Abstract

Several studies have examined the causes and consequences of major national security problems, especially terrorism, which has become a major challenge across the globe. Other studies have examined terrorists target behavior. While food security is widely accepted as an important element of national security, few studies, if any, have explored the nexus between both. By focusing on terrorism and using the Boko Haram insurgency in Nigeria as a case study, this paper explores three dimensions of the food-national security nexus. First, it presents a conceptual framework to explain food security as a root cause of terrorism. Second, it presents a conceptual and a theoretical framework for explaining why and how terrorists target agriculture and food security and presents empirical evidence to support a number of related hypotheses. Third, it presents yet another conceptual framework for explaining the consequences of terrorism and explores several effects on agriculture and food security. The paper concludes by presenting important reasons why the nexus between food security and national security should be more aptly investigated and discusses the benefits of such investigation.

Key Words: Agriculture, Terrorism, Inclusive Growth, Root Causes, Food Security, Boko Haram, Nigeria.

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Agriculture, Inclusive Growth and National Stability: Exploring the Nexus between Food Security and National Security

A. Introduction

Traditionally, the term, National Security, was broadly defined as the maintenance of national peace and stability. Because much of the historical threats to peace and stability were external, efforts to maintain and protect national security mostly focused on the use of the military and security agencies to protect territorial integrity, contain subversive activities and protect the state and its instruments (US Department of Defense, 2005). More recently, several factors have led to much broader thinking about what constitutes national security. These include: (a) the growing evidence that poverty, inequality, lack of employment opportunities, ethnic rivalry, religious extremism, disdain for corruption and other socio-economic factors affect the potential for disenfranchised groups to organize and engage in subversive activities; (b) the growing tendency of such groups to challenge existing or widely constituted state authority; and (c) and the growing tendency of domestic unrest to have cross-border or spillover effects through transnational terrorism. I propose a more appropriate and contemporary definition of National Security: “the maintenance of the survival and prosperity of a nation through the prevention of and protection from human, economic, social, physical, resource, food, environmental, natural, external and other threats to its national interests”.

Threats to national security are those events, actions or the absence thereof that may threaten the existence of the nation by creating mass disturbance, hurting large numbers of people, causing significant loss in human life, causing major property damage, destabilizing the economy, disrupting government functions or undermine governance and national cohesion (see Security Council Report, 2011). Over time, the key threat that a nation faces will vary. National security management is about the prevention, containment, management and abatement of these threats. The ability to prevent these threats before they emerge or respond to them as they emerge is what undergirds a good national security strategy. In essence, the objective of national security agencies is to prevent and manage these threats in order to promote state stability, continuity and prosperity. The range of things to effectively prevent or manage to achieve national security is obviously expanding.
The term, “Food Security”, on the other hand, has many definitions, depending on the scale and context to which it is being applied. At the global level, a widely accepted definition is “physical, social and economic access of all people of the world at all times to safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (see UN, 2004; UN, 1975; UNFAO, 1983; World Bank, 1986). In this paper, given the interest in the food-security-national security nexus at the national level, I define food security as the access of people to adequate food for an active and healthy life”. The implication of this definition is that food security negates the concept of food “want” or “hunger”.

From the above definitions, to the extent to which it could affect a large numbers of people; cause the mobilization of people to engage in unrest, insurgency and terrorism; and therefore, result in significant loss in human life and property damage, food insecurity should be viewed as a major threat to national security. Recent events in the Middle East and North Africa (MENA) region suggests that high food prices, amidst eroding employment and income opportunities, contributed to demonstrations, unrest and the eventual overthrow of long-existing governments (Shrier, 2011). On the other hand, the outcomes of national insecurity could further exacerbate the socio-economic root-causes of insecurity, creating secondary adverse effects. It is therefore important to better understand the key relationships between food security and national security.

In this study, to explore the relationship between food and national security, I focus on the terrorism element of national security. Across the globe, terrorism has emerged as one of the most significant threats to national security and stability. 1 “Terrorism” can be defined as “the pre-meditated use or threat to use violence by individuals or subnational groups to obtain political or social objective by intimidating a large audience beyond that of the immediate victims” (see Enders and Sandler, 2012; Hoffman, 2006; and RAND, 2012). While in many cases, it is closely linked to “insurgency” because it is a prominent course of action that insurgents chose to achieve their objectives (overthrow of an existing government, secession, violent capture of

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1 In the context of a developing country or fragile state, other threats to national security include such things as ethno-communal clashes, frequent armed robbery, major acts of sabotage, mass acts of arson, subversive activities, large scale looting, wanton vandalism, labor unrest, students unrest, demonstrations, violent riots, strikes, extra-government violence, intra-government violence, pro-government violence, acts of espionage, drug trafficking, cyber-attacks, regional challenges to democratic governance and piracy (see Security Council Report, 2011, amongst others).
territory, etc.), some cases of terrorism do not involve insurgency.² Terrorism begins to approach insurgency when a grand vision and plan to achieve the goals of the terrorists are present.

Terrorism is characterized by acting outside of normative legal and political mechanisms, as the terrorist either cannot access these mechanism, does not trust the available mechanisms or these mechanisms do not serve their goals. Terrorism typically involves the bombings of innocent victims, government targets and critical infrastructure. The desire to destroy is paramount to the causes and actions of terrorists (Elu and Price, 2015). In addition, terrorists are often motivated by a sense of higher morality, freedom seeking, economic suppression and alienation.³ Depending on the key motivations, structure, degree of sophistication and extent of the resources of the terrorist organization, their destructions can be ghastly and heinous and can involve a large number of innocent victims, communities, infrastructure and industries.

Since the September 11, 2001 attack on the World Trade Center in New York City and the Pentagon near Washington DC by the Islamic terrorist group, Al-Qaeda, terrorism has increasingly become a global phenomenon which continues to pose dangerous threats to global security. Terrorism is generally understood to be the use or threat of violence to create fear for political, religious and/or ideological reasons. Used in both times of peace and conflict, terrorism is a method used to achieve the greatest attainable publicity for an individual, group or cause. The change is desired so desperately that its achievement is more highly valued than human lives. For that matter, the impact of terrorist violence and damage typically reaches more than the immediate target victims, for example, government and military, but it can also be directed at targets consisting of a larger spectrum of society, such as civilians, or even society as a whole.⁴

Three (3) factors related to the rapid expansion of the new global economy may help explain the increase in terrorism: (a) as terrorism thrives on isolated conditions and the globalized economy is expanding rapidly, those left behind without knowledge, skills or access will become more isolated and disaffected; (b) the clash of cultures for those who simply do not believe in the

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² The Term insurgency can be defined as “an organized rebellion against a widely constituted and recognized state authority when the perpetrators are not widely considered to be legitimate representatives of their claimed constituency and/or their actions are not considered legitimate or appropriate under international rules of sovereign conduct or war” (see Morris, M.F, 2005).
³ In the New Globalized Economy, these conditions are intensifying. Often, these motivations are most acute in rural isolated areas, with populations that have low levels of education and high rates of poverty.
⁴ http://www.sagepub.com/upm-data/51172_ch_1.pdf
tenets of the global economy will intensify; and (c) high growth sectors are those that these isolated populations cannot participate in.

The far-reaching and prolonged effects of the coordinated attacks on the United States exemplifies the depth of the problems associated with terrorism. This monumental act of aggression and provocation killed almost 3,000 people and cost the United States an estimated USD80 to USD90 billion in direct and indirect costs when the gross domestic product (GDP) of the United States in 2001 was about USD10 trillion. The immediate losses associated with the attacks include the value of lives lost, the value of damaged structures, the loss of four civilian aircrafts, injuries sustained, lost wages, destroyed goods, cleanup costs, losses to the insurance industry, and reduced commerce. The secondary costs of the attack include subsequent expenses such as federal emergency costs (enhanced security costs, heightened airport security, retrofitting of aircrafts with anti-terrorist devices, sky marshals), higher insurance premiums and lost future commerce (Sandler, 2014).

In the Middle East, with the influence of the Islamic State of Iraq and Syria (ISIS or ISIL) and Al Qaeda, terrorist activities are strong in Syria, Iraq, Israel and Yemen while occasional targets have been reported in countries such as Jordan, Lebanon, Oman, Saudi Arabia, and the United Arab Emirates. In North Africa, states like Libya, Egypt, Tunisia, Algeria, Mauritania and Morocco have recently experienced terrorism. In Asia, places in Afghanistan and Pakistan have been under attack. Even in Europe, within the past ten years, attacks have occurred in the United Kingdom (London), Netherlands (Apeldoorn), Sweden (Stockholm), Greece (Athens), Denmark (Copenhagen), France (Paris), Germany (Frankfort), Italy (Brindisi), Belgium (Brussels), Spain (Madrid), Turkey (Istanbul) and Portugal (Lisbon). In sub-Saharan, East and West Africa, Algeria, Angola, Burkina Faso, Cameroon, Chad, Cote D’Ivoire, Djibouti, Ethiopia, Kenya, Libya, Mali, South Africa, Sudan, Tanzania, Tunisia, Uganda, Zimbabwe and Nigeria have witnessed terrorist activities. In fact, perhaps the most deadly terrorist activity in the world today is the Boko Haram (BH) insurgency in Nigeria (CNN, 2015) where over 2 million people have been displaced from their homes, jobs and communities.

Many studies have investigated the relationships between terrorism, on the one hand, and both its causes and consequences. For example, Piazza (2006) studied the role of poverty in
causing terrorism; Enders, Sandler and Parise (1992) and Drakos and Kutan (2003) studied the economic impacts of terrorism on the tourism industry; while Enders and Sandler (2012) examined more aggregate economic impacts. However, few studies, if any, have directly examined the nexus between food security and national security.

