Design for Biosecurity

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Lecture 4

Livestock Biosecurity and its Preventive Measures

Welcome back to the fourth class. In our previous session, we delved into the novel weapon hypothesis and bioherbicides. Today, we'll shift our focus to livestock. My formal journey with livestock began in 1994 when I joined the National Dairy Research Institute in Karnal, Haryana, for my master's degree in animal physiology. It was there that I first encountered a large-scale animal farm in a structured environment. Prior to that, my experience with livestock was limited to seeing them in villages and at home, but I had never witnessed such an extensive farming operation.

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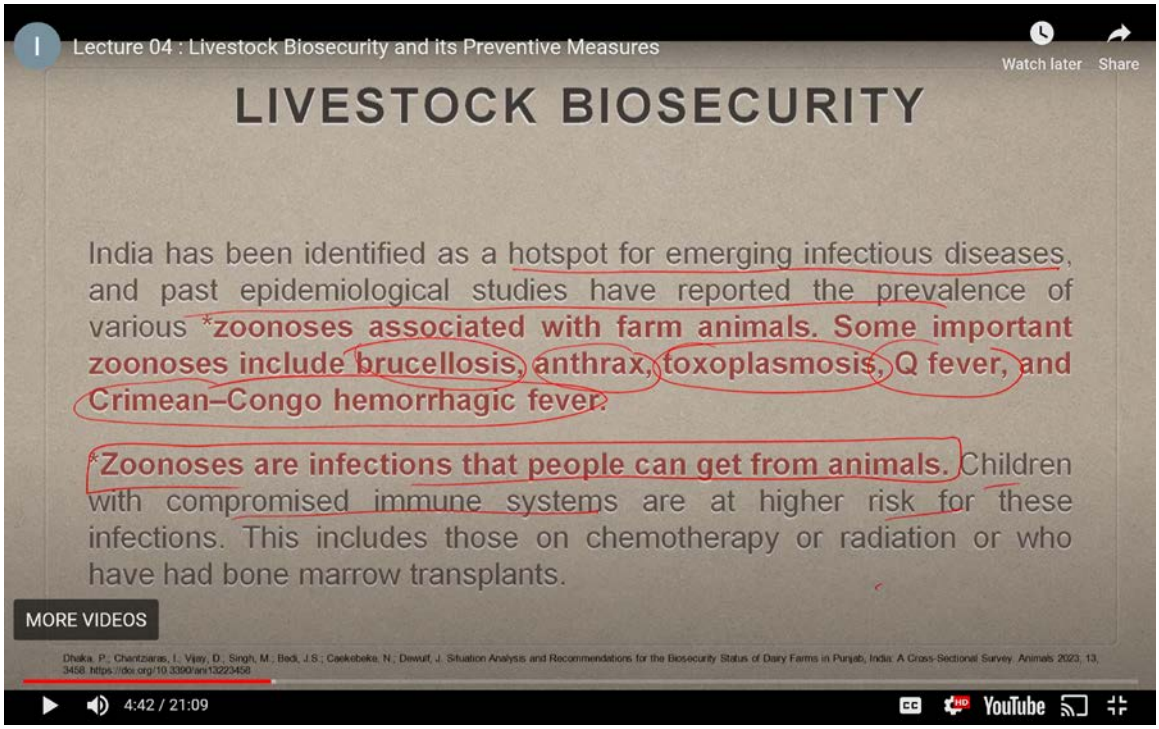

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Following that, I continued to visit various places, including the Indian Veterinary Research Institute (IVRI) and other livestock farms. These experiences revealed to me that livestock farming, while offering numerous advantages, also comes with significant risks. You must understand that, much like a human community, livestock is susceptible to diseases, communicable diseases, chronic illnesses, and more. It's a world with its own unique challenges.

