictly. Sanitization of hands before and after interacting with animals or handling equipment. Use farm-dedicated tools and equipment that are disinfected before use.

During work: Limit direct animal contact as much as possible and report any unusual behavior, illness, or signs of infection immediately to the supervisor. If early warning symptoms of any disease outbreak is observed initiate protocols for isolating sick animals from the healthy population. Reporting

health status of pigs in a farm by the farm workers is critical to the success of every pig farm.

Exit procedures: Before leaving the animal areas, all staff must change out of farm-dedicated clothing and leave it in the designated laundry area. Cleaning and disinfection of all equipment or tools used during the shift is recommended. Workers should thoroughly wash their hands and disinfect footwear upon leaving the pig units. Personal showers may be required depending on the biosecurity level of the farm. Logbook detailing the entry and exit times, and any incidents observed during the working shift is very important.

Reporting non-compliance: Any failure to follow biosecurity protocols must be reported by the supervisor to the farm manager immediately. Corrective measures for non-compliance will eventually improve the biosecurity compliance and overall sustainability of the pig farm.

Visitors

Visitors to the farm area should seriously follow strict biosecurity measures. Normally visitors should not be allowed to enter the core biosecurity zone. Most of the vehicles and visitors should be restricted to the office area or farmhouse area. In conditions that warrant authorization of a farm visit by a visitor, strict adherence to biosecurity protocols is required.

- Foot dipping, hand washing etc., are mandatory.
- Visitors should change dress and wear caps, masks, aprons, and gumboots.
- Visitors should record the date of the last visit to other pig farms or slaughterhouses.

The information on visitors' travel itineraries during the preceding week will be critical for preventing their entry into the farm's buffer zone and core zone. Any person having a history of visiting an infected animal or handling a pathogen during the previous three days, should not be allowed to enter the farm. For small farmers, it is always advisable to entertain their family guests at home and restrict their reach up to the farm area.

Checklist of biosecurity accessories for staff and visitors

- Visitor record maintenance.
- PPE, including gloves, masks, goggles, and protective clothing for visitors.
- Change room facilities.
- Farm uniform, gumboots, gloves for staff.
- Foot dip and sanitation at each checkpoint.
- Disinfection SOPs and weekly follow-up charts.
- Sprayers for disinfectants.
- Tyre dips and vehicle wash facility.

Self-declaration format for visitors at the farm gate

Farm Biosecurity – Visitor's Declaration		
1. Have you visited any farms, livestock premises, livestock fairs and abattoirs during the last 7 days.	Yes	No
2. Are you rearing any animals in my home.	Yes	No
3. If yes, do your herd have any incidence of diseases during the past 30 days.	Yes	No
4. Has your vehicle/equipment contacted livestock or materials of animal origin during the last 7 days.	Yes	No
5. Have you visited or travelled any overseas country in the past 30 days.	Yes	No
6. If Yes, did you visit any livestock farm or abattoir or livestock fairs during the overseas travel.	Yes	No

I declare that the information provided above are true to the best of my knowledge.

Signature

Name:

Details of the visitor:

Vehicle: Contact number:

In time : Out time:

Purpose of visit:

INSTRUCTION

Visitors who answered "Yes" to any of the above questions may be redirected to the farm administrator for assessment of the biosecurity risks associated with their entry.

Risk assessment of visitors

Following table may be used to adopt a decision based on the inputs received from the self-declaration of the visitor. Visitors may be classified as low-risk visitors, moderate-risk visitors, and high-risk visitors. The entry of high-risk visitors to the farm may be guarded and should be allowed only in cases of urgency while abiding by all biosecurity protocols

Biosecurity risk-based decision-making for permitting visitor's entry

Risk classification	Description	Appropriate decision
Low-Risk Visitors	Come from urban areas and do not contact livestock.	Entry with proper biosecuruity on the same day
Moderate-Risk Visitors	Those people who travel from farm to farm but do not directly come in contact with livestock, vectors, abattoirs, or manure	Restrict entry. Waiting period of 2-3 days
High-Risk Visitors	Those people who travel from farm to farm and work with livestock, vectors, abattoirs, manure and exposed to pathogens	No entry

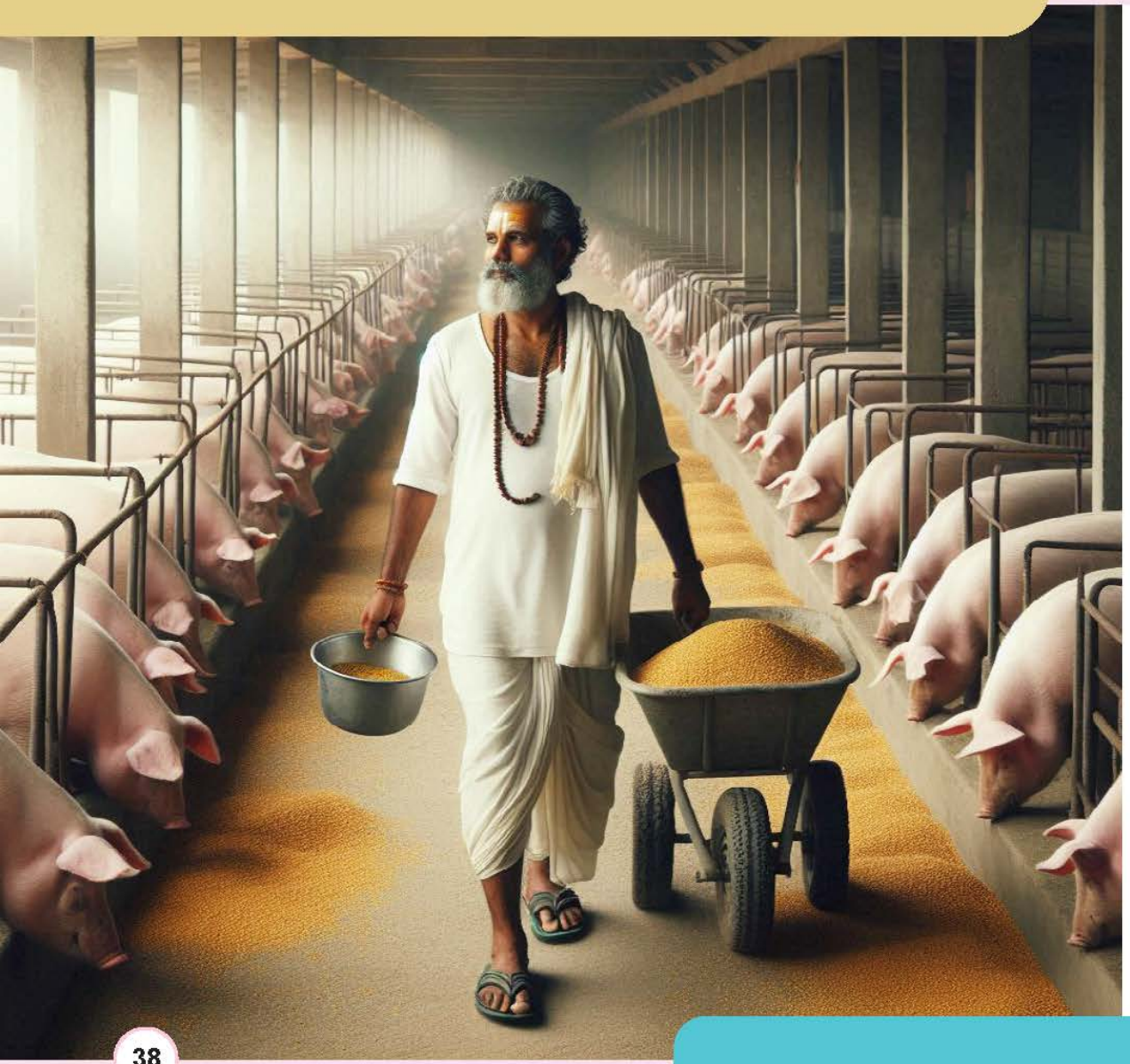
Feed

Feed and water are also sources of infectious pathogens. A proper biosecurity plan should ensure quality potable water for all livestock on the farm. Moreover, ensuring feed quality is also critical.

Swill feeding is practiced in swine husbandry to reduce input costs. Foods or food waste that contain meat or meat products are known as 'swill'. Farmers should be aware of the potential risks. Food containing meat or meat products or that has had contact with meat may contain pathogens that can cause severe disease in pigs. Pig is also a multiplier host, notoriously called a "mixing vessel" for interspecies transmission of many pathogens. Proper cooking is always recommended.

The following points need to be considered

- **Storage area and facilities**:
  Establish a designated and secure area for storing feed and fodder, away from potential sources of contamination such as pests, chemicals, and other animals. Ensure the storage area is clean, dry, and well-ventilated. Regularly inspect the storage facilities for any signs of damage, moisture, or pests, and take appropriate measures to address them. Areas in and around storage space need to be cleaned between batches of feed. Moisture problems need to be addressed periodically.
- **Feed and fodder**:
  Source feed and fodder from reputable suppliers who follow good manufacturing practices (GMP) and follow quality control measures. Inspect incoming feed and fodder for signs of contamination, such as mould, pests, or unusual odours. Keep records of the supplier information, delivery date, and batch/lot numbers for traceability purposes.
- **Feed handling and distribution:**
  Designate personnel or trained staff for handling and distributing feed and fodder. Follow proper hygiene practices, including handwashing and wearing clean protective clothing, when handling feed and fodder. Use dedicated equipment to avoid cross-contamination. Regularly clean and sanitize feed storage containers and feeding equipment to minimize diseases. Feed refusals are disposed of if not eaten within 12 hours.
- **Rodent and pest control:**
  Implement effective pest control measures to prevent rodents, birds, and insects from accessing feed and fodder storage areas. Regularly inspect and repair any gaps, cracks, or openings that may serve as entry points



for pests. Store feed and fodder in rodent-proof containers or bins, and monitor for signs of pest activity.

- **Regular quality assurance:** Conduct periodic testing and analysis of feed and fodder for quality, nutritional content, and potential contaminants. Maintain records of feed testing results and track any deviations from expected standards.
- **Training and awareness:** Provide training to staff and personnel involved in feed and fodder handling on biosecurity protocols and procedures. Promote awareness of the importance of biosecurity and adherence to SOPs among all farm workers. Regularly review and update the biosecurity SOPs based on emerging research and industry best practices.

Animal Movement

Procurement of replacement stock

Live pigs represent the greatest risk for disease introduction to a pig farm. Current production systems necessitate the periodic replacement of breeders to maintain optimal productivity thresholds. In most cases, a renewal of the whole breeding population every 2–2.5 years may be required. Replacement stocks can be produced internally or purchased from reputed breeder farms.

In farms practicing external replacements, especially the finisher farms, the higher the frequency of new entries increases the probability of pathogen entry. Similarly, if breeding using a male from other farms or using semen doses from outside is practiced, there can be a risk for the introduction of new pathogens as well. Internal replacements may be convenient for farms maintaining a closed breeding system and relying on their own males (semen). However, internal replacement has limitations in genetic improvement and eradication of endemic diseases. In this case, the most efficient way of organizing production is by adopting batch mating/ farrowing (usually by planning breeding in a period of 3 weeks).

For procurement of replacements, the biosecurity measure should invariably include disease testing based on a list that classifies diseases based on the risk they pose to the farm. This will enable discarding the stock at the supplier's end itself.

Checklist for procurement of replacement stock

- All purchases should be made from a reliable, quality-assured source.
- Perform disease testing.
- Procure vaccinated stock, if possible.
- All the new pigs may be purchased from the same source rather than from multiple or unknown sources.
- A health certification by an authorized veterinarian at the source will reduce risks.

- Transportation should ensure animal comfort and abide by the state rules.
- Request a record of treatments including medications, vaccines, and other chemicals administered.
- Additionally, the vendor supplying the replacement stock should comply with certain requirements as represented in the diagram.

Quarantine

In all instances, a meticulously devised and vigilantly executed quarantine regimen represents the most efficacious strategy for mitigating risks associated with external pathogen introductions. The quarantine involves the isolation and acclimatization of incoming stock from other animals on the farm. This is important because an animal may not exhibit symptoms of a disease for a period, termed the incubation period, even after the entry of the pathogen. So, following an observation period under veterinary supervision, at an intermediate station, will minimize the risk due to asymptomatic animals and animals in the incubation period. Vaccination against endemic diseases, deworming, and testing for diseases like such as brucellosis, PRRS, PCV2, ASF and PPV infections, etc may be performed during the period.

