The Application of Geospatial Intelligence in National Security for Sustainable Development: Resolving the Menace of Illegal Small-scale Mining in Ghana

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Abstract

The industrial and especially illegal small-scale gold mining has resulted in serious environmental degradation in mining communities in Ghana. It continues to threaten human well-being, endangering health, physical security, and social cohesion. Other issues include the ability to meet material needs, rapidly disappearing forests, deteriorating landscapes, polluted waters, and urban sprawl. With the application of spatio-temporal technology in the form of Geo-spatial Intelligence, a framework based on the principles of human security is presented to resolve the menace of illegal small-scale mining. Using the qualitative content analysis approach, the study focuses on the characteristics of language as communication with attention to the content or contextual meaning of text and/or imagery. The use of Geographical Information System (GIS) via Geo-spatial Intelligence (GEOINT) involving a combination of imagery, imagery intelligence, information communication and technology and geo-spatial information underpins the framework in resolving and/or reducing the incidence and menace of small-scale gold mining towards an enhanced national security architecture and the process of sustainable development in Ghana.

Keywords: Environmental degradation, illegal small-scale mining, Geographical Information System, Geo-spatial Intelligence, National security.

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Introduction

As the world population increases, so is the rate of interaction and impact of humankind on its ecosystems and the landscape. A casual glance at the exponential growth of the human population would be startled by the magnitude and change rate of anthropogenic influences on planet earth. The world population took more than 10,000 years to increase from 5 million to 1 billion by 1830, but the time interval to reach the second, third, fourth, fifth, and sixth billion decreased to 100, 30, 15, 13, and 12 years, respectively (Kaufman & Franz, 1996; United Nations, 2004; Wu, 2008a). The increased growth rate of human population has resulted in pressing environmental problems around the world, including biodiversity loss, global climate change, land degradation, water and air pollution, and natural resource depletion (Chen & Wu, 2009). Therefore, the last few decades have witnessed a growing awareness of the need for better understanding of the effects of man`s activities on all facets and/or dimensions of the landscape.

The search for and extraction of mineral resources is one of such activities through which the environment is adversely affected. Humans have always been conspicuous in their ability to alter the surface of the earth for various purposes. Some of the most extreme alterations occur in the extraction of minerals (Mbaya, 2013). It is an established fact that the environment is integrated, and its components are linked by dynamic processes (Roots, 1978). The extraction of minerals in Ghana, especially small-scale illegal mining operations has left undesirable effects on the land surface and other ecosystems. The widespread destruction of rural landscape is caused by the indiscriminate mining of forest regions. Most environmentalist and conservationist have envisaged mining operations as some of the worst devastating and far-reaching consequences to rural environments (Ripley, Redman, & Maxwell, 1978). It has been observed that the very process of small-scale illegal mining defaces the land with great scares and pits, destroys ecosystems and brings on many undesirable side effects including water pollution, disturbance of the hydrologic systems, forest, and farm degradation and more importantly, existential impact in the form of human security threat leading to tension and conflicts undermining

the very foundation of society. The negative and detrimental effects of small-scale illegal mining on the environment at local, regional, and international levels will continue to draw public attention and concern. It is against this background that the study is designed to examine the application of geo-spatial intelligence technology in national security for sustainable development as a framework and system at resolving and/or reducing the menace of illegal small-scale mining in Ghana.

Statement of the Problem

Mining and its related activities have always resulted in changes in the environment. These changes differ from one area to another; since not all services can be maximized simultaneously, every land use decision involves trade-offs, often resulting in competing interests and substantial conflicts about the desired use of land among stakeholders (Rodriguez & Beard, 2006; Turner, Lambin, & Reenberg, 2008). Nevertheless, mining significantly contributes to the economies of most developing economies. In several low and middle-income countries rich in non-fuel mineral resources, mining makes significant contributions to national economic development as measured by the revised Mining Contribution Index (MCI-Wr). Ten countries among the twenty countries where mining contributes most (highest MCI-Wr score) have moved up one or two steps in the World Bank's country classification between 1996 and 2016; African countries have benefitted. Socio-economic development indicators also show signs of progress for African mineral-rich countries (Ericsson & Lof, 2019).