A particularly challenging aspect is that many livestock diseases can jump from animals to humans, posing a major public health challenge. Another critical point to consider is the economic impact. The economy of a region can be severely affected if a particular disease is introduced into its livestock population, whether it’s a naturally occurring disease or something introduced intentionally. Livestock suffers from as many diseases as humans do, which underscores the crucial importance of livestock security in the broader context of biosecurity.

Earlier, I mentioned the importance of biosecurity concerning fish, but now we are discussing larger animals, cows, buffaloes, camels, horses, livestock that serves multiple purposes worldwide, including food production, transportation, and more. When we look at the situation in terms of livestock, it’s important to note that India is identified as a hotspot for emerging infectious diseases, with livestock often being a source of these infections. Epidemiological studies have consistently reported the prevalence of zoonotic diseases associated with farm animals. Some of the most significant zoonoses include brucellosis, anthrax, toxoplasmosis, Q fever, and Crimean-Congo hemorrhagic fever.

These infections, particularly zoonoses, can be transmitted from animals to humans, with children who have compromised immune systems being at higher risk. Therefore, whether you're managing a small-scale or large-scale livestock farm, it's crucial to have a thorough understanding of the potential disease epidemics that could arise. This is even more important in today's world, where animal production is often conducted on a massive scale. Take poultry farming, for instance, a sector we'll discuss in more detail later. Poultry is particularly vulnerable to infections, and when one bird gets infected, it can spread rapidly, infecting an entire flock in no time.

To prevent such outbreaks, it's essential to implement appropriate vaccination protocols tailored to each type of animal or bird. Moving on to the next slide, let’s consider the situation in India. Biosecurity within livestock production systems involves measures that can be implemented by farmers at the farm level to manage the risk of infectious diseases. These measures represent the foundational controls against both endemic and exotic diseases and can be classified as either external or internal biosecurity measures.

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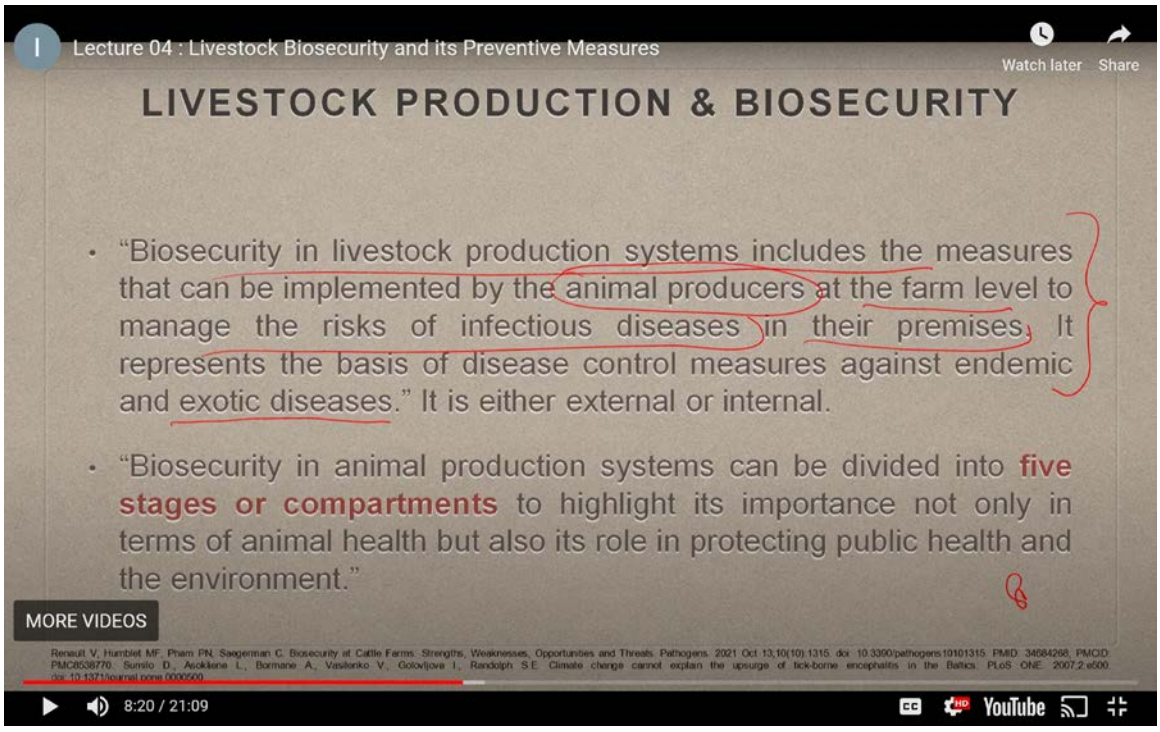

