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# Ecological Governance and Organisational Resilience: A Structural Model of Environmental Risk in Pandemic Conditions

**Bernardo Lopez**[a]
**Marie Peters**[b]

**Abstract**
*This study seeks to identify and sequence the determinants that shape environmental risk management within workplaces during and after a pandemic. The research design integrates a systematic review of recent academic and practitioner literature with structured data collection, rigorous analysis, and the derivation of practical implications. The literature review produced a preliminary catalogue of determinants that was subsequently validated by a panel of sixteen experts drawn, through purposive sampling, from diverse stakeholder groups, environmental regulators, industry representatives, and professional practitioners, so as to capture a broad range of perspectives relevant to ecological governance. Analytical procedures relied on interpretive structural modelling and on matrix impact cross multiplication applied to classification. These complementary techniques revealed a hierarchical configuration of influence among the determinants. The "level of company operations" occupied the base tier, indicating relatively limited systemic influence, whereas "environmental analysis of business activities" emerged at the apex, underscoring its pivotal role in structuring effective risk-mitigation strategies. Within the dependence–driving matrix, the operational-level determinant displayed high dependence and low driving power, confirming its status as an outcome variable, while all remaining determinants exhibited both dependence and driving power, thereby classifying them as linkage variables that reciprocally influence one another. As the first empirical investigation to map workplace environmental risk drivers in a pandemic context, this research enriches the literature with nuanced insights. Its findings offer actionable guidance to regulatory bodies, international agencies, policymakers, researchers, and industry managers seeking to strengthen ecological stewardship and organisational resilience in the face of current and future public-health crises.*

***Keywords:*** *Environmental Risk Management, Workplace Resilience, Pandemic Governance, Ecological Stewardship*
***JEL Codes:*** *Q01, Q56, M14*

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## 1. INTRODUCTION

The environment is central to public health, directly shaping the well-being of humans and animals and influencing community quality of life. The outbreak of the novel coronavirus disease, identified in late 2019 in Wuhan, China, introduced significant challenges not only for global health systems but also for ecological conditions worldwide (Barouki et al., 2021; Cheval et al., 2020). As the pandemic rapidly expanded to more than two hundred countries, its impact extended beyond health, revealing weaknesses in social structures, economic resilience, and especially environmental governance (López-Feldman et al., 2020; Sarkodie & Owusu, 2021). In the initial months, decreases in transportation, industrial activity, and energy use led to notable short-term improvements in air quality and reduced greenhouse gas emissions (Adeel, 2019; Le Quéré et al., 2020; Venter et al., 2020; Modibbo & Inuwa, 2020). Nevertheless, as these early effects have been analyzed in

[a] Escuela de Gobierno y Transformación Pública (EGAP), Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM), Mexico
[b] Escuela de Gobierno y Transformación Pública (EGAP), Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM), Mexico, dromarie.peters@hotmail.com

greater depth, new concerns have emerged regarding the persistence of negative environmental impacts in the longer term (Zambrano-Monserrate et al., 2020). For example, global reliance on single-use plastics surged, particularly due to the demand for personal protective equipment and packaging, which has created complex waste management challenges (Khan, 2020; Silva et al., 2021; Russo, 2022). Moreover, changes in energy consumption—such as higher residential usage offsetting reductions in commercial and industrial demand—may complicate progress toward sustainable energy transitions if not addressed through strategic planning (Raja & Iqbal, 2019; Narayan & Doytch, 2021). Simultaneously, many nations experienced interruptions in environmental monitoring and enforcement, as policy focus shifted toward the immediate public health crisis (Sharma et al., 2020). Another area of concern is workplace environmental risk: as societies move toward post-pandemic recovery, attention has shifted to the necessity of safeguarding both worker health and environmental safety within occupational settings (Sarkodie & Owusu, 2021; Akbar & Hayat, 2020; Sangkham, 2020). Thus, the COVID-19 crisis has brought renewed awareness to the interconnectedness of human health, ecological sustainability, and resilient economic policy, reinforcing the need for comprehensive and integrated environmental risk management strategies (Bashir et al., 2020). Although an extensive body of scholarship has emerged examining the broader implications of the COVID-19 pandemic for individuals and families, there remains a notable deficiency in the literature regarding the management of environmental risks within workplace environments. The factors influencing occupational environmental risks during and after the pandemic are multidimensional, varying substantially according to shifts in governmental policies, institutional strategies, and unique regional circumstances (Barouki et al., 2021; Espejo et al., 2020; Rehman & Malik, 2020). As the pandemic unfolded, it exposed the intricate linkages between ecological and economic systems, with interventions or disruptions in one sphere frequently generating cascading impacts across entire societies (Sarkodie & Owusu, 2021; Fateh & Fakih, 2021; Mehdi et al., 2025). The interconnected nature of these systems underscores the need for holistic approaches that consider both immediate and long-term environmental implications of organizational and governmental responses. Recent research has identified various environmental determinants associated with the emergence and proliferation of the coronavirus disease, such as increased rates of urbanization, loss of biodiversity due to habitat fragmentation, intensification of agricultural and livestock production, and the acceleration of global transport and mobility (Rume & Islam, 2020; Barouki et al., 2021). Occupational environmental risk determinants before, during, and after the pandemic are diverse; they change significantly according to trajectories of government policy, institutional responses, and specific local realities (Barouki et al., 2021; Espejo et al., 2020; Rehman & Malik, 2020). The pandemic revealed the complex interplay between ecological systems and economic systems, whereby interventions or disturbances in one zone often create cascading impacts throughout populations (Sarkodie & Owusu, 2021; Fateh & Fakih, 2021; Mehdi et al., 2025). The interconnectedness of these systems necessitates universal approaches that will take into account both immediate and long-term environmental consequences stemming from organizational and governmental responses.

