Smart Protein: Reimagining safer protein production for India

The dietary habits in emerging economies are rapidly evolving due to higher disposable incomes and increased urbanisation. This change in lifestyle can also be seen in India, where upward mobility is leading Indians to increase their consumption of animal-sourced foods (ASF) such as meat, eggs, dairy, and seafood. At the same time, growing global evidence suggests that over-dependence on ASFs poses substantial risks to public health by increasing the chances of antimicrobial resistance (AMR) and zoonotic diseases in human populations.

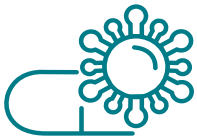
The rising demand for protein in India

Even as India undergoes diet diversification, protein deficiency remains a persistent concern among a significant share of the population. The Food and Agriculture Organisation (FAO) projects that by 2050, the global consumption of animal protein will rise by two-thirds when compared to today's levels. The demand will be led by emerging economies like India, whose population is projected to peak at 1.7 billion by 2050.

Although the per capita consumption of meat is below 5 kg in India, as per projections, the per capita demand for protein is slated to increase by 89% by 2050. Driven by growing consumer preferences towards products such as poultry and dairy, the per capita consumption may rise up to 10 kg. Currently, India is ranked first in milk production, contributing to 24.64% of global production. India is the second-largest producer of goat meat in the world and one of the biggest buffalo meat producers for global export. India is also the world's second-largest aquaculture producer, with carp and shrimp as the key contributors.

Although these increases in consumption and production fare much lower than global standards, they point to a steadily growing demand for quality protein and an overall projected increase in the production of ASFs to meet said demand. Balancing this demand for protein with innovative, sustainable, and nutrient-rich solutions offers an opportunity to protect both public health and environmental resources.

The looming threat of superbugs



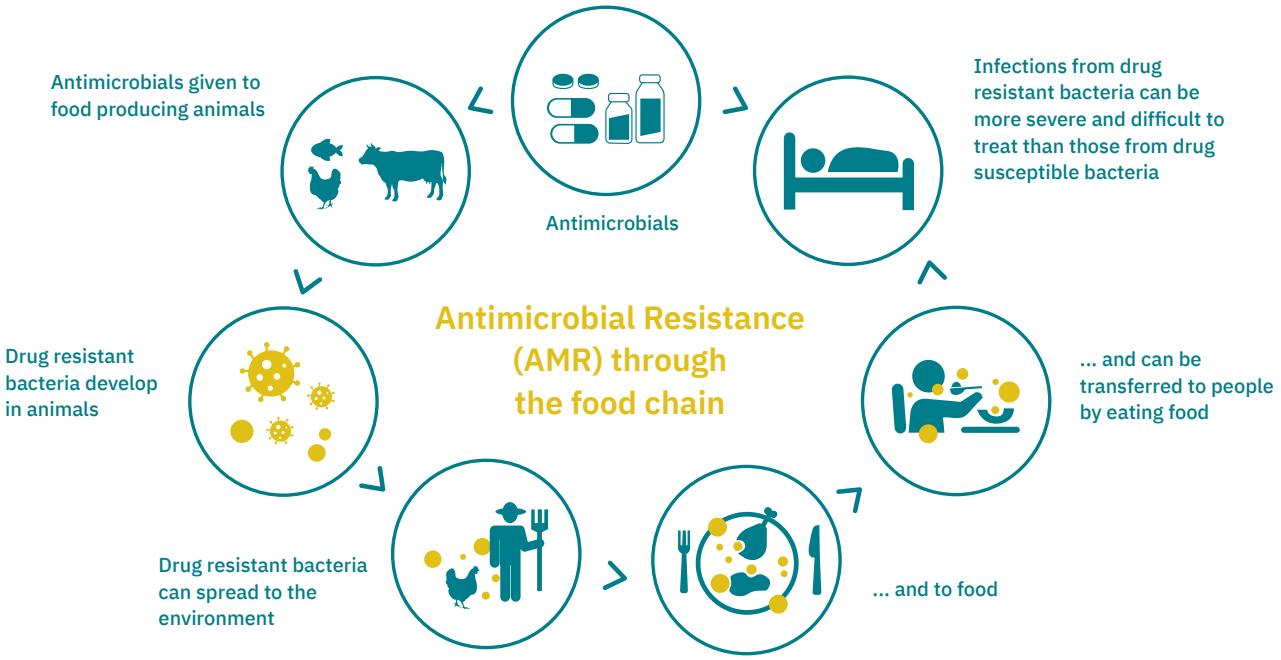
Antimicrobial resistance is one of the most concerning risks linked to rapidly rising ASF consumption. AMR is a grave situation wherein bacteria do not respond to antibiotics, resulting in extended medical treatment of infections due to the infectiveness of the drug, culminating in financial and health burdens on patients and healthcare systems. The resistant bacteria are known as drug-resistant organisms or "superbugs". The World Health Organisation lists AMR as one of the top threats to global public health and development. In fact, between 2010 and 2030, India is predicted to double its antibiotic use in animal agriculture with the rise of vertically integrated intensive farms.