There are three major dimensions of this nexus. The first is the extent to which food insecurity contributes to insurgency and terrorism. This relates to past studies on the causes of terrorism (CAUSE). The second is the extent to which terrorists or insurgents target agriculture, the food value chain and/or food insecurity in order to advance their cause. This relates to past studies on terrorist targeting behavior (TARGET). The third is the destructive and disruptive impacts of terrorism on agriculture and the food system, especially in rural areas where farming is the mainstay. This relates to studies on the costs and/or consequences of terrorism (CONSEQUENCES). The primary objective of this paper is to explore all three dimensions of the relationship between food security and terrorism by drawing on observations from the on-going Boko Haram insurgency and related terrorist activities in Northern Nigeria.

In Section B, based on on-going work on the Nigerian BH insurgency, a preliminary conceptual framework for exploring all three dimensions of the food security-terrorism nexus is presented. In Section C, a theoretical model to explain why and how terrorists attack agricultural areas is presented. In Section D, an empirical analysis designed to test various hypothesis that emerged from the conceptual and theoretical framework is presented. In Section E, the results of the empirical analysis is presented. Finally, in Section F, the paper draws some conclusions and discusses possible areas of future inquiry with respect to the nexus between food security and national security.

**A.1. Nigeria as a Case Study**

In Nigeria, terrorism has emerged in recent years as a rising challenge to national security, but there have been signs and symptoms of the phenomenon for several decades. This is due to the difficulty of achieving adequate security in the backdrop of acute food shortage, population explosion, low level of productivity and per capita income, low technological development, inadequate and insufficient public utilities and chronic problems of unemployment, not to mention religious intolerance and criminal politicking. Today, Boko Haram (Jama’at Ahl al-
Sunnah li Da’wah wa-I-Jihad), a group founded by Mohammed Yusuf as Yusufiya Islamiya Group in Maiduguri, Borno State between 2001 and 2002, poses the greatest terror threat to Nigeria. Boko Haram first became known internationally following sectarian violence when the police arrested several sect members including the leader, Mohammed Yusuf, who the police subsequently killed. The group has waged a violent campaign against the government to impose its authority under Sharia law.

B. Conceptualizing the Relationship Between Food Security and National Security: Terrorism

In this section, the CAUSE, TARGET and CONSEQUENCES aspect of the nexus between food security and terrorism are examined by drawing on observations from the on-going Boko Haram insurgency and related terrorist activities in Northern Nigeria.

B.1. Food Insecurity Pathway to National Insecurity (CAUSE)

An appropriate starting point for examining causality between food security and terrorism is to drill down on the definition of terrorism (see Section A). Unfortunately, a simple definition of terrorism is difficult to arrive at, as evidenced by the ongoing struggle of the United Nations General Assembly to create a common definition (UN, 2004). In understanding terrorism, it is therefore critical to carefully characterize it to achieve a common understanding. Core characteristics of terrorism include (see Blee, 2005; Hoffman, 2006; Vallis et. al, 2006; Schmid, 2004): (a) a fundamental motive to make political/societal changes; (b) political, economic, or religious aims by the perpetrator(s); (c) the goal of affecting society, (d) the use of violence or illegal force; (e) threats of violence; (f) attacks on civilian targets by non-state and/or sub-national actors; (g) the communication of fear to an audience beyond the immediate victim; and (h) attacks on government agents and facilities. The list above accentuated the need to properly understand the root causes, many of which have been identified in the literature (see Sandler, 2014). In this section, we explore findings from such literature in order to highlight the role of food insecurity in spurring terrorism.

Root causes of terrorism that have been mentioned in the literature include economic discrimination, marginalization of people or perceptions thereof, religious persecution,
nationalist/separatist motives, religious fundamentalism and clashes in political ideology (see, for example, Wilkinson, 1986; Kavanagh, 2011; and Enders, Hoover and Sandler, 2014). Other root causes mentioned include low income (Enders and Hoover, 2012; Gassebner and Luechinger, 2011), poverty (Krueger and Maleckova, 2003; Piazza, 2006) and the lack of liberties (Krueger and Maleckova, 2003). Gassebner and Luechinger (2011) further identified high population, existence of wars, religious and ethnic tensions, human rights abuses, absence of law and order, military spending, foreign portfolio investment and lack of economic freedoms as causes of terrorism. Despite these studies, there is little consensus about the totality of relevant root causes, how they are related to each other, and how each affects the incidence of terrorism.

As insurgency does not develop spontaneously, root causes are the necessary condition for the development of an insurgency. Based on existing literature, Figure 1 below provides a simple conceptual framework of how root causes create an environment of dissatisfaction which can lead to insurgency after two sufficient conditions are met. The first condition is the need for a significant segment of the population to be dissatisfied. Disenfranchised people with little to lose are key recruitment targets of terrorist groups. The second is the need for a group (or groups) to emerge with agenda for change in the status quo and their willingness to use terror as a means to achieve such change. Ideology is an important element of the veracity of terrorist groups. When the group begins to mobilize resources, recruit sympathizers and occupy territory, full blown insurgency has emerged. The consequences can become dire, intractable and destabilizing for the nation or region affected by terrorism.

There is currently no compelling empirical evidence of direct causality between food insecurity and terrorism. However, food insecurity is increasingly being mentioned as a factor that exacerbates other socio-economic and political drivers of insurgency, as well as a consequence of insurgency itself. For example, a number of popular articles have argued that the spike in world food prices in 2008 led to the Arab Spring and that the multi-year drought in Syria, which turned more than half of the nation into desert and resulted in more than 800,000 Syrians losing their entire livelihoods, created major dislocations which laid the ground for the uprising against an oppressive dictatorship and led the country into a full scale civil war (Speckhard, 2015). According to Speckhard, food insecurity heightens the risk of democratic breakdown, civil conflict, protest,
rioting and communal conflict, and it is intertwined with economic security, national security and global security.

Figure 1: Pathway to Insurgency: Causes, Effects, Group Emergence and Impacts

Due to its complexity, the Boko Haram case study provides a lens through which one can comprehensively explore these relationships. The states of Borno and Yobe, where Boko Haram emerged, are among the poorest in the world and are certainly the poorest in Nigeria (Adelaja, et. al., 2015). For decades, the region did not embrace modern education and many young people participated in Almajiri education (Quran schools), leading to a large number of people that are now disconnected from the emerging economic opportunities in Nigeria (Adelaja, et. al., 2015). Clearly, in the absence of strong social intervention programs, limited economic, employment and educational opportunities should translate into food insecurity. So, while direct evidence of causality between food security and national security is absent, the fact that Boko Haram emerged from that region suggests at least a possible food insecurity cause.

Another reason to expect causality between food security and terrorism derives from the tendency of terrorists to recruit from within the ranks of the disenfranchised who have very little to lose. Boko Haram has been known to lure recruits with money and food. Boko Haram has also been known to plant mines and other explosive devises on farms; to attack, kill and steal farm animals; and to kill ranchers; perhaps to create food insecurity and encourage potential recruits to seek food access through their terrorist group (Kindzeka, 2016). Boko Haram has also been known to blow up tractors, destroy irrigation systems, destroy food markets and
agricultural feeder roads, and chase away farmers. Given the limited number of non-agricultural communities in the Northeast Nigeria, Figure 2, which captures the attacks launched by Boko Haram from 2010 to 2016 and the associated fatalities, shows that these attacks were not only in urban areas with high densities of population and infrastructure. Many of these attacks took place in rural areas and many seemed to involve direct targeting of agriculture and the goal of creating food insecurity.

Figure 2: Boko Haram Attacks and Fatalities, 2010 – 2016.

The US Department of State Official Blogsite posted an article by Jonathan Shrier (2008) which attributes the following statement to Vice President Biden: "Investments made to ward off food insecurity and prevent its recurrence can prevent the vicious cycles of rising extremism, armed conflict, and state failure that can require far larger commitments of resources down the road." The recognition of this connection has spurred renewed investment in food security (e.g., Feed the Future Initiative (FTF)) as a centerpiece of the Obama Administration's foreign policy
(Shrier, 2008). FTF invests in small farmers, but also along the entire agricultural value chain in programs to improve access to credit, technology and markets in order to boost productivity.

**Latency of Food Insecurity and Other Root Causes**

Many governments hardly see insurgency and terrorism coming because the root causes tend to be largely unobservable, or latent, until some event then triggers some form of unrest, terrorist group formation and/or heightened terrorist activity. In the MENA region, for example, the demonstrations and riots that preceded the current spike in terrorism activities seem to have had their roots in many of the causes identified in Figure 1. Many of the leaders were ill informed about the dynamics of the early stages of terrorism. More importantly, the demonstrations themselves were triggered by simple things such as self-emolliation due to concerns about inadequate housing. Furthermore, from a methodological standpoint, the relationship between causal factors and insecurity (or terrorism) seems murky. The problem is akin to challenges associated with modeling latent variables in economic analysis. Because many of the causes seem related (e.g., poverty, lack of opportunities, low income and food insecurity), researchers face the added problem of multicollinearity and specification error. These methodological challenges, coupled with significant data challenges, especially in developing countries, may well explain the limited activity in research to explain the nexus between food security and national security.

**Importance of Understanding Food Security as a Causal Factor in Terrorism**

The relationship between food insecurity and national security deserves significantly more research attention. First, depending on how strong the relationship is and the relative costs of attaining food security versus managing the resulting crisis, the potential to stave off conflict by targeting policies to promote food security can be proactively pursued. Second, insurgency and terrorism, when they start, often become intractable and take on lives of their own. Costs that are well understood are better dealt with than unknown costs. Deeper understanding of the food security-related mechanisms that give rise to terrorism increases the willingness to pay for early warning systems and abatement decision support systems. Third, knowledge about this relationship could help support the advancement of food security programs as much higher priorities in developing countries.
B.2. Motivations for Terrorist Attacks on Agricultural Areas (TARGET)

Studies that previously investigated the motivations (e.g., Ozdamar, 2008), location decisions (e.g., Gaibulloev, 2015), targets (e.g., Brandt and Sandler, 2010) and lethality (Berman and Laitin, 2008) of terrorist groups provide a good foundation for a conceptual framework to guide analysis of why and how terrorists choose to target agricultural areas and food security. Three key elements point to the likelihood that terrorists are attracted to rural areas: (a) rural residents tend to be less educated, to earn less, to face fewer opportunities and to be less exposed. They may be more readily brainwashed and recruited for suicide bombing and other atrocities; (b) rural places have much more limited infrastructure and government safety and security apparatus; (c) gaps may exist in governance in rural areas and terrorist groups seeking to capture territory may likely see such areas as ungoverned places; (d) in many parts of the developing world, global warming has contributed to food security problems by causing draughts and reduced farm viability.

