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CHAPTER 3

Preemptive and Proactive Strategies for Food Control and Biosecurity

Ali T. Khalil⁎, Irum Iqrar†, Samina Bashir†, Muhammad Ali†, Ali H. Khalil‡, Zabta K. Shinwari⁎

*Qarshi University, Lahore, Pakistan †Quaid-i-Azam University, Islamabad, Pakistan ‡University of Engineering and Technology, Peshawar, Pakistan

3.1 Introduction

The basic dogmas of thriving society are safety and security. Life is greatly influenced by notorious accidents; however, efficient and well-defined tactics can be assumed to decrease the risk of massive losses. Like blasting and killing, attacks on food supplies do not smack terror in our hearts, but they should. The supply chain of the food industry has many points of susceptibility. Food contamination is the presence of harmful entities such as chemicals or other microbes which can cause consumer illness as well as degrade the quality of food. Providing a sustainable, safe, and secure food supply has been a challenging task which requires continuous monitoring of the food quality and quantity from production to consumption. Without an efficacious and productive detectable system, the food supply chain is subjected to contamination. The economies of many countries are dependent on agriculture, and therefore the agriculture sector is an attractive target for deliberate attacks. All the downstream food-related industries can be compromised after such attacks. Since the food supply chain has a global nature, there are numerous target points for deliberately contaminating the food by exotic pathogens (Gullino et al., 2008; Kingsolver et al., 1983). Agricultural resources comprise the foundation of producing food. With an increase in population, climatic changes, globalization of food business, biological weapons, and biocrime could represent major hurdles to the sustainable production of food (Stack, 2008). Lack of diagnostic infrastructure, global strategies, and a lack of awareness about food biosecurity represent critical issues. The current population of the world is above 7 billion. Among the major issues faced by governments of the present day is the widespread food insecurity for the increasing population. One out of nine people on the globe is undernourished, which leads to the death of 3.1 million children. With the decrease in farm lands due to urbanization and environmental changes leading to calamities like floods, our
food supplies are stressed. There is a great need to review and potentially reform the global agriculture and food production system to meet the needs of people in the future.

Agricultural and food industries resources make a substantial contribution to the economy of Pakistan. Agriculture contributes to about 24% of the overall GDP (Pakistan Bureau of Statistics, n.d.), and absorbs nearly 45% of the human resources. About 62% of the human resources are estimated to be linked to agriculture directly or indirectly. Livestock has been a massive contributor (53.2%) to the agriculture setup in the form of fisheries, hatcheries, and poultries (Shinwari et al., 2014). Dairy farming is a popular business making Pakistan the third largest milk producing country. It contributes 11.7% to the GDP. Dairy farming has been the source of living for approximately 40 million people in Pakistan (The Nation, 2013). Meat represents a widely consumed food, with the consumption of poultry and beef on the rise over the past two decades. Over a time frame of just 11 years, the consumption of poultry has risen by 239%, from 322 million tons to 767 million tons from 2000 to 2010–2011 (Ahmad, 2011). Farm animals and crops are the potential targets for agricultural bioterrorism while other targets include items which are in the processing stage or distribution stage, processed food at the retail or wholesale level, and agricultural facilities such as food storage and processing facilities, transportation elements, food outlets, and research labs (Parker, 2002).

3.2 Basic Concepts

“Biosecurity” is a relatively broad term that covers agricultural and food security, environmental security, health security, plant pathogens, zoonosis, pests, GMOs and LMOs. It can be said that biosecurity owes the 4Ts (Trade, Transportation, Tourism, and Travel) (Clevestig, 2009; Waage and Mumford, 2008). “Biosecurity is the management of risks to the economy, the environment, and the community, of pests and diseases entering, emerging, establishing or spreading.” Biosecurity is a holistic term that includes policies and regulations to protect humans, food, agriculture, and the environment from potential biological threats intended to harm innovations, standards, and practices that are utilized to secure pathogens, poisons, and delicate advancements from unapproved access, abuse, theft, or deliberate discharge.