The overall impact of the mining sector was much stronger if there were infrastructure benefits and strong linkages to other industries, especially through domestic procurement. Contrary to the notion that there are no jobs in mining, in this small sample, employment related to the mining sector was very high in countries where linkages were strong, even before the multiplier and fiscal expenditure impacts were accounted for (Mchahon & Moreira, 2014). Cooperation between the public and private sectors seemed essential to increasing such linkages. In addition, mining firms often made substantial contributions to local and regional development, at times due to legal requirements but

often not (Mchahon & Moreira, 2014). The mining sector in Ghana, contributes thirty-seven percent of export revenues and nineteen percent of all direct tax payments. Gold is the most commercially exploited mineral in Ghana and accounts for about ninety-five percent of the country's mineral revenue (Ghana Chamber of Mines, 2020).

Ghana's artisanal and small-scale mining (ASM) sector continues to grow and in significance. Its contribution to wealth creation, employment and the economy make it one of the nation's most important livelihood activities, directly employing an estimated one million people and supporting approximately 4.5 million more (Mcquilken & Hilson, 2016). However, most miners in Ghana, operate informally without the security of a licence. Thus, formalising Ghana's ASM sector is therefore, a significant, timely and pressing developmental opportunity that must be realized (Mcquilken & Hilson, 2016). There is a contrary belief that the negative impacts of mining such as water, air and noise pollution and the general deprivation of fertile lands for agriculture purposes leave the people much poorer in relative terms than they were before (Arah, 2015).

There are large mineral deposits including gold all over Ghana. Seasonal small-scale and artisanal mining activities have been coexisting with agriculture and husbandry for centuries in Ghana, but the nature of these mining activities have changed with the entry of largescale mining companies (World Bank, 2006). The lure of potential higher incomes in mining does appear to encourage the youth to engage in small-scale mining on a more permanent basis. While poverty and the lack of livelihood is a major underlying cause for galamsey[9] activities, it is important to note that significant numbers of rural inhabitants are attracted to artisanal and small-scale mining because of the income and independence resulting from these activities (Bagah, Angko, & Tanyeh, 2016). Small-scale mining activities in Ghana date

9 **Galamsey:** Means "gather and sell" in Twi and is used for describing an illegal small-scale miner or the activity of mining illegally, (Good Governance Africa, 2020). The word comes from Ghanaian Pidgin and combines the words for gather and sell. That's how people in Ghana refer to this illegal gold mining. It is an umbrella term for small-scale mining, (Preuss, J., 2017): https://www.dw.com/en/how-a-young-german-director-documented-illegal-gold-mining-in-ghana/a-40969514

back more than 2000 years, with evidence of gold mining as far back as the seventh and eighth centuries. It also accounts for the colonial name of the country "The Gold Coast" (Good Governance Africa, 2020).

Ghana is presently the second largest producer of gold in sub- Saharan Africa, only behind South Africa. However, this enviable position is bolstered by the returns from small-scale mining or galamsey. It is estimated that about thirty percent of Ghana's total gold output is derived from the activities of an estimated one million small-scale miners, with most of them (galamsey operators) without any mining permits (Good Governance Africa, 2020). The increased rate of illegal small-scale mining has attracted Chinese migrants into Ghana. A recent phenomenon is the dominance of the Chinese in the supply chain of illegal small-scale mining with their financial, technical, managerial acumen, the sale and transfer of gold proceeds, and political patronage. This dominance accounts for the massive negative social, economic, environmental, and political impact of illegal small-scale mining in the country (Antwi-Boateng & Akudugu, 2020). The Chinese illegal working community is believed to be highly organised and hierarchical, with one kingpin allegedly employing over 300 Chinese migrant workers together with several Ghanaians. Galamsey, and the informal communities it creates, is associated with a rise in crime and violence. Police have said that the number of armed robberies has risen in illegal mining areas, often with guns brought in by the Chinese to protect themselves (Burrows & Bird, 2017).

Along with the growing presence of weaponry, the trafficking and use of narcotics has also increased. A senior police official told the authors that a proportion of the cocaine and methamphetamine trafficked through Ghana is directed towards galamsey miners. It is believed that the miners use these drugs in order to "give them courage" and help survive long hours in dire conditions. Such drug use proliferates in informal and illegal gold mining camps in South America. As Ghana becomes a key narcotic trafficking transit state, patterns repeat themselves (Burrows & Bird, 2017). Moreover, galamsey can set in motion a vicious circle in terms of employment. Mining often occurs in cocoa farming regions and can lead to the seizure of land and environmental destruction.

Both outcomes further erode the viability of agriculture, leading to the local population's deepening dependence on illegal mining for income (Burrows & Bird, 2017).