Terrorists seek to inflict damage and raise fear amongst populace. To illustrate the implications for urban and rural areas, Table 1 was developed to explain the place implications of terrorism. As shown in Table 1, the damage and fear from terrorism can be measured in various terms. The Human damages, which typically attract significant attention, tend to include: (a) where they choose to attack (population), (b) how frequently they chose to attack the area, (c) the number of fatalities, (d) the number of injured people, (e) the number of people displaced (i.e. Internally Displaced Persons (IDPs)), (f) the number of captured/kidnapped people, and (g) the national and international visibility of the fatalities, injuries, kidnapped and captured. The infrastructure damage includes: (h) the critical nature of the facilities damaged or destroyed, (i) the number of facilities damaged or destroyed, (j) the value (cost) of damaged/destroyed facilities, (k) the disruptive effects of the damage and destruction to facilities on the economy, and (l) the national and international visibility of the facilities damaged and destroyed. Naturally, terrorist groups are attracted to urban areas because of the high concentration of people, schools, health facilities, critical government offices and assets, public infrastructure and market facilities, because they have much greater national and global regional and economic connectivity, and because they are more nationally and globally visible. However, urban areas
are much more difficult to penetrate because of the higher concentration of security forces, the strong desire to protect such areas and their residents, and the logistical coherence of those places for security forces. Furthermore, urban areas tend to be characterized by higher levels of education and better prosperity, thereby making them less attractive for recruitment purposes.

**Table 1: Objectives of Terrorists and Conceptualized Effects of Terrorism.**

<table>
<thead>
<tr>
<th>Human Impacts</th>
<th>Infrastructure Impacts</th>
<th>Capacity Impacts</th>
<th>Food Security Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Where they attack</td>
<td>h. Critical nature of facilities damaged</td>
<td>m. Extent to which destructions &amp; damages deter counter-attacks.</td>
<td>u. No. of farmers killed</td>
</tr>
<tr>
<td>b. How frequently the area is attacked</td>
<td>i. No. of facilities damaged</td>
<td>n. No. of recruits</td>
<td>v. No. of injured farmers</td>
</tr>
<tr>
<td>c. No. of fatalities</td>
<td>j. Value of damaged facilities</td>
<td>o. Acquired weapons</td>
<td>w. No. of farmers kidnapped</td>
</tr>
<tr>
<td>d. No. of injured</td>
<td>k. Disruptive economic effects of damage &amp; destroyed facilities</td>
<td>p. Stolen combat equipment</td>
<td>x. No. of displaced farmers</td>
</tr>
<tr>
<td>e. No. of IDPs</td>
<td>l. National/global visibility of damaged &amp; destroyed facilities</td>
<td>q. No. of captured farmers.</td>
<td>y. Destroyed markets</td>
</tr>
<tr>
<td>f. No. of captured or kidnapped persons</td>
<td></td>
<td>r. Stolen foods</td>
<td>z. Destroyed food supply chain</td>
</tr>
<tr>
<td>g. National/global visibility of injuries, fatalities, captured &amp; kidnapped</td>
<td></td>
<td>s. Stolen farm equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>t. Stolen seeds &amp; other inputs</td>
<td></td>
</tr>
</tbody>
</table>

The capacity building effects relate to the desire of terrorist organizations to enhance their capacity through their attacks. These include: (m) extent to which destructions & damages deter counter-attacks, (n) number of recruits, (o) volume of acquired weapons, (p) volume of stolen combat equipment, (q) number of captured farmers, (r) volume of stolen foods, (s) volume/value of stolen farm equipment, and (t) volume/value of stolen seeds & other inputs. Because terrorists must also maintain a decent level of financial, food and resource endowments, they often stage raids in order to accumulate assets and resources to enhance their future operations. The first four of the capacity building effects or motives (m, n, o and p) make urban areas attractive to terrorists, while the (q, r, s and t) make agricultural areas attractive.
The food insecurity effects or motivations are those that squarely affect food security. These include: (u) the number of killed farmers, (v) the number of injured farmers, (w) the number of kidnapped farmers, (x) the number of displaced farmers, (y) the extent of destroyed markets, and (z) the disruptions to the food supply chain. Figure 2 suggests that BH has not only attacked agricultural areas, but anecdotal evidence suggests that they have deliberately targeted these places and carted away such things as fertilizer, non-perishable food items, tractors and mobile farm equipment and experienced farmers. They have also destroyed immovable farm equipment while mining farm fields, presumably to render agricultural areas incapacitated. Coupled with the mass migration of rural people into urban areas such as Maiduguri, Yola, Damaturu, Bauchi and Gombe, these attacks have debilitated agriculture in many rural areas of Northeast Nigeria, ground the agricultural economy to a halt and created one of the most poignant food security problems in the world today. The ultimate effects of agricultural and food security attacks include higher prices, reduced supply, unmet demand, limited access to markets, and therefore, greater food insecurity.

In many rural settings, terrorist groups kill people, recruit new members, destroy homes, poison wells, burn markets, attack local and religious leaders and frequently destroy the economic base, thereby making people flee to safer places (often urban areas) due not only to the human and physical destruction, but also the resulting collapse in the viability of the community, job market, product and other markets and food supply chain. For example, in the case of North-East Nigeria, Boko Haram activities have generated over 2 million Internally Displaced Persons (IDPs) who have migrated to urban centers such as Maiduguri and other more rural places and over 300,000 refugees who have sought refuge in places in Niger, Cameroon and Chad. With homes and villages in rural areas destroyed, the economies of vast areas have collapsed as both employers and workers have run for their lives. The large displacement of people has created a huge humanitarian challenge, whereby federal and state government, domestic and international humanitarian organizations (United Nations, the Red Cross Society, etc.) and global and local development partners have had to mount an enormous humanitarian response as they sought to reduce the suffering of people.
Based on their survey of the general public in Maiduguri, Awodola and Oboshi (2015) confirmed the food insecurity effect. They reported that amongst the list of security challenges faced in Maiduguri, agriculture was perceived by respondents to be the most adversely impacted (56.3%). This compares with 8.6% for the security sector, 12.6% for the educational sector, 4% for the government sector, 9.9% for the religious sector and 8.6% for the economic sector. When asked how Boko Haram affected food security, 34.7% of respondents indicated higher food prices, 31.1% cited adverse impacts on farming, 19.3 percent cited reduced food supply, and 14.9% cited reduced food access. Finally, respondents reported that the largest price increases were in pepper (160%), cattle (122.22%), tomato (81.82%), millet (80%), maize (50%), goat (54.16%), watermelon (43.75%), fish (35.71%), wheat (33.33%), sweet potato (32.25%) and orange (31.25%). Price increases were reported for all food prices.

Another aspect of attacks in rural areas is the impact on land use. To create a large disruptive impact, terrorists have been known to plant mines and other improvised explosive devices to ensure that farmers do not return to their fields. The outmigration of farmers to safer grounds essentially means that agriculture and fishing are ground to a halt. The mainstay being agriculture in rural areas, rural terror attacks often lead to a major roll-back in efforts and advances in rural economic development. Much of the poverty alleviation and economic development strategies of federal and state governments, as well as development organizations, in rural areas has been in the development of local agriculture. Attacks on agricultural areas therefore translate into a major setback in rural economic development as past investments can be destroyed almost overnight.

The fear element is important to highlight. Essentially, it amplifies the adverse direct effects of terrorism. Fear helps to explain why many flee from affected areas. Such fear includes concerns about loss of life, injury, dismemberment, loss of family, loss of livelihood, subjugation to terrorists control, rape and torture.

**B.3. Effects of Terrorism on Agriculture and Food Security (CONSEQUENCES)**

An important starting point for examining the costs and consequences of terrorism on food security is to understand the root causes of terrorism (see Section B1) and the motivations and targeting behavior of terrorists (see Section B2). The diversity of the activities and tactics
that the Boko Haram, coupled with existing literature on costs, consequences, motivation and targeting behavior, provides a rich context for exploring a wide range of damages and losses possible from terrorist activities.

Studies on the economic consequences of terrorism tend to support the argument that terrorism generates adverse economic impacts and hinders economic development (e.g., see Neumayer, 2004; Frey et al, 2009; Abadi and Gardeazabal, 2008; Gassebner et al., 2008: Barth et al, 2006; Gaibulloev and Sandler, 2008; and Sandler and Enders, 2008). Specifically, terrorism has been linked to damages to homes, businesses and infrastructure; reduced investments, adverse impacts on tourism; reductions in the flow of goods and capital; and reductions in quality of life, government instability, increased government spending on defense and national security, slowdown in financial markets, negative impacts on supply chains and human productivity losses. These general impacts are expected to also affect agriculture and food security, especially when terrorist activities occur in agricultural and food production areas.

With respect to financial systems, regions that terrorists took hold of were often rural and somewhat isolated to begin with. Terrorist activities further disconnect the people of these regions from the financial system. The results include limited formal support for commerce, few operational banks, limited access to cash and few safe money storage facilities. A barter economy can emerge, making the reestablishment of a financial system even more difficult.

The communication impacts are complex. On the one hand, terrorists can destroy cellular towers, making telecom communications and data connectivity impossible. On the other hand, they can make access to cellular tower management extremely difficult. Finally, even when cellular communications are functional, governments often intentionally disrupt or cut them off in efforts to deny strategic communication to terrorists. By extension, everything that relies on communications technology (information movement, communication and financial action) is impaired. This includes electronic banking and information tools for farmers and food companies.