These driving forces are aggravated by natural ecosystem degradation, which depletes many natural buffers and increases the risk of zoonotic disease transmissions. Empirical studies have also analyzed how interrelated the pandemic and environmental parameters might be-such as examining concurrent effects between disease outbreaks and air quality, surface water management, and land use patterns across different regional contexts (Cheval et al., 2020; Bashir et al., 2020; Marc et al., 2025). Though a substantial amount of literature has enhanced understanding of these dynamics in relatively developed economies, much less work seems to have been done in context-specific studies focusing on developing and emerging economies. Here, resource constraints, informal arrangements of work, and dissimilarity in regulatory frameworks often produce different challenges with respect to governance and mitigation of workplace environmental hazards (López-Feldman et al., 2020; Sangkham, 2020; Audi et al., 2025). Henceforth, forthcoming studies should prioritize cross-regional comparative work to inform specific interventions, taking into account the unique risks to policy-related needs posed to occupational environments in low- and middle-income economies.

There has been a persistent highlighting by both the scholarly and scientific communities of an urgent need to look into the environmental consequences of the coronavirus disease pandemic and parallel risk management strategies. Among other assessments, Barouki et al. (2021) report that considerable research programs have been set up in the European Union (EU), for example, the Horizon 2020 HERA project, to systematically identify knowledge gaps regarding pandemics and their environmental effects. Additionally, a number of scholars emphasized that this is crucial for the participation of the scientific community in identifying the causes, impacts, and mitigation strategies for environmental risks associated with the pandemic (United Nations Environment Programme, 2021; Rume &Islam, 2020). They have reiterated the importance of public enlightenment and awareness concerning environmental danger in the milieu of infectious disease and outbreak concerns (Morens et al., 2022). The economic and ecological costs of environmental hazard management during these crises vividly call for proactive policies and institutional capacity building for the future (Klemeš et al., 2020). Comprehensive reviews of empirical studies have delivered clear evidence of the correlations between environmental factors and the incidence of coronavirus disease. These include air pollution, population density, temperature, and humidity, which have been shown to not only impact transmission but also influence the severity of disease outbreaks (Domingo et al., 2020; Bashir et al., 2020). In contrast, the pandemic itself has engendered some short-term changes in the environment, such as a temporary improvement in air quality due to lockdowns, changes in wildlife activities, and socioeconomic disruption (Le Quéré et al., 2020; Zambrano-Monserrate et al., 2020). This evidence lays bare the dynamic interrelationship and bidirectionality between environmental

conditions and infectious disease dynamics, thus reinforcing the need for integrated and adaptive environmental risk management strategies.

Increasingly, scholars across disciplines are emphasizing the need for a deeper investigation into the complex interactions between pandemic events and the environment. Great academic interest has developed, especially in themes such as environmental uncertainty and risk, as well as broader ecological effects that result from global health emergencies during the time of the coronavirus disease pandemic (Barouki et al., 2021; Rume & Islam, 2020). Yet, hardly any literature exists to deal critically and in comprehensive terms with the dynamic, bidirectional relationship between pandemics and environmental systems: Many factors are still underexplored. For example, with almost every sector affected by the pandemic, including workplaces, the organizations are now under scrutiny on their organizational risk management practices, with the importance of resilient environmental strategies in corporate decision-making emphasized (Sharma et al., 2020). Le Quéré et al. (2020) believed that the cost of dealing with the impact of a pandemic is neither the immediate economic nor social burden that it imposed; rather, it is about the lessons learned in terms of future preparedness and resilience from public health threats. Transparency, information sharing, and collective action of researchers, policymakers, and industry leaders would make a big step toward developing more effective approaches to environmental risk management. It would help raise awareness about the lessons learned from the pandemic that could then foster greater collaboration and enable societies to respond much more salubriously to upcoming challenges, thus potentially saving countless more lives globally (Morens et al., 2022). Systematic analysis of the existing shortcomings while promoting a culture of scientific openness will involve the academic community's contribution towards a global preparedness and adaptability culture in future crises (United Nations Environment Programme, 2021).