"ALL-IN-ALL-OUT"

Ideally, a pig farm should operate an "All-in-All-Out" protocol, where all animals are bought in together and sold together. In this management strategy, the transmission of diseases can be minimized and sanitation is easy. Practically in finisher farms, the market demand need to be considered while adopting this strategy. For breeder farms "All-in-All-Out" can be practiced in farrowing pens by adopting batch farrowing. In quarantine sheds "All-in-All-Out" strategy is mandatory.

Quarantines must be designed as bio-contention units, to avoid the spillover of any undesired pathogen brought by the incoming animals. Typically, this entails constructing the quarantine at a considerable distance from the principal farm units and treating it as an autonomous entity, akin to an external facility.

Ideally, a quarantine shed should be located at least 500 meters away from the core zone or main farm unit. The quarantine facility should be equipped with separate clothes and equipment for the staff. A minimum quarantine period of 21 days is recommended. Stocks in quarantine sheds should follow an all-in, all-out strategy, where the new animals are brought together and moved out together. Proper disinfection should be followed during each cycle.

Labour management in a quarantine facility

- Establish a controlled access point for the quarantine shed, preferably with a footbath and hand-washing facilities.
- Restrict entry to authorized personnel only, and maintain records.
- Implement a strict biosecurity protocol, including wearing protective clothing, such as coveralls, boots, and gloves, when entering the shed.
- Ensure that visitors and vehicles are disinfected before entering the premises.

Cleaning and disinfection of quarantine facility

- Develop a regular cleaning and disinfection schedule for the quarantine shed.
- Detergent wash is preferred to remove all organic material, including manure and bedding, from the shed before cleaning.
- Use appropriate disinfectants effective against common pathogens, following recommended dilution rates.

- Pay special attention to areas, such as feeders, waterers, and walls, during cleaning and disinfection.

Animal management in quarantine facility

- Keep animals in the quarantine shed separate from the main herd to prevent disease transmission.
- Ensure All-In-All-Out strategy.
- Retain for a minimum of 21 days.
- Perform disease testing.
- Perform vaccinations and deworming.
- Monitor for any signs of illness or abnormal behaviour during the quarantine period.

Waste Management in quarantine facility

- Implement proper waste management practices, including the safe disposal of manure and other organic waste from the quarantine shed.
- Ensure that waste disposal areas are located away from water sources to prevent contamination.

Record Keeping in Quarantine Facility

- Maintain accurate and up-to-date records of animal movements, health status, treatments, vaccinations, and any other relevant information.
- Regularly review and update records to facilitate traceability and disease management.

Cleaning and Disinfection

Cleaning

Cleaning involves the removal of all organic waste matter from sheds. An unhygienic premise predisposes the incidence of disease in a herd. Adherence to routine removal of excreta and adopting proper disposal methods to minimize environmental concerns is very important. In

addition to the routine disposal of bedding materials, dung and urine, there should be detergent washes before introducing new batches. In the event of any unusual death of pigs, carcasses should be buried, composted, or burned biosecurely.

Disinfection

Disinfectants are compounds used to kill germs (bacteria, viruses, and parasites). The application of a suitable disinfectant destroys the infectious or parasitic agents of animal diseases, including zoonoses. Application of disinfectants should be done on premises, vehicles and different objects which may have been directly or indirectly contaminated. Its choice & strength depends on surfaces to be cleaned, disease-causing microbe etc. The various disinfectants and their specific uses are mentioned in table 7.1, for easy reference. Cleaning surfaces before disinfection is recommended.

Table 7.1: Description of disinfectants in Pig farm

Sl No	Disinfectant	Strength	Suitable surface
1	Lime (Calcium hydroxide)	1% Solution	Floors, drains & ground
		As powder	Passages, pavements
2	Bleaching powder	30% available chlorine	Dusting floors, drains & ground
3	Caustic soda (Sodium hydroxide)	2% solution	Sheds, Premises
4	Quaternary Ammonium Compounds	0.1-0.2%	Sheds, feeding troughs
5	Potassium peroxymonosulfate	1% solution	Sheds, feeding troughs, premises
6	Sodium hypochlorite	2% solution	Tyre wash, footbath, shed & premises
7	Potassium permanganate	3-5 g/Litre	Tyre wash, footbath
8	Formaldehyde	1% solution	Tyre wash, footbath
9	Phenol	2-5% solution	Vehicles, cages, premises
10	Boric acid	5-6% solution	Skin, equipment
11	Chlorine tablets	0.2-1mg/L	Chlorination of drinking water

Standard Operating Procedure (*Cleaning and disinfection)*

- Clean heavily soiled areas by initially softening dirt and manure with a low-pressure water spray, allowing it to soak.
- Use high-pressure sprays (preferably between 750 psi to 2,000 psi) to thoroughly remove all dirt and organic material.
- Begin cleaning from the back of the pen or building, progressing towards the front.
- Start by spraying the ceiling, followed by the walls, and finally the floor.
- Utilize sprayers and nozzles capable of reaching difficult-to-access areas, including the undersides of troughs, feeders, and flooring whenever possible.
- Once the pen is clean, rinse all surfaces to remove accumulated aerosol organic material.
- Apply a surfactant or emulsifying agent to eradicate residual organic materials, then rinse all surfaces again.
- For effective disinfection, ensure surfaces are thoroughly cleaned beforehand, as disinfectants only work on clean surfaces.
- Disinfectants work best at temperatures above 18°C (65°F), but not above 43°C (110°F). Adhere to the manufacturer's application instructions for the disinfectant product being used.
- Apply the disinfectant with pressure, ideally through a pressure washer, to ensure penetration into pores, cracks, and crevices. Alternatively, fog or aerosol application can serve as a secondary method.
- When applying, proceed systematically from back to front and from top to bottom of the room.
- Provide proper time for drying.

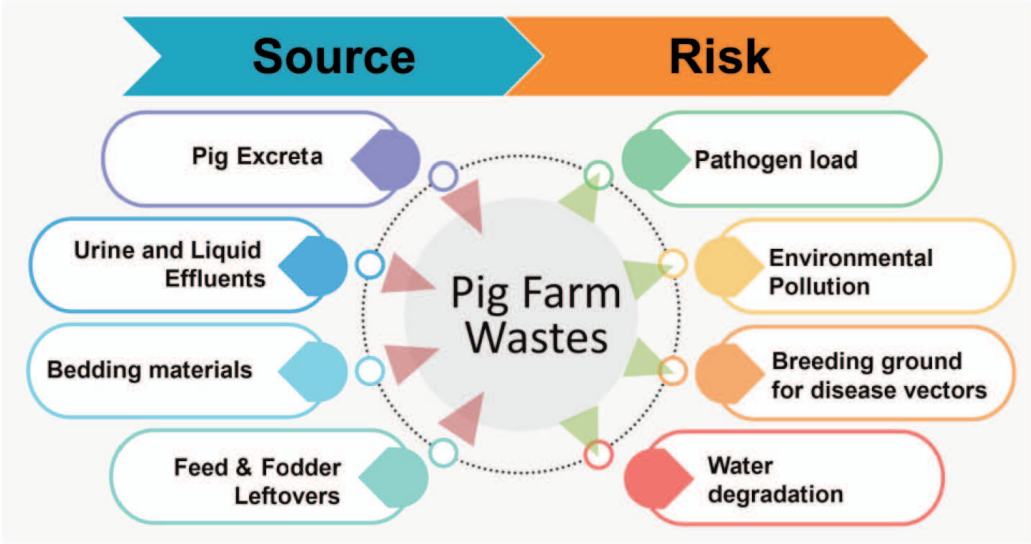
Disposal of manure and effluents

Implementing a proper biosecurity protocol for the disposal of manure (faeces) and effluents from a pig farm is essential to prevent the spread of diseases and minimize environmental impacts. The potential for disease transmission due to manure and its handling equipment should not be overlooked. Bedding and manure should be removed routinely and disposed of at a site in biosecurity zone I. The manure may be processed by composting or vermicomposting. The effluents produced as a result of the shed and animal washings should be securely disposed of

without contaminating other shed areas. Utmost care should be taken to avoid the flow of effluents from the isolation shed and change rooms into/through the main farm area, as they possess serious biosecurity risks.

General considerations for manure and effluents

- **Manure storage area:**
  Establish a designated area for storing manure and effluents, located away from water sources, residential areas, and animal housing facilities. Ensure the storage area is properly constructed with impermeable surfaces, such as concrete or lined pits, to prevent seepage into the soil or groundwater. Implement measures to control odours and minimize fly breeding, such as covering the stored manure or using effective odour management techniques. Monitor the manure storage area regularly to ensure it is not overfilled and has proper ventilation. Prevent the accumulation of stagnant water in the storage area to minimize the risk of disease transmission and breeding sites for pests.
- **Manure handling and collection:** Regularly collect manure from the animal shelter and dispose it at the designated storage area using appropriate equipment and containers. Minimize the risk of cross-contamination by using dedicated tools for manure collection.
- **Safe disposal methods**: Consider implementing anaerobic digestion or composting techniques to effectively treat and manage the manure. If spreading the manure on agricultural land is practised, then avoid spreading manure on areas prone to runoff, steep slopes, or environmentally sensitive areas.



Healthcare

Measures for early disease detection

Regular health monitoring

Early detection of a disease is the key to minimising an outbreak on a farm. All animals should be routinely monitored for any symptoms of diseases. Knowledge of the various disease symptoms will be always beneficial for early disease detection.

Symptoms like fever, reduced appetite or decreased feed intake, diarrhoea, vomiting, reduction in body condition or wasting of the body, laminitis, discolouration on the skin, abortions, sudden death etc., are important. Farm staff and farmers should be properly trained to detect these symptoms at the earliest and call veterinary care, immediately.

Alarm signals for disease outbreak

There are some alarm signals in a herd, which every farmer or farm manager should be cautious about.

In sows,

- Four or more sows are off fed with an elevated temperature.
- Four or more sows breathing rapidly and with obvious respiratory distress.
- Abortion in four or more sows within seven days may be an indicator of disease in the herd.

In a suckling herd,

- A noticeable rise in pre-weaning mortality over a week period should be seriously taken care of

In the case of growing and finishing herd-

- A noticeable rise in post-weaning mortality.
- Scour spreading through any age of pigs.
- A marked rise in the number and severity of pigs coughing or with laboured breathing.
- Three or more unexpected deaths in one day etc., are very important alarm signals.

Moreover, for animals of any age group if there is

- The development of lameness among penmates or groups of pigs.
- Blisters on the snout or excessive salivation in penmates or groups of pigs etc., should be immediately attended to, and proper diagnosis should be done.
- Coughing or laboured breathing.
- Three or more unexpected deaths in one day etc., are very important alarm signals.

Vaccination

Vaccination of the herd induces long-term protective immunity. Adhering to a standard vaccination protocol is important to prevent the incidence of disease on a farm. It should always be noted that vaccination is, indeed, a firewall against the disease, but it is not a substitute for poor hygiene or faulty biosecurity measures on a farm. Recommended vaccination schedule for a pig farm is provided in table 8.1.

Table 8.1: Recommended vaccination protocol in pig farm

Vaccine	Dose / Route	Primary vaccination	1st Booster	Re-vaccination
Classical Swine Fever Vaccine	1ml, S/C or I/M	After weaning	After 30 days	6 months interval
FMD **vaccine**	2ml, I/M	2 Months onwards		6 months interval
Porcine Circovirus vaccine	1ml, I/M	3 weeks age		

Parasitic control

Diseases like African Swine fever have ectoparasitic aetiology. Biosecurity measures that focus on careful scrutiny of incoming pigs, and sourcing pigs from a minimal number of herds with a similar health status are usually adequate to prevent the reintroduction of the parasite. Pig shelter can be disinfected with phenolic disinfectant (2.5-5%) or sodium hypochlorite (0.25% solution). In addition to this, routine examination of animals for any symptoms of ectoparasitic infestation along with follow-up treatment using parasite-specific protocol is required.