With respect to industry and manufacturing, companies rely on connectivity to suppliers and distributors, and access to logistics, to function. Therefore, businesses can be grounded to a halt when they are disconnected. Supply and distribution chains, as well as logistics, can be disrupted or completely halted. The labor market can dry up, and so can talent be displaced to
find other opportunities. This creates a long term recovery problem. For those that try to weather the storm, a massive security overhead exists. Private armies and secured stockpiles are often needed to support logistics. This means that only extremely profitable ventures can operate. One can expect the industrial support base of the agricultural and food system to be seriously compromised in areas facing insurgency.

With respect to education, the damage has been devastating in the case of Northeast Nigeria. Education systems are often seen as the expression of interests opposed to terrorist movements as is the case in Nigeria with Boko Haram. School infrastructure has been deliberately targeted and students and teachers have been captured frequently. Indirect impacts could include the migration of talent, isolation from national assistance programs and mass migration of the student body. In Nigeria for example, arrangements were made to transfer hundreds of students to schools in other parts of the country, but this only affected less than 1% of students displaced from school. In the longer term, this loss of connectivity and economic activity creates high unemployment. Once can again expect an indirect effect on agricultural and food system.

The health system is expected to face challenges similar to the educational system. When health infrastructure is destroyed, medical talent migrates to more prosperous areas. For talented medical professionals that stay, security is compromised and there is a lack of access to national assistance programs. Patients are dispersed and economies of scale are reduced or become non-existent. The health system is also subject to other impacts, including disrupted supply chains, and cold chains for medicinal storage and limitations to patient movement. Problems that are typically manageable can become acute, as health care is deferred due to risk of movement and lack of affordability. Farmers’ health is critical to their ability to contribute to food security. Hence, damage to the healthcare system has implications for food security.

Utilities are similar to telecommunications. They are subjected to a series of impacts, which in turn may lead to disruptions in other sectors that depend on electricity, water, sanitary services, etc. Specifically, utilities are vulnerable to disruptions in supply, maintenance, logistics, revenue collection and new installations. Huge security investments are often needed to regenerate utility-related services. In the longer term, infrastructure development is halted, slowing down re-development for years. The fact that transmission and distribution companies
can lose their profit base in insurgent areas leads to industry decline. Isolation of the insurgent area from national and regional infrastructure prevents synergies and effective management.

As a luxury good, the threat of terrorism stops the tourism cold turkey. Given the difficulty in restoring national and global perception, the time lag to recovery can be very long. International trade faces similar challenges in that the revenue generating capacity is lost, leading to a long recovery period. One of the few international trade activities that can flourish is illicit trade in such areas as narcotics, weapons, endangered species and precious gems and metals. Once these activities take hold, they can aid the financing of insurgency. They are also very hard to eradicate after the insurgency.

Bad governance is often a root cause of terrorist activity and insurgency. Therefore, it is often specifically targeted by terrorists. Some of the impacts include financial strain on political leadership, the fleeing of political leadership and the disconnection of public services. As government cannot reach its people, communication and feedback loops are broken with the people. Often, a bunker mentality develops that can give rise to summary judgement, human rights abuses and the choice of security over democracy and civil rights. Accountability of officials is also hampered as participatory processes stop. The rule of law subsequently suffers and government legitimacy can be further called into question. Obviously, agriculture and food security are impacted by this.

*Agricultural and Food System Impacts*

Many terrorist groups locate their bases in rural areas where people can easily be radicalized and indoctrinated. Terrorist groups that have the desire to capture territories often select their base locations based on the capacity to capture, defend, hold and expand such territory. Urban areas are more difficult to capture and hold, compared with rural areas. In the case of Boko Haram in Nigeria, they launched numerous attacks in and around the city of Maiduguri. While they made some areas of the city unsafe, and in some cases often had overwhelming influence, the city was never fully captured. On the other hand, at the height of the insurgency, twenty four (24) of the twenty-seven (27) local government areas of Borno State were either fully or partially occupied by Boko Haram. These were mostly in rural areas where agriculture was the mainstay.
Generally, agricultural areas tend to feature food availability, unemployed and less educated youth, less governed spaces, less resistance from security agencies and the military, and other factors critical to terrorist recruitment success. This puts agriculture and food security in the path of terrorism. With respect to food, non-perishable agricultural plant products such as cassava, millet, rice and soybeans may be particularly attractive to terrorist groups as they can be easily stored or transported to their home bases without spoilage. Small animal livestock such as chickens, turkeys, pigeons and small goats will probably also be more desirable than cows if the plan is to transport these back to their bases. Anecdotal information and observations from the Boko Haram situation suggests that terrorists target rural communities, not just urban areas, but for different reasons. I hypothesize that they target more urban and built places when their objective is to do (killing, maiming, visibility, etc). However, they target rural areas more when the objective is to support their capacity building and survival motives.

Figure 3 below, which shows the distribution of IDPs from the Northeast from the Boko Haram insurgency, shows a movement away from rural areas to more urban areas where government security and support facilities are more prominent. This supports the hypotheses that terrorists target agricultural areas. This pattern of population shift also puts pressures on host communities and on IDP camps while leaving many rural areas largely abandoned. Among the impacts on host communities are stressed infrastructure, law and order challenges, security problems, greater poverty, stresses on the police, stresses on the food supply system, stresses on schools and conflicts between new entrants and long-term residents. One of the prominent food security impacts of this pattern of migration is high food prices, which have been documented by Awodola and Oboshi (2015) in the case of Maiduguri.

Another expected impact results from the disconnection of people from their home communities, lands, existence, homes, market infrastructure, schools, livelihoods and jobs. With the large number of IDPs and international refugees resulting from insurgencies, the humanitarian challenges tends to be amplified when terrorists attack agricultural area. The costs to governments at all levels are significantly high as the food bills of many people must now be picked up via public funds from governments, humanitarian agencies and donor agencies. While these food security challenges have been highly visible, they have not been an important part of
investigations into the costs and effects of terrorism. Clearly, based on the above, it is important to gain better understanding of the vulnerability of agriculture and the food system to terrorist attacks and the impacts of such attacks on agriculture.

Figure 3: Internally Displaced Persons (IDPs) from Boko Haram

In conclusion, when terrorists attack rural areas, one should expect a series of negative impacts, ranging from direct disruption, decimation of input markets, dismantling of product markets, disruptions to the flow of goods, human dislocations, loss of political representation, and the loss of land. Hypothesized effects of terrorism on agriculture, the food system, and therefore, food security are summarized below, with the nature of the effects also shown.
I specifically highlight the talent related effects of terrorism. Protracted terrorism represents a loss of agricultural production and market talent, making the recovery very difficult. This is because migrants take with them their talent, connection to the land, agronomic knowledge and know how. This simultaneously creates a “ground zero” effect whereby rebuilding the system would require simultaneously addressing a complex set of problems, starting almost from scratch. Water, seed, knowledge and markets systems all need to be addressed simultaneously. This requires a large infusion of budgetary and talent resources. Even with adequate resources, coordination becomes a central problem as the entire system loses
communication, feedback and signaling capacity. In short the breakdown of the Agri-food system is confounded by a deluge of catch 22’s and comprehensive efforts are needed to recover. In the past, significant development investments were made in agricultural areas in order to reduce poverty, improve productivity and boost rural economic growth. Therefore, attacks on agricultural areas have the tendency to compromise or obliterate past investment activities thereby offering significant disruptive value to terrorists.

A better understanding of the consequences can help accentuate progressive abatement and prevention programs. However, such programs and strategies need to be tested for effectiveness. Deeply understanding the economic consequences is foundational to developing a cost benefit analysis for recovery and abatement and the strategies of optimal response scaling can be developed. It also paves the way for developing a “cocktail of responses” that comprehensively address the issues, rather than piecemeal strategies that cannot address the problem holistically. The Matrix in Figure 3 summarizes the impacts of terrorism by sector. It shows that most sectors should be expected to be adversely affected, depending on the seriousness of the insurgency at hand.

Table 3: Matrix of Hypothesized influence of Terrorism on Various Sectors

<table>
<thead>
<tr>
<th>Impacts</th>
<th>Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Agri-food</td>
</tr>
<tr>
<td>Infrastructure Destruction</td>
<td>X</td>
</tr>
<tr>
<td>Supply Chain Disruption</td>
<td>X</td>
</tr>
<tr>
<td>Labor Migration</td>
<td>X</td>
</tr>
<tr>
<td>Talent Migration</td>
<td>X</td>
</tr>
<tr>
<td>Maintenance and Loss of know how</td>
<td>X</td>
</tr>
<tr>
<td>Logistics Interruption</td>
<td>X</td>
</tr>
<tr>
<td>Market Disruption</td>
<td>X</td>
</tr>
<tr>
<td>Operational Shutdown</td>
<td>X</td>
</tr>
<tr>
<td>Added Security Cost</td>
<td>X</td>
</tr>
<tr>
<td>Co-option</td>
<td>X</td>
</tr>
<tr>
<td>Isolation</td>
<td>X</td>
</tr>
</tbody>
</table>
C. Theoretical Framework for Agricultural Attacks

To explore the feasibility of modeling the three dimensions of the food/national security nexus, the target choice of terrorists (see section B.2 above) is chosen for further development in this section. The author is currently working on all three dimensions. An appropriate starting point is the objective function of the group. As argued earlier, terrorists seek to inflict damage and raise fear amongst the populace. As shown in Table 1, such damage include human, infrastructure, capacity and food security impacts. Therefore, it is assumed that a terrorist group maximizes its utility by optimally choosing between specific locations to attack. Each location provides impact possibilities (opportunities to inflict human, infrastructure and food security damages such as death, injury, destruction of property, disruption of economic activity, secession of agriculture and the displacement of people).

