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REVIEW ARTICLE

Environment, social and governance in sustainable agricultural practices in developing countries: A short note

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ABSTRACT

This review paper highlights the importance of environment, social and governance (ESG) in sustainable agricultural practices in developing countries. The importance of incorporating an environmental perspective has been discussed. The enhanced sustainable crop farming practices under ESG are precision agriculture technology, controlled environment agriculture, improving crop breeding, agricultural biotechnology, packaging innovation and coatings, reducing food waste, and regenerative agricultural practices. The green-minded leadership model should stem from this concept of ESG in sustainable agricultural practices in developing countries.

Keywords: environment; social; governance; leadership

1. The importance of ESG in agriculture in developing countries

The United Nation's Principles for Responsible Investment require corporations globally to contribute to sustainable development[1]. Corporate actions must benefit society and the globe as sustainability becomes more important. Environmental, social, and governance (ESG) practices indicate corporate social responsibility. Implementing mandatory ESG disclosure by capital market regulators in the UK, Japan, and numerous European nations shows this rising interest. ESG is more prevalent in developed countries, whereas developing countries are still evaluating it[2–10].

Janah and Sassi[2] examined four significant ESG-corporate financial performance (CFP) relationships in developing countries. Their review showed that poor nations require more convergent research. Liu et al.[3] investigated public ESG perceptions. ESG is new in China, and ESG policies are incomplete. Policymakers and firms may use the data to better understand public demands and enhance ESG communication on social media and policy. Singhania and Saini[4] reviewed ESG regulatory regimes for developed and developing countries and conducted a cross-country comparative ESG study. A country's social and governance disclosure was pushed by voluntary or required norms, which could not improve its ESG level alone. Sustainability reporting and integrated reporting must be addressed to improve ESG.

Future ESG studies in developing countries must address these limitations. First, ESG performance measurement is contentious in the ESG literature[2]. The lack of a standard ESG performance measurement

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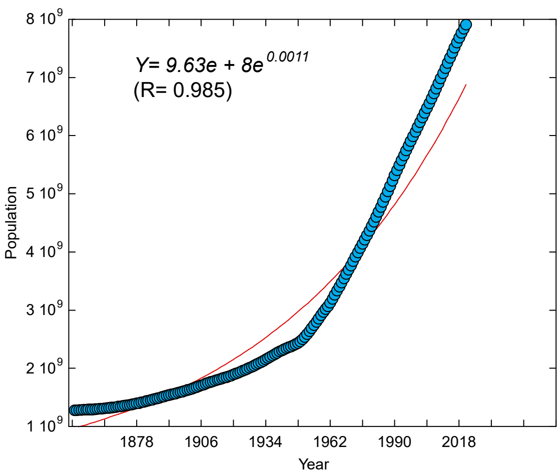
method may explain the various outcomes in the ESG CFP literature[5,6]. Second, researchers are limited by unreliable ESG data. The lack of ESG disclosure legislation until recently may be a factor. Interestingly, ESG rating agencies do not track corporations in a few developing countries[2].

One Weber[7] study on Chinese firms showed that ESG reporting improved financial market returns. Researchers repeated this investigation in additional developing countries with similar findings. Chauhan and Kumar[8] showed that ESG disclosure helps Indian public enterprises with information difficulties. ESG disclosure impacts developing countries significantly, regardless of business ESG initiatives. The huge information asymmetry of ESG data in developing countries may explain this. Future studies in developing countries should examine how past-year ESG measures affect the following year's financial performance, as in developed countries like Japan[9] and Europe[10].

The ESG paradigm is more important than ever in the contemporary Anthropocene epoch. Due to the pandemic, climate change, and more social consciousness, the world is constantly changing. Thus, customers want to know their money is supporting ethical companies. It is impossible to dispute that the human population has expanded from 1851 to 2021[11] (**Figure 1a**). To maintain the goodwill of the general public, stakeholders, and investors and ensure the planet's survival, an understanding of ESG is required.

The agriculture sector must take responsibility for the steadily rising global carbon dioxide (CO_2) emissions from 1851 to 2021[12] (**Figure 1b**) that are linked to the food system. The relationship between worldwide human population expansion[11] and worldwide emissions of CO_2 from 1851 to 2021[2] is positive (**Figure 2**). Agriculture is tasked with the onerous duty of feeding the world's population. Yet, it isn't easy to reduce emissions due to the daunting scale and complexity of the food system. These are the two main aims of the agricultural sector, yet achieving both simultaneously seems nearly impossible for farmers and governments.



