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Conserving Ghana's biodiversity: A Spotlight on the potentials in green informatics

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Abstract: Rapid biodiversity loss is a global concern with associated impacts on ecosystems and human welfare. But Ghana, a West African country, is not exempt. The country's biodiversity has been threatened by deforestation and illegal mining. Green informatics can be used to manage the challenges posed by climate change-related streams and conserve Ghana's biodiversity. Using green informatics means intelligent solutions to sustainability in biodiversity conservation projects in countries. Green informatics has been utilized for different districts and it is protecting biodiversity that is released as an ecological issue in some nations. Green informatics is relatively new to Ghana and its potential in conserving biodiversity is yet unexplored. This perspective paper examines the idea of green informatics and explores its potential in biodiversity conservation for Ghana. The study opens with a short discussion of biodiversity in Ghana and the threats that it faces. It proceeds by defining the term green informatics, outlining its core elements before broadening into a more detailed exposition on how these may be expected to confer specifically around biodiversity conservation. The paper concludes by emphasizing the importance of green informatics as a necessity for biodiversity conservation in Ghana and further research on this topic.

Keywords – Biodiversity, Computer science, Ecosystem, Green informatics, Information communication technology

1. INTRODUCTION

Global human impacts on the environment show the detrimental determinants of biodiversity loss (Cepic et al., 2022). Biologists and conservationist, on the other hand, conceptualize in terms of biodiversity that describes all possible kinds of organisms living on earth including plants, animals and many more. (Isbel et al., 2017). The biodiversity is being depleted slowly because of organisms losing their efficiency and functions promoting the habitats that they are found in (Cardinale et al., 2012). The use of natural resources for other purposes in agriculture, the misuse of natural resources without considering sustainability also, human activities that cause negative change in a broader perspective cause biodiversity loss (Naeem et al., 2016). Global evolution and growth over time has heightened a great demand for the use of more natural resources like food, land, water and energy

supply (Isbel et al., 2017). Humans depend on these natural resources and as the world evolve, the world's population also increases rapidly and there is the obvious reason why the world depend natural resources more to enjoy the benefit that these biodiversity offer. Notwithstanding this fact, the overuse of these resources, miscalculations and mismanagement of these resources through human activities interferes with the ecosystem sustainability. The more these flawed activities gain higher rate, the more harmful effect on the environment outweigh the benefits derived (OECD, 2019).

In the case of Africa, Africans generally place value on plants and animals and they believe that these resources support their existence and sense of living. Africans are widely noted for herbal medicine practices. They benefit from natural resources using plants to treat a lot of health problems (Cardinale et al., 2019). Aside the herbal benefits derived, these natural resources are used for other domestic purposes. In the indigenous setting of the African people, they share certain common religious beliefs and practices that support biodiversity conservation. Some cultural factors like rules, regulations and taboos are drivers that up to the support of biodiversity. These drivers normally are of the interest of sustainability promotion (Eva et al., 2018) channeled through cultural and religious beliefs and practices. In spite of all these, Africa on a larger scale is recorded to be the second most populated continent in the world and is without equal in terms of facing environmental challenges (UN, 2015). Comparatively among continents, Africa rises to have the most damaged habitation resources when compared to Asian continent like India with other continents inclusive (Archer et al., 2018).

An African country like South Africa is reported to have a higher rate of terrestrial biodiversity and as well as plant species and comes out as the sixth out of the seventeen countries ranked as countries that have a higher rate of biodiversity (Rouget et al., 2003). However ways that Africa is endowed with incredible varied biological resources, people take advantage of the endowment when utilizing the ecosystem. Human destructive activities such as overfishing are some of the key things that lead to biodiversity loss. For instance in West Africa, fishing is one of the primary agricultural activities that people engage in but because of overfishing biodiversity loss takes its place when fish stocks reaches its level of decreasing in number. Another instance worth noting is an African country like Congo, that has been recorded as having high rates of deforestation; an added factor of biodiversity loss (Igamba, 2023).