There’s another important aspect to consider. Currently, if you examine most of the milk-producing cow breeds in India, you’ll find that they are hybrids of European and traditional Indian breeds. This genetic mixing has led to significant animal movement, which must undergo stringent quarantine protocols. This process is crucial, much like the challenge we face with alien invasive species in plants. Any non-native species, whether plant or animal, introduced into a new geographic or biogeographic region must be carefully monitored.

For example, traditional Indian cow breeds like Ongole were historically resistant to certain diseases that were common in the European subcontinent. However, with the introduction

of hybrid cows through genetic mixing, some of these diseases have now become prevalent among Indian livestock, where they previously were not. These hybrid cows have undergone anatomical changes, such as losing their characteristic humps, having flatter backs, and udders that are closer to the ground, which makes them more susceptible to infections. In contrast, the older Indian breeds are generally taller and less prone to infections. These hybrids, while being higher milk producers, are also more vulnerable to diseases compared to the traditional breeds.

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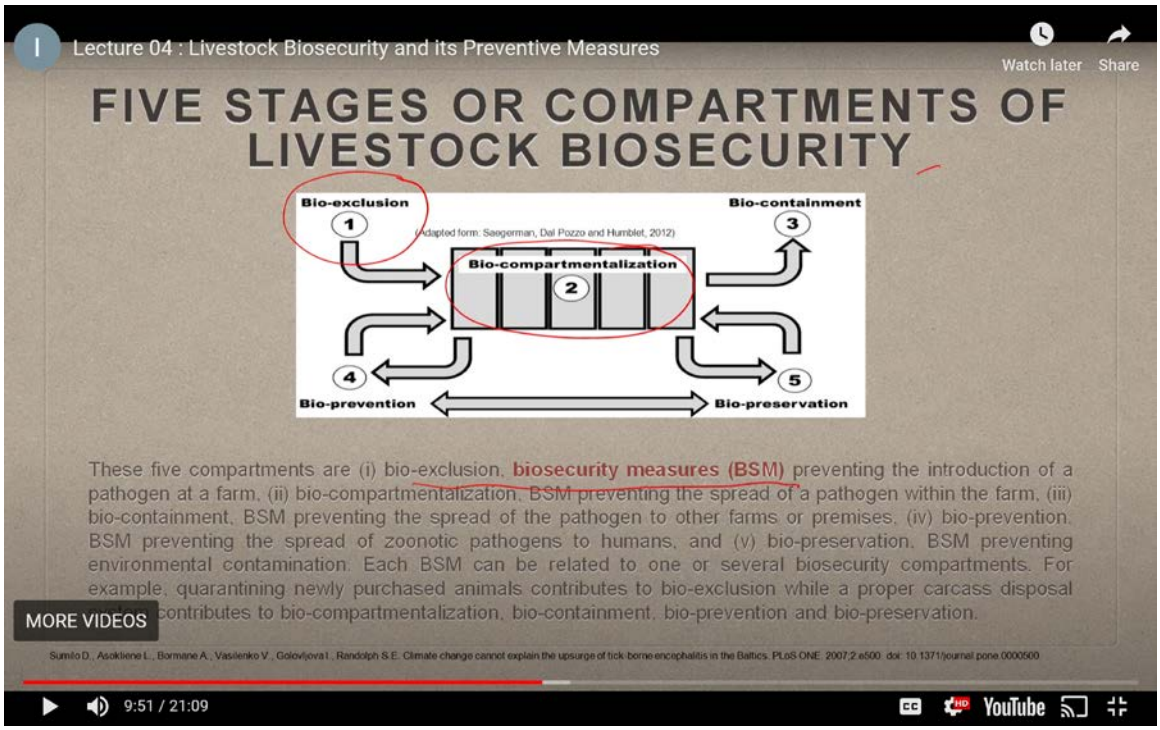