## 2. LITERATURE REVIEW

Since the outbreak of the coronavirus disease in 2019, governments and societies across the globe have introduced several measures to stem the tide of the disease and control its severity. These measures include the extensive use of personal protective equipment, such as face masks or hand sanitizers, and policy measures that include lockdowns of borders, social distancing, and closure of borders (Rume & Islam, 2020). These efforts do contribute importantly to reducing transmission, but through an environmental lens, they have had mixed results. For example, huge increases in the volume of disposable personal protective equipment have led to significant plastic waste generation and raised concerns about the possible impact that effect will have on terrestrial and aquatic ecosystems (Silva et al., 2021). At the same time, however, a multitude of research has put a spotlight on some ambient improvements that are related directly to pandemic restrictions. Reductions in industrial activity, vehicular traffic, and international tourism have evidenced improvements in air quality, reduced greenhouse gas emissions, reduced water and noise pollution across many regions during lockdown (Cheval et al., 2020; Zambrano-Monserrate et al., 2020; Saadat et al., 2020). Some of these improvements occasionally foster the temporary recovery of local ecosystems and biodiversity. For instance, significant reductions in atmospheric pollutants during lockdowns in European cities were noted by Cheval et al. (2020), while Zambrano-Monserrate et al. (2020) documented environmental changes—both positive and negative—across countries most affected by the pandemic, such as China, the United States, Italy, and Spain. The reason for concern, however, is that while temporary, such improvements in the environment might be, they are often outweighed by negative developments, including the piling up of medical and plastic waste as well as disruption of waste management infrastructure (Sharma et al., 2020). Governmental quarantine and travel bans, along with the shift to working from home and virtual meetings, together led to emission and energy savings in the transportation sector (Venter et al., 2020). These findings together show the complex and at times contradictory environmental impacts of measures that have been put in place in response to the pandemic, illustrating how urgently we need integrated strategies that seek to balance public health protection with long-term ecological sustainability.

During short-term favorable conditions for the environment, emanating from the lockdown conditions, the negative aspects of the coronavirus disease pandemic on the environment have become more and more apparent, especially in terms of waste generation. Medical waste is generated extensively and inappropriately disposed of, including treated and untreated materials such as face masks, gloves, and disinfectants; these present a serious risk to terrestrial and aquatic ecosystems (Rume & Islam, 2020). The sudden and extremely high consumption of personal protection equipment and sanitation products such as hand sanitizers and prevention kits has led to severe land and water pollution in many geographic areas (Cheval et al., 2020; Saadat et al., 2020; Zambrano-Monserrate et al., 2020; Silva et al., 2021). Research established that the use of disposable plastic in facemasks and respiratory devices contributes millions of tons of monstrous plastic waste to the environment, resulting in the formation of microplastics through multiple physical, chemical, and biological processes and thus contaminating ecosystems and threatening public health (Patrício Silva et al., 2021). In opposed to all of this, Zambrano-Monserrate et al. (2020) underscored the alarming rise in biomedical waste and the slowing down of recycling programs during the pandemic, which further contributes to increasing pollution of the land and water. A study in Brazil conducted by Urban and Nakada (2021) reported that even if the general amounts of solid waste reduced production across urban environments, likely due to social isolation and diminished activities among businesses, the effect of a large hole in the treatment of a high portion of medical waste, face masks included, has made risks of disease transmission higher. The postponement of operations related to recycling not only weakened efforts toward conserving natural resources but also translated into considerable losses: a vast amount of recyclable materials ended up in landfills, curtailing their future operational lifespans. Sousa (2021) also pointed

out that the dramatic spike in plastic usage during the pandemic has aggravated both environmental and social issues with regard to contamination of water bodies, as well as worsening existing waste management challenges.