Ghana is a biodiversity habitat, and it has various plant and animal species such as the African elephant (Lax et al., 2018), West Africa chimpanzee (Hattie et al., 2004) and giant pangolin. Forests, wetlands and savannas are habitats for the thousands of species found in the country all contributing to its economy through eco-tourism, agriculture and fisheries. According to Tsai et al. (2019), the forests in the southern part of Ghana are one such biodiversity-rich zone and provides critical habitats that support the sustenance and survival of several plant species including, mahogany trees (Swietenia macrophylla), rosewoods or ebony tree among others. The forests also play host to a variety of wildlife as primates; for example, chimpanzees and birds in Ghana. In addition to forests, savanna regions in Ghana consists of grasslands and scattered trees that support species like antelopes simply as diverse bird populations. The coastal zone is also significant in Ghana as it hosts mangroves, fish habitats and offer important coast protection (Ampofo et al., 2016; Appiah et al., 2019). The freshwater systems of Ghana, that is rivers and lakes as well as wetlands are important for aquatic biodiversity, fish species found in the West Africa sub-region, water birds, streams within forest areas among others (Gordon et al., 2012). But as in so many other countries in the Anthropocene epoch (defined by human activity), Ghana is struggling with myriad threats to biodiversity including deforestation, habitat loss and poaching; pollution and climate change. Given that Ghana is said to be the most bio-diverse nation in West Africa, efforts at conservation are inevitable otherwise our natural heritage would soon become extinct posterity notwithstanding spur sustainable land use practices especially while advocating for having more protected areas and involving community participation with all aspects of which

promote biodiversity conservation. Ghana is a country with rich biodiversity, home to numerous plant and animal species including Africa elephants (Loxodantte africana), West African chimpanzees, and giant pangolins. The nation's forests, wetlands and savannahs provide ecosystems for these species as well economic support through ecotourism, agriculture and fisheries (Eva et al., 2018).

According to Tsai et al. (2019), high in biodiversity the forests of Ghana have attracted much international attention that include the Southern part forest where large numbers of plant species and precious timber trees such as mahogany (Swietenia macrophylla) and ebony (Diospyros ebenum). Hackman (2014) also highlights forests like the Kakum National Park provide habitat for hundreds of species including primates such as African elephants, chimpanzees along with an array different bird species. Apart from its forested areas, Ghana is composed largely of savannahs that cannot support various species like antelopes and numerous birds. The coastlines of Ghana are also significant as they support mangrove forests that act as breeding grounds for fish and contribute to coastal stability (Ampofo et al., 2016). Freshwater ecosystems such as rivers, lakes and wetlands serve important functions in supporting aquatic biodiversity, with species like the West African cyprinid fish (Gordon et al., 2012) and water birds reliant upon these habitats. However, as with countless other countries across the world Ghana is under mounting pressure to its biodiversity through deforestation, habitat destruction, poaching and climate change. Private sector enterprises among many others, holds the belief that conservation initiatives are necessary to ensure Ghana's biodiversity for posterity and encourages sustainable land use practices and community engagement in wildlife conservation efforts.

2. CHALLENGES AND THREATS

Ghanaian Biodiversity is threatened by many challenges, talking about mostly the enemies of the state at hand. It is one of the major threats to biodiversity in Ghana logging; mining and agriculture have deforested more than 80% of the country (FAO, 2015). This deforestation does not only cause loss in the habitat but also resulted to fragmentation of habitats that affect species mobility and food accessibility. This process further aggravates the factors contributing to global climate change since it transfers carbon from trees into the atmosphere and is a significant driver of loss in biodiversity. Illegal mining also poses a threat to the biodiversity of Ghana, it is known for its abundant mineral resources such as gold, bauxite and manganese. But rampant illegal mining also known as ‘galamsey’ has resulted in the loss of habitats and pollution of water bodies with dire consequences on aquatic biota. Ghana's biodiversity is also threatened by overfishing. Sources from Wikimedia Ghana reported that a number of fish including sardines, mackerel and tuna in its coastal waters has seen overfishing and depletion of some species of fishes in the water bodies. Overfishing however has caused the depletion of fish stocks which in turn affects the livelihoods based on fishing by coastal communities (FAO, 2008).

