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**POTENTIAL OF BIO-/AGRO-TERRORISM IN KENYA**

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**Abstract:**

The growing Biotechnology and Bio-Engineering may have by commensurate measure contributed to bio-terrorism. This has led to stringent measures to deal with it especially, in developed economies like the USA. Under the docket of Homeland Security, the USA has put elaborate strategy to counter Bio-/Agro terrorism. Considering Bio-terrorism is a broad area, this paper will have a bias towards Agro-terrorism. Agro-products finally ends up on the table as food or in the selves as medicine, thus any form of Agro-terrorism will be a huge blow to food and pharmaceutical /medical sectors. The objective of this study is therefore to explore the past actions related to Agro-terrorism. It will also address possible channels of exposure and our preparedness agro-terrorism. **Agroterrorism**, or **Agriterrorism**, is a malicious attempt to disrupt or destroy the agricultural industry and/or food supply system of a population through "the malicious use of plant or animal pathogens to cause devastating disease in the agricultural sectors". In the past years Kenya has suffered a number of epidemic plants and animal disease attack. These included; coffee berry disease in the 1970s and 80s, Rift Valley fevers in animals, Necrotic lethal maize mosaic virus, blast in rice, aflatoxins among others. Such attacks have far reaching consequences in human health and food security. In case of diseases (like RVF) and aflatoxins fatalities have been reported in human who consume

products contaminated with disease pathogens. If these outbreaks were any form of act of terrorism then, Kenya needs to increase its alertness and surveillance. This can be done by training a team(s) of experts to contain and prevent such attacks. Methods of execution of terrorism include dissemination (firing) of pathogens in the fields during strikes; slow introduction by agro-tourist and through food and seed imports. The current advances in genetic engineering of various microorganisms (bacteria, phages etc) may lead to organisms with very strong gene expression prowess that could aggravate the problem. Inclusion of strong promoters like that of Tobacco Mosaic virus in various gene cloning vectors may have increased the virulence of many potential pathogens. In Kenya the regulatory bodies dealing with dangers Agro-terrorism dangers include; KEPHIS, Directorate of Veterinary, National Biosafety Authority and other related bodies. However, they still need to be empowered to increase their responsiveness to any form of terrorism danger. In conclusion, Agro-terrorism, is by all means real and can be deadly hence need to prepare for counter action.

Key words: Biotechnology, Bio-engineering, Bio/Aggroterrorism

## 1. Introduction

Terrorism is becoming a global problem with involvement of global society and using globally diverse weaponry. The type of weaponry used includes the bioweapons. A biological weapon is a weapons system that intentionally uses bacteria, viruses or toxins to cause death or disease in people, animals or plants (Kate, 2000). Between 1936 and 1980 there have been several definitions for terrorism (Wilson et al 2000). Agro-terrorism poses some great dangerous risk, and because of this the USA Government has put elaborate strategy to counter Bio-/Agro terrorism under the docket of Homeland Security. Among the is the “Bioterrorism” which is defined as the intentional use of microorganisms or toxins derived from living organisms to cause death or disease in humans, animals, or plants on which we depend. Effects of Bioterrorism may not have be weighty in the past, as technology advances it is increasing being recognised as a major risk avenue where terrorist activities could take place. In the past it has been used by many countries including USA, former Soviet Union, British and even Chinese (Harris, 2002, Harris, 1999; Inglesby, 2001). Biological weapons are considered to be weapons of mass destruction or weapons of mass casualty. The weapon are gaining preference because they are invisible, silent, odorless, and tasteless, inexpensive to produce.” Act of terrorism needs to be differentiated from biowarfare where the later occur in situation where there is a declared war the former is an ambush. The only common denominator is that both use biological weapons. Terrorism uses biological weapons but in a non-conventional manner like use of letters to disseminate dangerous materials like anthrax. Considering that Bio-terrorism is a broad area, this paper will have a bias towards Agro-terrorism.