Findings on the effects of mining on socio-economic activities revealed that the immediate benefits in terms of financial returns are more important to the people than the hazard caused to the physical environment (Gana, 1999). From the foregoing therefore, there is the need to undertake an in-depth study to examine the promotion and application of geo-spatial intelligence in resolving and/or reducing the incidence and menace of small-scale gold mining towards an enhancement of national security and the process of sustainable development.

Literature Review and Theoretical Framework

According to historical records, there is strong evidence of gold extraction and/or mining activities in Ghana as far back as the seventh and eighth centuries A.D., as gold deposits attracted Arab traders into the country (Hilson, 2017). Mining activities were strategically located along rivers where sediments believed to contain deposits of gold were washed constantly to separate the gold grains (Hilson, 2002). This was a source of wealth for these communities and individuals engaged in mining. As time went on, it was revealed that deposits of iron, limestone, kaolinite, and other clay minerals exist in some quantities. Gold, however, was and is the principal mineral extracted and accounts for ninety percent of extracted minerals (Hilson, 2017).

According to Hilson (2002), Ghana's first gold mining companies were established shortly after the British established the Gold Coast Colony in 1874, and, following two successive gold rushes in the early-1900s, gold prospecting and extraction were widespread in Obuasi, Tarkwa and Prestea. However, the industry soon entered a period of depressed production, which began at the time of country independence in 1957 and ended shortly after implementation of the country's Economic Recovery (ERP) Plan in 1983. The Ghanaian gold mining industry has since grown rapidly, supplanting cocoa cultivation as the country's

chief economic activity (Hilson, 2002, p. 13). Within the last three decades, gold production has increased in the order of seven hundred percent; output from resident gold mines accounts for some thirty-seven percent of national exports and ninety-seven of mineral exports (ibid.).

Traditionally, gold mining served as a source of wealth for rural communities and individuals engaged in mining. However, as time went on, it was revealed that deposits of iron, limestone, kaolinite, and other clay minerals exist in some quantities (Akabzaa & Darimani, 2001). Gold, however, was and is the principal mineral extracted and accounts for ninety percent of extracted minerals (Akabzaa & Darimani, 2001).

In Africa and Asia, there may be as many as six million artisanal miners world-wide. In Ghana, the mining sector accounts for forty-one percent of the country's foreign exchange and it is the leading foreign exchange earner. Gold now accounts for over United States $600 million and ninety percent of all mineral productivity annually and has replaced cocoa as Ghana's principal foreign exchange earner (Boachie-Yiadom, 2010). Increased investments in the mining sector resulting from Ghana's economic reforms have several benefits. Mining is the principal earner of foreign exchange in the country, providing a large amount of government revenue, a source of income and social infrastructure to the population, creating direct and indirect employment and contributing to community development in mining areas (Hilson, 2017).

Mining involves the process of digging the earth to mine and extract minerals which are found in it. There are basically two methods of mining: surface mining and underground mining. The former also known as open-pit mining is undertaken when the mineral deposit is discovered on the surface of the earth. This method is relatively more cost effective and uses fewer workers to produce the same amount of ore compared to underground mining. On the other hand, when the mineral deposit lies deep below the surface of the earth the underground mining method is used. Mining is capital intensive, and the risk and rewards are also extremely high for both the mining companies and communities involved (Marshall, 2001).

In Ghana, there are two forms of mining; large scale and small scale or artisanal mining. The small-scale mining sector employs close to 300,000 people; the large-scale mining sector employs very few people but who are highly skilled in the use of mechanized equipment (Bagah, Angko, & Tanyeh, 2016). It has been observed that artisanal small-scale mining is an important source of livelihood for most poor rural communities, and it is characterized by the application of poor technological practices with significant environmental, social, and health costs, particularly with mercury for amalgamation (UNEP, 2011).

Due to the importance of the environment to the sustainability of life on earth, goal seven of the Millennium Development Goals (MDGs), which is critical to the attainment of the other goals, is geared towards ensuring environmental sustainability (Bagah, Angko, & Tanyeh, 2016). It is a well-known fact that environmental degradation is a phenomenon which has led to climate change. The current rate of environmental degradation in mining communities in Ghana is alarming. It continues to threaten human well-being, endangering health, physical security, social cohesion, and the ability to meet material needs, rapidly disappearing forests, deteriorating landscapes, polluted waters, and urban sprawl (Bagah, Angko, & Tanyeh, 2016).