3. CURRENT CONSERVATION EFFORTS

Ghana has been making a great deal of biodiversity conservation efforts to shield its considerable natural heritage and likewise ensure the sustainability with regards on the ecosystems. A significant measure taken in Ghana is creating protected areas such as national parks, wildlife reserves and forest reserves, to protect critical habitats as well as species (Adom et al., 2018). These protected areas also serve as home for flora and fauna, support biodiversity conservation and eco-tourism; hence a source of income to the national development (Samal & Dash, 2023). Community-based conservation project is vital in the augmenting Ghana´s efforts to conserve its biodiversity. Empowering the people of Ghana to be stewards in their natural environment, these projects integrate nearby neighborhoods into conservation tasks that contain sustainable source administration, environmental education and opportunity livelihood applications. Community engagement offers a greater sense of ownership

and duty to the conservation activities, hence leading toward effectiveness and having sustainable outcomes (Brooks et al., 2012).

Also, Mitsilegas (2022) opine that it also strengthened its national wildlife protection units and launched public awareness campaigns .The country had been working on anti-trafficking illegal wildlife in Ghana as well as to stem this tide of illegal activities the demand for wildlife product must be reduced through greater enforcement, monitoring and prosecution on all culpable who are found to have committed these offences if the biodiversity that underpins Ghana's future is to survive. Therefore, success in combatting transboundary wildlife crime is largely dependent upon international cooperation (Lacher et al., 2012). This study confirms understanding former reports on biodiversity patterns, landscape dynamics and species conservation requirements whilst offering essential tips to guide the identification of research projects in decision-making and policy development. It also includes monitoring programme for changes in biodiversity and to monitor research conservation interventions, measuring the effectiveness of actions (Waylen et al., 2010). Furthermore, Shidiki et al. (2020) expresses that agroforestry, sustainable agriculture along green infrastructure practices remnant a dimension of these enhancement strategies which might be essential intended for determination in Ghana's biodiversity preservation motivation. By integrating conservation into land-use planning, resource management and development projects in Ghana, the country is striving for more sustainable growth that values economic interest against environmental stewardship to conserve biodiversity on a national scale. Thus, the conservation of biodiversity in Ghana captures an incorporated and collaborative agenda grounded on good judgment findings; there is also a trade-off among upholding knowledge acquired from technological understanding as opposed to featured gaps want inclusive engagement institutions within them.

4. GREEN INFORMATICS

Green informatics emerges as an interdisciplinary field that leverages principles and practice from environmental science, computer science and information technology to develop sustainable solutions. This purpose of the field is to create technologies and systems that reduce harm from environmental destruction, while optimizing social and economic benefits (Xu et al., 2020). Various environmental issues such as climate change, water management or waste reduction have been considered using green informatics (Kozlov et al., 2018). Green informatics consists of an ensemble data, analysis and models for decision-making purposes. It uses various technologies such as GIS, remote sensing and machine learning for environmental monitoring. Such data is then fed into models and simulations which informs environmental managers how to make decisions in a conscious way (Xu et al., 2020). Moreover, green informatics enables the formation of online platforms and other decision support tools to foster cooperation among communities, politicians, academia and stakeholders (Andreopoulou, 2012). Green Informatics implicitly encourages individuals and organisations to be more informed about the environmental impact of their work, thus hopefully guide them into better decisions for themselves by linking data sharing, information submission as well as stakeholder engagement together. As a whole, green informatics can be used to address the grand challenges of environmental sustainability such as pollution and resource depletion (Wang et al., 2010), by complementing traditional approaches to protecting biodiversity. In short, combining environmental science and conservation principles with information technology to explore how green informatics can contribute in innovative ways to protect ecosystems around the planet, promote sustainability of human life on earth; minimizing adverse effects as a result of any conflict between humans and nature.

5. POTENTIAL TO SUPPORT BIO-DIVERSITY

However, the challenges of green informatics in Ghana would be greater since our situation technologically speaking demands more technology consideration on energy resources. Infrastructure was a big issue. A lack of consistent electricity access, poor internet connection and old hardware can slow down the uptake of green informatics technologies (Kozlov et al., 2018). These challenges contribute to difficulties in collecting, analyzing and

releasing data on the environment; which impairs conservation interventions. An additional issue is insufficient funding and not enough investment in green informatics. The limited resources can obstruct the new technologies and systems to adopt in order to tackle environmental problems (Xu et al., 2020). The degree and efficiency of environmental activities in Ghana may be greatly influenced by the issues regarding lack of international collaboration on green informatics usage within the country. To address planetary environmental issues together in a global context, sharing such best practices as well knowledge from relevant resources is needed attempts beyond national boundaries. Inaction among Ghana will also cost them vital opportunities for technology transfer, knowledge exchange and collaborative research that could ultimately enhance their conservation efforts. Also, there is a shortage of experts in the area that can analyze and interpret environmental data (Rogalla von Bieberstein et al., 2019).