The risk of a disease outbreak due to the appearance of unexpected events whose incidence is uncertain is what risk stands for under pandemic situations. All employers—including self-employed people—are required by the Management of Health and Safety at Work Regulations, 1999, to assess the impact of their activities against the health and safety of other people, with risk assessment as the primary step in wider risk management processes (Yarahmadi et al., 2016). The pandemic has increased the interest in risk assessment and management, leading to an increase in the number of studies focusing on preventive strategies. Take, for example, the recommendations of Sousa (2021) and Kumar (2021): that comprehensive prevention measures be instituted and implemented, which include but are not limited to the use of face masks, gloves, hand sanitizers or soaps, and other personal protective equipment in this effort to limit disease transmission. Mahmood et al. (2020) underscored healthy living and a strong immune system, in line with WHO's recommendations. However, while alcohol-based hand sanitizers have been endorsed by the World Health Organization for being effective against a virus, these substances are not without risks. The American Association of Poison Control Centers has reported thousands of accidental exposures in children, which sometimes result in states of confusion, vomiting, drowsiness, and in severe cases, respiratory arrest or death (Gharpure et al., 2020). Government measures in locking down residents, closing borders, and limiting social activity are effective in reducing infection transmission, but also create temporary environmental benefits like improved air and water quality (Cheval et al., 2020; Lokhandwala & Gautam, 2020). For instance, industrial shutdowns were observed in reduced levels of pollution by Roy and Chaube (2021). However, the crisis brought an increase in biomedical waste, which was an added burden to the already stressed environmental management systems in place (Mishra et al., 2021). Population increments and human activities in regulating the pandemic have also had an effect on environmental conditions, thus reaffirming the interconnectedness of human actions with the ecological outcome (Mishra et al., 2021).

Beig et al. (2020) examined the permanent baseline levels of hazardous air pollutants in Indian megacities and revealed a strong association between coronavirus-related mortality and baseline particulate matter levels, as well as correlations with temperature variations. Additional studies conducted by Choi et al. in the same year noted that some environmental determinants, such as the capacity for drying in the air and ultraviolet radiation, were responsible for transmission patterns of countries such as Germany and India. Altogether, these findings underscore the complications and widespread impact of direct and indirect responses to the pandemic on environmental health and sustainability.

Strategies developed for the control of coronavirus disease transmission are likely to bear significant direct and indirect consequences on public health and on the environment; therefore, they should be carefully balanced between human population protection and ecological integrity preservation. The extensive usage of single-use plastics for personal protective equipment like masks and disinfectant containers has brought an additional burden to waste management systems. However, advances in green technology present opportunities for converting plastic waste into valuable resources, thereby mitigating some of the environmental risks associated with pandemic-related waste (Silva et al., 2021). Notably, less than half of the surveyed respondents in China expressed favorable attitudes toward controlling pollution at its source, particularly concerning chemical disinfectants, highlighting the ongoing challenge of fostering environmental awareness and behavioral change (Guo et al., 2021). According to Huang and Wang (2022), implementation of circular economy principles can alleviate some of the environmental impacts of disposable face masks and other similar items since the circular economy concept promotes the reuse, recycling, and repurposing of products. Zoran et al. (2021), through their empirical research in Madrid, demonstrated that environmental variables such as air temperature, planetary boundary layer height, and ground-level ozone affected the numbers of new cases and deaths caused by coronavirus disease: such affirmation of variable interactiveness aligns the projection of climate conditions because of viral-pathogen transmission. Klemeš et al. (2021) further studied the energy and environmental aspects of mass vaccine production, indicating that the whole process of production, logistics, and waste management has a substantial environmental footprint, highlighting the need for sustainable production and energy-efficient logistics in preparation for future global health emergencies. The reviews of the pandemic environmental consequences mentioned by Silva et al. (2021) make a stronger case for transitioning away from conventional macro-plastics to bio-based and sustainable possibilities that minimize pollution and health hazards. Gasmi et al. (2022) further emphasized the importance of a multidimensional control approach to the pandemic, comprising risk assessment, management strategies, and the integration of dietary, medical, lifestyle, and environmental considerations. Advanced tools like satellite image applications, real-time monitoring stations, and air quality indices did assist in the monitoring of environmental conditions improvement during the pandemic, thereby presenting definitive evidence of how effective different prevention measures had been (Venter et al., 2020). Besides, Coccia (2020) designed a unique index for assessing cities' and regions' vulnerability regarding pandemic exposure, incorporating a number of environmental, demographic, climatic, and health parameters. This index varies from zero to one, allowing it to identify regions that have a greater risk of outbreaks of infectious diseases, thereby giving a firm basis for intervention and risk mitigation in that area. Altogether, the evidence from the above-mentioned scholarly articles suggests the urgent need for integrated public health protection and environmental sustainability policies and further urges that the policy circle be innovative in addressing short-term threats and long-term challenges.