Agro-products finally ends up on the table as food or in the selves as medicine, thus any form of Agro-terrorism will be a huge blow to food and pharmaceutical /medical sectors. In fact, **Agroterrorism**, or **Agriterrorism**

is defined as a malicious attempt to disrupt or destroy the agricultural industry and/or food supply system of a population through "the malicious use of plant or animal pathogens to cause devastating disease in the agricultural sectors" (Parker 2002). Countries over depending on Agriculture for the GDP are likely to be major targets of Agroterrorism (Linacre *et al.*, 2005). Due to this a form of Threat, Vulnerability, and Consequence (TVC) Analysis (Willis et al. 2004) is needed. Vulnerability to terrorism for both developed and developing is dependent on ; The proliferation of terrorist groups who have grievances against both developed and developing countries; 2) the dependence of a significant portion of the economy on agricultural exports and imports; and 3) the large scale of agriculture. However, developing countries may suffer more from: 1) lack of capacity to monitor for potential agricultural pests and diseases; 2) lack of expertise in risk assessment practice and decision-making; 3) poor existing security measures; and 4) often fragile economic circumstances.

The growing Biotechnology and Bio-Engineering may have by commensurate measure contributed to bio-terrorism. This has led to stringent measures to deal with it especially, in developed economies like the USA. This combined to traditional bio-terrorism aggravates the problem. In the USA the spinach and lettuce disasters where Salmonella was traced to contaminated tomatoes, which affected almost 200 people in 21 states (Wood, 2006) and E. coli outbreak associated with shredded lettuce (USFDA, 2008) respectively lead to economic loss of up to \$50- 100 million.

Bioweapons aiming at agricultural production have been conducted both by nation-states and by sub-state but organizations throughout history. Within the 20<sup>th</sup> century a number of states including Canada, France, Germany, Iraq, Japan, South Africa, United Kingdom, United States, and the former USSR had documented agricultural bioweapons programs (Fleischhacker S). Despite extensive research on the issue, biological

weapons have been used rarely against crops or livestock, especially by state actors. Examples of state actors using biological weapons against agriculture include Germany's use of glanders against Allied horses and mules in World War I, the alleged use of anthrax and rinderpest by Japan in World War II, and the alleged use of glanders by Soviet Union (Fleischhacker S). Although individuals or substate groups have used bioweapons against agricultural or food targets, only a few can be considered terrorist in nature. In 1952, the Mau Mau (an insurgent organization in Kenya) killed 33 head of cattle at a mission station using African milk bush (a local plant toxin) (Monke, 2007). In 1984, the Rajneeshee cult spread salmonella in salad bars at Oregon restaurants to influence a local election. Chemical weapons have been used somewhat more commonly against agricultural targets. During the Vietnam War, the U.S. used agent orange to destroy foliage, affecting some crops. Among possible terrorist events, chemical attacks against agricultural targets include a 1997 attack by Israeli settlers who sprayed pesticides on grapevines in two Palestinian villages, destroying up to 17,000 metric tons of grapes. In 1978, the Arab Revolutionary Council poisoned Israeli oranges with mercury, injuring at least 12 people and reducing orange exports by 40%.

Zoonotic diseases could potentially be used on war head carrier. This is because they kill the animal and get into the food plate on the table thus affecting even those who are not animal handlers. Also, sometime weapons targeting plants could be loaded with human pathogens. This creates panic and could cripple the agricultural and industries that depend on it. The terrorist objective is to cause destruction of livestock and crops in situation where it is difficulty to cause mass human casualties without harming the attackers. These agents also have the advantage of posing little threat to the people developing them and their use is less likely to lead to strong reprisals or loss of public support. They could therefore be attractive as a terrorist weapon. During World War II the government of the United Kingdom considered feeding linseed cakes containing anthrax to German cows and

infecting Japan's rice crops with a fungus, but instead chose to use more conventional weapons with more immediate effects (Kate 2002).

## **2. Potential agro-terrorism pathogens**

These include Anthrax caused by *Bacillus anthracis*; Plague caused by the bacterium *Yersinia pestis*; Tularaemia caused by a small bacterium called *Francisella tularensis*; Q fever is caused by *Coxiella burnetii*, a bacterium; Influenza caused by virus; Smallpox caused by smallpox virus; Viral encephalitis encephalitis viruses which are transmitted by mosquitoes; Viral haemorrhagic fevers (caused by many family of virus); Botulinum toxin (bacterium); Staphylococcal enterotoxin B caused by *Staphylococcus aureus* among others.