Biosecurity is to make life safe. Some applications of biosecurity seem worldly with wide results (like inhibiting the motion of mouth and foot viruses at farms using disinfectants). Whatever the practice is, all of the instances involve monitoring, regulation, and/or inhibiting the movement of different types of life. Sometimes it focuses on plants or animals, and sometimes on microbes. Sometimes the biosecurity alarms are raised due to lab scale accidents while sometimes they are raised due to the intentional misuse of microorganisms. Sometimes dealing with a life to make it safe seems direct or simple (like the farm’s sheep and cattle), but at other times many complex questions are hidden in this visible straightforwardness. Briefly, biosecurity is as complex as life itself, and certain problems are released by its applications.
3.3 Food Biosecurity

Risks associated with food contamination comprise potential infection (e.g., bioterrorism) and dispersion of disease because of the growing distance of transportation of food and animals. Risk of contamination with pathogenic bacteria increases with an increase in the time span of transport and lairage of cattle and poultry. All food processing includes the component of risk and it is difficult to fortify the risk control of food safety. The trend of eating food in restaurants or food in the streets is growing day by day. To measure the influence of foodborne diseases, it is necessary to know that some people, such as teenagers, old men, pregnant women, the immune deficient, those susceptible to serious illness, and those who go through chemical treatment, might be more susceptible to serious illness in contrast to normal people. Predictions show that the number of such type of people is increasing. The lifestyle of inhabitants in the developing world is noxiously evolving due to existing food safety issues. The most well-known definition of “food security” is “access by all individuals at all times to enough and suitable food to give the vitality and supplements expected to keep up a dynamic and sound life.”

“Food biosecurity” is the concept of food protection from biological hazards. Food security deals with the proactive precautionary measures against deliberate or accidental contamination of food that can cause harm and disruption. Eventually, it may lead to severe health care issues and to an economic outcry. Such events may be planned at different levels of the food chain by a violent group, a lone “copycat” person, or criminal activity. Such malicious activities can be focused on food items, production, and transportation processes. The aim of food and agricultural biosecurity is to alleviate the chances of introduction of exotic pests, pathogens, or their derived toxins in the food chain or in the environment. These biohazards have potential harmful repercussions on the environment, economy, and community (including people, plants, and animals). Effective biosecurity measures are intended to establish precautionary measures and an effective response mechanism for intentional or accidental events. Proper biosecurity protocols are intended to effectively manage, contain, or suppress infectious disease.

3.4 Food Terrorism (or Food Bioterrorism)

Food terrorism can be defined as spiteful intentional contamination or corruption of food by using biological or chemical agents. A few of these agents (biological or chemical) have an instantaneous effect and are odorless, insipid, and hard to find. Since few of them are hard to detect with the present technologies, the chances of terrorists developing and utilizing biological or chemical agents for the contamination of food or water are extremely high.
According to the World Health Organization (WHO) food terrorism can be defined as “an act of contaminating food intentionally for human use with chemical, biological or radio nuclear agents for the aim of inflicting harm or death to populations and/or breaching social, political, or economic stability.”

Administrative frameworks are confronting various new and proceeding with sustenance security challenges. Conspicuously, administrative powers are addressing new potential foodborne dangers (for instance, Bovine Spongiform Encephalopathy (BSE) and hereditarily changed life forms), while looking for ways to enhance control on other food related microbial contaminants like *Salmonella* and *E. coli*.

Further, there is developing political pressure for expanded controls as an instrument to bolster consumer trust in the security of the food supply taking after various “sustenance alarms.” In the meantime, food safety directions are progressively observed suspiciously from a monetary point of view, persuading for “productive” directions, especially for controls, taking into account execution criteria or, on the other hand, data procurement. Food sustenance protection controls, in any case, keep on concentrating overwhelmingly on procedure-based prerequisites. Comparable pressure has been created to guarantee that item obligation frameworks give proficient motivators to food producers, processors, and merchants to convey results of satisfactory protection. The study of disease transmission of foodborne infections is quickly evolving as recently perceived pathogens rise and highly perceived pathogens get connected to new food vehicles. Thus, there is a need to look at food sustenance instruction projects to guarantee that messages are focused at lessening the danger of the most pervasive and/or significant reasons for foodborne disease.