Having said that, the scientific community has gathered remarkable momentum in studying the origins, structure, transmission pathways, and management strategies regarding the COVID-19 pandemic. With the research output on COVID-19 experiencing a sudden boost, in a crisis-dominated inquiry framework these days, the subjects constitute significant parts of

modern scientific production, usually published in the form of rapid communications or short-format research articles (Coccia, 2021). There exists a very wide variation in the organizational responses to the pandemic risks, invariably tied to certain contextual factors, resource availability, and workforce characteristics. For instance, Nabe-Nielsen et al. (2021) found that the perceived risk of infection and strategies to mitigate those risks differed greatly between hospital and non-hospital frontline workers; within that context, a sense of workplace safety helped buffer psychological distress associated with perceived exposure. The extensive ramifications of the pandemic have, above all, interrupted socioeconomic trajectories and changed environmental risk perception at both individual and collective levels. Across higher environmental risk perception within crises, Zhang et al. (2021) in the Chinese cities manifested an onset of new social and economic recovery pathways. Hence, understanding public environmental risk perception represents a necessary prelude to effective risk communication and policy design. The long-term impacts of the pandemic for urban environments and public health will most likely endure, and thus, Cheval et al. (2020) asserted the need for sustained research and adaptive policy frameworks that acknowledge the dynamic nature of the risk landscape.

The responsibility of organizations toward ensuring decent work surrounds all environmental hazards, sanitation threats, drinking water threats, food safety threats, vector control, and risks from mass gatherings. The degree of readiness of the organizations to adopt and enforce such measures widely varies; this affects the safety and welfare of employees. Dobler et al. (2014) reviewed environmental risk disclosures for corporations in the United States, which exhibited inter- and intra-sectoral variations in perception and management of the environmental risks. Per their findings, an inverse relationship existed between the environmental performance and risk, and that risk management would not always imply good environmental performance; hence, such relationships are very complicated. The study further calls for a more context-specific analysis beyond the broad generalizations at the industry level. Lack of awareness of the interface between environmental health risks and workforce capacity remains a primary challenge facing public and private organizations (Ryan et al., 2021). The work of Janmaimool and Watanabe (2014) examined local assessments of environmental risk in Thailand by individuals who live in highly hazardous communities and found that such perceptions are influenced by various factors, including perceived likelihood of contamination, severity of consequences, and psychological variables, such as control, concern, and experience. The participants generally made rational risk judgments, particularly when faced with immediate or high-impact threats. The COVID-19 pandemic has brought about significant consequences in family structures and mental health. Spinelli et al. (2021) reported that parents of toddlers experienced high levels of parenting stress, household disorganization, and limited capacity for emotional regulation in their toddlers during prolonged lockdowns. Disruption to family life often extends into the workplace and tends to bring about negative workplace behaviors, most importantly affecting overall well-being. In combination, they introduce the need for holistic and adaptive risk management approaches across the crisis, connecting environmental risk with organizational and psychological realms.

Effective management of environmental risk forms a core area of sustainable competitive advantage for any organization in the present business context. While Sharfman and Fernando (2008) note that firms with effective environmental risk management practices often experience lower costs of capital arising from effective resource allocation and improved economic performance, such empirical analyses suggest that superior economic returns can be augmented by the capacity of firms to lower perceived environmental risks, thereby increasing access to capital markets for optimum debt-equity ratios. Improved environmental stewardship not only improves lending practice but also contributes to corporate reputation and stakeholder confidence.

Disruption from the COVID-19 pandemic, with lockdown and stay-at-home orders along with social distancing measures, caused massive disruption in the workforce and economic uncertainty (Shaw, 2020). The need for these interventions was to save public health; however, their impact remains inadequately understood in the long term on both workers and organizations. The reopening of economies for the reintegration of its workers poses a need for employers to come to terms with health vulnerabilities, exposure risks, and diverse styles of working introduced into the working arena during this crisis. Populations will also need organizations to start refocusing attention toward the evolving terrain of occupational health, environmental hazards, and social capital that together shape employee well-being and productivity in a post-COVID world.

Research by Gillespie et al. (2017) further elaborates the interrelationship of individual, organizational, and community-level factors in determining environmental and social risks in workplaces. Their cross-sectional study among emergency department workers in the Midwest United States disclosed that workplace violence-determined by a variety of worker, workplace, and environmental conditions-remains paramount, adversely affecting the majority of the participants therein. The study results suggest that violence and associated risks go beyond personal characteristics; rather, they exist in wider organizational and environmental contexts. This justifies the need for comprehensive risk management strategies extending beyond one-time reaction interventions. Indeed, while immediate measures may provide short respite from the environmental and workplace hazards, sustainable solutions require long-term systemic policies towards resilience, adaptability, and sustainability. Proactive environmental risk management investments for employee safety and within the community should be one of the priorities of organizations and policymakers for realizing the understanding and achievements in mitigating both current and future crises created by environmental and public health issues.