The great majority of small-scale mining operations are related to industrial large-scale mining. Land conflicts between large mining companies and galamsey operators are becoming common. Closed-down underground mines and/or surface mines are attractive targets for galamsey miners because mineral ore in mines that were or are operating are accessible with their artisanal equipment and technologies. As part of a renewed clampdown against illegal mining, the security forces arrested one hundred and twenty Chinese nationals (British Broadcasting Corporation, 2021). In the span of a few years, Ghana has attracted an estimated 50,000 gold seekers from China, almost exclusively from Shanglin County in Guangxi province (British Broadcasting Corporation, 2021).

In the current era of multiplying and escalating risks, both at the national and international level, the security of the individual (that is,

human security), from pervasive threats and fears, has become an area of intellectual discourse and policy debate. This is especially significant after the end of the cold war, the emergence of multi-polarity and the proliferation of global terrorism (Menon, 2007). Security is not new a concept in the social sciences. Security is the essential ingredient of the international system around which nation states originated and were sustained. However, the modern concept of security identifies the inherent weakness of this traditional security paradigm which basically focuses on security of the state instead of security of the individual. The dominant concept of security, traditionally, was state centric, extending support and legitimacy to instruments of states and upholding the principle of state sovereignty. Plato's ideal state (Scolnicov, 1988), Aristotle's Stateman (Rist, 1974), Hobbes concept of Leviathan (Olsthoorn, 2020), Machiavelli's Prince (Giovanni, 2013), and above all Marxian concept of dictatorship of the proletariat (Weydemeyer, 1962), highlight the ultimate goal or end of state as security and protection of individual and community, even though they have different views about the means to attain this goal (Menon, 2007).

The United Nations Development Programme (UNDP) (1994), the Global Human Development document, was among the first international document that clearly and explicitly articulated Human Security as a concept for future vision and agenda for action (Gomez & Gasper, 1994). The 1994 UNDP report was specific, listing seven essential dimensions of human security: economic, health, personal, political, food, environmental, and community. In a follow up, Mahbub UI Haq's (1995), Human Development Index and Human Governance Index gave a theoretical explanation of human security and paved the way for its global recognition and acceptance; he underpins the security of the individual and not the nation state. Accordingly, this new conception of security will be equated with the security of individuals, not just security of their nations or, to put it differently, security of people, not just security of territory (Haq, 1995). Additionally, Haq (1995) identified some major threats against human security including drugs, disease, terrorism and poverty. He further widened the concept by adding the issues of north-south divide, political economy of

hegemony, underdevelopment, and unequal distribution of wealth as threats to human security. While discussing the means through which human security can be achieved, Haq (1995) completely deviated from the military version to one of development. Inparticular he gives five radical steps to achieve human security: A human development conception with emphasis on equity; sustainability, and grassroots participation; a peace dividend to underwrite the broader agenda of human security; a new partnership between North and South based on justice, not charity which emphasizes equitable access to global market; and a new framework of global governance built on reform of international institutions such as the International Monetary Fund (IMF), World Bank and the United Nations and, finally, a role for global civil society (ibid.). In the same year, the UNDP gave a proper and clear definition of security for the first time in its inception: "human security is a child who did not die, a disease that did not spread, a job that was not cut, an ethnic tension that did not explode in violence, a dissident who was not silenced. Human security is not a concern with weapons – it is a concern with human life and dignity…it is concerned with how people live and breathe in a society, how freely they exercise their many choices, how much access they have to market and social opportunities and whether they live in conflict or in peace" (King & Murray, 2002, p. 230). In the same vein, the report gives components of human security including: economic security – an individual's enjoyment of a basic income, either through gainful employment or from a social safety net; food security – an individual's access to food via his/her assets, employment or income; health security – an individual's freedom from various diseases and debilitating illnesses and his or her access to health care; environmental security – the integrity of land, air and water, which make human habitation possible; personal security – an individual's freedom from crime and violence, especially women and children who are more vulnerable; community security – cultural dignity and to inter-community peace within which an individual lives and grows; and political security – protection against human rights violations (UNDP, 1994).

Thus, the meaning of the term "security" has deeply changed from the Classic and Medieval periods to the modern and contemporary world

although the notion itself has always been central to human societies. In pre-modern thought, security was rarely about protecting goods and material assets. Likewise, the idea of security seldom concerned specific threats; rather, it was related to the overall, philosophical, and religious, awareness that there are many things that lie beyond the influence of human actions (Mordini, 2014). The ancient Greek expressed this notion by using four different terms i. *arkeo,* which means "protection"; ii. *eruma,* which is the military security; iii. *asphales,* which is a concept related to something which stands, which does not fall; iv. *apemosyne,* which literally means "without worry" (Mordini, 2014). Another crucial feature of the security narrative in the "Golden Age of Security" was the "the daily new wonders of science and technology" (Adger, et al., 2014). Any optimistic account on human scientific and technological progress is no longer tenable in the contemporary world. It is however difficult to escape from the impression that—although in different forms and by using different communicational codes—the notion of security is still deeply interlaced with science and technology wonders (Mordini, 2014, p.620).