For tick control, the pigs need to be confined away from the infested pasture in extensive system. For lice and mange control, special attention to the ears, segregation of clean and untreated pigs, treatment of the boars, multiple treatments of sows prior to farrowing, and treatment of all introduced pigs, need to be performed. For the control of mosquitoes which are responsible for a disease like Japanese encephalitis, fly control must be continuous, especially in summer and rainy seasons. The aim is to prevent flies from breeding and destroy adult flies. Breeding of flies can be prevented by regular removal of dung. Insecticides are effective in the form of sprays.

The following points may be noted for control of endoparasites

- Faecal examination and diagnosis: Conduct regular faecal examinations to determine the presence and severity of parasite infestations. Collect fresh faecal samples from individual pigs or a representative sample from the herd.
- Anthelmintic selection: Select an appropriate anthelmintic (dewormer) based on the specific parasites identified and their susceptibility to different age groups. Follow label instructions and recommended dosages for the selected anthelmintic.
- Timing of treatments: Develop a strategic treatment schedule based on the life cycle and susceptibility of the parasites in your area. Consider the age, weight, and reproductive status of the pigs when determining the timing of treatments. Implement treatments at appropriate intervals to target both adult parasites and newly hatched larvae.
- Integrated approach: Combine anthelmintic treatments with other management practices to maximize the effectiveness of parasite control. Follow pasture rotation if roughage feeding is praticed. Simultaneously, carry out proper sanitation, and hygiene measures to minimize parasite reinfection. Also, implement measures to prevent further introduction of parasites to the farm.
- Monitoring and Evaluation: Continuously monitor the efficacy of the chosen anthelmintics through follow-up faecal examinations and herd performance evaluation.

Table 8.2: Recommended deworming protocol in pig farm

Age of Pigs (Months)	Anthelmintic Used	Dosage	Route of Administration	Frequency of Treatment
02-03	Fenbendazole	5 mg/kg	Oral	Every 3 months
04-06	Ivermectin	0.3 mg/kg	Injectable	Two doses in 2 monthly intervals
07-12	Albendazole	10 mg/kg	Oral	Every 2-3 months
Adults	Levamisole	7.5 mg/kg	Oral	Every 3-4 months

Monitoring farm workers' health

People who live or work on farms with animals should be aware that even farm animals can pass on pathogens to humans through their secretions and excretions. Children, pregnant women, the elderly and any person with a weakened immune system may be at an increased risk of getting sick or becoming severely ill, after direct or indirect exposure to the zoonotic pathogens. Monitoring the health of staff is also critical for farm biosecurity.

Biosecurity During Health Emergencies/ Outbreaks

If infectious aetiology is detected, the most important biosecurity measures to contain disease spread within a farm from the infected animal to other healthy animals are segregation, cleaning, and disinfection. Segregation involves the separation of an infected animal, cleaning is intended to remove all contagious materials in the shed, and disinfection kills all the adherent pathogens on the surfaces. Once a diseased animal is identified, a standard operating plan for disease contingencies needs to be initiated and followed strictly. The unhealthy animal needs to be segregated or isolated, the veterinarian should be alerted immediately and early treatment must be assured. Simultaneously, animals in close contact need to be monitored for any symptoms. Cleaning and Disinfection of the sheds, premises, utensils, clothes etc should be initiated.

a. Labour management

1. Take bath
2. Change clothes
3. Sanitise
4. Wear gumboots & foot dip
5. Early disease detection
6. Inform Veterinarian

The following points should be implemented regularly on a farm. During a disease outbreak in the locality or nearby farm, strict monitoring is warranted.

- Avoid contact with suspected agents: Farm workers need to be educated about the risks of getting in contact with infected animals or pork during their stay or movements outside the farm area.
- Personal hygiene: Take a bath and change into clean clothes before entering the pig farm premises. Practice regular hand sanitization using alcohol-based sanitizers.
- Footwear and foot dip: Wear dedicated gumboots or boots that are only used on the farm. Use a foot dip with a disinfectant solution before entering and leaving pig housing areas.
- Early disease detection: Be vigilant and promptly report any signs of illness or abnormal behaviour observed in the pigs to the farm management.
- Isolation of infected animals: If an animal is suspected or confirmed to be infected, isolate it from the healthy animals immediately to prevent disease spread. Follow proper isolation procedures and ensure strict separation between healthy and sick animals.
- Inform veterinarian: Notify the farm veterinarian or veterinary authorities as soon as possible when a disease outbreak is suspected or confirmed. Provide accurate and detailed information about the signs, symptoms, and history of the disease on the farm.

b. Segregation (Isolation)

The word "segregation" indicates the entire list of possible management interventions in a pig farm, for keeping all potentially infected animals and materials, away from healthy animals. From a broader perspective segregation of the farm prevents the entry of disease into the herd; while, inside the farm, segregation of the infected animals helps to contain the disease and limit its spread across the population.

Isolation shed

The isolation shed is dedicated to the on-farm isolation facility which is physically separate from any buildings used for other livestock. It must be designed such that any discharges, effluent and manure are retained there or disposed of in such a manner that they do not come into contact with other livestock. Construction of a separate loading and off-loading facility is advisable. The entire facility must be fully cleansed and disinfected routinely.

Standard operating procedures in Isolation shed

1. Restrict entry of visitors to this area. Any person entering the isolation facility must wear protective clothing and

footwear, and use the disinfectant footbaths at the entrance.

2. Dedicated utensils and clothing for the isolation shed are recommended. Otherwise, disinfect them after use.
3. All types of wastages including feeding stuffs, fodder, bedding, etc., must be disposed of separately.
4. Dedicated attendants are recommended. Otherwise, healthy animals should be attended first.
5. Disinfectant footbaths must be provided and used at the entrance(s) to the isolation facilities.
6. Welfare of animals especially, that of lactating sows should be safeguarded during isolation.
7. The pigs must be kept in the isolation facility for at least 21 days, once admitted to the isolation facility.
8. Pigs should not share isolation facilities with animals of any other species whatsoever the reason may be.

c. Disposal of biowastes

In the event of any disease outbreak the scientific disposal of manure, dung, bedding material etc., is crucial to prevent the spread of pathogens. Here are some biosecurity measures to consider for the disposal of these materials:

1. **Containment of infected biomaterials**: Isolate and segregate infected carcasses, manure, dung, bedding material, and any materials associated with diseased pigs from healthy animals and other farm areas. Use dedicated containers, bags, or designated areas specifically for holding and containing infected materials.
2. **Personal Protective Equipment (PPE)**: Wear appropriate PPE, including gloves, masks, goggles, and protective clothing, when handling infected materials to prevent potential pathogens. Follow proper hygiene practices and handwashing procedures before and after handling the materials.
3. **Disposal Methods:**

- Burial:

  Bury manure, dung, and bedding material in designated burial sites or pits that are located away from water sources, human populations, and areas prone to flooding. Follow local regulations and guidelines for burial depth and site selection.

- Incineration:

  Consider incineration as an alternative disposal method if permitted and suitable facilities are available. Follow proper incineration protocols to ensure complete

combustion and prevent the release of hazardous emissions.

4. **Reporting**:

   Report the disposal activities, including the methods used and the quantities of disposed materials, to the relevant veterinary authorities or regulatory agencies as required by local regulations. Maintain accurate records of disposal activities for future reference and compliance.

d. Disinfection and cleaning

Once the disease is reported on a farm thorough cleaning and disinfection help in decreasing the pathogen level and prevent or break the disease cycle. Following disposal of animals and infected materials, the premises should undergo thorough disinfection. Refer table 7.1 for details regarding preferred disinfectants for farm structures, equipment, animal houses during diseases outbreaks.

Clean-up and disinfection protocols should consider the following points:

- Removal and safe disposal of manure, feed, and debris by burial or burning, followed by thorough scraping and cleaning of all buildings and equipment, must precede the application of a chemical disinfectant.
- All traces of the cleaning agent must be rinsed away with clear water before the disinfectant is applied because some may inactivate the disinfectant. Provision must be made to contain and safely dispose of cleaning solutions, rinse water, and disinfectant.
- The infected premises/area should be disinfected by spraying disinfectants like 2% sodium hypochlorite or 4% formalin. Floors, ceilings, walls of the sheds should be washed to remove organic matter and disinfected using 3% calcium- hydroxide solution/ bleaching powder and apply lime on the floors. Concrete areas must be whitewashed with lime; closed sheds and rooms should be fumigated using potassium-permanganate ($KMnO_4$) and formalin. Also the use of quaternary-ammonium salts for the treatment of walls, floors, ceilings, and equipment etc., may reduce surface contamination.
- Liquids such as blood urine, etc. should be disinfected with a 30% suspension of chloride of lime. Walls, floors, doors, and tools may be cleansed with a suspension of bleaching powder (1:20).
- All the equipment's, and materials, should be treated with 2% sodium hypochlorite solution for 48 h and other metal structures should be disinfected using flame gun.

- Disinfection of vehicles plying through the affected animal holdings should be carried out with appropriate chemicals/disinfectants like ether (20%), chloroform, formalin (1%), phenol (2% for 15 minutes), sodium hypochlorite (2-3%), iodine compounds (1:33 dilution) and quaternary ammonium compounds (0.5%).
- Farm workers and visiting officials should wash their hands and feet with soap and disinfectant with approved detergent or rectified spirit.
- Water reservoirs must also be emptied, washed, and disinfected in regular intervals.
- It is imperative to refrain from directly applying disinfectants to animals unless explicitly labeled for such purposes.
- The effectiveness of disinfectants may diminish by prolonged storage, so check its activity before use. (eg. Sodium hypochlorite should have a concentration of 0.5% active chlorine for proper disinfection).
- A single disinfectant may not effectively address all pathogens. The choice of disinfectants and procedures for disinfection depends on the disease and objects to be treated (*viz* premises, vehicles etc).
- Standard operating procedure for cleaning and sanitation as mentioned in the page number 46 may be followed during the incidence of a disease outbreak in the pig farm.

Carcass disposal

When it comes to the safe disposal of pig carcasses, implementing proper biosecurity measures is crucial to prevent the spread of diseases and protect both animal and human health. Effective planning for the timely and secure removal of animal carcasses and associated materials, along with the disinfection of premises, is essential to prevent disease spread and safeguard biosecurity. Inadequate carcass disposal can lead to site, groundwater, and environmental contamination, as well as public health concerns and disease transmission *via* scavengers, mosquitoes, and vermin. The overarching objective of any plan for animal carcass disposal and management is to guarantee the clean and safe disposal of all materials, prioritizing the protection of human, animal, and environmental health. Considerations for safe carcass disposal in livestock, with a specific focus on pigs, is outlined below.

General consideration for carcass disposal

- In case of high-risk diseases (eg. Classical Swine Fever, African Swine Fever), carcass and biomaterial should be disinfected and preferably incinerated, whereas in low risk diseases it may be burned in pits or buried.
- For mass burial, the site shall be at least two hundred fifty meters away from human habitation. Mass disposal should be done under the supervision of State Animal Husbandry Department and local bodies.
- Use appropriate personal protective equipment (PPE), including gloves, coveralls, and boots, when handling and transporting carcasses.

- Mass disposal site should be selected in consultation with local bodies and pollution control authorities.
- In case of delay disposal, the carcass and related material should be disinfected, covered and kept in cold condition.
- Use leak-proof and sturdy containers, bags, trolleys for carcass storage and transport to prevent leakage and contamination and carcass should not be sliced before loading. The vehicle should not be overloaded and should be driven carefully to avoid spillage.
- Staff should carry approved disinfectant and equipment to handle spills during journey.
- Small carcasses (if required) may be placed in a plastic trash bag (industrial strength bags with 3mm thick plastic) or water-tight barrel for transport to disposal area.
- In case of delay disposal, carcasses may be stored in a top-loading chest freezer.
- After disposal ensure proper disinfection of equipment and vehicles used for carcass handling and transport.
- Use designated equipment or tools solely for carcass removal and avoid cross-contamination. Equipment used to handle carcasses or compost should not be used to handle feed.
- Unauthorized and unrestricted access to disposal sites shall be prevented. Signages or display boards should be erected to prevent man and animal movement.
- Steps should be taken to prevent from wildlife, rodents, pets, and other scavengers from the disposal sites to avoid disease transmission risk.