### 3.5 Biological Weapons Threats to Food and Agriculture: A Brief History

The basic concept of *bioterrorism* is “the deliberate use of biological and chemical agents to inflict harm” Bioterrorism is a global issue. Since foods are traded globally, bioterrorism agents can easily disperse over the globe. Owing to these facts, international cooperation is needed to make an efficient system to contest bioterrorism. Biological weapons have been used for malicious purposes from ancient times to the present day, and have been executed by nonstate actors, criminals, and state enemies (*Dudley and Woodford, 2002*). The broad range of bioterrorists includes state enemies, state sponsored or military ambush, and individuals, among others (*Zilinskas and Carus, 2000*). Historically, plants and microorganisms or their derived toxins, contaminated blankets, animal carcasses, and infected human corpses have been used for bioterrorism. The work on bioterrorism has been for a long time ago; hence, it is not a new task (*Hobbs, 2006; Kutz, 2013; Luning and Marcelis, 2009*). Food and agricultural industries are particularly prone to bioterrorist
activities, and although these threats may lack shock value, the economic consequences are immense. In sixth century BC, ergots were utilized by Assyrians to contaminate the wells of drinking water of their foes. Throughout the Krissa attack, flam cabbage was developed by Solon of Athens to defile the water supply. In 1996, research facility laborers at a vast restorative focus in Dallas, Texas, were welcomed through email to have muffins and doughnuts in the lunchroom. Eight people developed loose bowels and showed positive results for *Shigella dysenteriae*. One of the research facility laborers was the culprit. The FMD outbreak in 1997 led to a loss of $6.9 billion USD in addition to the loss of 50,000 jobs in Chinese, Taipei. Following the eradication of FMD, an additional $15 billion USD were spent on decontamination (Pearson, 2000). One million pigs were slaughtered in 1999 as a result of Nipah virus infection that lasted for about 3 months in Southeast Asia. In England, 3,900,000 animals were slaughtered, leading to a loss of $2 billion USD/day because of the notorious FMD outbreak in 2001 (Dudley and Woodford, 2002). These were accidental events which caused massive losses. A bioterrorist event can also have similar consequences. The food infrastructure is also prone to bioterrorist attacks. Some of the documented examples include the widespread food poisoning by the Rajneesh cult in Oregon, USA, in 1984. There were also attempts carried out by the Japanese-based “Aum Shinrikyo” organization in the 1990s to spread anthrax and botulinum toxin (Parker, 2002). There are many more examples of how microorganisms can be a source of economic damages, already reviewed by (Shinwari et al., 2014).

Pakistan is the sixth most populous country in the world and it will be a challenge to feed the nation with continuously reducing arable lands and water scarcity. Costly fertilizers and other expensive agrochemicals pose a threat to production of food in sufficient quantities. In the wake of climatic changes, earthquakes, and recurrent floods, agricultural production will be a problem in the coming years.

### 3.6 Lack of Food Security and Safety Measures

Besides the health and environmental issues, a bioterrorist event may lead to severe economic damage on the national and international levels. There are a number of interrelated repercussions. For example, the foremost consequence will be the immediate halt in the food production or at processing facilities until the time when the stocks are decontaminated. Depending on the scale of the devastation, there will be diagnostic and treatment services needed to stop the spread of the disease. Proper trainers must be hired to effectively dispose of the contaminated stocks. Overall, export markets will be lost and for a specified time restrictions will likely be in place. Loss of consumer confidence in the product or affected industry is another major issue. Another concern will be the changes in pricing. Let us assume a hypothetical scenario by considering two industries (A and B) of similar production nature.
Let industry “A” be the one which has faced the event and is now under restrictions for a specified period. Such a situation will lead to the substitution effect in economic terms which means that eventually if products from industry A are not available, there will be an increase in demand for a similar product produced by industry B. Increasing demands can create scarcity of the product, which can lead to the increased price of the product. In addition, some government funds will be directed for the compensation of affected people. A recent example of the lapse in food safety was the presence of *Salmonella* in peanut butter in America, which led to the biggest recall of products in the history of United States that includes more than 200 downstream food manufacturers (Hobbs, 2006).

Crop-related infections are difficult to monitor as they are grown over large areas making it impossible to detect a diseased plant. Usually plants are observed to be infected only after the disease has spread. Efforts are required on a large scale to reduce the time of discovery. Even after it is established that the disease is present, the samples may still needed to be transported for specific diagnosis, which delays the response. Building the technical capacity to deal with these issues is therefore critical. Often the labs are understaffed or lack an expert or equipment (Wheelis et al., 2002). Zoopathological and phytopathological labs should be built with highly sensitive equipment (Shinwari et al., 2014). International trade and globalization of food and agricultural markets have also provided ways of pathogen introduction. For example, the FMD outbreak in Japan occurred because of straw imported from China that is used as bedding for cattle (Matsubara, 2000).

National animal and plant well-being frameworks attempt to stop the presentations of new vermin or maladies. Wherever this fizzles, obliteration is a plausibility if communities of the presented species are still relatively small and regional. In case this is not productive, the possible choice could likewise be to stifle populaces on a long haul premise to lessen the sway.