## 3. METHODOLOGY

The methodology section discusses the research design, tools, sampling strategies, criteria for expertise inclusion, data collection procedures, and analytical methods employed in this study. This study is interpretivist, focusing on subjective meaning and rich contextual understandings when addressing complex organizational and social phenomena (Creswell & Poth, 2018; Saunders et al., 2019). It uses an inductive approach, developing theory from empirical The approach starts with an extensive literature review followed by data collection and analysis, culminating in conclusion and recommendation development (Creswell & Poth, 2018; Saunders et al., 2019). A systematic literature review was used as the first level of the study to identify and extract important determinants related to environmental risk management. The process of refining these determinants includes structured expert consultation, ensuring their validity and contextual significance (Okoli & Pawlowski, 2004). Data for this study were collected at a single point in time using a cross-sectional design suitable for addressing contemporary issues (Bryman, 2016; Saunders et al., 2019).

Expertise selection is done according to established guidelines. Individuals are experts when they possess advanced domain knowledge and are actively engaged in the relevant field (Okoli & Pawlowski, 2004; Powell, 2003). For instance, this study requires that an expert have at least ten years of hands-on knowledge in environmental risk management. Preference is drawn towards an expert panel with an optimal size, which is said to be between fifteen to thirty for homogeneous groups and five to ten for heterogeneous groups to ensure a wide-angle view of perspectives and consensus (Okoli & Pawlowski, 2004; Hsu & Sandford, 2007). Therefore, in this research, a panel of sixteen well-rounded experts is formed by including representatives from the industry, academia, and environmental agencies.

Data collection and validation would be through a multi-stage Delphi technique, as highly regarded best practices from literature (Hsu & Sandford, 2007; Okoli & Pawlowski, 2004). The first round takes the introduction of the research aims and objectives, and lists some preliminary determinants of factors. The next round involves experts giving feedback about the determinants they feel need to be added, deleted, or modified. The very last round would elicit judgments about the relationships among determinants, which is critical for subsequent modeling and analysis.

Interpretive Structural Modeling and MICMAC analysis are the most common primary analytical techniques, both of which are established methods for exploring and modeling complex interdependencies among variables (Warfield, 1976; Duperrin & Godet, 1973; Jabbour et al., 2013). Interpretive Spatial Modeling facilitates identification and hierarchical structuring of relationships among determinants, while MICMAC analysis classifies these determinants in terms of their influence and dependence, allowing for comprehensive system modeling (Jabbour et al., 2013). In order to develop systematic expert input, a close-ended, matrix-format questionnaire is used, which allows obtaining structured data at the same time providing a basis for methodological triangulation (Hsu & Sandford, 2007). This improves the findings' validity and reliability through expert consensus and cross-validation.

## 4. ANALYSIS, RESULTS & DISCUSSION

Table 1 organizes the critical summary of key factors that determine the environmental compliance and management of an organization during recent occasions like the pandemic. Each determinant is said to be assessed concerning driving power, dependence, overall effectiveness, cluster categorization, and hierarchical level. The determinants are all distributed under dependent as well as linkage clusters, with none under a purely independent cluster; hence, this shows the high interconnectedness within the factors. The scope of organizational operations in a dependent determinant is somehow low in terms of independent influence but high in terms of external drivers. This means that operational scale and complexity are highly determined by contextual and organizational factors beyond market dynamics, regulatory pressures, and the availability of resources to enhance operational change. In fundamental terms, these external influences would set the framework upon which the company adjusts itself to new regulatory demands and environmental concerns (Delmas & Toffel, 2008; Bansal & Roth, 2000). Prior studies have emphasized that larger or more complex organizations may exhibit greater inertia, potentially constraining their responsiveness to environmental policy changes, while smaller or more flexible entities might adapt more readily (Darnall et al., 2010). Evidence collected brings to light that all other variables concerning analysis determinants for adaptive capacity and sustainable performance ought to focus on the organizational context and interdependence.