Check list of items for carcass disposal

- PPE Kits, gloves, masks, and other protective and disposable materials
- Mobile handling facilities for animals like trolleys
- Disinfectant powders and solutions
- Disinfection equipment like sprayers
- Fuel
- Transportation facility for experts, trucks, tractors, bulldozers, and front-end loaders

Preparation

In situations involving disease outbreaks or biosecurity risks such as natural disasters, prompt disposal of animals is crucial. The effectiveness of this process depends on pre-established structures, policies, infrastructure, and even financial readiness. Farmers are likely to prioritize safety measures aimed at preventing disease spread during animal

disposal and transport to disposal sites. Offering adequate compensation to owners for lost animals, coupled with awareness campaigns, can enhance farmer acceptance of disposal measures.

Site Selection

In case of catastrophic mortalities, several factors should be considered while selecting a suitable disposal method. For example, the disposal by mass burial has a risk of groundwater pollution, while open incineration may invite public discontent due to its pollution potential. If burying the carcasses, select a suitable burial site that is away from water sources, wells, and areas prone to flooding. Ensure that the burial site is properly secured to prevent scavenging by animals and unauthorized access. Follow local regulations regarding burial depth and distance from water sources.

In pig farms, establish a dedicated area for carcass disposal to minimize the risk of disease transmission. Limit access to the disposal area to authorized personnel only. Signages or display boards should be erected to prevent man and animal movement through the area.

Record Keeping

Maintain accurate records of carcass disposal activities, including date, location, method, and quantity. Keep records of any diseases or health issues associated with the carcasses for future reference.

Monitoring and Reporting

Monitor the disposal process to ensure compliance with biosecurity protocols and local regulations. Report any unusual or suspected disease cases to relevant authorities or veterinary services.

Training and Education

Provide training to personnel involved in carcass disposal on proper biosecurity measures and protocols. Promote awareness and education among livestock producers and workers regarding the importance of safe carcass disposal and disease prevention.

Disposal Methods

Choose an appropriate and approved disposal method based on local regulations and guidelines. The carcass may be disposed of by on-site burial, incineration, rendering, and composting. Transport to landfill sites or alkaline hydrolysis and anaerobic digestion are additional technologies that potentially may be used for mortality disposal, but the availability of specialized facilities and equipment for these processes currently are limiting factors. If necessary, technologies such as fermentation, acid preservation, refrigeration, or freezing could be used for biosecure storage of mortalities until disposal can occur by more traditional methods. Consider factors such as biosecurity, environmental

impact, feasibility, and cost-effectiveness while selecting the disposal method.

Burial

Bury infected pig carcasses, manure, dung, and bedding material in designated burial sites or pits that are located away from water sources, human populations, and areas prone to flooding. Follow local regulations and guidelines for burial depth and site selection. General considerations for burial are listed below.

- The site should not be in a drinking water catchment area and near to coast and should be away from towns, dwellings, roads and free from underground pipelines.
- For proper management, pits should be dug on a common land within the infected zone in limited numbers.
- The site should be on soils of low permeability with significant clay content (lining pits with clay soil may be considered).
- The pits should not be on a slope greater than 6%.
- The groundwater table level should be minimum of 6 meters below the lower level of deep burial pit.
- The water source should be away from the burial sites such as lakes (1000 ft), rivers (400 ft), tube well (200 ft).
- Pit should be 2 meter deep and half filled with waste, then covered with lime within 50 cm of the surface, before filling the rest of pit with soil. On each occasion when bio-waste is added to the pit, a layer of 10 cm soil shall be added to cover the carcass/bio-waste.
- Burial pit/trench should be at least 2.3 meter (not more than 3 meter) wide and 3 meter deep (7x9 ft). The length should be as per the number of carcasses.
- A floor space of 1.3 m^2(15 ft^2) may accommodate 5 mature pigs. For each additional meter (3 ft) in depth, the number of animals per 1.3 m^2 of floor space may be doubled. The total weight of dead animals in a pit should not exceed 2500 kg.
- Land requirement of 0.3 cubic meter for pig may be considered.
- The carcasses should be covered with at least 400 mm soil with unbroken layer of slaked lime - $Ca(OH)_2$. Avoid lime in anthrax cases. Lime should not be placed directly on carcasses, because in wet conditions it slow down decomposition.
- Burial pit should be covered with at least 2 m (6 ft) soil.
- During closing the pit surplus soil should be heaped over it as overfill.
- Lime should be added over pits, to prevent earthworms from bringing contaminated material to the surface after pit closure.

- No person should enter the trench more than 1.5 meters deep without stabilizing the sides.
- All the remnant feed and soil upto 2 inches deep must be disposed off along with the carcass.
- The pit sites should be fenced and permanent warning signboard should be fixed in all the pit sites.
- The pits should be monitored at regular intervals to check any sinking, water accumulation during rainy season etc.
- No crop should be grown further for at least one year on the pit site.
- All the pits should be dug one day in advance of the disposal and while digging pits, it should be ensured that no water is oozing out of the pit.
- After the disposal clean and disinfect all equipment and area.

Burning / Incineration

Incineration is the thermal destruction of carcasses by using high-temperature combustion (by using fuels like diesel, natural gas, and electric energy) to convert carcasses to inert gases and sterile ash. The method has the advantage of deactivating pathogens. Consider incineration as an alternative disposal method if suitable facilities are available. Follow proper incineration protocols to ensure complete combustion and prevent the release of hazardous emissions. General considerations for incineration/burning of carcasses are given below.

- The site identified for incineration shall be at least two hundred fifty meters away from human habitat.
- Burning should be away from public view and on flat, open ground with legal approvals.
- Keep vehicles, personnel, and other equipment at a safe distance away from the fire bed.
- Burning space: 8x3 ft. for 5 mature pigs. At least 1 meter fire bed length may be assumed for 5 pigs.
- In pyre burning: Place carcasses on top of solid fuel with sufficient airflow, on their backs lower and alternating head to tail. (Approximately one cord of wood (128 cubic feet or 3.4 meter^3) is required per 500 kg of carcass)
- Burn pit: The pit should be 0.5 m deep and extended 0.75 m beyond each end of the pyre. The pit should be 25 cm wider than the pyre on each side.
- The trench should be filled with mud after the entire carcass is burnt.
- Do not use tyres, rubber, plastic and similar materials for burning.
- Handlers and supervisors should use PPE.
- Firefighting equipment should be readily available.

- After the operation clean and disinfect all equipment.
- Anthrax carcasses can also be disposed of by burning (if incinerator is not available). All vessels and instruments should be disinfected with 3% sodium carbonate solution.

Composting

Composting transforms organic material in a predominantly aerobic environment and it is capable of destroying most pathogens except a few (eg. Spore forming *Bacillus anthracis*). General considerations for composting of carcasses are given below.

- It involves layering/mixing carcass with co-compost material (sawdust, silage etc) with at least 60 cm covering of composting material.
- Composting should be at least 100 meters away from water sources and 300 meters away from roads.
- Compost piles kill most pathogens in 10-14 days in case of small carcasses, and may take longer time for large carcasses.
- Land area of 3.5 square meters per pig carcass is required.
- The site should be 120 cm above seasonal high-water level and at least 1 meter above bedrock. The site should not be located on flood plains.
- On the base of litter, the carcass and related material along with the bulking agent are added in layers so that the carbon-to-nitrogen ratio is in the range of 15:1 to 35:1 (optimal 23:1).
- Necessary measures should be taken to minimize odour, flies, rodents, bird menace, and fire hazards.
- Leachate should be re-circulated in the compost plant for moisture maintenance.
- The volume of dead animal(s) in the compost pile must not exceed 25% of the total volume of the compost pile.
- The material should be removed from the compost pile after the carcass/related material is completely composted with minimum odours.

Rendering

Rendering is a process that uses heat to convert animal carcasses into safe, pathogen-free feed protein, meat and bone meal, fat or tallow and other final products and byproducts. The method is not recommended for anthrax carcasses.

- Carcass transport should be biosecured in leak-proof, clean and disinfected transport trucks.
- Temporary storage may be needed if carcasses cannot be rendered right away.
- The carcass should be processed before putrefaction.
- Rendering should not be used if barbiturates are used

for chemical euthanasia.

- A carcass cooker with an operating pressure of 35-40 psi and a capacity of 250 kg is preferred.
- Chlorination should be adopted for the treatment of effluent before discharge.
- Proper pollution control measures should be adopted for gaseous products, liquid effluents, and solid wastes.
- Maintain proper records of each rendering cycle.
- The rendered product shall not be used as an ingredient of animal feed.

Table 10.1: Commonly used disposal methods and disinfectants for animal diseases

Sl.No.	Disease	Disposal Method	Preferred Disinfectants for farm structures, equipment, animal houses
1	Anthrax	**Burial or Burning** Note: If incineration is unfeasible, deep burial of the carcass (at least 6 feet) is deemed acceptable. Prior to burial, the carcass should undergo decontamination procedures. It is imperative to seal all body openings (e.g., anus, mouth, nose) of the carcass using absorbent materials to prevent exudate leakage. Ensure that the head of carcass is covered with heavy duty plastic bag. There should be 1 m clay at the base of the pit and also carcass should be covered with minimum 1 m clay.	10% formaldehyde, 4%glutaraldehyde, 3% hydrogen peroxide, and 1% peracetic acid. Note: Hydrogen peroxide and peracetic acid will not work in the presence of blood. Soil from areas of anthrax contamination should be removed for incineration or soaked with 5% formaldehyde. Contaminated materials should be incinerated, and non-disposable items should be soaked with 4% formaldehyde or 2% glutaraldehyde. Avoid using lime and other calcium products on carcasses or contaminated ground.

Cont.

Sl.No.	Disease	Disposal Method	Preferred Disinfectants for farm structures, equipment, animal houses
2	FMD / Swine vesicular disease	**Burial or burning**	2-4%Glutaraldehyde, Citric acid, Sodium carbonate, 0.5% sodium hypochlorite solution (5000 ppm available chlorine), Virkon® (2%)
3	African Swine Fever	**Burial or Burning or Rendering.** Note: Carcasses shall not be allowed to move out of the area and shall be disposed in the Infected premises itself. In case of exceptions where the carcass disposal is not possible, the transport the carcasses using leak proof vehicles and dispose under supervision of regional veterinary authority. National Action Plan should be referred.	Appropriate disinfectants for ASF include 2% Sodium hydroxide, hypochlorite (0.5% available chlorine for 30 minutes), detergents and phenol substitutes, sodium or calcium hypochlorite (2-3%available chlorine), Ortho- phenylphenol 3% for 30minutes, formalin 0.3 % for30 minutes, iodine compounds and Virkon® (2%). Note: Disinfection must be carried out in three stages:a) Pre-disinfection: This step aims to prevent the spread of viruses in the room. Begin by cleaning the surface with a broom, then apply the disinfectant by spraying it from a distance of approximately 50 cm onto the surface. Allow the disinfectant to react for 30 minutes.b) Cleaning: This stage is designed to eliminate over 90% of the viruses present in the area. Therefore, after pre-disinfection, scrub the surface with water and soap, and then allow it to dry.c) Disinfection: Any remaining viruses will be destroyed during this final step. Spray the disinfectant onto the surface and allow it to react for 2 hours.

Cont.

Sl.No.	Disease	Disposal Method	Preferred Disinfectants for farm structures, equipment, animal houses
4	Classical Swine fever	**Burial or burning**	B-propiolactone (0.4%), Cresol (5%), sodiumhydroxide (2%), formalin(1%), sodium carbonate (4% anhydrous or 10% crystalline), ionic and non- ionic detergents as well as strong iodophors (1%) in phosphoric acid, Virkon® (2%).
5	Other common bacterial and viral diseases.	**Burial or burning**	Quaternary Ammonium Compounds, 5% Sodiumhypchlorite, 5% calcium hypochlorite, 5% acetic acid,5% Sodium hydroxide, Sodium carbonate, 2-4% Glutaraldehyde, Formalin, Formaldehyde gas, Some of the commercially available disinfectants such as Virkon® (1%), AlkaSept™ Active, PowerCull™ Extra, Combi Sept, Bactrex Plus, Germitol, Germisol, Potassium permanganate (1-2 grams / litre of water) and Lysol (500 ml of Lysol in 9.5 lit of water) can also be used to sanitize the premises depending on type of disease organisms and related factors.