This phenomenon isn't limited to just cows, it’s a trend observed across the entire livestock sector. The intentions behind these genetic mixings were undoubtedly noble, driven by the need to increase food production and feed more people. However, every introduction from outside the existing co-evolutionary environment disrupts the ecological balance. If you recall from our previous class, we discussed how introducing foreign elements into a co-evolutionary system can have significant ecological consequences. These disruptions, although well-intentioned, come with a cost. The cost here is the need for comprehensive biosecurity protocols.

Thus, biosecurity in animal production systems can be divided into five stages or compartments. This division underscores its importance, not just for the health of the animals, but also for the protection of public health and the environment.

This topic is extremely important when considering zoonosis, the transmission of diseases from animals to humans. If we examine the five stages or compartments of livestock biosecurity, we begin with bioexclusion. For instance, if you suspect that an animal on your farm is showing signs of illness, the first step is to isolate it, much like how you would separate a sick family member by placing them in a different room to prevent the spread of the illness if it's contagious. This is the primary principle of bioexclusion.

The second stage is biocompartmentalization. This involves creating distinct compartments within the farm to prevent the spread of pathogens. Again, it's akin to how you would isolate a sick family member in one part of the house to ensure that others do not get infected. By separating the infected animal from the rest, you're effectively compartmentalizing the risk.

Next, we have biocontainment. This strategy involves physically containing the disease within a specific area or compartment, similar to keeping an infected individual confined to one room, so the illness doesn't spread to others. It's about ensuring that the infection remains isolated.

The fourth stage is bioprevention, which encompasses the measures you must take to prevent zoonotic pathogens from spreading to humans. For example, if a particular pathogen exists within an animal, steps must be taken to ensure it doesn't jump to humans. Consider a milk-producing cow; you must be vigilant to ensure that pathogens do not enter the milk via the cow's bloodstream. This is critical because, as history reminds us with the outbreak of mad cow disease, there was a time when the sale of beef was completely banned across Europe due to animals carrying harmful pathogens. Such incidents highlight the importance of biosecurity when maintaining animal or avian farms.

Finally, the fifth stage is biopreservation, which focuses on preventing environmental contamination. This is the last but crucial pillar in maintaining livestock biosecurity on a farm.