The human, infrastructural, agricultural and capacity building attributes or features of alternative places make them attractive or unattractive (e.g. concentration of people, key destination points, concentration of critical assets, access to crops and livestock). However, the terrorist group also has the objective of building its own capacity when it attacks or raids places. Such capacity building comes through kidnapping or collateral recruitments, acquisition of stolen weapons and other combat equipment, stolen foods, stolen farm equipment, stolen seeds and other inputs and the targeting of attacks in such ways as they deter retaliatory action from security agencies. However, a terrorist group must also consider the costs associated with each target (distance, accessibility, penetration possibility, military presence, etc.)

The motivations and strategies of a terrorist group can be analyzed as follows. A terrorist group located in place J chooses places to attack (targets) based on the human/people ($Z_1$), infrastructure ($Z_2$), Agro-Food ($Z_3$), and capacity building endowments of such places ($E\mu$). The target choice is constrained by their capacity, which invariable derives from their income ($Y$). Utility from $Z_1$, $Z_2$ and $Z_3$ depend on the accessibility of the terrorist group to the endowments of the places they wish to attack (i.e., the accessibility factor for human-related endowments ($\gamma$), for infrastructure ($\alpha$), for agro-food-related endowments ($\phi$), and for capacity building (e.g. recruitment) opportunities ($w$). $\phi$ itself is influenced by $Z_1$, $Z_2$ and $Z_3$ because place attributes, which vary with the type of place attacked, also affect the types of people in the place. For
example, it seems plausible that quality urban places are likely to attract more informed and knowledgeable people who are difficult to recruit by terrorists while less endowed places are more likely to offer better recruitment opportunities. In essence, the accessibility parameter for capacity building, \( w \), reflects the fact that places have varying people recruitment, weapon capture and food capture and other resource building capacities.

Terrorists chose either to stay at their base location (J) and not attack any place, or attack other potential locations (i), depending on the relative benefits of attacking these other places (i), vis-à-vis staying within their domain (J). Let Q be all the general goods and services consumed by terrorists (a numeraire). Let \( Z_{1i} - Z_{1j} \) be the difference in people related endowment between location \( J \) and all other potential locations, \( i = 1, \ldots, J-1 \). Let \( Z_{2i} - Z_{2j} \) be the difference in infrastructure related endowments between location \( J \) and all other potential locations. Let \( Z_{3i} - Z_{3j} \) be the difference in agri-food related endowments between location \( J \) and all other potential locations. Let \( P_{z1} \) be the potential cost of attacking place endowments \( Z_1 \) and \( P_{z2} - P_{z1} \) be the difference in accessibility price of attacking people-related assets in location \( i \) rather than continue their operations at the home base \( J \). Let \( P_{z2} \) be the potential cost of attacking place infrastructure endowments \( Z_2 \) and \( P_{z2} - P_{z1} \) be the difference in accessibility price of attacking infrastructure-related assets in location \( i \) rather than continue their operations at the home base \( J \). Let \( P_{z3} \) be the potential cost of attacking place agri-food endowments \( Z_3 \) and \( P_{z3} - P_{z1} \) be the difference in accessibility price of attacking agro-food-related assets in location \( i \) rather than continue their operations at the home base \( J \). Let the difference in the potential capacity building benefits of an attack is between locations \( i \) and \( J \) be \( (E_i(\mu) - E_j(\mu)) \) while the differential cost of capacity building (attracting resources, weapons and people) between locations \( i \) and \( J \) be \( w_i(Z_1, Z_2, Z_3, E_{\mu_i}) - w_j(Z_1, Z_2, Z_3, E_{\mu_j}) \). Let \( Y_J \) be terrorist group disposable income (including current earnings). Recall that \( \gamma, \alpha, \phi, \) and \( w \) are accessibility parameters (0 = no access, 1 = open access).

Let

\[
\begin{align*}
\tilde{Z}_1 &= \gamma_i Z_{1i} - \gamma_j Z_{1j}; \\
\tilde{Z}_2 &= \alpha_i Z_{2i} - \alpha_j Z_{2j}; \\
\tilde{Z}_3 &= \alpha_i Z_{3i} - \alpha_j Z_{3j}; \\
\tilde{P}_{Z_1} &= P_{z1} - P_{zj}; \\
\tilde{P}_{Z_2} &= P_{z2} - P_{zj}; \\
\tilde{P}_{Z_3} &= P_{z3} - P_{zj}; \\
\tilde{E} &= (E_i(\mu) - E_j(\mu)); \\
\tilde{w} &= w_i - w_j
\end{align*}
\]

Then, the objective function of the terrorist group can be specified as:
\[ \text{Max } U[Q, Y_j - \tilde{w} - \tilde{P}_{Z_1} \tilde{Z}_{1i} - \tilde{P}_{Z_2} \tilde{Z}_{2i} - \tilde{P}_{Z_3} \tilde{Z}_{3i}, \tilde{Z}_{1i}, \tilde{Z}_{2i}, \tilde{Z}_{3i}, E_{\mu}] \]  

Terrorists maximize utility by optimally considering \( \tilde{Z}_{1i}, \tilde{Z}_{2i}, \tilde{Z}_{3i} \) and \( E_{\mu} \) across locations. The conditions for optimization are:

\[
\begin{align*}
U_{\tilde{Z}_1} + U_{\tilde{w}} E_{\mu \tilde{Z}_1} &= \tilde{P}_{Z_1} + [U_{\tilde{w}} \tilde{w}_{\mu \tilde{Z}_1} + U_{\tilde{w}} \tilde{w}_{\tilde{Z}_1}] \\
U_{\tilde{Z}_2} + U_{\tilde{w}} E_{\mu \tilde{Z}_2} &= \tilde{P}_{Z_2} + [U_{\tilde{w}} \tilde{w}_{\mu \tilde{Z}_2} + U_{\tilde{w}} \tilde{w}_{\tilde{Z}_2}] \\
U_{\tilde{Z}_3} + U_{\tilde{w}} E_{\mu \tilde{Z}_3} &= \tilde{P}_{Z_3} + [U_{\tilde{w}} \tilde{w}_{\mu \tilde{Z}_3} + U_{\tilde{w}} \tilde{w}_{\tilde{Z}_3}] \\
U_{\tilde{w}} \tilde{w}_{\mu \tilde{Z}} &= U_{\tilde{w}} \tilde{E}_{\mu}.
\end{align*}
\]

The relationships in Equations (2), (3), (4) and (5) characterize a spatial equilibrium. That is, optimal target choice would occur when the marginal change in utility from killing, maiming and hurting people and building capacity through raids between their base location and other potential locations equal the marginal cost share differentials and net resource development cost of terrorist raids (from Equation (2)). The same applies to infrastructure damage and agricultural damage (from Equations (3 and 4)). Furthermore, the marginal utility from differential capacity building activities must equal the recruitment cost differential (from Equation (5)). These conditions define the decision to attack or not, and to which location(s) to attack.

The choice of target by the terrorist group, given \( \tilde{Z}_{1i}, \tilde{Z}_{2i}, \tilde{Z}_{3i} \) and \( E_{\mu} \) are, however, controlled by accessibility. With respect to access to endowments, the optimal target choice for human attacks, given degree of accessibility is:

\[
(1 - \tilde{P}_{Z_1})[U_{\tilde{Z}_1} \tilde{Z}_{1'}] = U_{\tilde{w}} \tilde{w}_{\tilde{Z}_1} \tilde{Z}_{1'}.
\]

The optimality condition in Equation (6) suggests that ease of attacking people can enhance utility if \( \partial U / \partial \tilde{Z}_1 > 0 \), and that at equilibrium, the utility enhancing effect of such ease is equal to the downward resource access cost effects.

It is important to note that the marginal utility of access to human endowments of places is weighted by \( (1 - \tilde{P}_{Z_1}) \). As \( \tilde{P}_{Z_1} \) increases (i.e., the attack cost differential), the utility associated with attacking people assets declines. When \( \tilde{P}_{Z_1} \) equals 0, there is no human capital cost advantage and the community attacked provides the same resource acquisition cost on \( \tilde{Z}_1 \) as
the terrorist base community. In this case, the utility associated with enhanced access to human damage increases. Furthermore, as $\tilde{P}_{Z_1}$ becomes negative (i.e., the community target choice provides lower capacity building cost share on $\tilde{Z}_1$ than the base community), the utility associated with access to human damage substantially increases.

The weighting factor $(1-\tilde{P}_{Z_1})$ can play a crucial role, given access to location endowments. From Equation (6), let $U_{w}^{*} \tilde{w}_{Z_1} \tilde{Z}_{1y} = A$, and $U_{Z_1} \tilde{Z}_{1y} = B$. Then, given access to place endowments, it follows that:

$$
\begin{align*}
A &= (1-\tilde{P}_{Z_1})B & \Rightarrow & \quad \text{Optimal target choice given } \gamma \\
\text{If } \tilde{P}_{Z_1} \in (0,1) \text{ and } \tilde{P}_{Z_1} \uparrow & \Rightarrow A > (1-\tilde{P}_{Z_1})B & \Rightarrow & \quad \text{Targ et J becomes attractive given } \gamma \\
\text{If } \tilde{P}_{Z_1} = 0 & \Rightarrow A = B & \Rightarrow & \quad \text{Targ et choice \ldots indifference} \\
\text{If } \tilde{P}_{Z_1} < 0 & \Rightarrow A < (1-\tilde{P}_{Z_1})B & \Rightarrow & \quad \text{Targ et J becomes much less attractive given } \gamma 
\end{align*}
$$

(7)

The effect of access to infrastructure assets can similarly be shown by differentiating the terrorist group’s utility function with respect to this access. It then follows that:

$$(1-\tilde{P}_{Z_2})[U_{Z_2} \tilde{Z}_{2\alpha}] = U_{w}^{*} \tilde{w}_{Z_2} \tilde{Z}_{2\alpha}.$$  

(8)