Regulations and Jurisdiction

The guidelines regarding the disposal of carcasses and other potentially contaminated items during outbreaks of infectious and contagious diseases are outlined in the Prevention and Control of Infectious and Contagious Diseases in Animals Act, 2009 and the Prevention and Control of Infectious and Contagious Diseases in Animals Rules, 2010. Compliance with these regulations mandates the State Animal Husbandry Departments (AHDs) to proactively identify disposal sites (including buffer zones), monitor the disposal procedures, and duly document them.

Biological sample collection & disposal

Timely and accurate diagnosis of diseases can be a practical guide for pig farmers to take early action to control disease outbreaks. For accurate disease diagnosis in pigs, an appropriate sample collected and sent in a timely manner under appropriate conditions is a very important step for laboratory diagnosis. The initial and important step in any laboratory investigation of disease conditions in pigs is the collection of fresh and accurate samples. An accurate laboratory diagnosis requires data on disease history, selection of animal, antemortem and post-mortem examination, sample selection, sample handling, sufficient preservation, and promptness to shipment to the diagnostic laboratory.

Selection of pigs for collection of samples

Whenever possible, pigs selected for laboratory analysis should be free from antibiotic therapy and in an early or acute disease stage. Selected tissues should be collected as aseptically as possible. Ideally, two or three humanely euthanized pigs in the early stages of disease that are displaying typical clinical signs and immediately necropsied will yield the most reliable diagnostic data. Clinical history should be recorded and communicated to laboratory.

Restraining of pig

Appropriate sample could be collected with minimum stress. Adequate restrain of pig is necessary for any injection to be given or any sample to be collected. The period of restraint should be brief to prevent unnecessary stress, overheat and injury to the animal. Pigs of almost 40 kg and larger can be restrained by the use of a hog snare/ string/ rope. Pig should be calmed down by touching their belly/teats or scratching base of the ear. Then loop of the hog snare/ pig catcher string/rope is placed around the animal's nose and the upper jaw and tighten properly. The pig reacts to this restraint device by pulling back against the snare, reaching a stalemate with the operator. Squeeze the pig against wall/post/tree and place leg of the handler behind fore legs of the animal.

Smaller animals up to 20 kg can be restrained manually. The small pig can be picked up and secured on a lap. Alternatively, pigs of 10-20 kg can be restrained in dorsal recumbency. However, without sedation, it is difficult to prevent head movement.

Restraining of young pig

Restraining of adult pig by rope method

Collection of samples

1. **Tissues:**

Tissues may be collected for bacteriological, virological examination, or histopathology tests. For post-mortem samples, the skin of the dead animal may be removed with ordinary instruments, but the body cavities should be opened with sterile instruments. A fresh set of sterile instruments should be used to collect the pieces of the various organs required. Each piece of tissue should be placed in a separate sterile screw-capped jar or plastic bag, fully labelled with

the date, tissue, and animal identification. Care must be taken not to contaminate one tissue with another. Instruments can be heated on a burner. Disinfectants must not be used on or near tissues to be sampled for bacterial culture or virus isolation.

The fresh samples should be forwarded to the laboratory by the fastest direct route. For samples reaching the laboratory within 24 hours wet ice/ ice packs will suffice. Longer duration transport warrants tissue storage in dry ice or in bacterial or virus transport medium depending on the examinations required. For histopathology, blocks of tissues not more than 0.5 cm thick and 1-2 cm^2 are cut and placed in neutral buffered 10% formalin, which should be at least 4 times the volume of the tissue sample. Samples for histology should not be frozen.

2. Blood:

Blood samples may be taken for hematology or for culture and/or direct examination for bacteria, viruses, or protozoa, in which case the blood is added to anti-coagulants such as heparin. They may also be taken for serology, in which case a clotted sample is required. The lateral, intermediate and medial ear veins are superficial and visually accessible. Marginal/lateral ear vein is stable and it can be engorged by placing tourniquet around base of the ear. One must grasp the ear securing to prevent movement during collection of blood. After proper swabbing the engorged vein, a 20-22 gauge needle/ butterfly needle attached with rubber tubing can be inserted into the vein and collect blood.

Cephalic and lateral sphenoid can be used for collection of 5 ml blood. The cephalic vein is located along cranial aspect of the fore leg and across the thoracic inlet. The lateral saphenous vein is visualized easily; however, it is difficult to obtain large blood samples from this site. The medial saphenous vein is a good site for collection of blood.

For large blood samples, venipuncture of the cranial vena cava is the method of choice. This may be done eighter on a standing pig or one in dorsal recumbency. To make thoracic inlet accessible on standing position, the head should be held high and on dorsal recumbency, forelegs should be drawn back along the body. The needle (20-22 gauge) of 3.8 cm is inserted on the right side in the depression between the point of the shoulder and the manubrium sterni, order to avoid vegus nerve. The needle is aimed at opposite shoulder and passed into the cranial vena cava.A blood sample is taken, as aseptic as possible. Ideally the skin at the site of venepuncture should first be shaved and swabbed with 70% ethyl alcohol and allowed to dry before collection. For samples with anti-coagulant and/or antibiotics, thorough mixing is necessary as soon as the sample has been taken. It may be also necessary to make a smear of fresh blood on a microscope slide.

Sample collection vacutainers

Sample collection method from ear vein

3. Swabs:

Nasal swabs for sample collection

Swabs from the nose, eyes and rectum from the diseased pigs may be required for isolation of virus and bacteria. Swabs from reproductive tract may be collected to diagnose genital infections. These swabs should be collected from the acutely ill animals and placed directly into screw-capped tubes containing a viral, bacterial transport medium. Chioce of swab is equally important. Use of the incorrect swab and media may jeopardize the ability to detect or culture the offending pathogen.

1. Aerobic Culture: Commercial swabs with Stuart's or Amies transport media is recommended to prevent desiccation.
2. Anaerobic Culture: Anaerobic transport system. (The Port-A Cult® tube can be used for anaerobic, facultative, and aerobic bacteria.) For abscesses orexudates use a capped syringe with needle removed ora tube with a snug cap.

3. Nasal Swabs-Bacterial Suspect: Clean the external nares and internal nostrils with a moist towel to remove common contaminants. (Use swabs with transport media such as Amies or Stuart's). Insert swab into the pre-cleaned nasal cavity and rotate. Upon successful sample collection, the swab is inserted into the accompanying sterile plastic sheath. The ampule located at the end of the sheath is gently crushed, releasing transport medium.
4. Nasal Swabs-Viral Suspect: Prepare nostrils and sample as in bacterial suspect. For viral swabs use Viral Culturette® or equivalent.

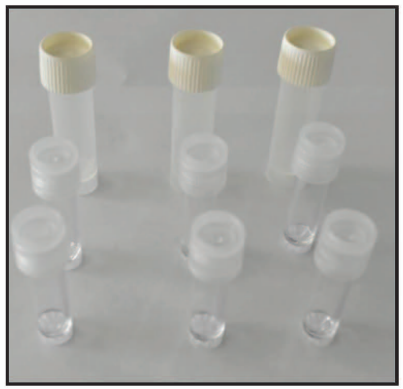
4. Faeces:

Faecal samples should be collected at least 4-5 gm either in a rubber-capped vial or in a polythene zip pouch for parasitic egg/ova count. Culturing of larva pooled faeces sample or separate sample from each animal is collected without adding preservative. Faeces for coccidial oocyst are collected in 2.5% pot dichromate solution and time should be noted.

Faecal sample collection vials

5. Urine:

Urine is collected either through a catheter or at the time of micturition in a sterile container for microbial analysis.



Urine collection vials

6. Skin scrapings:

The hair of the suspected skin area should be clipped with scissors. The area should be smeared with liquid paraffin. The area should be smeared with liquid paraffin. The lesion should be scrapped several times with the help of an oily scalpel till a small amount of blood appears on the skin. The skin scrapings adhered to the scalpel blade can be collected and kept for examination.

Checklist for sample collection kit

1. Sterile forceps, scissors, and scalpels.
2. Sterile swabs.
3. Vials for containing transport medium for collection of samples for isolation or identification.
4. Bottles for collection of faeces, blood, and other samples that do not require transport medium.
5. Bottles containing formalin saline for tissues to be examined histologically.

6. Blood collection equipment- without additive for serum, and with anticoagulant for isolation
7. Notebook, permanent markers and labels for recording and labelling specimens
8. Swabs and transport medium for bacteriological investigation
9. Cool box (Thermos flask)
10. Heavy-duty plastic bags for post-mortem materials

Specimens for histopathology

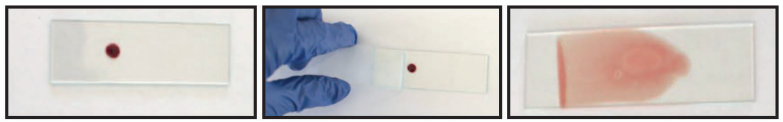
Formalin should be used for the preservation of material for histological examination. Material which has been frozen either before or after placing in formalin is useless for histology as the ice crystals formed damage cell structure. Samples should be fixed in 10% formalin. Commercial formalin is 40% formaldehyde gas in water, and must be diluted with water before use. Undiluted it causes great hardening and shrinkage of the tissue, rendering specimens useless for histological examination. Use 1 volume of 40% formaldehyde (commercial formalin) plus 9 volumes of water as fixing solution. Stock solutions can be neutralised by adding a few marble chips to the container.Cut the tissue to be examined into slices between 5 and 10 mm thick. Include the edge of any lesion so that both normal and abnormal tissue is seen.Jars should hold at least 10 times as much 10% formalin solution as tissue.Brain samples should be either:(a) fixed whole in a jar; or(b) cut down the midline - to allow easy removal from the jar. Don't cut the brain into pieces or slices as the tissue is soft and much of the histological structure will be lost.A meaningful history of the disease outbreak and a tentative diagnosis, based upon clinical evaluation and necropsy findings, should be included. Laboratory test results are directly affected by animal selection, necropsy technique, specimen selection, specimen handling, adequate preservation, and speed of shipment to the laboratory.

Tissue sample preservation in 10% formaldehyde solution for histopathology

Preservation of samples

Various preservatives are used for different specimens, e.g. phosphate buffered glycerin for tissues; EDTA, sodium citrate or heparin for whole blood and transport media (TPB) for swabs. The preserved specimens are most frequently transported on ice in a thermos flask or other suitable containers. The method of preservation depends mainly on the type of examination to which the material is to be sent to the laboratory.

a) **Blood/Pus smear for bacteriological examination:** The air dried smear is heated gently by passing quickly over the flame of a spirit lamp. To ensure adequate fixation by heating the heated smear,when placed on the back of the hand should be tolerable.



b) **Blood smear for protozoan parasite:** The smear should be prepared slightly thicker than the blood smear for bacteriological/haematological examination. The air-dried smear should be fixed byimmersing in methyl alcohol for 2 minutes,dried wrapped in paper and sent to laboratory without any preservative.

c) **For Histopathology or biopsy:**Tissue pieces are preserved in 10% formalin solution in the ratio of 1:10.

d) **Tissue for viral isolation:** Either in ice pack or in 50% phosphate buffer glycerine saline.

e) **Whole blood for haematology:** In anticoagulant containing vacutainer or adding anticoagulant of 1:9 ratio.

f) **Serum:** For serological study in ice pack.

g) **Urine:** For bacterial isolation in ice pack,for chemical analysis @2drops of 40%formalin for 30ml urine.

Information to be sent with samples

It is essential that individual samples be clearly identified using appropriate methods. Markinginstruments should be able to withstand the condition of use, i.e. being wet or frozen (useindelible marking pen). Pencil has a tendency to rub off containers and labels attached to plasticwill fall off when stored at –70°C. Information and case history should always accompany the samples to the laboratory, and should be placed in a plastic envelope on the outside of the shipping container. As outlined in the following section on transport of samples, this information must also be inside theshipping container. The following are suggesteditems that should be addressed. It would be advisable to contact the receiving laboratory todetermine if it has a submission form that it would like to have submitted with the samples or if it needs other information.