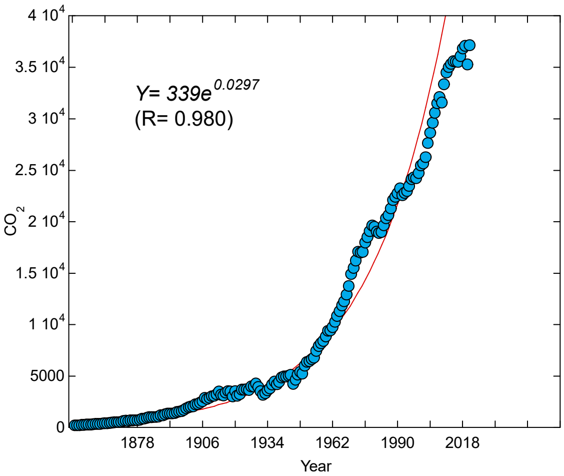


Figure 1. (a) Worldwide human population expansion from 1851 to 2021[11]; and **(b)** worldwide emission of carbon dioxide (CO_2) from 1851 to 2021[12].
Source: Ritchie et al.[12]. Both graphs are drawn based on an exponential equation.

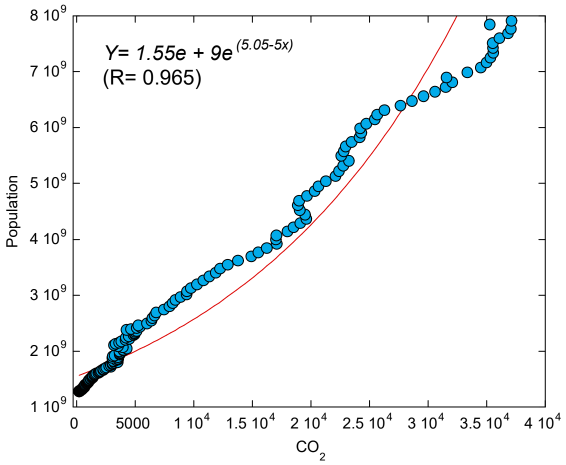


Figure 2. Relationship between worldwide human population expansion[1], and worldwide emission of carbon dioxide (CO_2) from 1851 to 2021[12].
Source: Ritchie et al.[12]. This graph is drawn based on an exponential equation.

2. Agriculture as a food source supply and its challenges

The literature review shows ESG in agricultural business, although it is still limited[13–20]. The study's issue is pertinent because agricultural firms must adopt a new management culture that considers the dangers to humankind posed by environmental concerns worldwide. Agriculture is one of the most promising areas for capital investment with the objectives of sustainable development and preservation of Russia's biocapacity and market leadership in the world when the market for green (responsible) finance is just starting to take shape in Russia. Definition of the issue. Due to its conservative management and state regulatory monopoly, the agricultural industry is now unappealing for venture capital and green finance from banks, negatively impacting its innovation activity and application of sustainable development principles[13]. Fundamental industries include forestry and agriculture. Stakeholders are becoming more interested in the connection between ESG and business performance in agriculture and forestry as the ESG concept develops[14].

To develop specific proposals for the involvement of agribusiness enterprises and financial institutions in financing sustainable development projects as an objective necessity for preserving life on the planet, Dorashka et al.[13] set out to systematically study the existing practices of green financing of agribusiness enterprises worldwide and the specifics of the Russian ESG financing market. 156 listed agriculture and forestry firms were analysed by Zeng and Jiang[14] using two-stage least squares to investigate the theoretical and empirical effects of ESG on corporate performance. They said that (1) there is a strong and positive correlation between ESG and corporate performance and that higher ESG ratings are advantageous for enhancing corporate performance; (2) social and governance performance is more suited to encouraging business performance growth than E performance is; (3) there are no noticeable differences between listed firms in forestry and agriculture in terms of how ESG affects corporate performance; (4) while the proportion of female CEOs has a positive moderating impact, tax incentives and the degree of regional marketization have a negative moderating effect. They also encouraged listed firms to take a more proactive role in green growth. Their findings offered important insights for listed companies in agriculture and forestry to improve ESG performance and, subsequently, corporate performance.