The revolutionary shift from analogic to digital has created a totally new category of objects, allowing translating into digits almost everything. This has amplified our capacity for storage and data processing to an extent which was simply unthinkable until a few years ago. Today information and communication technology (ICT) allows us to handle a huge amount of data, and to generate new information by merging and fusing archives and data sets. For instance, by observing and fusing publicly available data, such as web search queries, blogs, micro-blogs, internet traffic, financial markets, traffic webcams, Wikipedia edits, and so forth; it is possible to anticipate events such as disease outbreaks, financial and political crises, economic instability, resource shortages, and responses to natural disasters (ibid.).

In December 1988, the General Assembly requested the Secretary-General to follow future scientific and technological developments, especially those with potential military applications, and to evaluate their impact on international security. The outcome of the Secretary-General's report to the General Assembly at its forty-fifty session

maintains that since the first satellite was placed in orbit in 1957, space capabilities have developed essentially in four areas: space transportation, sensors, spacecraft, and ground segment. Many of these capabilities are unique and cannot be duplicated by airborne or ground-based systems. Military activities in space have been devoted to five traditional support missions: communications, reconnaissance and surveillance, navigation, meteorology, and geodesy. The ease with which command and control can be exercised through satellite-based communications makes space-based systems very attractive for military commanders. Broadly, the current trend in space and related technologies is towards the development of more effective satellite-based sensors, more survivable spacecraft and improved command and control systems. Both incremental advances and radical improvements in any one or more of these areas could contribute towards a more efficient performance of the traditional military support missions in space. Technological advances have also opened the possibilities for a host of future military missions in space. Among those envisaged, the following have frequently been debated: elaboration of space-based nuclear weapons capabilities; support to conventional forces; anti-satellite and satellite defence weapons; and space-to-Earth weapons. Some of these hypothetical future technological possibilities are considered either technically fanciful or as addressing issues of peripheral military concern, not to mention the prohibitive costs. To be effective as space-based systems, the kinetic-energy and directed-energy weapons, for example, must have target surveillance and acquisition systems, discrimination against decoys, pointing and tracking systems, kill-assessment capability, appropriate weapons and infallible command and control arrangements. In addition, the costs of hypothetical missions remain incalculable. In this respect, a major lesson learned from man's odyssey into space is that the cost of breaking free from the Earth's gravity remains very high (United Nations,1992).

Until recently, security software applications have traditionally been built around monitoring through a close-circuit television (CCTV) and related software that integrates cameras to observe and detect potential security threats. The use of Geographical Information System (GIS), however, allows greater enhancements not just to

monitoring but also planning and forecasting potential security threats, both from physical and cyber threats. The field of Physical Security Information Management has seen large growth in the last two decades as security interests have increased. Software responses have included the development of platforms that work to integrate various sources of data, including CCTV, life critical systems, radar, sensor and Global Position Systems (GPS) data from field sites (Altaweel, 2018).

Geospatial science is the study of human behaviour as it relates to how human's use the earth's attributes; be it natural or man-made. This distinctive discipline has led to the creation of Geospatial Intelligence (GEOINT); a term that covers the information obtained from this study, with analysis of the locations on the planet and physical features. The intelligence could be obtained from a variety of sources, including: satellite imagery, GPS, coordinate geometry (COGO) and, unmanned aerial systems (drones). A unique aspect of GEOINT is the additional benefit of tradecraft involving the cognitive method by which location-based intelligence can be applied to ensure a strategic advantage (Spatial Sciences Institute, 2021). A GIS is computer software and system that is expressly applied for the collection of data, integration, analysis and distribution of resulting products about the earth with regard to a physical position. Its applications could be used in a number of military and civilian purposes, including: analysts identifying pollution trends for bettter environmental management; insurance companies reviewing location data to assess risk; logistic companies mappibg out optimum delivery routes; health companies training public health professionals to help analyze potential geographic effects on health crises; and aid workers predicting possible food shortages (Spatial Sciences Institute, 2021).