The estimation of long haul control of buildup and infections is occasionally delivered by just agrarian makers. Through the spread of the possible new vermin menace, governments ought to organize where to give money in counteractive action, obliteration, and management. This has resulted in the intergovernmental biosecurity systems worldwide by taking in to account various pests as well as pathogens. For plants, these incorporate the IPPC (International Plant Protection Convention), conducted by the FAO (Food and Agriculture Organization) of the United Nations, related territorial plant insurance associations, and several particular provincial understandings. For creatures, they incorporate the FAO and OIE (Organization International des Epizooties).

The regular livestocks of the provincial zones of Pakistan suffered enormously from different diseases. About 500 camels were tainted by a “puzzling ailment” in Noorpur Thal (District Khushab-Punjab) and connecting areas in May 2015. The foot-and-mouth disease is very common in the rural areas of Pakistan. The reemergence of FMD disease in cattle since mid-2010 in a few villages of District Sargodha and Mandi-Bahudin, Punjab was also reported.
Likewise, the Pakistani agriculture sector, especially the mango and citrus growing areas, has suffered from diseases affecting the plants and trees. The citrus greening, instigated by the microscopic organisms \textit{Liberibacter asiaticus} is a major issue for citrus growers in the region (The infection was initially reported in China more than 20 years back, and has been spreading to citrus in locales in various mainlands.) In recent years, the mango growers’ economy was harshly affected especially in District Multan and Sind province. The iteration of the diseases is due to the poor management of biosecurity in Pakistan.

The food supply chain has seen an expanding pattern in the economic process of food sourcing and therefore progressively intricate supply chains. Expanding globalization of food exchange implies that an incapability to react to a food crisis could have critical outcomes on the haleness and trade in numerous countries. Governments likewise have a part in encouraging deterrent food security through both deliberate and administrative components.

\textbf{3.7 Food Safety Management and Control}

Producing a safe product is not a simple process and needs genuine controls across the food production to consumption chain. Everyone (managers, engineers, chemists, microbiologists, food technologists, etc.) has to play their part in order to maintain the quality and safety of food from farm to fork. Food safety engineers should apply the engineering principles integrated with biology and chemistry to ensure a sustainable and healthy food supply. Some of the intervention technologies have been found very useful in increasing the safety and quality of food. Technologies like Pulsed Electric Field Processing (PEFP) and High-pressure Processing (HPP) have replaced the traditional thermal means of decontamination of food products that usually cause chemical as well as physical changes in food (Kutz, 2013). Quality management can contribute significantly to the safety and sustainability of food production systems. Agri-food processing industries can use a quality management system (QMS) to direct the implementation of policies that underlies the safety and sustainability of the product. QMS includes the formation of the organization, processes, responsibilities, and procedures that are intended toward food safety and quality (Luning and Marcelis, 2009).

- Food items must be free of biological as well as chemical hazards if safe nutrition is to be provided to human beings. Some of the biological hazards such as pathogenic microbes can become increasingly possible under environmental and climate changes as microbial growth is favored by high humidity and temperature. Possible contaminations may occur across the food supply chains, and there must be wide-ranging monitoring of foodborne diseases (Gustafson \textit{et al.}, 2016). Some of the managerial steps can decrease the possible contamination of flocks or herds, and food or water from an infectious agent (https://www.sdstate.edu/sdces/fcs/upload/FoodBiosecurity_PPT.pdf). Routine practices involved to train first responders are summarized in Figs. 3.1 and 3.2.
When seeking to establish, appraise, strengthen, or otherwise revise food control systems, national authorities must take into consideration a number of principles and values that underpin food control activities, including the following:

**Fig. 3.1**
Series of management steps.

**Fig. 3.2**
Food control covers the areas which are related to food process control or to food safety of human food.

### 3.7.1 Food Control: A Shared Responsibility

When seeking to establish, appraise, strengthen, or otherwise revise food control systems, national authorities must take into consideration a number of principles and values that underpin food control activities, including the following:
Preemptive and Proactive Strategies for Food Control and Biosecurity

• maximize the risk reduction by applying the principle of prevention as fully as possible throughout the food chain;
• address the farm-to-table continuum;
• establish emergency procedures for controlling particular hazards (e.g., recall of products);
• develop science-based food control strategies;
• identify priorities based on risk analysis and efficacy in risk management;
• establish integrated, holistic initiatives which target risks and impact on economic well-being;
• recognize that food safety and security are a shared responsibility which needs healthy interaction between all of the stakeholders.

Certain basic principles and associated issues are discussed later.