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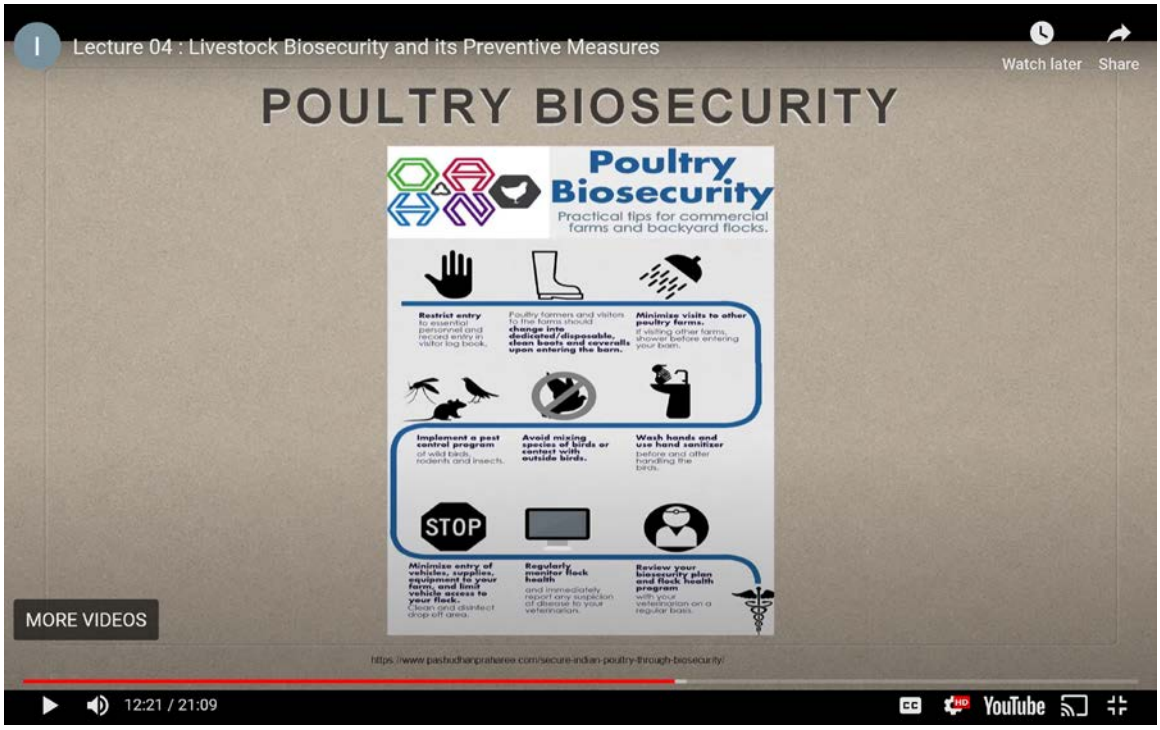

Now, turning our attention to poultry, an area I briefly mentioned earlier, it's important to highlight that poultry farms are particularly vulnerable. Poultry farmers face inherent risks, especially when dealing with large flocks. Avian species, by nature, can contract diseases very quickly. Moreover, managing the waste, such as feces, is a critical task that must be handled with utmost care to maintain cleanliness and hygiene. Poultry farmers must be diligent in keeping the environment clean, removing waste promptly, and ensuring that all birds are properly vaccinated.

Interestingly, with the global increase in broiler production, maintaining strict biosecurity measures has become even more crucial. Poultry farmers know that any lapse in hygiene or preventive measures can lead to rapid disease spread, making biosecurity an indispensable aspect of their operations.

It has been observed that the inherent immunity of poultry and other avian species has been compromised due to large-scale flock production. The reasons for this, especially from an evolutionary perspective, are not entirely clear. However, we do know that, much like how large expanses of crops become more susceptible to insect or pest attacks, large flocks of poultry face similar vulnerabilities. The larger the population concentrated in a small area, the greater the opportunity for pathogens to spread.

In such densely populated settings, the situation can be a double-edged sword: either the entire population develops resistance to the pathogen, or it becomes uniformly susceptible. Unfortunately, in poultry farming, the latter scenario is often the reality. This increased susceptibility necessitates rigorous biosecurity measures.