Antibiotics are frequently used in industrial livestock farming for purposes of therapeutics, metaphylactics, and disease prevention. A more controversial use of antibiotics is for growth promotion and is banned in several countries, including the U.S., European Union, and China. In India, a specific legislation banning its usage is yet to be established. Even for antibiotics that are used for health management strategies, there is a lacuna in stringent compliance and monitoring mechanisms. Over-the-counter (OTC) availability of antibiotics allows producers to purchase non-prescribed antibiotics, leading to self-administration and misuse.

While future demand for antibiotics is expected to rise in line with the growing demand for ASFs, there is sufficient alarming data on the presence of AMR in our current food systems. A significant number of studies have documented the presence of multidrug-resistant bacteria in meat and poultry products in India. For instance, antibiotic-resistant *Staphylococcus aureus* was reported in cow and goat milk and eggs. Disturbingly, southern India is predicted to be one of the global hotspots for multi-drug-resistant bacteria in freshwater aquatic animals.

The risks of AMR are not limited to consumers' direct consumption of ASFs. The resistant bacteria can spread to humans through direct contact with live animals and carcasses at poultry farms and slaughterhouses, and more latently, through the environmental contamination of soil, water, and air from animal waste run-off. A study revealed that certain strains of bacteria in poultry litter were tested to be 40–75% resistant to more than five types of antibiotics, contributing to this environmental hazard.

In aquaculture, infectious diseases caused by bacteria, viruses, and parasites are a major drawback. The economic losses in shrimp farming due to diseases are estimated at 5,647 crores INR annually. To meet the rising demand for the consumption of aquatic animals, the overuse and reliance on antibiotics to boost production levels are anticipated. Therefore, despite sirens raised by bodies such as EAT-Lancet to reduce animal antibiotic use by 30% by 2030, its growing and currently poorly regulated use in Indian livestock systems renders ASFs a significant risk factor for the country's public health systems.



Source: FAO. (2024). Movement of resistant pathogenic bacteria from animals to humans through food chain [Infographic]. FAO Knowledge Repository BETA.https://openknowledge.fao.org/items/03d3e3bb-518f-493f-bcce-753313f5a8d5.

The dangerous risks of zoonotic diseases

Another major public health concern linked to ASFs is the risk of zoonotic diseases and food-borne illnesses. 'Zoonosis' or zoonotic diseases are infectious diseases, transmitted between species from animals to humans. Many current infectious diseases are considered to have a zoonotic origin. Anthropogenic changes, particularly in land use and agricultural practices, are the major contributors to the increased frequency of zoonotic disease emergence and re-emergence in recent decades. Zoonotic diseases can place an immense socio-economic and public health burden on countries such as India.

In India, where the regulation and hygiene standards in the livestock sector are often disparate, ASFs remain notable vectors for zoonotic diseases. For ASFs sold at retail centres and wet markets, the risk of microbial contamination increases with every step of the slaughtering and transportation process. Although meat in India is available at retail outlets, it is more commonly sold in open-air stalls where vegetables, fruits, meat, and seafood are kept on ice and water to keep them fresh. About 90% of the poultry meat in India is sold through wet market conditions. Products sold at retail shops do not reduce the risk of contamination. For example, eggs collected from retail outlets were found to have bacterial contamination on the eggshell, yolk, and albumin.

Some zoonotic diseases that affect humans include bovine tuberculosis, highly pathogenic avian influenza, anthrax, Campylobacteriosis (dysentery), and cysticercosis (pork tapeworm), among others. Avian influenza, which is widely recurring in India, highlights the public health risks posed by industrialised ASF production and the urgency to address it. The frequent outbreaks of avian flu are linked to poor sanitary conditions in farms and live animal markets. Furthermore, poultry, seafood, and sheep/goat meat are contaminated with *Salmonella spp.*, *Cronobacter spp.*, *Campylobacter*, and other pathogens, which are commonly linked to foodborne illnesses. Moreover, several other neglected zoonotic diseases in poorer regions often go undetected and unrecognised, making it difficult to fully understand the total impact of zoonotic diseases on human health and well-being.

Smart protein — a safer bet

	Animal-sourced foods	Alternative proteins
Antibiotics	👍	👎
Risk of Zoonoses	👍	👎
Greenhouse gas emissions	⬆	⬇
Land and water use	⬆	⬇
Contributor to food insecurity	👍	👎

Feeding a growing world population that demands higher amounts of protein would mean raising the overall food production to almost double. The growing risks of zoonotic diseases, food-borne illnesses, and alarming rates of AMR indicate the urgent need to reduce the reliance and overdependence on ASFs to fulfil growing food and protein requirements. The planetary burden of ASFs coupled with the dangerous public health risks requires a paradigm shift in food production systems. Furthermore, as India grapples with a persistent malnutrition crisis, improving our food habits to ensure a better intake of micro- and macronutrients such as protein becomes even more critical.

The adoption of smart proteins presents a remarkable pathway to address the public health concerns associated with current practices in ASF production, providing a safer and more sustainable option. Smart proteins do not require antibiotics for their production, thereby eliminating the risk of antibiotic resistance. They are a technological solution that harnesses agri-tech and bioprocessing to make proteins that could provide similar taste and texture to typical ASFs. Globally, the three primary modalities of plant-based, fermentation-derived, and cell-cultivated proteins are on the rise and increasingly being seen as a means to achieve food security and resilience. By investing in smart proteins, India can reduce the public health threat posed by antibiotic-resistant superbugs and zoonotic diseases and make significant strides towards providing safer, more sustainable nutrition to its people.

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