Buallay[15] investigated the effects of sustainability reporting on the agricultural sectors' operating, financial, and market performance. Their conclusions from the actual data show no meaningful association between ESG and operational performance, financial performance, or market performance. Surprisingly, the results show that governance transparency positively influences market performance when each ESG factor is independently regressed against performance. In their discussion of the current trends in corporate sustainable reporting with a focus on the agricultural and food processing industries, Hrebicek et al.[16] measured the performance of an organization's environmental, social, economic, and governance (ESG) factors. A significant difficulty has been identified in the connection between environmental and sustainability indicators and corporate sustainability reporting[16].

Business data and information related to the environment, economy, and society are typically tracked, standardized, registered, and compiled into key performance indicators[17]. This fact suggests, in a roundabout way, that in the event of such demands, the organization can gather these data and include them in the corporate sustainability or environmental report[18,19]. Thus, the combined attainment of ESG performance indicators would serve as the yardstick by which to evaluate business success in these particular economic activities. However, sustainability performance is frequently defined as performance in terms of the environment, society, and economy/finance, disregarding governance performance[20]. The agricultural sector, which significantly affects various sustainability concerns related to food processing and is relevant for all links in the food supply chain, is not the primary target of the ESG and the indicators. In this regard, the ESG supplement in the food processing sector encompasses actions taken by the food sector to improve the environmental, social, and economic sustainability of food production chains, including agriculture[16].

3. Enhanced sustainable crop farming practices under ESG

In EGS, the fine balance is still being maintained. One worry is that making supply networks more environmentally friendly might raise food prices. Those who are currently experiencing food insecurity may see their position worse, and those who are about to join it may also experience it. There will be a cost associated with updating the agricultural network.

The entire food system needs a comprehensive, long-term overhaul. Only the business community's strong commitment and a carefully thought-out strategy can make this transition achievable. Alternative proteins, cutting-edge farming practices, and minimizing food waste are emerging as possible possibilities, while various fundamental market shifts are being examined.

Businesses covered by ESG may employ a range of enhanced sustainable agriculture practices, such as:

a) Precision agriculture technology

These technologies give farmers greater control, resulting in less energy being used, including guiding systems, variable rate irrigation, and maps of soil moisture, canopy, and yield[21–23]. Precision agriculture may be able to incorporate technical advancements because of the information age[24].

According to Pierce and Nowak[21], precision agriculture uses ideas and technology to control the temporal and spatial variability associated with all agricultural production areas to enhance crop performance and environmental quality. They hypothesised that while prospects for present precision management improve with increasing geographical dependency, the challenge of implementing precision management worsens with increasing temporal variation. Because the space-time continuum of crop production has not been sufficiently addressed, precision agriculture's promise for economic, social, and environmental advantages is complicated and mostly unmet.

In their presentation of a general research programme for precision agriculture, McBratney et al.[22] provided a typology of agricultural nations and analysed the possibilities of each type for this sort of farming. Based on literature produced mostly during the previous two years, Zhang et al.[23] offered an overview of the global development and current state of precision-agriculture technology. Natural resource variability, variability management, management zones, the effects of precision agriculture technologies on farm profitability and the environment, technological advancements in sensors, controls, and remote sensing, information management, the prevalence of precision agriculture technologies around the world, and the potential of these technologies to modernise Chinese agriculture are some of the topics covered[22].

b) Controlled environment agriculture

The crops are cultivated in greenhouses and vertical farms to maximise output and reduce environmental consequences[25–27]. The growing need for food worldwide may be met with the aid of controlled-environment agriculture (CEA). Vertical farms and plant factories, two examples of CEA applications, have the potential to move food production closer to metropolitan areas, meeting both the needs of huge populations and contributing to the achievement of global climate objectives. Numerous applications have shown that growing crops in controlled conditions is possible, although most require energy-intensive procedures[25]. However, even though the greenhouse business has made significant technological advancements for the temperate climatic zones of our world, protected agriculture in the more harsh climates still has to be significantly enhanced[26].