Most of them, in particular, include the availability of sound environmental skills, conduct environmental audits, commitment, and forward-looking attitudes of organizational leadership, legal requirements, and other related factors, which comprise the signaling cluster. The signaling factor extends beyond just an impact on other variables and is also highly affected by the interaction of external and internal organizational forces. High driving and dependency values indicate their interconnected as well as dynamic nature, which can depict current environmental compliance frameworks, where management practices, regulatory involvement, and specialized technical capacity are in a constant state of interaction and mutual reinforcement (Testa et al., 2014; Montabon et al., 2007). In particular, action orientation and commitment by top management appear to be critical factors within this cluster, which score highly along both driving and dependence axes. This shows their basic yet fundamental role in developing and strengthening compliance mechanisms as well as creating an organizational culture inclined toward fostering stewardship (Sharma & Henriques, 2005; Bansal & Roth, 2000). Empirical research has exhibited that strong management commitment motivates not only compliance with statutory requirements, but also innovation and constant improvement of environmental performance through the introduction of qualified experts and regular auditing

practices (Darnall et al., 2010). Thus, under these factors lie all the master's secrets in developing good systems for environmental management well as in developing all sustainability-oriented targets in any organization.

Strong linkage characteristics within the environmental management systems may be represented by such factors as contributions by environmental specialists, consistent contact with regulatory authorities, and attitudes within organizations toward environmental compliance. Ongoing engagement with regulators and proactive compliance attitudes enhance statutory compliance and could lead to reputational and operational efficiencies for the organization (Gunningham et al., 2003; Aragon-Correa & Sharma, 2003). Effective cooperation with auxiliary agencies in regulatory compliance will readily identify compliance problems well in advance, simplify the adaptation process, and enhance the trust of stakeholders. Furthermore, the level of technical expertise in environmental protection and the capability to manage and document the compliance processes score highly on both the driving and dependent axes. This indicates that capacity is very much dependent on the maintenance of effective compliance frameworks and adaptive resilience under crisis conditions, such as COVID-19, by robust knowledge transfer and continuous training, as well as diligent record-keeping (Kolk & Pinkse, 2005; Bansal et al., 2015). In circumstances of disruption, such organizations stand in a better position to adjust to evolving laws and maintain performance on the environmental front if they have in place well-established administrative procedures and deep technical know-how. Thus, these determinants act as vital connectors in sustaining both the technical and strategic perspectives of organizational sustainability.

Severity of non-compliance, intensity of damage done to the environment, and sensitivity of affected ecosystems are critical determinants of linkages in an organizational environmental management framework. They prove that compliance goes greater than just being a technical or administrative approach, but rather is closely linked to the greater ecological aftermath of business operations (Auld et al., 2008; Darnall et al., 2010). The emergence of organizations in literature illustrates a need for comprehensive risk-based approaches and environmental impact assessment mechanisms that would inform organizations about proactive identification, assessment, as well as mitigation of potential harms associated with their activities (Montabon et al., 2007; Bansal & Roth, 2000). This shows how firms will be able to carve out compliance strategies that respond to particular vulnerabilities and sensitivities in the environments where they operate, which would, in turn, promote more efficient and responsible stewardship.

**Table 1: Summary of Findings**

| Code | Determinant | Driving | Dependence | Effectiveness | Cluster | Level |
|---|---|---|---|---|---|---|
| 1 | Level of Company Operations | 1.489378 | 20.85901 | -18.4086 | Dependent | I |
| 2 | Availability of Environmental Experts | 19.37901 | 19.68469 | -0.24159 | Linkage | II |
| 3 | Environmental Audits | 19.8507 | 19.47678 | 0.252207 | Linkage | II |
| 4 | Commitment of Management | 19.54663 | 18.41213 | 0.321571 | Linkage | II |
| 5 | Pro-activeness of Management | 20.46701 | 19.67377 | 1.817211 | Linkage | II |
| 6 | Statutory Obligations | 19.77513 | 19.87852 | 1.835436 | Linkage | II |
| 7 | Level of Impact of Pandemic on Business | 19.47788 | 18.20623 | 0.166611 | Linkage | II |
| 8 | Input by Environmental Specialists | 20.68552 | 19.88647 | 0.846101 | Linkage | II |
| 9 | Engagement with Regulators | 20.76181 | 18.21874 | 1.609509 | Linkage | II |
| 10 | Attitude towards Environmental Regulatory Compliance | 20.65414 | 18.57022 | 1.366911 | Linkage | II |
| 11 | Alternative Measure Available | 19.63637 | 19.29587 | 1.433112 | Linkage | II |
| 12 | Documentation Required | 20.3619 | 19.76162 | 1.755575 | Linkage | II |
| 13 | Severity of Non-Compliance | 19.85863 | 19.68904 | 0.388152 | Linkage | II |
| 14 | Nature of Environmental Harm | 20.25049 | 18.82034 | 0.200202 | Linkage | II |
| 15 | Sensitivity of the Environment | 20.21399 | 18.11347 | 0.546807 | Linkage | II |
| 16 | Technical Knowledge of Environmental Protection | 20.83712 | 18.32493 | 0.244375 | Linkage | II |
| 17 | Likelihood of Success | 19.46798 | 18.63116 | 1.716534 | Linkage | II |
| 18 | Financial Implications | 20.48563 | 19.69818 | 1.408919 | Linkage | II |
| 19 | Environmental Representative in Pandemic Management Team | 20.80423 | 19.2226 | 1.673606 | Linkage | II |
| 20 | Environmental Analysis of Business Activities | 19.23763 | 17.14785 | 1.71456 | Linkage | III |