Let $U_{w}^{*} \tilde{w}_{Z_2} \tilde{Z}_{2\alpha} = A$, and $U_{Z_2} \tilde{Z}_{2\alpha} = B$. Then, it follows that:

$$
\begin{align*}
A &= (1-\tilde{P}_{Z_2})B & \Rightarrow & \quad \text{Optimal target choice given } \alpha \\
\text{If } \tilde{P}_{Z_2} \in (0,1) \text{ and } \tilde{P}_{Z_2} \uparrow & \Rightarrow A > (1-\tilde{P}_{Z_2})B & \Rightarrow & \quad \text{Targ et J becomes attractive given } \alpha \\
\text{If } \tilde{P}_{Z_2} = 0 & \Rightarrow A = B & \Rightarrow & \quad \text{Targ et indifference.} \\
\text{If } \tilde{P}_{Z_2} < 0 & \Rightarrow A << (1-\tilde{P}_{Z_2})B & \Rightarrow & \quad \text{Targ et J becomes much less attractive given } \alpha 
\end{align*}
$$

(9)

Finally, let $U_{w}^{*} \tilde{w}_{Z_3} \tilde{Z}_{3\alpha} = A$, and $U_{Z_3} \tilde{Z}_{3\alpha} = B$. Then, it follows that:

$$
\begin{align*}
A &= (1-\tilde{P}_{Z_3})B & \Rightarrow & \quad \text{Optimal target choice given } \phi \\
\text{If } \tilde{P}_{Z_3} \in (0,1) \text{ and } \tilde{P}_{Z_3} \uparrow & \Rightarrow A > (1-\tilde{P}_{Z_3})B & \Rightarrow & \quad \text{Targ et J becomes attractive given } \phi \\
\text{If } \tilde{P}_{Z_3} = 0 & \Rightarrow A = B & \Rightarrow & \quad \text{Targ et indifference.} \\
\text{If } \tilde{P}_{Z_3} < 0 & \Rightarrow A << (1-\tilde{P}_{Z_3})B & \Rightarrow & \quad \text{Targ et J becomes much less attractive given } \phi 
\end{align*}
$$

(10)

In this framework, though the target preference and, hence, attacks of different types could be different in lethality, I only provide a basic framework for the evaluation of roles of place
desirability and damage opportunities on attack probability. Various types of attack–related differences are discussed elaborately in the empirical section.

**D. Empirical Framework for Agricultural Attacks**

Several hypotheses emerge from the theoretical framework presented in equations (1) through (10). The framework suggests that attack related measures (e.g. probability of attacking a place, frequency of attacking a place and the lethality of attacks) are functions of place related attributes (people, infrastructure, food security and capacity building attributes). The more endowed a place is, the more motivated the terrorist group is to attack the place, ceteris paribus. The independent variables therefore should include these measures of place attributes.

Proposed independent variables include the people, infrastructure, food security and capacity building attributes of interest to terrorists. For example, terrorists are expected to prefer highly crowded, globally visible places if their objective is to do huge and visible damage. Therefore, variables capturing such things as population density, road density, infrastructure density, scope of the built environment, destination points, gross domestic product and income would be expected to be positively related to attack-type variables.

Terrorists are also known to target those things they are opposed to. For example, with Boko Haram, there is a fascination with blowing up schools and churches and targeting areas where the highly educated reside because of their disdain for modern education. One would expect a positive relationship between variables capturing the things they abhor and their attacks. But Boko Harm also has to survive. To do so, they have attacked rural areas, presumably to gain access to food to replenish their stock or to attack the agricultural capacity of places to render them non-productive. That is, if Boko Haram needs to replenish its food supply, it would attack a rural area and cart away as much food as it could. This would probably be in an area outside its domain. But if its objective in the attack is to increase the volume of hungry unemployed people that can easily be radicalized, it would seek to destroy the place’s agricultural capacity by mining the fields, destroying tractors, killing farmers and destroying markets. This would probably also be in an area outside its domain. If Boko Haram seeks to expand its base of productive places under its governance, it would capture the place, not destroy the capacity to produce and put locals to work producing for them. This will probably close to its home base.
Another broader area to explore is the likelihood that different attacks have different motivations. Based on the patterns of Boko Haram attacks, which has been to attack both cities and rural areas, it is useful to test this hypothesis. If the motivations differ by attacked places, then it would make sense to separate the data for urban and rural places and model the relationships separately, but test for structural differences.

The constraint on the activities of terrorists, which forces them to choose between locations, is essentially their income. But income translates directly into such factors as travel distance and cost in the case of terrorism. The distance to the base of Boko Haram is clearly a key constraint. Not only does it translate into travel and logistics cost, it also translates into degree of difficulty in combat operations. The longer Boko Haram has to travel, the more likely they will be intercepted by the military. Therefore, distance is a key variable in this analysis. To test the hypothesis that terrorists target specific types of agricultural commodities, it would be appropriate to include the agricultural production levels of places in the regression specification. The coefficients will show whether terrorists directly target some areas producing specific crop and animal products.

The empirical framework for the evaluation of target richness and accessibility derives from the theoretical framework above. The dependent variables of interest to the author are (a) a binary choice variable (ATTACK) measuring whether a location has ever been attacked by Boko Haram (Model 1), (b) a count variable (ATTACKS) indicating the number of times the area has been attacked, and (c) a count variable (FATALITES) indicating the number of fatalities.

The first category of independent variables are measures of human damage potential that are related to the motivation for human attacks. Potential proxies for this category include measures of population, income, economic activity, employment, education, literacy and gender.

The second category of independent variables are measures of infrastructure damage potential. Potential proxies for this category include measure such as road density, road miles, urbanization, electricity access, sanitation access and water access, amongst others.

The third category of independent variables are measures of agricultural/food damage and capture potential. Potential proxies for this category include measure such as inventory of
animal production, volume of crop production, agricultural human capital and the dominant landscape (agriculture, built environment, water and pasture).

Finally, the fourth category of independent variables are measures of resource capacity development through attacks. Potential proxies for this category include such measures as distance from each attack location to the centroid of the Sambisa Forest (heartland of Boko Haram) and distances from Yola, Maiduguri and Damaturu – the key cities in the Northeast of Nigeria. Some of the variables in a given category may also apply to another category. For example, a terrorist group might target a place for the ability to do major damage in the form of fatalities, but may also eye it for the recruitment of poor youth and the kidnapping of doctors, young girls and highly skilled professionals. Details about the data sources and treatment are provided below.

**D.1. Management of Data**

Recall that the objective of this analysis is to evaluate the relationship between attacks and other factors that describe the characteristics of where such attacks took place. Of particular interest are the location characteristics that explain target choice, including agricultural, infrastructure, socio-economic, demographic, health and other attributes. For example, we wish to ask a fundamental question. “Do the agricultural characteristics of a place affect the choice of the place as a target for a terrorist attack?

The Armed Conflict Location and Event Data (ACLED) Project, directed by Clionadh Raleigh (2016), provides data on armed conflict events in Africa, by location and for the years 1997 to 2015 (Version 6). The data included terrorist events, including Boko Haram attacks. Variables in this database include an event code, country code, year code, time code, perpetrator code, a code identifying those attacked, interaction type, the number of fatalities, latitude, longitude, and measures of confidence about location and time precision. Because such data is geo-coded, it could easily be integrated with contextual data available at scales ranging from point and line upwards through local government area (LGA) and state levels. Therefore, a rich context could be constructed for each place where an event has taken place. In this analysis, only Boko Haram related elements of the database were utilized. Given the objective, there was a need to relate
the ACLED database to other existing contextual data that provide information on place characteristics.

The Agricultural Census of the Nigeria Federal Ministry of Agriculture and Rural Development (FMARD) provides data on agricultural production variables at the regional, state and LGA levels. This includes data on farm products and inputs. However, the Food and Agriculture Organization of the United Nations (FAO) provides agricultural production data at the 25 square kilometer grid level. On the other hand, the Agricultural Census provided by the Federal Ministry of Agriculture and Rural Development (FMARD) provides similar data, but at the state level. With respect to socio-economic data, information on income, farm employment, farm income exists on the LGA level while information on unemployment, farm ownership, and poverty exists at the state level. With respect to health data, information on such things as HIV incidence, Incidence of typhoid, incidence of malaria, malaria deaths, malaria survivors, male deaths, female deaths and births are provided by the Nigeria Federal Ministry of Health (NFMH), but only at the state level. With respect to education data, schools by type and the number of students is available as point data. However, information on primary, secondary and university enrollment exists at the LGA level while information on graduation rates, literacy and type of training exists at the state level. Information on the locations of schools (primary, secondary and universities) are provided at the point level. With respect to infrastructure, data exists as polylines. This includes roads by type, electricity infrastructure and gas and oil pipelines. As additional proxies for infrastructure presence, access to improved water supplies, improved sanitation, phones, computers and Internet are available at the state level (see Table 4 for a general description of the sources and nature of the data).

An innovative framework was developed to connect and overlay all of this data, such that the terrorism attack data, the agricultural production data, the infrastructure data and the socioeconomic and demographic information could be built into the same data file. Therefore, a mechanism was developed whereby the whole nation of Nigeria was divided into 25 square kilometer grids (5 Kilometers x 5 kilometers), matching the FAO grid structure, thereby enabling two levels with respect to units of analysis.
One level of analysis involves these 25 square kilometer grids cells whereby all information associated with each cell would represent a unit of analysis. There were 1197 grid cells developed for the nation, 910 of which were in the North, and 587 of which were in the Northeast. This allows significant degrees of freedom in any econometric modeling analysis. Therefore for each grid cell, we could model the relationship between the events within the grid and the place characteristics of the grid. Boko Haram attacks were highly concentrated in the three (3) states of Borno, Adamawa and Yobe (Bay States). However, they also attacked other Northeast states (Bay states plus Bauchi, Gombe and Taraba). Beyond the Northeast, Boko Haram also attacked other areas of the North (e.g., Kaduna, Kano and Jos), as well as other parts of the country such as Abuja. Only 585 observations could be attributed to Northeast Nigeria. These 910 observations (80%) from the North and the 587 from the Northeast were used in subsequent analysis.