3.7.1.1 Integrating the notion of farm to table

Keeping in mind the end goal of shopper confidence in the safety of the food, it is important that well-being and product quality be considered along with nourishment from creation to consumption. The requirement is an extensive and incorporated farm-to-table methodology in which the maker, transporter, processor, merchant, and purchaser all assume a dynamic part in confirming the nourishment, well-being, and quality of the product. The goal of decreased biological risk can be attained most viably by anticipating risks all through the creation, handling, and showcasing chain.

In some cases, it is hard to mastermind adequate security to the customer by just examining and dissecting the final product. The presentation of preventive measures at all phases of the nourishment creation and conveyance chain, instead of just assessment and dismissal at the last stage, bodes well on the grounds that inadmissible items can be recognized early in the chain. The more financial and viable technique is to oblige nourishment makers and administrators with an essential role in sustenance security and quality.

An all-around organized, preventive approach that controls procedures is the favored strategy for enhancing sustenance security and quality. Sustenance perils and quality misfortune may happen at an assortment of focuses in the natural way of life, and it is troublesome and costly to test for their potential. Numerous food-related risks can be managed along the production chain with the help of standard practices such as good manufacturing practices (GMP), good agricultural practices (GAP), and good hygienic practices (GHP).

The Hazard Analysis Critical Control Points (HACCP) is a deterrent approach that can be linked to every step, i.e., from manufacturing of food items to there supply. A standardized procedure for HACCP has already been documented by the Codex Committee on Food Hygiene that gives an important base for identifying and controlling of the food-related hazards (Food and Agriculture Organization of the United Nations,
Administration should perceive the utility of HACCP methods by the nourishment business as a central instrument for increasing the food safety and security. Government controllers are then in charge of examining the execution of the nourishment framework through observation and reconnaissance exercises and for upholding lawful and administrative prerequisites. Hazard control contrasts from survey-based controls in that it must be science based and be created from a game plan of nourishment well-being objectives. An operational danger administration point on an auxiliary, national, or nearby scale ought to address arranged nourishment sullying. The potential culprits of bioterrorism and the agents that they could utilize ought to be resolved so that powerful hazard controls can be executed.

3.7.1.2 Risk analysis

Hazard investigation is settled in for compound dangers, WHO and FAO are presently incorporating the mastery and experience set up from danger examination of concoction dangers to that of microbiological perils (Zoonoses, n.d.). All food handling includes a component of risk and it is basic to guarantee viable danger administration of viand protection. Hazard valuation is the exploration of comprehension perils, the probability of their event, and the outcomes on the off chance that they do happen. Hazard control is the system of recognition and evaluation of different risks in the manufacturing, processing and supply of food. Hazard information is characterized by “the intuitive trade of data and opinions concerning hazard among risk assessors, risk managers, consumers, and other invested individuals.”

Hazard investigation is characterized as a procedure consisting of three segments:

- Risk evaluation include:
  1. hazard recognizable proof
  2. hazard portrayal
  3. exposure evaluation
  4. risk portrayal
- Risk administration—the procedure, unmistakable from danger appraisal, of measuring arrangement choices, in interview with all invested individuals, considering hazard evaluation and different variables identified with the well-being of customers and for the upgradation of reasonable exchange practices, and selecting proper control and avoidance conceivable outcomes.
- Risk correspondence—the teaming up of feelings and data all through the danger investigation process concerning dangers and perils, hazard-related variables and danger experiences, among danger administrators, hazard assessors, industry, customers, the scholarly group.
3.7.1.3 Transparecy

A sustenance control framework must be built up and executed in a straightforward way. Sustenance control powers ought to likewise inspect the way in which they exchange nourishment security data to people in general. As needs be, it is imperative that all basic leadership procedures are straightforward, permit all partners in the natural way of life to make successful commitments, and clarify the premise for all choices. This will empower collaboration from all concerned gatherings and enhance the adequacy and rate of consistence (Zoonoses, n.d.).

The certification of purchasers in the well-being and nature of the sustenance supply relies on their familiarity with the dependability and adequacy of nourishment control operations and exercises. This may take the type of experimental sentiment on nourishment well-being matters, reviews of appraisal action, and discoveries on sustenance embroiled in foodborne sicknesses, nourishment harming scenes, or gross defilement. This could be considered as a piece of danger correspondence to encourage purchasers to better comprehend the dangers and their obligations regarding minimalizing the effect of foodborne risks (Food and Agriculture Organization of the United Nations, 2003; Zoonoses, n.d.).