**Attempts to use terrorism act:** Aum Shinrikyo sect, in 1984, who had well trained scientist in Japan attempted to use pathogen against test innocent society; The Rajneeshee salmonella case in Dalles Oregon state where Bhagwan Shree Rajneesh tried to put the bacteria in the salad bars of ten local restaurants over a three-week period in September of that year.

### **Bioterrorism: the threat and the realities**

There are a number of indicator that show potential occurrence of bioterrorism.

This includes scenarios;

a) There are a number of unemployed or underpaid scientists who used to work on the biological weapons programs of the Soviet Union, Iraq or South Africa. Some of them might be tempted to sell their knowledge or expertise. It is also rumoured that some of Russia's secret criminal gangs possess biological agents which were developed in the Soviet bioweapons program (Alibek 1999: 272).

- b) Terrorist groups might now be competing for attention and seeking more dramatic methods.
- c) Biological weapons could also be attractive to terrorists who wish to remain anonymous and to appear as ‘enigmatic, unseen, and unknown assailants’ (Gilmore Report 1999: 11).

### **3. Use of Anthrax : A case of Agro-terrorism / Bioterrorism**

The Anthrax bacterium has been most popular in both biological weapons programs and terrorist attempts (sometime hoaxes). It is fairly easy to grow, sturdy and relatively easy to disseminate in spore form, and has a high fatality rate. Smallpox is also easy to produce and stable and has the added advantage of being transmissible from person-to-person, but it is now more difficult to acquire the virus in the first place. Anthrax disease which is caused by a bacteria called *Bacillus anthracis* is much easier to culture and package spores for terror attack. The risk factor is that bacteria's are microscopic and cannot be recognised easily like an ordinary weapon (e.g. grenades and other types of weapon of mass destruction) yet its effects are disastrous. Recognition becomes obvious after its effective incubation period (5-7 days). Besides the forms of exposure exist--cutaneous (skin exposure), gastrointestinal (entering through the digestive system), and inhalation are the routine forms of handling our pets and food.

#### **Why Anthrax as a Weapon?**

The bacteria is a biological agent will kill people, livestock. Anthrax is one of the most likely agents to be used because;

- Anthrax spores are easily found in nature, can be produced in a lab, and can last for a long time in the environment.

- Anthrax makes a good weapon because it can be released quietly and without anyone knowing.
- The microscopic spores could be put into powders, sprays, food, and water. And because they are so small, they are not seen by naked eyes, not smelt, and have no taste .
- Anthrax has been used as a weapon before.

#### **4. Agroterrorism entry points**

Attack can be launched directly to animals or plants, however it can also include: Transportation systems; Water supplies; Grain elevators or other storage facilities; Producers, farmers, and farm workers; Restaurants and food handlers; Grocery stores; Food and agriculture research laboratories; and packing and food processing facilities among others. Take example of scary anthrax directed to the USA in 2001 (Johnson 2001). The total cost of the anthrax bio-attacks was over \$1 billion. This included decontamination of various buildings, treatment and procurement of irradiation equipment for irradiating mail. This exclusive of indirect cost like clean up and response to false alarms over "white powder" of household origin, and lost productivity associated with resultant work stoppages (Barakat, et al., 2002).

#### **5. The Threat-Vulnerability-Consequences (TVC) analysis framework**

Due to increasing agroterrorism attack a preparedness is necessary through a form of risk assessment. Risk can be defined as function of interactive effects of  $s_i$ ,  $p_i$ ,  $x_i$  where  $s_i$  is the risk scenario and each  $s_i$  has a probability  $p_i$  of occurring and a consequence  $x_i$  if it occurs (Kaplan and Garrick 1981, Kaplan 1997). Terrorism risk may be thought of as a function of the threat level, vulnerability to the threat, and consequence from the



terrorist action (Willis et al. 2004). For example, Terrorist attack on food factory; the risk estimate could refer to an attack by terrorists against food factory using a particular disease or toxin. The threat would then be an estimate of the terrorists' priority for as attack against the available alternatives. Vulnerability could be estimated as likelihood of post interception and the consequences would be an assessment of the impact of the disease see figure 1.