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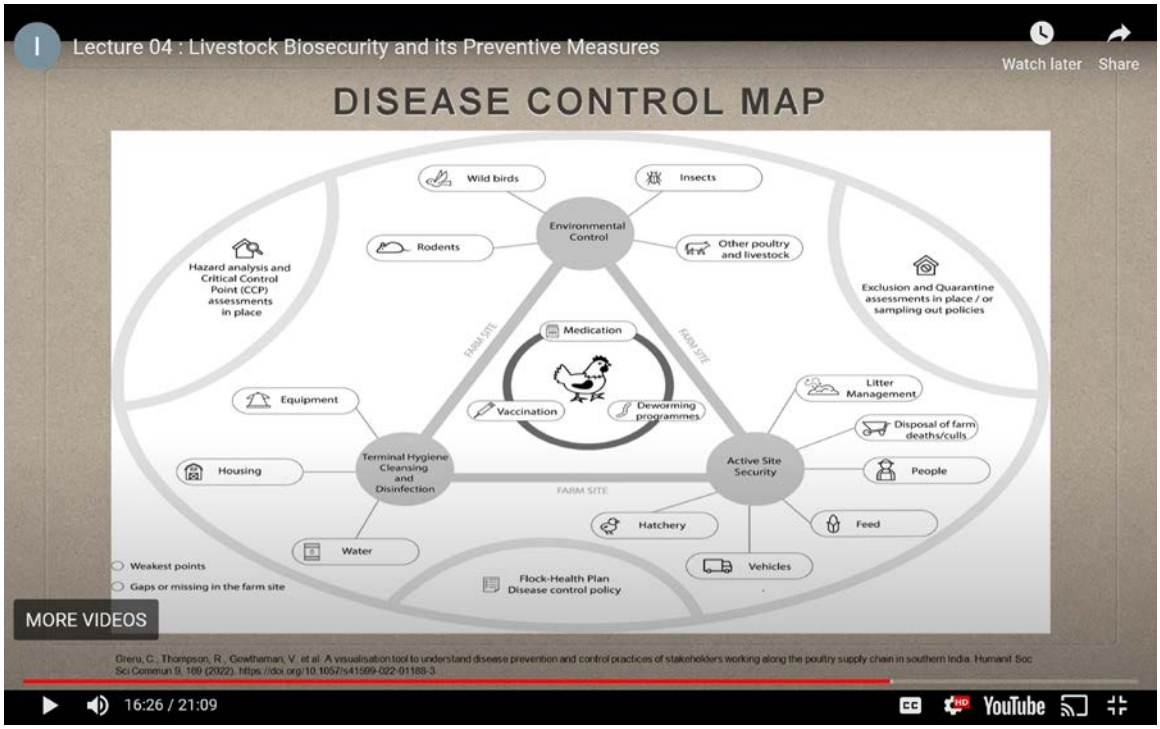

To mitigate these risks, poultry farms must adhere to stringent cleanliness protocols and ensure effective isolation from external environments. The biosecurity measures, bioexclusion, biocompartmentalization, biocontainment, bioprevention, and biopreservation, must all be meticulously implemented. These principles are often visually

represented in detailed diagrams to emphasize their importance in poultry production, as poultry are particularly vulnerable to various threats.

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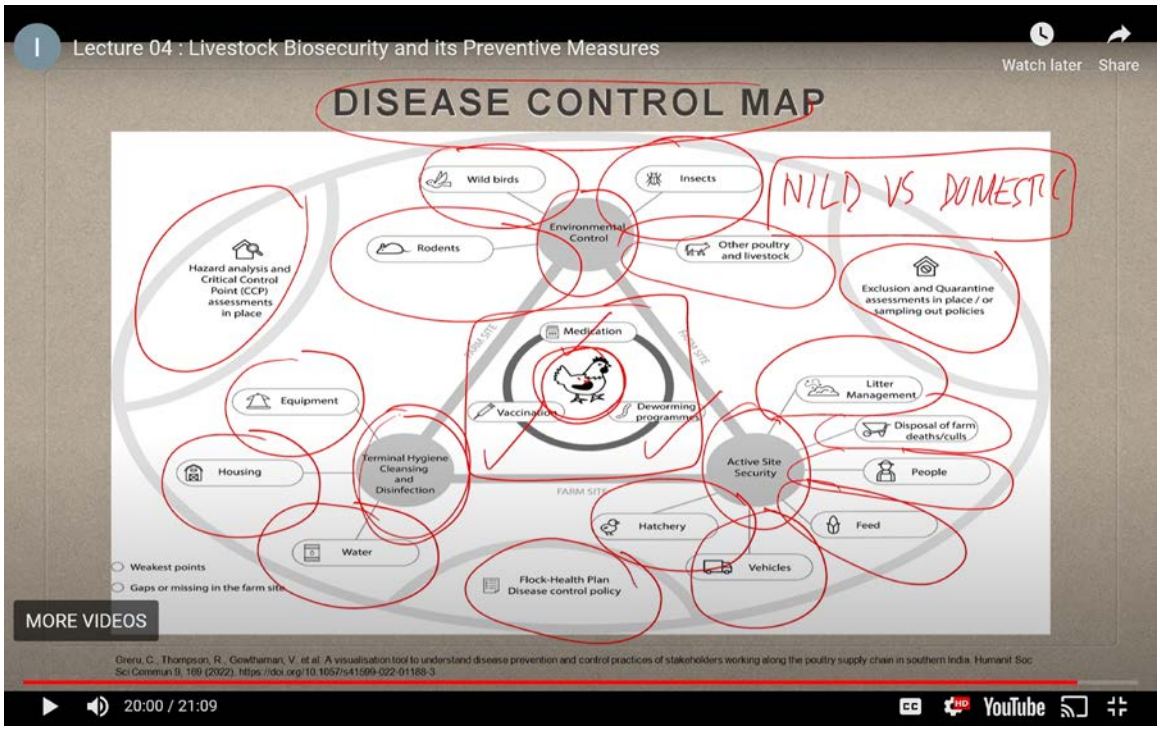