3.7.1.4 Regulatory impact assessment

Whenever arranging and executing nourishment control measures, thought must be given to the administrative expenses (staff, assets, and money-related claims) to the sustenance business, as these expenses are at last passed onto customers. The imperative inquiries are: What is the most very much sorted out administration alternative? Do the advantages of control legitimize the expenses? Send out examination frameworks that are intended to guarantee the well-being and nature of sent out sustenance, will ensure universal markets, produce business, and secure returns (Zoonoses, n.d.).

Creature and plant well-being measures enhance agrarian efficiency (Waage and Mumford, 2008). Interestingly, nourishment security is a fundamental general well-being objective and may force costs on makers, yet interests in sustenance well-being may not be promptly compensated in the commercial center. Regulatory Impact Assessment (RIA) is of expanding significance in deciding needs and help sustenance control organizations in altering or reconsidering their procedures to accomplish the most useful impact. They are, be that as it may, hard to do.

Two methodologies have been recommended for deciding cost/advantage of administrative measures in sustenance well-being:

- Cost of ailment taking care of lifetime therapeutic expenses and lost efficiency.
- Theoretical models can be produced to gauge ability to pay (WTP) for lessened danger of grimness and mortality.
Both methodologies require significant information for elucidation. COI evaluations are maybe less demanding for arrangement producers to comprehend and have been generally used to legitimize measures for nourishment control, despite the fact that they do not quantify the full estimation of danger decrease. As anyone might expect, it is less demanding to perform an RIA for a fare review intercession, than for an administrative approach which accomplishes a general well-being result. Various components of the operational risk management are indicated in Fig. 3.3.

![Diagram of operational risk management steps]

**Fig. 3.3**
Steps of operational risk management. extensive framework to determine the burden of food-related infections.

In order to evaluate the burden of disease estimation in a specific area, WHO is internationally renowned for years for playing crucial role in:

(a) Developing the capacity of public health leadership capacity  
(b) Collecting health information according to international standards  
(c) Assembling expertise and knowledge of organizations as well as individuals together to have a role in estimating the burden of foodborne disease for development of a food safety policy (Food and Agriculture Organization of the United Nations, 2003)

There are no current data on the comprehensive levels and magnitude of foodborne diseases. In order to get a clear picture of foodborne diseases, the causes (parasitic, microbial, biological, and chemical toxins) need to be addressed using a multidisciplinary approach to get meaningful and integrated results.
3.8 Strategic Plans for Protecting Food Supplies

- Generation of baseline and trend data on foodborne diseases, which will reinforce the capacity of countries
- Encouraging the stakeholders to streamline the food safety policies and standards and utilize cost-effectiveness of interventions estimation analysis
- Setting a priority list of agents of concerns for food safety (chemical or biological)

3.9 Responding to the Food-Related Health Crises

For outbreak detection, assessment, and response, there is still a lack of essential investigation aptitude. In addition, owing to a lack of communication among veterinary, agriculture, and food sectors, foodborne disease occurrences go undetected. The WHO, along with its associates, has created a number of tools and networks to address these gaps. Global Foodborne Infections Network (GFN) was initiated to improve the regional and national prevention, investigation, assessment, and surveillance for controlling the foodborne pathogens. This network enhanced the surveillance capability of labs and increased the national and international communication and collaboration among epidemiologists and microbiologists across many disciplines. Targeted, needs-based capacity building efforts are key for strengthening this network to further improve the connected response mechanisms. On the basis of robust assessment, early warning to inform action and encourage timely communication is another important aspect of addressing health threats.

The Global Early Warning System (GLEWS) for transboundary animal diseases, including zoonosis, was a joint project by the FAO, WHO, and OIE in order to respond to threats like Severe Acute Respiratory Syndrome (SARS) and Avian influenza virus (H5N1). GLEWS involves a multidisciplinary and international partnership for in time identification and calculation of health-related risks at the human-animal-ecosystem interface.

3.10 Food Safety Management

Food safety administration programs need to confront the counteractive action, discovery, and control of food harm. The improvement of these projects will incorporate the nitty-gritty danger investigation to distinguish potential risks and the probability and seriousness of their existence. The potential culprits of intentional food defilement or food terrorism which should be considered in the danger administration approach incorporate the workforce.