Figure 1. Overlapping regions of high threat, vulnerability, and consequence great security risk.

### Applying the TVC analysis framework to agroterrorism

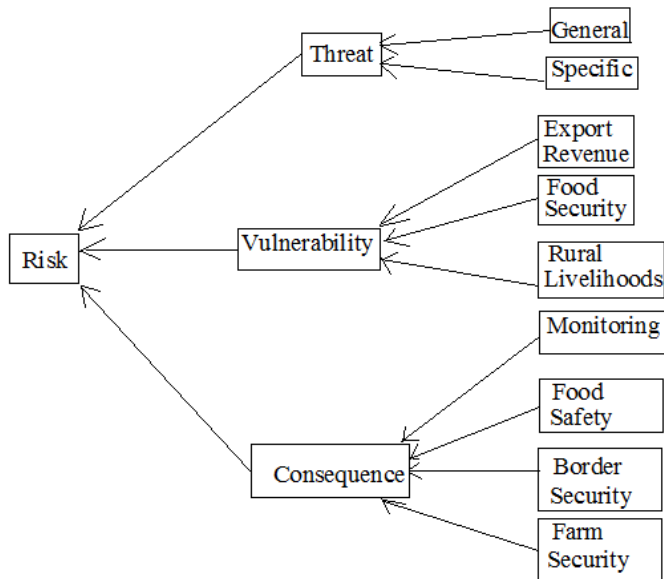


Figure 2. The anatomy of the threat, vulnerability, and consequence analysis.

## **6. Agro-terrorism - Threats and Preparedness**

Agro-terrorism is real and thus preparedness is a must;

- i) Development of Technologies to counter bioterrorism: For example by-products of the production of castor oil and classified by the Centers for Disease Control (CDC) as a Class B bioterrorism agent has high level of ricin. Biotechnology can be used to produce transgenic castor oil with low levels of ricin (ARS 2001).
- ii) Improve on Biosecurity: According to Food and Agriculture Organization of the United Nations (FAO) the term “biosecurity” is inclusive of, phytosanitary and zoosanitary measures need to be applied in food and agricultural regulatory systems.
- iii) Greater global cooperation in the form of financial aid and technical assistance can help build capacity in biosecurity and ability to cope, especially developing countries, with any emerging specific threats of agroterrorism as well as the more general spread of pests and disease.
- iv) Increased surveillance and to restrict biotechnologies of “dual-use” to useful activities. Bio-engineering has useful aspect but it equally has a disastrous aspect. Exam virus test kit can be used for diagnosis as well as for terrorism.
- v) Enhance bioterrorism attack monitoring systems. Early detection of attack can reduce the risks.
- vi) Strengthen animal disease immunization and breeding of resistant breeds and plant varieties: These are measures are at plant/ animal level.
- vii) Increased Biodefence research: research focuses on a number of areas, including vaccine development, treatment of disease, and rapid detection of biological attacks. The research on biological detectors is at an early stage.

The most sophisticated detector currently available is the Biological Integrated Detection System (BIDS).

viii) Global epidemiological surveillance: An international agency would be established to investigate unusual outbreaks of diseases to determine whether they have occurred naturally, through accidental release of biological agents or through the deliberate use of a biological weapon.

## **7. Biotechnology and Agro-terrorism**

Biotechnology provide very fertile ground for agro-terrorism. For example, the virus and bacteria that are used to make vaccine could as well be used for terror activities. Besides, the increase bacteria, viral and fungal engineering can lead to more virulent plant and animal pathogens that are difficulty to control. Inclusion of strong promoters like that of Tobacco Mosaic virus in various gene cloning vectors (Njiruh 2015) may have increased the virulence of many potential pathogens.