Additionally, there are several levels of control that need to be applied throughout animal production. One crucial aspect that has not been covered yet but deserves attention is vector-borne diseases, which significantly impact livestock production, particularly in Africa and Asia. Many insects serve as vectors for diseases that can infect livestock, adding another layer of complexity to managing animal health in these regions.

Overall, there are three key aspects of disease control that are crucial in poultry production: environmental control, terminal hygiene and cleaning, and active site security. These pillars are essential for preventing disease outbreaks. Additionally, a well-established protocol for medication, deworming, and vaccination is critical to maintaining flock health.

In modern poultry production, the costs are substantial due to the extensive use of various reagents and the large scale of operations. As mentioned earlier, the issue of whether a population will succumb to or resist diseases can be influenced by their environment.

Domestic poultry often have lower natural immunity compared to their wild counterparts, presenting a challenge that arises from the contrast between wild and domestic settings.

Understanding the evolutionary aspects behind these differences will likely provide further insights into these challenges. Basic biosecurity measures are fundamental to managing these issues. Terminal hygiene and cleaning require meticulous attention to detail, including thorough cleaning of equipment, housing, and ensuring the cleanliness of the water source used for feeding animals.

Environmental control involves managing potential disease carriers such as wild birds, rodents, and insects, all of which can transmit vector-borne pathogens. Active site security also includes effective litter management, which is crucial for maintaining a healthy environment. So, implementing these biosecurity measures effectively is vital to ensuring the health and productivity of poultry and other livestock.

This presents a significant challenge. Proper disposal of farm animal carcasses, managing human interaction, monitoring the sources of feed, and regulating vehicles entering the facility are all critical factors that must be carefully managed. In addition, hatchery operations need to be meticulously controlled.

To address these concerns, a comprehensive hazard analysis and critical control point (HACCP) plan should be in place. This plan should include a detailed flock health plan, disease control policies, and stringent exclusion, quarantine, and sampling protocols. Essentially, managing a livestock or avian system requires an epidemic control unit, complete with facilities for hospitalization and quarantine.

It is crucial to ensure that all potential intruding elements, whether animals, rodents, birds, or even humans, are effectively managed to optimize operations and minimize risks. As we advance, maintaining livestock will increasingly involve a broad spectrum of measures to address emerging challenges.

Next, we will briefly review the Agriculture Biosecurity Bill of India, introduced in 2013, before moving on to discuss human biosecurity, bio-terrorism, and bio-weapons in our upcoming class. Thank you.