The one that links with the association that desire to defile the aliment origin; who desire to ingress the aliment origin inside an office either by deviousness, through constrained passage, or different manners; and the individuals who plan to make outside assaults from outside the
office. The potential operators, which should be tended to inside the danger administration
approach, are those that could prompt either a restricted or a boundless food security event
and include:

Coherently nonirresistible or irresistible pathogenic microorganisms, including viruses,
bacteria, microbiological poisons, algae, protozoa, algae, parasites, worms, and insects which
could be conveyed in the type of solids, liquids, or aerosols; synthetic compounds which
could be conveyed as airborne beads, liquids, aerosols, or solids (eliminating conflicting
specialists, i.e., manufactured and natural poisons including pesticides, rodenticides,
heavy metals, cleaning chemicals, dangerous chemicals); Physical (including bone silvers,
clay, glass splinters, metals, wood etc.) which can enter to the supply chain at any phase;
Radiological (radioactive components capable for bringing about damage); Prions; and
allergens including grains containing scavengers, milk, gluten, eggs and related items, nuts,
soybeans, fish, sesame seeds, mustard, and celery.

The strategies for exposure of these operators include identification apparatus (physical
and radiological tainting), chemical examination (chemical pollution), and microbiological
examination (organic tainting). These agents all have the potential to be utilized as a part of
an occurrence of bioterrorism. It is necessary to train and aggravate consciousness between
viands managers with respect to protected viand managing drills.

### 3.11 Improved Organizational Structures Can Enhance Food Control

In order to strengthen the food control systems, a better organizational model with improved
collaboration and coordination can be very effective. Collaboration, coordination, and
integration of organization remain pivotal across the farm to table. The operational levels may
include (Fig. 3.4):

Such systems have the following advantages:

- Uniformity in applying the risk control measures across the food chain, from production
to consumption
- Consistent delivery in the food control system
- No interference in the routine investigation and implementation roles of other food
control departments to make them politically more acceptable
- Separate risk assessment and risk management functions, resulting in objective consumer
protection measures with resultant confidence among domestic consumers and credibility
with foreign buyers
- A well-prepared and informed population about international standards of food control
- Accountability in implementation and transparent decision-making are encouraged
- Long-term cost-effective influence
An integrated Food Control Agency should have the mandate to move resources to high-priority areas, to discuss important sources of risk, and should address the entire food chain from farm to table. Such an agency establishment should not involve day-to-day food inspection responsibilities. These responsibilities should continue to lie with existing agencies at state/provincial, local, and national levels. The role of private analytical, inspection, and certification services, particularly for export trade, should be considered by the agency (Zoonoses, n.d.).

### 3.12 Funding Food Control Systems

It is necessary for a country where food safety is managed by various state departments and agencies to discuss and revise the funding structure to ensure the continuity of funds. It will confirm continuity of funds and resources. Full assurance by the government is needed for this purpose to establish necessary structures and develop strategies to provide the optimal level of consumer protection. The resources and funds which can be used for restructuring and improving the systems for food control will be distributed by the national government.
Over the course of time, the tendency toward public sector funding is little and the government needs to prioritize its funding arrangements with sufficient allocation for food safety and security, though with resource limitation securing enough resources may be a difficult task. Many nations practice cost recovery. This should be managed appropriately as it will be ultimately passed onto consumers in the form of some indirect taxation on items of food. Such taxation can affect the poor segments of the society. Private sector services can be hired to carry out specific food-related checks such as examining the quality of food, surveillance, and inspection. Some of the challenges are summarized in Fig. 3.5.

![Fig. 3.5](image)

**Fig. 3.5**

Major challenges and policy options and actions for food security.

### 3.13 Food Security Challenges for Pakistan

Pakistan is an agricultural country. Agriculture fulfills the food and fiber requirements of the fast growing population of the country (Ahmad and Farooq, 2010). Its population is increasing rapidly and if it continues to increase at the present rate, it is expected that the population will double by 2050. Currently Pakistan is the sixth most populous country in the world; doubling its population by 2050 will make it the fourth most populous country in the world.
world (Pakistan, Government of National Nutrition Programme. Ministry of Health, 2010). Wheat is the major food crop of Pakistan. During 2010, wheat production has been increased about fivefold but Pakistan became just a marginal importer of wheat (Ahmad and Farooq, 2010). To narrow the gap between the food supply and demand chain, dedicated efforts are required to control population growth and to achieve advances in technology.

An important portion of SDGs (2015–2030) focus on decreasing hunger, poverty, and food insecurity. These are also prerequisites for economic development. Furthermore, the developmental process of national economic growth and food security mutually interact and support each other (Timmer, 2004). A country is said to be not a food sovereign state if it fails to produce the required food and lacks resources to buy food from the international market for fulfilling its supply and demand gap (Pinstrup-Andersen, 2009).