In response to the September 11 2001 terrorist attacks in the United States of America, carried out by al-Qaeda the Department of Homeland Security (DHS), recognized the strategic advantages of using maps for military and domestic response activities. The DHS essentially has five basic purposes: detect threats to the country; build preparedness in the face of terrorist attacks or natural disasters; prevent and/or disrupt potential extremist activities; protect infrastrasture and national

artifacts; and, respond and recover in the face of large-scale attacks or disasters such as mass shootings. To enhance the oversight of GEOINT, the DHS in November 2004, created the Geospatial Management Office. The department provides leadership in terms of supporting policy and strategic planning for geospatial intelligence. Moreover, the organization provides oversight for the related technology used to obtain and analyse geospatial data (Spatial Sciences Institute, 2021). The DHS has recognized the importance of sharing GEOINT data to related communities to ensure coordinated preparation for potential threats be it natural or man-made to the nation's safety.

Kreiss (2014) takes a coherent navigation between security technology and technogical security. Notably, he is intrigued by the definition of security and its relationship with a more general understanding of human nature; he perceives the deep link between the overall techno-science apparatus and the human security dimension. In such a context, he uses privacy as heuristic paradigm and human security dimension. This leads him to formulate the notion of an individual as a techno-social hybrid and poses a question about what it mans to be human—homme in the age of encompassing surveillance (Kreiss, 2014).

Research Approach, Method and Materials

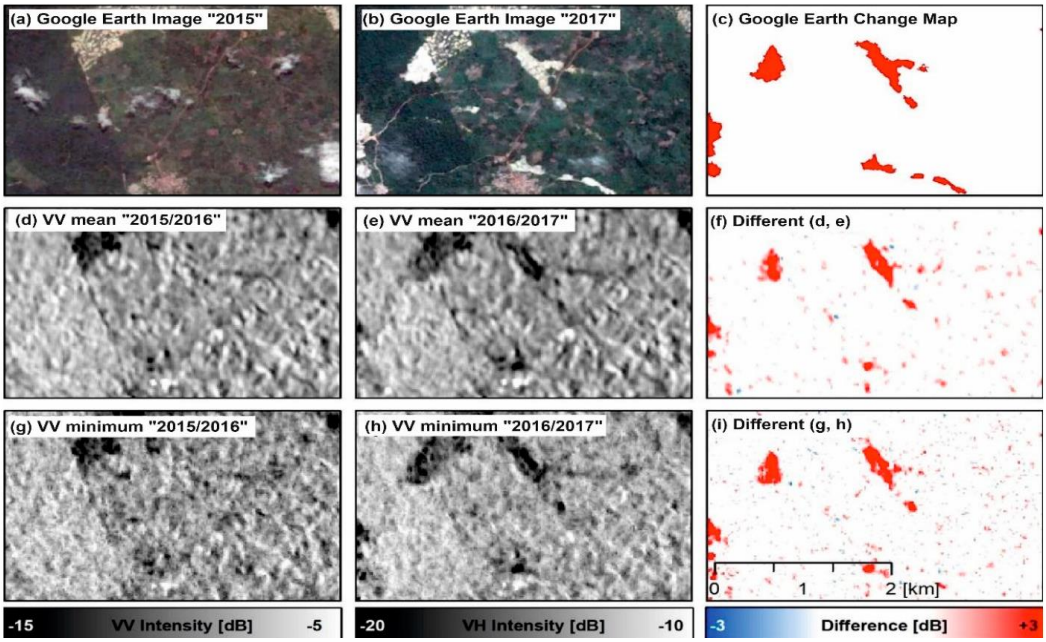
The study is conducted within qualitative methodology and content analysis as a preferred method. Shank (2002) defines qualitative research as "a form of systematic empirical inquiry into meaning" (p. 5). By systematic he means "planned, ordered and public", following rules agreed upon by members of the qualitative research community. By empirical, he means that this type of inquiry is grounded in the world of experience. Inquiry into meaning says researchers try to understand how others make sense of their experience (Shank, 2002). Denzin and Lincoln (2000) claim that qualitative research involves an interpretive and naturalistic approach: "This means that qualitative researchers

study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them" (Denzin & Lincoln, 2001, p. 3). Hawking and Mlodinow (2010, p. 39) go further by arguing that, from the point of view of people interacting with their surroundings, there is no such thing as an objective reality: what an individual person regards as "reality" is actually a model constructed by that individual on the basis of a process of personal observation and interpretation of events. However, it all seems real to the person in question (Hawking & Mlodinow, 2010).