Furthermore, the implementation of green informatics in Ghana is also confronted with institutional and policybarriers. The adoption of not wasteful approaches to manage the environment may be limited by lack of government assistance, inadequacy or lacking environmental strategies and unproductive regulatory frameworks (Kozlov et al., 2018). There may also be issues surrounding data security and privacy that could present challenges to working together on green informatics efforts and sharing environmental information (Chavan & Penev, 2011).

6. POSSIBLE SOLUTIONS

These could be a broader view for Ghanaian green informatics solutions by foreign organizations, country academic institutions and partners that can bring in diversity of angles to which case studies or user scenarios are exposed, diverse technical creative solution options as well as extra funding. Displaying from a broader perspective, international cooperation could help Ghana in collaborating its efforts to preserve the environment according to other global frameworks and standards or initiatives ensuring that they are together progressing with best practices worldwide but also further sustainability aims (Okeke & Illoh, 2020). Having Ghana could be a solid reference in the worldwide ecology community and utilizing their networks to facilitate positive changes on ground level city or planet wide; by joining global systems like alliances, conventions together with strategies for knowledge transfer. Proactive engagement, networking and diplomacy are required to unlock outside funding for Ghanaian green informatics projects but also allow mutual learning in order to help build strategic alliances with these obstacles of limited international collaboration (Visseren-Hamakers, 2009).

Besides, building an institutional and policy framework is also essential to address the barriers of green informatics in Ghana. This could include the design and implementation of environmental laws, development of a legislative framework allowing sustainable use for natural resources; targeted measures to increase intended state ecological-economic funding (Kozlov et al., 2018).

Furthermore, capacity building and training programs for local talent are required to overcome the issue of lack of technical skills and knowledge. This will develop local skills and establish the longevity of green informatics initiatives (Kasim, 2019). Moreover, to solve the challenge of data availability and quality it is key that there will be development of standardised data collection protocols in combination with accessible platforms for sharing data. This will inform the availability of credible and task ready data for decision making (Amoah et al., 2019).

It is therefore necessary to develop sustainable policies and laws that support the incorporation of green informatics into environmental management practices, in order to respond adequately when challenged by insufficient policy-books, creating an environment conducive to the realization of green informatics initiatives (Ofori-Boateng et al., 2018).

The creation of strong data governance frameworks is crucial for elevating green informatics projects in terms of enhanced data privacy and security under the explanation by Ofori-Boateng et al. (2018) and ethical frameworks for data sharing and collaboration. Practicing to manage data securely, auditing it periodically and communicating the basic principles of privacy on a broader spectrum with an assortment of attentiveness are some factors that

could cultivate trust, transparency as well as accountability in environmental data initiatives across Ghana (Veiga et al., 2017). However, by implementing innovations such as these and developing an enabling environment for green informatics innovation Ghana can indeed tackle obstacles to implementation, use technology towards environmental sustainability and advance continue saving biodiversity, natural resources and environmental quality of this nation to benefit future generations.

7. CONCLUSION

In a nutshell, green informatics could be a panacea to the challenges facing biodiversity conservation in Ghana. This notwithstanding, numerous challenges need to be confronted with issues ranging from limited funding, lack of technical expertise and know-how, data availability and quality as well as a weak policy and legal framework. Nevertheless, to mitigate these challenges collaborations and partnerships as well as capacity building and training programs are needed for standard data collection protocols; policies, regulations. More green informatics research is needed to further our understanding of the intricate links between society and its environment, as well as to find (computational) approaches for addressing environmental problems. As an example, we need more sophistication in the data analysis and modeling methodology that will give us improved accuracy of predictions which may assist better decision-making. Further research is also required to assess how green informatics translates into conservation practice, including best practices for applied deployment. That green informatics holds enormous promise for the conservation of biodiversity in Ghana and more research is necessary to advance understanding, provide synergistic solutions for environmental control restoration efforts. Green informatics can be employed to protect our biodiversity and preserve ecosystems for the benefit of future generations.

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