Various CEA methods, ideal indoor growth conditions, fruitful case studies, and suggested energy systems research were all examined by Engler and Krarti[25]. In many CEA case studies, improvements to a facility's exterior, lighting, and adoption of distributed generating technologies were shown to cut power use by up to 75%[25].

Lakhiar et al.[27] presented a cutting-edge method for soil-less plant growth. Frequent droughts are anticipated to become more likely due to global climate change. Around the world, agriculture is going through a significant transformation phase and is facing significant issues. Providing a clean and fresh food supply for the rapidly expanding population using traditional agriculture will be challenging in the future. Soilless farming is an alternative method that can adapt well to such situations. The soil-free method is connected to hydroponic and aeroponic systems. They concluded that an aeroponics system is the ideal plant-growing technique for ensuring food security and sustainable development. The approach has demonstrated some encouraging results in several nations. It is advised as the most effective, substantial, practical, affordable, and practical plant growing system when compared to soil and other soilless alternatives[27].

c) Improving crop breeding

New molecular biology discoveries can boost productivity by reducing costs and accelerating the mapping of accessible plant codes[28–30]. Plant breeders should concentrate on features with the best chance of increasing yield[30]. Delivering new technologies (better genotyping and phenotyping techniques) to poor nations will provide tremendous benefits, but they must be widely available and economically feasible. Crop enhancement via breeding provides a significant return on investment and a practical means of enhancing food security[30].

Gao[28] evaluated the creation and use of genome editing tools in plants while emphasising recently created methods. Focusing on recent developments in genome editing-based plant enhancements that could not be accomplished through traditional breeding, he discussed innovative breeding techniques based on genome editing and their influence on crop output.

Fess et al.[29] suggested that plant breeding objectives and research goals change from high-performance agriculture with high energy input to those with better yield and rationalisation. As global resources are expected to dwindle and the population is expected to rise, crop breeding programmes that are more centred on the nutrient economy and local environmental fitness will help lower energy needs for crop production while still delivering enough amounts of good-quality food[29].

d) Agricultural biotechnology

New, low-carbon feed choices and alternative fertilizers are being developed using biotechnology in agriculture to reduce feed-related emissions[31–33]. For instance, agricultural biotechnology and, specifically, the development of genetically modified crops have been contentious for several reasons, including worries that the technology may have adverse effects on the environment or human health, that it would cause agriculture to become (further) corporate, and that it is unethical to experiment on living things[31].

New approaches to food security and developing novel biomaterials under changing climatic conditions are produced by advances in our understanding of plant biology, innovative genetic resources, genome editing, and omics technology[32]. Long development phases based on trial and error employing extensive field testing are required before new gene and germplasm candidates projected to increase agricultural yields and other plant attributes under stress may be tested[32]. The primary objective of the plant biotechnology revolution in agriculture should be integrating innovative molecular tools, screening technologies, and economic evaluation[32].

To create crops that are more resistant to abiotic challenges, Varshney et al.[33] examined the integration of molecular breeding and genetic engineering with conventional breeding using two important technological methods. We also look at several obstacles that must be removed to fully utilise agricultural biotechnology for sustainable crop production to fulfil the growing global population's rising food supply demands.

e) Packaging innovation and coatings

Changing packaging to keep food safer and fresher for longer is an important component of climate crisis mitigation[34–36]. Due to their functionalization, flexibility, and low cost, polymer nanocomposites are a preferable alternative to conventional packaging materials, including glass, paper, and metals for industrial, food, and agricultural products[34].

Idumah et al.[34]'s explanation of the functionalization of composites' interfacial interaction and how it relates to improving packaging materials' qualities, including antibacterial propensities, enzyme immobilisation behaviour, biosensing affinity, and other things, can be found in their paper. New developments in electrical sensors, nanostructured polymeric composite materials, and culinary, agricultural, and industrial packaging materials are explained along with their present uses.

Consumers' need for more cutting-edge and inventive packaging than currently available has led to innovative packaging, such as active packaging[35]. Natural active agents are increasingly being used in more environmentally friendly packaging materials for active packaging that aim to increase shelf life or increase safety while retaining quality. Using suitable active packaging technologies can greatly minimise food quality deterioration, depending on the packed food needs [35].