Information and case history should always accompany the samples to the laboratory, and ideally should be placed in a plastic envelope. The information should include the following points:

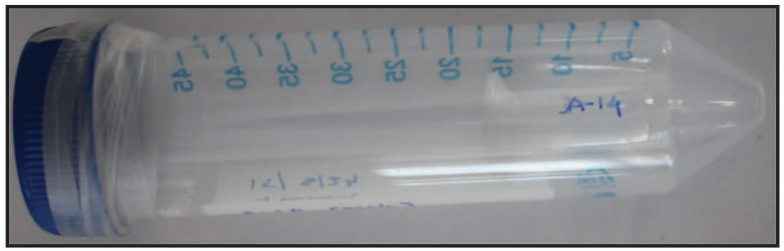
1. Name of veterinarian/Name of farmer/herd owner.
2. Name and address of owner/resident where disease occurred, with telephone and fax numbers.
3. Disease suspected.
4. Samples submitted and tests required (transport medium used).

5. The species, breed, sex, age and identity of the animals sampled.
6. Length of time on the farm; if recent arrival, where from.
7. Date of first cases and of subsequent cases or losses
8. Description of the spread of infection in the herd.
9. Number of animals dead, the number showing clinical signs, and their age, sex and breed.
10. The clinical signs and their duration including the condition of mouth, eyes and feet, and production data.
11. Type and standard of husbandry, including the type of feed available, possible contact with poison or poisonous plants.
12. A list of description of the samples submitted for examination, and post-mortem findings.
13. Any medication already applied to the animals, and when given.
14. Any vaccination already given, and when given.
15. Name and address of sender, with telephone and fax number, and date of submission.

Transportation of samples

Samples must be carefully packed for no leakage or cross-contamination and should be delivered within 48 hours and must be kept cool during transit. The transport of biological samples requires the use of a cool pack to maintain cold chain or the addition of preservative agents that do not interfere with the diagnostic procedures. for conûrmatory diagnosis of infectious agents in the diagnostic/testing laboratories. Some samples should not be frozen. Screw-capped bottles should be used and should be additionally sealed with adhesive tape or paraffin wax. Samples in individually identified containers should be placed in larger strong, outer containers and packed with enough absorbent material to protect from damage. Official shipping regulations must be consulted. It is advisable to contact the laboratory in advance in the case of unusual requests. It is essential to do so, where material is sent to a laboratory in another country. Many countries require a special import license to be obtained in advance for any biological material, especially for tissues which could contain animal pathogens. This should accompany the package and be attached in an envelope to the outside of the parcel.

Transportation of biological sample in a primary container packed inside a screw capped secondary container sealed with adhesive tape.



Transportation of biological samples in a container with ice pack maintaining 4°C inside

Processing and disposal of samples to maintain biosecurity

Carcasses, leftovers after specimen collection etc need to be disposed off cautiously by on-site burial or incineration. Specimens sent to the laboratory should be transported in leakage-free containers to nullify the chances of contamination *en-route* the transit. This is important to prevent the spread of pathogens to new areas.

From a laboratory, biological waste can be disposed of as per the laboratory biological safety guidelines. The waste must have been decontaminated by autoclave, chemical disinfection or by appropriate decontamination method. Commonly, biological wastes should be autoclaved in an autoclave bag. After autoclaving and the bag has cooled, place the sealed waste in the box-bag unit for pickup. If an autoclave is not available the waste may be collected in orange/red autoclave bags, closed with tape and placed in the box-bag unit as untreated biological waste. Agencies approved to handle biological wastes should be employed to routinely pick up all box-bag units on, at least, a weekly basis. Incineration of the collected tissue samples is also effective to deactivate the pathogens before reaching the environment.

Biosecurity during transportation

During the transportation of pigs or livestock, it is crucial to follow biosecurity guidelines to prevent the spread of diseases between farms or locations.

- **Clean and Disinfect Vehicles:**

  Thoroughly clean and disinfect transport vehicles before and after each use. Remove all organic matter, such as manure or bedding, from the vehicle. Use appropriate disinfectants effective against common pathogens and follow the manufacturer's instructions for application.

- **Limit Vehicle Access:**

  Restrict access to the vehicle only to essential personnel involved in the transportation process. Minimize contact between the vehicle and other animals, people, or equipment that may carry potential pathogens.

- **Separate and Segregate Animals:**

  Ensure proper segregation of different groups of animals during transportation to prevent the mixing of different populations. Separate sick or visibly unhealthy animals from healthy ones to avoid disease transmission.

- **Implement Biosecurity Barriers:**

  Use physical barriers, such as partitions or dividers, to separate different groups of animals within the vehicle. Provide adequate ventilation to minimize stress and maintain

a comfortable environment for the animals.

- **Biosecurity Measures for Personnel:**

  Personnel involved in transportation should follow proper hygiene practices, including wearing clean and appropriate clothing, gloves, and footwear. Regularly wash hands or use hand sanitizers before and after handling animals or touching surfaces within the transportation area.

- **Record Keeping:**

  Maintain accurate records of the origin, destination, and date of transportation. Keep a record of any potential disease signs observed during transportation.

- **Communication and Collaboration:**

  Communicate with the receiving farm or facility regarding the transportation details and any relevant health information. Coordinate with veterinary authorities or professionals to ensure compliance with local regulations and guidelines.

Table 12.1: Animal transportation - Biosecurity assessment

Sl No	Describe	Yes	No	Remarks
1	**Legal validation**: Does the vehicle and cages for transport have adequate facilities as per the existing laws / guidelines for animal transport and have required documentations?			Refer Transport of Animals rule (1978) and its amendments (2009). Moreover, transport duration and distance should be kept as per rules.
2	**Facility checks**: Is the facility spill proof, preventing waste from falling outside the container; secure and escape proof; provide adequate ventilation; have a solid floor; and be free of sharp edges that could harm the animal?			Physical verification required. Check floor, corners and sides for sharp items, ventilation facility. Ensure that the wastes from animal will not be spilled out during the animal transportation.
3	**Transportation history**: Is there any suspicious history of infected animal transportation in preceding days?			Check transporters preceding exposure to other animals. Check days after last transportation, species transported, their health status.
4	**Sanitation and hygiene**: Has proper organic content removal, detergent wash followed by disinfectant application protocols performed before loading animals?			Check cleanliness, hygienic standards of drivers, attendants and vehicle. Confirm disinfection protocol followed by the transporter.
5	**Segregation facility**: Is there adequate separating facility available for different age groups and for isolated animals?			Check for the segregation facility.
	If Any of the questions returns an answer as "No", then report as: "Biosecurity at risk, require corrections"			

Biosecurity Integrity Assessment Scoresheet

Farm Details

Name of Farmer			**Number of animals reared:**	**Adult:**	**Piglets:**
Address			Type of farm:	Backyard ☐	Organized ☐
Farm infrastructure					
No	**Assessment Criteria**	**Score(Please tick (✓) one)**	**Description**		
01	Zone-wise compartmentalization of pig farm areas based on exposure to risk factors	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor** : Direct entry into farm shelters from outside **Fair** : Establishment of fencing and boundary walls **Good** : Establishment of partition within the farm based on exposure to risk factors **Excellent**: Zonal classification with proper fencing between risk zone, buffer zone and core zone with controlled movement between the zones.		
02	Biosecurity signboard in farm	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor** : No biosecurity sign board or sign board in bad condition **Fair** : Temporary structure, lack of information, inappropriately placed. **Good** : Display boards mounted on a permanent frame, appropriately placed, contains all required information **Excellent** : Display boards mounted on a permanent frame, appropriately placed, contains all required information in simple, uncomplicated and short wordings with pictorial representations		

03	Fencing of farm premises	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No perimeter fence, incomplete/damaged or partial structures. **Fair**: Temporary wooden/bamboo fence, green net fencing, fencing inappropriately done. **Good**: Adequately spaced barbed wire fencing with wooden pole support. **Excellent**: Chain linked fencing or adequately spaced barbed wire fencing with concrete pole or iron post support. Fencing in between various biosecurity zones in the pig farm.
04	Functional foot dip at entry points	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No foot dip or the foot dip is not functional. **Fair**: Foot dip present, replacement of disinfectant is not regular, poor maintenance. **Good**: Good construct, regular cleaning and disinfectant replacement, facility properly used by farm workers. **Excellent**: Concreted foot dip, solution nicely maintained, facility properly used, person in charge identified and trained on disinfectant solution preparation & replacement.
05	Functional tyre dip at the entrance of the farm	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No tyre dip or the tyre dip is not functional. **Fair**: Tyre dip present, replacement of disinfectant is not regular, poor maintenance. **Good**: Good construct, enough size, regular cleaning and disinfectant replacement, facility, properly used. **Excellent**: Concreted tyre dip, regular cleaning and disinfectant replacement, facility properly used, person in charge identified and trained on disinfectant solution preparation & replacement.
06	Change rooms/Wash stations (Before core biosecurity zone)	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No wash station or it is not functional. **Fair**: Limited water supply or water in containers, no soap provided. **Good**: Change rooms/ ante rooms present. Proper supply of water, soap are provided. Facility routinely used **Excellent**: Change rooms/ ante rooms present. Proper supply of water, soap are provided. Facility routinely used. Bath facility with facility for dress change.

07	Farm gears for workers and visitors (boots/shoes and farm clothes)	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No designated farm boots/shoes. Clothes/farm gears not used. **Fair**: Gumboots provided and regularly used but no farm clothes. **Good**: Gumboots and farm clothes provided, properly used and maintained. **Excellent**: Gumboots & farm clothes provided, properly cleaned, maintained and used. Separate apron, boot covers and head covers for visitors.
A	**Overall farm infrastructure score**	**Total score /7=**	**High risk:** Average value 0 - 1 **Medium risk:** Average value 1.1 - 2 **Fairly Protected:** Average value 2.1 - 3

Farm management

No	Assessment Criteria	Score	Description
08	Cleanliness of farm area and premises	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: Unclean, waterlogged, unmanaged garbage, rodent infested, covered with bushes. **Fair**: Free of garbage. Proper manure disposal and bushes properly trimmed. **Good**: Clean premises, free of rodents, cleaning schedule present, proper manure disposal. **Excellent**: Concreted clean surrounding, cleaning and disinfection schedule maintained, pest control programs implemented, proper manure disposal.
09	Drainage system	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: Absence of drainage system or drainage system not functional. **Fair**: Drainage system not properly planned; drainage clogged. **Good**: Drains proper, free outflow of farm effluent. **Excellent**: Well-planned drainage system with traps at inlets/outlets, Proper disposal facility.

10	Isolation/ sick animal shed	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: Absence of isolation facility or unused facility. **Fair**: Facility available, but occasionally used for other purposes. **Good**: Separate shed, maintained clean, used appropriately. **Excellent**: Separate shed, at least 100 m away from other sheds, maintained clean, proper record maintenance, separate dress and utensils for workers.
11	Quarantine shed	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: Absence of isolation facility or unused facility. **Fair**: Facility available, but occasionally used for other purposes. **Good**: Separate shed at least 500 m away from animal sheds, maintained clean, proper use, record maintained. **Excellent**: Separate shed, at least 500 m away, clean, record maintained, all in all out system followed, vaccination and deworming done here for new animals, record maintained.
12	Cleaning and disinfection	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: Extraneous matters on floor, dirty walls, evidence of rat infestation, smell intense. **Fair**: Floor free of extraneous matters, excreta. **Good**: Floor free of extraneous matters & excreta, cleaning schedule maintained. **Excellent**: Clean floor, absence of immense smell, cleaning and disinfection schedule maintained, proper training on cleaning and disinfection for workers on regular basis.
13	Feed and feed storage	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No feed store room, no feed records maintained. **Fair**: No feed store room, no proper feed records maintained. Feed stored in owners house, protected from rats and birds. **Good**: Temporary or semi-permanent feed store, nicely stacked, protected from rain water, rats, birds and other animals, feed records maintained. **Excellent**: Permanent feed store room, well ventilated, feed nicely stacked over wooden pallets maintaining sufficient gaps from walls, protected from rain water, rats, birds and other animals. Feed records maintained, follow first-in-first-out stock rotation.