Qualitative content analysis is one of numerous research methods used to analyze text data. Research using qualitative content analysis focuses on the characteristics of language as communication with attention to the content or contextual meaning of the text (Budd, Thorp, & Donohew, 1967). Qualitative content analysis goes beyond merely counting words to examining language intensely for the purpose of classifying large amounts of text into an efficient number of categories that represent similar meanings (Weber, 1990). These categories can represent either explicit communication or inferred communication. The goal of content analysis is to provide knowledge and understanding of the phenomenon under study (Downe-Wamboldt, 1992).

The study applied secondary sources of data from official documents, web documents (Sentinel 2 and Google Earth Imagery ___ Figure 1), and published materials in developing a framework of geospatial intelligence in national security for sustainable development in resolving the menace of illegal small-scale mining in Ghana. The presented Geo-spatial Intelligence framework involved the application of Mindjet Mind manager 2019 software.

Figure 1: Land use Change of illegal Mining



Source: *Forkuor, Ullmann, & Griesbeck, (2020).*

Figure 1 depicts the visual comparison of forest cover within the Western Region of Ghana between 2015 and 2017. The classification indicates the intense mining activities (the red zones) within the spatio-temporary period under consideration.

Discussion of Findings

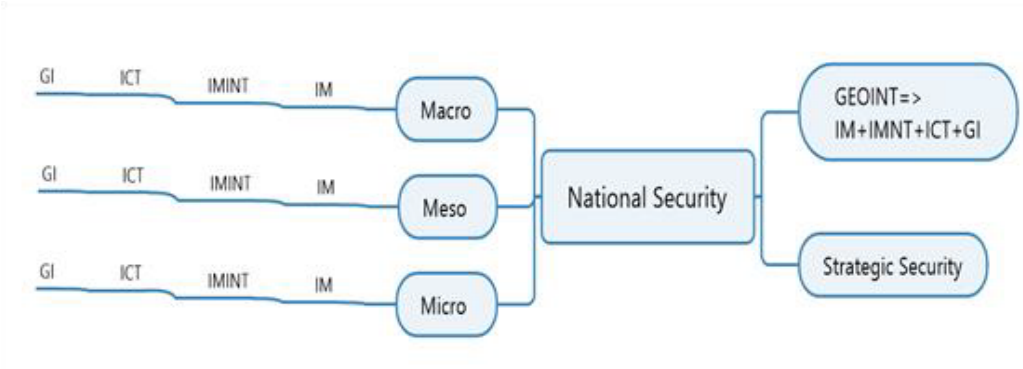
Geospatial intelligence is summed up as seeing what everybody has seen and thinking what nobody has thought; it creates the objective connection between a geospatial problem representation and geospatial evidence (Bacastow & Bellafiore, 2009). Two pillars underpinning geospatial intelligence framework are information gathering which emphasize finding information: and, sense making, place emphasis on giving meaning to foraged information. In the USA, the application of Integrated Socio-cultural Environment for Behaviour (ISEBOX) as part of the structured geospatial analytic method enables not only the monitoring but the prediction of human behaviour thus, allowing the military to bring together data at its disposal in making better and faster informed decisions relative to threats (Bridges, 2010).

National security has been described as the ability of a state to cater for the protection and defence of its citizenry. It is clear that policy-makers need a sharper eye as to what is and is not national security. It cannot be all things to all people; if it were, it would be meaningless. Therefore, a definition of national security must be limited not only to decide what the government should be expected to do, but equally important, is to decide what it should not do. This is especially true in the face of budget and capability restraints (Holmes, 2014). National security is the safekeeping of the nation as a whole. Its highest order of business is the protection of the nation and its people from attack and other external dangers by maintaining armed forces and guarding state secrets (Holmes, 2014). In view of the reformation of the concept of human security as presented in preceding pages, the contending branches of national security could include: military security involving the interplay of offensive and defensive capabilities of the Ghana Armed Forces (GAF); economic security which covers economic activities in addition to the financial sector that enables the state among others to discharge the directive principles of state policy "the state should ensure adequate means of livelihood to its people" and, "The State shall take all necessary action to ensure that the national economy is managed in such a manner as to maximize the rate of economic development and to secure the maximum welfare, freedom and happiness of every person in Ghana and to provide adequate means of livelihood and suitable employment and public assistance to the needy" (Constitution of the Republic of Ghana, 1992, Act 36:1); political security, this involves the organizational stability and systems of the body polity of Ghana, in respect of the directive principles of state policy "The Directive Principles of State Policy contained in this Chapter shall guide all citizens, Parliament, the President, the Judiciary, the Council of State, the Cabinet, political parties and other bodies and persons in applying or interpreting this Constitution or any other law and in taking and implementing any policy decisions, for the establishment of a just and free society" (Constitution of the Republic of Ghana, 1992. Act 34:1) and "Ghana shall be a democratic state dedicated to the realization of freedom and justice; and accordingly, sovereignty resides in the people of Ghana from whom Government derives all its powers and authority