Irrespective of recent developments, including the ongoing COVID-19 pandemic whose major scenarios have probably changed to a few determinants, examples are the extent of disruption to business activity caused by the pandemic and the inclusion of environmental experts on pandemic response teams, further highlighting how environmental compliance is now often more dynamic and cross-functional (Sarkis et al., 2020; Sharma et al., 2021). The inclusion of environmental representatives within crisis management will show the evolution towards adaptive and collaborative models of management whereby organizations will quickly, yet appropriately, respond to global disruptions without losing sight of regulatory and

environmental standards (van der Vegt et al., 2015). This management approach on adaptive management today has continued to receive wide endorsement as the one requisite for achieving organizational resilience with its provision for complexity in uncertainties while protecting environmental integrity along with business continuity (Boin & Hart, 2010; Linnenluecke, 2017). Hence, current studies assert an integrated approach of risk-based assessment, impact analysis, and adaptive governance, especially because of such global crises, assuring progress made towards compliance in addressing future demands while furthering long-term sustainability in organizations (Montabon et al., 2007; Sarkis et al., 2020).

Environmental impact assessment from business operations has been placed within the highest-level cluster of linkages (Level III). It is so fundamentally important that it generally establishes pathways toward organizational compliance and management effectiveness. Firms with environmental analyses in their strategic decision-making processes are better placed to understand regulatory demands and can orient operational practices around the sustainability objectives of the firm, thereby creating a culture of proactive environmental stewardship (Montabon et al., 2007; Bansal & Roth, 2000). This integration not only shapes compliance outcomes but also is an innovation driver, risk mitigator, and value creator over the long term, placing environmental considerations as a main pillar of a comprehensive business strategy (Darnall et al., 2010; Aragon-Correa & Sharma, 2003). As research suggests, performance tends to be better both on the regulatory side as well as sustainability generally among those organizations that purposely build environmental analysis at a strategic level since its influence is that wide-reaching (Montabon et al., 2007).

## 5. CONCLUSION

Developing environmental risk management variables in an organizational context was identified and sequenced in a systematic manner during and after pandemic disruptions. This interdisciplinary study, utilizing systematic literature review, expert validation, and advanced modeling techniques, saw the building of a hierarchical model that mapped various drivers' interactions in shaping ecological governance in workplace settings. It was established that the level of company operations emerges as a dependent outcome, reflecting limited systemic influence but high sensitivity to the broader risk environment, whereas environmental analysis of business activities stands at the apex of influence, thus designating its foundational role in effective risk mitigation and adaptive management. Central to the analysis is the identification of linkage variables—such as the commitment and pro-activeness of management, availability of environmental experts, engagement with regulators, technical knowledge, and statutory obligations—which collectively form the backbone of robust environmental management systems. These determinants exhibit both high dependence and high driving power, revealing a dynamic web of reciprocal influence where organizational leadership, technical capacity, and collaborative regulatory engagement are essential to navigating complex risk landscapes. Importantly, the results underscore the necessity of integrating environmental representatives into pandemic management teams and institutionalizing systematic documentation, auditing, and alternative measures to enhance organizational adaptability. The practical implications of these findings are significant for a diverse array of stakeholders. For policymakers and regulatory agencies, the results provide a roadmap for strengthening compliance frameworks by promoting collaborative governance models, incentivizing management engagement, and fostering continuous capacity-building among environmental professionals. For industry leaders and practitioners, the study offers actionable strategies to embed ecological stewardship within core business operations, with particular emphasis on proactive leadership, regular risk assessments, and the institutionalization of technical expertise. The explicit mapping of determinant hierarchies can guide organizations in prioritizing investments and interventions that bolster both resilience and environmental performance during periods of disruption. The continued evolution of environmental risk management in organizational settings will require cross-sector collaboration, knowledge exchange, and an unwavering commitment to adaptive governance. As global health and ecological crises become increasingly intertwined, this study affirms the imperative for businesses, regulators, and communities to move beyond reactive responses and cultivate enduring resilience rooted in proactive environmental analysis and integrated risk management practices. In summary, embedding ecological governance as a strategic priority not only enhances organizational adaptability in times of crisis but also contributes to sustainable development and public health in a rapidly changing world.

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