14	Farm equipment	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: Equipment not cleaned after use, some equipment borrowed from other farms. **Fair**: Own routinely required equipment and utensils. The utensils brought from outside are cleaned and disinfected before entry to farm. **Good**: Own equipments and utensils. Cleaned after every use. **Excellent**: Own equipments and utensils. Cleaned after every use. Separate utensils for quarantine and isolation facilities.
B	**Overall farm management score**	**Total score /7=**	**High risk:** Average value 0 - 1 **Medium risk:** Average value 1.1 - 2 **Fairly Protected:** Average value 2.1 - 3

Healthcare

No	Assessment Criteria	Score	Description
15	Vaccination and deworming (Check farm records)	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No vaccination / deworming done, records absent. **Fair**: Vaccination and deworming done, records not maintained. **Good**: Vaccination and deworming schedule followed, records maintained. **Excellent**: Vaccination and deworming schedule followed, records maintained, cold chain maintenance proper, absence of disease out breaks history.
16	Routine health monitoring	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No evidence of animal health monitoring or health checks. **Fair**: Checks the health of animals once a day, no records maintained. **Good**: Health checks twice a day, records maintained. **Excellent**: Health checks twice a day, records maintained. Training on early warning signs given to workers. Records on diseases, treatment history and post-mortem findings are properly maintained and updated.
17	Sick animal management	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No isolation facility, no treatment records maintained. **Fair**: Treatment records available but not properly maintained. **Good**: Have isolation shed and treatment records maintained. **Excellent**: Prompt cleaninig and disinfection plan when disease is detected. Have isolation shed and treatment records maintained. Records indicate isolation of sick animal for required period and evidences of observing withdrawal periods before sale.

18	Outbreak reporting to national disease reporting system	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: Do not know whom to report. **Fair**: Knows at least one agency to report to. **Good**: Knows whom to report to, have contact numbers of responsible officials for reporting, reports within 24 hours. **Excellent**: Knows whom to report to, have contact numbers of responsible officials for reporting, reports within 24 hours. Records of disease reporting in earlier cases available.
19	Source of water supply to the farm	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor** : Dirty water source. **Fair**: Open water source. Owner takes care of the source to protect from contamination. **Good**: Clean water source. There is no chance of contamination from nearby farms. **Excellent**: Clean water source / own water source. There is no chance of contamination from nearby farms. The effluent water is decontaminated before release to open area.
20	Carcass disposal	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No proper disposal methods followed. **Fair**: Dispose by burial. **Good**: Deep burial in secured place and fenced. **Excellent**: Site secured and fenced. Dispose in burial pit with proper disinfectant application or perform incineration.
21	Entry of visitors (Verify visitors records)	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No restriction for visitors. **Fair**: Allow visitors merely based on farmer's judgement. **Good**: Restricts unnecessary visitors, allow only essential visitors. Foot dips, hand wash and other biosecurity measures as per biosecurity plan are followed. **Excellent**: Restricts unnecessary visitors, brief essential visitors, risk assessment for such visitors, follow biosecurity procedures for essential visitors, avoid direct contact with animals, proper record maintenance.
C	**Overall healthcare score**	**Total score /7=**	**High risk:** Average value 0 - 1 **Medium risk:** Average value 1.1 - 2 **Fairly Protected:** Average value 2.1 - 3

Record Keeping			
No	**Assessment Criteria**	**Score**	**Description**
22	Treatment record	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No treatment record. **Fair**: Record maintained without details **Good**: Record maintained with animal and treatment details. **Excellent**: Record with proper animal IDs, Clinical signs, tests and treatment details
23	Mortality records maintained	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No mortality records maintained. **Fair**: Mortality records are maintained but information recorded are not adequate. **Good**: Mortality records are maintained with adequate and up to date information. **Excellent**: Morbidity and mortality records are maintained with animal details, diagnosis and disposal methods.
24	Animal stock record	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No animal stock records maintained. **Fair**: Some form of animal stock records maintained, partial data entry. **Good**: Animal are identified, stock records are maintained with complete information. **Excellent**: Animal are identified, stock records are maintained with real-time, accurate and up to date information.
25	Visitor's record	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No visitor's record maintained. **Fair**: Some sort of visitor's record maintained, partially entered without complete data. **Good**: Visitor's record maintained with adequate information. **Excellent**: Visitor's record maintained with adequate information, risk assessment done before permitting entry and evidence of strict implementation.

26	Cleaning, disinfection and decontamination records	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No records maintained. **Fair**: Records without any proper schedule. **Good**: Records verifying adherence to proper schedule. **Excellent**: Records verifying adherence to proper schedule, with display of disinfectant protocol of farm at proper place.
27	Livestock receival & inspection record	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No records maintained. **Fair**: Records with partial data entry **Good**: Records with complete data entry **Excellent**: Records with complete data entry, matching with present stock data of farm
28	Format of training record	☐ 0 – Poor ☐ 1 – Fair ☐ 2 – Good ☐ 3 – Excellent	**Poor**: No records maintained. **Fair**: Records indicating absence of regular training. **Good**: Complete data entry indicating regular trainings. **Excellent**: Regular training indicated by records, assessment and follow-ups.
D	**Overall score on record keeping**	**Total score /7=**	**High risk:** Average value 0 - 1 **Medium risk:** Average value 1.1 - 2 **Fairly Protected:** Average value 2.1 - 3
	Overall farm biosecurity score	**= (A+B+C+D)/4=**	**High risk:** Average value 0 - 1 **Medium risk:** Average value 1.1 - 2 **Fairly Protected:** Average value 2.1 - 3

Annexures

Annexure 1: Health calendar for pig

1. Vaccination program:

All the animals should be vaccinated for classical swine fever, Foot and mouth disease and porcine circovirus as per the standard protocol mention below:

Vaccine	Dose & Route of administration	Age of Primary vaccination	1st Booster	Revaccination
Classical Swine Fever Vaccine	1ml, I/M	Post weaning (Weaning is usually done at 45 days)	After 30 days of 1st vaccination	Every 6-month interval
FMD Vaccine (Oil adjuvanted trivalent vaccine)	2ml, I/M	2 Months	-	Every 6-month interval
Porcine Circo virus vaccine	1 ml, I/M	3 weeks of age(Single dose vaccine)	-	-

2. DEWORMING SCHEDULE:

Deworming of the animals should be don for both end and ecto parasites as per the recommendation

For Control of Endo parasite				
Name of dewormer	**Dose rate**	**First dose**	**Second dose**	**Repeat**
Piperazine liquid (45% w/v)	100-300mg/kg body weight	at 3 weeks of age	at 21 days of first deworming	at 2 months interval
Albendazole	5- 7.5 mg/Kg. body weight orally			
Fenbendazole	5-7.5 mg/Kg. body weight orally orally			
For Control of Ecto-parasite				
Ivermectin	0.3-0.6 mg/kg. body weight subcutaneously (based on clinical signs)			

Annexure 2: Format of Visitors Record

Sl No	Date	Name	Address	Purpose of visit	Contact number	Risk assessment			Date of latest exposure to livestock	Entry & exit time
						Low	Medium	High		

Annexure 3: Format of Vehicle Decontamination Record

Sl No	Date	Vehicle type	Vehicle Number	Has the vehicle ferried animals/ biological risks during the preceding week? (Yes / No)	The intended purpose of entry to the farm	Cleaning method adopted

Annexure 4: Format of Livestock Receival & Inspection Record

Sl No	Date	Source	Age	Breed	Stock size (n)	Vaccination (Yes /No)	Disease testing (Yes /No)	Health certificate (Yes /No)	Comments (Body condition, Injuries, Risks)	Quarantine period (from–upto)

Annexure 5: Format of Treatment Record

Sl No	Date	Animal ID	Age	Shed number	Clinical signs	Test results (if any)	Treatment	Remarks

Annexure 6: Format of Mortality Record

Sl No	Date	Age	Animal ID	Cause of death	Disposal method	Remarks

Annexure 7: Format of Training Record

Employees name:

Employees position:

Sl No	Knowledge gap	Date of training	Subject/Topic	Training assessment		Follow up (topic & date)	Remarks
				Satisfactory	Improvement required		

Annexure 8. Sample display boards on Farm Biosecurity

STOP

জৈৱসুৰক্ষিত ক্ষেত্ৰ -I
जैवसुरक्षित क्षेत्र -I
Biosecurity Zone-I

আপুনি এটা জৈৱ সুৰক্ষিত এলেকাত প্ৰৱেশ কৰিছে।
অনুগ্ৰহ কৰি নিম্নলিখিত নিৰ্দেশসমূহ পালন কৰক।

১। প্ৰৱেশ প্ৰাৰ্থীসকলে মুখ্য দ্বাৰত প্ৰয়োজন অনুসৰি নিজৰ আৰু বাহনৰ বিশেষ তথ্য প্ৰদান কৰাতো বাঞ্ছনীয়।
২। প্ৰৱেশ পত্ৰ অবিহনে ভিতৰত সোমোৱা নিষেধ।
৩। বিশিসম্মত ফাৰ্মগেট পাছ অবিহনে কোনো ব্যক্তি আৰু বাহনৰ প্ৰৱেশ নিষেধ।
৪। বহিঃ এলেকাৰ কোনো জীৱ-জন্তুক এই এলেকাত প্ৰৱেশৰ অনুমতি দিয়া নহয়।

'आप एक जैव सुरक्षित क्षेत्र में प्रवेश कर रहे हैं।
कृपया निम्नलिखित निर्देशों का पालन करें'।

1. आगंतुकों / वाहनों को मुख्य द्वार पर आवश्यकतानुसार विवरण प्रदान करना अनिवार्य है।
2. परिसर में प्रवेश करने के लिए गेट पास अनिवार्य है।
3. परिसर में बाहर के किसी भी जानवर की अनुमति नहीं है।

"You are entering a bio-secured area.
Kindly adhere to the following instructions."

1. Visitors and vehicles should provide details as required at main gate
2. GATE PASS is mandatory for entry into campus
3. Animals from outside are not allowed in the campus

By the order
Director, ICAR- NRC on Pig

STOP

জৈৱসুৰক্ষিত ক্ষেত্ৰ -II
जैवसुरक्षित क्षेत्र -II
Biosecurity Zone-II

সংৰক্ষিত কৰিব পৰিছিৰ প্ৰৱেশ। আপুনি মধ্যৱৰ্তী এলেকাত প্ৰৱেশ কৰিছে।
নিৰ্দেশসমূহ পালন কৰক

১ ফাৰ্মৰ প্ৰৱেশৰ বাবে কেৱল বৈধ ফাৰ্ম গেট পাছ ধাৰক বাহনেহে অনুমতিপ্ৰাপ্ত হ'ব।
২ প্ৰৱেশকাৰী বাহনৰ চকাসমূহ চম্পূৰ্ণভাবে পৰিষ্কাৰ কৰা আৰু চকাসমূহ ধুই পৰিষ্কাৰ কৰাটো বাধ্যতামূলক।
৩ এই সীমাৰ পৰা গমবুট পিন্ধিব লাগিব।
৪ হাত ভালদৰে ধুই আৰু হাত বিশেষভাবে পৰিষ্কাৰ কৰাটো বাঞ্ছনীয়।
৫ ইতিমধ্যে সংক্ৰমণ হোৱা পশুৰ সংস্পৰ্শলৈ যোৱা ব্যক্তিসকলে অতি কমেও সাত দিন ফাৰ্মলৈ নাহিব।

ध्यान दें - प्रतिबंधित प्रवेश - आप बफर ज़ोन / मध्यवर्ती क्षेत्र में प्रवेश कर रहे हैं।
निर्देशों का सख्ती से पालन करें।

1. केवल 'फार्मगेटपास' वाले वाहनों / व्यक्तियों को आगे जाने की अनुमति होगी
2. वाहनों के चाकों को धोना और तेज़ दबाव वाले पानी से धुलाई करना सभी वाहनों के लिए अनिवार्य है।
3. पैर को धोना और हाथ की सफाई का दृढ़ता से पालन किया जाना अनिवार्य है।
4. इस सीमा के बाद से गमबूट पहनना अनिवार्य है।
5. प्रभावित अथवा संक्रमित जानवरों के संपर्क में आने वाले कर्मचारियों को कम से कम 3 दिनों तक फार्म में नहीं जाना है।

"Attention – Restricted entry: You are entering into Buffer Zone.
Strictly follow the instructions"

1. Only vehicles and persons with FARM GATE PASS will be allowed to proceed
2. Tyre dipping and pressure washing is mandatory for all vehicles
3. Wearing gumboots is mandatory from this point onwards
4. Hand sanitization and Foot dipping are mandatory
5. Please do not proceed if you have visited other pig farms or handled pathogens during last 3 days