The development and usage of an aliment biosecurity or safeguard administration arrangement is one of the most ideal approaches to diminish the dangers of sustenance terrorism and its results. For example, preventive practices are implemented by many food service operations for chemical use and storage as compared to other areas of practices. It is believed that having MSDS (material safety data sheets) in place and knowing the perils brought on by the substances have driven operations to practice safe food management practices. Moreover, the preventive practices identified with nourishment managing involve obtaining aliment fixings from fair suppliers who have suitable licenses. This practice is liable to be set up with the end goal of value control and nourishment security measures that the greater part of the food service operations had formerly applied before nourishment terrorism turned into a critical issue in the food service business.

### 3.14 Future Concerns

The availability of food specifically in the form of calories and proteins is dependent on agricultural production. An ample supply of food at reasonable prices is the cornerstone of the food security policy in Pakistan and in other regimes. Noteworthy progress has been made by Pakistan with respect to increasing food supplies (Ahmad and Farooq, 2010).

The policy failures relevant to food safety and security can be of two types which induces uncertainty in food control, safety, and security. One is the rapid withdrawal of funds from the agriculture sector for developmental programs, and the other is the failure in the food supply system due to paying less attention to safety and security of food supplies and agriculture. Owing to these chaotic events, governments of developing countries and international donor agencies decreased investment in research and development and withdrew their support respectively (Zezza et al., 2007). An increase in rural poverty and reduction in agricultural productivity have been observed due to a lack of policy support without providing alternative solutions. Another important reason for the massive reduction in accessing food is lack of awareness of essentially interlinked sectors. This contributes to the poverty-food insecurity
helix. Apart from a few food security programs at the regional level, Pakistan has never had a national food policy (Mittal and Sethi, 2009).

### 3.15 Preventive Measures and Readiness

Common protection frameworks which react to a scope of crises shape a noteworthy segment of national reaction components. Reaction systems are generally known as danger controls, which ought to be tended to in a case of conscious sustenance defilement.

- Preventive measures, for example, an HACCP administration arrangement involving instruments for the purpose of recognition as well as detection of harmful operators.
- The manufacturing as well as the distribution process of food should be designed in such a way to minimize any risk of contamination from production chain to the supply chain.
- Health experts monitoring the side effects in people brought on by potential agents including FAD and reporting systems to distinguish patterns instantly.
- New techniques for the rapid detection of food contaminants should be developed.
- Viable antibodies, therapeutics as well as chemoprophylaxis being promptly accessible.
- Various awareness raising and training programs in maintaining stringent biosecurity and biosafety standards in food industries will be fruitful.
- Rapid and meaningful ways of communication among the various stakeholders in case of any food safety or security event will be helpful to confine the large scale damage.
- Ejection of corpses and perhaps the human cadaver.
- Protecting the sustenance and water production network.

### 3.16 Evaluating Weakness

The WHO (2002) proposes that weakness ought to be surveyed on the premise of “the political, social, experimental, and financial situations of a nation to gauge the degree of the risk and to set needs for assets.” The WHO further notes that powerlessness ought to be surveyed “as a multidisciplinary movement, with contribution from legitimate, insight, therapeutic, investigative, monetary, and political areas.” On a national level, vulnerability might be surveyed on the premise of:

- the viability of the nation’s sustenance well-being administration foundation and current reconnaissance systems
- accessibility of the probable diet sullying doer
- inspiration for culprits of food terrorism
- capacity of the doer to taint lump created aliment and increase far reaching circulation
- capability of human-to-human transmission of the agents
- ability for a compelling crisis reaction
- probability of the danger to the viands production network, animal health, and welfare
- transport sustenance exchange, traversing, and people well-being
3.17 Conclusion

Keeping the food supply safe from biological or chemical risks requires teamwork that involves participation from federal and local governments, as well as the private sector. New and updated food standards are specifically required by national governments to address issues related to food security objectives. Implementing such standards would allow for a food chain that is greatly controlled and supplied with appropriate data on contaminants, hazards, and risk management strategies. Biosecurity standards need to be adopted by a country to the greatest extent possible. Solid scientific advice must be used as a base for developing and implementing biosecurity standards. It is also critical to build risk assessment competence in the country or region. Risk assessment will confirm that standards are reformed to the prevailing conditions and are capable of delivering a maximal level of public health protection when implemented appropriately.

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