## **8. Dual use organisms**

The deadly Virus and bacterium have been bio-engineered to produce various vaccines. Vaccines like Bacillus Calmette-Guerin (BCG) Vaccine, rabies, anthrax among others are made of various viruses or bacteria in attenuated or non-leaving forms. Such microbes are highly dangerous yet highly useful. Strict screening is needed so as to regulate people who handle such microorganism

## **9. Kenya incidences**

- Kenya's "The Prevention of Terrorism Act, 2012, MNO. 30 OF 2012 is meant to prevent terrorism in all forms. In Kenya the regulatory bodies dealing with dangers Agro-terrorism dangers include; Kenya plant Health

inspectorate service (KEPHIS), Directorate of Veterinary, National Biosafety Authority and other related bodies needs to enhance their surveillance method with early detection of Agro-terrorism. It is always good to be aware of manifestations of a bio-terrorism attack. According to (Eitzen, 1999) a biological attack is suspected if the following are noticed;

- A disease appears which does not occur naturally in that area, or there are unusual combinations of diseases in same animal or plant fields.
- There are unusually large numbers of infections or casualties.
- The epidemiological data suggests the outbreak originated at a single source. · The disease has an unusual apparent route of transmission.
- In case of zoonotic diseases, morbidity and mortality rates are high.
- The casualties occur within a limited geographical area.
- There are low infection rates among people who work within closed ventilation systems.
- Plants and animals in the area are also succumbing to the disease.
- The disease is normally vector-borne, but the natural vector is not found in the area.

Kenya has suffered many incidences in the so called emerging diseases.

Among them includes Rift Valley fever, Aflatoxin, Maize necrotic lethal virus diseases, Citrus greening disease

**a) Rift Valley fever**

Rift Valley fever is characterized by high mortality rates in young animals and abortions in pregnant ruminants. In addition, epizootics are often accompanied by human disease. This makes it a good candidate for use in terrorist. In the current history, the 2006–2007 outbreak was the most extensive in cattle, sheep, goats, and camels affecting thousands of animals in 29 of 69 administrative districts across six of the eight provinces in Kenya (Munyua et al., 2010). About 700 human lost their lives. This could qualify

in description given of agro-terrorism, only that confirmation needs to be done.. The outbreak lead to closure of abattoirs hence meat industry that contribute Kenya's 4 per cent of the gross domestic product.

**b)     **Aflatoxins****

Aflatoxin is produced in minute quantities, but its potency, prevalence, and the ease with which it can permeate farmers' fields and storage areas makes it highly carcinogenic metabolite (Steve *et al.*, 2010). Mycotoxins can be used as chemical warfare agents (Ciegler, 1986). There is considerable evidence that Iraqi scientists developed aflatoxins as part of their bioweapons program during the 1980s. Toxigenic strains of *Aspergillus flavus* and *Aspergillus parasiticus* were cultured, and aflatoxins were extracted to produce over 2,300 liters of concentrated toxin (Ciegler, 1986). The majority of this aflatoxin was used to fill warheads. The current endemic in the former Eastern province of Kenya need further scrutiny to identify if it could be at one time an act of terrorism.

**c)     **Viral uses in agroterrorism****

Viral infection is meant to cause food shortage and create national tension. It is suspected to have been used in some African and Asian countries to cause total financial shortage and partial food shortage for human and livelihood. One of the challenging disease Kenya has experience is Maize necrotic lethal MNL viral disease. It is not known if the MNL viral disease is any form of terrorism, but what is obvious is financial loss is great.

**Coffee berry disease**

The disease is caused by fungus called *Colletotrichum kahawae* and it can lead to

near crop failure. It can infect leaves, stems bark and twigs of the coffee plant. Only *C. kahawae* can infect immature or green berries. When occurring on the immature green berry this disease is also known as brown blight. When it attacks it can lead to near crop failure. Coffee is full of trade rivalry and it is not know if the disease could be intentionally be spread through agro-tourism to square out trade rivalry.

## **Conclusion**

There could have been unnoticed act of Agro-terrorism in Kenya because some emerging diseases seem severe as described in other areas where Agro-terrorism may have taken place. Therefore, Kenya needs to put in place a strong Agro-terrorism surveillance mechanism. Same time, a strong biodefence research is needed so as to avail means of mitigation in case of agro-terrorism attack.

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