The second level of analysis possible is at the event level. In this case, all socio-economic, demographic, agricultural, infrastructure, education, health and other data associated with a grid cell become associated with events that occur within the cell. There was a total of 1047 events. Therefore for each event, it is possible to model the relationship between the event and the place characteristics of the event. It is important to note that there are only 145 grid cells in which Boko Haram events occurred, but in some cells, multiple events occurred. For this pilot analysis, data occurring at larger special units than the sampling unit were spatially joined to the sampling grid without adjustment in magnitude or variation. Thus the values for a state are repeated for any variable in each cell that is within or intersects that state. The same applies to data available at the LGA levels. Conversely, all data available as continuous or count variables such as grids, lines and points, were intersected with the analysis grid and up sampled to the grid geography. Hence, some data is devolved from larger geographies and some data is amplified from smaller geographies. This particular paper does not involve analysis at this scale.

There are obviously limitations associated with this approach, whether the analysis is at the grid or event level. The primary one is while several of the variables are available at the grid level, many of our variables only exist at the LGA or state levels. We therefore expect some degree of heteroschedasticity with our analysis, which can be tested and corrected for. The
author is currently working on further treatment of the data to allow for more precision in order to reduce measurement errors.

**D.2. Model Estimation**

The data on the dependent variables were available at the grid level. In Model 1, ATTACK (ATTACK=1 if attacked, 0 otherwise) was regressed against hypothesized causal factors via a logit model. The dependent variables in Models 2 and 3 are count data. King (2008) showed that the use of Ordinary Least Squares (OLS) or other linear estimation methods to estimate models where the dependent variable is count data leads to misspecification, inefficiency, bias, inconsistency, insufficiency and other problems. The Exponential Poisson Regression (EPR) technique is therefore the appropriate estimation technique for Models 2 and 3.

The decision to focus the analysis on data from all Northern States, not just the Northeast, is based primarily on knowledge of the history and nature of Boko Haram attacks. Figure 1 suggests that highest number of attacks took place in Borno State, the epicenter of the Boko Haram influence; and that the attacks in the Borno, Adamawa and Yobe (BAY) states of the Northeast far exceeded those in Bauchi, Gombe and Taraba combined. Further, beyond the Northeast, going toward the North West and North Central, one observes far less attacks. Kano and Kaduna (North West) and Jos (North Central) are examples of places beyond the Northeast that Boko Haram also attack. Even Abuja (Federal Capital Territory – FCT). For this reason, rather than restrict the analysis to only the Northeast, it was applied to the entire North, including the Northeast, North West, North Central and the Federal Capital Territory –FCT). All in all, the region of analysis included 19 out Nigeria’s 36 States, as well as the FCT.

With respect actual independent variable used, various measure were included as either direct indicators or proxies for the human damage motive of terrorists, for the infrastructure damage motives, for the food security motives and the capacity building motives. To capture the human damage effect, the following variables were included: (a) population (popula), which was measured at the State level; (b) average incomes of Heads of Households and their spouses (income), which was measured at the LGA level; (c) total number of unemployed (unemployed), which was measured at the State level; (d) an optimism variable measuring the percentage of
people in 2010 who felt that things were worse off for them over the past 10 years (worse off); and (e) the level of basic education which was proxied by the percentage of people that have completed primary education (edat_prima), measured at the State level.

The list of variables considered in the modeling exercise is provided in Table 4. With respect to the infrastructure damage motivation of terrorists, the following were included: (a) growth density within the grid (road-density); (b) road length in the grid (road-length); (c) the percentage of people with adequate modern sanitation, which was measured at the Local Government level (sanitation); and (d) the percentage of households with electricity in their homes (electric), which was measured at the Local Government Area (LGA) level. To capture the capacity building and food security objectives of Boko Haram, the variable (ag) was included. This variable was generated based on the dominant land use in a given grid cell. If an area is more than 50% agricultural land, the variable ag=1, otherwise ag=0. Similarly, three other variables were generated: built=1 if a grid had more than 50% of it in a built (urban) environment, otherwise built=0; water=1 if a grid had more than 50% water, otherwise water=0; pasture=1 if a grid had more than 50% pasture, otherwise pasture=0.

Two distance measures available at the grid cell level as proxies for the cost of attacking far locations: (a) distance from centroid of the Sambisa Forest where Boko Haram is headquartered to the centroid of the grid cell in question (sambisa_disc) and (b) distance from the center of Yola to the centroid of the grid cell in question (yola_dist). These were chosen based on knowledge of Boko Haram networks. Boko Haram’s heartland is somewhat nestled between Yola and Maiduguri, but the road connectivity to the bulk of the region is through Maiduguri. Maiduguri is on the western portion of northern Borno while Yola is in the northern parts of Adamawa State. So, if both yola_dist and distance from Maiduguri are both used as proxies, the results would be hard to interpret since many attacks happened beyond Maiduguri, going west.

Module 1, 2 and 3 were repeated but, this time, expanding further on the ag variable. In Modules 4, 5, and 6, as substitutes for ag, twelve (12) measures of agricultural crop production and six (6) measures of animal production were included as independent variables. The crop variables included hectares planted in 2009 of the following: soy beans (soybeans), cassava
(cassava), maize (maize), yam (yam), rice (rice), cotton (cotton), ground nuts (groundnuts), millet (millet), water melon (melon), and kola nuts (kolanuts). The livestock inventory variables included were 2009 animal count information for cattle (cattle), goat (goat), sheep (sheep), chicken (chicken), turkey (turkey), and pigeons (pigeons). The standing hypothesis are as follows:

a. Boko Haram is attracted to places producing high volumes of crop and animal products that are easy to gather, easy to transport and non-perishable, and that provide high calories and/or good nutrition.

b. Boko Haram is attracted to places producing high volumes of the same products in (a) above very close to their base so that they can capture those areas and maintain production for their own use.

c. Boko Haram is attracted to placing producing high volumes of the same products in (a) very far away from their base for the purpose of destroying these volumes and creating food insecurity.

For the products that fall within the above referenced list, one would expect the quo-efficient of ATTACK and ATTACKS to be positive but the expectation for the sign of fatalities is not so clear.

The result to be presented in the next section are preliminary results pending more aggressive clean up and construction of the databases used. The results are also somewhat abbreviated for the purpose of brevity. Empirical results are presented in Table 5. The signs of the coefficients that are significant at the 5% level are reported as +ve if positive and -ve if negative (0 if statistically insignificant at the 5% level). For more details on the results, please contact the author.
Table 4: Variables Considered in Alternative Models of Terrorist Attack Choices.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
<th>Source/Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTACKS</td>
<td>Number of terrorist attacks in grid cell</td>
<td>Calculated Point</td>
</tr>
<tr>
<td>ATTACK (DUM)</td>
<td>Whether or not a grid cell was attacked</td>
<td>ACLED grid</td>
</tr>
<tr>
<td>FATALITIES</td>
<td>Total fatalities in grid cell</td>
<td>ACLED grid</td>
</tr>
<tr>
<td>statename</td>
<td>State that cell belongs to</td>
<td>Calculated grid</td>
</tr>
<tr>
<td>bay</td>
<td>Dummy for Borno, Adamawa and Yobe (Bay) States (1= yes, null=no)</td>
<td>Calculated grid</td>
</tr>
<tr>
<td>northeast</td>
<td>Dummy for Northeast (1= yes, null=no)</td>
<td>Calculated grid</td>
</tr>
<tr>
<td>built</td>
<td>50% of the grid cell is considered built environment</td>
<td>Calculated using GIS and aerial imagery</td>
</tr>
<tr>
<td>sambisa_dist</td>
<td>Distance from Grid Centroid to Sambisa Centroid</td>
<td>Calculated grid</td>
</tr>
<tr>
<td>yola_dist</td>
<td>Distance from Grid Centroid to Yola</td>
<td>Calculated grid</td>
</tr>
<tr>
<td>sanitation</td>
<td>Access to improved sanitation (% of population)</td>
<td>Strauss Center SNAID State</td>
</tr>
<tr>
<td>roadlength</td>
<td>Road Length in grid (meters)</td>
<td>NIAF Roads, Calculated Grid</td>
</tr>
<tr>
<td>roaddensity</td>
<td>Road Density in grid (meters of road/sqm of area)</td>
<td>NIAF Roads, Calculated Grid</td>
</tr>
<tr>
<td>electric</td>
<td>Electricity in household (% of households)</td>
<td>Nigeria National Bureau of Statistics LGA</td>
</tr>
<tr>
<td>population</td>
<td>Total Population in 2010</td>
<td>FMARD AG Population State</td>
</tr>
<tr>
<td>income</td>
<td>Household Income_Head &amp; spouse 2010</td>
<td>NIAF, Third Dimension Technologies LGA</td>
</tr>
<tr>
<td>unemployed</td>
<td>Percentage unemployed 2010</td>
<td>Nigeria National Bureau of Statistics State</td>
</tr>
<tr>
<td>edat_primar</td>
<td>No. of People that Attended Primary</td>
<td>Nigeria National Bureau of Statistics State</td>
</tr>
<tr>
<td>worseoff</td>
<td>2010 % people who Perceived Economic Situation as Much Worse in 10 Years</td>
<td>NIAF, Third Dimension Technologies LGA</td>
</tr>
<tr>
<td>ag</td>
<td>Agriculture is 50% or more of land in grid</td>
<td>Calculated using GIS grid</td>
</tr>
<tr>
<td>cattle</td>
<td>Cattle Production 2009 Inventory</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>goat</td>
<td>Goat Production 2009 Inventory</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>sheep</td>
<td>Sheep Production 2009 Inventory</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>chicken</td>
<td>Chicken Production 2009 Inventory</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>turkey</td>
<td>Turkey Production 2009 Inventory</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>pigeon</td>
<td>Pidgeon Production 2009 Inventory</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>cassava</td>
<td>Area Planted of cassava, Ha</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>maize</td>
<td>Area Planted of maize, Ha</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>cotton</td>
<td>Area Planted of cotton, Ha</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>groundnut</td>
<td>Area Planted of Groundnut, Ha</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>millet</td>
<td>Area Planted of Millet, Ha</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>rice</td>
<td>Area Planted of Rice, Ha</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>yam</td>
<td>Area Planted of YamHa</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>melon</td>
<td>Area Planted of Melon, Ha</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>soybeans</td>
<td>Area Planted of Soybean, Ha</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>sugar cane</td>
<td>Area Planted of Cane, Ha</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>cashew</td>
<td>Area Planted of Cashew, Ha</td>
<td>FMARD and FAO State</td>
</tr>
<tr>
<td>kola</td>
<td>Area Planted of Kola, Ha</td>
<td>FMARD and FAO State</td>
</tr>
</tbody>
</table>