through this Constitution" (Constitution of the Republic of Ghana, 1992. Act 35:1); Social security, this involves the guarantee of freedom from discrimination based on language, religion, custom and ethnic origin "The State shall actively promote the integration of the peoples of Ghana and prohibit discrimination and prejudice on the grounds of place of origin, circumstances of birth, ethnic origin, gender or religion, creed or other beliefs" (Constitution of the Republic of Ghana, 1992. Act 35:5); and environmental security—healthy maintenance of the biotic and abiotic systems to guarantee an enhanced living standards of the Ghanaian relative to environmental dimension of the theory of human security and/or multi-sectoral understanding of insecurities.

The implementation of national security policies through a Geo-spatial intelligence framework must follow this noted sequencing: macro/ strategic security, meso security (middle) and micro security (unit) _ Figure 2.

Figure 2: Geo-spatial Intelligence Framework



Source: *Author's Construction (2021).*

From the framework (figure 2) above that incorporates human security as part of the Geo-spatial Intelligence (GEOINT) system, the national level (National Security) involves a combination of Imagery (IM), Imagery Intelligence (IMINT), Information Communication and Technology (ICT), and Geo-spatial Information (GI). At the national level, the framework involves the implementation of Ghana's National Security Strategy that enables for live and/or instantaneous integration

of variables and information from the macro level to be spear-headed by National Security Council. In addition, at the strategic security level, GEOINT allows and enables the new Security and Intelligence Agency (Act 1030) which makes provision for a Ministerial Security Coordinating Committee comprising the Minister for National Security, Defence, Interior, Foreign Affairs, Finance, Justice, and Communication and Digitization. At the meso (Regional Security Councils [REGSECS]) level, GEOINT allows for the instantaneous integration of IM, IMINT, ICT and GI into the macro (national) level; and from the micro (District Security Councils [DISECS]) level, information in the form of instantaneous integration of precise geographical/spatial coordinates (Cardinal points/longitude and latitudes) in addition to attribute table within a database. The micro level equally includes Ministries, Departments and Agencies (MDAs), Metropolitan, Municipal and District Assemblies. Therefore, there is a network of information involving IM, IMINT, ICT and GIS following from the micro level (field intelligence personnel) either through the meso or directly to the macro and hence the national security level. In a GIS, attribute tables are often joined or related to spatial data layers, and the attribute values they contain can be used to find, query, and symbolize features or raster cells. Thus, data without spatial reference does not provide geographic context and without geographic context, it is difficult if not impossible to comprehensively understand the risk and security threats emanating from illegal mining to the very existence of the Ghanaian polity.

The application of Geo-spatial intelligence in the national security architecture targeted at resolving the menace of illegal small-scale mining could enhance the processes of sustainable development relative to the principles of human security. The framework ensures synergy and effective information sharing between security agencies which promote effective decision-making through an integrated institutional system ensures an efficient coordination within a spectrum of seamless human security. With the plethora of cell phones, it thus creates an environment in which individual citizen could instantaneously feed the national security architecture with text and imagery. The received imagery and information could be triangulated via latitude

and longitude coordinates to verify for authenticity as the basis of an enhanced security framework.

Conclusion

The study presented a framework involving the application of Geo-spatial Intelligence anchored on the principles inherent within the theory of human security. The principles of human security includes: economic security – an individual's enjoyment of a basic income, either through gainful employment or from a social safety net; food security – an individual's access to food via his/her assets, employment or income; health security – an individual's freedom from various diseases and debilitating illnesses and his or her access to health care; environmental security – the integrity of land, air and water, which make human habitation possible; personal security – an individual's safety from crime and violence, especially women and children who are more vulnerable; community security – cultural dignity and to inter-community peace within which an individual lives and grows; and political security – protection against human rights violations. These noted principles are to form the core and thrust of the Geo-spatial intelligence framework targeted at resolving the threat posed by illegal mining that potentially undermines the very existence of the Ghanaian state and its citizens.

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