By the order
Director, ICAR- NRC on Pig

STOP

জৈৱসুৰক্ষিত ক্ষেত্ৰ -III
जैवसुरक्षित क्षेत्र -III
Biosecurity Zone-III

হাত ধুবলৈ, লোকৰ মাধ্যমেৰে ব্যক্তিগত প্ৰৱেশৰ অনুমতি দিয়া হয়।
আপুনি কৰি অঞ্চলত, চাবাৰ 'জৈৱ সুৰক্ষিত এলেকাত প্ৰৱেশ কৰিছে।

[illegible]

यहाँ रुकें - केवल अधिकृत व्यक्तियों को ही अनुमति दी जाती है। आप फार्म के
बाहरी भाग अर्थात बफर ज़ोन में प्रवेश कर रहे हैं।

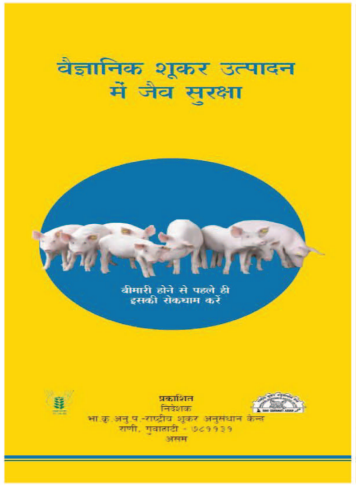
1. सभी आगंतुकों को एप्रन, मास्क, कैप और गमबूट पहनना अनिवार्य है।
2. सभी फार्मकर्मियों को स्नान करना , पोशाक बदलना और गमबूट पहनना अनिवार्य है।
3. पैर डुबोकर धोना और हाथ की सफाई करना सभी को अनिवार्य है।
4. पीछान और बाहर से किसी भी जैविक वस्तुओं का इस सीमा के बाद से जाना वर्जित है।
5. जो कर्मचारी / स्टाफ संक्रमित जानवरों के प्रबंधन का कार्य किये हैं , वे दूसरे जानवरों के प्रबंधन का कार्य न करें।
6. किसी भी बीमारी का संकेत दिखने पर तुरन्त फार्म प्रबंधक को सूचित करना अनिवार्य है।

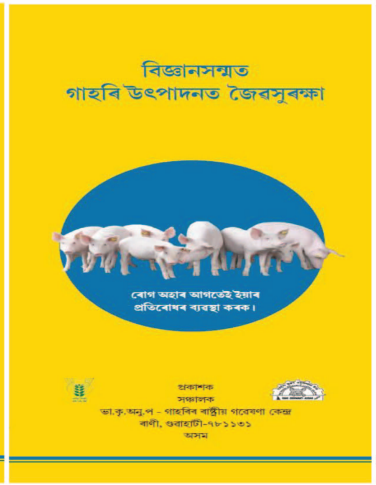
"Stop here – Only Authorized persons are allowed
You are entering Core Biosecurity Zone"

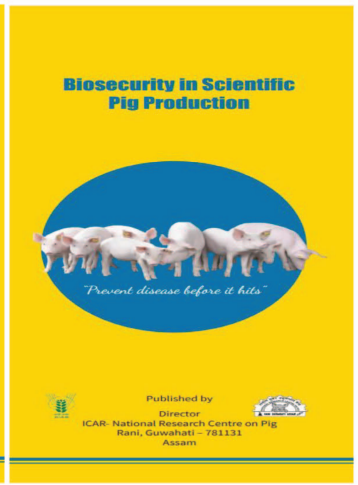
1. All visitors should wear Apron, Masks, Caps and Gumboots compulsorily
2. All farm workers should take bath, change dress and wear gumboots before entering farm
3. Dipping of foot and hand washing are mandatory
4. Food and biological items from outside are strictly prohibited beyond this point
5. Workers and staff attending infected animals should not attend other animals
6. Any sign of illness in animals should be reported immediately to farm manager

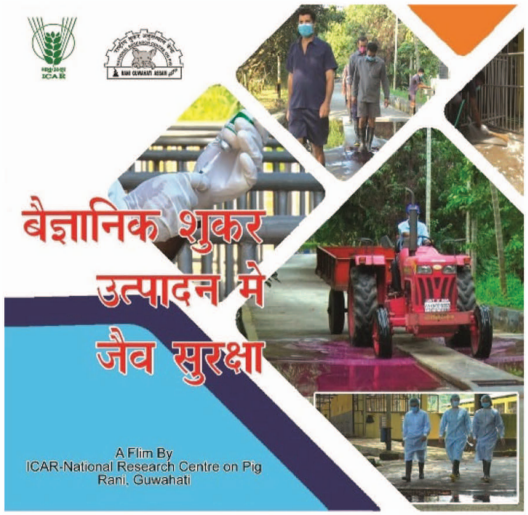
By the order
Director, ICAR- NRC on Pig

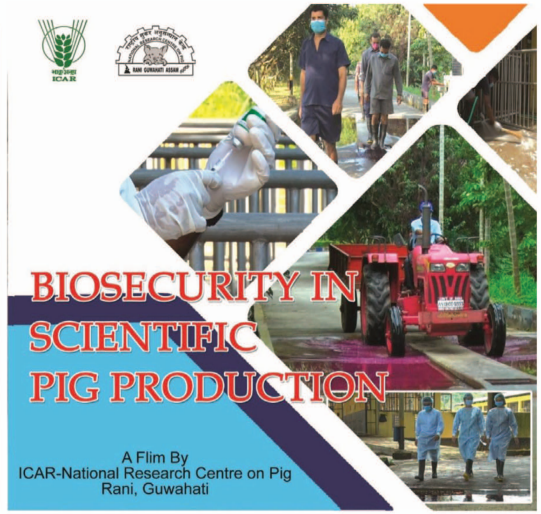
Annexures 9. Inventory of resources on pig farm biosecurity











Annexure 10. Terminologies associated with biosecurity

- **Antimicrobial resistance:**
  The ability of microorganisms, such as bacteria, to resist the effects of antimicrobial drugs, making infections more difficult to treat.
- **Biocontainment:**
  Measures taken to prevent the escape or release of pathogens from an infected area, such as using secure enclosures or barriers.
- **Biohazard:**
  Substances or materials that pose a risk to human or animal health, including infectious agents or hazardous chemicals.
- **Biosafety level (BSL):**
  A classification system that defines the containment requirements and protocols for working with specific pathogens or biological materials.
- **Biosafety:**
  Measures taken to minimize the potential risks associated with handling and working with biological agents, including pathogens.
- **Biosecurity:**
  The measures and protocols put in place to prevent the introduction and spread of infectious diseases in livestock populations.
- **Biosecurity audit:**
  A comprehensive assessment of biosecurity measures and practices implemented on a farm or facility to identify areas for improvement.
- **Biosecurity breach:**
  Any failure or violation of biosecurity protocols that can lead to the introduction or spread of disease.
- **Biosecurity signage:**
  Clearly visible signs or labels placed in strategic locations to remind and inform individuals about biosecurity protocols and practices.
- **Carrier:**
  An animal that harbors and spreads a disease-causing agent without showing any signs of illness.
- **Clean and dirty zones:**
  Designated areas within a livestock facility or farm where different levels of biosecurity measures are implemented,

separating areas with higher risk of contamination from areas with lower risk.

- **Compliance:**
  The adherence and adherence to established biosecurity protocols and guidelines to minimize the risk of disease transmission.
- **Contamination:**
  The presence or introduction of harmful pathogens or infectious agents into a livestock environment.
- **Contingency planning:**
  Preparing and implementing strategies to respond effectively to potential disease outbreaks or emergencies.
- **Decontamination:**
  The process of removing or neutralizing contaminants, such as pathogens or chemicals, from surfaces or materials.
- **Depopulation:**
  The intentional removal and euthanasia of animals from a population to control the spread of disease.
- **Diagnostic testing:**
  Laboratory tests and procedures used to detect, identify, and confirm the presence of specific diseases or pathogens in animals.
- **Disease surveillance:**
  The systematic collection, analysis, and interpretation of data on the occurrence, distribution, and trends of diseases in animal populations.
- **Disinfectant:**
  A chemical agent or solution used to kill or inactivate pathogens on surfaces, equipment, or materials.
- **Disinfection:**
  The process of killing or inactivating disease-causing microorganisms on surfaces, equipment, or materials to prevent the spread of pathogens.
- **Emergency response:**
  The coordinated actions and measures taken in response to a disease outbreak, natural disaster, or other emergency situation.
- **Endemic:**
  A disease that is regularly found in a particular region or population.
- **Epidemic:**
  The occurrence of a disease in a larger number of animals than usual within a specific population or area.

- **Epidemiology:**
  The study of the patterns, causes, and effects of diseases in animal populations, including the factors influencing their transmission and control.
- **Fomite:**
  Inanimate objects or materials that can carry and transmit disease-causing agents, such as equipment, clothing, or vehicles.
- **Footbaths/Foot dips:**
  Containers filled with disinfectant solution placed at the entrance of livestock facilities to disinfect footwear and prevent the introduction of pathogens.
- **Hygiene:**
  Practices and procedures that maintain cleanliness and prevent the spread of disease-causing agents.
- **Isolation:**
  Separating sick or infected animals from healthy ones to prevent the spread of disease.
- **Mortality:**

  The number of deaths within a population, often used as an indicator of disease severity or impact.
- **Outbreak:**
  The sudden occurrence of a disease in a specific population or area, often affecting a significant number of animals.
- **Pathogen:**
  An organism or agent, such as a virus, bacteria, or parasite, that can cause disease in animals.
- **Personal Protective Equipment (PPE):**
  Items such as gloves, masks, and coveralls worn by workers to protect themselves from potential disease transmission.
- **Pest control:**
  Measures to manage and control pests, such as rodents and insects, that can transmit diseases to livestock.
- **Pre-emptive culling:**
  The strategic removal of animals that may be at high risk of infection or transmission of a disease to prevent its spread.
- **Quarantine:**
  Isolating animals or groups of animals that have been newly introduced or suspected of being infected to prevent the spread of diseases to the rest of the herd.
- **Restricted access:**
  Limiting and controlling the entry and movement of people, vehicles, or animals onto a farm or facility to minimize the risk of disease introduction.

- **Risk assessment:**
  The process of evaluating potential risks and vulnerabilities in a livestock operation and implementing measures to mitigate those risks.
- **Risk communication:**
  The effective exchange of information about potential risks, preventive measures, and disease control strategies between stakeholders in the livestock industry.
- **Rodent control:**
  Measures taken to prevent and control populations of rodents, such as rats and mice, which can carry and spread diseases.
- **Sentinel animals:**
  Animals that are intentionally exposed to diseases or pathogens to monitor the presence or spread of infection within a population.
- **Serology:**
  The study and testing of blood serum to detect the presence of antibodies or antigens related to specific diseases.
- **Seroprevalence:**
  The proportion of animals in a population that have specific antibodies in their blood, indicating previous exposure to a particular disease.
- **Surveillance:**
  The systematic monitoring and collection of data on the health status of animals to detect and respond to disease outbreaks.
- **Traceability:**
  The ability to track and record the movement of animals, products, or inputs throughout the production and supply chain.
- **Vaccination:**
  The administration of vaccines to stimulate the immune system and provide protection against specific diseases.
- **Vector:**
  An organism, often an arthropod like mosquitoes or ticks, that can carry a disease causing agent from reservoir to the host.
- **Zoonotic diseases:**
  Diseases that can be transmitted between animals and humans.

ABOUT ICAR - NRC ON PIG

The ICAR-National Research Centre on Pig is a premier institute under the Indian Council of Agricultural Research. Our primary mandate is to conduct research, development, and technology transfer activities aimed at improving pig production and enhancing the livelihoods of pig farmers across India.

ICAR-NRCP focuses on various aspects of pig research, to facilitate better productivity through optimised management, improved germplasm, and precise health care. The centre also engages in capacity-building initiatives for farmers, entrepreneurs and extension workers to uplift the socio-economic status of rural communities. Through collaborations with national and international agencies, contributions of ICAR-NRCP to the development of the piggery sector is playing a vital role in ensuring food security and economic growth in India.

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PACKAGE OF PRACTICES ■ BIOSECURITY MEASURES IN PIG PRODUCTION