E. Empirical Results

The results of Module 1, 2 and 3 are discussed first. The pseudo R-Square for the ATTACK, ATTACKS and fatalities variables were, respectively 0.1649, 0.4649, and 0.3576. the coefficients of roadlength and roaddensity are positive in Module 1, suggesting that Boko Haram is attracted to the built environment, specifically road infrastructure.
Table 5: Empirical Results for Boko Haram Insurgency Attacks in Northern Nigeria

<table>
<thead>
<tr>
<th>Data</th>
<th>TOTAL NORTH</th>
<th>RURAL NORTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variables</td>
<td>ATTACK Dummy</td>
<td>ATTACKS Count</td>
</tr>
<tr>
<td>Pseudo R² or R²</td>
<td>.1649</td>
<td>.4649</td>
</tr>
<tr>
<td>No. of Observat.</td>
<td>910</td>
<td>910</td>
</tr>
<tr>
<td>Indep. Variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ag</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>length_m</td>
<td>+ve</td>
<td>-ve</td>
</tr>
<tr>
<td>density</td>
<td>+ve</td>
<td>+ve</td>
</tr>
<tr>
<td>edat_primar</td>
<td>+ve</td>
<td>+ve</td>
</tr>
<tr>
<td>total-popula</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>income_headspouse</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>sambisa_dist</td>
<td>-ve</td>
<td>-ve</td>
</tr>
<tr>
<td>yola_distance</td>
<td>+ve</td>
<td>+ve</td>
</tr>
<tr>
<td>unemployed</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>muchworseco</td>
<td>+ve</td>
<td>+ve</td>
</tr>
<tr>
<td>isanitatn</td>
<td>-ve</td>
<td>0</td>
</tr>
<tr>
<td>elechh</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>soybean</td>
<td>0</td>
<td>+ve</td>
</tr>
<tr>
<td>cassava</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>maize</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>yam</td>
<td>-ve</td>
<td>0</td>
</tr>
<tr>
<td>rice</td>
<td>+ve</td>
<td>+ve</td>
</tr>
<tr>
<td>cotton</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>round nut</td>
<td>-ve</td>
<td>-ve</td>
</tr>
<tr>
<td>millet</td>
<td>NS</td>
<td>-ve</td>
</tr>
<tr>
<td>melon</td>
<td>+ve</td>
<td>0</td>
</tr>
<tr>
<td>sugar-cane</td>
<td>-ve</td>
<td>-ve</td>
</tr>
<tr>
<td>cashew</td>
<td>-ve</td>
<td>-ve</td>
</tr>
<tr>
<td>Kola nut</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>cattle</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>goat</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>sheep</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>chicken</td>
<td>+ve</td>
<td>+ve</td>
</tr>
<tr>
<td>turkey</td>
<td>+ve</td>
<td>0</td>
</tr>
<tr>
<td>pidgeon</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Constant</td>
<td>-ve</td>
<td>0</td>
</tr>
</tbody>
</table>
This offers an opportunity to destroy connectivity but also supports their ability to access urban areas. The coefficient of edat_prima is also positive, supporting the widely held belief that Boko Haram targets places where people are more educated. Further analysis is being planned to investigate the effect of specific educational assets such as schools, universities, etc. Surprisingly, the coefficients of population and income are not significant, probably because the road infrastructure variables already capture the equivalent of population and income effects. The coefficient of Sambisa_dist is negative as expected suggesting that distance is a primary cost constraint for Boko Haram. Surprisingly the coefficient of unemployed is not significant. However, the coefficient of much worse is positive, suggesting that Boko Haram targets places where people are perceived to be suffering and economically handicapped reside. The coefficient of sanitation is negative, which is surprising given that the variable is an infrastructure proxy. The coefficient electric was found not to be significant.

The signs and coefficients of the ATTACKS variable were very similar to those of the ATTACK variable, except for the negative sign for roadlength, the positive sign of the worseoff variable and the insignificance of the sanitation variable. This essentially suggests that while whether or not a place is attacked is directly related to road length in the area, the frequency of attacks is negatively related. One explanation for this that once a place has been attacked and infrastructure is destroyed it becomes more difficult to penetrate the same area again. The coefficients of the FATALITES equation are also similar, except that more of these were insignificant. Fatalities seem to be positively related only to density and negatively related only to distance from the Sambisa forest. The latter suggests that when Boko Haram kills a large number of people it is usually in far visible places such as Maiduguri, Yola and other cities such as Kano, Kaduna, etcetera.

Now, examine the parameter estimates of Models 4, 5 and 6. Recall that in this model, the ag variable was dropped and replaced with specific production data by commodity. In these equations, the coefficients of both roadlength and roaddensity are not statistically significant, suggesting that for rural attacks, terrorists do not target road infrastructure. Indeed, the roads are needed to carry out their operations. Boko Haram is also not attracted to rural places with good sanitation or better access to electricity. This is consistent with the notion that in rural
areas, infrastructure does not attract Boko Haram. However, the coefficients of educ_prima were all positive, suggesting that Boko Haram is attracted to places where people are more educated perhaps because of the heavier education infrastructure in those areas. The coefficient of total population in the ATTACK model is not statistically significant, perhaps indicating that whether or not a place is attacked is not related to the population of the place. However, the coefficient of population in the ATTACKS and FATALITIES equations were both positive, suggesting that Boko Haram prefers more frequent attacks on highly populated rural areas and those attacks are more deadly. This may be indicative of the effort needed to subdue people in those areas.

Consistent with the signs of the coefficients in Models 1-3, the coefficients of income is not statistically significant in Models 4-6, suggesting that the income of rural residents is not a factor in the target choices of terrorists in rural areas. However, the while the coefficient of distance to Sambisa is positive in the choice of where Boko Haram attacks and how frequently they chose to attack those places, distance does not factor in the lethality of their attacks. That is, they seem to prefer to travel further to gather food, but their lethality when they do that reduces with distance. However, the farther they are from Yola, the less the likelihood and frequency of attacks.

The coefficients of unemployment is negative only for ATTACK, suggesting that they consider rural places with higher unemployment to be more attractive to attack, but the frequency of attack and the fatalities from those attacks are not influenced. The coefficients of worseoff is positive for the probability of ATTACK, suggesting that they consider rural places where the residents are impoverished to be more attractive.

Now, examine the crops that Boko Haram may be interested in. From models 4, 5, and 6, the signs of the coefficients suggest that Boko Haram’s probability of attacking a place is enhanced when they grow rice and melons. Rice can be explained on the basis of its caloric content, but the reason for attraction to water melon is hard to discern. The frequency of attack coefficient and the fatalities coefficient are positive for rice, suggesting that more repeated activity and more struggle when they attack rice producing places. The coefficients for soybeans, yam, cashew nuts and kola nuts were positive in the FATALITIES equation, suggesting that while they do not prefer to attack places producing these products, when they do, the fatalities are
more prominent. These can be explained based on the high values of these products. It appears that farmers in these areas do fight back in an attempt to protect their products or Boko Haram has disdain for them because of their revenue status.

Finally, examine the livestock products that attract Boko Haram. From models 4, 5, and 6, the signs of the coefficients suggest that Boko Haram’s probability of attacking a place is enhanced when they produce chicken and turkey, but not pigeons, cattle, goats and sheep. The coefficients for chickens and turkeys are expected, considering the hypothesis that Boko Haram will prefer animals that are easy to cart away. The coefficients for cattle, goats and sheep can be explained on the same basis because they are bulky. However, it is difficult to explain why they are not attracted to pigeons as these are also birds like turkey and chickens. The coefficients for chickens is positive for the fatalities model, suggesting greater struggle when Boko Haram raids poultry producing areas.

E. Summary and Conclusions

Boko Haram is probably the most lethal terrorist organization today. The broad scope and the diversity of their attacks provides a rich context for exploring the causes, consequences and attack location choice behavior of terrorist organizations, enabling one to explore deeper into the tactics and modalities of terrorists. The food insecurity motives of terrorists is of particular interest since despite strong anecdotal evidence of the connection between food security and terrorism, no empirical evidence previously existed. In this paper, these causes, consequences and attack motivations of terrorists are explored. With respect to motivation and attack probabilities, frequency and lethality in rural areas, a theoretical model is developed and empirically explored. The application of this model to a unique database on Boko Haram and Northeast Nigeria suggests that this terrorist group targets areas with agricultural assets and attributes, hereby establishing a relationship between food insecurity, terrorism and national security.

The results suggest that places producing products that can be easily carted away are more vulnerable to attacks. Specifically, places producing chicken, turkey, rice and melon seem more exposed to attacks, while places producing soybeans, yam, rice, cashew nuts and chicken seem to involve more fatalities. One implication of these findings is that based on the nature of
agriculture in a place, security agencies can better plan for the protection of agricultural assets. One of the possible counter-terrorism strategies is to protect such areas as a deliberate strategy for choking off terrorist groups from their food supply.

This study is just an early stage attempt to investigate the vulnerability of food security to terrorism. More work is needed in this area of inquiry. Such work could strengthen the development of early warning systems and community protection strategies in an environment of terrorism.
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