Consumers' need for easy, ready-to-eat, palatable, mildly processed food items with prolonged shelf life and sustained quality gave rise to novel food packaging methods[36]. The recent trend of customers having less time to prepare meals due to lifestyle changes presented a significant challenge to the food packaging industry for developing unique and inventive food packaging techniques[36]. These cutting-edge methods work by extending the shelf life, improving or preserving quality, giving signals, and controlling the freshness of food products. By adapting to individual lifestyles, revolutionary food packaging solutions aid in meeting needs throughout the food supply chain[36].

f) Reducing food waste

Several initiatives are underway to decrease food waste, including simplifying expiry labelling, setting reduction goals, and enhancing food storage in underdeveloped countries[37–39]. Even though food shortages are still a significant issue in many parts of the globe, food loss and waste (FLW) account for over one-third of all food production[37]. Even though resource and environmental limitations are anticipated to restrict food production globally, this is related to around one-quarter of the land, water, and fertiliser needed for crop cultivation. FLW reduction has drawn a lot of interest because it may provide a way to improve both food security and environmental sustainability[37].

In their assessment, Shafiee-Jood and Cai[37] emphasized the significance of FLW prevention as a supplementary approach to ensuring environmental sustainability and global food security. They identified knowledge gaps and research opportunities by combining the FLW reduction strategies and the barriers. These included (1) filling in data gaps, (2) quantifying the socioeconomic and environmental effects of FLW reduction strategies, (3) comprehending scale effects, and (4) examining the effects of global transitions. To minimise FLW, it is essential to implement more forceful yet scientifically supported measures. These activities call for participation from all parties involved in the food supply chain, including policymakers, food producers and suppliers, and food consumers.

To reduce FLW, Cattaneo et al.[38] outlined five issues as follows: (i) measuring and monitoring FLW; (ii) developing FLW-related policies and interventions under informational constraints; (iii) determining the costs and benefits of FLW reduction and the trade-offs involved; (iv) comprehending how interactions between stages along the food value chain and across countries affect the results of FLW reduction efforts; and (v) preparing for income transitions and the shifting relative importance of losses and waste as economies. From the viewpoint of operations management (OM), Luo et al.[39] reviewed the literature on food loss and waste (FLW). For academics and practitioners battling hunger and unequal access to food resources, supply chain FLW poses a significant challenge. They offered perspectives on FLW research from the viewpoint of the entire food supply chain and through the lens of certain phases within the food supply chain. In the FLW literature, they later discovered overarching study themes. Finally, they projected future study prospects based on their analysis of our collection of literature, talks they gave at the top OM conferences, working papers, and 30 semi-structured interviews with people involved in the food supply chain.

g) Regenerative agricultural practices

By replacing the organic carbon in the soil, regenerative agriculture strives to restore soil health[40–42]. Agribusiness is in trouble. The health of the soil is declining. The sixth mass extinction is imminent for biodiversity. The yield of crops is plateauing. A siren call for regenerative agriculture is rising in response to this crisis narrative[40,42]. The authors identify patterns from sustainable agricultural initiatives in underdeveloped nations involving research institutions, action agencies, and communities to present ideas for creating a soil health movement[42]. They do this by drawing on academic literature and their own experiences.

The phrase "regenerative agriculture" has been around for a while. It has backing from groups frequently seen as being on different sides of the agricultural and food issue[40]. They offered advice for research agronomists interested in regenerative agriculture as a means of conclusion. Mpanga et al.[41] looked at the land usage and farming methods used by small-scale producers in north-central Arizona to see how resilient they were to sustainable food production. The study's findings showed that only 5% of the producers employed traditional synthetic herbicides, while 95% utilized biological, cultural, or mechanical methods to control weeds, pests, and diseases.

4. Conclusion

For biologically based agriculture, more empirical study and agronomic analysis are required. The leaders who care about the environment should include the ESG. While improved knowledge and techniques can meet urgent on-farm demands, it is doubtful that they can bring about the desired improvements in agricultural systems on their own. Notably, environmental governance rules and institutional frameworks significantly impact agricultural practices. Effective EGS elements must also be taken into account in the green-minded leadership model in agricultural industries. Future studies in developing countries should examine how past-year ESG measures affect the following year's financial performance, as in developed countries.

Conflict of interest

The authors declare no conflict of interest.

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